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விவசாய நவீனமயமாக்கல் திட்டம்
Agriculture Modernization Project

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DISTRICT LEVEL FEASIBILITY STUDY REPORT

9 December 2022

Agriculture Sector Modernization Project

Ministry of Agriculture

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Foreword

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Project Director
Agriculture Sector Modernization Project
Ministry of Agriculture
Sri Lanka

Acknowledgment

The completion of this overall feasibility study for the EU component of the ASMP project was made possible through the people who have dedicated through efforts, time, professional contributions, support, guidance and facilitation. We, Team of EU Consultants are greatly appreciated the guidance and facilitation shared by the Project Director, Dr. Rohan Wijekoon and PMU staff, PPMU staffs and the Officers of the DoA. We, team of Consultants are willing to convey our special thanks to farmers of five project districts for their unconditional understanding, sharing their knowledge and experiences that inspire us to push beyond our limits and moral support to complete the mission.

This was indeed a worthy exercise, and we hope that the outcome can be used as reference in Sri Lanka and beyond. We also hope that these results can generate interest that can cascade into a great success in the provision of knowledge and know-how on agricultural value chain development special emphasis on export orientation to those willing and in need.

EU team of Consultants
December 2022

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ABBREVIATIONS AND ACRONYMS

APHs	Agro Processing Hubs
ASMP	Agriculture Sector Modernization Project
ATDPs	Agriculture Technology Parks
CABI	Agricultural Bioscience International
CCCRMD	Coast Conservation and Coastal Resources Management Department
CDP	Cluster Development Plan
CVC	Cluster Value Chain
CEA	Central Environmental Authority
DAD	Department of Agrarian Development
DSD	Divisional Secretariat Division
DWLC	Department of Wildlife Conservation
EDB	Export Development Board
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPL	Environment Protection License
EU	European Union
FBS	Farmer Business School
FBO	Farmer Based Organization
FCs	Farmer Companies
GAP	Good Agricultural Practices
GIS	Geographical Information System
GND	Grama Niladari Divisions
HARTI	Hector Kobbekaduwa Research and Training Institute
ID	Irrigation Department
IEE	Initial Environmental Examination
IPM	Integrated Pest Management
IQF	Individual quick freezing
LA	Local Authorities
LAA	Land Acquisition Act
MASL	Mahaweli Authority of Sri Lanka
MC	Municipal Council
MOA	Ministry of Agriculture
MOPI	Ministry of Plantation Industries
MRLs	Maximum Residue Limits

NEA	National Environmental Act
NGO	Non-government Organization
NIRP	National Involuntary Resettlement Policy
NLRC	National Review Committee
NPQS	National Plant Quarantine Service
PCCP	Permanent Crop Clinic Programs
PCR	Physical Cultural Resources
PGRC	Plant Genetic Resources Centre
PMU	Project Management Unit
POP	Persistent Organic Pollutant
PPMUs	Provincial Project Management Units
PUC	Public Unlisted Companies
ROC	Registrar of Companies
SMP	Social Management Plan
UC	Urban Council
UMCs	Urban Marketing Centers
VC	Value Chain
WB	World Bank

EXECUTIVE SUMMARY

Agriculture Sector Modernization Project (ASMP) of Ministry of Agriculture (MOA) funded by the World Bank (WB) and European Union (EU) is comprised of three components. In which, the Component-2, Productivity Enhancement and Diversification Demonstration (this particular assignment relates to the Component-2) is implemented by the Ministry of Agriculture (MOA). The Component-2 aims to support smallholder farmers to produce competitive and marketable commodities, improve their ability to respond to market requirements and move towards increase commercialization. Accordingly, MOA/ASMP decided to expand the original project area with five more districts namely Kilinochchi, Vavuniya, Kandy, Badulla and Ampara. In terms of developing the Agriculture Technology Demonstration Park (ATDP) as per the objective of ASMP, separate individual consultants were recruited by the ASMP for Conducting District level Feasibility Studies, Prepare & Implement twenty (20) Crop Cluster Development Plans (CDPs) and Prepare Environmental and Social Screening Reports and implementation of safeguards compliance requirements in New Project Districts.

The objective of the district level overall Feasibility Studies referring the key expectation of ASMP i.e. to identify the District specific most feasible ATDP interventions which are mainly characterized by the main crop clusters, shared cluster-based processing and marketing facilities, Public Unlisted Companies (PUC), and related other possible interventions which assure the business sustainability of the clusters in the long run.

Case study approach along with participatory tools was instrumental in collecting both qualitative and quantitative data across the various stakeholders. Study findings were based on key thematic areas; agronomy, agribusiness and value chain, economic, technology and infrastructure, institutional, geo-information and environmental and social safeguards. Findings highlighted the essential intervention strategies of each specialty areas considered and detailed analysis and recommendations are included in the report. Finally, crop and location selection were based on the criteria such as of agro-climate and agronomic, economic, demographic, institutional networking, value chain analysis and safeguards aspects. Moreover, selected crops value chains and locations were validated through several rounds of discussions performed with project management (PMU/PPMU), Department of Agriculture (DOA), Provincial Department of Agriculture (DOA), Mahaweli Authority of Sri Lanka (MASL), Irrigation Department (ID), Department of Agrarian Development (DAD), District Secretariats, Divisional Secretariats, Donors, downstream actors of the planned value chains and farmer groups.

Study ascertained the gaps and challenges in the crop cultivation practices in the selected field levels. It was highlighted that the farmers have continued traditional farming practices irrespective of productive technologies recommended by the experts at the DOA. It was observed that the pilot scale programmes, though modern technologies such as irrigation system, insect proof nets, etc yet the farmers unable to achieve the benefits of those technologies due to insufficient knowledge and skills.

Study revealed agricultural value chains of the selected project districts as well as other agricultural areas were fragile in nature, scattered, informal, unorganized and lack of market orientation. Further, upstream and downstream of the agricultural value chains joined through weak links and lack of coordination and poor communication act as main barrier. Accordingly, the feasibility study identified 23 main potential value chains and alternate crop value chains, value chain structures, actors, linkages and income distribution along the curve. Pilot clusters established in each district were studied and observed that the performances of those clusters are not up to expected level due to various reasons such as technology adaptation and insufficient marketing access due to inadequate institutional support for collective development. Future planning, strategic interventions to manage/improve the field level agronomic issues, especially for introducing best practices for land preparation, seed & planting material sourcing, surveillance on pest, diseases and climate change hazards; institutional barriers and mitigating issues related to value chain competitiveness would be a challenging task to be mitigated during cluster development plans.

The ATDPs will support the development and establishment of professional farmer producer organizations in the form of Public Unlisted Companies empowering the farmers to produce and market their produce through competitive negotiations under one trading platform. Analysis of the situation and challenges in the assigned project area were conducted to ascertain institutional aspects, existing farmer organizations, and producer organizations under pilot programs that required scale up support and outreach /communication.

Based on the farmer selection criteria the CDP for each Cluster Value Chain (CVC) will ensure 300 farmers per cluster on average. Organization of farmers in the cluster required to overcome small scale operations and fragmentation of land areas making the way forward to collective commercial farming and capture wide market access.

The meetings with farmers noticed that farmers have strong will to grow the selected crops and modernize their value chain activities through collective actions. The farmers indicated that in the past there were no proper guidance or mentoring of farmer organization to collectively capture the market access though it was noted wide array of market segments are available around. There is potential for establishment of crop-based cluster farmer companies with defined strategies for communication, outreach, training and mentoring for improved skills/ capacities for commercial agribusiness partnerships.

Proposed technological interventions of the project are based on infrastructure developments, farm mechanizations, micro irrigation facilities, processing machineries and technologies along with storing facilities. Increasing of production, productivity and farmer sustainability while reducing the post-harvest losses are the set objectives. Road access, water and electricity connectivity and processing centers are to be developed. Mechanization of agricultural activities starting from land preparation to crop harvest is not par with other countries due various reasons. Farm machineries are to be introduced base on their adoptability to Sri Lankans lands and proposed agricultural technologies. Water conservation and provided required amount of water for the cultivated crop is going to be practiced with micro irrigation systems. The selection of processing machineries and technologies are going to be finalized considering productivity, cost effectiveness and machinery utilization factors. The priority will be given for local manufactures/ vendors. More focus on manufacturing technologies that provide versatility for more products and industries while enhancing product shelf life.

Farmer sustainability is a key aspect that is going to be achieved by increasing profits, providing eco and worker friendly environment. Encouraging renewable energy, managing water resources where farmers can do their cultivation in both “Maha” and “Yala” seasons, reducing the product cost by mechanization, automation and selection of low-cost energy sources are to be elaborated.

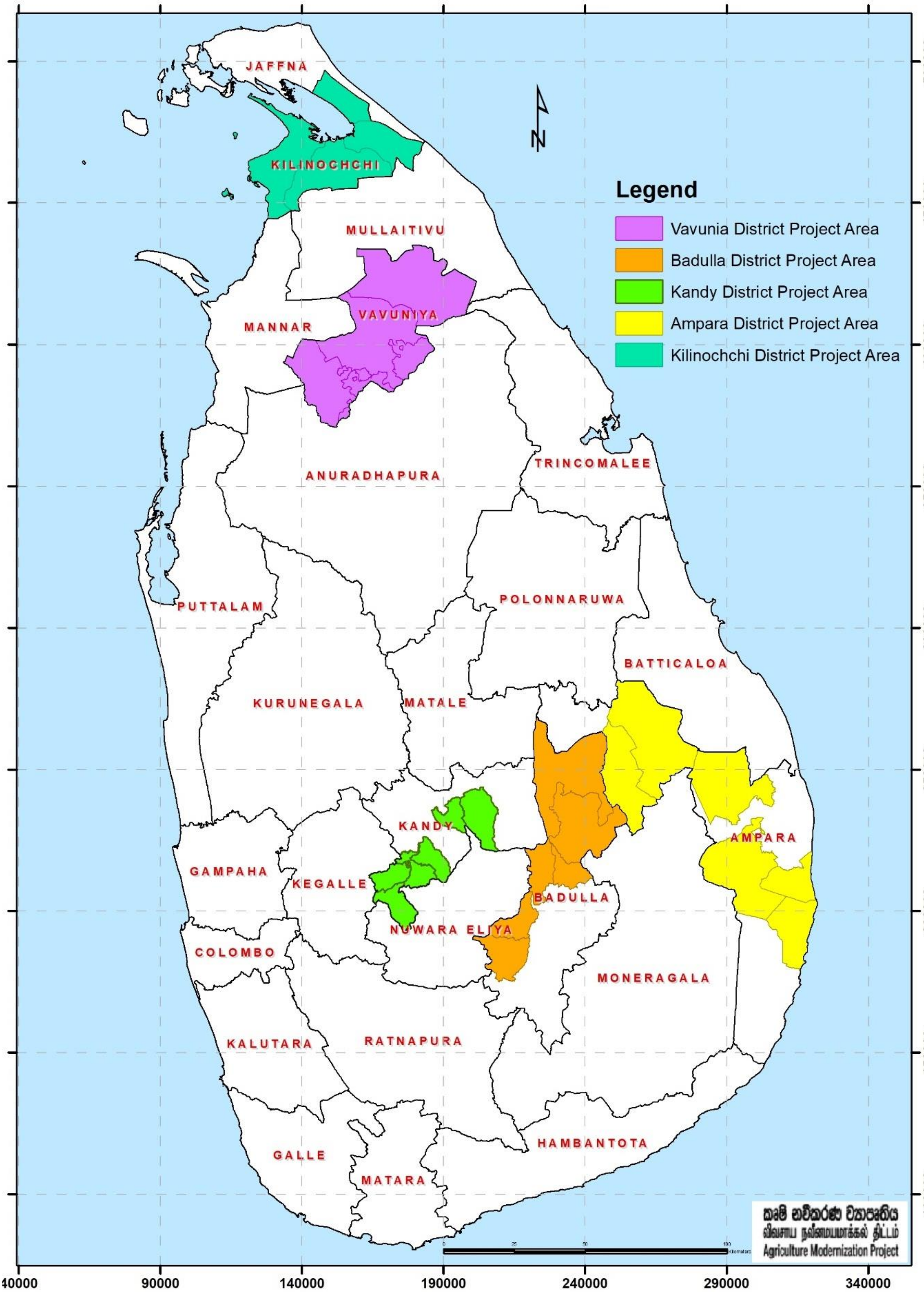
It is well evident that market oriented and export-oriented crop production systems generate higher income to the farmer and foreign exchange to the country. This kind of objective could be achieved through supporting smallholder farmers produce commercial and marketable commodities while responding the market requirements. It could also move towards increased commercialization through value addition and adopting diversification strategies and low-cost strategies. Development of human resources and building their capacities to modern day needs play a key role in this regard. Proper coordination among the stakeholders, monitoring and evaluation of the key tasks and improvement in logistics and infrastructure would create a conducive environment for export-oriented production system. Therefore, ASMP intends to develop Modern Agricultural Technology Parks (ATDPs) through creating crop clusters in Ampara, Badulla, Kandy, Kilinochchi and Vavuniya districts. In establishing the CDPs, the first step was to conduct district feasibility studies to identify what high valued crops can be cultivated and to evaluate their economic and market feasibility mainly. The results of the economic feasibility analysis suggest that selected crops in each district are economically feasible with project scenario. However, special attention should be given to intervention in seasonal crops identifying the proper technology package. Qualitative results of the analysis suggest that cost of production and cultivation quality should highly be considered as the analysis shows crop cultivation is somewhat challenging.

In general, the proposed crops in Kandy, Badulla, Vavuniya, Ampara and Kilinochchi Districts will have a significant positive impact on rural agriculture communities by enhancing their economic conditions and prosperity while it has an influence on national economy at the national level which outweigh the potential negative impacts.

Furthermore, in general Wild animal issues specially elephant threat on the cultivation will be matters in every district as mostly the potential areas are closer to forest or wildlife protected areas. In addition, water scarcity will be a serious concern for Ampara, Vavuniya and Kilinochchi whereas soil erosion will be highly concerned in Kandy, Badulla and Ampara.

Transparent farmer selection and possess of legal ownership for lands will mostly reduce social issues. However, proposed area for Papaya cluster in Nedunkerni (Vavuniya North) will have a great positive impact on many vulnerable groups including women headed families, widows, and disable groups. Further, most of the farmers in the area are youth. This will be an example cluster for ASMP.

ASMP - EU Component Project Area



CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Background

The Agriculture Sector Modernization Project (ASMP) is comprised of three components. The Component-1, Agriculture Value Chain Development, seeks to promote commercial and export-oriented agriculture and this component is implemented by the Ministry of Plantation Industries (MOPI). The Component-2, Productivity Enhancement and Diversification Demonstration (this particular assignment relates to the Component-2) is implemented by the Ministry of Agriculture (MOA). The Component-2 aims to support smallholder farmers to produce competitive and marketable commodities, improve their ability to respond to market requirements and move towards increase commercialization. The Component-3 focuses on human resource management, and capacity building, logistic requirements, monitoring and evaluation, communication, and coordination of the overall Project.

The listed below are the sub-components of the Component-2 of the ASMP implemented under the MOA:

a. **Farmer Training and Capacity Building:** Under this Sub-component, all the non-technical farmer trainings (mainly through ***Farmer Business School – FBS***) are provided to all the member farmers of the ***Farmer Companies (FCs)*** as well as to the selected non-member farmers living around the cluster areas with the aim of improving their soft skills (referring farming as a business), carry out related awareness and exposure visits (local as well as foreign), empowering Farmer Companies providing the related trainings to the lead farmers as well as to the potential second generation young farmers, and providing all the assets needed to operate the Farmer Companies.

   All related institutional capacity building activities are carried out under this sub-component in order to establish and empower the Farmer Companies.

b. **Modern Agriculture Technology Parks (ATDPs):** This is the main Sub-component the Component-2 of ASMP. All the crop cluster selection, design, establishment, and continuity of crop clusters is ensured under this sub-component. Each individual member farmer of the FC will receive a technology package as a grant under this Sub-component. In addition, farming related collective assets, cluster specific common ***Agro Processing Hubs - APHs*** (mostly one per each cluster), and common ***Urban Marketing Centers - UMCs*** (mostly one per each District), certain technical exposure visits, trainings and awareness, specific technical consultancies will be delivered under this Sub-component.

c. **Production and Market Infrastructure:** Under this Sub-component, Cluster / ATDP specific market infrastructures (Eg. Common APHs, UMCs, ***Compost Making Units -***

CMUs), required irrigation infrastructures, identified market access roads and any other specific supportive infrastructures will be established. In addition, the consultancy assignments related to Engineering Designing and Establishments will be carried out under this sub-component.

d. **Analytical and Policy Advisory Support:** Related Policy Studies as well as required Analytical Studies are carried out under this particular Sub-component. In addition, conducting certain related assessments / evaluations, organizing ***Techno Forums***, ***Policy Forums***, formulation Policy / Strategy briefs / guidelines are carried out.

Project Management Unit (PMU) of the ASMP together with the ***Provincial Project Management Units (PPMUs)*** implement the project activities with the support and the guidance of the Ministry of Agriculture mainly through its Project Management Unit, the Provincial Ministries of Agriculture and other relevant stakeholders.

The Project is technically steered, and monitored by the ***National Project Steering Committee*** headed by the Secretary to the MOA and the respective ***Provincial Steering Committees*** headed by the Chief Secretary of the Province.

The Democratic Socialist Republic of Sri Lanka has obtained a Credit of US$ 58.63 Million from the World Bank through the International Development Association (IDA) and received Grant of US$ 26 Million from the European Union (EU) for the ASMP of the Ministry of Agriculture.

1.2 Scope of the Work

Through conducting overall district level feasibility studies with the aim of establishing ATDPs, the Team of Consultants should basically identify the followings, but shall not be limited to:

- What high value crops (main crops as well as the crops for inter / rotational cropping) suitable for the districts based on the existing geo-climatic conditions & patterns, resource availability (Water, land, and etc.).
- What modern technologies as well as best practice applications feasible for small holder farmers in the districts to do their farming & post-harvest operations; mainly on farm value additions.
- Market sustainability of the respective crop clusters / ATDPs with the special reference to the sustainability of the Farmer Companies need to be established.
- Ultimately the combination of crops, technologies, and best practices recommended by the Team of Consultants should ensure achieving the Project outcomes for target

farmer communities during the project period, and ultimately the sustaining outcomes and impact for the Country as a whole.

The Feasibility Studies should be conducted within the following high-level framework which needs to be further elaborated meaningfully by the Team of Consultants and agree with the ASMP:

1. Feasible main high value crops and other crops (high value inter crops & rotational crops)
2. Geo-climatic feasibility
3. Technological feasibility (feasibility of farming / production technologies & other potential innovations, feasibility of post-harvest value additions, and all other technologies related to the ATDP establishments & operations)
4. Market feasibility
5. Economic / Financial feasibility
6. Socio-cultural feasibility
7. Resource / input feasibility
8. Environmental feasibility
9. Institutional / stakeholder analysis & feasibility

1.3 Geographic Scope of the Work

ASMP currently works in five provinces namely Northern Province, North Central Province, Uva Province, Eastern Province and Central Province in the implementation of the Component-2. Twelve districts have been selected to implement the Agriculture Technology Demonstration Park concept namely Ampara, Anuradhapura, Badulla, Batticaloa, Jaffna, Kandy, Kilinochchi, Matale, Monaragala, Mullaitivu, Polonnaruwa, and Vavuniya.

Out of the above 12 Districts, this particular assignment relates only to the new ASMP Districts, namely Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya Districts.

1.4 Objective of the Feasibility Report

The Team of Consultants should work together to conduct district level overall Feasibility Studies referring the key expectation of ASMP i.e. to identify the District specific most feasible ATDP interventions which are mainly characterized by the main crop clusters, common APHs, Farmer Companies, and related other possible interventions which assure the business sustainability of the clusters – in long term basis, ultimately ensure the business sustainability of Farmer Companies with respect to the commercial scale modern small scale Agriculture.

Through conducting overall District level Feasibility Studies with the aim of establishing ATDPs, the Team of Consultants should basically identify the followings, but should not be limited to:

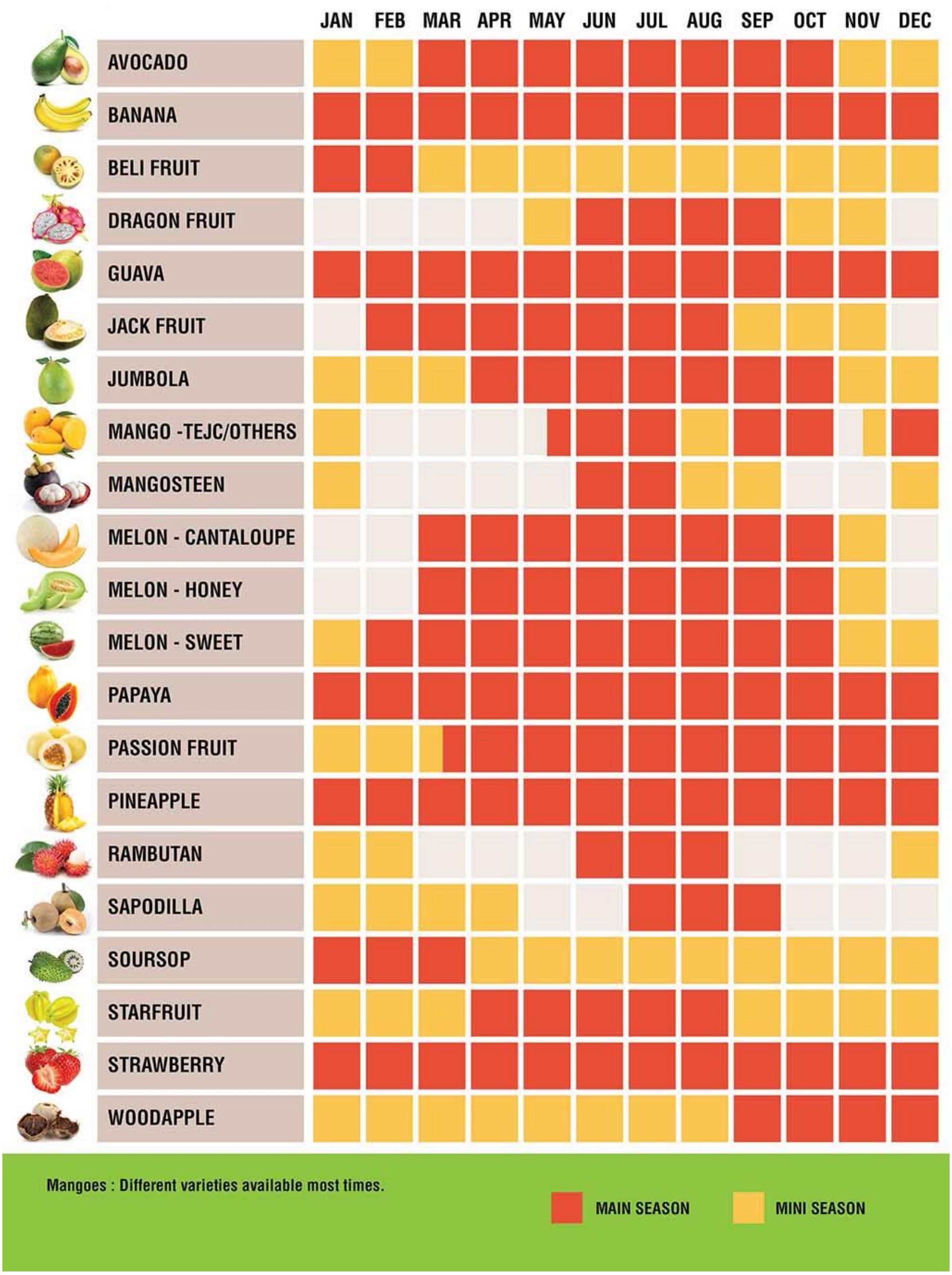
Specific Objectives

- What high value crops (main crops as well as the crops for inter / rotational cropping) really suitable for the districts based on the existing geo-climatic conditions & patterns, resource availability (Water, land, and etc.).
- What modern technologies as well as best practice applications feasible for small holder farmers in the districts to do their farming & post-harvest operations; mainly on farm value additions.
- Market sustainability of the respective crop clusters / ATDPs with the special reference to the sustainability of the Farmer Companies need to be established.
- Ultimately the combination of crops, technologies, and best practices recommended by the Team of Consultants should ensure achieving the Project outcomes for target farmer communities during the project period, and ultimately the sustaining outcomes and impact for the Country as a whole.

1.5 Context

Agriculture is synonymous with Sri Lanka due to the country's fertile soils integrated with autonomous clusters of farmers around eighty different varieties of fruit and vegetable in varied agro-climatic areas. Low country dry or wet areas are for a variety of tropical fruits and vegetables ranging from gherkins, green chilli, red onion, pumpkin, bitter gourd, melon, sweet and sour banana types, queen pineapple, papaya, mango, and lemon. Certain endogenous yams (Lecranthus and Xanthasoma sagittifolium), underwater stems (Lasia spinosa and Nymphea lotus) and fruits and pods of perennial crops such as bread fruit, young jackfruit and murunga are exports. Seasonal fruits such as mangosteen, ripe jack, avocado, rambutan, star fruit, passion fruit and anoda are acclaimed for their unique flavour, aroma, and taste associated with its nutritional and health values.

Fruit and vegetable are mainly revolved around home gardens and semi-commercialized small farmers' allotments whose individual extent of land does not exceed a hectare. Private sector involvement in commercial cultivation too has been encouraged by the Sri Lankan Government with support from 'contract growing' farmers, and steps have already been taken by the leading entities to enhance cultivation. Sri Lanka produces more than 900,000 metric tons of fruit and vegetables annually and exports both fresh and processed varieties to many destinations in the world. 65% of the fresh products is targeted to the Middle East and the Maldives Island and almost about 98 per cent of the processed products to the European market. United Arab Emirates, Saudi Arabia, Maldives, India, UK, Kuwait, India, Germany, Qatar, Pakistan have been enlisted as top fruit and vegetable importing countries from Sri Lanka (Sri Lanka Export Development Board). The fresh food demand is increasing rapidly day by day. So, the real challenge in this industry is to provide freshness from the start to the end of it with low cost. If successful can be achieved in that task there will be no threat for the fresh food export business (Huang, 2004). However, the potential is largely untapped as most produce is grown for local consumption. Compared to tea and spices, the fruits and vegetables sector is the least organized and probably needs the most attention to improve its productivity and availability for catering the demand uninterruptedly. Similar to most other agricultural sectors, the fruits and vegetables sector consists of a large number of small growers. Figure 1 highlighting the fruit crop calendar for the main fruit crops which is available for both local and export market.



Source: Fruit and Vegetable Producers, Processors and Exporters association

Figure 1: Fruit calendar of Sri Lanka

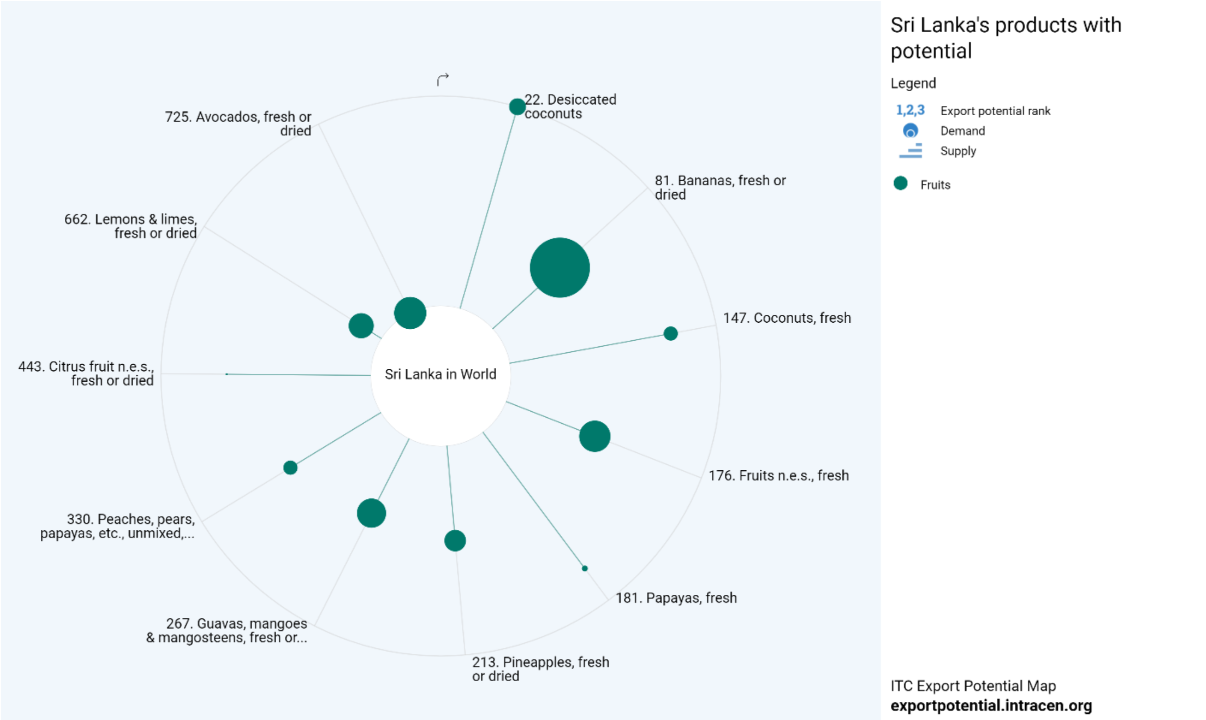


Figure 2: Analysis of export potential for fruits

Figure 2 explain the export potential map of fruits for Sri Lanka. Export potential rank, demand, supply and the gaps were highlighted in the figure.

Further figure 3 explain the Sri Lankan's potentials for fruit exports where figure highlighted the actual fruit exports, potential and gap. Both figures immensely helpful us on crop selection process.

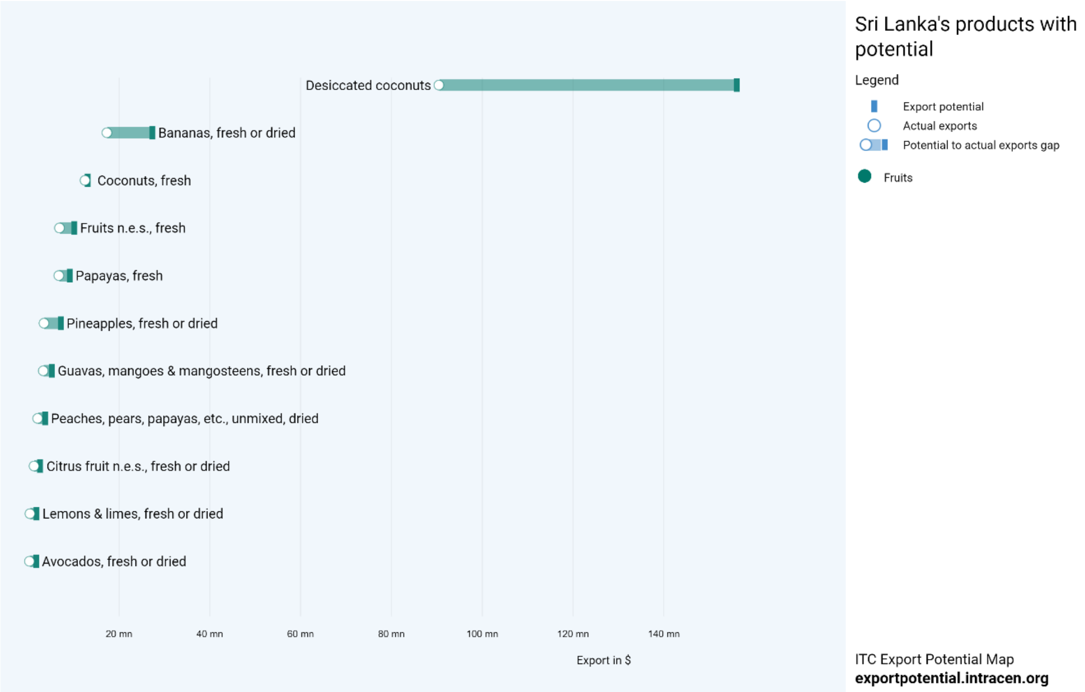


Figure 3: Sri Lanka's fruit products with export potential

CHAPTER 2: APPROACH AND METHODOLOGY

2.1 Market-led identification of crops and value adding

The project approach on selection of high value crops, value creation and value addition to the agriculture produce based on participatory approaches (figure 4). Market-led identification of best produce or most suitable export-oriented crops for value addition and marketing was first ascertained through virtual interactive platform attended by 3 main groups, such as Agri-Food exporters, Agri-Food processors and policy makers/institutional representatives. Results of the virtual interactive platform gave strong recommendations towards to best crop combinations for each project district along with potential value creations and value adding options (annex 01: report on virtual interactive platform). Second level of intervention was made through the two virtual interactive discussions with scientists/crops experts of the DoA and focus groups discussion were aimed to explore the possibility of selected crop types, availability of planting materials, practical issues on agriculture input supply, especially on fertilizer and agro-chemicals, pest and disease problems, IPM (Integrated Pest Management) interventions, available appropriate technology, etc. (annex 02: report on online focus group discussions with DoA experts. Our final approach, interactive participatory discussions with farmers and farmer society members of project districts and the discussions based on focus group guide (annex 03: focus group guide). Further, each project district we were able to conduct in-depth meetings with regional project staff at the Provincial Project Management Units (PPMU) of ASMP and DoA on validation of the outcomes of farmer meetings and plan the project work (annex 04: photos of filed visits). Outcomes of the feasibility report based on the results of the participatory work conducted in 5 project districts established list of potential and existing crop value chains to be promoted or scale up under 20 CDPs were discussed at second interactive platform, (IP 2) with the short-listed potential buyers/ exporters/ processors. Main aims of the IP2 were identified potential private sector partners for each crop cluster (finalize type of crop, value added form-fresh/semi processed, processed, etc), obtain their consent on establishing the Agri+ consortia, a Pvt. -Pvt. (2P) partnerships with proposed PUCs for each crop value chains. Also elaborated the strategic interventions related to establishment of standards, certification-organic, fair-trade, GMP/ISO etc, and enter into MOU with PMU or PUC.

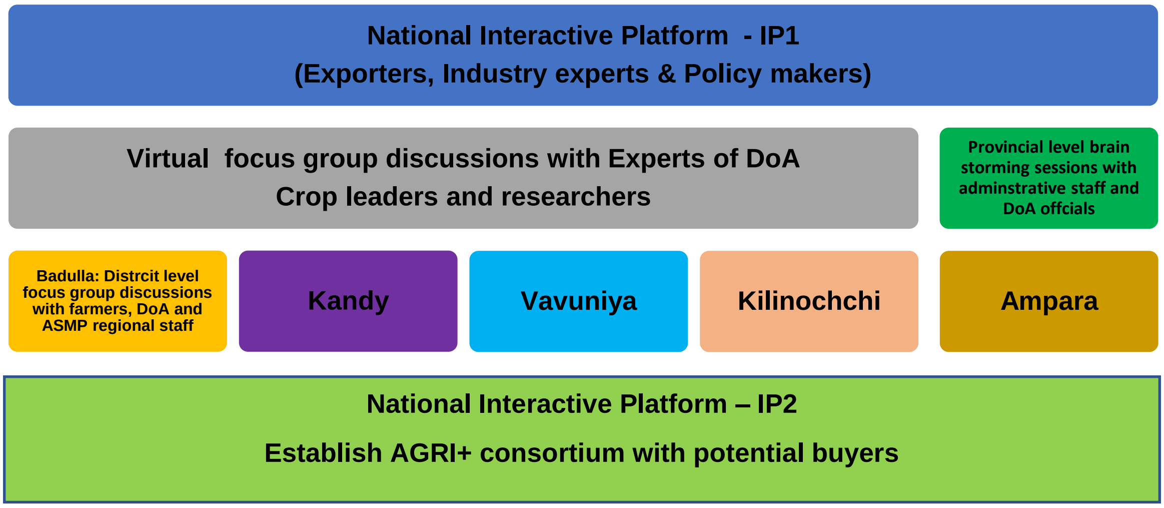


Figure 4: Approach for selection of crops, cluster locations and buyers

2.2 Value chain methodology

Value chain analysis is an internal assessment of competitive advantage. Rapid value chain analysis will conduct on each selected agribusiness/crop establishment in order to identify the competitive advantage. A cluster or faring community is in essence a collection of activities that are performed to produce, market, deliver and support its products. Goal is to produce the products in such a way that they have a greater value to customers than the original cost of creating these products. The added value can be considered the profits and is often indicated as ‘margin’. A systematic way of examining all of these internal activities and how they interact is necessary when analyzing the sources of competitive advantage. Custer or community gains competitive advantage by performing strategically important activities more cheaply or better than its competitors. Michael Porter’s (1985) value chain helps disaggregating a group of actors into its strategically relevant activities, thereby creating a clear overview of the system.

VC analysis consists of a scoring methodology that presents a comprehensive and resource-effective way of assisting clusters with the selection of its target agricultural value chains. It can serve as the basis for ASMPs strategic plan, by assisting them in prioritizing the highest potential for impact value chains, as well as visualizing and highlighting the strengths and weaknesses of each value chain. The selection of the most promising agricultural commodities value chains has been based on objective and subjective criteria that are the basis to the recommendations to target sectors. The objective criteria assessed the product markets, unmet demand, growth potential, market trends and competitiveness. As well as identifying sub-sector constraints and opportunities (e.g. finance, infrastructure, policy). The subjective criteria assessed the competitive factors, the distribution of benefits to various actors, and the bottlenecks to sub-sector expansion (including costs, regulations). The scoring methodology consisted of analyzing the following sixteen criterions of each commodity. Scores were given for each criterion from one to five (five representing the most favourable and one representing the least favourable agricultural commodity value chain to engage). Overall sums were calculated out of a possible perfect score of 80. Value chain selection criteria varies as follows; 16 - 47 = less favourable, 48 – 63 = moderately favourable and 64 – 80 = highly favourable.

Objective criteria:

- Market growth – local, regional and International
- Market competition - National vs. Imported products
- Job creation potential
- Self-sustainability
- Proof of concept (realization of a certain method or idea in order to demonstrate its feasibility)
- Import substitution
- Consumption trends

Subjective Criteria

- Food security
- Likelihood of intervention success
- Priority of the country
- Farmer skill suitability
- Impact per intervention dollar
- Transportation
- Impact on ASMP success

The essential elements of a VC establishment justify a need to consider five feasibilities: stakeholder, market, primary production, structure and enabling environment (Figure 7). Analysis of these different feasibilities and their interactions constitutes a strategic planning process to identify roadblocks, gather information for designing the chain's structure, attract and plan equity investment and inform (public) actors' decision-making on the VC establishment. Figure 5 presents a stepwise holistic framework used in feasibility analyses. The stakeholder feasibility explores actors and their interests in the VC establishment. Understanding existing interests allows averring if (claimed) goals can be achieved. Balanced representation of relevant actors in identifying conditions and constraints for VC support and participation is a key condition to uncover sustainability from different perspectives. The market feasibility provides understanding of market demand and requirements for products to be successfully produced and marketed in the chain. Market orientation and knowledge are conditional to market access (Grunert et al., 2005; Trienekens, 2011). Thus, market feasibility focusses on investigating market segmentation, demand and supply, pricing, specifications, barriers to entry and market options. The primary production feasibility aims at understanding primary products and production-related factors to create a sustainable production system (Herman and Thai, 2020). Byerlee et al. (2009) argued that a sustainable production system presents economic, social and ecological aspects for achieving viability, equity and environmental sustainability within the system (Roy, 2012). Hence the production feasibility emphasizes characteristics of primary resources required for production, environmental consequences of their exploitation, primary productivity, potential incomes generated for primary producers and factors facilitating and inhibiting the production. The structure feasibility investigates the chain's functions, potential actors' roles and relevant knowledge and experience, value addition and distribution and governance to determine how to organize the chain.

Studying VC structure allows understanding how value is generated and captured by different functions, thus highlighting the role of VC governance to enhance the fairness of value distribution among actors involved. VC governance is the process of organizing activities with the purpose of achieving a certain functional division of labour along the chain, resulting in specific allocations of resources and distributions of gains (Ponte and Gibbon, 2005). The process involves various actors and their actions to define terms and conditions for their participation in the chain, implementation of value-adding activities and obtainment of corresponding benefits (Ponte and Gibbon, 2005; Bolwig et al., 2010).

VC governance can be categorized as rules for product quality control (Keane, 2012), rules for vertical integration (Gereffi et al., 2005; Bolwig et al., 2010), rules for horizontal integration (Bolwig et al., 2010) and rules for vertical–horizontal integration for actors within the same function to acquire additional roles or functions in the chain (Trienekens, 2011). Analysing governance can identify different mechanisms by which diverse actors involved can gain and maintain benefits when participating in the chain. The enabling environment feasibility investigates local, national, and international contextual factors influencing VC structure, functions, and markets. Enabling environment is a set of policies, informal institutions, support services and other conditions that create and improve a general operational environment, bringing together VC actors in a cooperative manner (Trienekens, 2011).

This feasibility focusses on environment, land use and trade legislations and their enforcement in practice, public capacities and services and informal functioning rules in the socio-cultural embeddedness. These factors set boundaries to VC establishment and determine whether setting up the chain is feasible from an institutional and social perspective. Finally, the overall feasibility assessment screens the five feasibility analyses and relates the analyses to each other to question sustainability and feasibility of the to be established VC (Herman and Thai, 2020). A reflecting mechanism is employed in order to move back and forth between the different feasibilities. Interactions between different feasibility elements within the five feasibilities are identified, followed by distinguishing synergies, causal relations, and discord between the elements. Conclusions on how those interactions affect overall feasibility are drawn.

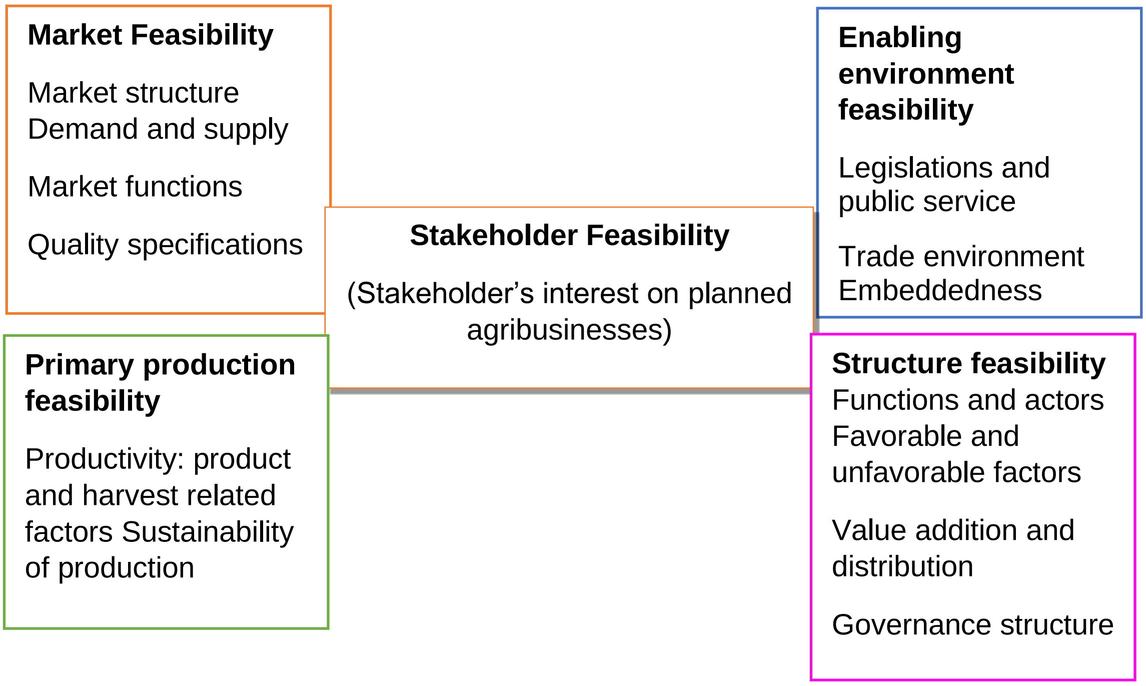


Figure 5: Feasibility analysis framework

2.3 Identification of agribusinesses

At one end of the agricultural value chain are the producers, the farmers who grow crops and raise animals. At the other end are the consumers who eat, drink, wear and use the final products. And in the middle are many thousands of men and women, and small and large businesses. Each person and each business perform one small step in the chain, and each adds value along the way – by growing, buying, selling, processing, transporting, storing, checking, and packaging. Other people and other businesses have important roles supporting the chain. Banks provide loans; governments establish laws and policies, and agricultural research organizations develop ways for farmers to more successfully participate in value chains. Table 1 explain the results of overall feasibility of 5 districts.

Table 1: Feasibility of location and crops for Kilinochchi, Vavuniya, Ampara, Badulla and Kandy districts

Feasibility	**Good**	**Moderate**	**Poor**	**Remarks**
1. Primary Production Feasibility				
Natural resource variability				Suitable Climate, soil, rainfall
Availability of seeds & planting materials				Limited parental lines of hybrid maize available in DoA Hass avocado – timely availability of imported planting material Limited availability and poor germination of Jumbo peanut seeds Selection, multiplication of best quality planting material of Ambun banana
Knowledge on new crop types, crop management and technological interventions				Unclear agronomic practices of **Jumbo peanut**, poor seed filling, issues of deshelling, poor storage facilities, storage pests, poor yield records, etc. **Hass avocado** – brand new crop, no clear idea on market potential and demand both local and export market
Clear economic attractiveness to producer				Chili, Jumbo peanut, Passion fruit, Soursop, papaya, shown positive & attractive returns
Familiarity with commercial crop production for market				Only chili, jumbo peanut, green gram, black gram, papaya, Mango, cassava, passion fruit, seed potato & vegetable crops

				have previous experience of commercial production
Land availability for specific crop requirements				Clear land ownerships will be considered based on the documentary proofs. Number of lands plots for pilot clusters are not available such as seed potato and chilli in Vavuniya
Farmers exposure and experience in crop production & marketing				Farmer's experience is rich on selected crop production for consumption but not for commercial production.
DoA & ASMP district level officers' experience and exposure on new crop types, establishment, etc.				Exposure and experience of local staff on technological intervention is low and there is a need to upgrade the know-how. Certified seed production such as Jumbo peanut and Potato need to be inline with establish protocols.
2. Enabling Environment Feasibility				
Embedded constraints to reliable supply				Seed production capacity depends on availability of parental lines from the DoA. Import of Hass avocado scion and local root stock (grafting)
Capacity building for to guarantee the compliance of legal framework on access to lands				Clearing lands, soil erosion, need of careful soil conservation measures, especially soil nutrient management for Jumbo peanut, special irrigation management for most of the crops

Trade barriers to market entry				Competition with existing producers (dry chili, papaya, maize seed, cassava), limited market access, poor market linkages, pricing decision & poor market information
Available subsidy for VC development				ASMP-EU program funds Stakeholder/ Pvt. Sector willingness to facilitate training, tech transfer, capacity building, financial assistance on certification and maintain standards
Potential long-term conflicts over land use				Potential conflicts on land selection for crop production. Especially farmer selection would be tough task due to competition among farmers to join the program. Farmer recommendation: rotate beneficiaries based on Keth Ela system
3. Market Feasibility				
Reliability of supply is key for market participation				DoA guaranteed certified seeds eg. Jumbo peanut and chilli SLGAP certified crops Farmer cluster with 300 will be able to meet the market requirements
Standard specifications apply to products				SL GAP, Organic, Fair trade, GMP & HACCP DOA/ SLSI intervention is essential
Increased supply might negatively affect pricing				There is a high local demand on selected crop seeds. But in

				the long run there may be competition with imported seeds if import restrictions lift
Recognized buyer is interested				DoA, market under the new brand of proposed farmer company Potential buyers along with quantity and quality requirements
Potential supply of seeds & planting materials from other sources				Assume that there may not be policy changes on seed supply.
Crops with promising market demand both locally and internationally				Local production will reduce high import dependency, and secure expenditure on imports Dry chili, soursop, passion fruit, mango, casava, green gram, black gram, jumbo peanut
4. Structure Feasibility				
Possibility to make use of external supports				ASMP-EU program, DoA – Contribution of experts (crop leaders, seed certification division), regional DoA officers, private sector agri-input suppliers Consortium of Pvt. sector companies who are willing to join with clusters as buyers
Well-organized producer associations as a necessary condition for effective participation				Farmer organizations, producer organizations, women's organizations, coops, etc
Adequate post-harvest chain management as a necessary condition to control quality				Essentially need to establish postharvest management system for selected crops.

				Seed viability and shelf-life deterioration is common in current system. Beyond seed certification, seed treatments, especially protecting from fungal infections, storage, packaging is essential for sustainable supply
Necessary to establish a management system to control quality and sustainable exploitation				Capacity building of Proposed farmer companies: Seed production technology, pest & disease management, harvesting and postharvest management, seed certification, branding and marketing Insufficient awareness, exposure and adaptation of IPM practices Involvement of educated youth and female members of farm clusters and empower them through knowledge and skills is essential to establish sustainable seed business
5. Stakeholder Feasibility				
Exploring new products and diversifying supply				Joint research and development work with ASMP-EU project experts, DoA and farmers clusters: initiate cluster innovations hub
Promoting and opening market for commercially viable crops				Cater the demand of local market Supply of seeds and planting material is starting node of

				several economically important crop value chains
Increasing job opportunities and income for women and youth,				Attractive farm business for youth, chances for women Women headed and widow representation is observed in Vavuniya north Papaya cluster
Valorising (increase in the value of capital assets through the application of value forming labour in production) lands				Effective irrigation management, soil nutrient management, minimize post-harvest losses
Promoting renewable resources related economic activities				Solar powered dryers Bio diesel production Biochar and compost production
Sustainable resource exploitation				Enhance land productivity through high value crop, utilize appropriate modern technology
Generating fair employment benefits				Premium price for farmers, CSR, farmer training & capacity building
Strengthening domestic horticultural sector				Introduce new crops, Hass avocado, pomegranate, mango, passionfruit
Optimizing use of existing processing facilities				Limited capacity of threshing, grading, storage, etc. need to establish regional certified seed processing centers

Table 2: Value chain development – Vavuniya district

Crop	Product/s	Products from byproducts/ waste	Producer	processor	Exporter/buyer
Hybrid maize seed	Certified, Treated hybrid maize seeds / SL GAP certified	Compost Biochar	Farmer cluster	Cluster processing center	DoA Private sector
Chili MICH -1	Certified organic SL GAP certified Dry Chili (pods, pieces, powder, Moru Miris, etc)	Discards will be used for bio-pesticides	Farmer cluster	Cluster processing center	Cargills CBL
Black gram	Certified Seeds SL GAP certified Seeds, Splits, Flour	Compost	Farmer cluster	Cluster processing center	Local market
Jumbo Peanut	SL GAP certified deshelled seeds	Shell – biochar Discards or second grades - compost	Farmer cluster	Cluster processing center	C.W Mackie
Mango - TomEJC	SL GAP certified fresh mango	Discards or second grades – Mango sauce	Farmer cluster	Cluster processing center	Cargills
Papaya – Tainung	SL GAP certified fresh mango	Discards or second grades – dehydrated fruit snack	Farmer cluster	Cluster processing center	CBL MAA Cargills

Table 3: Value chain development – Kilinochchi district

Crop	Product/s	Products from byproducts/ waste	Producer	processor	Exporter/ buyer
Jumbo Peanut	SL GAP certified	Shell – biochar	Farmer cluster	Cluster processing center	C.W Mackie

	deshelled seeds	Discards or second grades - compost			
Chili MICH -1	Certified organic SL GAP certified Dry Chili (pods, pieces, powder, Moru Miris, etc)	Discards will be used for bio-pesticides	Farmer cluster	Cluster processing center	Cargills
Black gram	Certified Seeds SL GAP certified Seeds, Splits, Flour	Compost	Farmer cluster	Cluster processing center	Local market
Passion fruit	SL GAP certified fresh fruits Frozen pulp	Waste - compost	Farmer cluster		Cargills CAP Organic
Pomegranate	SL GAP certified fresh fruits	Waste - compost	Farmer cluster	Cluster processing center – pack house	Cargills MAA JH Holdings

Table 4: Value chain development – Ampara district

Crop	Product/s	Products from byproducts/ waste	Producer	processor	Exporter/ buyer
Hybrid maize seed	Certified, Treated hybrid maize seeds / SL GAP certified	Compost Biochar	Farmer cluster	Cluster processing center	DoA Private sector
Chili MICH -1	Certified organic SL GAP certified	Discards will be used for bio-pesticides	Farmer cluster	Cluster processing center	Cargills CBL CW Mackie

	Dry Chili (pods, pieces, powder, Moru Miris, etc)				
Mung bean/Cowpea	Certified Seeds SL GAP certified Seeds, Splits, Flour	Compost	Farmer cluster	Cluster processing center	Local market
Jumbo Peanut	SL GAP certified deshelled seeds	Shell – biochar Discards or second grades - compost	Farmer cluster	Cluster processing center	C.W Mackie
Soursop	SL GAP certified fresh fruit/frozen pulp	Discards or second grades – dehydrated mix fruit snack	Farmer cluster	Cluster processing center – pack house	CAP Green
Lime	Lime concentrate Lime powder	Discards or second grades – compost	Farmer cluster	Cluster processing center	Export/local
Bee keeping	Bee honey – in bottle, sticks,	Discards – Bee wax	Farmer cluster	Cluster processing center	Cargills

Table 5: Value chain development – Badulla district

Crop	Product/s	Products from byproducts/ waste	Producer	processor	Exporter/ buyer
Hybrid maize seed	Certified, Treated hybrid maize seeds / SL GAP certified	Compost Biochar	Farmer cluster	Cluster processing center	DoA Private sector
Chili MICH -1	Certified organic SL GAP certified	Discards will be used for bio-pesticides	Farmer cluster	Cluster processing center	Cargills CBL

	Dry Chili (pods, pieces, powder, Moru Miris, etc)				
Vegetable - Carrot/Leeks	SL GAP certified vegetables Carrot pulp	Discards-Compost	Farmer cluster	Cluster pack house and processing center	Cargills
Mung bean/Cowpea	Certified Seeds SL GAP certified Seeds, Splits, Flour	Compost	Farmer cluster	Cluster processing center	Local market
Seed Potato	Certified seed potato	Potato for local market Discards - compost	Farmer cluster		DoA
Hass Avocado	SL GAP certified fresh fruit	Discards or second grades – oil	Farmer cluster	Cluster processing center - pack house	CBL Lassana flora

Table 6: Potential value chain development – Kandy district

Crop	Product/s	Products from byproducts/ waste	Producer	processor	Exporter/ buyer
Chili MICH -1	Certified organic SL GAP certified Dry Chili (pods, pieces, powder, Moru Miris, etc)	Discards will be used for bio-pesticides	Farmer cluster	Cluster processing center	Cargills
Banana/Ambun	SL GAP certified fresh fruit	Discards or second grades – compost	Farmer cluster	Cluster processing center – pack house	

Casava	SL GAP certified fresh yams	Discards - compost	Farmer cluster	Cluster processing center – pack house	CAP Organic CBL
Hass Avocado	SL GAP certified fresh fruit	Discards or second grades – oil	Farmer cluster	Cluster processing center – pack house	Lassana flora
Jack Fruit	Ripe fruit - frozen Baby jack fruit – bottled baby jack cubes in brine, spiced pulled pork/ mimic pork taste	Discards - compost	Farmer cluster	Cluster processing center	CAP organic MAA Hayleys

Conceptualization on value chain development of horticultural crops

Fruit, vegetables and legumes are considered as high value crops in terms of food and income security of the farm house holds. ASMP EU project eyed on value chain development of the 5 economically, socially and environmentally feasible districts. EU districts stretched from North to East and towards to central. Selected districts representing diverse agro-ecological zones, contrasting crop mixtures along with socio-culturally diverse farming communities who has unique agricultural identities.

Agricultural productivity of these commodities is unsatisfactory, farmer returns are poor, both rain fed and irrigated farmlands, mechanization and application of modern technological knowhow is limited. However, looking into the potentiality, marketed volumes of fruit and vegetables are still low despite the good possibility of increasing area and productivity of these crops. Careless handling of crops during loading and unloading and a lack of storage facilities are contributory to postharvest losses. Project facilitation includes following key areas;

1. Production support: Identify pocket areas, institutions, and beneficiaries, support extension provision on production practices, support the establishment of PUCs, revolving fund operation for input support

2. Postharvest loss management: Prepare the strategy for technology dissemination Support the physical facilities of postharvest laboratory Prepare extension materials and training manuals
3. Market linkage: Provide physical support to collection centres capacitate extension workers and farmers Strengthen the market information system

Value chain suitability

Value chain suitability was measured through the scoring methodology and the analysis based on sixteen criterions of the commodity. Figure 6 brings the results of the value chain suitability and results highlighted that market competition of imported maize hybrids will less favorable for the hybrid maize value chain.

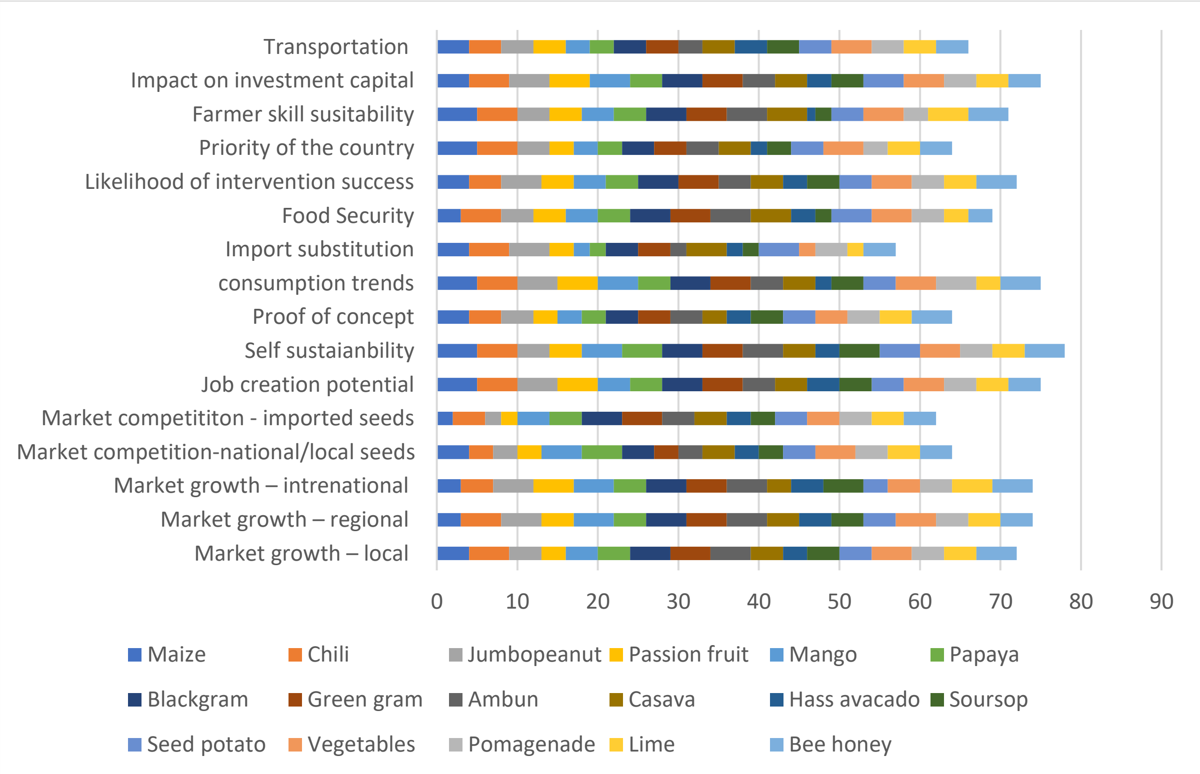


Figure 6: Value chain analysis: suitability

2.3.1 Value Chain map

Value chain mapping exercise was performed with the participation of industry stakeholders, subject matter specialists of DoA and ASMP project, officers of seed certification division, DOAs, leaders of farmer organizations and farmers of Badulla, Vavuniya, Kilinochchi, Ampara and Kandy districts. Focus group discussions, virtual interactive platforms were key sources feed information to the process. In general, agricultural value chains are short, complex and fragile in nature. Crop value chain model is a combination of several short length function specific value chains embedded in a value network. Value network exchanges both tangible and intangible values. Tangible value exchanges involve all exchanges of goods, services or revenue, including all transactions involving contracts and invoices, return receipt of orders, request for proposals, confirmations or payment and Intangible knowledge exchanges include strategic information, planning knowledge, process knowledge, technical know-how, collaborative design, policy development, etc.

Upstream of the value chain comprised of various government and private sector input suppliers, breeders, and importing companies, farmers, out growers, traders, collectors, wholesalers and retailers. Figure 7 explain the value chain enabling environment and service providers.

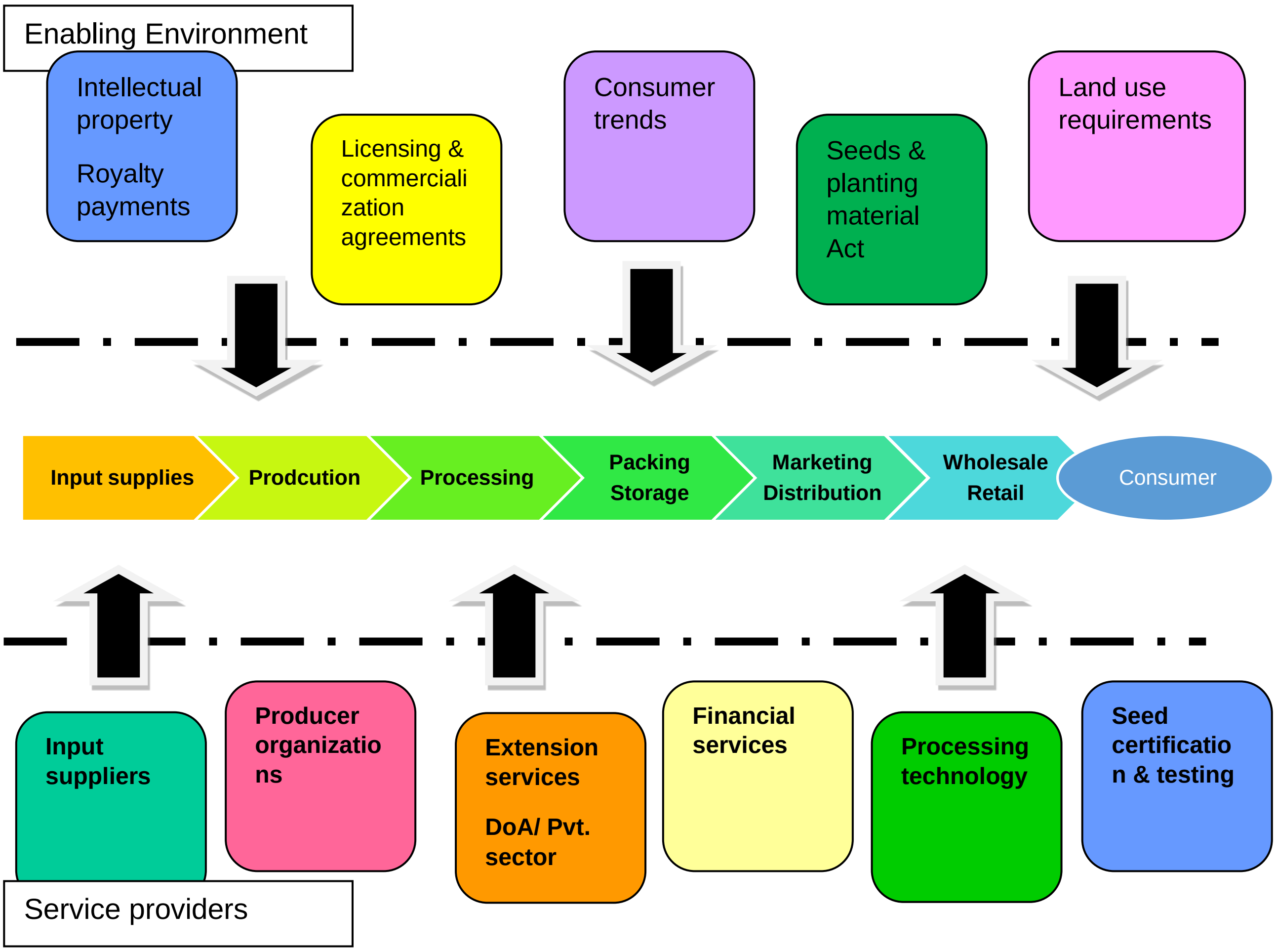


Figure 7: Value chain & the enabling environment

2.4 Selection of Crops Clusters and Methodology of Agronomy

The methodology used for selection of crops and feasibility for the cultivations were done through a consensus building process. The series of awareness building meetings and the key stakeholder meetings, and dialogues were conducted in the district levels and find out the best crops for the cultivation and recommended for the districts.

The farmer selection criteria for the meetings were done by the provincial agriculture officers i.e. Agriculture Instructors were involved in the farmer selection. The agreed criteria for selecting the farmer were defined. Especially the land ownership, farming land should need to be in the given area etc.

The consensus building meetings and awareness clusters according to below levels.

1. The provincial agriculture officers' awareness meeting – all provincial level key agriculture service delivery officers took part in the meeting. They are Department of Agrarian Services, Provincial Agriculture Officials, Irrigation Department, and Chief Secretary etc.
2. The Farmer meetings organized – The crop wise farmer meetings conducted and during the meeting the focus group discussions were conducted.
3. Department of Agriculture – the subject specialists' meetings also being conducted.
4. The potential buyers meeting also being conducted.

The number of famers average 50 were participated for each district meetings. List of stakeholder consultations given in Annex 8.

The series of meetings and consensus building and relevant information gathered and finalized the list of recommended crops for each locality. The recommended crops' further screen down for the feasibility and screen down by using the climatologically, physiologically and agronomy wise.

The methodology used the preferential sampling when conducting the focus group discussion conducting (Table 7). Example Chili Farmers get together and discuss the associated problems.

The primary data were collected by following the above steps. In addition to that the secondary data were gathered as the desk review by compilation of resource locators of official websites and the subject books.

Table 7: Summery of the Crop cluster selection methodology

Feasibility Criteria	Methodology/indicators			Specific Methods for the Indicator
	Indicators to be used in agronomic feasibility			
Farmer-feasibility	Age/ health/ Family/ preference/ willingness/ Demographic characteristics.	Duration of experience/ type of crops grown.	Other farming activities/ Animal husbandry.	Pre-tested Questionnaire/ face to face interviews /Rapid rural appraisal
High-value crop selection /Seed types	ASMP recommendation/ highbred/ traditional Value adding potential/market demand.	Yield potential for the area/ Possible niches (e.g., natural variations) for higher yields.	Prices /local/ Export/ consumer	ASMP recommendations, Focus group discussions with the AIs and FO of the area/Consultation with marketing expert/ GAP officials.
Land feasibility/Rainfall	Soil fertility/ texture/ depth and drainage.	Fertility retention capacity.	Land preparation method/ Implements.	Literature review (i.e., ISP reports)/ soil tests by DOA/Review of rainfall data.
Seeding, planting	Seed-selection Hybrid/ traditional	Seed types and viability.	Planting method/ distances	Recruit an expert for GAP. Review of current practices and recommendations of the DOA/ISP
Fertilizer Incorporation/Technology	Mineral fertilizer/ Compost, Nutrient content/ composition of compost	Method and frequency of application/ Basal / growth stage/flowering stage	Facilities for compost making/ availability of green/ minerals (i.e. dolomite)	DOA fertilizer recommends. on compost, Focus group discussions with farmers and AIs of the area
Irrigation/Technology	Water quality/ quantity available, Machinery to be used	Method, drip / surface / sprinkle irrigation	Frequency of irrigation	DOA recommends. /Water quality tests/ Focus group discussions with

				farmers and Irrigation Officials
Pest and Disease Controlling Technology.	IPM/ identifying natural enemies/ planting practices/ crop sanitation practices	Chemical control incorporation/ Available pesticides	Indigenous method	Field observation /farmer consultations for Identifying natural enemies of pests/ crop sanitation methods/ traditional methods
Harvesting and Drying Technology.	Method: Machine/Manual	Availability of manpower/machines	Focus group discussions with farmers/ DOA officials/National Review Committee Feed backs/ weather forecast	Harvesting and Drying Technology.
Processing: peeling off, cutting, chopping, dehydration/storage and cold storage technology.	Manual/ Machinery (locally made and user friendly).	Storage type/ packaging designs/ packaging material availability	Discussions with farmers and Agribusiness partners/ Cost-benefit analysis with Economist	Processing: peeling off, cutting, chopping, dehydration/ storage and cold storage technology.

Figure 8: Rapid discussion with relevant officers in Government departments

Figure 9: Rapid Focus group discussions with farmers in the area

2.5 Selection of technologies / innovations

Selection of Processing technologies, machineries and bringing new innovations are based on the value chain assessment and agro technological establishments. Machineries and technologies used in processing of selected crops were identified by undertaking field visits, having discussions with the consultant team and industrial experts, studying on past implementations in local and global context.

Prior to bring new farming and processing technologies, it was vital to have an understanding and gain a basic knowledge on selected crop cultivation, production process, labor involvements, existing level of mechanizations, required standards and processing parameters. Then, it was easier to relate existing technologies with most suitable production process. Using local machineries were more emphasized considering the current economic crisis of the country. However, depending on absolute requirements in terms of processing and increasing productivity, foreign technologies and machineries were considered. Past studies, researches and technical publications were useful to gain the required knowledge.

Field visits and discussions with district level officials were used to ascertain the infrastructure requirements. Used my engineering knowledge and experience to understand the existing technical gaps and come up with new technical measures, designs and innovations in line with the proposed value chain assessment. The sustainability of farmer clusters and potential opportunities were elaborated. Providing a better working environment for farmers while ensuring higher productivity and farmer company sustainability was the key element in recommending machineries and processing technologies.

The following statistics give an insight on district wise farm mechanization and water management.

<u>Literature survey – Current farm mechanization and water source of five selected districts.</u>

Table 8: District-wise Distribution of Agricultural Machinery (Small Holding Sector)

District	Number of Owned machinery/implemented available for 1000 acres											
	4 W tractor	**2 W tractor**	**Hand operated sprayers**	**Power operated sprayers**	**Thresher with winnowing**	**Thresher**	**Winnowing Fan**	**Agricultural water pump**	**Combined Harvester**	**Seeding Machines**	**Reaper**	**Agricultural Grass Cutter**
Kilinochchi	11.4	2.5	33.7	1.6	1.2	0.2	0.6	84.6	0.9	0.0	0.6	0.1
Vavuniya	11.1	9.8	69.2	4.0	1.7	1.2	1.3	109.8	1.5	0.1	1.2	0.1
Kandy	2.1	13.4	67.5	2.7	6.1	6.3	6.4	4.8	0.5	0.3	1.6	1.6
Badulla	3.6	37.6	199.7	33.1	5.2	3.5	7.4	42.6	1.5	0.2	0.7	0.8
Ampara	11.4	35.0	59.1	6.5	1.8	1.2	3.0	6.8	3.6	0.0	1.8	0.3
Sri Lanka	6.7	30.1	77.9	7.7	3.9	3	2.9	29.7	1.8	0.1	1.6	4.1

Source: General Report – Economic Census 2013/14, Agricultural Activities Sri Lanka.

Table 9: Extent under Seasonal Crop Cultivation by Source of Water and District - 2014

District	**Extent by Source of Water (Acres)**					**Poverty Head Count Index - 2016**
	Major	**Minor**	**Rainfed**	**Agro well**	**Tube Well**	
Kilinochchi	18,831 (35%)	1,283 (2%)	30,200 (55%)	2,928 (5%)	1,344 (3%)	18%
Vavuniya	3,647 (7%)	16,510 (30%)	24,682 (45%)	9,095 (15%)	1,531 (3%)	2%
Kandy	11,881 (18%)	17,649 (27%)	34,067 (52%)	626 (1%)	940 (2%)	6%
Badulla	34,836 (23%)	40,234 (26%)	75,536 (49%)	2,042 (1%)	1,392 (1%)	7%
Ampara	111,057 (60%)	7,308 (4%)	64,448 (35%)	1,014 (0.5%)	761 (0.5%)	3%
Sri Lanka	710,700 (27%)	394,103(15%)	1,345,187 (52%)	96,603 (4%)	57,532 (2%)	

Source: General Report – Economic Census 2013/14, Agricultural Activities Sri Lanka.

Table 10: Number of Parcels under Crop Cultivation (except Paddy) by Water Supply Method and District - 2014

District	Water Supply Method			
	Motor or other Plumbing Equipment	Sprinkler/Drip	Canal	Other
Kilinochchi	5,380 (64%)	155 (2%)	244 (3%)	2,619 (31%)
Vavuniya	9,247 (73%)	121 (1%)	1,185 (9%)	2,058 (17%)
Kandy	1,508 (8%)	170 (1%)	9,402 (49%)	7,940 (42%)
Badulla	9,239 (13%)	2,760 (4%)	37,018 (53%)	21,444 (30%)
Ampara	3,412 (26%)	262 (2%)	3,922 (30%)	5,479 (42%)
Sri Lanka	184,531 (38%)	14,652 (3%)	121,285 (25%)	159,083 (33%)

Source: General Report – Economic Census 2013/14, Agricultural Activities Sri Lanka.

Key Findings

1. Farmers in Kilinochchi, Vavuniya and Ampara districts use 4 W tractors more than the rest of districts under preview. Thus, it can be assumed that mechanized land preparation in these districts is higher than the rest.
2. Use of 2W tractors is mostly for powering thresher and winnowing machines. Depending on the land terrain, 2W tractors are used for land preparation as well.
3. Combined harvesters are popular in Vavuniya, Badulla and Ampara probably due to higher paddy cultivation in these districts compared to the rest.
4. It seems that seeding is undertaken manually in most of districts.
5. Usage of agricultural water pumps in Kilinochchi and Vavuniya districts are extremely high. Agro and tube wells in said two districts are commonly used for irrigation purpose as well.
6. Dependency on rainfed irrigation is higher in Kandy and Kilinochchi districts. Low rainfall in Kilinochchi makes it worst for sustainable farming. The risk carries with rainfed irrigation is associated with low farm extent and productivity particularly in Yala season. It could be found that, districts that have higher dependency of rainfed irrigation make a less contribution for agricultural share in national GDP. Suggest to relate poverty head count index with dependency on rainfed irrigation.
7. Micro irrigation systems are not familiar among Sri Lankan farmers yet. Thus, there is higher potential to train and facilitate farmers in appropriate and sustainable water management.

All the findings and observations were used to identify location specified gaps and potential developments.

2.6 Methodology adopted in Financial Assessment

This section explains the methodology that was adopted in conducting district feasibility studies. As Ampara, Kilinochichi and Vavuniya are located more or less same agro climatological areas and that of Kandy and Badulla districts differs significantly, type of crops and cropping pattern differ significantly. Categorically, seasonal crops, paddy, permanent and semi-permanent crops are cultivated in those districts.

Through Cluster Development Program, development of ATDPs is considered to be one main objectives of component 2 (productivity enhancement and diversification demonstration) of ASMP project. The project also expects to establish production and market infrastructure and provide analytical and policy advisory support once the CDPs are identified and developed. In establishing the CDPs, the first step is to conduct district feasibility studies to identify what high valued crops are cultivated and to evaluate their economic and market feasibility mainly. In conducting the feasibility study, the following methodology will be adopted.

1. Initial Screening – prefeasibility
2. Feasibility study

Initial Screening – prefeasibility

This is essentially a pre-screening of the proposed action in the ToR and it attempts to examine if a proper feasibility assessment is worth doing. Initial screening of the crops is done based on the information and data available in DOA and other statistical bulletins. Based on the gathered data most contributory crops to the production and income generation in each district will be selected based on their current performance. Selection of the crops depends on the agro climatological zone, yield, productivity, input usage and so on. Initial screening of crops also depends on the ideas of expert opinions especially the agronomist and the agribusiness and value chain specialist. Apart from them, local officials within each district will be contacted and their opinions and ideas are also considered in in the initial screening. The initial screening of the crops is done so that feasibility analysis of each selected crops can be carried out based on initial screening. Information regarding the status of growers and their distribution in the district is collected through key informant interviews with the responsible persons of the concerned stakeholder organizations. The main purpose of initial screening is to identify the farmer’s potentials in high value crop production crop combination (inter-cropping, rotational cropping etc.) in each district.

Table 11: Land use pattern in each district

District	Agro climatological zone	Land use
Kilinochchi	Low country dry zone	Cashew, coconut, condiment’s, shrub, natural forests etc.

Vavuniya	Low country dry zone	Rain-fed upland crops, paddy, shrub, natural forests, mixed home gardens etc.
Ampara	Low country dry zone	Rain-fed upland crops, sugarcane, paddy, shrub, natural forests, mixed home gardens etc.
Kandy	Mid country wet zone	Mixed home garden, export agricultural crops, tea, paddy, rubber, natural forests etc.
	Up country wet zone	Tea, vegetables, forest plantations, natural forests
	Mid country intermediate zone	Tea, vegetables, forest plantations, natural forests, Mixed home garden, export agricultural crops
	Up country intermediate zone	Tea, vegetables, forest plantations, natural forests, Mixed home garden, export agricultural crops
Badulla	Mid country intermediate zone	Tea, vegetables, forest plantations, natural forests, Mixed home garden, export agricultural crops
	Up country intermediate zone	Tea, vegetables, forest plantations, natural forests, Mixed home garden, export agricultural crops

Feasibility Study

The main intervention of the project is to develop agricultural crop clusters in each district through cluster development plans and cluster investment plans. Hence the economic feasibility of selected crops from initial screening were evaluated to develop crop clusters. Having selected the most contributory crops in sustaining the livelihoods of the farmers and creating business minded entrepreneurial farmers, most advantageous crops with high income potentials and profit margins were selected through the basket of crops taken from the initial screening. In developing the clusters, it is expected that one crop per cluster is selected depending on the cost and benefits generated by the crops.

In conducting the feasibility analysis, qualitative as well as quantitative methods were used when the requirement arises depending on the availability of data, time duration, resource availability, transportation facilities etc. Data were gathered through both primary and secondary sources. For example, the primary data were gathered through a focused group discussions and field visits, focused group discussions and key informants. The focused groups comprised of officials of Department of Agriculture (DoA), private sector companies and most importantly farmers. Secondary data were gathered through the available data sources such Department of Census and Statistics, Department of Agriculture, HARTI, District and Provincial Agricultural officers, ASMP project offices and available publications. The data collected were analyzed using the following techniques (The Table shows the needed data, variables and analytical tools).

- Per unit cost analysis
- Profits or gross returns/ gross margins
- Break even analysis
- Benefit - Cost analysis
- NPV analysis
- IRR
- Return on Investment (ROI)

Apart from the quantitative approach mentioned above, a qualitative approach proposed by O'Brien *et al*. (2018) in their study related to Sri Lanka were adopted. As our main objective of the intervention is to produce export oriented entrepreneurial farmers who produce high value crops. On the other hand, Qualitative approach can be used due to time constraints and problem of data availability. O'Brien *et al*. (2018) proposed 17 dimensions taken of feasibility. Those 17 dimensions are listed under six broad criteria. The dimensions include the facts from cultivation to processing to marketing. They also include costs, skills and other barriers involved with it.

Table 12: Criteria and Dimensions

CRITERIA	DIMENSIONS
<u>Criteria 01</u> Cultivation costs (Skills, money, technology)	• Skills, special knowledge needed • Equipment/ technology needed • Labor needs for cultivation
<u>Criteria 02</u> Cultivation quality (difficulties for high quality cultivation)	• Difficulty to get inputs for cultivation • Difficulty reaching adequate quality by farmers (including vulnerability to damage during cultivation)
<u>Criteria 03</u>	• Skills for processing • Money needed for processing • Technology needed for processing

Processing costs (Skills, money, technology needed for processing)	
<u>Criteria 04</u> Marketing standards (for processed crops/ food)	• Indian market standards • EU market standards • US market standards • ME market standards
<u>Criteria 05</u> Scaling up (difficulty getting high quality supply)	• Difficulty for processors get enough supply • Difficulty of reaching adequate quality by processors and exporters
<u>Criteria 06</u> Infrastructure costs (assets needed across entire value chain)	• Water • Electricity • Transport infrastructure

Table 13: Matrix of Feasibility Scores

Feasibility criteria	Scores: 1 (low)	2	3 (medium)	4	5 (high)
1. CULTIVATION COSTS (skills, money, technology needed for cultivation)					
Skills / special knowledge needed for cultivation	No need of special awareness for soil or planting. Very little specialized knowledge -- just throw seeds.Nearly all of farmers in Sri Lanka can do this easily.		Most or all farmers can do it, but not all are aware of the right planting materials / varieties, but can easily teach them. Techniques are relatively easy to follow.		Needs special awareness for soil / planting. Different from other crops -needs very specialized knowledge --only applies to that specific crop. Very few people or companies know how to grow it, very few are aware. Harder to learn.
Equipment / technology needed for cultivation (cultivation equipment or harvest equipment (e.g. tractors for paddy), greenhouses, or drip irrigation	None of this equipment		some of the equipment (e.g. drip irrigation) would be useful, but not yet common in Sri Lanka		all of the equipment is needed (drip irrigation,greenhouse, high tech cultivation or harvest equipment e.g. tractor)
Labour need for cultivation (estimate)	No need labor for cultivation.		additional labors need for the cultivation which home labor not sufficient		high labor intensive cultivation & equipment can't replace
2. CULTIVATION QUALITY (difficulties for high-quality cultivation (finding inputs & successfully growing)					
difficulty to find inputs for cultivation (including planting materials, quality, varieties)	Very low cost, easy-to-get inputs		Planting materials are low cost; shortage of planting materials for some variety		Key inputs or varieties are banned (due to Seed Act orother) or are prohibitively expensive.
difficulty reaching adequate quality by farmers (including vulnerability to damage)	Little-to-no quality premium; no special treatment needed during growing, harvest and transport; hard to damage		High quality premium and care needed to reach quality during growing and harvesting and duringtransport		Buyers need extremely high quality and product is vulnerable to damage; very high costs to protect the product during transport
3. PROCESSING COSTS (skills, money, technology needed for processing)					
Skills for processing	products are not processing and no skill required		high skill required for processing		skill labor is not available in the country
Money needed for processing	no product processing and no money need for processing		money need for primary processing (e.g. drying,value addition)		High investment required for change the entire set up of the processing. (biosecurity farm for shrimp production)
Technology needed for processing	no technology applicable for processing		advance technology required for processing which is available in local context		Technology is only available in developed countriesand can't transferred.
4. MEETING STANDARDS (for processed crops / foods (ISO, HACCP etc.)					
Indian market standards Middle East markets standards US market standards EU market standards	Virtually no regulations.		Relatively simple regulations / standards. Many (butnot all) companies can meet them.		Most strict / difficult standards / regulations. Only the top Sri Lankan companies can meet them.
5. SCALING UP (difficulty getting high-quality supply)					
difficulty for processors to get enough supply	adequate supply for processing (e.g. pepper)		supply is not adequate for processing (e.g. Gherkin)		supply is not available for processing (e.g. Vanilla)
difficulty reaching adequate quality processors & exporters	quality is not considered as important factor for processors and exporters e.g vanilla		quality can be enhance by limited processing (tomatoes , bell peppers)		quality is extremely bad which is rejected by the processors and exporters and more advance processing and required (E.g. Prawns product which has not gain adequate weight)
6. INFRASTRUCTURE COSTS (assets needed across the entire value chain)					
water	drought resistance for some agricultural products / processing (E.g. lemon grass)		water required for cultivation /processing (most of the crops)		Water is must for cultivation /processing (E.g. Shrimp, sea cucumber)
electricity	no need electricity for entire value chain/minor cost incur		average cost incur throughout the value chain		due to the cost factor electricity can't be supply throughout the value chain
transportation infrastructure	quality does not deteriorate by transportation e.g. dry products		required extract attention with low cost - mango		high tech transportation facilities required when transportation and effect to deteriorate quality due to very sensitive

Source: O'Brien *et al*. (2018)

Analysis of Data in the qualitative approach

In analyzing the data, a five-point qualitative scoring scale was used. The two extremes of the scale are having the score of 1 for most feasible and 5 for most difficult or challenging. For example, if the core value is low, it implies that it is feasible while the high score denotes least feasible or challenging or difficult crop.

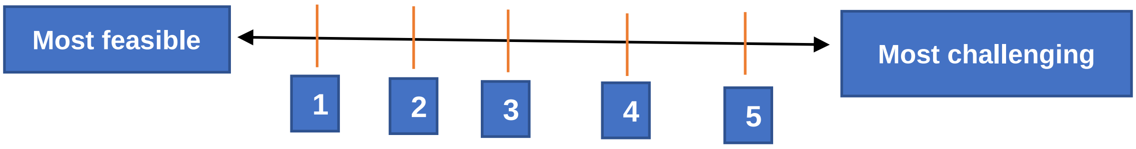


Figure 10: 5-point qualitative scale (O'Brien *et al*., 2018)

Eg: Low Scoring product/ crop ➔ very easy
High Scoring Product/ crop ➔ very difficult

Once a few crops are selected based on the initial screening depending on the technical aspects, stakeholder feedback and the views of each consultant, each crop was used to find the score and most feasible crop/ crops were identified.

2.7 Farmer organization development & training methodologies

2.7.1 Farmer Based Organizations

As aware that the smallholder farming sector in Sri Lanka plays a dominant role in the economy that recognizes the importance for providing employment, income generation, poverty alleviation and regional development. In this context, Farmer Based Organizations (FBO) were considered a structured arrangement to acquire the social capital (an entity) representing the farmers in a given geographical area to deal with Agro value chain/ enterprise related needs.

The individual consultants assigned with the tasks under each TOR worked as a team during the feasibility study and carried out, formal meetings/group discussions, observations/ assessment of PPMU initiated pilot cluster programs, virtual forums with relevant stakeholders, farmer groups, leading marketing entities, agro–service providers, PPMU, PMU and ascertained the most feasible Cluster Value Chains (CVC) with rotational crops with due consideration of the prevailing economic, social and political status in the country.

Based on the formal discussions with Farmers, DOA officials, MASL, Irrigation Department, PPMU and PMU the preliminary crop list was validated for each district, and follow up with introductory meetings with farmer groups coordinated with relevant institutional partners. The confirmed list was developed as noted below:

Table 14: District wise CVC determined for Farmer organization development

District	Agreed CVC clusters /CDP	Divisional secretariats
Ampara	Soursop Hybrid Maize Seed Jumbo Peanut Chili-(Dry)	Padiyathalawa/ Uhana Padiyathalawa/ Maha-Oya Thirukkovil Damana/ Thirukkovil/ Potuvil
	Rotational cropping G/gram, Sesame, Black gram*. *Lime & Bee keeping – for value addition for sustainable operation/ income *for FC*	
Badulla	Chili (Dry) Avocado (Hass)/ /seed potato Hybrid Maize Vegetables	Mahiyanganaya/ Redeemaliyadda Welimada/ Uva Paranagama/ Bandarawela/ Passara Kandaketiya/ Meegahakiwula Welimada
	Rotational cropping G/gram, Naimiris. Soursop/ Potato seed on going cultivation for value addition for sustainable operation/ generation income *for FC.*	
Kandy	Avocado (Hass)/Cassava Cassava Banana (Ambon) –Ceylon Cavendish Chili	Pathahewaheta, Pasbage korale, Udapalatha Doluwa/ Udapalatha Medamahanuwara Pasbage korale/ Udapalatha/ Gangaihala korale
	Rotational cropping Maize, legumes Cherry tomato, Naimiris, Yams (Kiri-Ala); Jak fruit value addition of existing home garden production sustainable operation/ income *generation for FC*	
Kilinochchi	Jumbo peanut	Karachchi/Kandawelai
	Chili	Karachchi/Kandawalai
	Passion Fruit	Karachchi
	Pomegranate	Pachchilaipillai
	Rotational cropping Green gram, Black gram, Sesame, Chili, and border crop Jatropha for renewable energy sustainable operation/ income *generation for FC*	

Vavuniya	Mango (TJC)	Vavuniya North/ (MASL System L)
	Papaya (Tannin 1)	Nadunkerny (Vavuniya North)
	Hybrid Maize Seed	Vavuniya and Vengadachettikulam
	Chili	Vavuniya and Vavuniya South
	Rotational cropping Green gram, Black gram, Vegetable, Chili, and border crop Jatropha for renewable energy sustainable operation/ income *generation for FC*	

2.7.2. Farmer Organization Development Feasibility

Farmer Organization Development feasibility assessed under two distinct areas identified as;

a) Feasibility for farmer organization development (Institutional development)
b) Assessing feasible training needs/ methodologies.

The methodology for **feasibility assessment on institutional development** considered following criteria and dimensions in relation to select CVCs in select regions as noted under 2.7.1 also the focus is given for institutional aspects as described in the TOR for Institutional Development Specialist.

Criteria	Description/ indicators	Proposed evaluation method
Study the Existing FBOs/ pilot POs (ASMP/ PPMU) in the select area.	• Types of FBOs • No. of members, *(active/ inactive)* • Org. Structures/ model of FBO, • Responsible institution • Mandated products/ resources	• Meetings with – Farmers, POs, FBO, relevant institutional staff *Discuss;* *Role of FBO/ Institutions, interests of members* *Level of interaction (member-FBO-Institution-Market)* *Opinions on services provided, advisory personnel* *Improvements observed – knowledge/ skills, interaction with others/ networking, influence for sharing resources*.
FBOs/ POs performance on	• Identified needs of members • Farmer household support	• Discussion with FBO/PO- EC, Members,

fulfilling the needs of the members.	• Training support • Market access/ Collective actions • Approach for retention of membership & motivation to stay active.	• Review minutes of meetings • Training activities/ modules/ curricular • Capacity to mitigate gaps/ challenges for FBO/ individual • Commercial mindset *(EC meetings, AGMs & other special meetings). Decisions made, records of progress, member registry*
Extension support CVC/ social/ economic	• Interaction with GOSL/ private service providers, • Activities to improve member knowledge/skills /technology, • Mitigation of Agro- problems, • Facilitate/conduct training, monitoring/ for achieving expected benefits from select CVC.	• FGD, KII, identify the farming needs • No. of CVC promoted, (including rotational crops) • No. of trainings achieved. • No. of participants, % of the membership *Knowledge/ capacity gained & further needs related to CVCs & productivity*
Interventions with input/ resources	• Collective procuring/ distribution of Crop inputs, • Documentation/logistics support • Availability of shared services (office and operation infrastructures, farm machinery, irrigation equipment), • Capacity to facilitation of post-harvest processing & storage, • involvement in Joint events, labour sharing, • Managing community resources	• Member opinions, • FBO mechanisms. (managerial/financial) • Meeting with service providers *(opinion on FBO)* • Member views/attitudes on participation in common activities (on farm/off farm). • Challenges observed in development of crop plan and implementation procedures. *Member dependency on service providers, input suppliers/informal financial Services, agri-businesses, etc.*
Financial support for members	• Facilitation of farmer credit, • Coordination with PFIs,	• Farmer interviews, Identify knowledge on banking services • FBO interventions in accessing PFI

	• bulk loan services, negotiating • Donor funds, insurance support, • FBO/ Member investments • Member fee	• Farmer attitudes towards formal/ informal financial services. • Awareness on accountability/financial procedures *Member opinions on informal PFIs and profitability of CVC*.
FBO adherence to administration and financial procedures	• Established constitution, MOA • Procedures, record keeping • member bank accounts/ FBO acct • transparency- financial statements/ audited accounts, knowledge of EC	Meeting with EC, members, institutional advisor, ROC *FO management/ governance and constitutions available*
Marketing of produce	• Member awareness, • improve member capacity for acquire knowledge, build commercial attitudes • market identification, negotiation capacity for competitive market access • Induce product diversification, processing/ value addition • Branding to capture competitive market edge.	• Interest and attitudes of VC actors- *marketing companies/ agribusiness ventures* • Discuss the FBO/ member/ capacity for negotiating • Effectiveness of prevailing marketing practices (documentation, timely delivery) • Change expected, strengthen and better access of market. • Member/ FBO opinion to promoting the formation of FCs. *Ongoing marketing systems, issues & challenges, proposed methods for improve the market access.*
Involvement of investment promotion/ other business activities	• Review any income generation activities. *Potential with members/ FBO* • Capacity to organize/ facilitate/ enterprise development on the own • Trade/ activities based Promotional capacities	Availability of FBO/ human resources and knowledge base for investment promotion Identify the gaps for marketing and investment promotion.

		Assess the institutional capacities in terms of human capital, infrastructure and diversity of value chains.

Feasibility of training development propose to assess through Key Informant Interviews (KII), meeting with relevant service providers, ISP experts, PMU, PPMU, AgEDIS/ DOA, PDOA, field extension officials in the regions.

- Ascertain the farmers' preferences/willingness for accessing different sources of information available in the locality/region and those published through physical or virtual platforms.
- Capacity of members-especially the;

  Organizational mind-set,
  Financial and administrative knowledge, skills/attitudes,
  Adoption of modern /innovative technology, best agriculture practices,
  Improved market access/consolidated marketing of produce at FO level,
  FO capacity related to on farm operations, financial management, farm business operation, planning/ implementation
- Review of ongoing training/ capacity building programs/ materials/ modules/ curricular including Farmer Business School practices.

TNA report, modules developed/ available/ training activities under PMU reviewed and adopted as appropriate.

2.8 Methodology of Spatial Database Development

2.8.1 Geo Information Database Development

Development of a Geo-Database that are to be established in selected Clusters within the five districts namely Kandy, Badulla, Ampara, Kilinochchi and Vavuniya under the ASMP-EU clusters. Under this project there are 4 clusters from each district and 300 farm plots in each cluster will be selected for implementation in different crops. Those Farmers should be selected closest DSDs at least closest GNDs for minimize transportation and development of PUC etc.

Following DSDs were selected with agreed crops with intercrops & rotations crops which are mentioned above table 15 during field visit & consultation with DOA provincial staff & EU consultant team.

Table 15: Selected DSD and GND for Crop clusters

S no	District	DSD Name	No of GNDs	Area (Ha)
1	Ampara	Padiyathalawa	20	1935.13
2	Ampara	Mahaoya	17	4007.17
3	Ampara	Uhana	55	909.73
4	Ampara	Pothuvil	27	999.54
5	Ampara	Thirukkovil	22	852.03
6	Ampara	Damana	34	1618.75
7	Badulla	Kandaketiya	26	15269.5
8	Badulla	Mahiyanganaya	35	59830.9
9	Badulla	Meegahakivula	20	10869.51
10	Badulla	Rideemaliyadda	42	43845.91
11	Badulla	Uva paranagama	68	13746.15
12	Badulla	Welimada	64	19506.86
13	Kandy	Doluwa	33	10033.89
14	Kandy	Ganga ihala korale	31	8892.01
15	Kandy	Kundasale	81	8076.41
16	Kandy	Medadumbara	94	19024.75
17	Kandy	Pasbage korale	32	12180.48
18	Kandy	Udapalatha	49	9095.17
19	Kilinochchi	Kandavalai	16	25885.72
20	Kilinochchi	Karachchi	43	43296.06
21	Kilinochchi	Pachchilapalli	18	16844.4
22	Vavunia	Vavuniya	51	61719.88
23	Vavunia	Vavuniya north	26	76315.38
24	Vavunia	Vavuniya south	22	22000.97
25	Vavunia	Vengalacheddikulam	20	40494.93

Geo information Database is useful for ASMP staff and DOA planners and farmer Company to achieve targets, increased production and reduced costs by enabling better management of resources.

Backbone of a *successful* GIS is properly designed and developed *geo-database. The proposed methodology mainly focuses on developing an optimum geo-database to support required spatial analysis and* starting from planning stage, continue with the project implementation and finally to analyses for avoid weaknesses get maximum profit for the farmers.

2.8.1.1 Geo Database planning, development and implementation process

- Planning, design, implementation, management, and proper usage are the key phases of any effective and successful GIS Project. Therefore, a structured process is proposed to develop this GIS which fulfils the needs of ASMP. This methodology comprises the following main phases

2.8.1.2 Organize a planning workshop for Requirement Analysis

It is proposed to organize a planning workshop prior to system designing. This is a vital step to ensure that the design of the Geo-Database fulfils the expected spatial analysis of ASMP. Main participants of this workshop are consultants of the project, PMU, MOA/ DOA staff, and the GIS consultant/ development team and finally designed database structure for Geo information Database.

2.8.1.2.a. Following Tasks to be completed after planning workshop,

- Spatial analysis needs
- Data needs for reporting
- Required Geographic data and sources
- Sources of acquiring Drone Imagery for farm areas
- Farm level baseline data
- Farm level agricultural data (initial)
- Farm level monthly data
- Selection of GIS software and application extensions
- Selection of Hardware

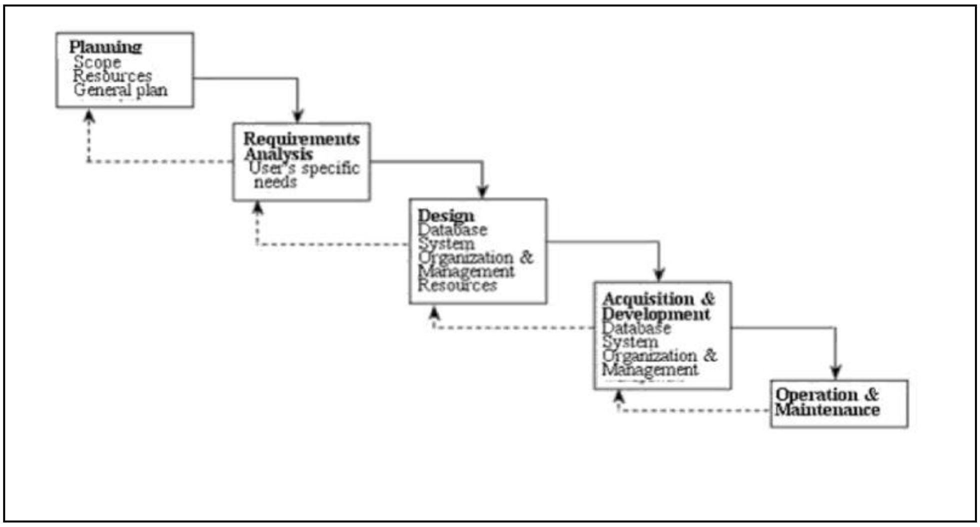


Figure 11: Tasks to be completed

- **Design of Geo-Database**

  The process focuses on designing a database structure that will be used as a plan to store and manage the identified data. Good design is an essential pre-requirement to construct a complete Geo-Database. That includes Database Management System (DBMS), Cloud-based Database Hosting and Development of a database for farm-level data.

- **Data Base Management System (DBMS):** DBMS is the most important component of the GIS. Once identified the geographic and related attribute data during the planning workshop, it is required to select a suitable DBMS to create and maintain these data. A suitable Open-source software will be select as the DBMS.

- **Cloud based Database Hosting:** Maintaining an in-house database server to host Geo-Data is an expensive task due to high cost of required hardware/software and recruitment of trained staff. Therefore, it is proposed to host the ASMP geo-database in a reliable cloud-based server (will be called as "ASMP server"). It has added flexibility of cloud computing and has advantages such as ease of access, scalability and disaster recovery.

- **GIS Data Processing Centre:** It is proposed to establish a Data Processing Room (Operation room) to install the GIS hardware and software in a central location after completion of the main task of structure of the database and development spatial database, processing centre will be move into ASMP Office in suitable place. This will help to minimize transportation costs during field operations and enumerators can transfer the field data without much delays.

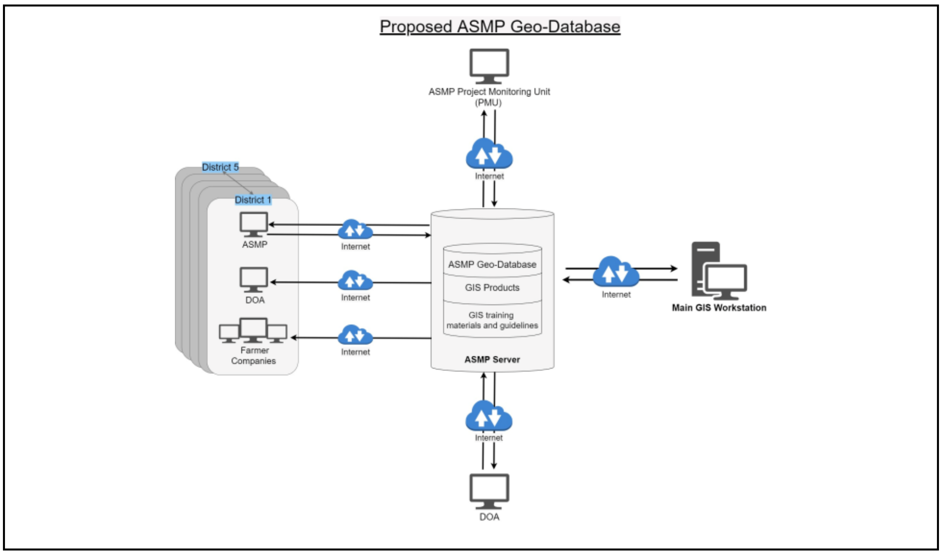


Figure 12: Proposed Database

- **Development of database for farm-level data**
  Based on the database design farm level data base will be implemented to store and manage baseline and monthly data for all clusters. Also, a set of user-friendly forms will be developed for hassle free data entry and editing purposes.

2.8.2 Installation of GIS Software and Hardware

2.8.2.1 Selection & Installation of GIS Software and Hardware

Choosing the most appropriate GIS software and hardware are critical to the success of the project. Based on the findings of “application requirements” during the planning workshop and considering the future expansion, widely used popular software with wide range of application modules will be recommended. Consultant will also provide specifications for the required hardware with sufficient processing power and memory (considering the processing of drone imagery) to ASMP.

2.8.2.2 Main GIS installation

Identified GIS Software and Hardware will be installed in the Data Processing Room. It is required to provide high speed internet facility, furniture and other facilities for the installation.

2.8.2.3 GIS Installations in Districts

By providing high speed internet facilities all ASMP District office can access data and GIS products from the server. Also, it is possible to carryout spatial analysis if software is available.

2.8.3 Development of database for farm-level data

Based on the database design farm level data base will be implemented to store and manage Also a set of user-friendly forms will be developed for hassle free data entry and editing purposes.

A team of field officers will be deployed to capture the GPS location of each farm plot and other related data (identified during the planning stage) about farmers, plot details, existing crops, etc. Unique identification numbers will be assigned to these plots as required. Primary data will be collected from District Office and Secondary Collection from field investigation.

Develop a Geo-Database for the ATDPs that are to be established in selected locations within the five districts namely Kandy, Badulla, Ampara, Kilinochchi and Vavuniya under the ASMP starting from planning stage, continue with the project implementation and finally to analyses

2.8.3.3 Drone imagery survey & new land use maps for crop clusters

After Established cluster development plans, large-scale maps (e.g. land use and Farm pots etc) can be developed for farm clusters using drone imagery. These maps will be extremely useful for detailed crop planning and visual analysis purposes. Required drone imagery will be purchased by the ASMP time period attached here.

2.8.4 Data Acquisition and Development

This will be the most time-consuming activity of the project cycle. During this phase following components will be developed and implemented. After selection of suitable land for different crops, ASMP Cluster coordinator collect all primary data and GIS staff will collect other secondary data related each farm land using GPS and field visit for update Geo database.

2.8.5 Spatial Data Sets

Acquiring existing Spatial Data

All identified map-based datasets for the project areas acquired from various sources such as Survey Department of Sri Lanka, Department of Agriculture, Irrigation Department and other relevant agencies will be uploaded to the ASMP server. When acquiring these datasets quality of data, published year, scale and other related information will be verified. For all data layers required **metadata** will be included for references.

1 : 10000 scale topographic data will be collected from Survey Department, Land use from Land Use and Policy Department, Geology, soil data and any other sources for the 5 Districts.

2.8.5.1.a Baseline Survey:

A team of field officers will be deployed to capture the GPS location of each farm plot and other related data (identified during the planning stage) about farmers, plot details, existing crops, etc. Unique identification numbers will be assigned to these plots as required.

2.8.5.1.b Monthly Updates:

It is required to collect important fields such as fertilizer & weedicide application to the farm lands etc. This is a time-consuming field activity which needs proper coordination with the Cluster coordinators. Also, required advice and support is expected from ASMP consultants, PMU and district level staff.

2.8.5.2 User Interfaces and Applications

User friendly Interfaces will be developed for ASMP users to login to ASMP server access data and GIS products. Data and product downloading routings will be developed for fulfill ASMP user needs.

2.8.5.3 Testing the System

The GIS consultant, database and application developers will test the database related applications, data outputs and other routines before deploying the ASMP GIS.

2.8.5.4 GIS Training for ASMP staff

Consultant will provide basic GIS training to selected ASMP and MOA staff. Also, required on-the-job training will be provide to selected staff on maintenance, update of the geo-spatial and data analysis. Two basic awareness GIS sessions will be conduct for PMU staff and other staff.

2.8.5.5 Spatial analysis & GIS Product Development

ASMP District users could easily access Geo-Data via internet and perform spatial analysis using their GIS workstations.

(a) Operation and Maintenance

The importance of the GIS is judged by its usefulness for operational and decision-making purposes. Therefore, management support, proper data management, and application development to fulfil user requirements are essential to ensure success

(b) Spatial analysis & GIS Product Development

It is vital to clearly identify the spatial analysis, monitoring, and reporting requirements of project planners and consultants during the planning workshop. Based on their needs will be able to fulfil analytical needs. Input from Agronomist and other ASMP experts are expected when developing spatial analysis models and reports.

2.8.6 System Maintenance

During the project period the GIS consultant and developers will maintain the Geo-Database and GIS components. Which includes Updating the databases, Data/System protection and Data backups Expected contribution from relevant parties: This task needs to be completed within time period of 6 months. Therefore, all necessary information, timely selection of clusters and farm plots is necessary. Contribution from all experts, ASMP staff, District Coordinators, Cluster Coordinators and other relevant parties are expected for Development of Geo information Database. Ensure the expected results. Findings are useful to refine the processes.

Consultant requests the following assistance and coordination with relevant Institutions and parties who are involved in the Project without delay.

2.8.7 Reviewing project performance

Consultants will review the performances of the project activities throughout the project duration

1. Documents available with the ASMP, any available appropriate data.
2. Contact details of field level operational officers
3. Digital data and maps from relevant agencies.

2.8.8 Installation of GIS Software and Hardware

Purchase equipment such as GIS Work station, GPS equipment, GIS software, Drone imagery etc.

2.8.9 Spatial analysis & GIS Product Development

ASMP District users could easily access Geo-Data via internet and perform spatial analysis using their GIS workstations.

2.8.10 Deliverables & final results

- All the required maps, Graphs and charts will be prepared
- Geo database access to all relevant parties will established (Ministry staff, Farmer companies and other relevant parties)

2.9 Methodology adopted in Environmental and Social Assessment

The proposed methodology for safeguards assessment is based on the ToR and it should be customized to meet the requirements and overcome the challenges according to the ground situation.

Available published and unpublished literature relevant to the project reviewed and socio-economic and environmental data available from local authorities collected. The feasibility study team made aware of the potential impacts associated with different options and recommended mitigation measures; and all field data and information collected by the feasibility study team reviewed.

This informal scoping task brought the expert's team to a one flat form while improving & understanding the Terms of References issued by ASMP. The information collected in this exercise used in identifying the major types and distribution of terrestrial, aquatic habitats, eco-systems including Protected Areas, forest reserves and conservation areas, existing land use patterns, existing natural & man-made vegetation and other structures, spatial distribution of habitats and ecosystems, natural and anthropogenic impacts to environment in the project area etc. In addition, all the existing maps (land use, hydrology, vegetation etc.) of the study area collected during this assignment.

In order to address above main key areas of the scope of services, it is proposed that the physical, biological and socio-economic environment of the project area and its surrounding assessed in detail under each sub categories in specific sub methodologies under each sub sections of ToR.

Table 16: Methods of Data Collection

Primary Data	Secondary Data
Direct Observation	Published Data
Focus Group Discussions	Unpublished Data
Key Informant Interviews	Maps

2.10 Overview of Environmental Legislation

The constitution of the Democratic Socialist Republic of Sri Lanka under chapter VI Directive Principles of State policy and Fundamental duties in section 27-14 and in section 28-f proclaim "The state shall protect, preserve and improve the environment for the benefit of the community", "The duty and obligation of every person in Sri Lanka to protect nature and conserve its riches" thus showing the commitment by the state and obligations of the citizens.

The following section outlines the broad legal and institutional framework in Sri Lanka for environmental management and World Bank's environmental safeguards requirements, which will be relevant to the proposed project. A detailed review of environmental and social legal framework is given Annex 5.

2.11 Detail Review of Key Environmental and Social Services Related Legislation

The National Environmental Act. No. 47 of 1980 & its amendments: As per the initial screening, majority of project's activities are not yet finalized and considering the proposed components, project might be fallen under the prescribed categories. Considering the low impacts of project already identified and the present assessment carried out in compliance with WB's Safeguards policies would be sufficient with continuous monitoring during the construction, operation & maintenance phases. However, considering the complexity of the project activities, project might require an environmental assessment. During next phase of the assessment, project will submit the proposal to the CEA and CEA recommendation will be implemented accordingly. Any project activity which will be coming under Prescribed activities, EIA/ IEE process will have to be followed. In addition, any industrial activity coming under Technological Improvements such as Processing Hubs should obtain EPL for its operations and should comply with CEA regulations related Air quality, Noise, Vibration and Waste Management.

Pesticides Act No. 33 of 1980, as amended by the Act No. 06 of 1994 & the Act No. 31 of 2011): Project has prepared a comprehensive Pest Management Action Plan in complying with the above enactment and the WB's Pest Management Plan. All agronomical practices which are to be undertaken under ASMP should be in-line with Integrated Pest Management Plan. IPM is triggered policy under WB's Operational Policies related to ASMP and from land preparation up to marketing, IPM should be implemented as practicable as possible.

Plant Protection Act No.35 of 1999: Project has prepared a comprehensive Pest Management Action Plan in complying with the above enactment and the WB's Pest Management Plan. All agronomical practices which are to be undertaken under ASMP should be in-line with Integrated Pest Management Plan. IPM is triggered policy under WB's Operational Policies related to ASMP and any activity propose under agronomical practices should be in complying with these requirements stipulated.

The Fauna & Flora Protection Ordinance Act No. 49 of 1993 & its amendments: Ampara**,** Kilinochchi, Vavuniya, and Badulla districts as a whole have several important Wildlife designated areas namely Protected Areas (National Parks, Sanctuaries, Reserves, etc). Any cultivation or development related activity falling in or around such areas should be consented by the DWLC. Specially in Badulla, Kandaketiya, Mahiyanganaya, Welimada, and Demodara, Ampara Padiyathalawa, Maha oya and Komari are boarded to Wildlife protected areas.

Local Authorities Acts: The infrastructure improvement activities funded under ASMP through the LAs comprise of the basic services they ought to render to the public in line with these acts. Subsequently, maintaining this infrastructure would be the prime duty of the local authorities. In addition, majorly, management of solid waste should be in-line with LAs mandate.

Water Resources Board Act No. 29 of 1964: Use of ground water in cultivation or infrastructure development should be seek recommendations from WRB in advance with a proper yield test.

Forest Ordinance including Amendments: Project interventions especially lands within the purview of Forest Department, should be obtained approval from Forest Department prior to implement the activities. This requires specially when removing trees within the proposed site. Badulla is consist of 11 forest types where Kandaketiya, Mahiyanganaya, Rideemaliyadda, Haldummulla, Welimada, etc are very rich in forest areas. In addition, Badulla nearly 40%, Vavuniya 49% (101811ha) and Kilinochchi 30% (31047ha) are under forest. Padiyathalawa, Maha Oya, Kanchikudiaru, and Komari areas in Ampara district have several forest reserves.

The Irrigation Ordinance (Chapter 453): Any activity relevant to ID's command areas should be consented by the ID. Badulla (Badulu Oya and Bathmedilla), Damana and Eggal oya in Ampara, Vavuniya and Kilinochchi (Iranamadu, Kalmadu, etc).

Mahaweli Authority of Sri Lanka Act no 23 of 1979: Any areas within Mahaweli systems should be complied with MASL requirements. Under this programme, Padiyathalawa and Maha Oya in certain areas, and System L in Vavuniya are coming under MASL.

Women Charter of Sri Lanka: Inclusion of minimum of 40% female

Seed Act No. 22 of 2003: As there will be seed production activities under ASMP, the entire process of seed production should be in complying the regulations stipulated under this act. Process should be coming under proper Seed Certification programme and any planting material proposed under this programme should be complying with its regulation.

Table 17: Important Services in Agriculture Sector

Name of unit	Mandated Functions
National Plant Quarantine Service (NPQS)	Facilitate the import and export of pest free plants and plant products, for the development of agriculture and related industries in the country.
Plant Genetic Resources Centre (PGRC)	Explore, collect conserve, introduce, evaluate and utilize the diversity of crop genetic resources

Agrarian Development Act. No. 46 of 2000: Conversion of paddy lands including abandoned paddy land to any other land use should be as per the approval of the Commissioner, Agrarian Development Department. Specially in Kandaketiya and Girandurukotte in Badulla, proposed areas are paddy cultivated areas where during yala used for Maize cultivation.

World Bank Safeguard Policies: Projects and programs funded by IDA resources need to comply with the World Bank's operational policies. Therefore, all sub-projects eligible for funding under this project will be required to satisfy the requirements of the safeguard policies of the World Bank, in addition to conformity with national environmental regulations. The Agriculture Sector Modernization Project undertakes several cultivation, and infrastructure subprojects and they have to be screened and impacts have to be identified. The World Bank OP4.01 discusses the environment assessment process to be followed.

The main environmental safeguard policy to be triggered under this project will be OP/BP/GP 4.01 on Environmental Assessment. The other three environmental safeguard policies namely, OP/BP/GP 4.36 and 4.04 on forestry and natural habitats respectively, have been identified as there will be activities inside such habitats and will be considered to ensure minimal adverse environmental impacts due to the project.

Table 18: World Bank safeguards policies triggered by the project

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment (OP/BP/GP 4.01)	[x]	[]
Natural Habitats (OP/BP 4.04)	[x]	[]
Pest Management (OP 4.09)	[x]	[]

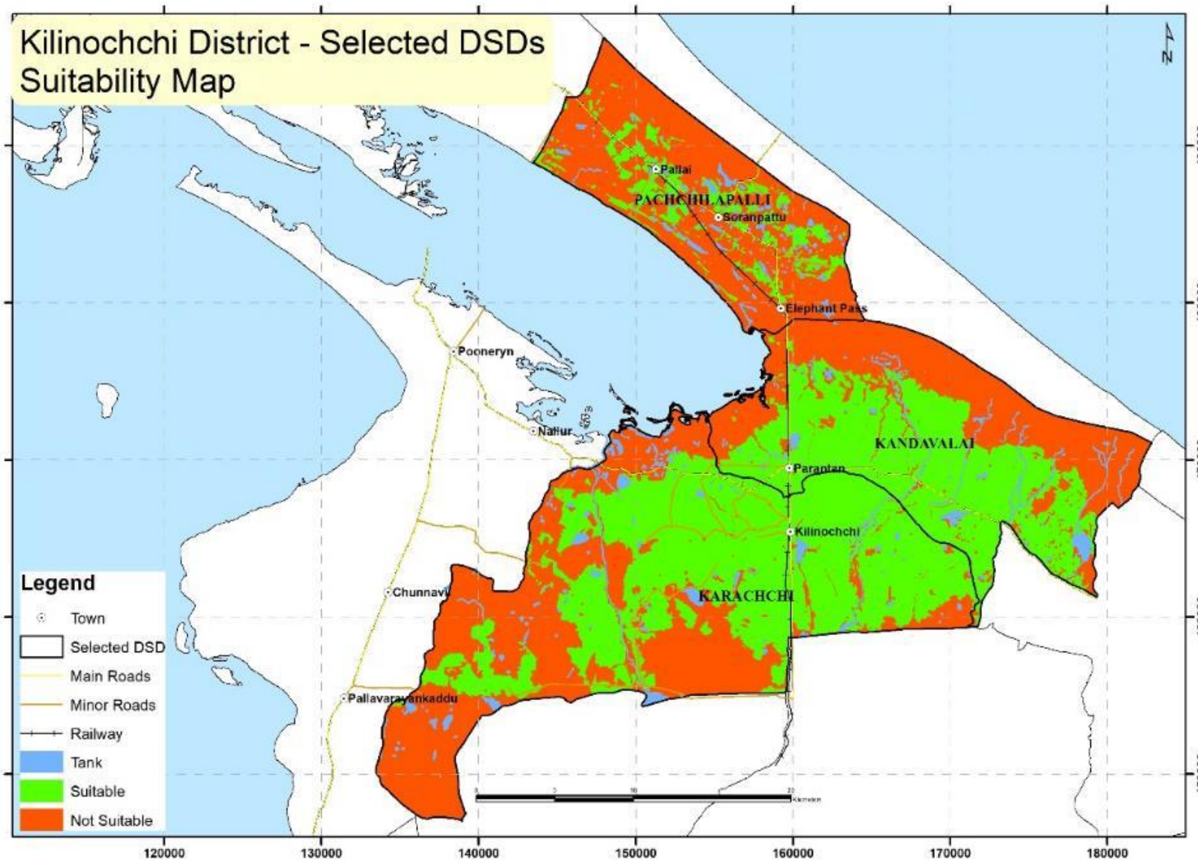
Physical Cultural Resources (OP 4.11)	[]	[**x**]
Involuntary Resettlement (OP/BP 4.12)	[]	[**x**]
Indigenous Peoples (OD 4.20, being revised as OP	[]	[x]
Forests (OP/BP 4.36)	[x]	[]
Safety of Dams (OP/BP4.37)	[]	[x]
Projects in Disputed Areas	[]	[x]
Projects on International Waterways (OP/BP/GP	[]	[x]

Project Categorization

When OP 4.01 is triggered, the World Bank classifies proposed projects in to one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts.

Proposed project is classified as **Category B** if its potential adverse environmental impacts on human populations or environmentally important areas including wetlands, forests, grasslands and other natural habitats are less adverse than those of Category A projects. These impacts are site specific; few if any are irreversible; and in most cases mitigatory measures can be designed more readily than for Category A projects. The scope of an EA for Category B projects may vary from project to project, but it is narrower in scope when compared with Category A projects.

CHAPTER 3: ASSESSMENTS OF THE SITUATION AND KEY ISSUES



3.1 Kilinochchi District

3.1.1 Agricultural Analysis

Sri Lanka is divided into 24 Agro Ecological regions. The criteria for segregating the Agro-ecological Zone are a land resource mapping unit, defined in terms of climate, landform and soils, and/or land cover, and having a specific range of potentials and constraints for land use. The highly variable agro-ecological zones in the region make it a suitable production area for a wide variety of crops. A number of food crops are cultivated by smallholder farmers with the economic, social, and nutritional importance varying from one agro ecological zone to another. Sri Lanka has the diversified soil types dispersed in the agro ecological regions. The key soil groups found in Sri Lanka as follows: Oxisols, Aridisols, Alfisols, and Ultisols comprise major parts of the soils in the tropical belt and Alfisols and Ultisols cover large extent of soils in Sri Lanka.

Most of the people live in this area (especially in remote villages) are highly depend on farming. Although the majority of them are farmers, their farming is not methodical at all, do farming on scattered manner. No focus or target for any proper market, just they cultivate for their own consumption and sale for outsiders is very limited. In 2015 Kilinochchi District had 11,734 Samurdhi recipients (Samurdhi Annual Report, 2016). Karachchi is one of DS divisions In Kilinochchi with 42 Grama Niladari Divisions (GND) and, 364 families registered on the electoral roll in 2020. Families in 27 GNDs are living on crop production and out of 42 GN Divisions 37 and 22 divisions, respectively, are subjected to drought and wild animal disasters. All 42 GNDs and 39 GNDs respectively are affected by alcohol and drug menace according to the reports of the Department of Census and Statistics (DCS, 2020). Karachchi division has two agro-product purchasing centers, nine fertilizer selling centers, and five agricultural equipment selling centers. Other than crop production ten GNDs are living on livestock and wood and jewellery crafts.

Some common problems could be notified as follows:

a. Young generation not involves in agriculture.
b. Always they suffer the capital investment.
c. Not any new or appropriate technology adopt.
d. Not proper trainings are given methodically, only ad hock trainings.
e. Crop selection for cultivation also not methodical, just from tradition or influence of peer farmers.
f. Due to the crop selection is not rational, at the harvesting time market get flood and ultimately farmers get very low prices.
g. Land, labour and irrigation water are not use in productive manner and the ultimate results are very poor and their living standards are stagnated.
h. Marketing system is very primitive, at the harvesting time local collectors are coming and collect the entire harvest at dirt cheap prices. These poor farmers have no alternative option and always they depend on them.
i. Vulnerability for drought is very high.
j. No machinery uses for any activity other than basic land preparation.
k. They have not heard about Value chain process or farmer companies.
l. Family labour availability is significantly high and at least addition two heads are there in addition to the farmer.

Table 19: Current practices and remedies to overcome drawbacks

Crop	**Current practise**	**Improvements suggested**	**Expected ultimate goal**
Chili	Farmers think only about the season	Proper trainings	Reach to the level of potential output

	Knowledge about the agricultural practices like land selection and preparation, Fertilizer application, watering etc. very poor. Nursery management also very primitive.	Introduce relevant implements. Improve proper monitoring system.	Achieve the customer expectation i.e. quality as well as the time delivery.
Pomegranate	Farmers don't have experience on this crop.	Proper field trainings and exposure visits. Introduce other basic trainings. Do soil analysis and fertilizer recommendation.	Potential yield and income. Meet customer requirements.
Jumbo Peanut	Never practise soil analysis or proper land preparation.	Follow proper training module and introduce appropriate technology and implements.	Achieve the target of potential yield as well as the quality.
Passion fruit	Never practise correct the things land preparation and Soil analysis. Not proper training to identify diseases.	Introduce proper packages for land preparation, Pest and disease management.	Achieve the target of potential yield as well as the quality.

Table 20: Agro ecological analysis of Kilinochchi district

DSD	Agro ecological zone	Rainfall - mm	Soil type	Terrain
Kandawalai	DL3, DL4	750 <	RYL, Regosol soils	Flat & slightly undulating, Flat
Karachchi	DL1f, DL3, DL4	800<	RBE, LHG, Grumusol, RYL, Regosol soils	Undulating, Flat & slightly undulating, Flat

Pachchilaipalai	DL3, DL4	750 <	Solonchaks, Solodized-Solonetz, RYL, Regosol soils	Flat & slightly undulating, Flat
Poonakari	DL3, DL4	750 <	RYL, Regosol soils	Flat & slightly undulating, Flat

According to the table 20, different DSDs of Kilinochchi district has almost same soil type and Rainfall pattern except Karachchi. That means the vegetation of the area must be almost same. Therefore, the crop cultivation of district may be same among different DSDs.

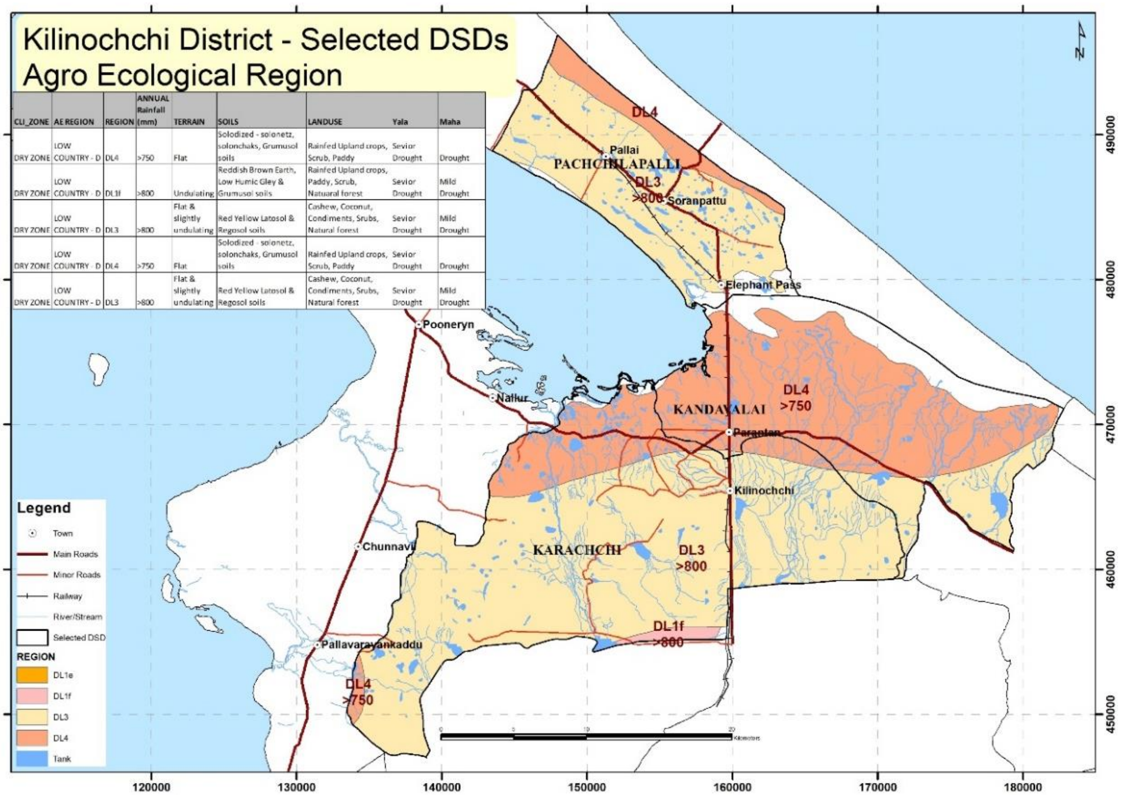


Figure 13: Kilinochchi District Selected DSDs Agro-Ecological Region Map

3.1.2 Agri-business and Value Chain Analysis

1. Jumbo Peanut

Introduction

Groundnut looking into the past, groundnut cultivation in Sri Lanka has always indicated lower production than required. A number of programs were established with the aim of enhancing the production capacity of the groundnut to meet the national requirement. “Supplementary Food Crop Program”, implemented by the Ministry of Agriculture, set its objectives to gain self-sufficiency in supplementary crops by 2016 (Ministry of Agriculture, 2020). Also, the Ministry of Agriculture sets a 200 acre “peanut cultivation zone” in Mullaitivu in 2018 along with “Let us Grow, Let’s Build the Country” program. Introduction of “Sri Lanka Jumbo” Variety & imposing of trade restrictions on groundnut imports are among other measures taken to achieve the target. However, all operations on the run were unable to produce a satisfactory outcome so far. In dry and intermediate zones of Sri Lanka, it can be grown as rain fed crop in highland during Maha season and irrigated crop in paddy lands during Yala season. In Sri Lanka, it is grown mainly in Moneragala, Kurunegala, Ampara, Badulla, Puttalam and Ratnapura districts. Department of Agriculture released eight varieties such as Red Spanish, Number 45, Tissa, Walawe, Indi, Tikiri, ANK G1 and Lanka jumbo (Department of Agriculture, 2012b). Tissa. Higher oleic/linoleic ratio greater than 1.6 offers a longer shelf-life of processed foods, health benefits to consumers and increases profitability to farmers through higher yield compared to normal peanuts. Furthermore, keeping quality of the candidate variety was superior compared to other small seeded varieties. This new peanut nominee is well fitted to the cropping pattern of the country. Hence, candidate line ICGV 98396 × ICGV 10663 was released by the Variety Releasing Committee of The Department of Agriculture in 2020, renaming it as ANKGN3 considering its suitability for confectionary industry and greater potential for increasing productivity of peanut in Sri Lanka (Jeewani et al., 2020).

High oleic acid content of peanut has emerged in recent years as a key market trait in the world. It improves shelf life, enhances the oil quality and offers health benefits to consumers (Shasidhar et al., 2019). Peanut oil and peanut-based food products with the high-oleic content have 5 to 10 times longer shelf life than that of normal peanut (Braddock et al., 1995; O’Keefe et al., 1993). A diet with high oleic acid and low palmitic acid is an exceptional way to reduce the risk of cardio-vascular diseases, promotes a healthier ratio of High Density Lipo-protein (HDL) to Low Density Lipo-protein (LDL), and reduces triacylglycerol and blood glucose levels (Sabate et al., 2001; Kris-Etherton et al., 1999). High-quality peanut products with oleic acid rich kernels will generate sustainable income and livelihood to resource-poor farmers as well as ensure the supply of quality peanut to the consumers and industry.

Newly introduced variety jumbo peanuts have become a popular high yielding food crop in the country replacing the imported variety. This has helped to save much needed foreign exchange spent to import jumbo peanuts. Although Sri Lanka is growing its own peanuts, the quantities are not sufficient to meet the requirement and the government imports a large amount of the groundnut to the country annually. In 2020, 19,975 hectares of land were cultivated with peanuts and harvested 24,200 metric tons of peanuts. Another 9,904 metric tons of peanuts were imported in the year at a cost of Rs. 689 million. The most imported variety is the 'jumbo peanuts' which have exceptionally large plump kernels. As a substitute for these varieties, Sri Lanka's Department of Agriculture has introduced a new peanut variety called 'Sri Lanka Jumbo'. 'Sri Lanka Jumbo' is a high yielding variety which yields plump and delicious extra-large peanuts. Also, harvesting can be done 110-115 days after cultivation. It is also possible to harvest large groundnuts and the variety will yield more than 4400 kilograms per hectare. It is believed that by cultivating the new variety, the national requirement of 27,294 metric tons can be grown locally and save the Rs. 700 million annually spent on imports.

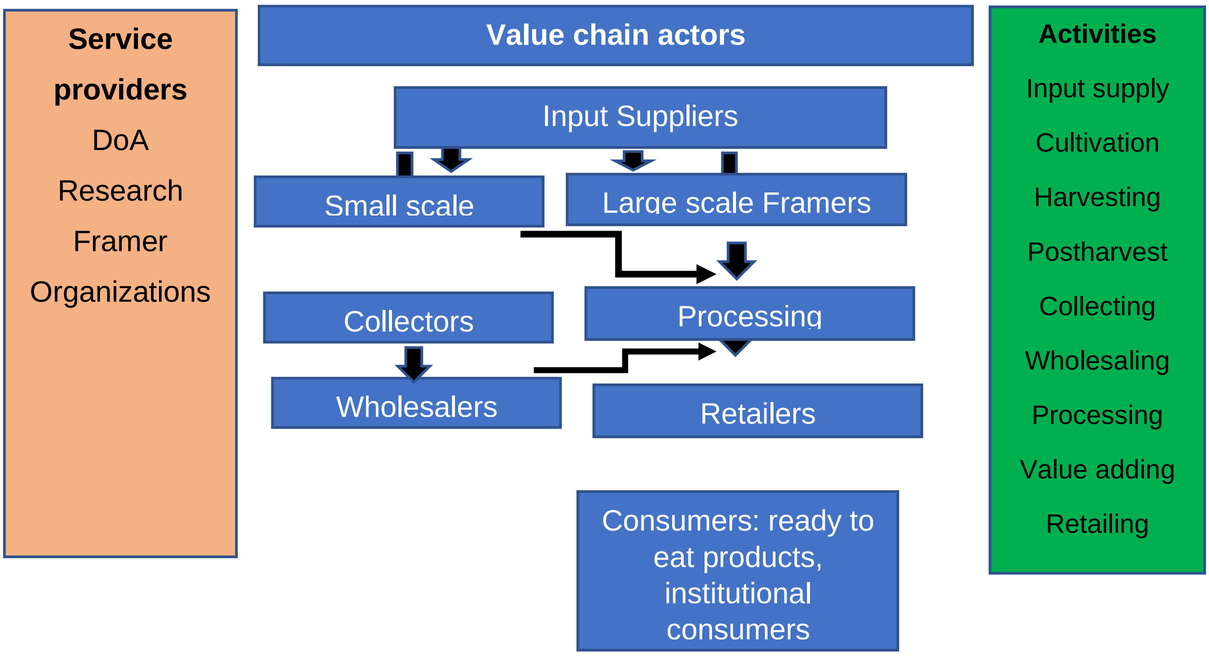
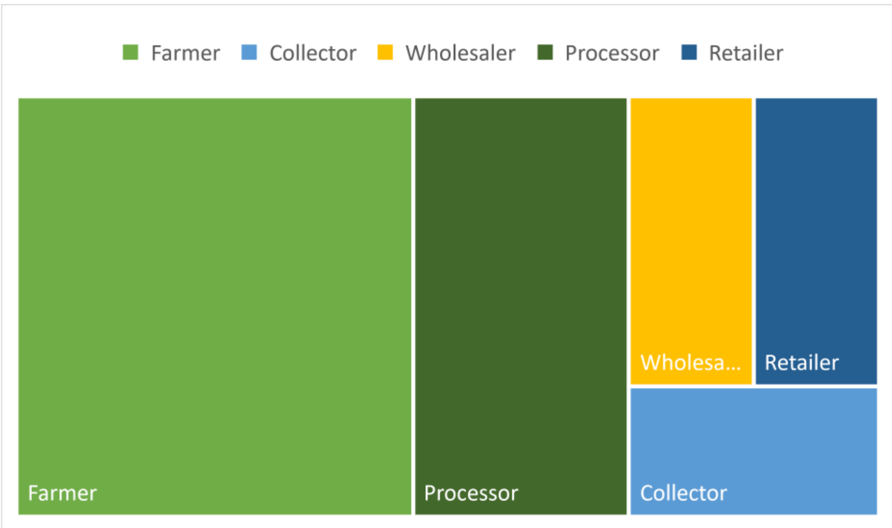
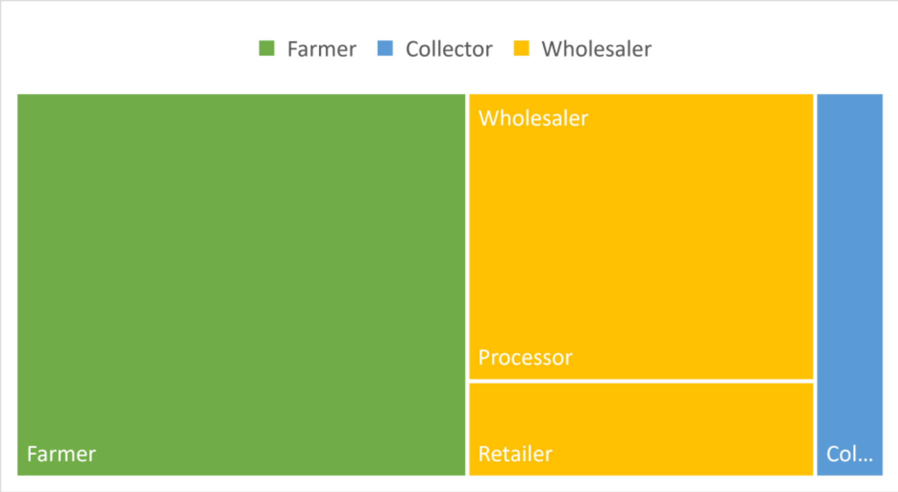


Figure 14: Jumbo peanut value chain

a. 



b.

Figure 15: Share of value chain members: a. peanut and b. jumbo peanut

Figure 16: Jumbo peanut value chain-Photograph analysis, Kilinochchi district

2. Chili Value chain – Hybrid MICH1

Introduction

Chili is one of the largest produced spices in the Asia. It is belonging to "Solanacea" family and genus of capsicum. Scientific name is Capsicum annum L. Chili produces pungent chemical which is called as capsicum. Fruits are a rich source of vitamin A&C, B_6. Also high in K, Mg, and Fe. (JICA, 2003) Plant type may be small or medium shrub. It is a multi- branched-semi woody small shrub. Plant height may be 30cm to 2m or up to 2m. It depends on the variety. Perennial crop and it has short-lived life cycle. Sometimes it was treated as a long-seasonal annual crop. Should be provide optimal ecological requirements for well growth of the plant. Need 600-1200 mm annual rainfall. Growing temperature is 20 ^{0}C- 30 ^{0}C. Varies soil types that are well drained can be used for cultivation. Optimal soil pH range is 6.0-6.5. Open fields, green houses, poly houses, under shade nets, pots, containers and back yards can be used for chili cultivation. Farmers have to do various kind of farming activities to get maximum yield. Among them land preparation, nursery bed preparation, identify pest and disease, apply pesticides and agro-chemicals, and should be control optimum soil fertility level by applying proper fertilizer are the main farming activities. Fruits are consumed as fresh, dried or value-added forms.

Background and Importance of promoting chili value chain in Sri Lanka

When consider the Sri Lankan context of chili cultivation, chili is one of the most important cash crops grown in large scale in the dry zone specially, in north central province and intermediate zone. At present, major growing district are Anuradhapura, Moneragala, Ampara, Puttalam, Vavuniya, Kurunegala, Hambantota, and Mahaweli system H (DOA, Department of Agriculture, 2015). It is used as an essential condiment. DOA has recommended 5 open pollinated chili varieties up to now namely MI-1, MI-2, KA-2, Arunalu, MI-Hot, and F_1 hybrids. (DOA, Depatment of Agriculture, 2021)The estimated per capita consumption of dry chili is 2.1-2.31 kg/annum and around 60000 tons of dry chilies are required to fulfill the national annual requirement. The average annual chili production was 70000 tons in 2021. According to that about 50000-55000 tons of dry chili is imported to fulfill demand (Sri Lanka Cutoms, 2021).

In the present, chili market price is high in the local market. Not only the dry chili and fresh fruit also value-added products' prices are high. According to the above-mentioned data, lack of supply to fulfill market demand is one of the major problems in Sri Lanka chili cultivation. Consider the current context, economic crisis, fuel crisis, and Covid-99 pandemic situations are due to increase the market price and decrease the supply. With this economic crisis fertilizer and agro-chemicals prices were increased, transport cost was also increased. It affects for the primary producers' behavior in their farming activities. In commercial level, their main target is profit maximization. Postharvest losses, lack of marketing information, poor infrastructure, lack of knowledge of primary producers are affect for the price changes. Other than that middleman involvement in the supply chain is significantly affect for the market price. According to those problems, there are gaps buildup each step in the supply chain. This gap can be describing as a gap between market price and primary producer selling price, knowledge gap between each stakeholder, market supply and demand gap etc. Therefore, value chain analysis is important to identify these gaps and fulfill these gaps through the better solutions.

Chili value chain mapping performed through the participatory approach. Key concerns were on identify value chain actors, their functions, roles and linkages among the actors. Both qualitative and quantitative data were used to identify share of each actor and income distribution along the value chain. Primary producers (farmer) of main chili growing districts, Anuradhapura, Polonnaruwa, Vavuniya, Kilinochchi, Hambantota were contacted to obtain the data on selling price, input cost, and farming activities. Wholesalers' selling prices were collected from dedicated economic centers' records. Building roadmap for chili value chain upgrading was designed with the participation of stakeholders: Common issues in chili value chain were identified and building roadmap for chili value chain upgrading.

Analyzing the fresh (green) chili value chain

Fresh chili is not processed and it can be consumed directly after harvesting.

Actors and their functions in fresh chili value chain

- Input suppliers: Input suppliers are the people who provide inputs to the farmers. Agro-chemicals, finance, seeds and equipment are the major inputs for chili cultivation. They may be a government sector or private sector input suppliers. DOA is the main government input supplier. They provide quality seeds, fertilizer at low price. Prominent non-government organization is farmers' organization in the village. It provides financial supports and equipment like things. CIC, Hayles are popular private sector input suppliers. Micro level financial supporters are public and private banks, regional banks, NGOs.

- Primary producers/ Farmers: In commercial level chili farmers use large lands. Land preparation, nursery bed preparation, transplanting and harvesting activities are done by the primary producers. Some fresh chili farmers directly sell to the local customers. Otherwise, they sell to the whole sellers, retailers, collectors or exporters.
- Collectors: They are kind of ding the bridging role between primary producer and consumer. They manage their own transport, own storage facilities. They influence for the price volatility in the market. They directly purchase the harvest from the farmers. Sometimes collectors may be whole sellers or retail sellers.
- Whole sellers: They purchase bulk amount of harvest at the farm gate. Grading, storing, packing, and marketing activities are done by them. They put the harvest economic centres, retail shops or value-added products producing companies.
- Retailers: They sell their own harvest or which is bought from farmers. Their target group is day to day consumers. Retail shops, village and urban fairs are the main marketing channels.
- Consumer: Consumers may be local or foreign consumers. The amount paid by the consumer is shared among all stakeholders in the fresh chili value chain.

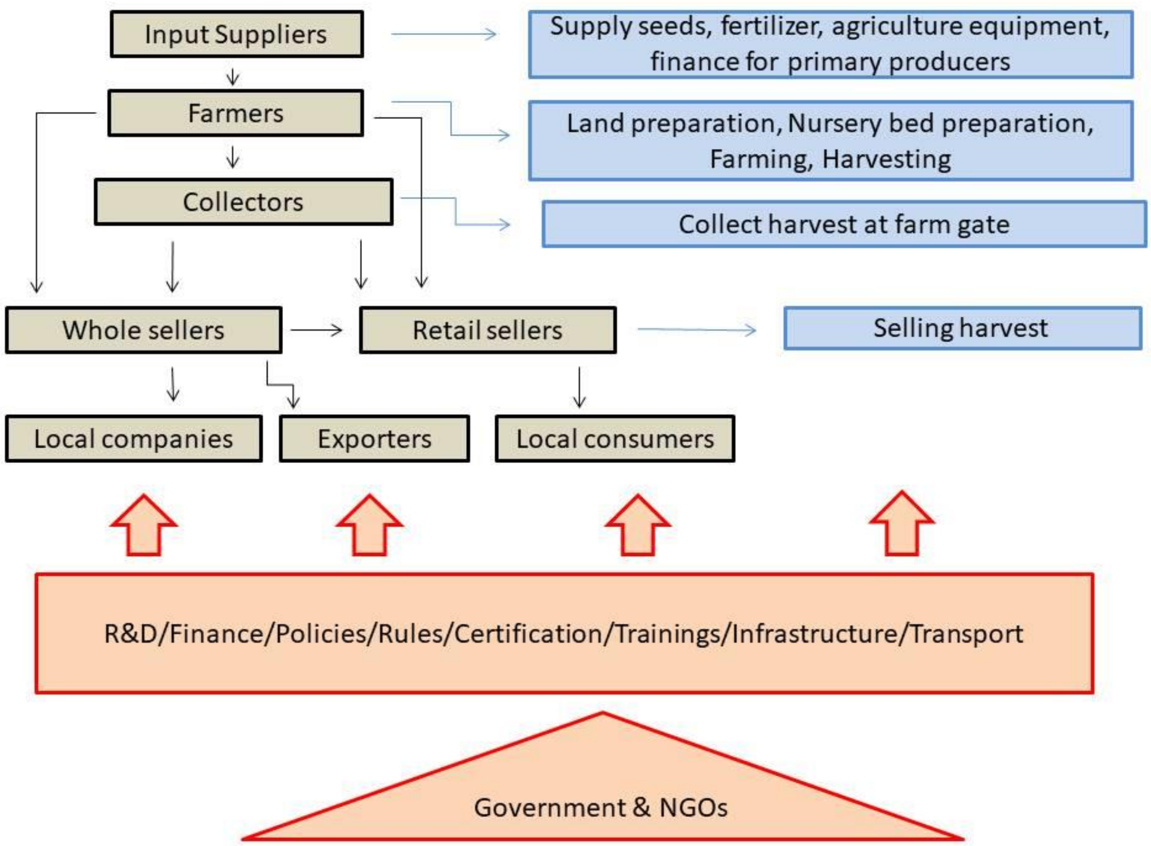


Figure 17: Green Chili Value Chain

Main supportive activities

- Infrastructure development: In the present, roads in chili cultivation areas are in good conditions for transport. Most of the villages are connected by carpet roads. Some villages connected with highways. The highway provides excellent link to market. But some areas faced drought and floods. Therefore, need proper irrigation facilities and proper lands for cultivations.
- Research and Technology development: DOA, HARTI, seed producing companies, government and private institutions are conducting research and technology development activities for chili cultivation. Produced hybrid varieties, introduced new agro-chemicals, and analyze problems which are facing primary producers, things like activities are done under R& D activities.
- HR management: Ministry of Agriculture, DOA and HARTI like government organizations and NGOs conduct training program to improve farmers' skills and knowledge.

- Procurements: National and International funds give some subsidiaries to the farmers to improve their livelihood. Other than that, formal and non-formal financial suppliers provide financial services to enhance productivity.

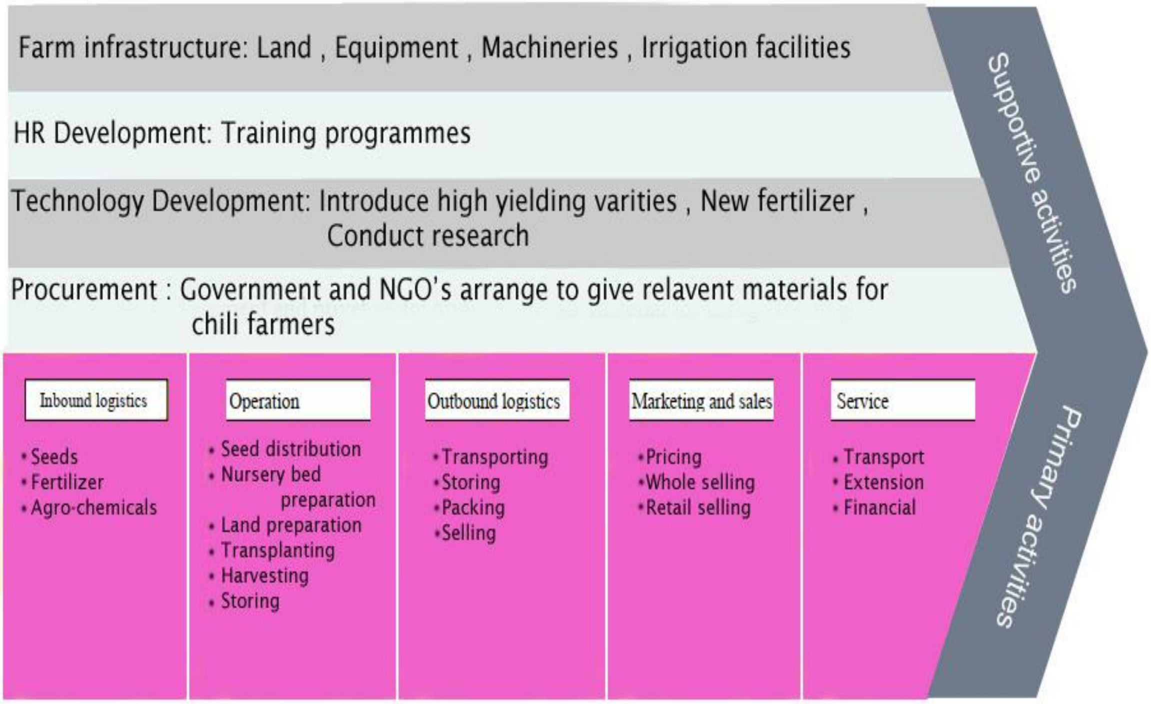


Figure 18: Chili value chain model

Main supportive Rules

Food safety rules: Food safety rules influence for the production step in value chain specially, if produce value added products.

- Government contribution: Food control Administration unit responsible for ensuring food safety and safe production of foods. Ministry of health, Ministry of fisheries and Aquatic resources, and Ministry of Agriculture are the ministries which are due to control food safety rules and regulations. According to the Food Act No.26 of 1980, all food business needs to be registered with the food authority of area.
- Certification: The product certification (The SLS Marks Scheme), systems certification such as ISO 9001, ISO 14001, GMP, ISO22000 etc, providing training, providing laboratory services, and providing information services are some of the services thus provided. (Unit, p. SL FOOD SAFETY PROFILE)

Agricultural practices rules

- GAP: It includes practices in primary production to ensure safety and quality of food products and minimize the negative impact on the environment as well as the workers' health.
- ICM and IPM: Should be followed by farmers to ensure environmental, economic and social sustainability.

Land rules

Agriculture Land Policy, Act (No.42 of 1973), National Agricultural policy and National land use policy are the main act and policies which provide information and rules about land ownership and what kind of crops can be grown in particular area.

Analysis of sub value chains- Value added products

This section describes the common value-added products produced from chili in Sri Lanka.
Dried Chili: After harvesting, the chili is dried by using sun light. Usually, preservatives are not added because drying process extent the shelf-life.
Red Chili Powder: Chili powder is produced through the grinding dried chili. This processing is not only done for industrial level, some farmers do it for their personal consumption.
Red Chili Paste: It is a condiment made using dried red chilies. This spicy is red and fiery paste. Has long shelf-life.
Red Chili Pickle: It is kind of tangy spicy. Use fresh red chili to produce. It shelfs life depend on production method.
Chili sauce: Chili sauce may be hot, sweet or combination.

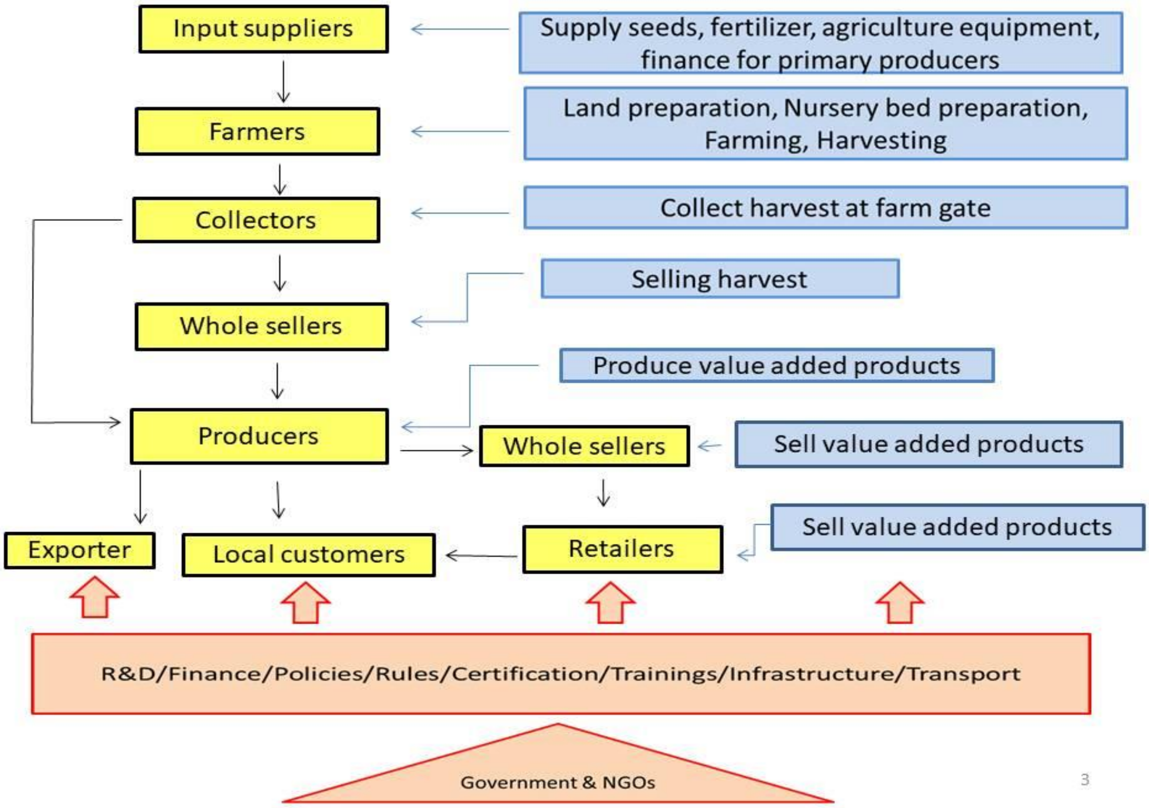


Figure 19: Chili value added products value chain

Value chain analysis of green chili and dried chili

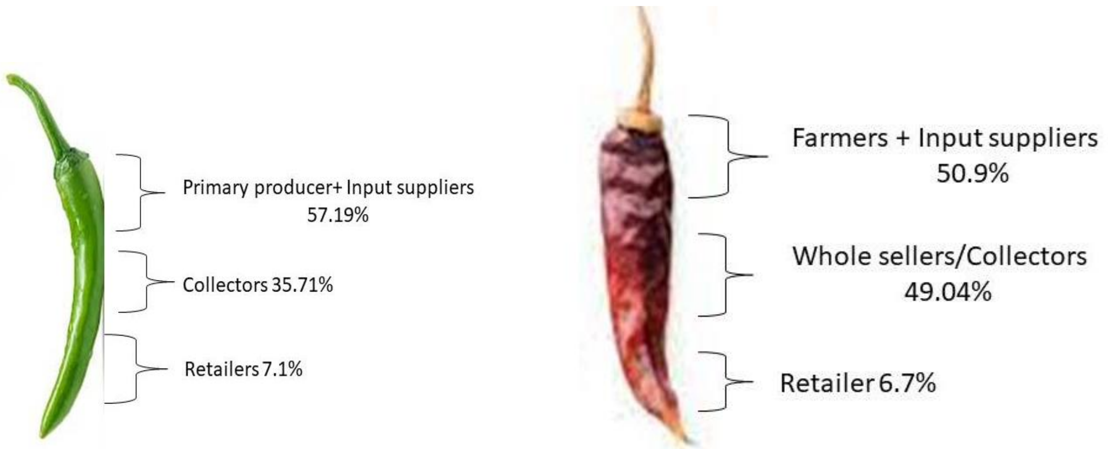


Figure 20: Breakdown cost green chili and dried chili

Common issues characterizing the fresh green chili value chain

Seed production or seed collection:

- Farmers have to purchase seeds every season and cost for imported seed is high. Quality certified hybrid chili seeds available from DoA. Locally available some of the hybrid seed varieties are poor in quality, low germination and disease proven.

Nursery bed preparation

- Nowadays lack of polythene bags and trays and their higher price due to limit good quality plant production by using these inputs.
- If they use nursery beds, they have to sterilize the beds before sowing seeds to avoid diseases. But, sterilization agro-chemical cost is high in current situation.
- Sometimes nursery beds destroyed by droughts.

Land preparation and transplanting

- Impact of drought and flooding
- Climate change
- High labor requirement

Farming

- Barriers for use agro- chemicals

Harvesting

- Post-harvest losses
- Lack of storage facilities

Transporting

- Storage under improper conditions
- High transport cost

Selling

- Poor linkage between primary producer and market

Building a roadmap for value chain upgrading green chili and sub value chains

Under this section, describe what are the upgrading -strategies in green chili and value-added products value chains. We can create a value in each step of value chain to upgrade it. These creative values are directly affected for the productivity enhancements and market development.

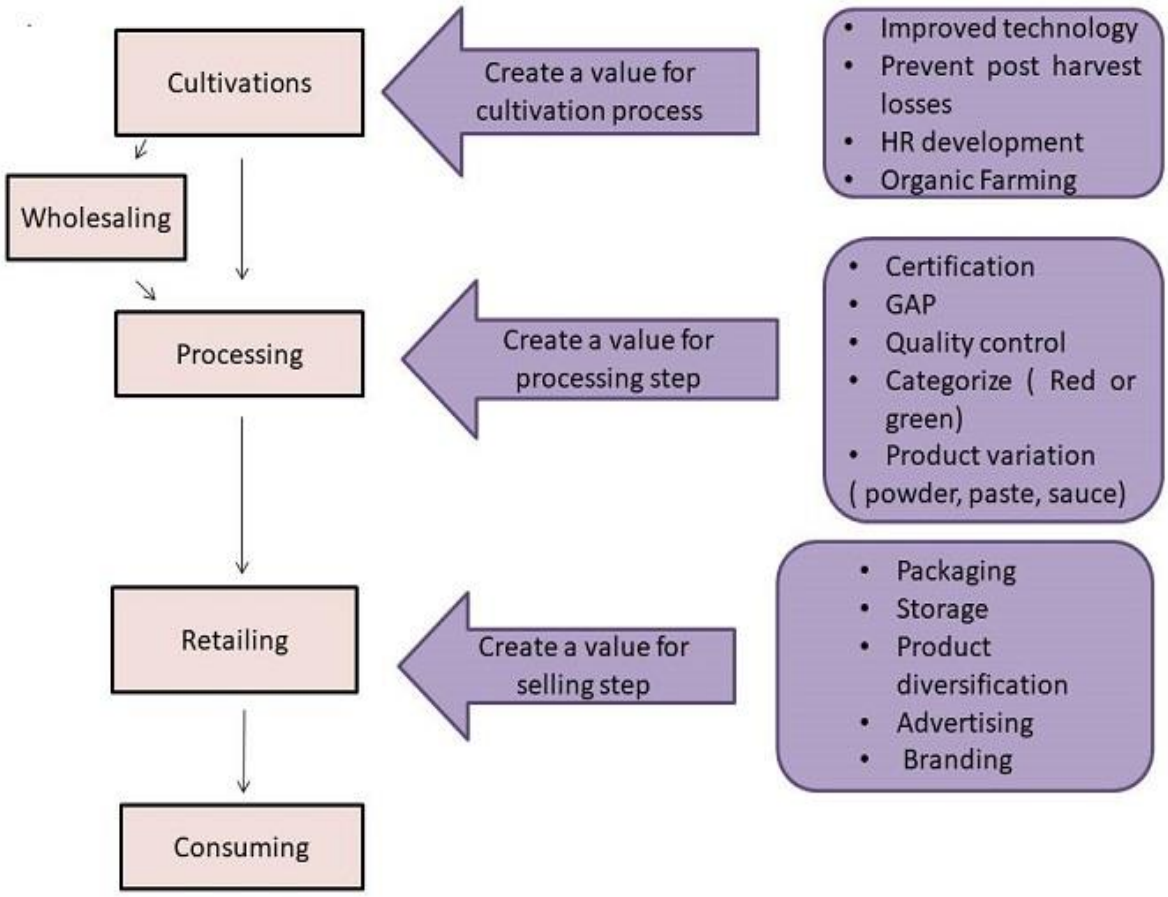


Figure 21: Roadmap for value chain upgrading green chili and sub value chain

3. Passion Fruit Value chain

Introduction

Passion fruit (*Passiflora edulis*) is a native of tropical America (Brazil) belongs to the family Passifloraceae. It is an attractive, sweet and sour fruit that has a delicate flavor with a pleasing aroma and high nutritive value. In Sri Lanka, Passion fruit is mostly cultivated in Kalutara, Gampaha, Rathnapura, Kurunegala, Galle, Colombo and Nuwara Eliya districts and evenly passion fruit is cultivated in the district where water supply facilities are in shortage etc. Anuradhapura and Jaffna.We mainly cultivate three passion fruit varieties. “Horana Gold”, “Bandarawela purple” and “Rahangala hybrid”.

Horana Gold

Horana Gold is suitable to cultivate in the wet, intermediate and dry regions of our country. This variety gives a high yield. The average weight of a fruit is about 135 grams. The pulp is yellowish-orange in color. The color of the bark when ripe is yellowish orange. Fruits are round or oblong. This type is far sourer than the purplish one. Both yellow variety and the purple variety are used for juice processing.

Bandarawela Purple

This variety is Recommended for mid-upland and upland wet zones. The weight of a fruit is between 100-120 grams. The rind of the fruit is reddish-purple. Moderately resistant to viruses and root rot diseases. The first harvest can be obtained about 10 months after planting. A vine can yield 16 kg in the first year and 24 kg in the second year.

Rahangala Hybrid

Recommended for upland areas. Fruits are pinkish purple in color. The quality of the juice is high.

Horana Gold

Bandarawela Purple

Rahangala Hybrid

Passion fruit contains high nutritional value. Its pH takes 3.2 due to citric and malic acid. The fruit provides a good source of nutrients such as Vitamin A, B2 and C and non-nutritive phytochemicals, carotenoids and polyphenols. It is also rich in minerals like K, P, Ca, Fe, Na, Mg, S, Cl and protein. The nutritional composition of passion fruit per 100g is shown below (Rocky Thokchom, 2017).

Table 21: Nutritional Profile

Nutrients	Nutritional value per 100g	Nutrients	Nutritional value per 100g
Energy	97kcal	Thiamine	0.0mg
Carbohydrate	23.38g	Vitamin A	1274IU
Protein	2.2g	Vitamin C	30 mg
Total fat	0.7g	Potassium	348 mg
Cholesterol	0.0g	Calcium	12mg
Dietary fibre	10.4g	Iron	1.6mg
Folates	14g	Magnesium	29mg
Niacin	1.5g	Phosphorus	68mg
Pyridoxine	0.1g	Carotene	743µg
Riboflavin	0.13g	Cryptoxanthene	41µg

Having a high nutritional value, unique taste and aroma have already been a competitive advantage to demand for passion fruit in both local and export markets. In order to bring passion fruit more demanded, understanding the value chain of passion fruit is important.

Passion fruit Value chain

Passion fruit value chain begins with producers; largely small holder farmers and limited number of commercial farmers and ends with consumers who eat, drink wear and use the final product. And in the middle, there are many intermediaries who provide logistic services to bridge the upstream and downstream of the value chain. Each person in the chain performs one small step and each adds value along the way – by growing, buying, selling, processing, transporting, storing, checking, and packaging. The common aim of all actors in the value chain is to reach consumer needs while increasing their own profits. On the other hand, we are all part of value chains in one way or the other as producers, consumers of goods and services, processors, retailers, finance providers etc.

Importance of promoting passion fruit value chain

Promoting the value chain allows looking at current challenges in a value chain, as well as the opportunities to improve the efficiency of the value chain and the benefits for everyone involved.

Bring greater income

From a farmer's perspective, being part of a well-functioning value chain can bring greater income. Farmers will be updated about prize scales time being. But sometimes, participating in a well-functioning value chain will not bring greater income but a more stable and predictable income. Promoting the value chain, supports identifying the challenges, weaknesses and strengths along with value chain and creates more opportunities. Framers can reach the final actor without middlemen in the value chain process resulting in a higher profit.

Persuade farmers to become entrepreneurs

There is a huge market for the passion fruit value addition industry. Doors are opened for the farmers who have willingness to join product production chain. The value chain describes how actors jointly work and how each actor being benefits. This may attract young people to farming or persuade create value for the fresh passionfruit, offering better ways to earn money.

Issues in passion fruit value chain

Post-harvest loss

The annual loss of fruits during postharvest operation represents about 210,000 metric tons of fruits, which is about 30 %– 40 % of the harvest, representing approximately US$ 90 million losses in financial terms. (Leelananda Rajapaksha, 2021). The main reasons behind the huge loss are, Relative humidity fluctuations, Incorrect harvesting methods before the correct maturity, Poor handling procedures in the field, Improper storage conditions, Poor transportation and incorrect wholesale and retail selling approaches. In considering Passion fruit, mainly losses occur due to poor transportation practices. During transportation, it is a common practice that the people are sitting and sleeping on the poly-sacks in which fruits are tightly packed. In addition, rough handling loading and unloading take place during transportation, causing serious damage to tender fresh passions. It limits passion fruit related product processing sector and impacts the entire value chain actors negatively. Figure 22 shows the marketing channels where post-harvest losses can occur when fruits are moving from producer to consumer.

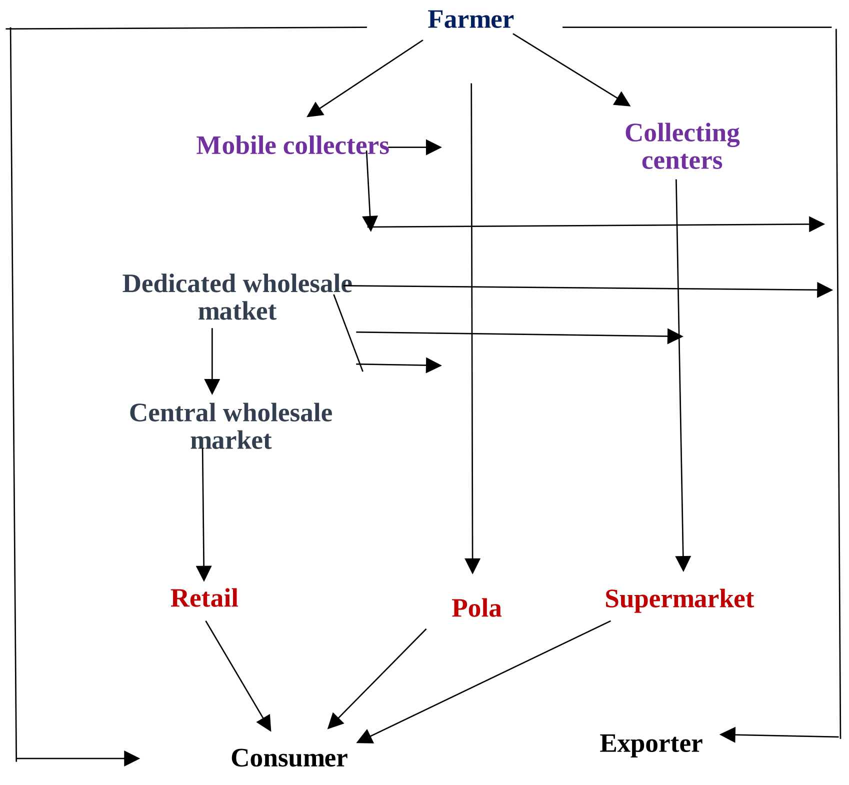


Figure 22: Value chain map

❖ Limited market information

Farmers have limited access to reliable market information. As a result of it, farmers are less aware of the final price offered in the value chain. Farmers have poor visibility of overall demand for passion fruit in the final market. Farmers do not know how to use available market information to maximize their profit. They do not go for price differentiation for the verities of passion fruit even.

- ❖ Narrow knowledge to grab opportunities

Farmers are not knowledge equipped on how to market their production. Few farmers are engaged to process some products and packaging them ex: Passion fruit pulp

- ❖ Natural constraints and virus infestation

Unpredictable nature and diseases make Farmers difficult to guarantee the large quantity of continues supply, creating a gap in production.

- ❖ Less aware of Passion fruit varieties among consumers

Consumers are not familiar with other types of Passion fruits. Ex: Rahangala hybrid. Therefore, the demand will not be differentiated based on the variety.

Recommendations

- Practicing primary sorting and fruit grading treatments, avoiding rough handling and using proper packaging systems may help to avoid the loss.
- Mobile market platforms can be introduced to the farmers and they can easily reach market information. It helps them command a fairer price for their harvest. Involve the more end market players like Traders, Supermarkets, Processors and exporters to work with farmers to assuring market access.
- Strengthening the policies to benefit farmers by stabling the position of farmers in the value chain or protecting them from unpredictable fluctuations in price.
- Develop the basic business and accounting skills of farmers and Training farmers on how to ‘farm as a business’ by using the available market information to maximize their final selling price.
- Educate farmers in processing and packaging methods. Helping farmers get a higher price of their produce by presenting it in a more appealing way to customers
- Introduce purple variety fruit for the fresh market as an alternative to the yellow variety. (S.N. Venkatprahlad)

Analysis of the value chain

- Primary and supportive activities

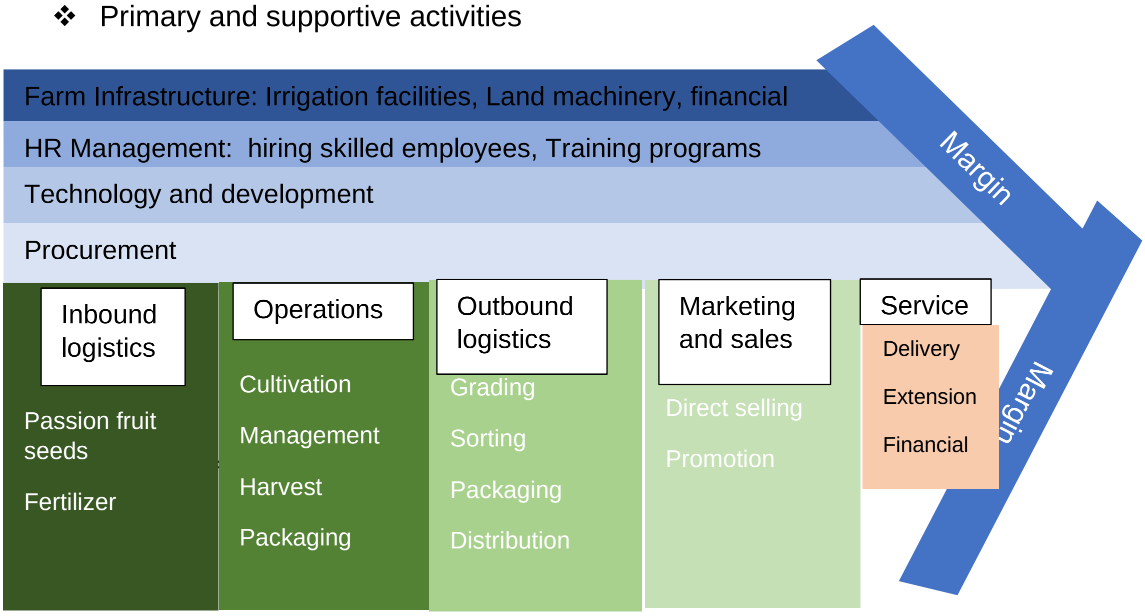


Figure 23: Passion fruit value chain- Primary activities and supportive services

Source: Porter, 1985

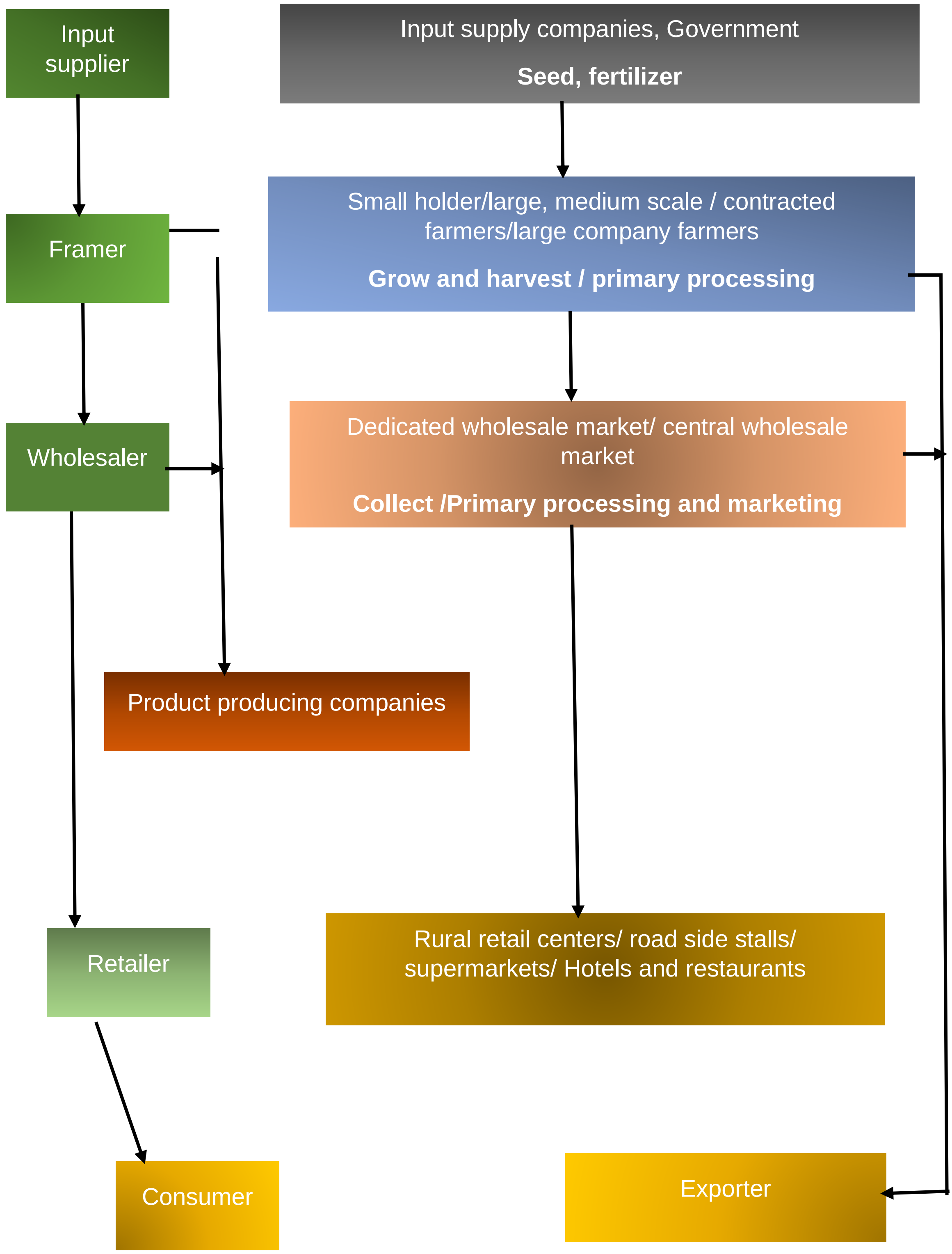


Figure 24: Passion fruit value chain map

- **Market share for each actor in the value chain**

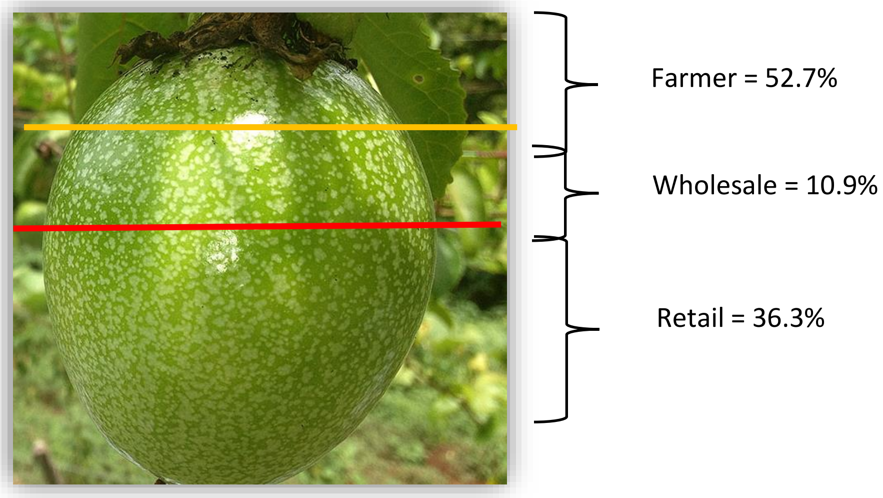


Figure 25: Income distribution pattern of the Passion fruit value chain

Value additions from passion fruit

- Passion fruit pulp

Passion fruit pulp is used in wide variety of food and beverage products. Good opportunity to the farmers link with the production chain by supplying frozen pulp.

- Passion fruit chocolate

An Ideal sweet type that is coated with chocolate, covering sour and sweet passion fruit milky mixture.

- Passion fruit peel flour

Passionfruit peel flour has properties of food additives. The waste peel can be used to make flour which can be used as a food stabilizer, emulsifier and thickener.

- Passion fruit jam

Most common value addition in passion fruit.

- Passion fruit juice concentrate

It is a liquid extract obtained from passion fruit that is used in making sauces, desserts, ice cream, cocktails so on.

4. Pomegranate Value chain

Pomegranate (*Punica granatum*) is a fruit full of nutritional factors, each part of the fruit having a high medicinal value. It can be cultivated in both cold and hot climates, provided there is a good water supply. In Sri Lanka, pomegranate cultivation can be seen mainly in dry zones and it takes six-eight years to get the maximum harvest from a pomegranate tree. Depending on the conditions, about 300 pomegranates can be plucked from one tree per year. Pomegranate can be stored below 50 ^{0}C for about seven months.


Figure 26: Local varieties: Kalpitiya Hybrid Nimali

Nayana, Daya and Nimali are the Sri Lankan varieties of pomegranate recommended by the Agricultural Department of Sri Lanka in 2001. A new hybrid variety was introduced later by the Kalpitiya Research Centre. The parts of the fruit can be categorized as: calyx, peel /rind (outer skin), albedo (thick underskin), membrane, aril and seed (aril- the juicy sac covering the seed). Nimali, Daya and Nayana are the three recommended varieties by the Department of Agriculture in Sri Lanka; Nimali has become the most popularly grown variety with preferable economical attributes like high yielding ability, soft seeded and sweet fruit taste except yellow in peel colour and pale pink arils. Average yield is about 5.71 mt/ha per year or 5.7 kg/plant and average fruit weight of variety Nimali is about 200 g. Variety Daya is also similar to Nimali having soft seeds, sweet taste and yellow color peel. Compared to the other varieties, variety Nayana has bigger fruits with high juice content with hard seeds.

Recent studies have demonstrated the potent anti-oxidant, anti-inflammatory and anti-microbial effects of pomegranate. Pomegranate has the ability to scavenge free radicals which damage the body cells and also has the ability to prevent lipid peroxidation which leads to cholesterol plaque generation. The compounds contained in pomegranate help to control the inflammatory processes seen in many diseases' generation processes. Pomegranate also has anti-microbial actions which act against bacteria, fungi and viruses. It prevents bacterial growth and also prevents DNA and RNA replication of viruses. Thus, pomegranate has a place in treating infections.

People eat the pomegranate arils; some eat the pomegranate seeds and almost all the people throw away the pomegranate peel. Though the peel has a bitter taste, it is rich in compounds with anti-oxidant, anti-inflammatory and anti-microbial properties. Thus, it is better to consume the pomegranate peel without throwing it away. Pomegranate peels can be broken into small pieces then dried and used to make tea or it can be dried and then powdered, mixed with bees' honey and consumed.

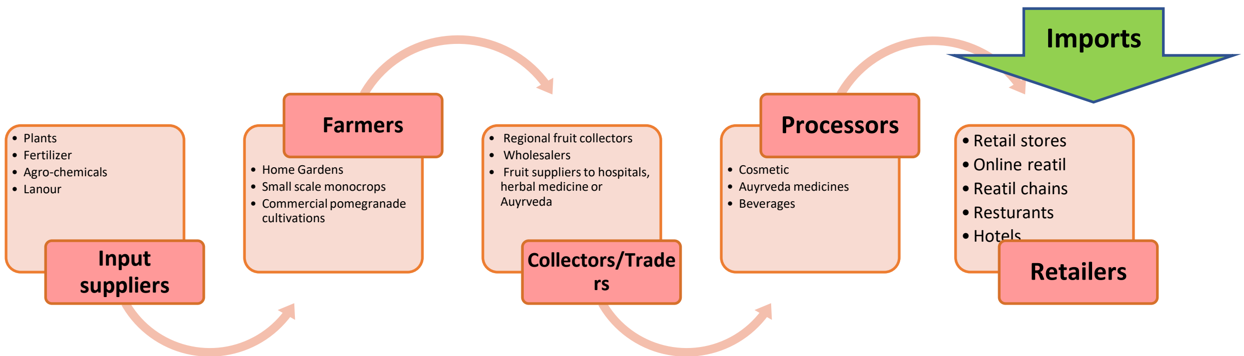


Figure 27: Pomegranate value chain map

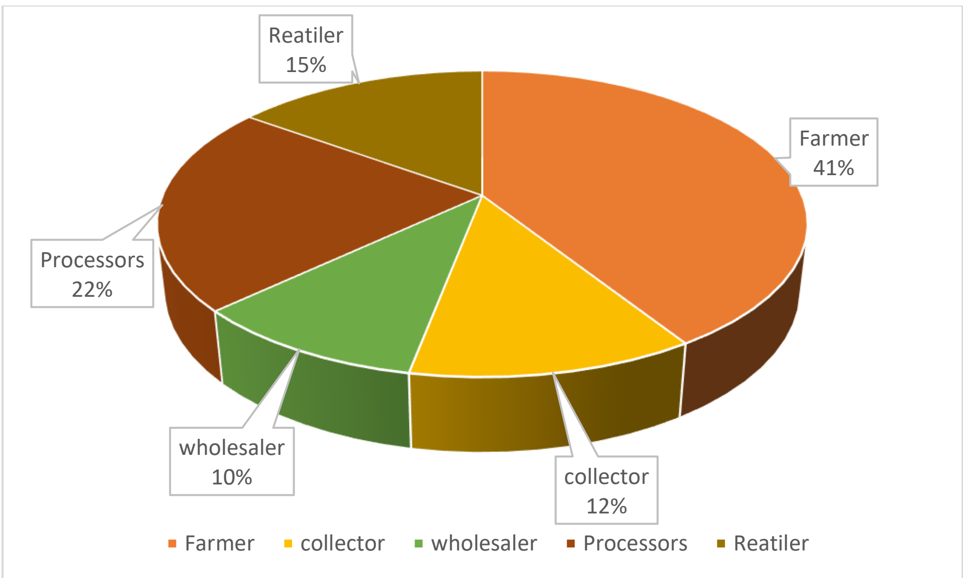


Figure 28: Share of the Pomegranate value chain actors

Figure 29: Value added personal care products

Black gram value chain – Rotational crop

Introduction

Subsidiary food crops traditionally grown in Sri Lanka include kurakkan, sesame, Green gram, Black gram, maize, groundnut, red onion, big onion, chili, cowpea, and soybean. These are also grown primarily for consumption. Most of the subsidiary food crop production is concentrated in the dry zone. These crops are now cash crops generating employment opportunities and enhancing the agrarian socio – economic situation. Sri Lanka's total requirement of OFCs is achieved partly by imports (40%) costing the country nearly Rs. 40,000 million in 2016. Figure 30 explain the extent of cultivation and production volume of the black gram.

Importance of black gram:

1. one of the important pulse crops grown in North of the country
2. Black gram is consumed in the form of 'Dal'
3. It is the chief constituent of 'papad, idly and dosa'
4. For milk cattle, it is used as nutritive fodder
5. It is also used as green manuring crop.
6. It controls soil erosion and compete with weeds effectively due to its deep root system and foliage cover
7. It contains protein (25%), carbohydrates (60%), fat (1.3%) and rich in phosphoric acid
8. It fixes atmospheric nitrogen into soil and improve the soil fertility

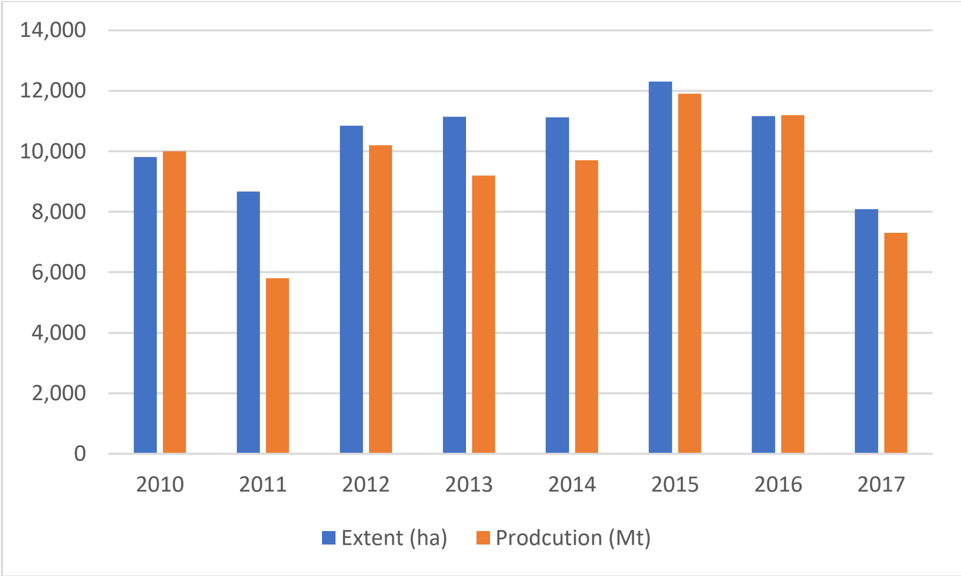


Figure 30: Black gram cultivated land extent and the production

Analyzing the black gram value chain

Black gram one of the important legume crops mainly growing in North of the country and catering to the needs of ethnic foods.

Actors and their functions in black gram value chain

- Input suppliers: Input suppliers are the people who provide inputs to the farmers. Agro-chemicals, finance, seeds and equipment are the major inputs for black gram cultivation. They may be a government sector or private sector input suppliers. DOA is the main government input supplier. They provide quality seeds, fertilizer at low price. Prominent non-government organization is farmers' organization in the village. It provides financial supports and equipment like things. CIC, Hayles are popular private sector input suppliers. Micro level financial supporters are public and private banks, regional banks, NGOs. Some seed companies import cowpea seeds and farmers who want import seeds, they can get seeds from those companies.
- Primary producers/ Farmers: Majority small holder farmers based in North and Eastern provinces. Commercial level cowpea farmers use large lands. Land preparation, farming and harvesting activities are done by the primary producers. In general harvest is used for own consumption, some part direct selling to collectors. Large part of the harvest usually sells to the whole sellers and retailers based in urban centers. Further, local grain mills are purchase part of the harvest directly from farmers and produce several value-added products.
- Collectors: They act as a bridge between primary producer and consumer. They manage their own transport, own storage facilities. They influence for the price volatility

in the market. They directly purchase the harvest from the farmers. Sometimes collectors may be whole sellers or retail sellers.

- Whole sellers: They purchase bulk amount of harvest at the farm gate. Grading, storing, packing, and marketing activities are done by them. They put the harvest economic centers, retail shops or value-added products producing companies.
- Retailers: They sell their own harvest or which is bought from farmers. Their target group is day to day consumers. Retail shops, village and urban fairs are the main marketing channels.
- Consumer: Most of the consumers are local consumers. The amount paid by the consumer is shared among all stakeholders in the cowpea value chain. Small scale exporters who cater the ethnic markets are engage in processing and export value added products from black gram.

Figure 31: Share of the black gram value chain actors

Main supportive activities

- Infrastructure development: In the present, roads in black gram cultivation areas are in good conditions for transport. Most of the villages are connected by carpet roads. Some villages connected with highways. The highway provides excellent link to market.
- Research and Technology development: DOA, HARTI, and private sector seed producing companies, are conducting research and technology development activities for black gram cultivation.
- HR management: Ministry of Agriculture, DOA and HARTI like government organizations and NGOs conduct training program to improve farmers' skills and knowledge.
- Procurements: National and International funds give some subsidiaries to the farmers to improve their livelihood. Other than that, formal and non-formal financial suppliers provide financial services to enhance productivity.

Food safety rules: Food safety rules influence for the production step in value chain specially, if produce value added products. Most common value-added types are black gram flour, instant Dosa mixtures, Instant Wadai mixtures, Papads, porridge mixtures, and flour mixtures for home baked foods.

Government contribution: Food control Administration unit responsible for ensuring food safety and safe production of foods. Ministry of health, Ministry of technology, SLSI and some initiatives of NGOs engage in food safety and quality management. According to the Food Act No.26 of 1980, all food business needs to be registered with the food authority of area.

- Certification: The product certification (The SLS Marks Scheme), systems certification such as ISO 9001, ISO 14001, GMP, ISO22000 etc, providing training, providing laboratory services, and providing information services are some of the services thus provided.

Agricultural practices rules

- GAP: It includes practices in primary production to ensure safety and quality of food products and minimize the negative impact on the environment as well as the workers' health.
- ICM and IPM: Should be followed by farmers to ensure environmental, economic and social sustainability.

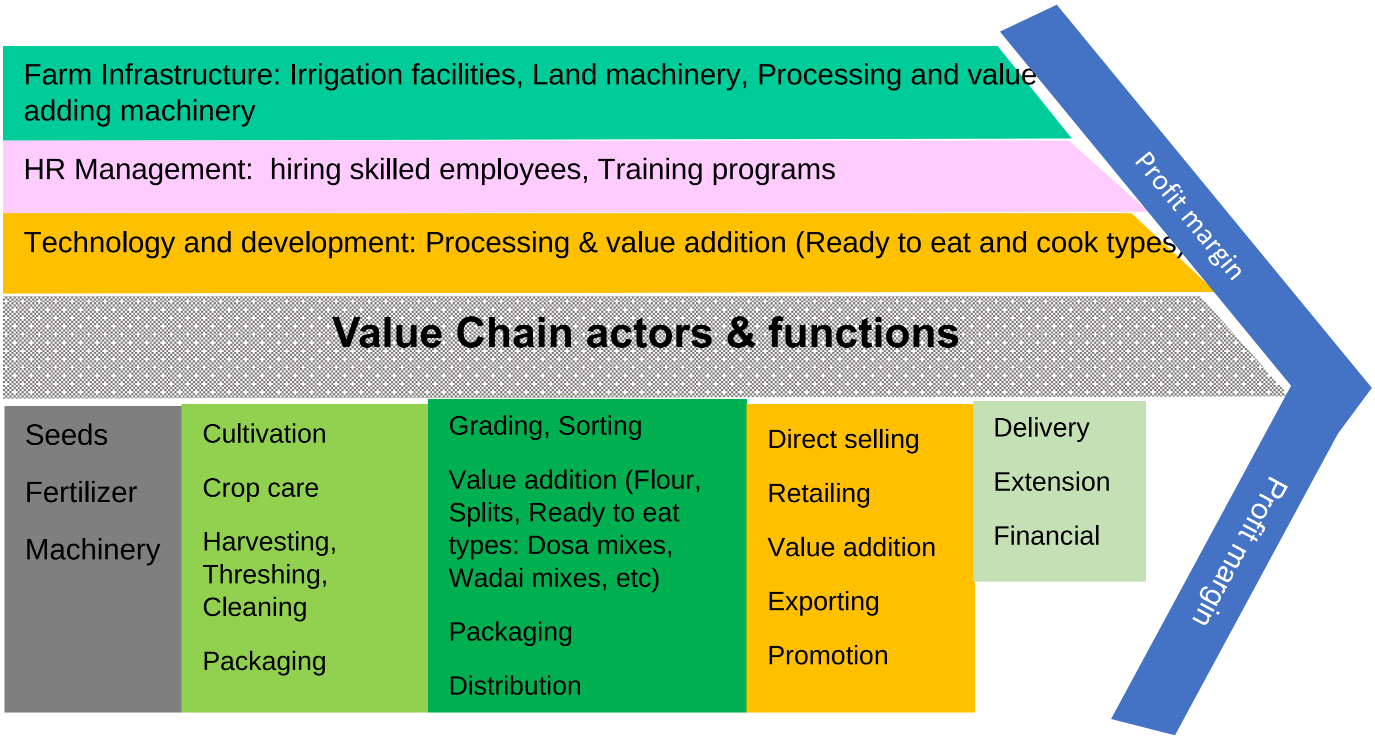


Figure 32: Black gram value chain

Building a roadmap for black gram value chain upgrading

Under this section, describe what are the upgrading -strategies in black gram and value-added products value chains. We can create a value in each step of value chain to upgrade it. These creative values are directly affected for the productivity enhancements and market development. Figure 33 roadmap for value chain upgrading and its' sub value chains.

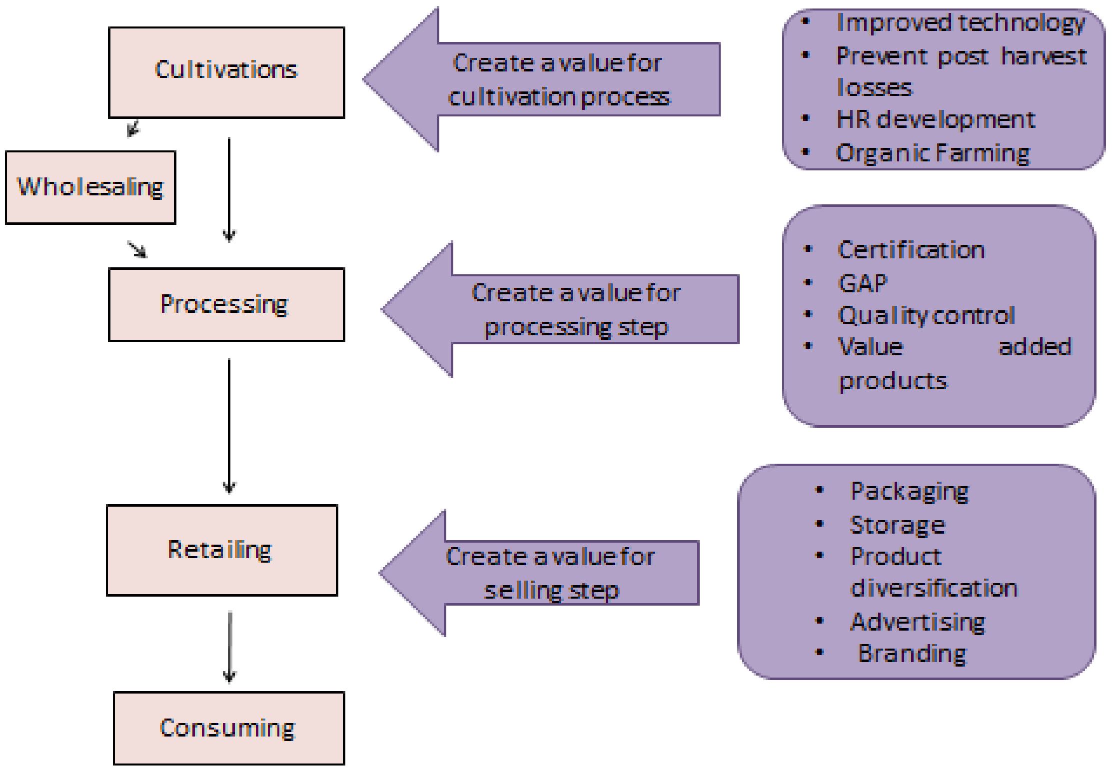


Figure 33: Road map for value chain development

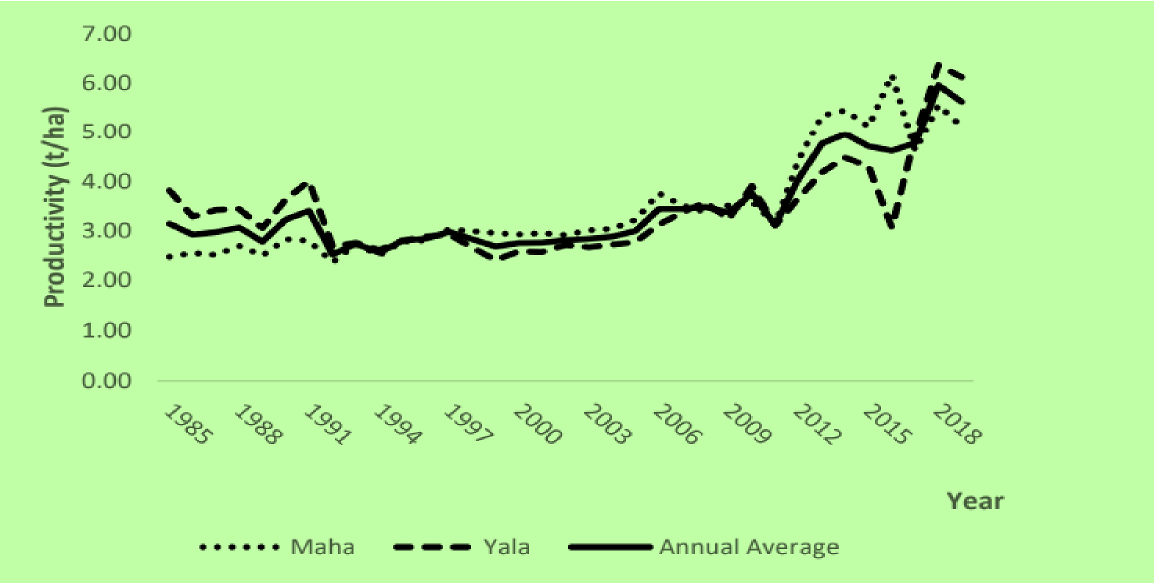
Developed Value chain for Kilinochchi is given in table 3.

3.1.3 Technological Analysis

3.1.3.1 Dry Chile Production

3.1.3.1.1 Understanding the requirement of technical inputs

Sri Lanka cultivates Chili approximately in 13,000 hectares per year. 2/3 of the extent is cultivated in Maha season with rain-fed irrigation. The average green chili yield is around 5 to 6 tons/ha. But recent technical interventions have shown that it has a potential yield of 35 to 50 ton/ha. Good agricultural practices, Chili varieties, irrigation systems, fertilizer applications, pest and weed managements are the key aspects in improving yield. Thus, all technical inputs need to be planned on achieving the potential yield or go beyond.



Source: Data Management Division, HARTI (2021)

Figure 34: Productivity of technical interventions

Chili cultivation in Kilinochchi districts is around 250 – 300 hectares per annum (2% of national chili cultivation extent). Cultivation in Yala season is less than 1/3rd of Maha season mainly due to dependency on rainfed irrigation. The green chili yield drops to 1.5 ton/hectare in Yala season (*Department of Provincial Agriculture, 2010)*

The level of mechanization in dry chili production is still primitive. As per the records in year 2013, the cost on machinery usage is around 7% while the balance is for manual processing. *(Fedrick Abeyrathne and Hiroyuki Takeshima, 2013)*

3.1.3.1.2 Land Preparation

The primary objective of land preparation is to provide a well aerated, levelled and weeds free land for cultivation purpose. The recommended land preparation involves ploughing followed by one or two harrowing, rotovating, levelling and bed making.

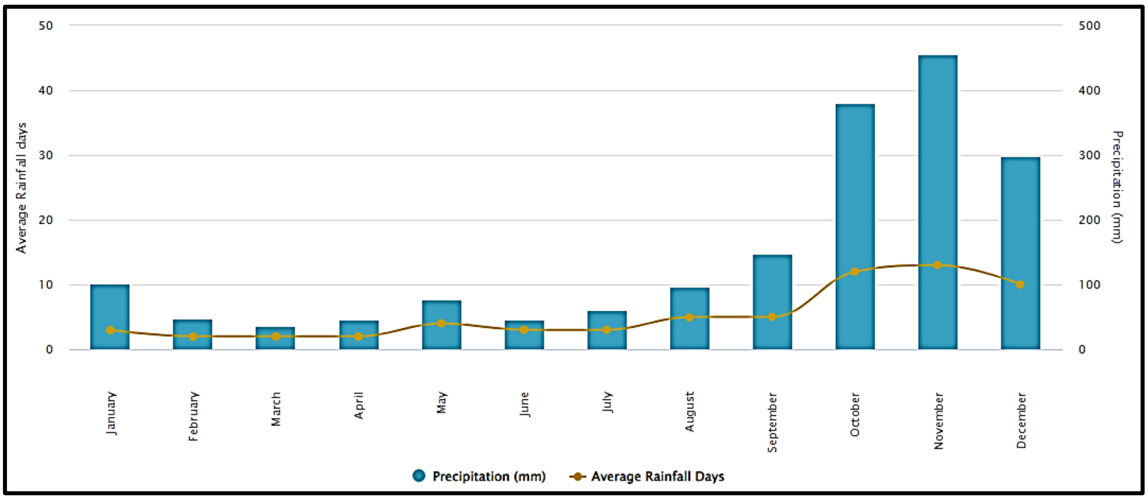
Ploughing can be done by using either “moldboard plough” or “disc plough” coupled to a 45 HP four-wheel tractor. The “moldboard plough” is used for a hard soil while “two discs plough” is commonly used to provide optimal ploughing depth of 8” to 12”.

The using of discs harrows machine with 14 discs followed with a rotovator can be recommended for tilling the soil. Land levelling can be undertaken either manually or using a laser levelling unit attached to a 4W tractor. However, it is very essential as it is required to avoid water clogging and maintain uniformity in soil moisture even with a micro irrigation system.

A rotavator raised bed maker can be used to make chili cultivation beds (ridges). The optimal bed height is 1 foot to 1.5 feet. Furrows between the beds serve as irrigation channels and ridges prevent water-logging of the root zone since the ridge tops are above the zone that is watered. Preventing water-logged ridges will help to prevent diseases.

3.1.3.1.3 Water Management

The water requirement for chili as an average is 4.50 mm/day. Required irrigation water capacity depends on application efficiency of selected irrigation method and soil condition (vertical and horizontal water penetration). The average annual rainfall in Kilinochchi district from year 2010 to 2015 was 4.27 mm/day.



Source - [What is weather like in Kilinochchi, Northern Province, LK (worldweatheronline.com)]

Figure 35: Monthly average rainfall in Kilinochchi district

It is advisable to start chili cultivation in October. However, irrigation system with a reliable water source is a must as chili plant expose to dry weather from February to May/June.

Table 22: Effectiveness of Irrigation Methods for Chili cultivation

Irrigation Method	Surface Irrigation	Sprinkler Irrigation	Drip Irrigation
Water application efficiency	50%	70%	85%
Weed Pressure	High	Low	Minimum
Favorable for diseases	High	Low	Minimum

Required water pressure	Not applicable	High	Low
Fertigation	Not possible	Not always	Possible
Recommendation	Not recommended	Recommended if drip irrigation is not possible	Recommended

Drip irrigation uses plastic tubing which is designed and manufactured with precision water emitters spaced at regular distances along the length of the tubing. The emitters are engineered to release a specific amount of water which is 2 l/h at 1 bar pressure. Drip tape can be practices but less durable compared to tubes. Water for drip irrigation systems must be free of solid particles which can clog the emitters. Thus, filtering systems are highly recommended.

The recommended drip irrigation system can be used to supply the required plant nutrients by using a fertigation unit.

3.1.3.1.4 Weed and Pest Management

Weeds in the field reduce the availability of nutrients and water for the main crop reducing the yield. The extent of reduction in yield of chili has been reported to be in the range of 60% to 70% depending on the weed density in standing crops *(Wickramarathne WAGCP, Wathugala DL, Amarasekara DABN, and Kumarasinghe HKMS, 2021*). Manual, mechanized and chemical weed managements are very common in agriculture. But recent intervention of poly mulch becomes more popular as it has more benefits other than weed control. It decreases water evaporation, increases irrigation efficiency, increases yield, significantly reduces weed infestation, produces an earlier and higher-quality crop. Poly mulch combined with drip irrigation, is considered the current “state of the art” in irrigation that can be used particularly with high value crops. However, temperature is a limiting factor in selecting of poly mulch application.

Chilis are attacked by a number of pests such as leaf miners, mites, thrips, and white flies. Pests can cause significant crop losses. Depending on the severity of the attack, losses can range from minor to total.

The pest management needs to be designed based on identification of vulnerable pest attacks and its severity. Biological, chemical and mechanical measures can be elaborated further. Under technical feasibility, it is more focused on mechanical measures such as introducing an insect-proof mesh cover and sticky traps.

Figure 36: Poly mulch, insect proof nets and sticky traps in one picture

3.1.3.1.5 Harvesting

Chili harvesting is not a onetime activity. It matures over an extended time period so harvest also occurs over an extended time period. Thus, planning agricultural time lines with weather patterns is very important. Harvesting in rainy weather condition reduces product quality to a greater extent. Chilis should be picked and immediately placed in well-ventilated plastic baskets or crates. Packing in polypropylene bags doesn't provide adequate ventilation and can lead to fungal contamination and secondary diseases. Number of harvesting cycles and chili plant structure limit the possibilities of introducing mechanized harvesters.

Harvesting chili pods encourages the plant to produce more pods, so it's important that chili pods don't remain on the plant any longer than necessary to reach maturity. Famers used to harvest chili in green chili stage at the initial three harvesting cycles. As per the past experiences, red chili can be harvested in weekly for about 20 harvesting cycles.

The harvested chili needs to be kept indoor for 1- 2 days allowing partially ripe pods to develop a uniform red color. The best temperature for ripening is 22-25^{o}C and direct sunlight is to be avoided since this can result in development of white patches.

3.1.4.1.6 Processing

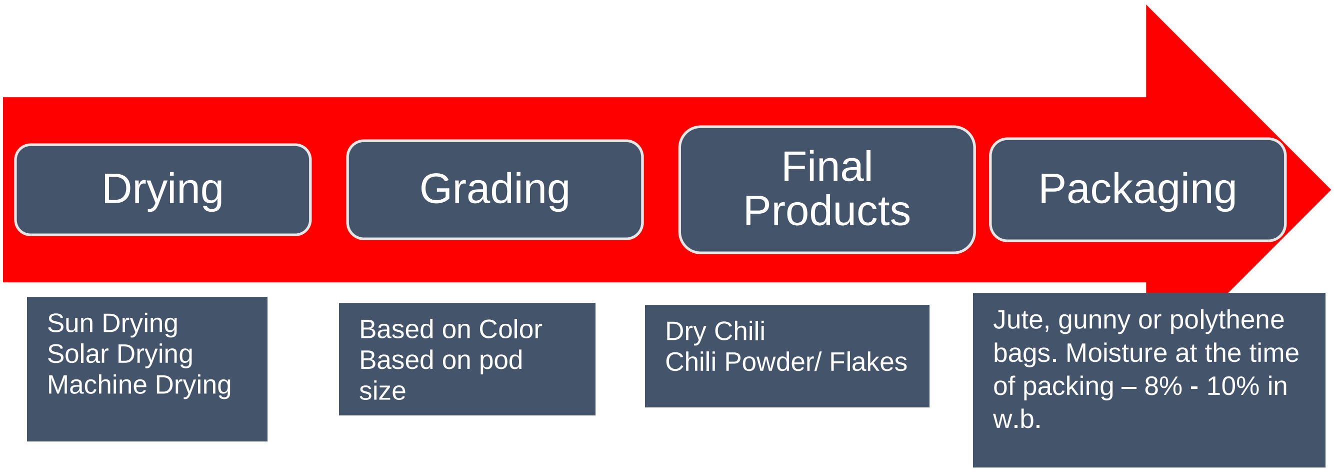


Figure 37: Processing of Chilli

3.1.3.1.7 Drying

Chili drying is not an evaporation process but rather a diffusion. Thus, the moisture should be removed in a controlled manner with controlled drying parameters i.e., temperature and relative humidity. Thus, sun or solar drying are technical infeasible to achieve proper drying characteristics.

The moisture rapidly decreases at the initial stage and afterwards slows down until equilibrium moisture level. The drying time required for lowering the initial moisture content of chili (86.31%, wb) to the desired moisture content (* 8%, wb) varied between 14 and 19 h. The desired hot air temperature is around 50 to 60 ^{0}C. It is advisable to have a positive temperature gradient. The reason of slow moisture removal during drying process could be attributed to the low diffusion of moisture within the chili than that of evaporation of moisture from the surface, and therefore the overall drying process is diffusion-controlled mass transfer phenomena (Wiriya et al. 2010). Introducing a chili flattens system will reduce possible texture shrinkage in the drying process. However, chili must have dried to certain degree prior passing through flattens as it may break chili pods due higher moisture content.

Either batch type or continuous type drier can be used. The dryer capacity should be selected based on potential dry chili intake for the cluster processing centre. There are few options for selecting the thermal application for the dryer namely wood fired furnaces, diesel or kerosene fired burners, steam boilers and heat pumps. Out of these, heat pumps are more effective in terms of efficiency, cost, conveniency and environmental aspects. It is further proposed to use solar tunnel dryers for initial one or two days after harvesting. This will provide initial withering, fast removal of surface moisture that leads for fungal formation while chilies are undergoing unripen pods maturation. The intermediate drying helps to reduce the thermal load and drying time requires in machinery drying process.

Table 23: Existing Chili dryers in Sri Lanka

Dryer Type	Capacity	Thermal Source	Remarks
Batch Type	450 kg of green chili/batch	Kerosene – 25l/batch	Fuel cost – Rs. 94.44/kg of dried chili
Batch Type	800 kg of green chili/batch	Kerosene – 60l/batch	Fuel cost – Rs. 127.50/kg of dried chili
Proposed Batch Type	5000- 6000 kg of green chili/batch	Heat Pump	Electricity cost – Ascertained at Rs. 25/kg of dried chili

3.1.3.1.8 Grading

To achieve the product quality and marketing edge, it is proposed to have a chili grading system based on its color and pod size. A color sorter with a grading facility can be used to meet the purpose. Having a grading system will be more useful when chili harvesting happens in rainy weather conditions as more mold and white patches are inevitable.

Grading details – Anuradhapura Chili Drying Centre

Grading method – hand picking by women.

Rejection 2nd and 3rd quality – 20%.

Sorting output – 20 kg per man day.

Current daily wage – Rs. 1,500 per women.

2nd & 3rd quality category goes for chili powder.

Basic Calculation

Chili cultivated extent per cluster - 150 acres

Expected green chili per season – 3,000,000.00 kg

Expected percentage that goes for dry chili production – 50%

Potential dry chili production/season – 300,000.00 kg

Labor cost on chili grading – Rs. 22,500,000.00.

Expenditure on color sorter machine – 61000 USD

Simple payback period – one year.

Figure 38: Three grading qualities

Secondaries can be used for making chili powder, flakes or paste.

3.1.3.1.9 Packing and Storing

Once the sorting and grading process is over, chili should be packed and prepared either for transporting or storing. Jute, gunny or polythene bags can be used for packing depending on packing density decided by the selected marketing channels i.e., wholesale or retail marketing. The bulk density of dry chili at 10% moisture is about 110 kg/m^3 *(M.A. Hossain & B.K. Bala, 2009).* Thus, the ascertained storing density is 18 kg/square feet at storing height of 6 ft. Around 40 ft x 30 ft storing area will be adequate to provide chili storing facility at a cluster processing centre considering monthly dry chili production and buyer collection or distribution to the market.

<u>Important features in a chili storing facility</u>

1. Sound structure

   Floor: Brick, tile or concrete without openings that allow rodents and insects to enter

   Roof: Rainproof, sealed and insulated roofing structure.

   Walls: Solid construction with concrete, brick, metal. No openings for rodents, birds or insects. High walls, with space between top of wall and ceiling covered with a fine mesh through which heat can escape.
2. Natural, forced or combination of both ventilation facilities needs to be provided. Air circulation ensure the maintenance of low temperature and relative humidity that

increase shelf life of dry chilies. Refrigeration-based dehumidifiers are available and a viable option for large-scale storage facilities.

3. Chile bags must be off the floor using wooden pallets or racking system.

3.1.3.2 Production of Jumbo Peanut

3.1.3.2.1 Understanding the requirement of technical inputs.

In Sri Lanka, peanut crop is mainly cultivated in Dry and Intermediate Zones and the annual cultivation extent was 15,752 ha with the production of 27,602 t pods. Kilinochchi contribution for national ground nut production is about 3% while the highest contribution is from Monaragala district (19%) *(Source: Department of Census and Statistics, 2020).*

Peanuts having a seed mass of more than 70 g per 100 seeds are considered as Jumbo peanuts. Six peanut varieties, namely, Tissa, Walawa, Indi, Tikiri, ANKG1 and Lanka Jumbo have been recommended by the Department of Agriculture (DOA) for general cultivation and all those varieties have been developed at Grain Legumes and Oil Crops Research and Development Centre, (GLORDC) Angunakolapelessa. The average yield of new peanut variety was (1.25 ton/acre), higher than that of Lanka Jumbo (1 ton/acre) and Walawa (850 kg/acre), and the potential yield was 1.5 ton/acre. (*D.G.C. Jeewani, et al., 2020).*

However, discussions had with farmers at Kilinochchi revealed that the actual yield from the pilot project was around 300 kg per acre mainly due to low seed germination rate and absence of proper irrigation and water draining facilities. It was further noticed that Jumbo peanut quality has been well below the standard mainly due to absence of well-designed and engineered drying and storing facilities.

Note: Kilinochchi farmers have sold 2,550 kg of deshelled jumbo peanuts to C.W Mackie and out of that 1,800 kg was rejected and returned due to presence of warms.

3.1.3.2.2 Land Preparation

The maximum moisture retention, precision planting, fast uniform seed germination and effective weed and disease control are expected from good land preparation practices. Mould Board or Disc plough attached to four-wheel tractors can be used to have a desired ploughing depth about 45 cm. To provide a better root growing environment, the land must be prepared to the possible depth.

The second tillage operation can be conducted using a harrow in order to create a suitable seedbed that is loose, smooth and level. Land preparation should be planned to provide facilities for mechanical harvesting and well managed water drainage facilities. Thus, sowing in ridges is highly recommended.

3.1.3.2.3 Water Management

The total water requirement for Groundnut production is 500 – 800 mm per annum (1.5 mm to 2.5 mm/day) (*Water and Soil requirements – Fao,org*). The highest water requirement which is 50 mm per week for groundnut is at the fruiting stage (Source: [Timing critical in watering peanuts | Farm Progress]). The average rainfall in Kilinochchi is about 4.27 mm/day with highest and lowest average values of 15mm/day and 1mm/day respectively. Considering the past irrigation applications, thoughts of field experts, regional climate conditions, soil type, water availability and water requirement, sprinkler irrigation method is recommended.

Arranging sprinklers with 2m height in 5m-by-5m distances and operating the same at 1.5 to 2 bar pressure with flow rate of 800 l/h rate has been tested successfully in Sri Lankan context.

3.1.3.2.4 Seeding

Locally designed and fabricated machines are available for seeding cum ridge formation. Approximately these type machine can be used for seeding 3 acres per day.

3.1.3.2.5 Weed Management

Weeds are a major problem for peanuts especially during the first 4-8 weeks. They reduce yields by competition for water, fertilizer and sunshine. Weeds increase the threat on pest as well. Peanut is inherently a poor weed competitor and emphasis on cultural practices such as good land preparation and crop rotation are best recommended practices to farmers. Inter cultivator machine cab ne used for managing weeds.

3.1.3.2.6 Harvesting

Jumbo Peanuts are harvested mainly by hand. Around 40% out of the total labor requirement goes for manual harvesting. It is important to harvest at the right time since this is critical for determining peanut quality. Too early harvest results in pod loss, and late harvest may result in fungal infestation.

As per the experienced gained in Kilinochchi district Jumbo Peanut pilot project, it was found that only 60 % of jumbo peanuts pods can be harvested for beneficiary purpose as a 20% is immature while another 20% is overmature at the time of harvesting. The overmature portion is remained in the field with manual harvesting due to weakened pegs/links with roots. Thus, it is suggested to plant jumbo peanuts on well-made ridges and introduce mechanical harvesters. Application of mechanical harvesters coupled to four-wheel tractors should be considered at the land preparation and cultivation stage.

Generally, Jumbo Peanuts are harvested at an average kernel moisture content of 18-25 %

3.1.3.2.7 Processing

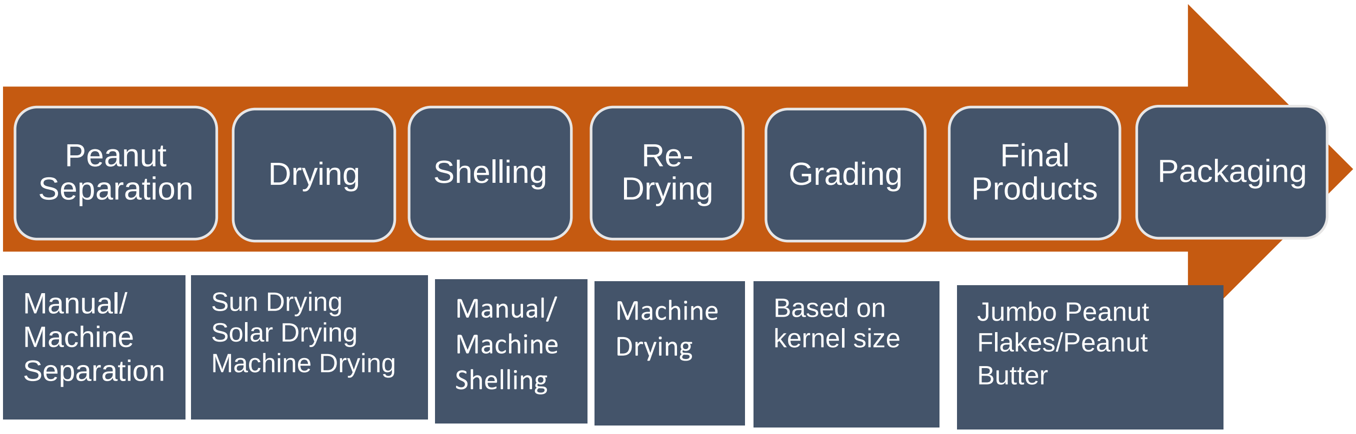


Figure 39: Processing of Jumbo Peanut

3.1.3.2.8 Jumbo Peanut separation (Depodding)

Currently ground nut separation from roots is taking place manually. Workers are paid at Rs. 35/kg. Generally, one worker can manage 50 kg per day. Locally fabricated separator machine has an output around 1 ton/h.

3.1.3.2.9 Drying

Peanuts must be properly dried if desirable flavor, texture, germination and overall quality are to be maintained. Moisture reduction is the major consideration in peanut and may be accomplished by son/solar drying or by artificially drying in a control environment. Drying should be rapid to prevent mould growth and the possible formation of Aflatoxin. However, the drying rate must be controlled to prevent excessive slippage and splitting when the nuts are shelled. Nuts should be dried to a moisture content of approximately 8-10% using hot air at 40 – 45 ^{0}C temperature.

Current practice in Kilinochchi area is sun drying for three to four days prior to pack in poly bags. The average packing density is 15 to 20 kg per bag.

Drying at low temperature of 35 deg. Celsius or high temperature of 55 deg. Celsius enhanced the development of higher quantity of free fatty acid than drying at medium temperatures, 40, 45 and 50 ^{0}C. Kernels which were dried at 55 ^{0}C had the lowest germination of seed. Peanuts thus, could be dried continuously by hot air at 40 ^{0}C or 45 ^{0}C. After shelling, the kernels could be dried further at 45 ^{0}C to reach the moisture content (8 – 10% in wb) which is safe for storage.

3.1.3.2.10 Shelling and Grading

Shelling is the removal of grains from their pod either by stripping, impact action and rubbing or any combination of these methods. The most popular method of groundnut shelling, which is still widely used is the method of crushing or pressing the pods in between the thumb and the first finger to break off the pods and release the seed. This method has low efficiency, it is time consuming, and has high demand of energy *(Adwal Ravindra, et al., 2017).*

Power operated groundnut shelling machines are available. The optimum moisture content of groundnut kernels at 10-15 % wet basis gave minimum broken and blemish during mechanical shelling *(Groundnut drying by hot air (fao.org)).*

A vibratory conveyor type grading unit can be introduced to segregate the final product into three different categories based on kernel size. The splitted peanuts can be segregated as well. Grading will enhance 1st product quality to fetch higher selling price. It also helps to product branding based on its qualitative aspects. Locally fabricated shelling and grading machines having output capacity around 400 – 500 kg/h are available.

Jumbo peanut farmers in Kilinochchi don't have deshelling facilities and some of them send their harvest to Mullaitivu.

3.1.3.2.10 Storing

The key issue found with Kilinochchi Jumbo peanut farmers is not having storing/warehouse facilities. This leads to insect and rodent infestation, fungal development, flavor changes, rancidity, viability loss, physical changes like shrinkage and weight loss.

Best storage conditions for normal bulk storage of unshelled groundnuts is about 7.5% kernel moisture content at 10°C and 65% relative humidity i.e. moisture in the surrounding air. If such storage conditions are maintained, unshelled groundnuts can be stored without significant loss in quality for about 10 months. *(Source: Storage of Groundnut | agropedia (iitk.ac.in)).* It is recommended to store jumbo peanuts as pods rather than as kernels. The deshelling process should start in line with the buyer orders.

The average bulk density of jumbo peanut at 6ft storing height is 40 kg/square feet. Considering the expected yield (800 kg/acre/season), time requirement for pre-processing and efficient collection from buyers, the required of storing capacity is 1,500 square feet. Converting unusable container boxes to cold rooms is another potential option.

3.1.3.3 Passion Fruit - Cluster expansion

3.1.3.3.1 Understanding the requirement of technical inputs

Sri Lankan passion fruit production in year 2017 was 731 metric tons *(Source: DOA, Sri Lanka)* at an average yield of 625 kg per acre. The expected production from Kilinochchi district Passion fruit cluster (150 Acres) under Agricultural Sector Modernization Project (ASMP) intervention is 600 to 750 metric ton per annum.

Passion fruit processing mainly frozen pulp making demands technical inputs. There are few Passion fruit-based products namely juice, nectar, jelly, syrup …etc. Hygienic processing and appropriate storing conditions need to be provided.

3.1.3.3.2 Potential technical inputs for passion fruit farming

Activity	Description
Land Preparation	Basic land preparation i.e., ploughing, harrowing, levelling and removing weeds needs to be undertaken. It is required to dig 45 cm x 45 cm x 45 cm holes for transplanting passion fruits. The distance between two plants and two rows are kept at 14 feet and 7 feet respectively. Mamoties and crowbars can be used for digging planting holes.
Staking & trellising	1 ¼” GI pipes and GI wires needs to be provided. The GI wire should be tightened enough and fixed firmly to the end GI poles/posts to bear the weight of green cover and passion fruits. Solid staking and trellising ensure plant protection from heavy rains and winds. As an average 350 number of GI poles are required for 1 acre. Recent price hike of GI pipes makes the passion fruit farming more costly. However, it is proposed to bear 50% of GI poles cost by the project.
Micro Irrigation	Drip irrigation facility. Annual water requirement is 900 mm to 2000 mm. The water requirement differs with plant growth. 2.8 mm/day – after transplanting 5.0 mm/day – vegetative stage (when the side branches are developing).

	5.7 mm/day – Flowering and fruiting stage. Providing poly mulch helps to maintain a uniformity in soil moisture content while reducing weed infestation. A bio degradable mulch can be tried.
Harvesting	Manual. Harvesting can be done after 7 to 8 months of transplanting when 75% color change from green to yellow. Using of stackable plastic crates will minimize the post-harvest damages during handling and transporting.

3.1.3.3.3 Processing

The fully matured Passion Fruits are to be delivered fresh to the processing centre which is under construction in Akkarayan. The quality of intake passion fruits needs to be assured by assessing for foreign material and physical defects. The passion fruits are washed, thawed, pulp extracted, inspected and frozen to -18°C or below. The process ensures that the natural flavor & aroma of the fruit is retained in final product.

Freezer, fruit pulping machine and heat treatment to deactivate microbial contamination are proposed to be provided. The capacities of the processing centre machineries are to be decided after elaborating all existing and potential marketing channels. However, it is expected that around 1,000 kg of passion fruit harvesting per week from the Kilinochchi cluster.

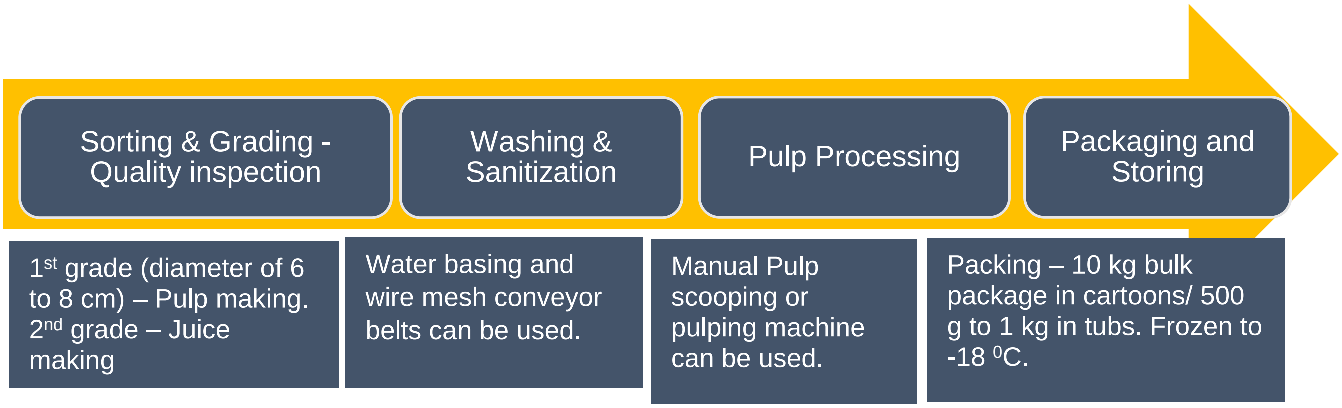


Figure 40: Processing of Passion Fruit

Note: During stakeholder meeting, it was discussed whether buyers can supply freezer trucks for transporting processed pulp. Further discussions with buyers are to be conducted. Converting unusable container boxes to cold rooms is another potential option.

3.1.3.4 Pomegranate Cluster

3.1.3.4.1 Understanding the requirement of technical inputs

Sri Lankan Pomegranate production in year 2015 was 7,524 metric tons *(Source: DOA, Sri Lanka)* at an average yield of 2,285 kg per acre. As an average, Northern Province cultivates Pomegranate in 200 ha per annum and archives production around 850 – 1000 metric tons. In year 2010 Yala season, Kilinochchi district farmers have harvested 140 metric tons by cultivating in 20 hectares *(T.A. Dharmaratne, 2014).*

Providing pre-cooling and storing facilities are the expected key technical interventions.

3.1.3.4.2 Potential technical inputs for pomegranate farming

Activity	Description
Land Preparation	Basic land preparation i.e., ploughing, harrowing, levelling and removing weeds needs to be undertaken. High density planting with a spacing gives 2 to 2.5 times more yield that that obtained when the normal planting distance of 5 m x 5 m. Dig size is 60 cm x 60 cm x 60 cm. Mamoties and crowbars can be used for digging planting holes.
Micro Irrigation	Drip irrigation facility. Annual water requirement is 500 mm to 800 mm. The water requirement differs with plant growth. Immediate after planting (1st irrigation) – 5 mm Within the 1st month – irrigating once a day or once every two days. Water volume per plant is 2 – 4 l/day. After one month – 1-2 times per week at 2 to 3 mm/day. Providing poly mulch helps to maintain a uniformity in soil moisture content while reducing weed infestation. A bio degradable mulch can be tried. Applying fertilizer by using a fertigation unit can be done with micro irrigation facility.
Harvesting	Fruits should be harvested with secateurs or clippers' help because manual twisting may cause damaged fruits in clusters. A healthy Pomegranate tree can produce up to 12 to 15 kg/ plant yield during the first year. From the second year onwards, the yield per plant is around 15 to 20 kg.

3.1.3.4.3 Processing

As per designed value chain assessment, it is planning to sell the harvested pomegranate as fresh fruits.

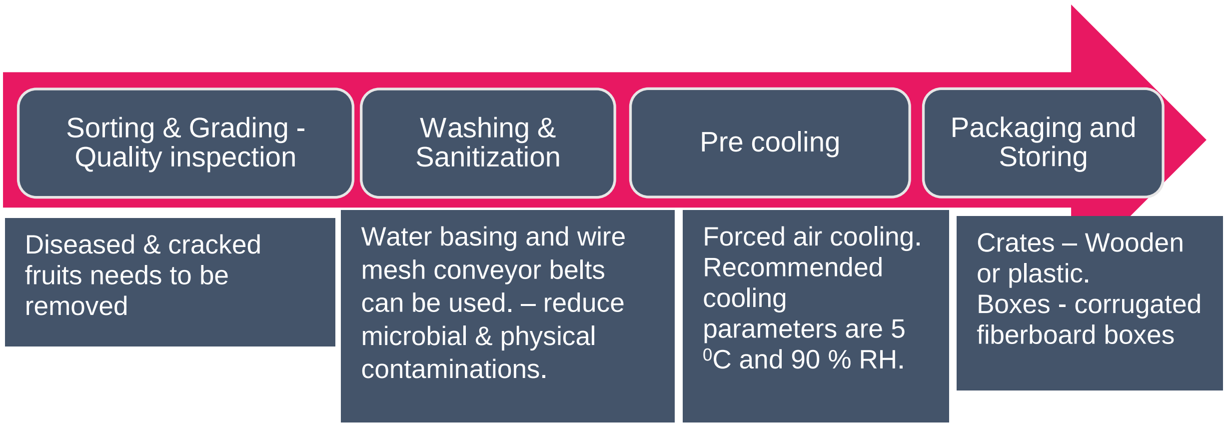


Figure 41: Processing of Pomegranate

Note: Pre-cooling - It is an essential operation before storage of fruits, so it helps to remove vital heat and field heat of produce which results in shelf-life enhancement of fruit. Pre cooling and store in a cold environment will enhance the shelf life by 6 weeks.

During stakeholder meeting, it was discussed whether buyers can supply freezer trucks for transporting the harvest. Further discussions with buyers are to be conducted. Converting unusable container boxes to cold rooms is another potential option.

3.1.4 Analysis on physical infrastructure

<table>
<tr><th>Physical Infrastructure Requirement</th><th>Note on feasibility options</th></tr>
<tr><td>Access roads</td><td>As per the filed visits undertaken to pilot clusters and potential lands for new clusters and expansion of existing clusters, the required access roads rehabilitation is minimum. Concrete and gravel roads were seen more frequently. Gravel roads are proposed based on necessity and its impact to the cluster/s.

Road Kilometrage by Province and District 2019
<table>
<tr><th>Province/ District</th><th>Class A</th><th>Class B</th><th>Class C</th><th>Class D</th><th>Express-ways</th><th>Total</th></tr>
<tr><td>Northern</td><td>734</td><td>525</td><td>1,973</td><td>161</td><td>-</td><td>3,393</td></tr>
<tr><td>Jaffna</td><td>381 [a]</td><td>277 [a]</td><td>544</td><td>45</td><td>-</td><td>1,621 [a]</td></tr>
<tr><td>Kilinochchi</td><td></td><td></td><td>335</td><td>39</td><td>-</td><td></td></tr>
<tr><td>Mannar</td><td>113</td><td>92</td><td>309</td><td>26</td><td>-</td><td>540</td></tr>
<tr><td>Mullaitivu</td><td>113</td><td>103</td><td>390</td><td>17</td><td>-</td><td>622</td></tr>
<tr><td>Vavuniya</td><td>128</td><td>54</td><td>395</td><td>33</td><td>-</td><td>609</td></tr>
</table>
</td></tr>
</table>

(a) Total of Jaffna and Kilinochchi districts

Class A – Roads connecting national capital with provincial capital.

Class B – Minor roads connecting other important towns

Class C – Agricultural and local roads (12 ft width)

Class D – Graveled roads (8 – 10 ft)

Sources: Road Development Authority Provincial Road Development Authorities

Water Irrigation System

It is proposed to provide micro irrigation package for all farmers as described under each crop category. The main water sources and water supply methods up to the selected/potential lands

1. Akkarayankulam (mainly Chili cluster at Karachchi)– resuming existing lift irrigation with solar powered water pump – Providing individual water pumps based on absolute requirement to cater the operating parameters of proposed micro irrigation system. Electric pumps are recommended for farmers who have national grid facility. A portable engine driven pumps with zero suction head named as “boat pump” is being tested.
2. Iranamadu Tank (mainly Jumbo Peanut cluster at Karachchi and Kandavalai) – Using existing water canals with either engine or electric powered water pumps. Electric pumps are more recommended where electricity supply is available. Mobile solar units are proposed to be used in adjoining or closed by famer lands in shared basis. The solar arrangement can be used as an off-grid electricity supply as well.
3. Agro wells – It is persuaded to use common agro wells. However, it is not recommended to construct agro wells but pumping facility can be given to the existing agro wells based on its absolute necessity. As per finding from farmer discussions, 70% of existing water pumps are engine driven.

Province	Major Schemes		Medium Schemes		Total Extent (ha)
District	No of Schemes	Extent (ha)	No of Schemes	Extent (ha)	
North	**4**	**15,011**	**57**	**29,527**	**44,538**
Jaffna	0	-	0	-	-
Kilinochchi	0	-	9	13,831	13,831
Mannar	2	12,461	9	2,407	14,868
Vavunia	1	1,674	19	2,854	4,528
Mullaitivu	1	876	20	10,435	11,311

Minor Schemes

Summary of District Wise Distribution of Groundwater Aquifers

Province	No of Irrigation Schemes				Extent (ha)		
	Working		Abandoned		Working		
District	Tank	Anicut	Tank	Anicut	Tank	Anicut	Total
North	**1,638**	**18**	**156**	**7**	**26,053**	**361**	**26,414**
Jaffna	771	0			7,679	0	7,679
Kilinochchi	224	0			3,896	0	3,896
Mannar	61	3	51	6	1,164	25	1,189

Province District	Total Area (ha)
North	**893,743**
Jaffna	100,996
Kilinochchi	135,089
Mannar	199,756
Vavunia	200,428
Mullaitivu	257,474

Source: The Preparatory survey on the project for improvement of agricultural production and productivity in dry zone areas in Sri Lanka

More depends on medium scale irrigation system. Rainfed cultivation is about 55% (Land extent under rainfed cultivation/total cultivated land extent). Water conservation should be a key initiative. Application of micro irrigation methods are so valid and vital. It is better to plan on rain water harvesting as well.

Protecting farmlands from wild elephants

Electric fences and other destructive measure are not going to promote. Instead of that bio fencing (Lime cultivation with honey bees, cultivating thorny plants…etc) and using splashing lights are proposed.

Processing Centre

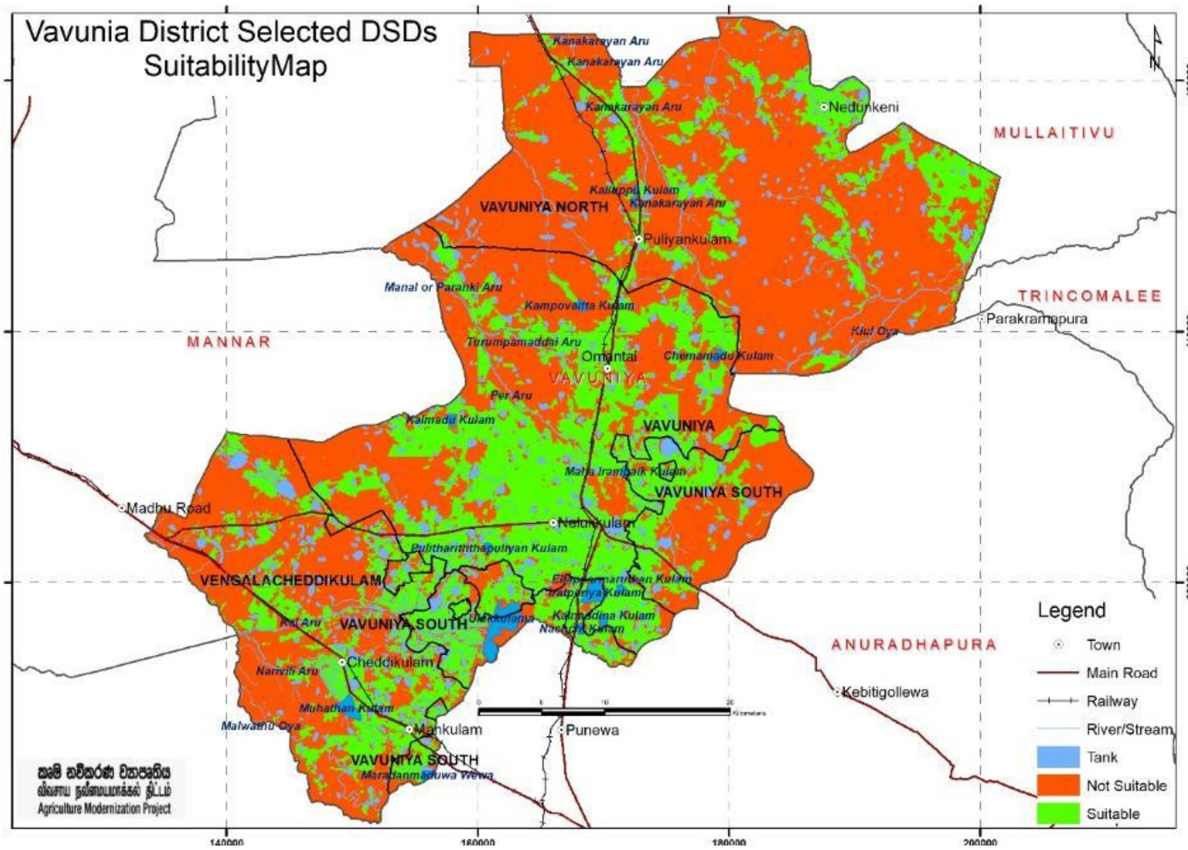
The processing centre needs to be designed based on machinery and production process flow required to meet the agreed value chain assessment and product certification.

It is more focus to rehabilitate and use abounded government building rather than construction of new buildings. Depending on distance from farmlands to the processing centre and usability of same machineries, a common processing centre for few crop clusters can be established. A land and building to be used as a common processing centre for Chili and Jumbo Peanut clusters near Kilinochchi town area are being evaluated.

Below mentioned component are to be included in a processing premises.

	1. Crop receiving, weighing, acceptance and pre-treatment section. Washing, intermediate drying or cooling and initial sorting are considered as pre-treatments. 2. Processing Section – Machineries are to be installed considering the productivity, worker convenience, effective process flow and space availability. 3. Storing facility – Pest control measures, proper ventilation, maintaining of required temperature and RH are going to be considered in order to enhance shelf life of products. 4. Auxiliary buildings • General Office with facilities for meetings and training sessions. • Marketing Outlets • Worker sanitary facilities • Compost making facilities • Machinery maintenance section • Store room – Manging inventory 5. Rooftop solar power generation under “Net Plus” scheme is proposed. This will reduce the operation cost and ensure the operation of critical processing steps even at a power outage.

3.2 Vavuniya District



3.2.1 Agricultural Analysis

The results of basic analysis are same as Kilinochchi but a few deviations are in Vavuniya district. Comparing agro-ecological zones in Vavuniya with Kilinochchi, Vavuniya has better and favorable condition for crop cultivation. Vavuniya has DL_{1b} to DL_{1f} zones Kilinochchi has only DL_{1f} zone in Karachchi DSD.

Table 24: Current practices and remedies to overcome drawbacks

Crop	Current practice	Improvements suggested	Ultimate achievement
Hybrid Maize seed	Only experience with commercial cultivation. All common weaknesses are there.	Introduce proper trainings. Practices like soil analysis. Close monitoring system.	Achieve the potential yield and quality parameters.
Papaya	Cultivate only old varieties with un	Introduce new variety “Tainung” with all	Potential yield and quality will be achieved.

	organized cultural practice.	practices in scientific way.	
Mango – Tom EJC	Not available	Proper training and all agricultural practices in scientific way.	Potential yield and buyer's quality expectation.
Chili	No proper nursery management. Not follow correct fertilizer application.	Start proper schedule of training especially on nursery preparation.	Achieve the potential yields and expected quality of the product.

Some common problems could be notified as follows:

a. Young generation not involves in agriculture.
b. Always they suffer the capital investment.
c. Not any new or appropriate technology adopt.
d. Not proper trainings are given methodically, only ad hock trainings.
e. Crop selection for cultivation also not methodical, just from tradition or influence of peer farmers.
f. Due to the crop selection is not rational, at the harvesting time market get flood and ultimately farmers get very low prices.
g. Land, labour and irrigation water are not use in productive manner and the ultimate results are very poor and their living standards are stagnated.
h. Marketing system is very primitive, at the harvesting time local collectors are coming and collect the entire harvest at dirt cheap prices. These poor farmers have no alternative option and always they depend on them.
i. Vulnerability for drought is very high.
j. No machinery uses for any activity other than basic land preparation.
k. They have not heard about Value chain process or farmer companies.
l. Family labour availability is significantly high and at least addition two heads are there in addition to the farmer.

Table 25: Agro-ecological analysis of Vavuniya district

DSD	Agro ecological zone	Rain fall - mm	Soil type	Terrain
Vavuniya	DL1b, DL1e, DL1f	800 - 900	RBE, LHG	Undulating
Vavuniya North	DL1b, DL1e, DL1f	800 - 900	RBE, LHG	Undulating
Vavuniya South	DL1b, DL1e	800 - 900	RBE, LHG	Undulating

Vengadachettikulam	DL1b, DL1f, DL3	800 - 900	RBE, LHG, RYL, Latosol	Undulating

According to the table 25, different DSDs of Vavuniya district has almost same soil types and Rain fall pattern except Vengadachettikulam. That means the vegetation of the area must be almost same. Therefore, the crop cultivation of district may be same among different DSDs.

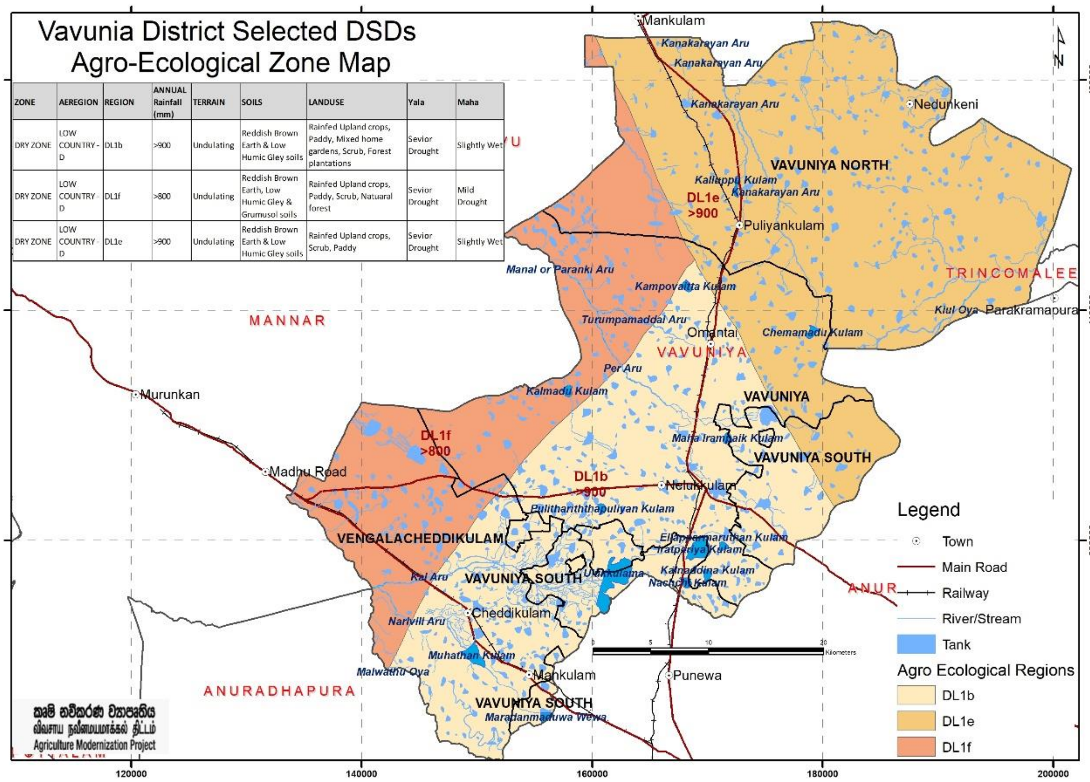


Figure 42: Vavuniya District Selected DSDs Agro-Ecological Region Map

3.2.2 Agri-business and Value Chain Analysis

Hybrid maize seed, Jumbo peanut, Mango (TomEJC), Papaya were the main value chains identified for Vavuniya district. Black gram was identified as potential rotational crop value chain for hybrid maize seed cluster. Further, Jumbo peanut selected as main crop cluster. This section aimed to describe the structure, functions and nature of the selected value chains except hybrid maize seed value chain which has submitted separately.

Jumbo peanut value chain (Inter crop with TomEJC mango)

Refer Chapter 1 of 3.1.2 chapter.

5. Mango (TomEJC) value chain

Introduction

The mango (Mangifera indica L.) is an important fruit crop in Sri Lanka. Mango is considered a tropical fruit believed to have originated in Asia. China and India are the world's two largest mango producers. Sri Lanka, Philippines, Thailand, Pakistan, Brazil, Nigeria and Mexico are famous for commercial mango cultivation. It is dry zone fruit crop. Mangoes grown in northern Sri Lanka show rich varietal diversity and have greater consumer demand compared with those from other regions of the country (Krishnapillai & R. S. Wilson Wijeratnam, 2016)**.** The ripe fruit is a rich source of energy, vitamins (ripe mango contains high quality of beta carotene (pro vitamin A) and vitamin C) and minerals. The fruit is prized for its excellent taste and medicinal value. In Sri Lanka, mango is the most widely cultivated tree fruit and it is the second most widely cultivated fruit crop after the banana Mango is grown in 29,229 ha of area with production of 529.5 million fruits in Sri Lanka (Department of Census and Statistics, 2020). Mango trees are a popular plant in many home gardens in Sri Lanka. Mangoes collected from home gardens constitute the majority of the fruit supplied to the market whereas commercial production is more limited.

Mangoes always available in marketplaces because a wide variety of mango cultivars grow in varied tropical agro-ecological zones that are favorable for year-round production. However, production is seasonal for most of the mangoes come to markets during April–July and October–January, whereas fruit are in short supply during February–March and August–September. In the wet zone, the majority of fruit trees are harvested during April–July, while trees are harvested during October–January in the dry zone.

Different mango types can be found in most of the districts where great variety was observed in northern province. The market offers a number of different mango types/varieties, including TomEJC, Betti, Kohu, Vilad, and Karthacolomban. Kurunegala, Gampaha, Ratnapura, Matale, Hambantota, Moneragala, Puttalam, and Matara are the main mango producing areas in Sri Lanka. Three major mango varieties that are frequently trading in the Sri Lankan market namely; TomEJC, Karthakolomban and vilad. The price information was collected during the major mango season in 2021, which is May-July. TomEJC is the commercially cultivating mango variety in Sri Lanka. Karthakolomban and Vilard are cultivated in small holder farms and home gardens in Sri Lanka (Rathnayake & De Silva, 2022). During the harvest season, local collectors and wholesalers used to rent out the trees and plantations and harvest the fruits to sell to processors, wholesalers, or exporters. Fresh fruits are sold by wholesalers to merchants. The processor sells its goods to retailers or wholesalers. Fruits are typically purchased by exporters from the wholesalers or collectors. (Value Chain analysis of key F &V product in sri lanka, July 2017).

Mangoes are marketed in much the same way as other fruits. The common marketing channels are direct channels; collectors, reatil marketfarmers, and or reatil chians directly buy from their out grwover farmer and retail through their own reatil outlets. A product goes directly from the collector to the export processor for export. When it comes to processed mango products, some processors sell to wholesalers while in other cases they supply the retailers directly. Additionally, there are institutional purchasers who purchase the fruit through wholesalers, including hotels and restaurants. Tourism industry added into the demand component and varieties demanded depends on the purpose of purchase.

In the agri-food sector, various chains of businesses operate through which products moves from producers to consumers. From the perspective of a value addition or value creation, such chains are referred to as agri-food value chains (Gagnon, 2012) . These chains are critical to human society as providers of food and income to the majority of the world's population (Collins, 2009; Gagnon, 2012, Neven, 2014). A typical Agri-food value chain operates as a complex technical-social-economic system based on an array of interrelated and interdependent activities (Pimbert et al., 2001; Silva and Filho, 2007).

With reference to value chain model, chain begins with from input suppliers through primary producers to processors, distributors, and retailers, work to satisfy each of these objectives.to finally meet other people's demands and satisfy customer requirements in order to profit (Bertazzoli, A. Fiorini, R. Ghelf, S. Rivaroli, & A. Samog, 2011).

In Sri Lanka three major mongo value chain are traditional, modern and export-oriented value chain models. Traditional value chains include producers, collectors, entire sellers, and retailers as its lower-level participants. Farmers, collectors, processors, entire sellers, and retailers make up the modern value chain. The various participants in the export value chain include farmers, collectors, processors, exporters, entire sellers, and retailers. Based on our observations, we were able to categorize the various end markets. As a result, while modern value chains target super markets, hotels, and restaurants as well as processing companies, traditional value chains cater to neighborhood businesses. Finally, the export market is being supplied via the export value chains. (Rathnayake & De Silva, 2022).

Figure 43: Common mango types available in local market: TomEJC, Karthakolomban & Villard

Importance of promoting the mango value chain

Mangoes may be grown in the allover the regions to provide money and reduce poverty. The mango's dual functions as a food source for households and a source of opportunities for economic growth. Mango fruit is essential in preventing nutritional issues in addition to providing employment chances. The mango is nutritionally superior to both tropical and temperate fruits, and it is packed with nearly all of the known vitamins and minerals. Mango's calorific value is primarily derived from its sugar content. It is much higher than that of apples, pears, or peaches, and comparable to that of grapes. With the exception of the avocado, the protein level is often a little higher than that of other fruits. Along with some calcium and iron, mangos are also a fair provider of thiamine and niacin.

According to the Food and Agriculture Organization (FAO), the world mango production is around 60 million metric tons per annum whereas there are nearly 1,000 verities of mangoes are cultivated worldwide. By promoting mango value chain, we can introduce new mango verity to increase harvest and selling price in farmer level.as an example TomEJC mango have high demand but limited number of farmers are grown TomEJC Varity. But promote mango cultivation to like these verity farmers can gain high profit.

If producers are adding value through better input, agronomic practices and innovation in processing can access to high value markets such as EU, USA and Japanese market. Participation in safety and quality assurance processes and product ingredient innovation is vital for the value chain sustainability. When considering about the inputs, high quality fertilizer, good quality planting materials, high-tech equipment in harvesting and post-harvest handling helps in ensuring the quality of the final product which delivers to the final customer.

Distributers are adding value through creation of access to high value market like export market and wholesale market. High quality products are delivered to high value markets to add value in higher quantities. It will help to increase the stakeholders shares throughout the distribution process. Product innovation can offer consumers new products with special attributes. Innovating products targeting different consumer preferences. Producer carefully understanding market trend and consumer need can economically develop mango value chain. The innovative process can be done in the different levels of the mango value chain by considering different aspects. The final innovation will increase the profit of each stakeholder level.

Also, when promote distribution to consumer supported way like product transparency, affordable price and delivery or pick up option may add more value for mango value chain. Specifically, in the delivery and pick up options can be customized based on the geographical factors and also the customer requirements which will add a greater proportion of the value to the product.

In this manner each and every aspect of the value chain can be used to gain higher returns for each contributor in the supply chain. Facilitating the supply chain by introducing more value in each and every possible level will help to create a remarkable value chain with higher importance to each contributor.

Common issues characterizing the mango value chain

The following constraints affect mango value chain in Sri Lanka a disorganized scattered production system with low yields due to improper tree management practices, which are associated with seasonal production patterns with annual production gluts and scarcity, the lack of an organized marketing structure, inadequate market information, a lack of cultivars that meet the export quality requirements of major markets, poor availability of quality planting materials, inadequate extension activities and training programs, and heavy postharvest losses.

Postharvest loss

Major limiting factor in mango industry is the low quality of fresh produce which leads to high postharvest losses. As a result of high postharvest losses of fruits, the nutritional status of the population and the economy of the developing countries are deeply affected. It is reported that 25-45% loss occurs at different postharvest stages of mango value chain (Alam et al. 2019). Major reason for that the majority of the fruits, particularly young fruits, are often harvested by collectors. Another issue that contributes to poor quality and health risks is incorrect artificial ripening techniques. Peel damage results from latex pouring from mango stems during harvest, gathering, and transportation.

To prevent any loss of fruit quality or quantity, proper postharvest management of fruit is crucial. Manual harvesting or using poles equipped with nets for mango picking should be used to gather the mature fruit. In order to allow any latex to drain away and stop the latex from burning the fruit, the stalk should be cut off and the cut stems should be stored with their cut ends downward. The fruit are stored in a box or room that can be sealed. Considering this situation in Sri Lanka, National Institute of Postharvest Management launched a development project 'Improvement of supply and value chain management practices of mango in Sri Lanka'. Under this project, ten mango processing zones where most of mango collectors were concentrated were established island wide. Stakeholders were adapted to follow improved postharvest technologies for harvesting artificial ripening, sorting, grading and packaging. In addition, equipment, such as, harvesting tools, plastic crates, corrugated fiber board boxes, and, ripening chambers, were also distributed among these stakeholders.

Lack of marketing information

Unorganized and informal marketing channels are common for the fresh produce**.** Absence of well-organized market structure for the handling and selling of mango leads to poor returns or benefits to both farmers and consumers. The production of mangoes is widely dispersed because they are primarily grown in home gardens. Mango collectors visit home gardens in outlying villages around the nation and gather fruit to supply the main marketplaces in urban areas. Fruit collectors who operate on a small scale in other towns and villages also collect fruit from home gardens. They sell this fruit at village fairs and markets roadside mango sell fruit along the main road during mango season. They are not very much aware about export market and other value addition thing. Only a small fraction (< 0.5%) of the total production is exported (Peiris, 2016).

Currently, Sri Lanka exports very minimal quantities and country's share did not feature in the top 10 Asian mango countries exporters. There is a huge potential for Sri Lanka to cater to this potential market. The major variety of mango exported from Sri Lanka is TomEJC mango variety. This variety is also seen as a major competitor to the Alphonso variety of India and has the potential to cater to the existing market of Alphonso. Farmers bargaining power is very weak. As farmers do not have direct contact with the marketing companies or traders, and they usually do not add value to their produce before sending the produce to the market, ensuring fair price is uncertain If farmers can directly sell to the retailer or consumer passing intermediaries and aware farmers about value addition thing and aware about proper marketing information mango value chain can upgrade very effectively.

Availability of infrastructure facilities

High investments costs due to remoteness and poor quality of roads and transport facilities that create high postharvest losses as well as difficulties in accessing markets is major issue due to poor infrastructure. Mangoes grown in Sri Lanka are harvested and packaged before being transported by road, air, or sea to consumers.it is mainly affect to post harvest losses.as a example about 10-20 % in case of TomEJC mangoes loss due to lack of proper infrastructure.so currently need infrastructure support like cold chain infrastructure, pack houses, collection places etc. to enhance efficiency in the mango value chain.

Availability of input for mango value chain

Thus, the agro-dealers play a crucial part along the value chain that aids farmers in their efforts to establish highly productive mango farms. But Main issue is lacks accessibility to quality planting material for cultivating like TomEJC mangoes. In Sri Lanka Only 36–40 certified nurseries produce planting material for TomEJC mangoes. Currently, over 5000 Sri Lankan families are working to grow the TomEJC variety of mango. Another input issue is fertilizer and recent policy changes on import of fertilizer significantly affected the mango production commercially.

Lack of knowledge

One of the issues causing low incomes is the lack of market know-how and intelligence and entire, mango value chain suffers from this, another factor that affects the entire value chain is technical know-how information. The current lack of technological expertise in pre- and post-harvest technology in Sri Lanka affects mainly the production of TomEJC mangoes.

Analysis of mango value chain

Mango value chain comprised of large number of small-scale producers, countable commercial producers, regional or area-based collectors, limited number of collectors for export purpose, processors, especially value-added product developers, diverse retails; road side retailers to retail chains and variety of consumers (individuals, restaurants, hotels, etc.). Value chain represent the participants involved in the flow of product from farm to market.

Input suppliers

Mango input suppliers are the people who supply inputs; such as agro-chemicals, fertilizer, planting materials and equipment’s and etc. Major input suppliers are department of agriculture and privet sector like CIC, Hayleys PLC, Horana plantation and etc. They also have their own distribution channel include wholesale and retailers. Nursery supplier for the primary product lines is TomEJC, Karthakolomban, and Villard varieties. Micronutrients, insecticides, fertilizers, and other materials required for mango cultivation are provided by agro-vet such as CIC, Hayleys. Additionally, they offer equipment for mango harvesting, ripening, and spraying. Additionally, ingredients needed for liming, Bordeaux mixture, pheromone traps, etc. are sought after from them.

Figure 44: TomEJC mango nursery, Ellawala Horticulture, Galkiriyagama

- **Producers**

The primary participants in the mango supply chain are farmers. In the regions where mangoes are grown, there are small, medium, and large farmers. In Sri Lanka mangoes are cultivated mainly in home gardens. But TomEJC verity producers are cultivated large area, i.e. >1 acre. Producers' roles are production, harvesting, and primary processing, maintain farm and finally sell to wholesaler, collector or exporter. Some farmers sell directly to the consumer, limited quantities handle. Small-scale farmers rarely use fertilizer in their operations. Harvesting decisions are typically made by farmers based on the size and colour of the fruit, and they only remove mature fruit from the trees. The majority of farmers harvest their crops by hand, either with their hands or using sticks that have hooks on the ends. Before selling the fruits, farmers who harvest themselves also keep them mostly at their farmhouse. The mangoes are kept for no more than a week.

Figure 45: TomEJC mango plantations, Nelna & Ellawala Horticulture

- **Wholesaler**

Wholesalers are bulk purchasing mangoes from farm gate. Wholesalers collected mangoes, which were then transferred amongst retailers in a variety of domestic markets. Wholesalers participated in contract farming, where they dealt with farmers in advance, fixed prices based on productivity assumptions, and paid farmers when the farmers sold the fruit. Most of fruit sell in Colombo wholesale market supplied by Boragodwatte, Minuwamgoda like wholesale collector, they pick mango and temporally storage and ripening of fruit. After that they grading, sorting, ripening, washing and packing and supply to retailer and consumer. TomEJC Grade 1 quality like high quality mangoes transport using corrugated cardboard board boxes to export. Others are pack in plastic crates. Further, retail chains and exporters also purchase from farm gate and perform grading and sorting of fresh mangoes and supply to company like MD, KIST, KVC and SMACK and etc. Some wholesalers distribute mangoes to the street mango sellers too.

Figure 46: Artificial ripening (conventional method) and improved method

- **Retailer**

Retailers are the end traders that deal with end consumers. They were the primary determinant of price. They had been monopolizing the market in accordance with the situation while taking into account the possibility of mango post-harvest loss. For the sale of mangoes, various types of retailers are active. Small fruit vendors, who sell fruits all year round, are well known for selling mangoes. During the mango harvesting seasons, certain seasonal stores also sell mangoes. During the mango season, super markets also sell mangoes. Mangoes are mainly sold by small fruit sellers like street seller, small fruit shops and online selling such as Daraz, Cargill's, kills and other platforms. become trend now. They purchase mango from farmer or wholesaler. Retailer also practices Grading, washing, sorting, packing and marketing of mangoes.

Figure 47: Retail packs for export

Figure 48: Export brands- fresh fruits: Ellawala Horticulture & Nelna

- **Consumer**

Consumers are end users of mangoes. They are the price bearers. There may be domestic or foreign users. The consumer price value share to all stakeholders in value chain of mangoes.

Main supportive activities for mango value chain

Mango research and development activities in Sri Lanka are conducted by government and semi government agencies and public universities. Department of agriculture conduct program on technology development related to the production, post-harvest management, extension, planting material production and certification to support mango development in the country. Export development board conduct programs that assist grower and exporter. Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI) works on mango marketing and universities do research related to mango.

Other than that, the supporting organizations are the Institute of Post-Harvest Technology, Asian Development Bank, and foreign-funded initiatives like the Agriculture Modernization Project. Government and corporate sector activities support the value chain actors primarily through consulting services, technology transfer, infrastructure, financial services, and trainings.

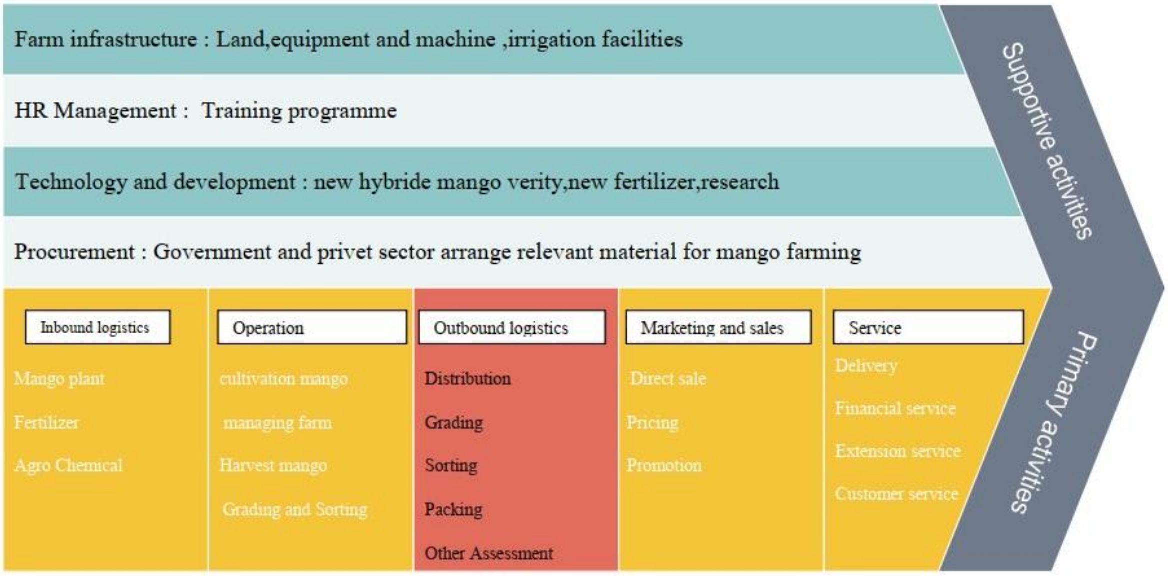


Figure 49: Mango value chain

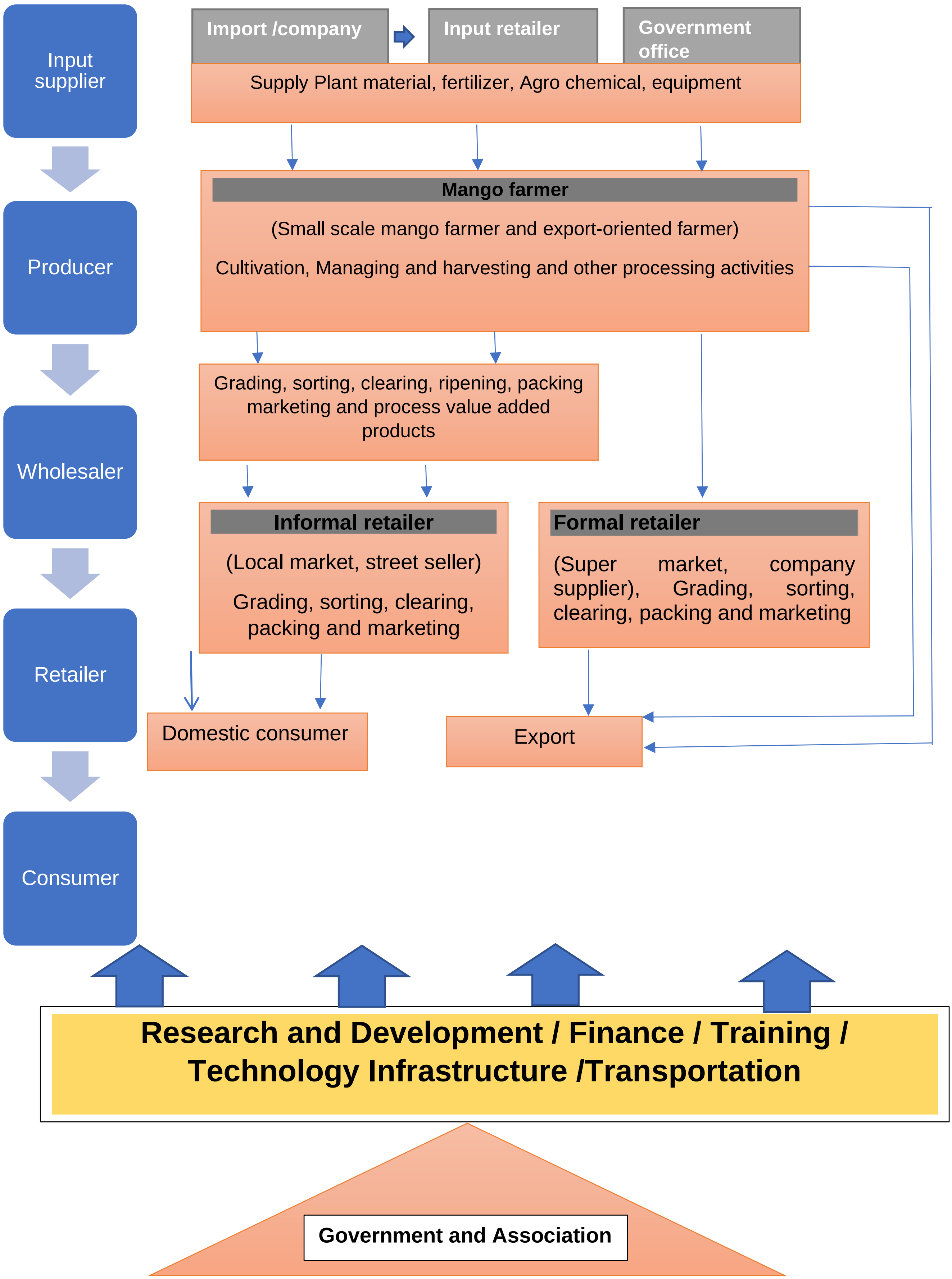


Figure 50: Value chain map for mango value chain

Table 26: Cost analysis mango per Kg

	TomEJC			Karthakolomban		
	Farmer	Wholesaler	retailer	Farmer	Wholesaler	retailer
Cost for stakeholder	150	70	55	80	35	25
Buying price	-	450	700	-	100	169.23
Selling price	450	700	950	100	169.23	250
Total cost	150	530	755	80	145	225
Profit	300	170	195	20	25	75

Each stakeholder shares in Mango supply chain

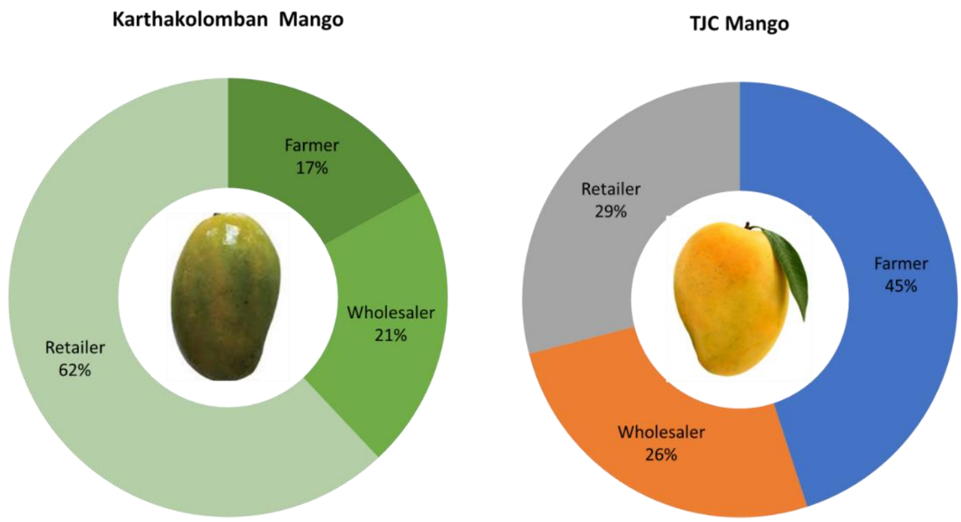


Figure 51: Value chain actor share

Mango value added product

- **Fresh cut mango**

Fresh cut mango is among the minimally processed fruits and vegetables with increased market demand within ready-to-eat fresh fruit products

- **Mango juice**

Mango pulp can be mixed with a specific ratio of water to produce mango juice. The mango juice can be used as a single strength juice or blended with other fruit juices as juice blends or incorporated in fruit shakes.

- **Mango juice concentrate**

Mango juice or pulp is used as the starting material for the processing of mango juice concentrate. When pulp is used to make concentrate, the pulp is broken down into its constituent pectin and cellulose using enzymes such as polygalacturonase, pectinase, and cellulose.

- **Mango squash**

Mango squash is a concentrated drink consisting of 25% juice, acidity with either Sulfur dioxide or sodium metabisulfite as a preservative

- **Cordial**

Simply said, cordials are crystal-clear squashes made by filtering the juice through a hygienic muslin cloth, sieve, or special juice filter. With the addition of sugar and citric acid, cordials can be made to have a TSS concentration of 12–14% of Brix and 3.5% acidity. They can also be kept fresh by adding sodium benzoate or sodium metabisulfite. Mango cordial can be made on its own or combined with other juices from other fruits or vegetables, including pineapple or carrots.

- **Mango and Probiotic Dairy Drinks**

Mango juice has the potential to be employed as a new food matrix substitute for dairy products as a probiotic delivery system when combined with other fruit juices. Mango juice increases the bacteria' survivability and the qualitative attributes of fermented beverages. Mango pulp can also be utilized in probiotic milk drinks with mango taste as a thickening, texture-changer, or substitute for sugar.

- **Mango wine**

Another beverage made from mango, called mango wine, can raise the price of mangos and lower post-harvest losses. Mango pulp is an ideal substrate for fruit wine fermentation because of its high sugar content. Mango wine has been proven to include ethanol and aromatic components that are similar to those of grapes.

- **Mango leather**

Fruit leathers are sheets of dried fruit pulp with a sweet flavour and a soft, rubbery feel. Although a number of fruits can be used to make leathers, mango, banana, and tamarind leathers are among the most well-known. Mango leather is made by evenly distributing the pulp to a depth of 1 cm on a tray covered with vegetable oil, then drying the pulp in mechanical or solar dryers until the final moisture content is between 15-20%.

- **Mango powder**

Mango powder is used as a flavour enhancer in various foods and beverages such as in ice cream, yoghurt, and the bakery and confectionery industries and also as a seasoning powder. Dried mango powder is processed by dehydrating mango pulp.

- **Mango waste**

Mango waste can use as,

1. Peel for produce pectin, biogas, alcohol.
2. Kernel for oil and flour production
3. Mango pomace can use for vinegar and wine production

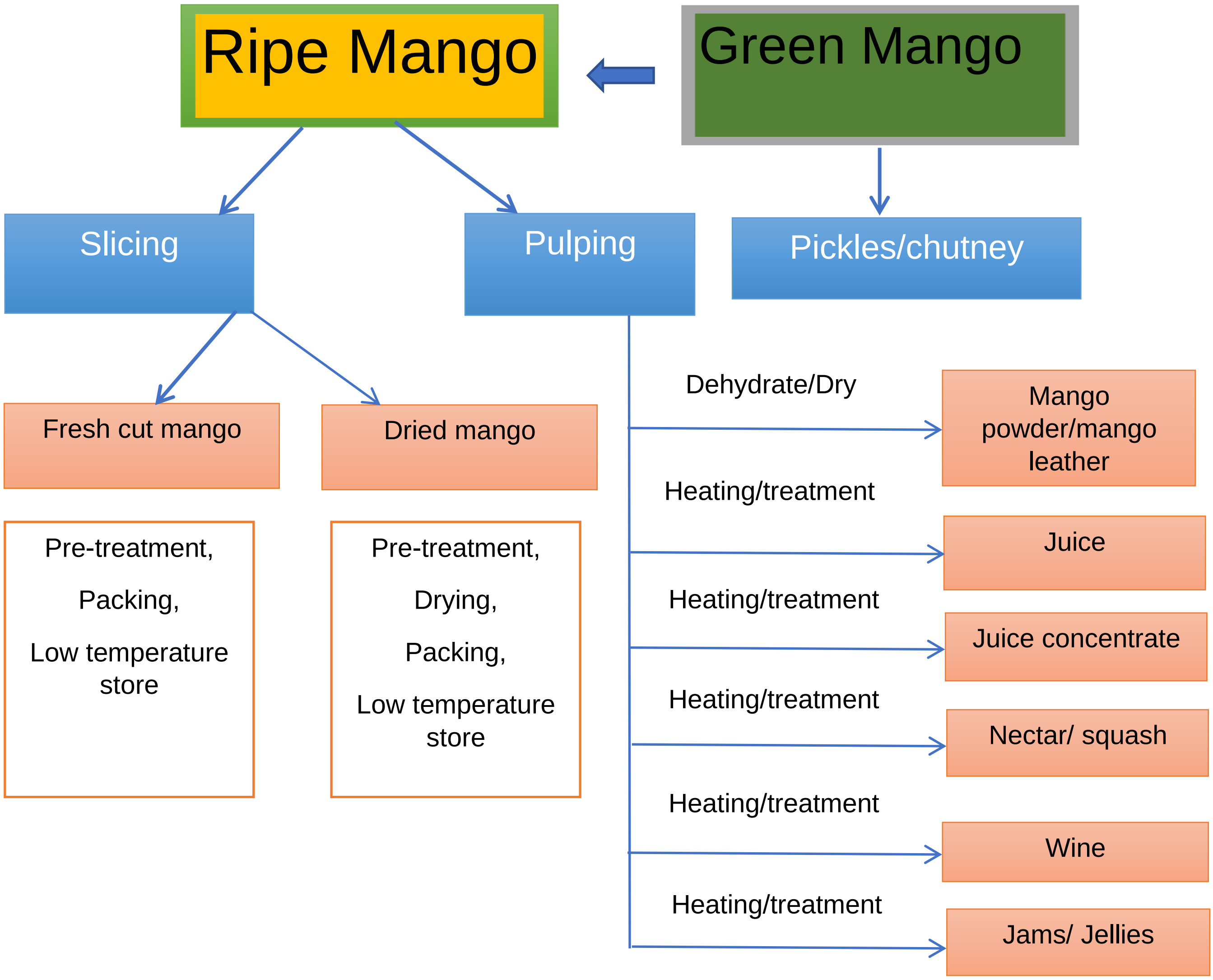


Figure 52: Mango value addition flow

Figure 53: mango value added products

6. Papaya Value chain

Introduction

Papaya (Carica papaya) Introduction on crop Papaya is a fruit plant that grows as herbs and belongs to the Carecacae family. It has a high economic value and is profitable to grow. Papaya contains the papain enzyme, which is very active and can speed up the digestive process, as well as protein, carbohydrate, and lipid content that the human body requires. Papaya is also used in traditional medicine, beauty products, and animal feed. In Sri Lanka, papaya is primarily grown as a home garden crop. Rathna and Red lady are the most popular varieties of papaya among the farmers. However, on a commercial scale, there is a limited extent that is steadily increasing, but there is no significant increase in production. The reason for these decreases could be due to some districts being infected with a virus in the wet zone. The Kurunegala district is the country's leading producer. The districts of Kalutara, Rathnapura, Gampaha, Galle, Anuradhapura, Puttalam, Hambantota, and Badulla all have commercial cultivations.

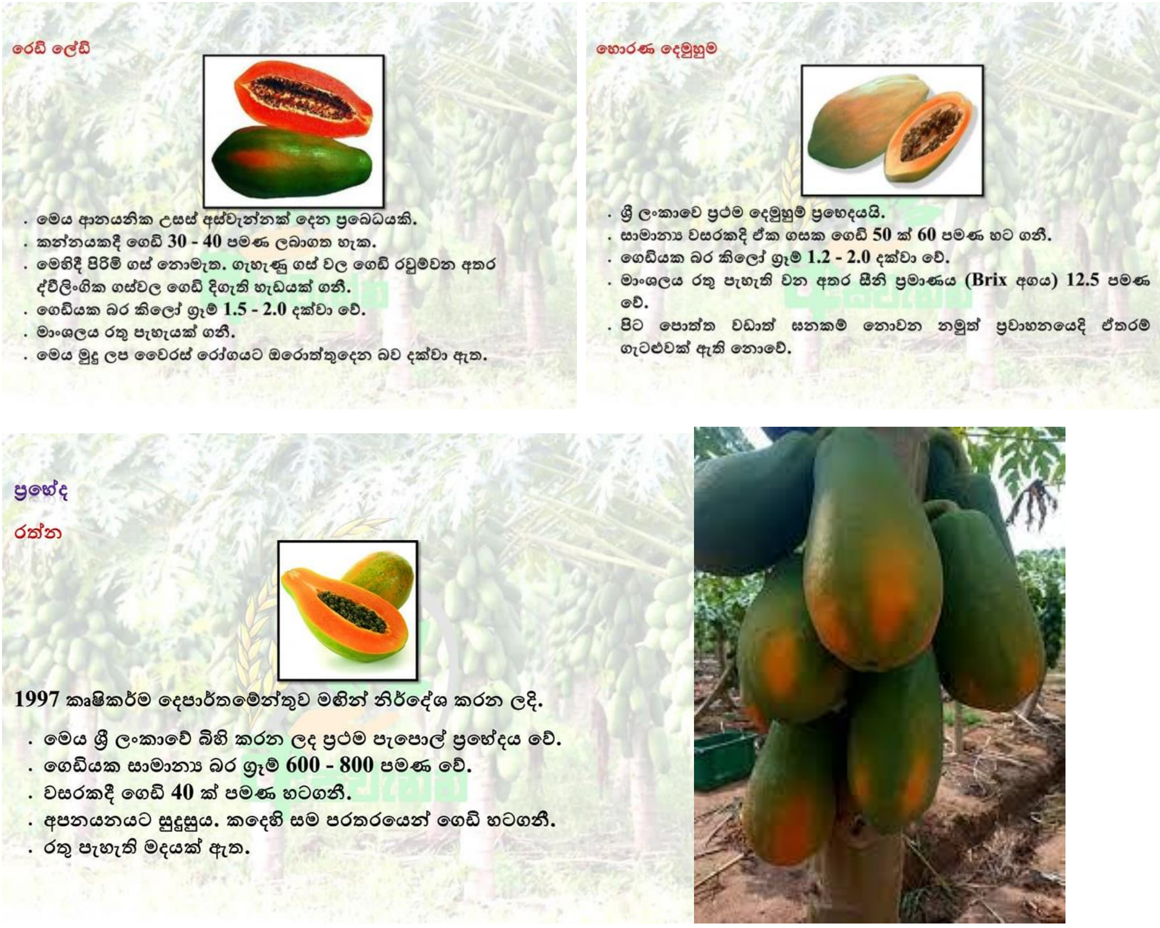


Figure 54: Papaya verities: Red Lady, Horana hybrid, Rathna and Tainung

Nature of the supply chain

The changing demand and supply conditions in the market, as well as many advances in transportation, storage, and information technology, have all contributed to the evolution of supply chains associated with the marketing of fresh fruit and vegetables. The financial and operational efficiencies gained by the partners in these supply chains can be attributed to the many changes that have occurred over time. The total amount of damage and perishing of fruits and vegetables in the supply chain is determined by the supply chain thread, as well as the method of handling, packing, and transportation. It was observed by selecting the papaya supply chain thread: farmer - collector - wholesaler - retailer - consumer.

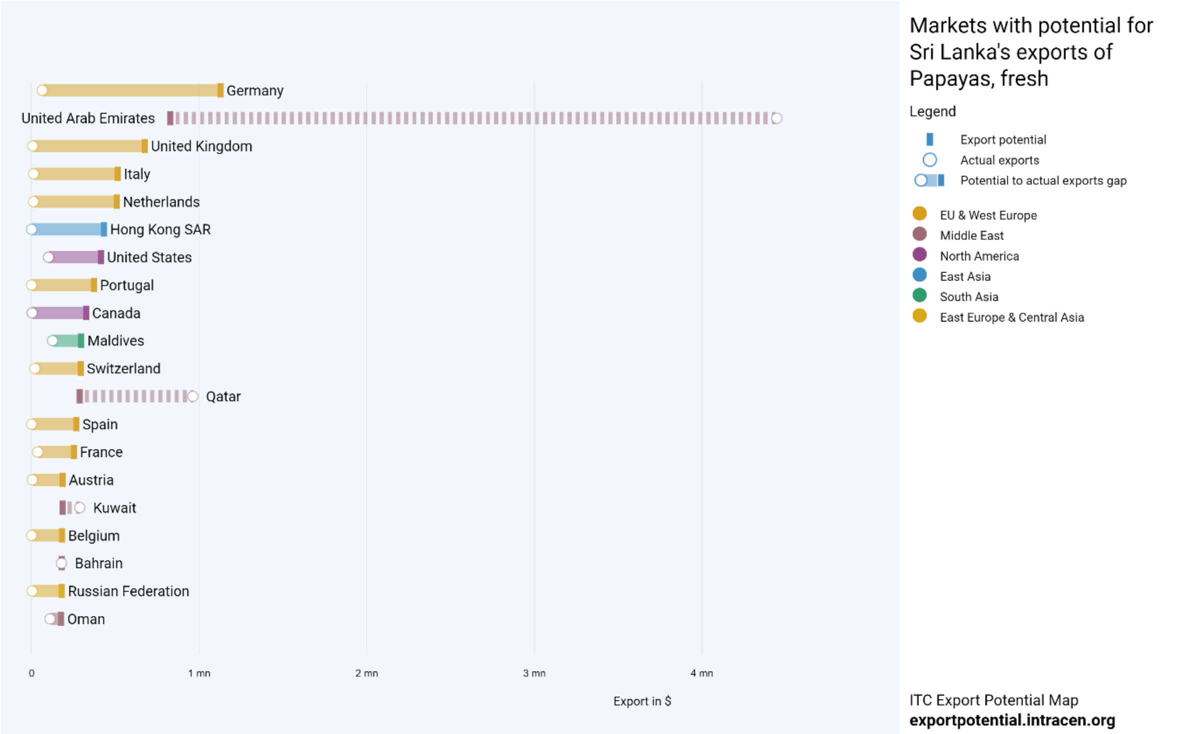


Figure 55: Export potential map for the papaya

In papaya, supply chain collectors are doing a major role by distributing papaya around the country. Collectors are collecting the harvest from papaya farmers in a particular area and distributed to the nearby economic center. Apart from that some farmers and few collectors used to transport papaya fruits to a particular processing plant or a hotel. Most of collectors having their own vehicles like Lorries and cabs Prices of the papaya would decide according to collaborative decision taken by main collectors. Furthermore, supermarket chain in Sri Lanka also establishes their centers in some parts of the country. Farmers in those areas used to carry their harvest directly to these collecting points. Here the farmers are getting benefit because of the short supply chain exists. Throughout the supply chain, actors used to transport papayas by wrapping in papers.

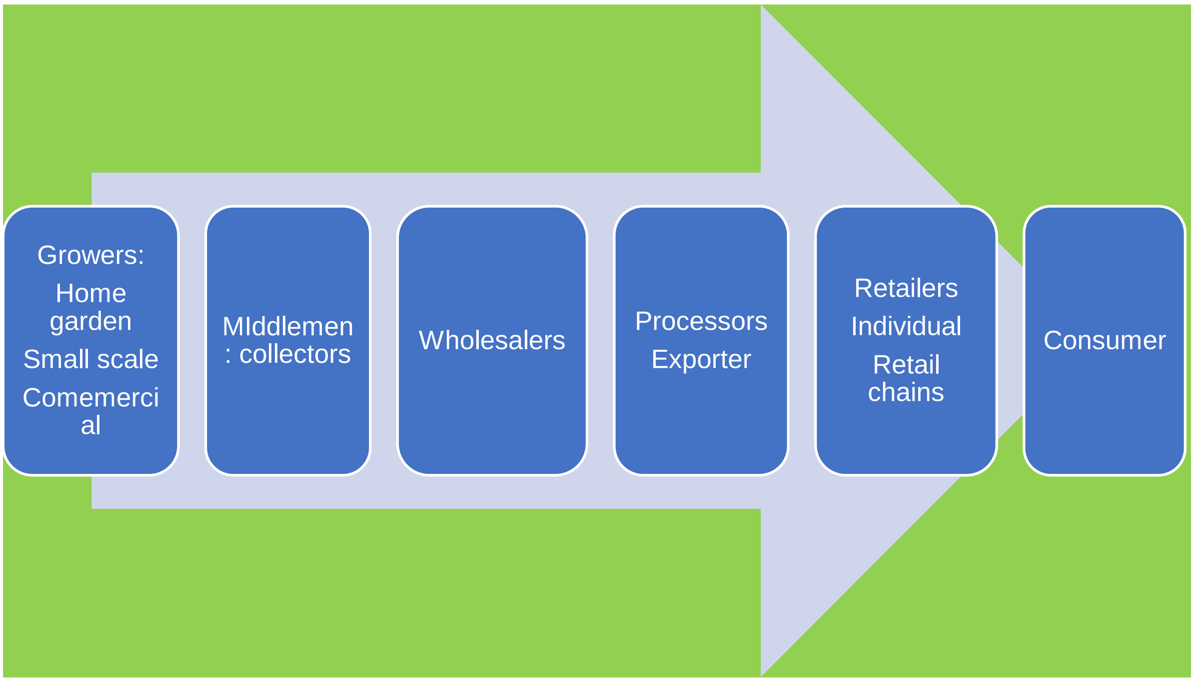


Figure 56: Papaya supply chain

Table 27: Profiling of the Papaya value chain actors

Grower/ Farmer Commercial Papaya growers/ companies	Managing agronomic practices, harvesting, handling and grading, packing 
Middlemen: collectors	Handling, transport and pack house operations 
Wholesalers	Handling, transport, storage, grading, packing

	
Processors Exporters	Handling, transport, storage, grading, packing Value addition and manufacturing value added products 
Retailers	Handling, transport, storage, grading, packing  
Consumers Individuals Institutors: restaurants/ hotels/ hospitals	Purchase, storage

Major cultivation areas are Anuradhapura, Hambantota, Matale, Kurunegala, and Ampara. The value chain actors are distributed mainly farmers in above mentioned cultivating areas and other intermediaries mainly in Colombo, Ratnapura, Hambantota, Matale and Polonnaruwa areas where most of economic centers and larger markers are available. In Colombo basically all the type of downstream actors can be seen. Measuring postharvest losses Maintaining the quality and safety of papayas as they travel from the farm to the market requires proper post-harvest handling. Over ripening, mechanical damage, and decay are all causes of papaya losses. Poor harvesting methods, rough handling, poor packaging, and poor transportation conditions are all to blame for these losses. If farmers are to benefit, these losses must be minimized. Good quality fruit and vegetables are increasingly in demand, and consumers are willing to pay for them. To ensure the quality of papayas, good post-harvest handling practices are required throughout the supply chain. The total amount of damage and perishing of fruits and vegetables in the supply chain is determined by the supply chain thread, as well as the method of handling, packing, and transportation. If plastic crates are used instead of cardboard boxes, total supply chain damages can be minimized or eliminated.

Drivers of Post-Harvest losses

Papayas lose water

Water makes up the majority of the fruit. The water lost during respiration cannot be replaced once it has been harvested. As a result, under low humidity conditions, the papaya fruit shrivels and loses weight, resulting in a loss of marketable weight. When the fruit is exposed to the sun, it loses a lot of water quickly.

Papayas are prone to decay

Papayas are also susceptible to organisms that cause decay (pathogens), which can cause them to deteriorate quickly. The pointed edges of large bamboo baskets with rough interior surfaces and pointed edges used for bulk packaging of papayas can damage the fruit. Pathogens can enter the fruit through damaged areas on the surface.

Papayas are prone to injury

Papayas are easily damaged. Their biological processes – respiration and ethylene production – accelerate when they are damaged, resulting in rapid deterioration. On the surface, the fruit may not appear to be damaged, but damage can appear later in the handling chain. Frequently, the damaged area does not change color.

Management of Post-Harvest Losses

At the ripe stage, papayas harvested at the proper maturity stage have good peel and pulp color, as well as a full flavor and aroma. Papayas are preferably harvested during midmorning to late afternoon to minimize latex stains on the fruit, which are unsightly and detract from consumer appeal. Harvesting papaya after it rains should be avoided at all costs, as the fruit will be more susceptible to decay. To protect the fruit from punctures and cuts caused by the container's sharp or protruding edges, collecting containers or field containers must be lined with clean paper or papaya leaves. It's worth noting that plastic crates are the best containers for collecting. Fruit that has been harvested must not be dumped on the ground. To avoid microbial contamination, papayas should not come into contact with the soil after harvesting. To avoid sun exposure, field containers and harvested fruit must be temporarily placed in the shade. Heat buildup from exposure to the sun causes water loss and can hasten ripening.

Pain Points in Papaya value Chain

Along with the changes in the supply chain, smallholder farmers are faced with several issues and challenges. Farmers receive lower price compared to wholesalers and retailers. The share of farm price to retail price has been generally decreasing over time. Because of a number of marketing layers along the chain, prices are inefficiently transmitted from the upstream to the downstream side of the chain. Prices are not integrated from one market to the other. This inefficient transmission of prices is an indication of distortion/market power along the chain. In terms of costs, marketing and production costs have been increasing over time. Despite the increasing productivity of farmers, production and marketing costs are increasing faster than the increase in price. This is due to inadequate logistics and infrastructure facilities and increasing fertilizer, pesticide and fuel costs. Hence, farmer's net earnings remain low. Increasing productivity and expansion of high value markets are some opportunities for smallholder farmers. High value markets offer a competitive price; however, they have stringent quality requirements.

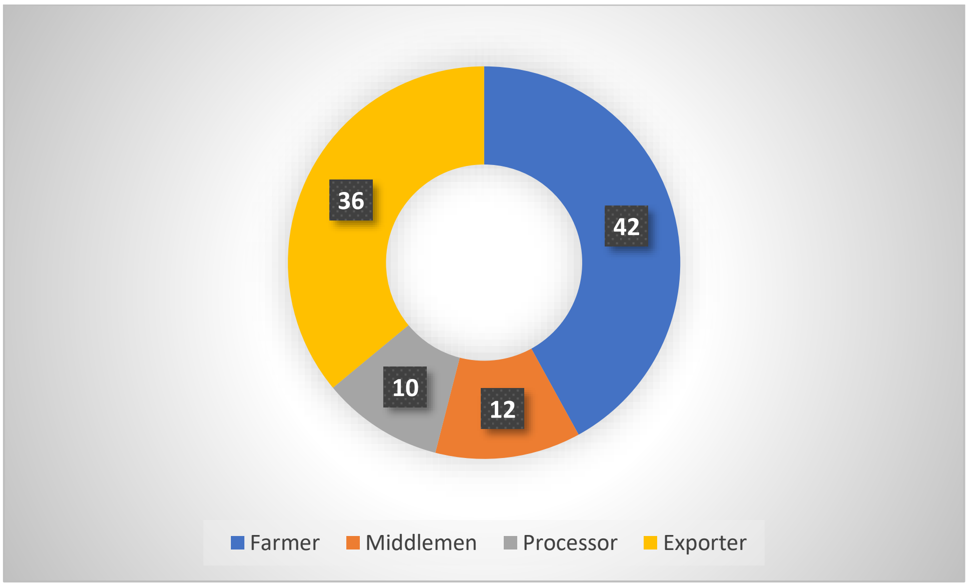


Figure 57: Income share (%) of the papaya value chain

7. Dry Chilli Cluster

Refer 2 of Chapter 3.1.2.

Feasible value chains developed for Vavuniya district given in table 2.

8. Maize Seed Production Cluster

Separate Feasibility prepared, submitted and approved.

3.2.3 Technological Analysis

3.2.3.1 Dry Chili Production

Chili cultivation in Vavuniya districts is around 400 – 500 hectares per annum (4% of national chili cultivation extent). Cultivation in Yala season is less than 50% of Maha season mainly due to dependency on rainfed irrigation. The green chili yield in both Maha and Yala seasons is maintained at around 1.2 ton/ha *(Department of Provincial Agriculture, 2010*).

The level of mechanization in dry chili production is still primitive. As per the records in year 2013, the cost on machinery usage is around 7% while the balance is for manual processing. *(Fedrick Abeyrathne and Hiroyuki Takeshima, 2013)*

3.2.3.1.2 Land Preparation

Already discussed under Kilinochchi district chili cluster.

3.2.3.1.3 Water Management

The water requirement for chili as an average is 4.50 mm/day. Required irrigation water capacity depends on application efficiency of selected irrigation method and soil condition (vertical and horizontal water penetration). The average annual rainfall in Vavuniya district from year 2010 to 2015 was 3.72 mm/day.

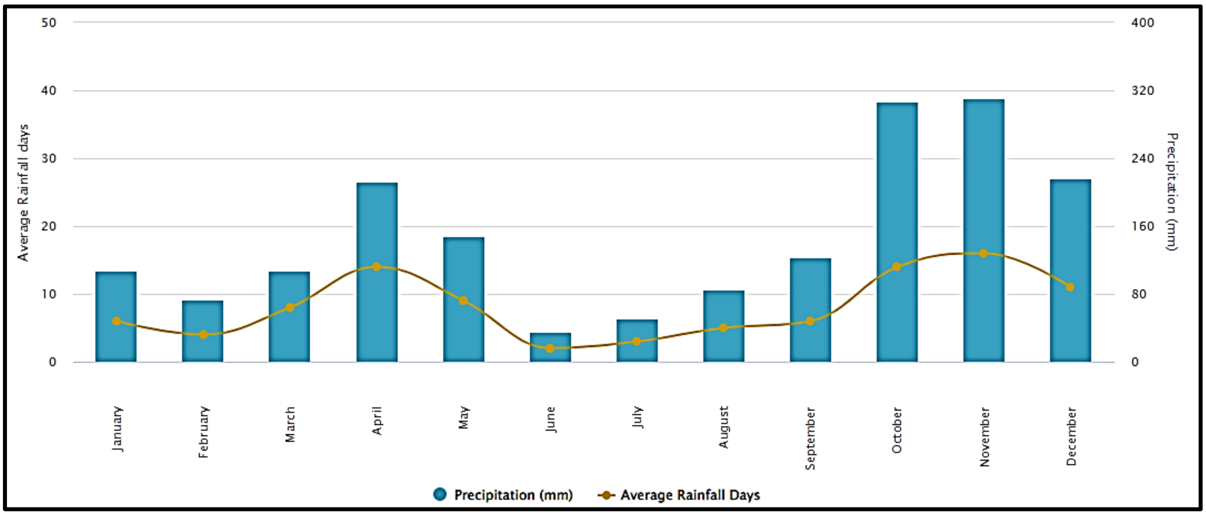


Figure 58: Monthly average rainfall in Vavuniya district

Source: [What is weather like in Vavuniya, Northern Province, LK (worldweatheronline.com)]

It is advisable to start chili cultivation in October. However, irrigation system with a reliable water source is a must as chili plant expose to dry weather from February to April and June to September.

Table 28: Effectiveness of Irrigation Methods for Chili cultivation

Irrigation Method	Surface Irrigation	Sprinkler Irrigation	Drip Irrigation
Water application efficiency	50%	70%	85%
Weed Pressure	High	Low	Minimum
Favorable for diseases	High	Low	Minimum
Required water pressure	Not applicable	High	Low
Fertigation	Not possible	Not always	Possible
Recommendation	Not recommended	Recommended if drip irrigation is not possible	Recommended.

Drip irrigation uses plastic tubing which is designed and manufactured with precision water emitters spaced at regular distances along the length of the tubing. The emitters are engineered to release a specific amount of water which is 2 l/h at 1 bar pressure. Drip tape can be practices but less durable compared to tubes. Water for drip irrigation systems must be free of solid particles which can clog the emitters. Thus, filtering systems are highly recommended.

The recommended drip irrigation system can be used to supply the required plant nutrients by using a fertigation unit.

3.2.3.1.4 Weed and Pest Management

The technological measures and approaches on weed and pest management are same as what we discussed under Kilinochchi chili cluster.

3.2.3.1.5 Harvesting

The technological measures and approaches on chili harvesting are same as what we discussed under Kilinochchi chili cluster.

3.2.3.1.6 Processing

Figure 59: Processing of Chilli

Process	Note on feasibility options
Drying	• Introducing a solar tunnel dryer for intermediate drying and initial withering. – Reduce required thermal load and minimize mould formation and spreading. • Either batch or continues type chili dryer. • Using electricity as the thermal power source will be convenient and cost effective for the farmer company. – Heat Pump

	• Having chili flattens system will reduce drying duration as well as texture shrinkages. • The desired moisture content at the dryer mouth is 8 % in w.b. • Inlet hot air temperature needs to be maintained at 50 – 60 ^{0}C. • Better to have a positive temperature gradient.
Grading & Sorting system	• Grading/sorting is based on pods colour and size. • Considering the current manual operation (hand picking), the investment on a colour sorter will be paid back within one year. (Kindly refer the workings under Kilinochchi district chili cluster) • Secondaries can be used for making chili powder, flakes or paste.
Packing & storing	• Jute, gunny or polythene bags can be used for packing depending on packing density decided by the selected marketing channels i.e., wholesale or retail marketing. • Ascertained storing bulk density of dry chili at 10% moisture is 18 kg/square feet at storing height of 6 feet. • The moisture content at the time pf packing should be around 8% - 10% in w.b. • An abounded building belongs to DOA in Vavuniya DSD, Palamoddai GN division has been identified to use as the chili processing centre after rehabilitating the same. • Designed features of chili processing centre have been discussed under Kilinochchi district chili cluster.

3.2.3.2 Mango (TomEJC) Cluster

3.2.3.2.1 Understanding the requirement of technical inputs.

Sri Lankan Mango production in year 2017 was 151,733 metric tons *(Source: DOA, Sri Lanka)* at an average yield of 2,150 kg per acre. In year 2010, Vavuniya district farmers have harvested 5,850 metric tons (around 4% of national Mango harvest) from 790 hectares recording a yield of 3,000 kg per acre *(T.A. Dharmaratne, 2014).*

Sri Lanka is targeting to produce 5,000 tons of TomEJC mango by end of the year 2022 from total plants of 60,000 in 650 acres *(source: A Fruitful Pursuit – Echelon).* Vavuniya TomEJC mango cluster has a potential of producing 4,000 tons of TomEJC mango from 300 acres which is par with current country production of TomEJC mango.

Providing pre-processing and storing facilities are the expected key technical interventions. The main issue that farmers are facing is higher post-harvest damage due to poor handlings and absence of storing facilities (cold rooms or refrigerator units).

3.2.3.2.2 Potential technical inputs for Mango (TomEJC) farming

Activity	Description
Land Preparation	Land should be prepared by deep ploughing by using mold board ploughs followed by harrowing and levelling with a gentle slope for good drainage. Planting density can be varied from 70 plants to 200 plants per acre. Intercropping is possible with less plant density.
Micro Irrigation	Drip or mini sprinkler irrigation facilities are possible. Annual water requirement is about 1000 mm. The water requirement differs with plant growth. 1st three months – watering 30 l per plant at every 3 -4 days. Watering is critical up to 3 years. However, irrigation is not recommended for 2-3 months prior to flowering as it is likely to promote vegetative growth at the expense of flowering.
General maintenance	Pruning after two months - Pruning kits needs to be provided. The fruit should be covered by using bag at the initial stage. This provides pest control and yellowish color.
Harvesting	Fruits should be plucked manually to a wooden or plastic crate. Fruit maturity period is 90 days.

3.2.3.2.3 Processing

As per designed value chain assessment, it is planning to sell the harvested TomEJC mango as fresh fruits. Processing of mango pulp and dehydrating have a potential market.

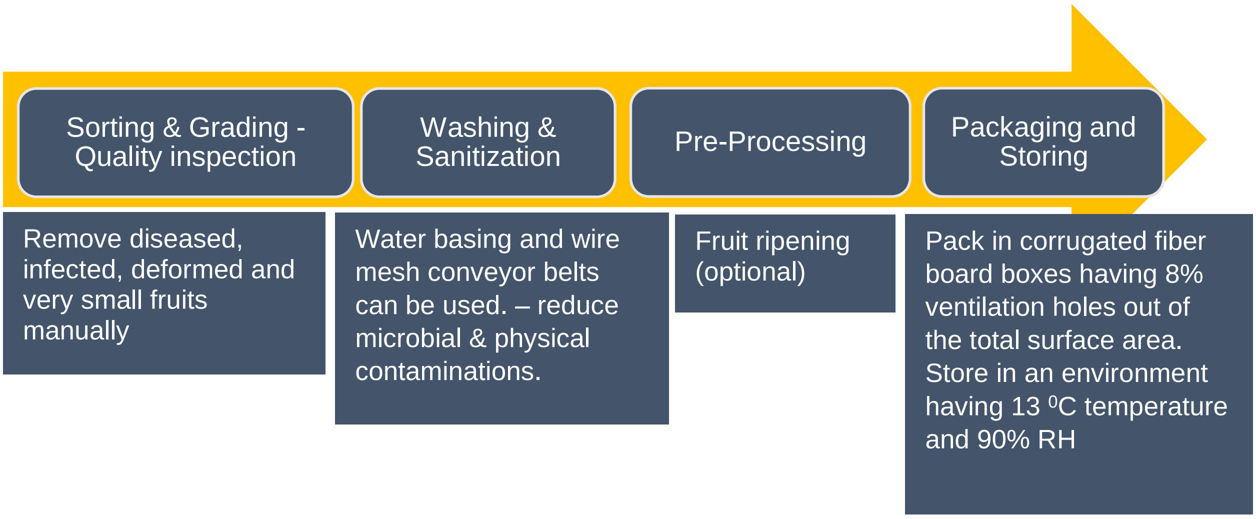


Figure 60: Processing of Mango

Note: Hot water treatment (HWT) where mature fruits are dipped for 5 to10 minutes in water heated to 52 ^{0}C-55 ^{0}C is recommended. HWT is considered as most effective post-harvest treatment against the main post harvest diseases of mango. It is revealed that post-harvest damage is about 20% in case of TomEJC mango.

Fruits can be ripened by exposing them to ethylene, which initiate the early and uniform ripening process.

It is going to check whether Individual quick frozen (IQF) technology can be adopted for increasing the shelf life of mango. Current shelf life of mango is about 2 – 3 weeks but with IQF it can be increased up to 2 years. The economic aspects on IQF technology needs to be further evaluated. For making mango pulp, the technology package discussed under Kilinochchi district passion fruit cluster can be followed.

During stakeholder meeting, it was discussed whether buyers can supply freezer trucks for transporting the harvest. Further discussions with buyers are to be conducted. Converting unusable container boxes to cold rooms is another potential option.

3.2.3.3 Papaya (Tainung) Cluster

3.2.3.3.1 Understanding the requirement of technical inputs

Sri Lankan papaya production in year 2017 was 86,219 metric tons *(Source: DOA, Sri Lanka)* at an average yield of 5,000 kg per acre. In year 2010, Vavuniya district farmers have harvested 4,039 metric tons (around 5% of national papaya harvest) from 278 hectares recording a yield of 5,812 kg per acre *(T.A. Dharmaratne, 2014).* There are new varieties and planting technologies to increase the yield even up to 40 tons per acre. Technological interventions are required to minimize post-harvest loss and increase the shelf life.

3.2.3.3.2 Potential technical inputs for papaya farming

Activity	Description
Land Preparation	Land should be prepared by ploughing followed by harrowing and levelling with a gentle slope for good drainage. Planting density can be varied from 550 plants to 800 plants per acre. Intercropping is possible with less plant density. Dig size is 45 cm x 45 cm x 45 cm. Mamoties and crowbars can be used for digging planting holes.
Micro Irrigation	Mini Sprinklers, Drip or spray jet irrigation facilities are possible. Annual water requirement is about 1600 mm to 2000 mm (4 mm to 5mm per day). Watering needs to be done in weekly in the absence of rain. Furrow and ring irrigation methods can be practiced in areas where water is readily available. Water should not come in direct contact with papaya stem.
Harvesting	Manual plucking until the plant height is manageable. Once the plant becomes too tall to reach the papayas, a fruit picker or hoe may be used to pull down the fruit. All papaya fruits were packed in plastic crates stem-end down.

3.2.3.3.3 Processing

As per designed value chain assessment, it is planning to sell the harvested Papaya as fresh fruits. Processing of Papaya pulp and dehydrating have a potential market as well.

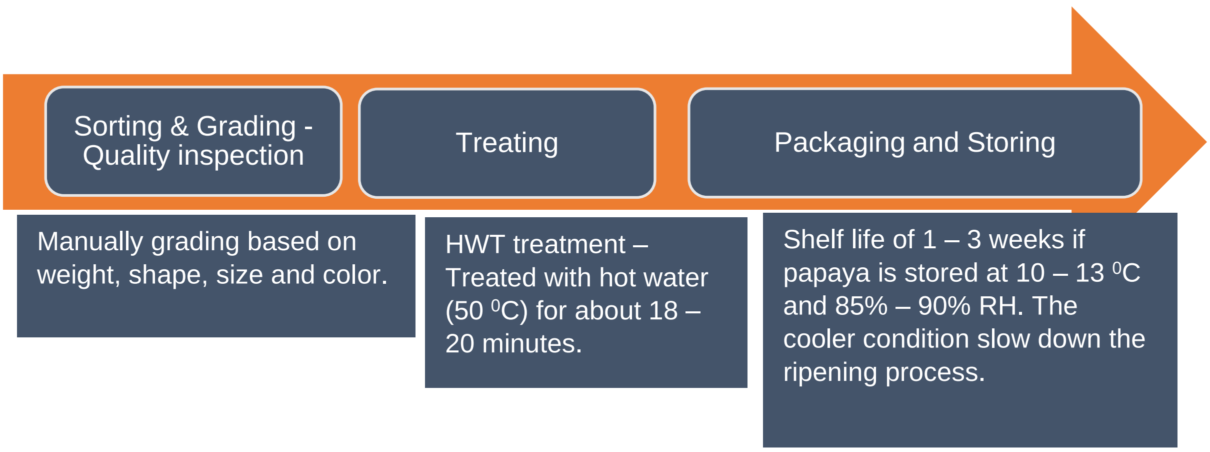


Figure 61: Processing of Papaya

Note: Papaya can be packed with a plastic foam packing net to minimize the post-harvest damages during transport. Postharvest loss of papaya is reported to be 46% (*K.H. Sarananda, S.T. Balasuriya and K. Ganeshalingam, 2004).* Mechanical damages caused during harvesting and transport and postharvest diseases are the major causes for the said loss.

Table 29: Shelf life of papaya

	Room Temperature	**Cold condition**
Unripe Papaya	1 – 7 days until ripe	
Ripe Papaya	2 – 3 days	5 – 7 days, can be increased up to 2-3 weeks by freezing or refrigerating.
Cut Papaya		2 – 3 days

3.2.4 Analysis on physical infrastructure

<table>
<tr><th>Physical Infrastructure Requirement</th><th>Note on feasibility options</th></tr>
<tr><td>Access roads</td><td>
As per the filed visits undertaken to pilot clusters and potential lands for new clusters and expansion of existing clusters, the required access roads rehabilitation is minimum. Concrete and gravel roads were seen more frequently. Gravel roads are proposed based on necessity and its impact to the cluster/s.

Road Kilometrage by Province and District 2019
<table>
<tr><th>Province/ District</th><th>Class A</th><th>Class B</th><th>Class C</th><th>Class D</th><th>Express-ways</th><th>Total</th></tr>
<tr><td>Northern</td><td>734</td><td>525</td><td>1,973</td><td>161</td><td>-</td><td>3,393</td></tr>
<tr><td>Jaffna</td><td>381[a]</td><td>277[a]</td><td>544</td><td>45</td><td>-</td><td>1,621[a]</td></tr>
<tr><td>Kilinochchi</td><td></td><td></td><td>335</td><td>39</td><td>-</td><td></td></tr>
<tr><td>Mannar</td><td>113</td><td>92</td><td>309</td><td>26</td><td>-</td><td>540</td></tr>
<tr><td>Mullaitivu</td><td>113</td><td>103</td><td>390</td><td>17</td><td>-</td><td>622</td></tr>
<tr><td>Vavuniya</td><td>128</td><td>54</td><td>395</td><td>33</td><td>-</td><td>609</td></tr>
</table>
Class A – Roads connecting national capital with provincial capital.
Class B – Minor roads connecting other important towns
Class C – Agricultural and local roads (12 ft width)
Class D – Graveled roads (8 – 10 ft)
Sources: RDA and PRDA
</td></tr>
</table>

Water Irrigation System

It is proposed to provide micro irrigation package for all farmers as described under each crop category. The main water sources and water supply methods up to the selected/potential lands

1. There are 756 village tanks that comes under minor irrigation. Out of that 80 tanks are inter-connected.

Agrarian Service Centre	No. of interconnected tanks
Cheddikulam	16
Pampaimadhu	16
Kovilkulam	05
Madukanda	04
Nedunkerny	07
Omanthai	17
Ulukulam	07

Province	Major Schemes		Medium Schemes		Total Extent (ha)
District	No of Schemes	Extent (ha)	No of Schemes	Extent (ha)	
North	**4**	**15,011**	**57**	**29,527**	**44,538**
Jaffna	0	-	0	-	-
Kilinochchi	0	-	9	13,831	13,831
Mannar	2	12,461	9	2,407	14,868
Vavunia	1	1,674	19	2,854	4,528
Mullaitivu	1	876	20	10,435	11,311

Minor Schemes

Province	No of Irrigation Schemes				Extent (ha)		
	Working		Abandoned		Working		
District	Tank	Anicut	Tank	Anicut	Tank	Anicut	Total
Vavunia	453	12	101	1	10,429	224	10,653
Mullaitivu	129	3	4	0	2,885	112	2,997

2. Agro wells – It is persuaded to use common agro wells. However, it is not recommended to construct agro wells but pumping facility can be given to the existing agro wells based on its absolute necessity.

   Summary of District Wise Distribution of Groundwater Aquifers

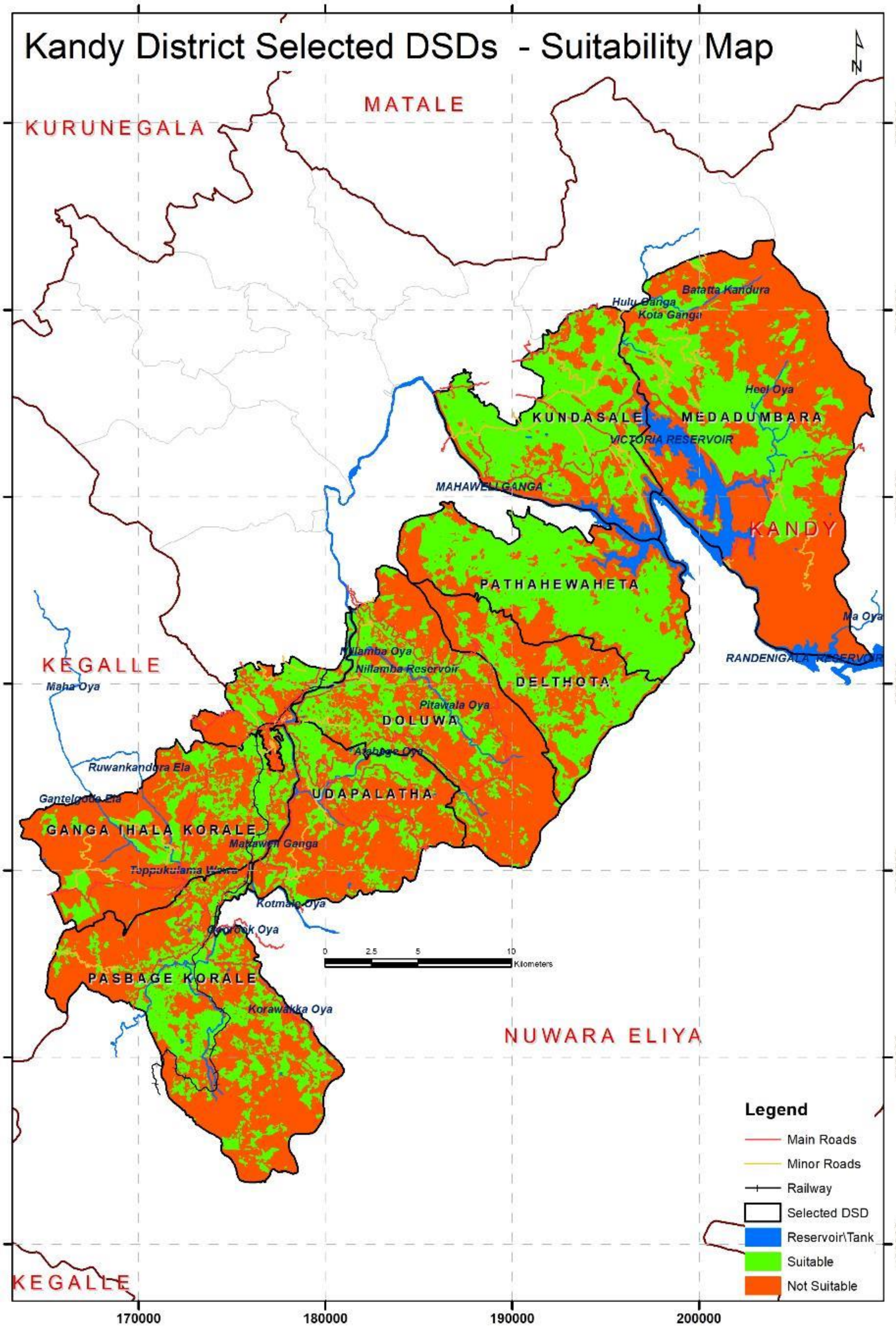
Province District	Total Area (ha)
North	**893,743**
Jaffna	100,996
Kilinochchi	135,089
Mannar	199,756
Vavunia	200,428
Mullaitivu	257,474

Source: The Preparatory survey on the project for improvement of agricultural production and productivity in dry zone areas in Sri Lanka

	More depends on minor irrigation schemes. Rainfed cultivation is about 45%. It is important to invest on water conservation practices – micro irrigation, rain water harvesting …etc. Due to availability of tanks, the water bed may be at an upper level. Thus, installation of tube wells is an option. Inter connected tanks increases water utilization factor.
Protecting farmlands from wild elephants	Electric fences and other destructive measure are not going to promote. Instead of that bio fencing (Lime cultivation with honey bees, cultivating thorny plants…etc) and using splashing lights are proposed.
Processing Centre	The processing centre needs to be designed based on machinery and production process flow required to meet the agreed value chain assessment and product certification. It is more focus to rehabilitate and use abounded government building rather than construction of new buildings. Depending on distance from farmlands to the processing centre and usability of same machineries, a common processing centre for few crop clusters can be established. A government building belongs to DOA for chili processing has been already identified. Below mentioned component are to be included in a processing premises. - Crop receiving, weighing, acceptance and pre-treatment section. Washing, intermediate drying or cooling and initial sorting are considered as pre-treatment. - Processing Section – Machineries are to be installed considering the productivity, worker convenience, effective process flow and space availability. - Storing facility – Pest control measures, proper ventilation, maintaining of required temperature and RH are going to be considered in order to enhance shelf life of products. Vavuniya district has commercial storing facility belongs to the food commissioner for rent. The said storing capacity is 1100 mt. Auxiliary buildings • General Office with facilities for meetings and training sessions. • Marketing Outlets • Worker sanitary facilities • Compost making facilities

	• Machinery maintenance section • Store room – Manging inventory Rooftop solar power generation under "Net Plus" scheme is proposed. This will reduce the operation cost and ensure the operation of critical processing steps even at a power outage.

3.3 Kandy District



3.3.1 Agricultural Analysis

Analysis method as same as Kilinochchi and Vavuniya districts but the results are different up to a certain extent. Kandy district has different agro-ecological zones as in Table 31. Intermediate upcountry (IU), Intermediate mid country (IM), Wet zone Mid country are the agro ecological zones in the Kandy district. Rainfall pattern and soil types also completely different to the previous districts. Therefore, a large range of crops can be cultivated in country.

Table 30: Current practices and remedies to overcome drawbacks

Crop	Current Practices	Remedies suggested	Ultimate achievement
Bana (Ambun) – Ceylon Cavendish	Just remove plants from bushes and plant at different place. If they have disease like Panama just forget about the plantation.	Bring down planting materials from separate district and maintain a nursery at isolated place. Introduce soil analysis and proper trainings on maintenance.	Maintain plantation without diseases and assure the potential yield and customer expectation.
Cassava	Plant using traditional method.	Introduce high density planting and proper watering system ridge and furrow planting method. Address to the crop physiology to get better export quality tubers.	Assure the potential yield and high-quality expectation.
Avocado (Hass)	Commercial cultivation not available.	Introduce a model farm easily encourage farmers to follow the correct practices.	Achieve the potential yields and expected quality.
Chili	Area selection and land selection procedure was very poor and not used any secondary data or stakeholder meetings. Trainings not given for any aspect of agricultural practise.	Use appropriate techniques to select area and lands. Introduce proper training module.	Achieve potential yield and expected quality.

Table 31: Agro-ecological analysis of Kandy district

DSD	Agro ecological zone	Rainfall - mm	Soil type	Terrain
Doluwa	WM2a, WM2b, WU2a, WU2b, IU2	2100 - 2400	RYP, Mountain Regosol & Lithosol	Mountainous, steeply dissected, Hilly & Rolling.
Pasbagakorale	WM1a, WM2a, WU1	3100 - 3300	Semi prominent A1 horizon, RBL, RYP	Steeply dissected, Hilly & rolling.
Udapalatha	WM2a, WM2b, WU2b	1800 - 2200	Semi prominent A1 horizon, RBL, RYP	Mountainous, steeply dissected, Hilly & Rolling.
Madadumbara	IM1c, IM3a, IM3c, IU1, WM3b	1300 - 1400	RBL, LHG, Immature Brown Loam	Very steep & Hilly, rolling, undulating, steeply dissected.
Yatinuwara	WM2b, WM3a	1600 - 1800	Semi prominent A1 horizon, RBL, RYP	Steep Hilly & Rolling.
Ganga Ihala Korale	WM1a, WM2a, WM2b, WU1, DL1b	900 - 3100	RBE, LHG, semi prominent A1 horizon	Undulating, Mountainous, steeply dissected, Steep, Hilly & Rolling
Pathahewahata	IM3a, IM3c, IU2	1200 - 2100	RBE, LHG, RB Latasolic, IB	Steeply dissected, hilly and rolling, mountainous.

According to the table 31 different DSDs of Kandy district has different soil types and Rainfall patterns. That means the vegetation of the area must be different according to the soil types and rainfall patterns. Therefore, the crop cultivation of district may be varied in different DSDs.

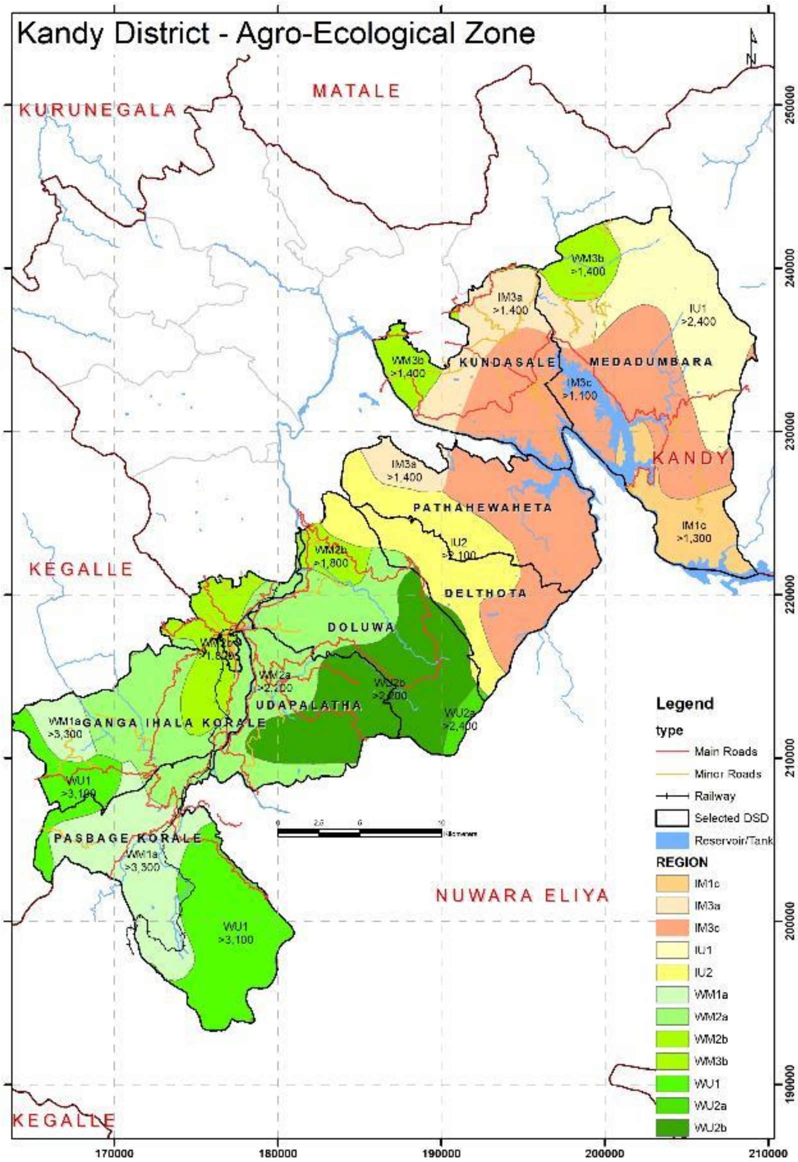


Figure 62: Kandy District Selected DSDs Agro-Ecological Region Map

3.3.2 Agri-business and Value Chain Analysis

9. Chili value chain

Refer 2 of Chapter 3.1.2

10. Banana value chain

Introduction

Banana (Musa spp) is a fruit crop which possesses major economic importance in all around the world. It is the fourth most important crop of the food market next to rice, wheat, and maize (Food and Agriculture Organization Statistical Division). This makes banana the prime leading fruit crop in terms of volume and value in the global market (Girma, Eweg, & Albertien, 2020). It is widely grown in tropical countries including Sri Lanka and has a higher consumer demand.

The ripened banana fruit is affluent with protein, minerals, vitamins and energy. The banana fruit is mainly priced for its satisfactory sweet taste as well as its medicinal values. Considering the area cultivated, production and consumption banana is the most prominent fruit crop grown in Sri Lanka (Kudagamage, Chandrasiri, & Razmy, 2002). Nearly 50,000 ha of land are uses for banana cultivation in Sri Lanka. The annual production of those areas is approximately about 450,000 metric tons (Wasala, Dharmasena, Dissanayake, & Thilakarathne, 2015). One of the reasons for its attractiveness for Sri Lankan farmers is its high economic gains throughout the year (Hirimburegama, Dias, & Hirimburegama, 2004). Although bananas have the largest cultivated area among fruits cultivation it is mainly grown on small subsistence farms which are less than 0.25 ha. (Ranathilaka, Lashmi, & Atukorala, 2017).

In Sri Lanka there are 29 banana varieties and 2 wild species. Five of those are cooking types and the rest except the two wild species are dessert types. Dessert banana varieties in Sri Lanka can be included in to three main groups. They are Mysore, the Kolikuttu, and the Cavendish. The ever-popular Ambul and Seeni bananas belong to the Mysore group. Kolikuttu, Suwendel, Puwalu, and Rath kehel banana verities are included in the Kolikuttu group and Anamalu, Embon, Bin kehel, and Nethrapalam come within the Cavendish group (Weerasooriya, 2016).

Importance of promoting the value chain

Banana plays a major role in food security in most countries and also banana production provides households with regular income throughout the year. Therefore, it is important to analyze and promote the banana value chain. The importance of value chain analysis has emerged with the changing agricultural environment in the rural sector as a result of rural to urban migration and the changing food habits and needs of the consumers (Hathurusinghe, Vidanapathirana, Rambukwella, & Somaratne, 2012).

Commercial agriculture is the most comfortable path to achieve the goals related to agriculture commodities. (Hathurusinghe, Vidanapathirana, Rambukwella, & Somaratne, 2012). It is not differentiated from bananas. It is vital to link small scale banana farmers to other value chain actors and institutions to achieve their maximum capacity of production. This step will widen up the market for small scale banana farmers. Other value chain actors will consider the aspects such as production, transport, processing and storage. When all the actors and activities within the vale chain are integrated properly it is called the value chain approach of banana production.

Common issues characterizing the banana value chain

Bananas grow in a particular area by farmers are distributed in to other parts of the country through collectors, whole sellers, retailers and the transporters. Farmers sell their banana produce collectors. Collectors collect the fresh banana produce from one or more farmers and then sell them in to whole sellers in whole sale markets. Then whole sellers sell the produce to retailers. Finally, consumers buy fresh banana produce from retailers. In between each value chain actor there are transporters. But there is no definite flow of produce along the value chain as mentioned above. According to (Wasala, Dissanayake, Dharmasena, Gunawardane, & Dissanayake, 2014) some farmers do not sell their produce to collectors directly. They transport banana produce directly to the whole sale markets or retailers. Some wholesalers in the value chain act as bulk transporters. Some consumers tend to buy the fresh products directly from farmers.

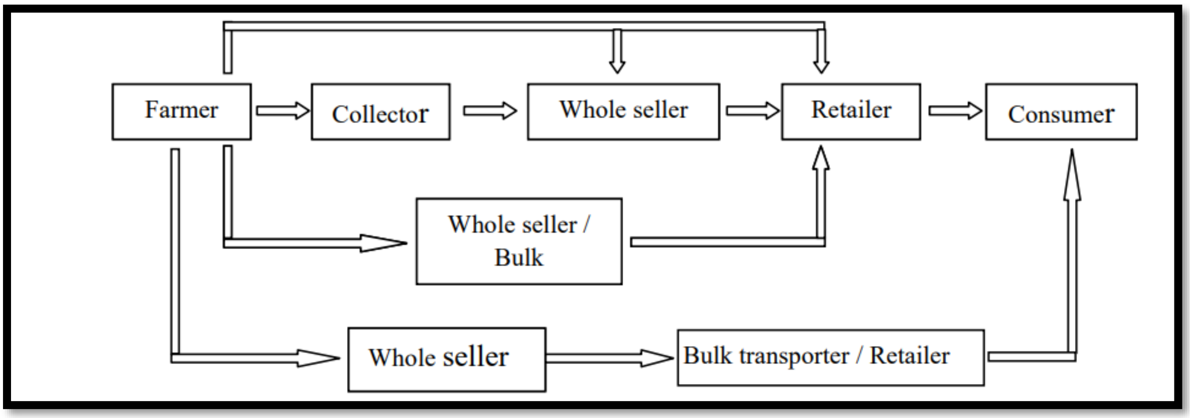


Figure 63: Banana value chain map

Value chain actors maintain own strategies to market their produce. Some banana farmers take their banana bunches to the closest economic center for sale without selling them to intermediaries. Very small proportions of banana farmers who are benefited with their own logistic services take their banana produce outside of their districts and rests are selling their produce within their own district. (Wasala, Dissanayake, Dharmasena, Gunawardane, & Dissanayake, 2014).

When considering the transportation of the produce, some farmers use manual methods whole banana bunches to the village markets/fairs, etc. In general, most of them use own or rented vehicles to reach distant markets. (Wasala, Dissanayake, Dharmasena, Gunawardane, & Dissanayake, 2014). According to (Wasala, Dissanayake, Dharmasena, Gunawardane, & Dissanayake, 2014) majority of the small-scale banana farmers prefer to sell banana as the whole bunch. The reasons given by them were that it is easy to transport, easy to sell and buyers can easily inspect the whole bunch before purchasing.

Fresh banana bunches are stacked horizontally one over other when they are being transported. Farmers use banana leaves as cushioning material around bunches but mostly in between layers of bunches. More experienced farmers prefer to use fresh leaves over dry leaves because the dry leaves may cause abrasion damages on fresh fruit surface. Banana is a relatively highly perishable fruit and therefore its post-harvest losses are high. These post-harvest losses happen during handling of the fresh produce and transportation in the supply chain.

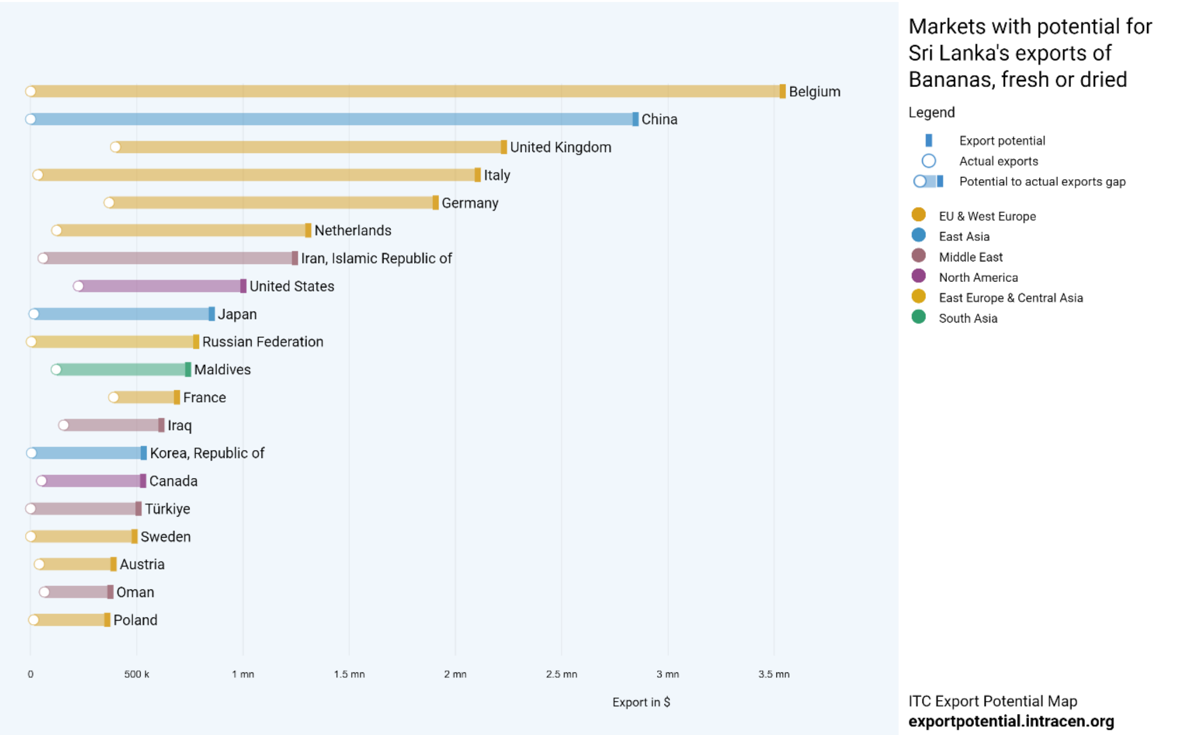


Figure 64: Export potential map of banana for the main markets

Banana value chain analysis

Banana value chains are quite short and complex. It is composed of upstream and downstream which small and medium scale banana farmers are the main actors in upstream and in downstream intermediaries with multiple roles are the main actors which connect banana farmers to consumers. (Weddagala, et al., 2016).

Banana farmers can be included in to three main groups. They are small scale; cultivated land is less than 1acre, medium scale; land is 1-5 acres, large scale; land is more than 5 acres. According to the size of operation, volume of banana production, banana variety, investment and network size can be varying. (Hettiarachchi, De Silva, & Karunaratne, 2020).

Value chain analysis of fresh Kolikuttu

As mentioned in (Hathurusinghe, Vidanapathirana, Rambukwella, & Somaratne, 2012) the value chain for fresh Kolikuttu in Sri Lanka can be divided in to four areas. They are, land preparation, planting, plant maintenance and harvesting. The total cost of production of Kolikuttu is Rs.18.18 per kg and the total cost is divided according to the relevant characters in these four sectors. Land preparation, planting, plant maintenance and harvesting were Rs.3.26, Rs. 4.43, Rs.8.80 and Rs.1.67 per kg respectively (pre-economic crisis era).

Figure 65: Value chain of cost of production of kolikuttu variety (Hathurusinghe, Vidanapathirana, Rambukwella, & Somaratne, 2012)

Out of the total cost of production, highest costs are for labour (61.3%) and plants (17.5%). The cost of Kolikuttu plants was 17.49% out of the total cost. Labour cost was 4.34% out of the total cost and fuel was 0.44% and other costs were 2.09%. Plant maintenance was divided into two major areas such as material inputs and labour. Material input cost includes fertilizer and pesticides and it was 10.5 %percent of the total cost of production. For the plant maintenance labour cost was 37.9 %t of the total cost. Harvesting cost includes only labour cost and it was 9.31 %t of the total cost.

In pre-economic crisis era farmer's price for 1kg of Kolikuttu was Rs.60.00. Collector's price was Rs.80.00, Wholesaler's Rs.100.00 and retailer's Rs 160.00. According to the cost breakdown the highest gross margin was kept by the retailer and it was about 33 % of the retail price. Producers' profit margin was about 25 % and the collectors' profit margin was about 11 %. In the trading sector the highest investment was by the collector who visits farmers and village fairs (Pola) to purchase banana. In addition, he sometimes distributes banana throughout the country and he has to wait 50 about two three months to collect his return from other traders. But he has to pay for the small-scale producers at the time he purchases banana. At the field level the transport and handling cost was about 01 %percent and in the urban areas it was around 03 - 04 % of the retail price. The cost in the urban area is higher mainly due to higher labour cost and higher fuel wastage incurred in distributing produce to the retail outlets.

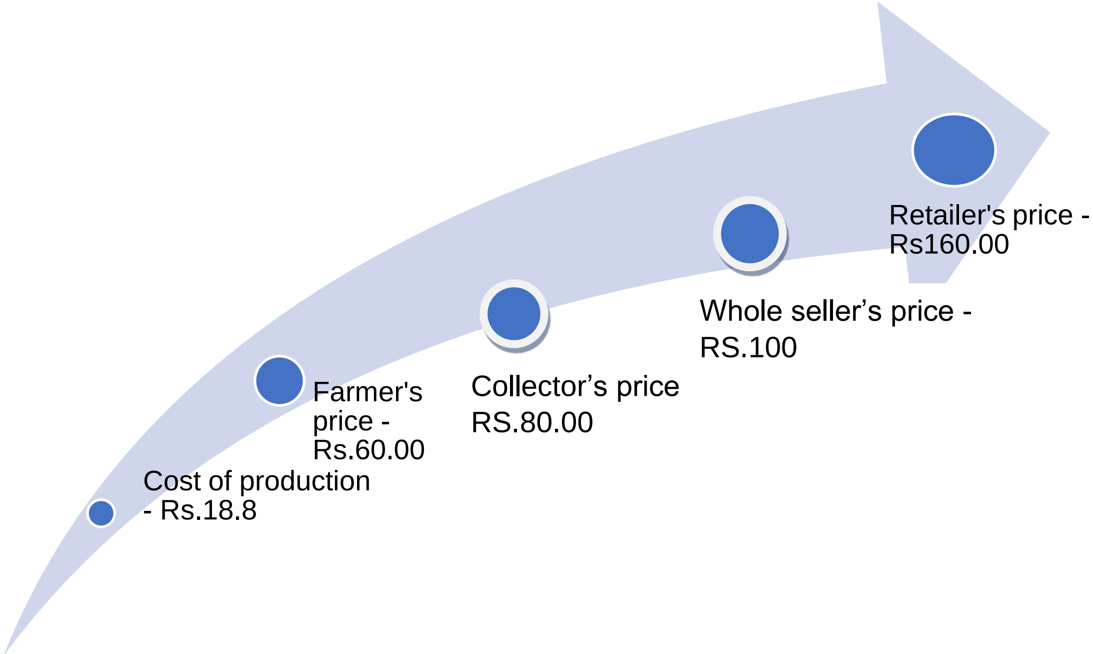
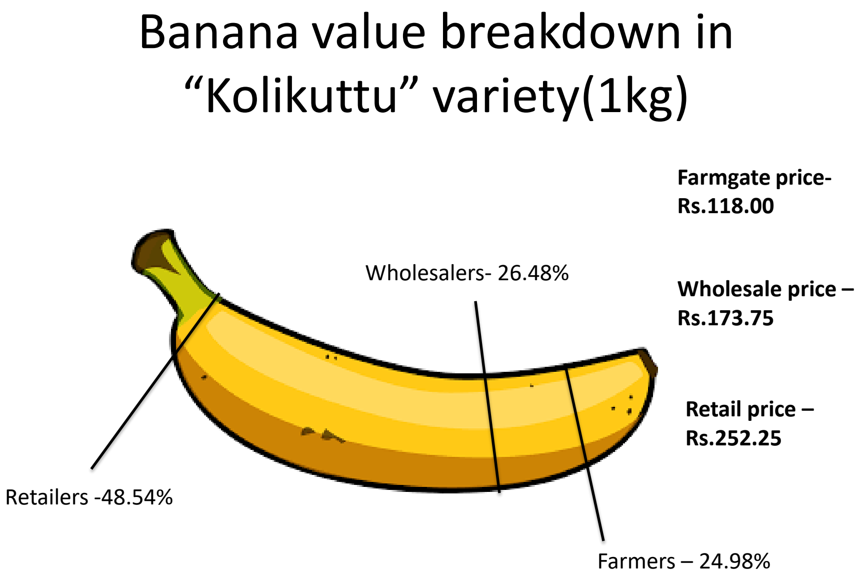


Figure 66: Value chain of Kolikuttu variety

Income distribution of Kolikuttu variety within value chain actors



Value chain analysis of fresh “Ambul” banana variety

Just as in Kolikuttu variety the value chain of Ambul banana can be divided in to land preparation, planting, plant maintenance and harvesting. Land preparation cost was Rs.2.80 per kilo. Planting, plant maintenance and harvesting were Rs.0.62, Rs.4.78 and Rs.0.24 per kilo respectively. Accordingly, the total production cost was Rs.8.44 per kg.

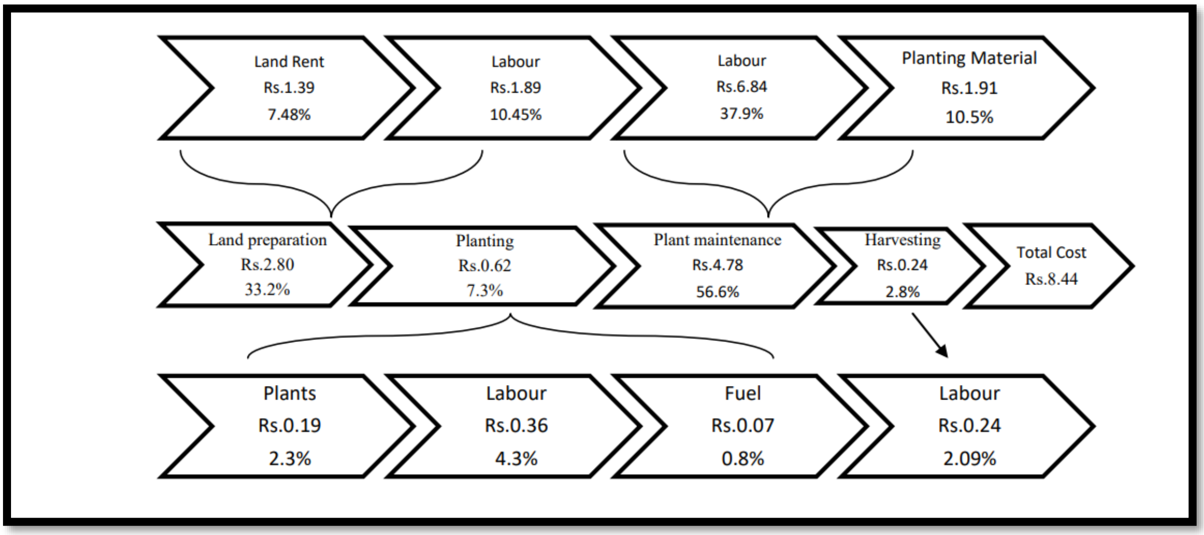


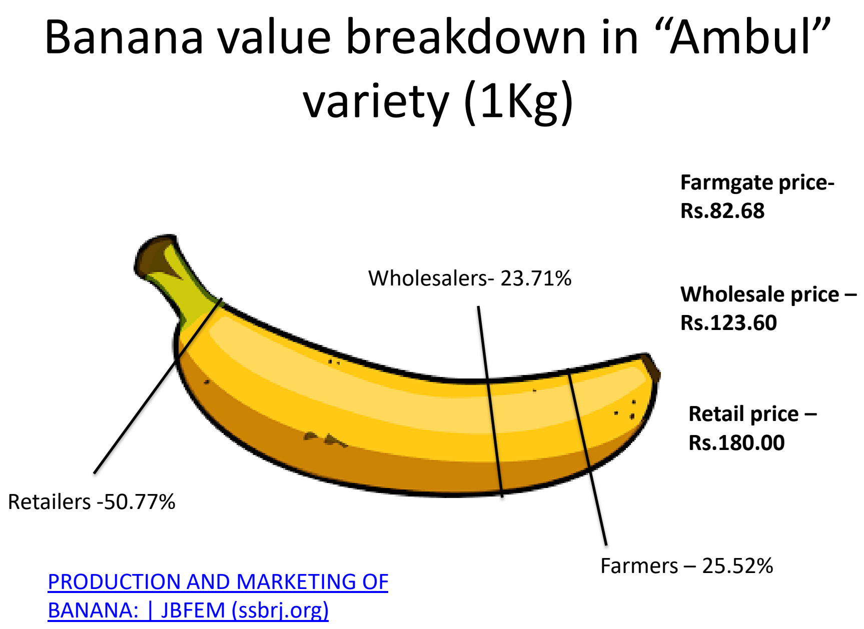
Figure 67: Value chain of cost of production of Ambul banana variety

The highest cost of ambul banana production is for plant maintenance. (Over 50 %) Nearly 90 % of the total cost is for land preparation and the maintenance of the plantation. The cost of land preparation is about 33 % and that of plant maintenance was 56.6 %t of the total cost. The cost for planting and harvesting was about 7 and 3 % of the total cost. The highest cost involved for land preparation was for land rent followed by labour and these costs were about 20 and 13% of the total cost. Of the land preparation cost about 62 % is spent for land rent and 40 % spent for labour. About 71 % of the plant maintenance cost was incurred for materials such as fertilizer, chemicals especially for weed control and equipment. This was about 40 percent of the total cost of cultivation and the highest cost reported for ambul banana cultivation. The second cost component was labour and it was about 30 %of the total cost of production.

In pre-economic crisis era farmer’s price for 1kg of Ambul was Rs.20.00. Collector’s price was Rs.25.00, Wholeseller’s Rs.40.00 and retailer’s Rs 60.00. The total value addition of ambul banana is about Rs.51.56 per kg. Producers’ profit margin was about 18 % and their transport and handling cost was only 01 % of the retail price.

Figure 68: Value chain of Ambul variety

Income distribution of Ambul variety within value chain actors



Cavendish banana group

Cavendish banana group is considered as the most popular and widely consumed banana group in Sri Lanka. Ambun and Anamalu varieties which belong to Cavendish group are cultivated majorly for the exporting purpose. Therefore, these banana varieties are relatively expensive than other varieties. Ambun is a dessert banana variety which possesses excellent qualities. It is large in size than other varieties and curved than other varieties. Its skin is relatively thick and light green when it is unripe and then turns deep yellow at full ripeness. Anmalu is a long banana variety and a local favorite. It has slender, curved shape. Anamalu possesses relatively thick skin. Its flesh is soft and gives consumers a unique taste. This banana variety is well-loved for its ability to generate a quick burst of energy.

Value chain analysis of fresh Ambun

In 2022 farmer's price for 1kg of Ambun banana variety is Rs. 180.00. Collector's price is Rs.220.00. Then the prices of wholesaler and retailer were respectively Rs.290.00 and Rs.420.00. The total value addition per 1kg of Ambun variety is Rs.360.00. During the pre-economic crisis era the total value addition was considerably low due to less expense of transport facilities and inputs. Producer's profit margin is about 21% and collector's profit margin is about 7%. Wholesaler's and retailer's profit margins are about 8% and 26% respectively.

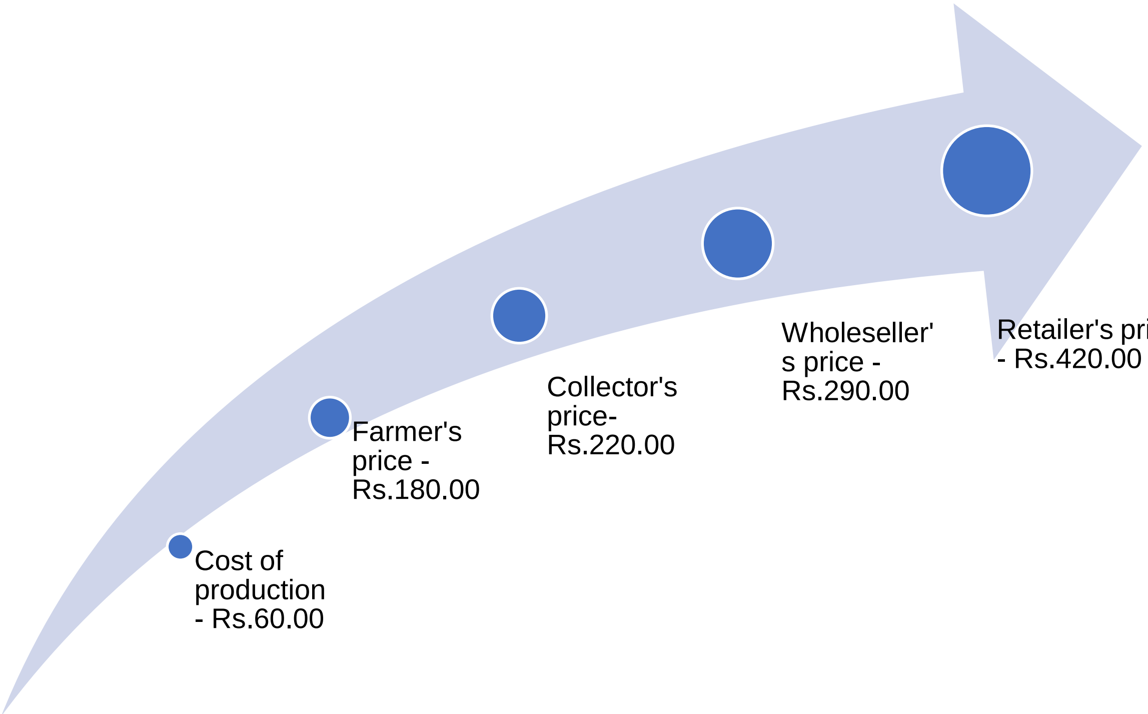


Figure 69: Value chain of Ambun variety

Income distribution of Ambun variety within value chain actors

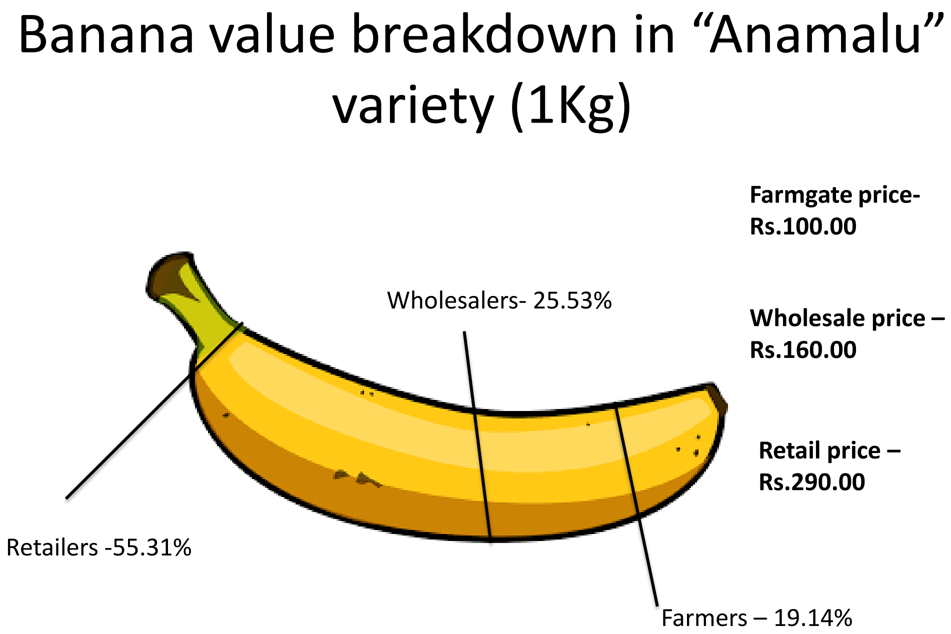
Banana value breakdown in “Ambun” variety(1kg)

Value chain analysis of fresh Anamalu

In 2022 farmer’s price for 1kg of Anamalu banana variety is Rs. 100.00. Collector’s price is Rs.120.00. Then the prices of wholesaler and retailer were respectively Rs.160.00 and Rs.290.00. The total value addition per 1kg of Anamalu variety is Rs.235.00. Producer’s profit margin is about 10.40% and collector’s profit margin is about 3.44%. Wholesaler’s and retailer’s profit margins are about 5.20% and 32.80% respectively.

Figure 70: Value chain of Anamalu

Income distribution of Anamalu variety within value chain actors



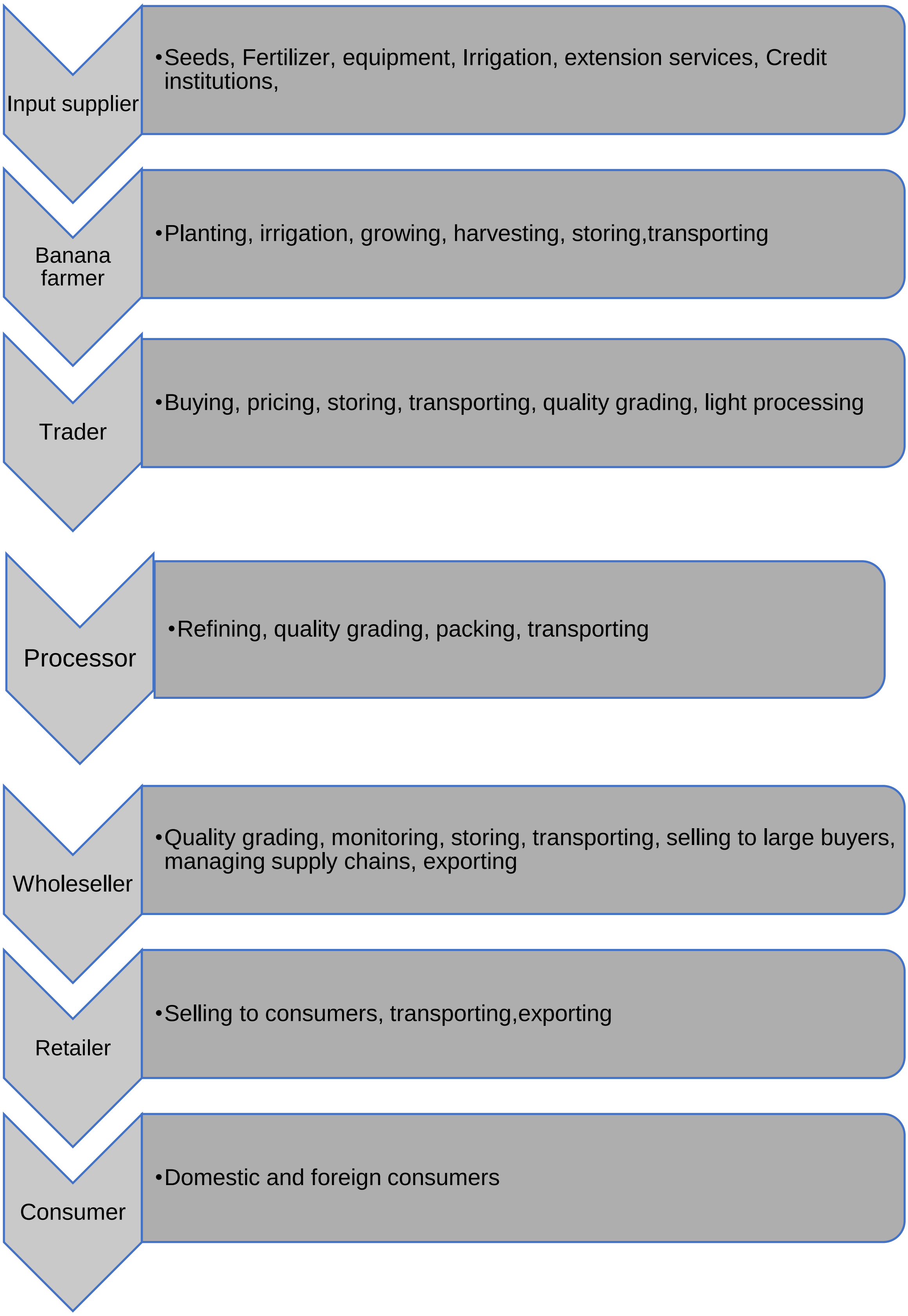


Figure 71: Roadmap of banana value chain

11. Cassava Value chain

Introduction

Cassava originated from South America and first distributed to Africa and Latin America. Cassava is a major staple food and livestock feed in mainly developing countries. (L, zhang L, & Zhang F, 2013).According to the united Nation Food and Agriculture organization (FAO) cassava considered the fourth largest carbohydrate source followed by rice, maize, and wheat. Cassava contain considerable amount of Calcium, Phosphorus and vitamin C is rich in root and also Cassava leaves rich in protein. Producers Use that value to produce different value-added product such as cassava chips, Alcohol, feed for animal and etc.

Cassava is drought tolerant crop so it capable of growing every climatic zone in Sri Lanka. Cassava mainly cultivated in Both wet zone (Gampaha, Colombo, Kegalle, Ratnapura and Matara Districts), Intermediate Zone (Kurunegala district) as a backyard crop or large-scale open land cultivation. Also, chena cultivation in large scale in Dry zone (Puttalam, Anuradhapura, Ampara, Hambantota, Moneragala Districts). There are mainly nine cassava varieties available in Sri Lanka. They are Wild accession, MU51, Kirikawadi, CARI555, Shani, Suranimala, Swarna, Hordi MU1 and Landrace. Among them, three improved Cassava varieties namely MU-51 (var.Peradeniya), CARI-555 and Kirikawadi having high yield and acceptable horticultural qualities have been recommended for cultivation by Horticultural Crop Research and Development Institute (HORDI), Gannoruwa . MU-51(var. Peradeniya), CARI-555 varieties generally take 6-8 months for harvesting while Kirikawadi variety requires 5-6 months for harvesting. Among them MU51, CARI555 and Suranimala verity have high export demand.

Hordi MU1

Kirikawadi

HorMU51

Swarna **Shani** **Suranimala**

Figure 72: Cassava Verities

The production of cassava in Sri Lanka was 281,075 Mt in 2019 and Cassava production was 314,846 Mt in the year 2020. The country had approximately 20,592.00 hectares under cassava cultivation. Cassava peak production can see in Maha season. In 2019 cassava on 6,314 Mt of cassava were exported. Sri Lanka mainly export cassava to United Arab Emirates (UAE), Qatar, Saudi Arabia, Australia and Canada. Sri Lanka's cassava exports as Fresh, chilled, frozen or dried roots and tubers.

In Sri Lanka traditionally farmers are not organized and the supply chain is not effective. When consider small scale cassava farmer not try to add value. There is a dominating role of the intermediaries (Collectors, Commission Agents, etc.), hence farmers' bargaining power is very weak. As farmers do not have direct contact with the marketing companies or traders, and they usually do not add value to their produce before sending the produce to the market, ensuring fair price is uncertain. Therefore, farmers' income is usually low in the traditional supply chain of cassava.

Important of promoting cassava value chain

A value chain is a series of tasks that a business engaged in a certain industry completes in order to offer a worthwhile product to the final consumer. Cassava value chain holds many opportunities for every one such as Farming, processing and services. When promoting cassava value chain, we can gain benefits to each stakeholder and also can develop country economy. Major potential benefits are increased production, food security, income generation and foreign exchange savings. Promoting value chain of the cassava sector necessarily brings with it a demand pull that leads to an increase in domestic production. For that Farmers might be encouraged to plant higher yielding cultivars and make use of enhanced agronomic and other postharvest procedures in order to meet the increased demand for the commodity.

Farmers and some stakeholder earn low income from cassava root selling. If promote cassava value chain for add adding value to cassava has been shown to have a high potential for farmers and other stakeholders along the value chain to earn premium prices from buyers in industry instead of selling only the perishable roots to traders. In the cassava sector, small-scale farmers or farmer's cooperatives can significantly increase their earning potential and improve their quality of life by introducing straightforward market-oriented technologies to them. They would be able to convert very perishable fresh roots into stable, market-grade intermediate products like chips, starch, glue, glucose, fresh frozen, and innovative alternative for substitute potato French fries.

Its cause to, expand their marketing opportunities reduce their dependence on traders, extend the storage life and market value of the harvested cassava, improve the quality and safety of intermediate products; and encourage end users to take up cassava as an input. When consider foreign market cassava have high demand. Products made from cassava, including chips, starch, etc., are highly sought after in many nations. When the cassava value chain is promoted, it gives other businesses a useful input and results in significant local currency savings.

Common issues in cassava value chain

The processing, marketing, and production problems in the Sri Lankan cassava value chain are the key problems. Significant production issues in Sri Lanka include lack of capital, high transport costs, bad stem cutting, poor storage issues, expensive labor costs, and unstable agricultural policies. Major cassava marketing issues in Sri Lanka include a lack of marketing knowledge, inaccessibility to the market for cassava sales, poor access to the market, and price fluctuation.

- **Lack of coordination between value chain actors**

When consider Sri Lankan cassava farmers they not better communication with value chain actors. Some farmers do production and sell their product to lower price in village level. Farmers do not have better agreement with actors to do continuous supply to processer and customers.

Improve coordination between value chain actors to increase the supply of cassava from farmers to processors. This will ensure the right raw material is delivered to processing plants in the most efficient and cost-effective manner.

- **Lack of capital**

In order to increase food production and cassava processing for national development, access to capital is crucial. Better financial availability would make cassava processing a more efficient way to produce food. But when consider Sri Lanka not specific financial availability for cassava farmers.

- **Low level of mechanization**

The cassava value chain in Sri Lanka has a low level of mechanization. Most farmers, processors, and other actors along the value chain do not use machines. If harvesting is done by automation, post-harvest loss may be reduced during peak times. To increase the productivity, quality, and quantity of cassava processing, mechanization is crucial.

- **Lack of infrastructure**

Good infrastructure must be available in order to increase cassava production and processing. Infrastructure issues like bad roads and a scarcity of water and poor transport are a big problem in some places. Transporting harvested cassava from the farm to the processing facility or market is challenging due to bad roads. It also has an impact on post-harvest losses and farm accessibility. Cassava farm gate price may decrease as a result of this.

- **Inadequate support**

Thinking about Sri Lanka Inadequate extension services can cause problems for cassava growers and processing initiatives. This has harmed the marketability of innovative cassava products and prevented people from participating in the cassava value chain. It's just operating traditionally.

Analysis of cassava value chain

Producers, local and international traders, wholesalers, and processors all traded cassava. The primary marketing channels used to get cassava and its products to the final consumers were tracked down to gain an understanding of how cassava is promoted.

Producer

There were different types of cassava farmers include small-scale farmers, home gardeners, farmers who grow Chena seasonally, commercial farmers, etc. Retailers in rural or urban areas received cassava tuber from the producer. Additionally, large-scale cassava farmers marketed their crop to wholesalers or other export-focused vendors. Value-added cassava producers, such as those that sell chips and cookies to retail stores or the wholesale market.

Wholesaler

Wholesalers bought cassava directly from farmers, sorting, grading and they transported fresh tubers to retail stores, economic canters, and exporters in places like Katunayaka, Gampaha, Embilipitiya, etc. Some wholesaler’s hire villager’s service to support the harvest, packs into boxes, and transfer goods to markets. Additionally, there were wholesalers that made contracts with producers for both fresh tubers and cassava chips.

Retailers

Various retail handles the downstream of the cassava value chain. Both physical retail formats and online formats are available. Village grocery store, village fair, road side stalls; retails in dedicated economic centres, supermarkets are common retail types. Online market places like Daraz, Cargills and Keels online retails, etc. engage in retail business. The retailer performed tasks including sorting fresh tubers based on size and customer preferences. Most rural retailers acquire cassava directly from farmers, whereas urban retailers purchase it through wholesalers. Retail stores could be large supermarkets or temporary shelters. Moreover, some chip producers who add value to cassava also serve as retailers.

Processors

Two main types; export processors and processors for local market and street food stall. Processors for the local market mainly engage in snacks business while export processors were engaged in various operations.

Exporters

To remove the damaged roots, raw cassava roots were graded for export. Then washing, fungicide treatment, packing with coco peat, sealing, and shipping. The processing facility solely utilized the MU1 kind of cassava, which is the cassava variety that the agriculture

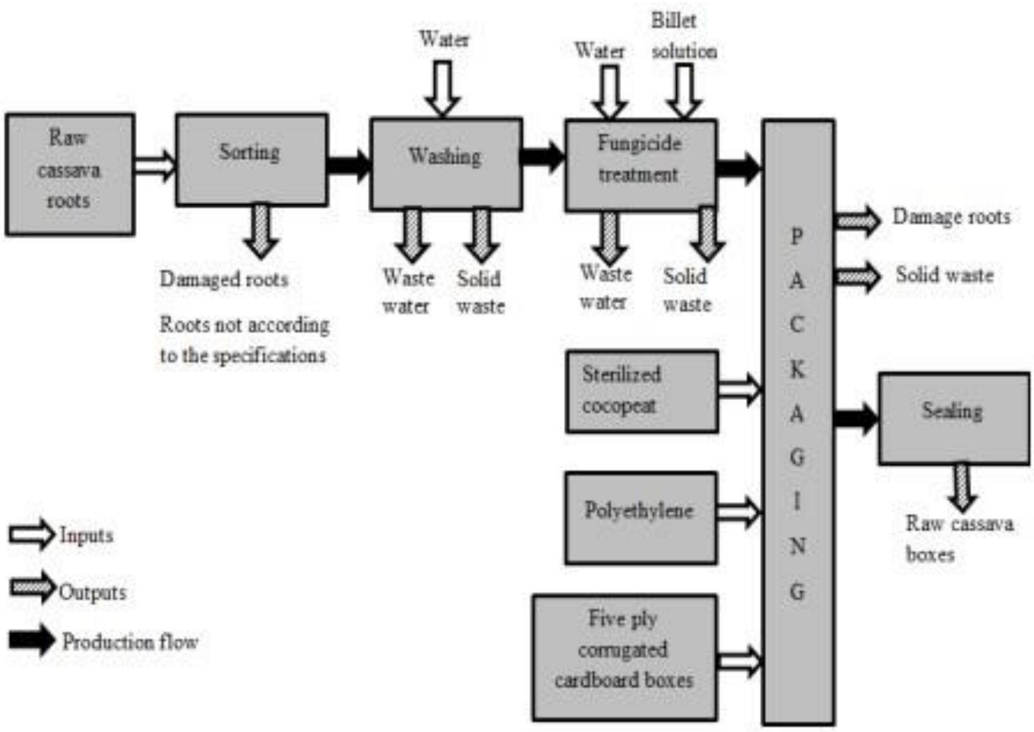


Figure 73: Production chain of raw cassava root packaging for export market develop by Somendrika et al. 2016

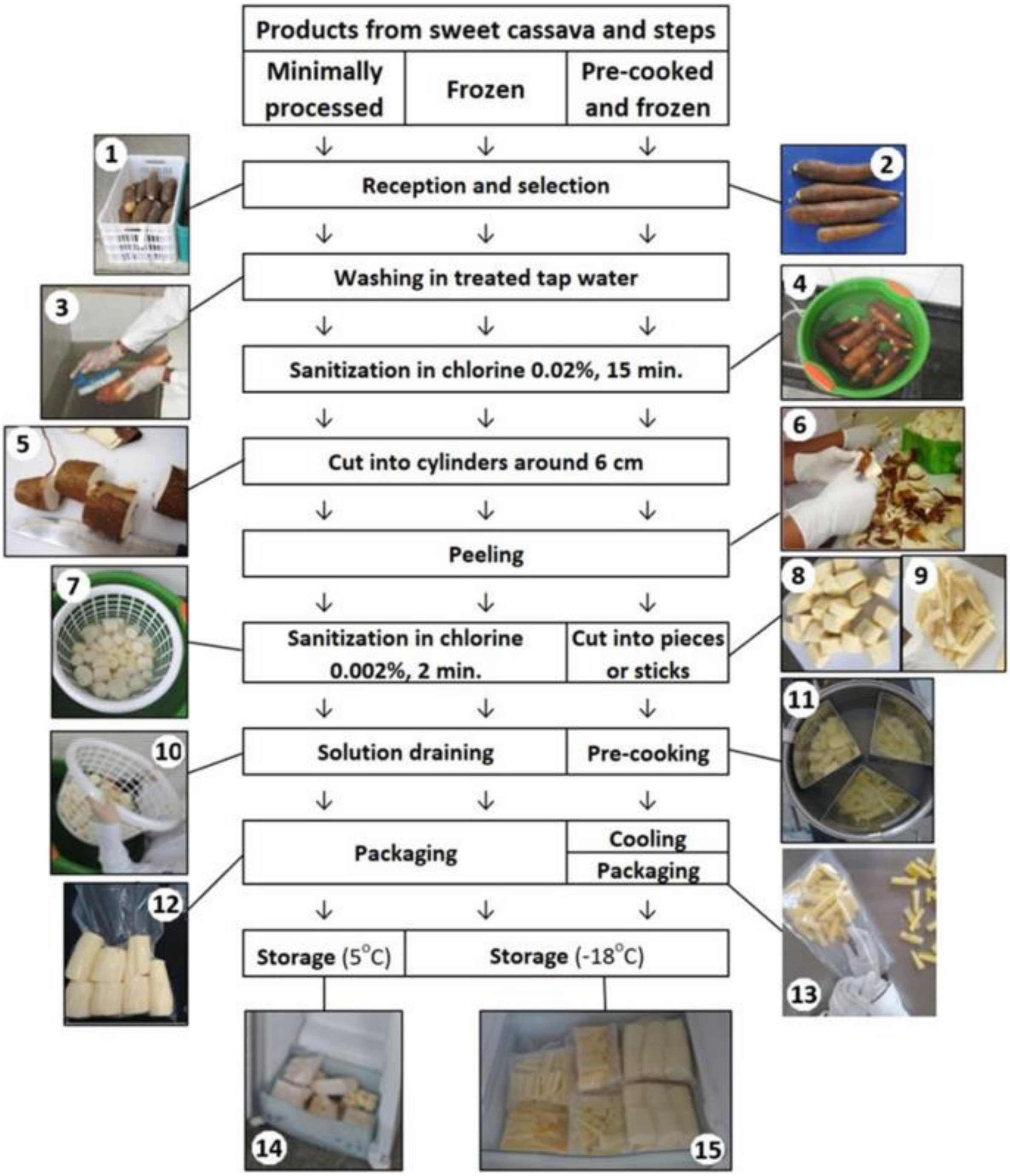


Figure 74: Cassava products processing steps

Road map for cassava value chain

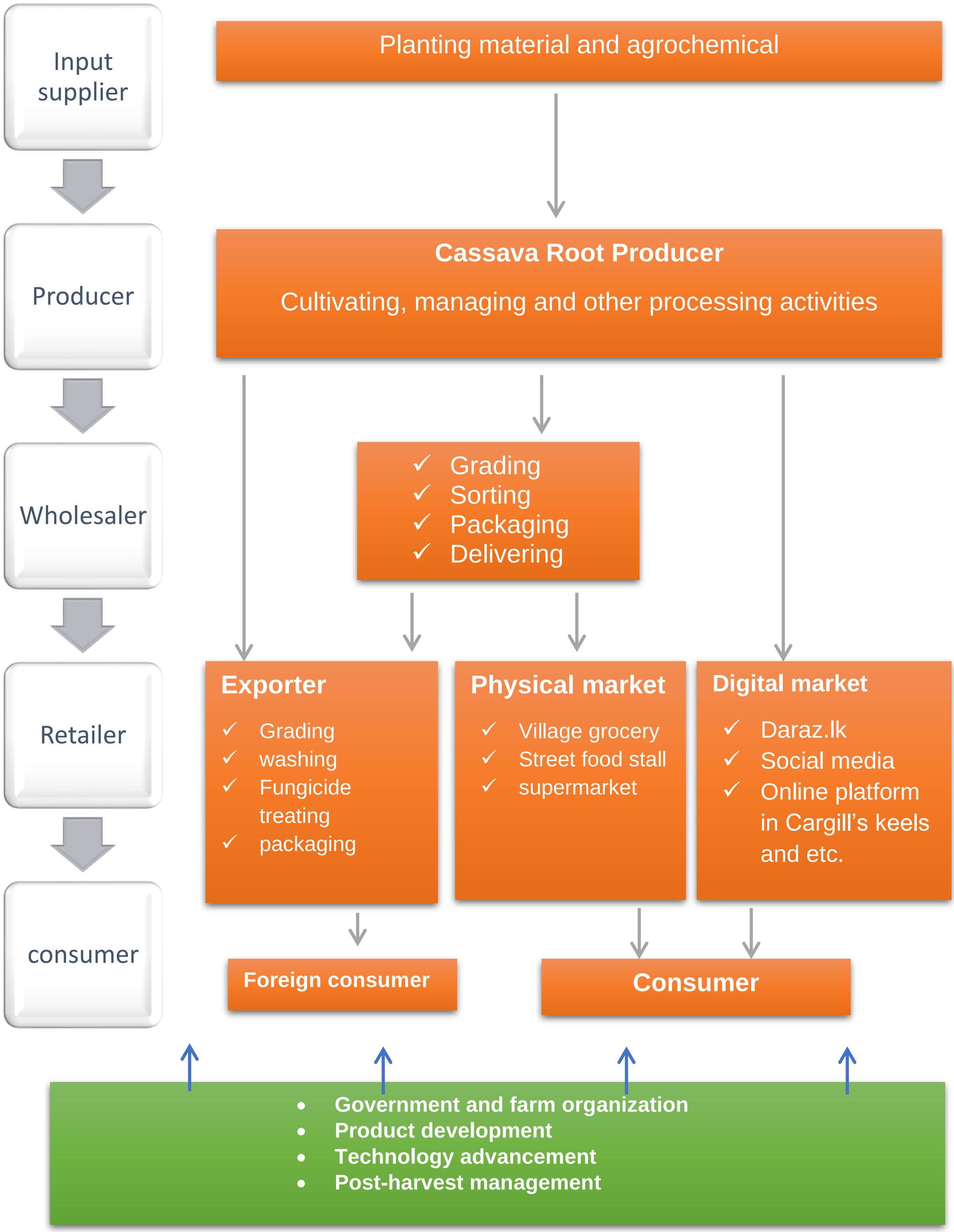


Figure 75: Cassava value addition and business development process

Stakeholder share

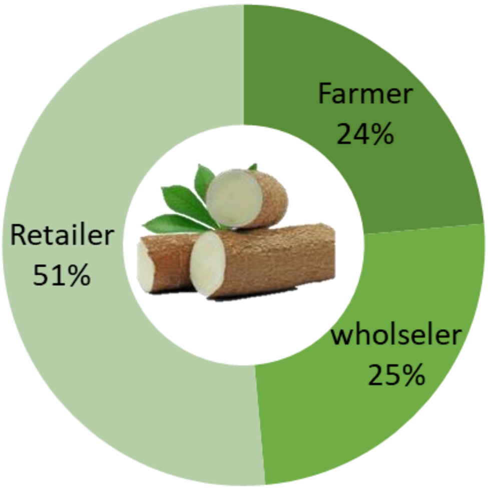


Figure 76: Income distribution in Cassava value chain

Figure 77: Prices at each value chain node

Cassava Value added product

The major motivations for processing cassava into various food products have traditionally been to prevent rapid post-harvest degradation and to lower cyanide levels. Cassava flour, Cassava starch, Cassava chips, Gari, Semolina, and bakery items including Cassava flour are some of the popular value-added products made from Cassava roots. Additionally, cassava is being utilized more and more in the production of various industrial goods and as animal feed (Uthpala et al. 2021).

- **Cassava flour**

Peeled, washed, and cut into chips fresh roots are used in the unfermented cassava flour process. The cassava chips are then sun-dried, ground into a fine powder, and packaged in materials that are moisture-proof. Nearly 30% of the flour generated in this cassava flour production process can be made from fresh cassava root input. Flour from fermented cassava roots are typically processed to make flour using either heap fermentation or sun drying of the peeled root followed by crushing and sifting.

- **Cassava chips and pellets**

The two exportable items with the greatest market potential are cassava chips and pellets. Cassava chips can be prepared by washing, slicing, and frying cassava roots. Chips are contained in clean jute bags, cotton sacks, or Multi Craft paper bags. Pellets are cylindrical particle solids that have been dried and hardened. Cassava roots can be peeled and processed into pellets in one of two ways, or the roots and leaves can be combined in a 4:1 ratio to create composite pellets. In Sri Lanka, cassava chips, including branded value-added and ready-to-eat goods as rancrisp, Mr. pop with different flavours and Smack, are the primary value-added product. Additionally, unbranded street retail products like several flavours of chips and unbranded retail packets are common.

Figure 78: Branded cassava chips

Figure 79: Unbranded cassava chips

- **Farinha and Gari**

Cassava root is used to make Farinha and Gari. Peeling, washing, grating, dewatering, crushing, sieving, and roasting procedures are used in both processes. Fermentation is a part of the Gari production process, it is not a part of the Farinha production process. Gari can be consumed either raw or cooked, and it can also be used to thicken soup and a variety of cakes. (*Figure 80)*

- **Extruded products**

Cassava flour is used to make extruded products. Cassava is extruded to produce a highly enlarged product with a bland taste. From tuber crops, snack foods can be made through extrusion cooking to create direct expanded extradites. Cassava extradites have significant nutritional value because they are completely oil-free. With the exception of quick noodles, the majority of pasta products on the market may be manufactured from cassava flour. Low temperature extrusion (less than 50 °C) is used to process them. (*Figure 80)*

- **Bakery products**

The production of new products including cupcakes, strudels, waffles, and doughnuts using cassava flour is possible. Major product categories include biscuits, cookies, snacks, cakes, pastries, and rusks and puffs. Gluten-free cookies and bakery products can be prepared by replacing wheat flour up to 50%-60% along with Cassava flour.

Cassava is also used to make biofuels, lumber, paper, textiles, and glue. Alcohol, organic acids, and derivatives of amino acids like monosodium glutamate can be produced as by-products of the manufacturing of cassava starch. Peel and pulp wastes are used to make compost and additional animal feeds. Additionally, there are throwaway things that are manufactured from by-products of popular cassava products that are environmentally beneficial. Therefore, looking for new markets for value-added Cassava products creates the potential for sustainable food chains in the future.

Figure 80: Extruded product and Gari

Value addition from waste

Cassava wastes are required due to post-harvest deterioration that occurs quickly, low protein content, and environmental contamination brought on by sewage and other related wastes are an eyesore. The waste products from the processing of cassava (e.g. starch) are separated into four groups: a) initial processing peelings, b) pulp waste, which is a fibrous by-product of crushing and sifting, c) The leftover starch from starch settling, d) waste water (effluent). There are technological viability and nutritional merit of using microbes to transform carbohydrates and their residues into products rich in protein. The prospect of producing viable value-added products through waste transformation exists. Cassava wastes can be processed and turned into value-added products as surfactant from cassava waste water, ethanol production from cassava starch-processing wastes, animal feed from cassava peel, and methane (biogas), among other things. The solvent known as biol and the solid fraction known as biosol, which are outstanding nutrients for a range of crops, are the by-products of the anaerobic digestion of the waste that occurs in a bio digester.

12. Avocado value chain

Introduction

Avocado (*Persea americana*), also known as butter fruit is one of the most popular fruit crops that grown and loved by consumers in the whole world. In most of the home gardens avocado are grown abundantly because it requires less crop maintenance practices and there are very few pest diseases that affect avocado crops. Due to the excellent adaptability to rainfall in its flowering season avocados are well suited for the wet zone of the Sri Lanka. It is believed that over 200 years ago during the period of Dutch, avocados were firstly domesticated in Sri Lanka. However, on 12th May, 1927 during the British occupation of Sri Lanka first recorded avocado cultivation were made. From there onwards varieties such as Datton, Gottfried, Winslowson, Puebla, Pollock and St. Anne were introduced to Sri Lankan soil. The avocado fruit is a climacteric fruit. It means that it matures on the tree but ripens off the tree. In commercial level the fruit is picked when it is green and hard then stored in a cooler temperature until they are ready to consume.

The avocado fruit has wide range of uses. But primarily it is used for consumption mainly due to its rich nutritional content. Avocado differs from other fruits because it possesses high oil and protein content. It is the only fruit known to contain many nutrients such as proteins, lipids, vitamins, minerals, salt, carbohydrate and water. Thus, avocado could play a crucial role to reduce malnutrition in the most of the countries especially in underdeveloped countries. Globally Mexico is the largest producer of avocados followed by Chile, Indonesia, Dominican Republic and USA (Hofman, Vuthapanich, Whiley, Klieber, & Simons, 2002). Majority of avocados produced in Mexico are used as a staple food in households. According to the statistics 160 tons of avocados were exported from Sri Lanka in 2018. The demand for Sri Lankan avocados (fruits category) has increased for the year 2018, rising by 416.129% from the previous year. Avocado exports surged by 1042.86 percent between 2016 and 2018, earning Sri Lanka $0.42 million.

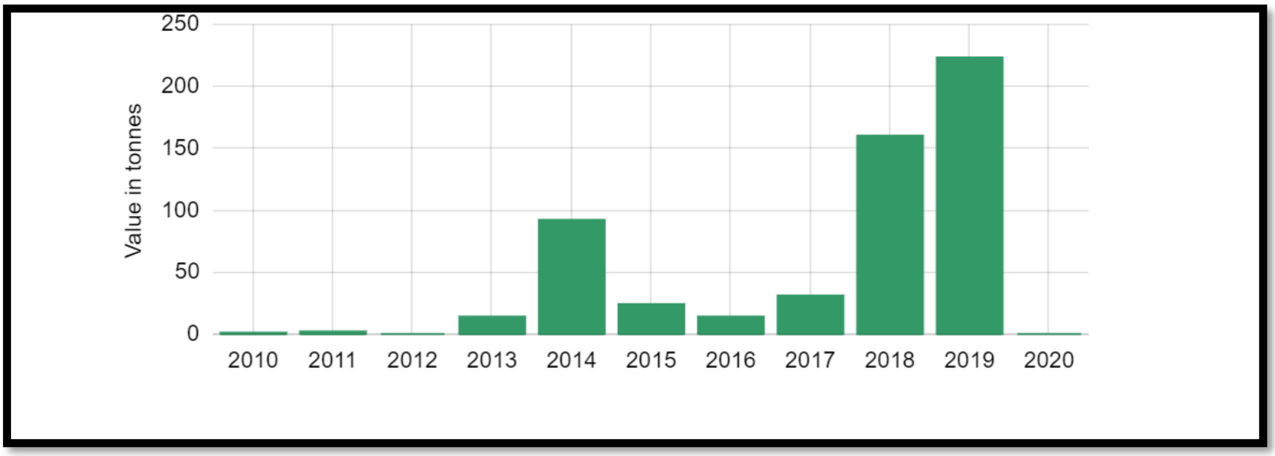


Figure 81: Avocado export in Sri Lanka in volume

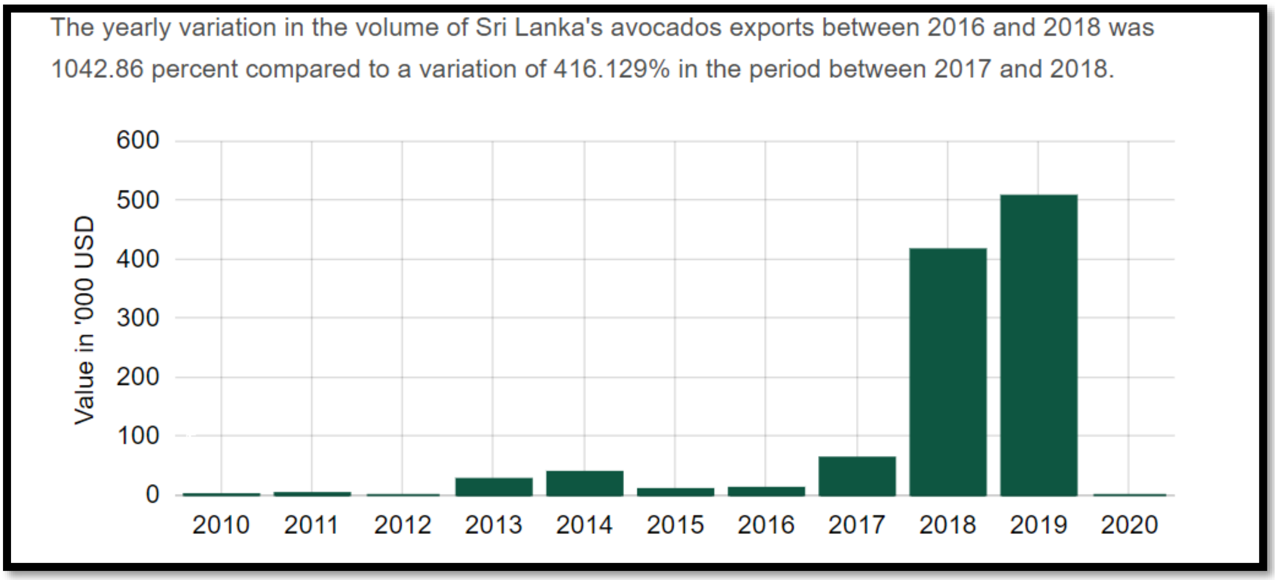


Figure 82: Avocado exports in Sri Lanka volume in USD

Figure 83: Sri Lanka’s export markets for Avocadoes

Avocado Value Chain Actors

Market participants along avocado value chain are producer, local collectors, wholesalers, retailers, processors and final consumers of the product**.** (TADESSE, 2011)**.** The first link actors who supply avocado to the market are producers. Farmers sell their avocados to local collectors, who are other farmers or part-time traders at assembly markets, with the intention of reselling it to wholesalers, retailers, and customers. They gather avocado in large quantities from the neighborhood using their financial resources and local expertise. Wholesalers are renowned for buying large quantities of goods with stronger financial and informational resources. They are prominent channel characters who either buy avocados directly from farmers or regional collectors. They purchase a lot of avocados and transport them to terminal markets and the local market. Retailers, who are the final actors, buy and deliver avocadoes to consumers.

According to (Mateows, Amanuel, & Asfaw, 2015), producers are the primary actors in avocado value chain and most of them are smallholder farmers who cultivate avocadoes and supply to the next actor of value chain. Local collectors are crucial participants in the value chain because they buy avocado from farmers and sell it to retailers and customers.

As mentioned in (Bezabih & Hadera, 2007), the middlemen working at the local level as well as those coming from larger marketing hubs are intimately related to the collectors. The collectors set the prices in the markets where the producers sell their goods, typically during the period of maximum supply. These set prices of collectors are generally very low. Retailers play a significant role in the avocado value chain by supplying consumers with the fruit. In other words, they buy fruits and distribute them to customers, either directly from producers or from neighborhood collectors. Semi-processed products are common from fresh avocado in the local market. These products are much famous among both local and foreign tourist. The final link in the value chain for fruit is the consumer. They are people that purchase avoc ado fruits from growers, local collectors, and retailers for their own usage. They can purchase the avocadoes from different actors in the value chain as the final actor in the value chain which comes either directly from the growers or from other value chain actors who are nearby retailers and collectors.

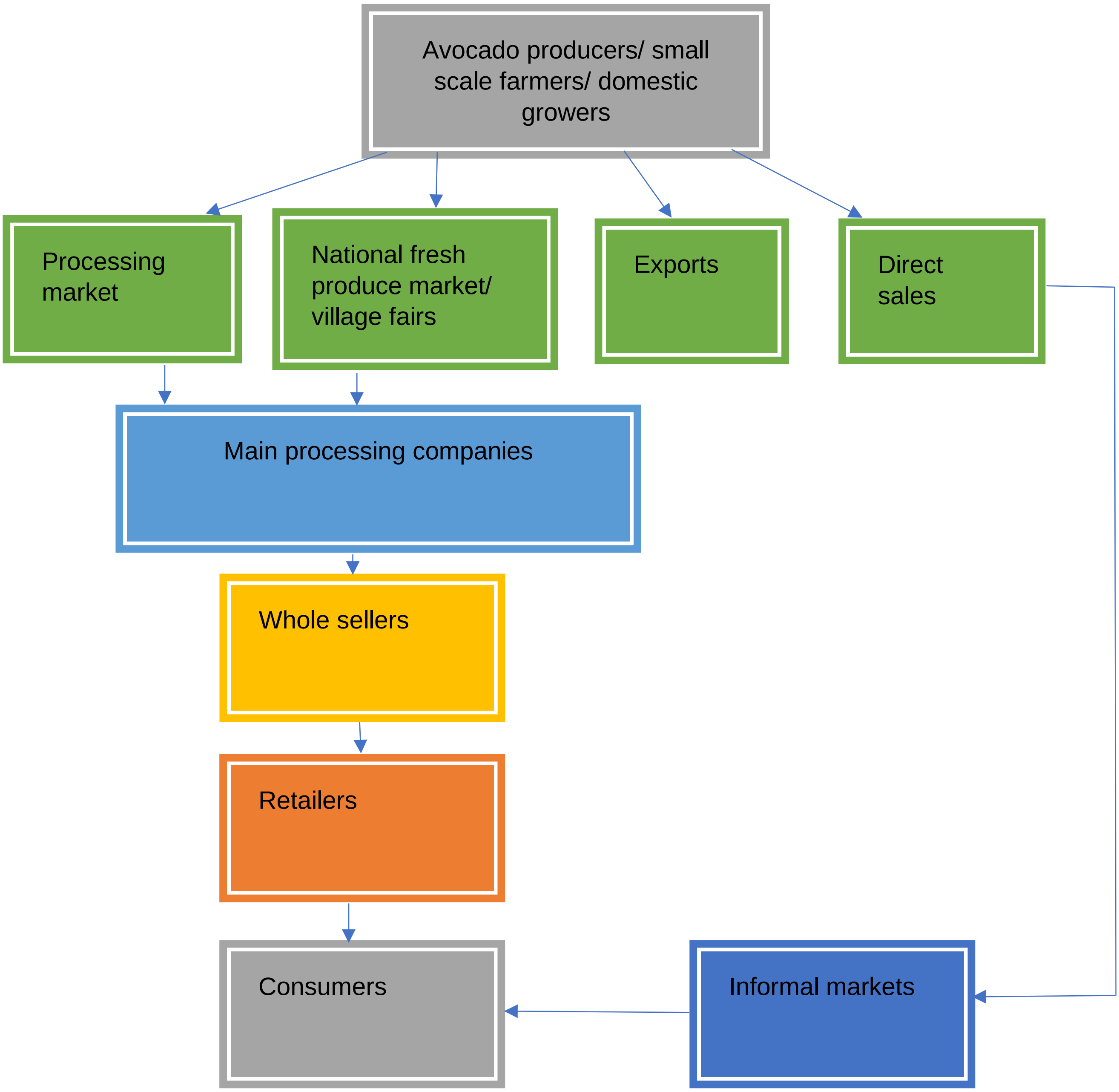


Figure 84: Overview of Avocado value chain map

Key elements of Avocado value chain

Logistics

Avocado is a highly perishable fruit. It is highly pressure and impact sensitive therefore it requires careful and appropriate handling measurement during transportation whether it is by Lorries, tractors or three-wheelers or when it's shipping to other countries. Avocadoes must be protected from damp weather conditions otherwise the avocado fruit can be over ripened before it reaches to end consumers. Most of the time moisture is the prime factor which causes over ripening of avocado therefore during transportation, proper care must be provided. When exporting the avocadoes, they must be compatible with the sanitary and health regulations of the importing countries. When exporting, majority of avocadoes are exported by sea in refrigerated containers under controlled atmospheric conditions. According to (Mwakalinga, 2014) sometimes a chemical derivative called 1-Methylcyclopropene is used as a synthetic plant growth regulator and is used as an alternative to controlled atmospheres.

Sorting, Grading and Packaging

These functions are basically carried out at the farm gate and at primary procurement centers via the efforts of local collectors. Thus, fruit is sorted according to consignment needs of collectors. Shrunken, smaller sizes, with splits and punctures are removed but t unsellable under-grades are not wasted as they are commonly consumed in farming households.

Packaging plays an important role in ensuring efficient and safe transportation of avocadoes and quality of the avocadoes. Proper packaging allows handlers to comfortably move the avocadoes without having any post-harvest losses. Packaging should also fulfill the need of marketing purpose with attractiveness. In Sri Lankan context there are no defined packing materials and methods which cause for the high post-harvest losses and awareness of value chain actors regarding the importance of proper packaging is low.

Cold Chain Management

When handling perishable products, especially agricultural products cold chain management plays a crucial role. Specially regarding the exporting of avocadoes this cold chain management is quite important. Starting with the initial packing facilities, moving on to the refrigerated container trucks that move the produce to the shipping terminals, then onto the storage facilities at these terminals, onto the actual shipping vessels and containers, and finally onto the importers and distributors who must clear the produce and move it to the markets or retail outlets. Increasingly significant traceability requirements, which call for an effective, managed supply chain and globally recognized corporate standards, are related to this. In order to maintain high standards of avocado quality, it is crucial to strictly manage all links in the cold chain because it takes around 25 days from the time of packing to reach the European merchant (Mwakalinga, 2014).

Common issues in Avocado value chain

Instead of placing the fruits on high platforms or tables, they are laid out on the ground on top of a thin covering of grass or mulch while operating in unsanitary conditions. According to traders, placing the fruits on tables instead on the floor speed up the deterioration. Sometimes clay soil is applied to fruits, maybe to increase shelf life (Mwakalinga, 2014). Market systems are not quite organized. Not only in avocadoes, in almost every agricultural value chain, actors in the value chain perform their activities in such a way that to maximize their own profits even at the cost of other value chain actors. Individual interests frequently take precedence over those of the industry, as is the case when harvesting and marketing immature crops.

Poor or improper packaging materials usage is common among local collectors and wholesalers. The fruit is transported in polythene bags, and wooden boxes that are not according to any appropriate level, which makes it susceptible to rotting. The export section uses high tensile stackable boxes. Lack of knowledge on product handling by value chain actors, (specially by growers) followed by poor overall handling is another issue in avocado value chain. Fruits have been observed to be plucked from trees by shaking them, bagged, loaded beneath other cargo, and laid out on the ground at retail markets. All of these result in significant losses.

Value Addition on Fresh Avocado Fruit

Consumption of fresh fruit is the primary market for avocados around the world. Other uses, such as the extraction of oil, are secondary, and they make use of any leftovers from the market for fresh fruit. There are obvious disparities between the domestic and export markets in terms of the potential to increase the fruit's value.

Table 32: Avocado value addition

Type of value addition	Benefits of adding value	Domestic Market Value Chain	Export Market Value Chain
Sorting Process of separating fruits with desirable and those	Reduces transport cost as fruits with non-desirable qualities are not transported	This is partly done at farm level, but producers leave sorting to traders at wholesale markets	Firstly, this is done at farm level during picking to avoid harvesting fruits that

with undesirable qualities.	Upstream of value chain.		won't be acceptable at the pack house. Then at the packing houses where experienced sorters and technological facilities are found
Grading It has been noted that fruits are not graded until they reach the retail market, which is significant when targeting a segmented consumer.	Graded products can be based on consumer desire or market sector, it aids in improving consumer targeting.	Generally, retailers do the grading. • Size- larger the better fruit • Taste – the fatter content (less water) the better. • Degree of ripeness – fruit in the middle between unlikeness and ripeness are preferred.	
Packaging	Serve to preserve the fruit's quality while being transported and sold, and by providing consumers with the appropriate product information, which aid in marketing.	This is done at farm gate level, and mostly in retailer level.	Special high tensile cardboard boxes are used to allow stacking several layers without bruising fruits.
Branding The supermarkets that carry the fruit or the supplier may take the lead in this**.**	Consumers are influenced by branding to connect a product with a particular value, setting it apart from competitors and fostering brand loyalty.	At the supermarkets.	At the supermarkets.

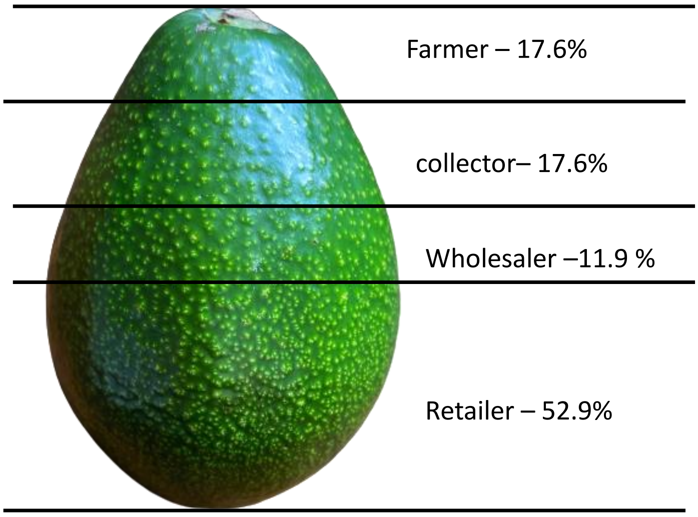
Value chain analysis of avocado

Figure 85: Value chain of avocado

As per the data collected at the third quarter of 2022, 1kg of local avocado farm gate price was Rs.120.00. And collector's price was Rs.150.00. Wholesaler's price and retailer's prices were respectively Rs.170.00 and Rs.260.00. It is quite obvious that just like in other agricultural products market power is highly concentrated around retailers. Producer's profit margin is about 11.5% and collector's profit margin is about 7.69%. Wholesaler's and retailer's profit margins are about 3.8% and 25% respectively. The total value addition per 1kg of Avocado is Rs.170.00.

Income distribution of Avocado within value chain actors

Avacado(Local) value breakdown for 1Kg



For 1 kg,
Cost of production – RS.90.00

Farm gate price-
Rs. 120.00 (Profit- 30.00)

Collector price-
Rs.150.00 (Profit- 30.00)

Wholesaler price -
Rs.170.0 (Profit- RS.20.00)

Retailer price -
Rs.260.000 (Profit- 90.00)

Source – Focuses discussions with value chain actors in Haldummulla and Pambahinna areas

Figure 86: Income share of the avocado value chain

Jackfruit Value chain

Introduction

Jackfruit (Artocarpus heterophyllus) is a dicotyledonous fruit crop that has a high economical value not only as food but also for other purposes. Jackfruit is cultivated in tropical areas of the world and it bears the largest fruit in all trees which is around 10kg -50kg weight of fruit. Jackfruit is a compound fruit that contains hundreds of seeds in one fruit. All growing stages are used as food. Immature un-ripened fruits are used as cooked food, un-ripened matured fruit is used as a major carbohydrate source and ripened fruit has a sweet flavor and it is used as a dessert. Value chain is a market-oriented approach promoted support small-scale rural farmers and other stake holders in the agricultural sector (Mitchell, Keane, & Coles, 2009). All activities in the chain are directed towards the market. In addition, systemic competitiveness—all stakeholders can benefit from improved chain performance—is one of the benefits of the value chain approach. Thus, effective value chains can play a key role in tackling poverty and food insecurity in developing countries (A. R. Dossou1, Adanguidi, K. N. Aoudji, & C. Gbedomon, 2021). In Sri Lanka jackfruit is an important crop that has an ancient history in Sri Lankan food culture. The jackfruit tree also known as the rice tree in Sri Lanka because it gives a complete meal. In the past times, Sri Lankan people only consumed edible jackfruit meat part by cooking it. Only jackfruit seeds were preserved for future consumption. But in the modern context all the parts of jackfruit are used to make value-added products.

Importance of promoting Jackfruit Value Chain

The value chain describes the entire range of activities required to bring a product from the input-supply stage, through the different phases of production, to its final market destination, including its disposal after use (A. R. Dossou1, Adanguidi, K. N. Aoudji, & C. Gbedomon, 2021). All activities in the value chain are directed toward the market and all the stakeholders will be benefitted from the improved value chain approach. Also, a developed value chain decreases poverty and food insecurity in a country. In Sri Lanka, there is no specific jackfruit production as a crop. Most of the jackfruit is harvested from the home gardens and from the wild near the village areas. Jackfruit is an underutilized crop and there are no fields to grow jackfruit in Sri Lanka. But in the present situation, the Sri Lankan government and non-governmental organizations are promoting jackfruit value-added products to generate income in the household level while supporting to secure the food supply for the future consumer demand in local and international markets.

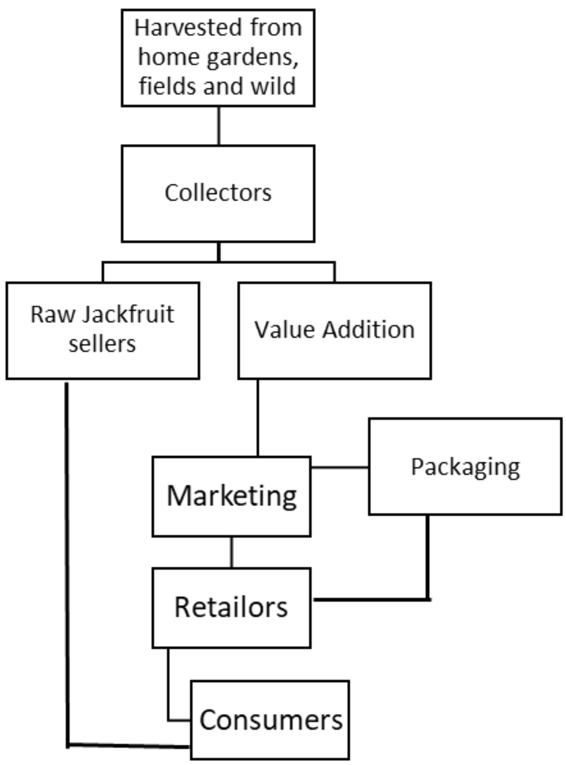


Figure 87: Actors of jack fruit Value chain in Sri Lanka

As described in figure 87 primary value chain actors of the Sri Lankan Jackfruit are producers in household levels, wild collectors and people who harvest jackfruit from their agricultural fields. Other actors are jackfruit collectors from producers, raw jackfruit sellers, value added product developers, marketing agencies, retailors and the consumers. By promoting each stage of above value chain in figure 87 jackfruit industry can be developed with greater extent. Other than the raw jackfruit value added products can be utilized by developing the value chain framework.

Common issues of characterizing the Jackfruit value chain

The main issue of characterizing the jackfruit value chain is that jackfruit is an underutilized product because of that there are no specific primary producers for jackfruit. Data collection is also difficult because primary jackfruit providers cannot be identified clearly. In western countries ripened jackfruit is very popular desert fruit. But in Sri Lanka due to the common availability and consumer attitudes it is not developed as a dessert fruit. One of the main issues characterizing the jackfruit value chain in Sri Lanka is wholesale and the retail market cannot be differentiated separately because most of the final consumers are specific consumer base with the need of jackfruit products. In Sri Lanka, several companies can be identified as jackfruit value added product selling retailors. Jackos, Tender table, Sirisara Products Lanka Real and Suboga are some companies retailing as their product. Most of these companies are using online marketing platforms as their marketing platforms.

Analyzing the Jack Fruit Value Chain

Jackfruit value chain actors can be identified as follows, producers in household levels, wild collector’s jackfruit collectors from producers, raw jackfruit sellers, value added product developers, marketing agencies, retailors and the consumers. In this value chain, each stake holder contributes value chain by adding value to the final product. To determine the sustainability of jackfruit value chain it is essential to analyze the profitability of each actor in the value chain. To calculate the profitability of a Jackfruit value chain cost for jackfruit products should be calculated. The share of the revenue for each actor in the value chain is called as the value breakdown of the jackfruit value chain.

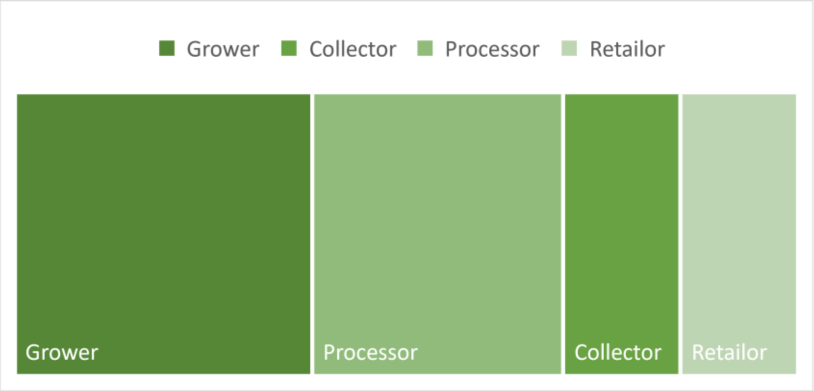


Figure 88: Income share of the Jackfruit value chain

Road map for value chain upgrading

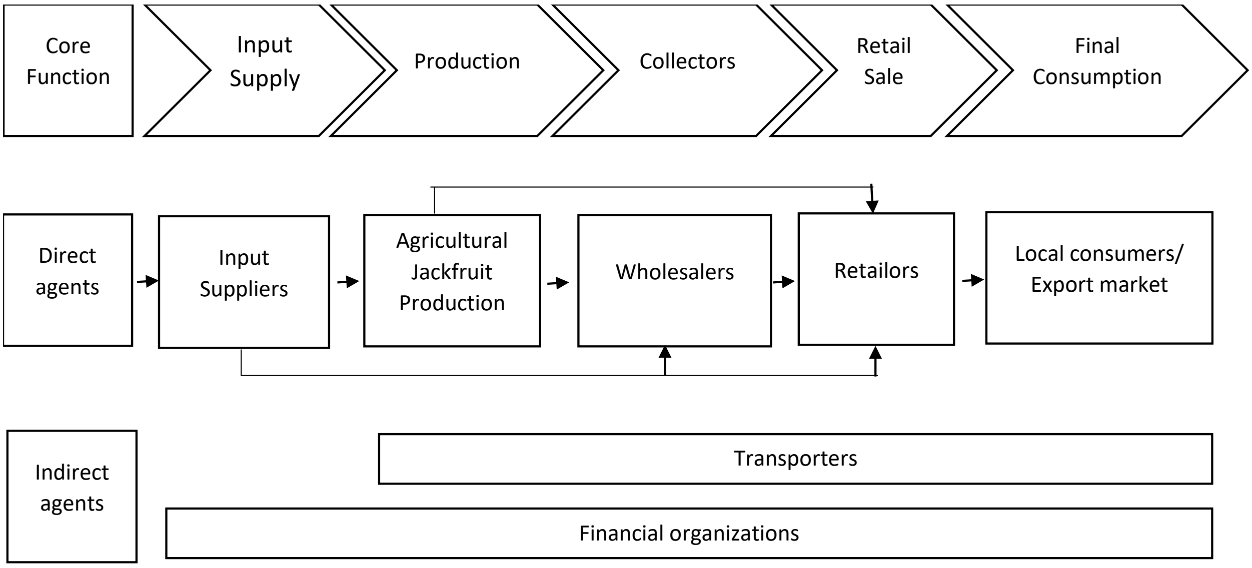


Figure 89: Value Chain map of the Jackfruit

Input suppliers

Input suppliers are the basic support providers in the Jackfruit value chain. But in Jackfruit value chain there are no any specific input suppliers. In agricultural fields or home gardens fertilzers used for other crops are used for the jackfruit. Input suppliers contribute for the foundation of the value chain and they comprise organizations and or individuals' entrepreneurs engaged in the construction and supply of beekeeping equipment to interested producers (M.T. Uddin, M.Z.I. Kamal, & M. Kamruzzaman, 2021).

Processors

The actors who buy raw fruit from producers or wholesalers and add value through processing and supply value-added jackfruit products to the market.

Companies

Companies are the brand name that distributes value added jackfruit products and to the market under a specific brand name.

Retailers

Retailers are the value chain actors who buy the products from wholesalers or companies and sell them to the final consumers. The grocery stores, supermarkets, shopping centers and online platforms are the major retailers prevalent in the market.

Consumers

Consumers are the final value chain operators. These actors are the actors who consuming the value-added products.

Value additions of Jackfruit

Packed raw fruit selling are the primary kind of jackfruit value addition. These products are sold at village markets and super market chains as fresh vegetable.

Raw jackfruit

Raw green jackfruit

Dehydrated and packed jackfruit seeds are one of the value-added products from the jackfruit which is very popular among the consumers due to its nutrient value.

Figure 90: Dehydrated jackfruit seeds

Jackfruit flour is another value-added product from jackfruit which is produced from the dehydrated jackfruit seeds. This can be used as substitute for the wheat flour as well.

Figure 91: Jackfruit flour

Dehydrated jackfruit is also a value-added product which also popular among the consumers because it can be preserved more than three months' time period.

Dehydrated ripened jackfruit

Dehydrated jackfruit

Table 33: SWOT analysis for Jackfruit value chain

Strengths

- Land resources
- Conditions for jackfruit production
- Labor
- Entrepreneurship

Weaknesses

- Capital
- Demand power
- Equipment
- Knowledge on value addition

Opportunities

- Local demand
- International market
- Tourism

Threats

- Lack of support from government and non-government organizations

To overcome the weaknesses first government, need to take action on popularizing jackfruit and its important as a carbohydrate source. Also, value added products from jackfruit needs to be popularized among the consumers. Financing companies also need to have loan schemes for agricultural value-added producers. Lack of knowledge on value addition is another problem which causes people are not involving in value added production in jackfruit. Government and non-government organizations should organize extension programs to train people on value added production.

Developed value chains for Kandy district are given in table 6.

3.3.3 Technological Analysis

3.3.3.1 Dry Chili Production

3.3.3.1.1 Land Preparation

There no location specified changes in land preparation for chili. Thus, the same land preparation method what we discussed under Kilinochchi district cluster can be applied here.

3.3.3.1.2 Water Management

The water requirement for chili as an average is 4.50 mm/day. Required irrigation water capacity depends on application efficiency of selected irrigation method and soil condition (vertical and horizontal water penetration). The average annual rainfall in Kandy district is 8 mm/day.

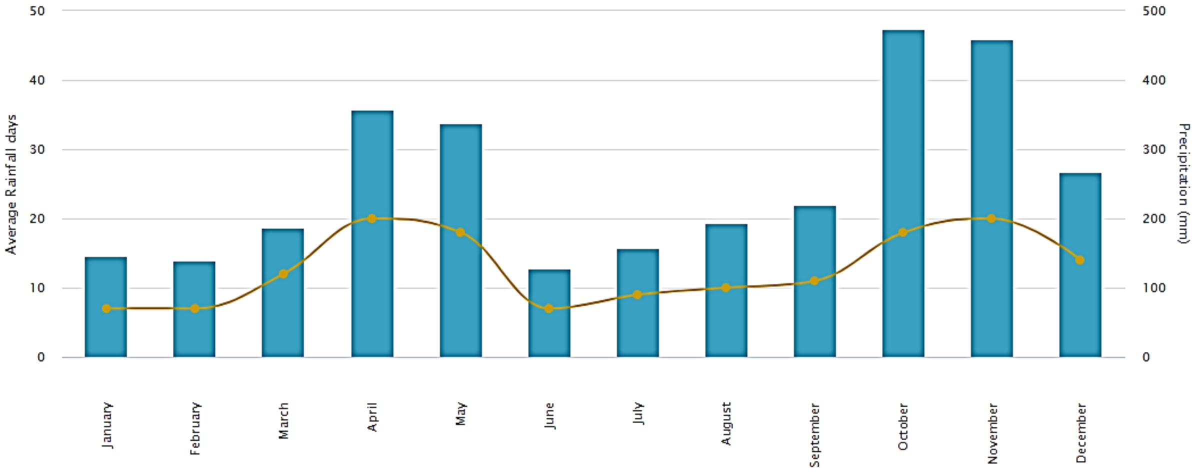


Figure 92: Monthly average rainfall in Kandy district

(Source - [What is weather like in Kandy, Central, LK (worldweatheronline.com)](worldweatheronline.com))

It is advisable to start chili cultivation in October. However, irrigation system with a reliable water source is a must as chili plant expose to dry weather from February to April and June to September.

Table 34: Effectiveness of Irrigation Methods for Chili cultivation

Irrigation Method	Surface Irrigation	Sprinkler Irrigation	Drip Irrigation
Water application efficiency	50%	70%	85%
Weed Pressure	High	Low	Minimum
Favorable for diseases	High	Low	Minimum
Required water pressure	Not applicable	High	Low
Fertigation	Not possible	Not always	Possible
Recommendation	Not recommended	Recommended if drip irrigation is not possible	Recommended

Drip irrigation uses plastic tubing which is designed and manufactured with precision water emitters spaced at regular distances along the length of the tubing. The emitters are engineered to release a specific amount of water which is 2 l/h at 1 bar pressure. Drip tape can be practices but less durable compared to tubes. Water for drip irrigation systems must be free of solid particles which can clog the emitters. Thus, filtering systems are highly recommended.

The recommended drip irrigation system can be used to supply the required plant nutrients by using a fertigation unit.

3.3.3.1.3 Weed and Pest Management

Already discussed under Kilinochchi district chili cluster.

3.3.3.1.4 Harvesting

Already discussed under Kilinochchi district chili cluster.

3.3.3.1.5 Processing

Figure 93: Processing of Chilli

Process	Note on feasibility options
Drying	• Introducing a solar tunnel dryer for intermediate drying and initial withering. Reduce required thermal load and minimize mould formation and spreading. • Either batch or continues type chili dryer. • Using electricity as the thermal power source will be convenient and cost effective for the farmer company. – Heat Pump • Having chili flattens system will reduce drying duration as well as texture shrinkages. • The desired moisture content at the dryer mouth is 8 % in w.b. • Inlet hot air temperature needs to be maintained at 50 – 60 ^{0}C. • Better to have a positive temperature gradient.
Grading & Sorting system	• Grading/sorting is based on pods colour and size. • Considering the current manual operation (hand picking), the investment on a colour sorter will be paid back within one year. (Kindly refer the workings under Kilinochchi district chili cluster) • Secondaries can be used for making chili powder, flakes or paste.
Packing & storing	• Jute, gunny or polythene bags can be used for packing depending on packing density decided by the selected marketing channels i.e., wholesale or retail marketing. • Ascertained storing bulk density of dry chili at 10% moisture is 18 kg/square feet at storing height of 6 feet. • The moisture content at the time pf packing should be around 8% - 10% in w.b.

- Evaluation of existing government buildings and lands are being evaluated for a common processing centre in Kandy district.
- Designed features of chili processing centre have been discussed under Kilinochchi district chili cluster.

3.3.3.2 Hass Avocado

3.3.3.2.1 Understanding the requirement of technical inputs

Sri Lankan Avocado production in year 2017 was 10,100 metric tons *(DOA, Sri Lanka)* at an average yield of 1,400 kg per acre. Avocado hardly find in large scale lands but popular a s a home garden. Avocado production in Kandy district is around 140 ton/annum (1% of national annual production) *(source : 07._Fruit_-_pg_65-77_-final.xls (live.com))* .

Malwatte valley plantations has started cultivating Hass variety in large extent. Their planting density is 120 plant per acre.

Technological interventions are required to minimize post-harvest loss and increase the shelf life.

3.3.3.2.2 Potential technical inputs for Avocado farming

Activity	Description
Land Preparation	After land clearance, it is required to follow soil conservation practices. Planting density is 100 plants per acre. Intercropping is possible with less plant density. Dig size is 60 cm x 60 cm x 60 cm. Mamoties and crowbars can be used for digging planting holes. Considering the land availability in Kandy district, it won't be able to allocate ½ acre for Avocado cultivation. Thus, it is proposed to distribute 50 plants (plants requirement for ½ acre) per farmer where he will plan out cultivation depending on his/her land availability.
Micro Irrigation	Annual water requirement is about 1200 mm to 1300 mm (3.5 mm to 4mm per day). Availability of land and terrain restrict the application of micro irrigation facilities. Thus, the cultivation is going to be in rainfed. Kandy annual rainfall and its variation throughout a year won't be an issue. If water is going to be irrigated, the required watering pattern is 10 l/plant at every 4 – 5 days.
Harvesting	Maturity level for avocado fruit is 4 – 6 weeks. Avocado wont ripe until it is plucked. Identification of proper maturity level for harvesting

minimize post-harvest losses in greater extent. Fruits are harvested using a picking-pole attaching a net bag to prevent possible damage due to falling. After harvesting, the avocado fruit must be carefully transferred from the picking bag into the field crates in order to avoid mechanical injuries, especially bruising.

3.3.3.2.3 Processing

As per designed value chain assessment, it is planning to sell the harvested avocado as fresh fruits. Extracted avocado oil has a great foreign market potential. Avocado pulp processing can be undertaken based on demand.

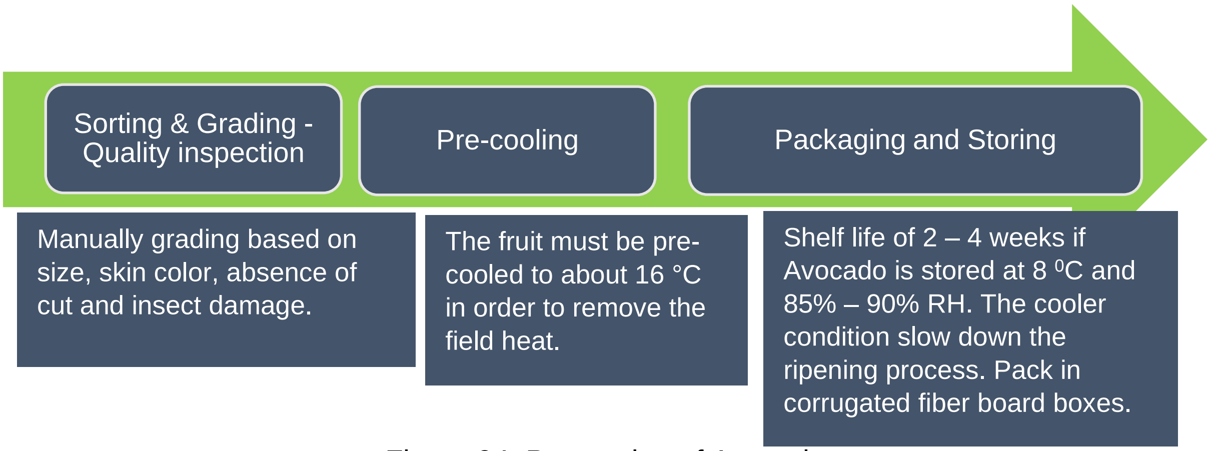


Figure 94: Processing of Avocado

Note: Artificial ripening is not yet practiced among farmers/ traders. However, keeping fruits at the collection points accelerates the ripening process due to heat buildup and ethylene liberated from other ripening fruits. Hot water treatment is recommended in order to control disease during storage and the marketing of fresh fruit.

Exposure to the sun will tend to increase the pulp temperature, which accelerates ripening and shortens the shelf life of the fruit. Evaporative or refrigerated cooling technology can be applied for pre-cooling which helps to increase the shelf life. Harvesting matured unripe fruits provide a better shelf life.

Table 35: Recommended storage conditions for specific avocado cultivars

Cultivar	Ripe or unripe	Temperature	Relative humidity	Duration
'Booth 1' (Guatemalan x West Indian hybrid)	Unripe	4.5 °C	85 to 90%	2 to 4 weeks
'Booth 1'	Unripe	4 °C	90 to 95%	4 to 8 weeks
'Fuchs' (West Indian)	Unripe	12.8 °C	85 to 90%	2 weeks
'Fuchs'	Unripe	10 to 13 °C	85 to 90%	2 weeks
'Fuerte' (Mexican x Guatemalan hybrid)	Unripe	5.5 to 8 °C	85 to 90%	3 to 4 weeks
'Fuerte'	Ripe	2 to 5 °C	85 to 90%	1 to 2 weeks
'Fuerte'	Ripe	3 to 7 °C	85 to 90%	2 to 4 weeks
'Hass' (Guatemalan x Mexican hybrid)	Unripe	5.5 to 8 °C	85 to 90%	3 to 4 weeks
'Hass'	Ripe	2 to 5 °C	85 to 90%	1 to 2 weeks
'Hass'	Ripe	3 to 7 °C	85 to 90%	2 to 4 weeks

[a]Source: Kader[92]

3.3.3.3 Banana (Ambon) –Ceylon Cavendish

3.3.3.3.1 Understanding the requirement of technical inputs

Sri Lankan banana production in year 2017 was 750,588 metric tons *(DOA, Sri Lanka)* at an average yield of 6 ton per acre. The potential yield with high density double raw banana cultivation is about 20 tons/acre. Banana production in Kandy district is around 16,000 ton/annum (2% of national annual production) *(source : 07. Fruit - pg 65-77 -final.xls (live.com))* .

The level of mechanization in banana cultivation is about 40% as at end of year 2017 (*M. B. Ranathilaka, 2019)*. Technological inputs are required to increase the production yield, shelf life of banana and reducing the post-harvest loss. Nearly 30% - 40% post-harvest loss for banana due to poor handing, transporting and storing.

3.3.3.3.2 Potential technical inputs for Ceylon cavendish banana farming

Activity	Description
Land Preparation	Ploughing and harrowing. Bananas cannot withstand stagnant water hence soil should have good drainage facility. Furrows and cultivating beds need to be made. Dig size is 60 cm x 60 cm x 60 cm. Mamoties and crowbars can be used for digging planting holes. The plant density varies from 250 to 450 per acre depending on the planting arrangements. High density double raw banana cultivation is popular in current context as well.
Micro Irrigation	Annual water requirement is about 1000 mm to 2000 mm (2.75 mm to 5.5mm per day). Mini sprinklers or drip irrigation are recommended for micro irrigation system. Watering cycle - 40-60 litres/plant per week split into 20L (in two splits). Liquid fertilizer can be applied with drip

	irrigation method by using a fertigation unit. Mini sprinklers working at 180 degrees can be used in a double raw arrangement. Mini sprinklers' flow rate 30 LPH at 1.5 to 2 bar pressure. Water filtering is a requirement.
Weed Management & Pest Control	Bio mulching is proposed for managing weeds. Polythene cover (micron 12 – 25) or a mesh can be used as a measure against pest attack. Skin color and absence of black dots give a competitive price edge. Records needs to be kept from the time of introducing polythene cover in order to ascertain the fruit maturity level.
Harvesting	Fruit maturity level – after 100 to 110 from appearing of 1st hand. Manual harvest with the help of sharp sickle is proposed.

3.3.3.3.3 Processing

As per designed value chain assessment, it is planning to sell the harvested Ceylon Cavendish banana as fresh fruits.

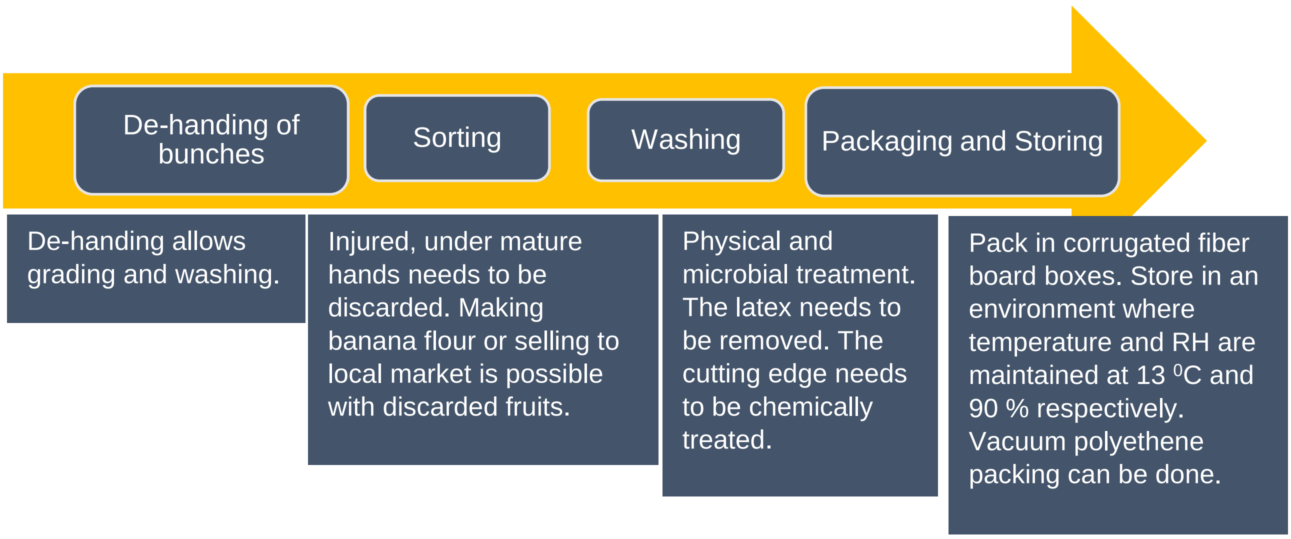


Figure 95: Processing of Banana

Note: Tree ripens banana will last for 3 to 5 days while fruit picked green and cooled and stored correctly typically lasts about 3-4 weeks. Using of "Individual quick freezing (IQF)" technology can be evaluated considering the captured market. IQF banana will last for even up to 24 months.

During stakeholder meeting, it was discussed whether buyers can supply freezer trucks for transporting the harvest. Further discussions with buyers are to be conducted.

3.3.3.4 Cassava Cluster

3.3.3.4.1 Understanding the requirement of technical inputs

The production of cassava in Sri Lanka was 281,075 tons in 2019 with an average yield of 5.5 tons per acre whereas the potential is 15 tons per acre.

Technological inputs are required to increase the production yield, shelf life of Cassava and reducing the post-harvest loss. Nearly 30% - 40% post-harvest loss for Cassava due to poor handing, packing, transporting and storing.

3.3.3.4.2 Potential technical inputs for Ceylon cavendish banana farming

Activity	Description
Land Preparation	Ploughing by using disc ploughs and harrowing are required. Planting on ridges is very important as it increase the yield and mechanized harvesting can be applied on ridged planting. Thus, ridge former is going to be used. Planting density in a range of 4,000 to 6,000 plants per acre. Land leveling is required as water clogging needs to be eliminated.
Micro Irrigation	Annual water requirement is about 1000 mm to 1500 mm (2.75 mm to 4 mm per day). Mini Sprinkler system having wetting radius of 5m can be recommended. The water discharge is 60 LPH at 1.5 to 2 bar pressure.
Weed Management	Bio mulching is proposed for managing weeds. Intracultivar can be used as well.
Harvesting	Manual method involves the use of hand hoe for cassava harvesting. It is a common and predominant method of harvesting for cassava that is planted on ridges. As per researches done in global context, the manual cassava harvesting requires 22–51-man day per hectare while it is 16 – 45-man day/ha and 1 -4-man days/ha for semi and fully mechanized cassava harvesting respectively.

3.3.3.4.3 Processing

As per designed value chain assessment, it is planning to sell the harvested cassava as fresh yams. Producing cassava flour and chips are other options. Cassava needs to be either processed or stored under favorable conditions within 48 hours after harvesting.

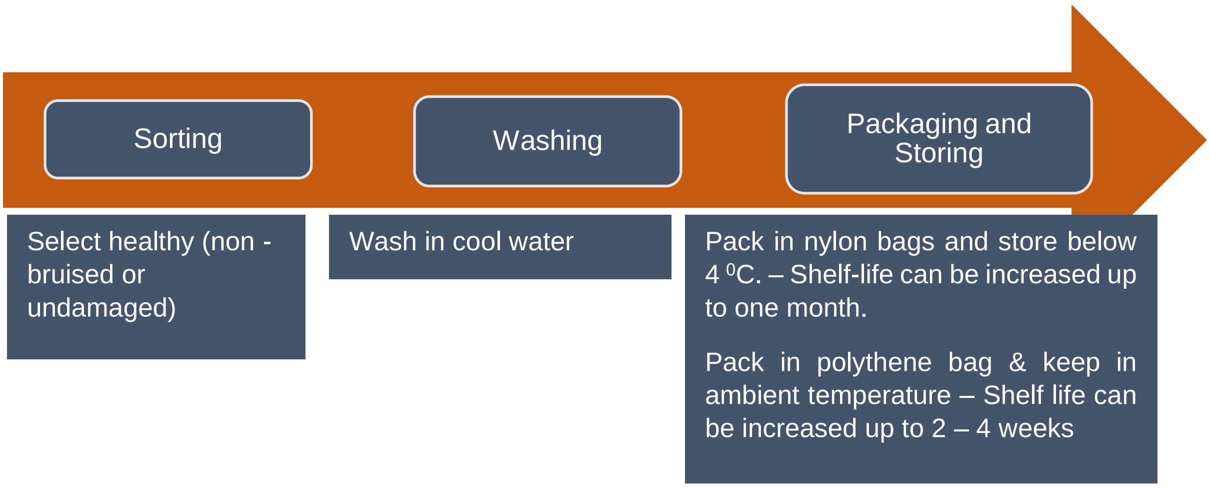


Figure 96: Processing of Cassava

Note: Drying (solar or machined dryer) and milling can be done for making cassava flour. Milling machines (hammer mills or roller-mills) that are used for grains can also be used for milling cassava chips and granules.

3.3.4 Analysis on physical infrastructure

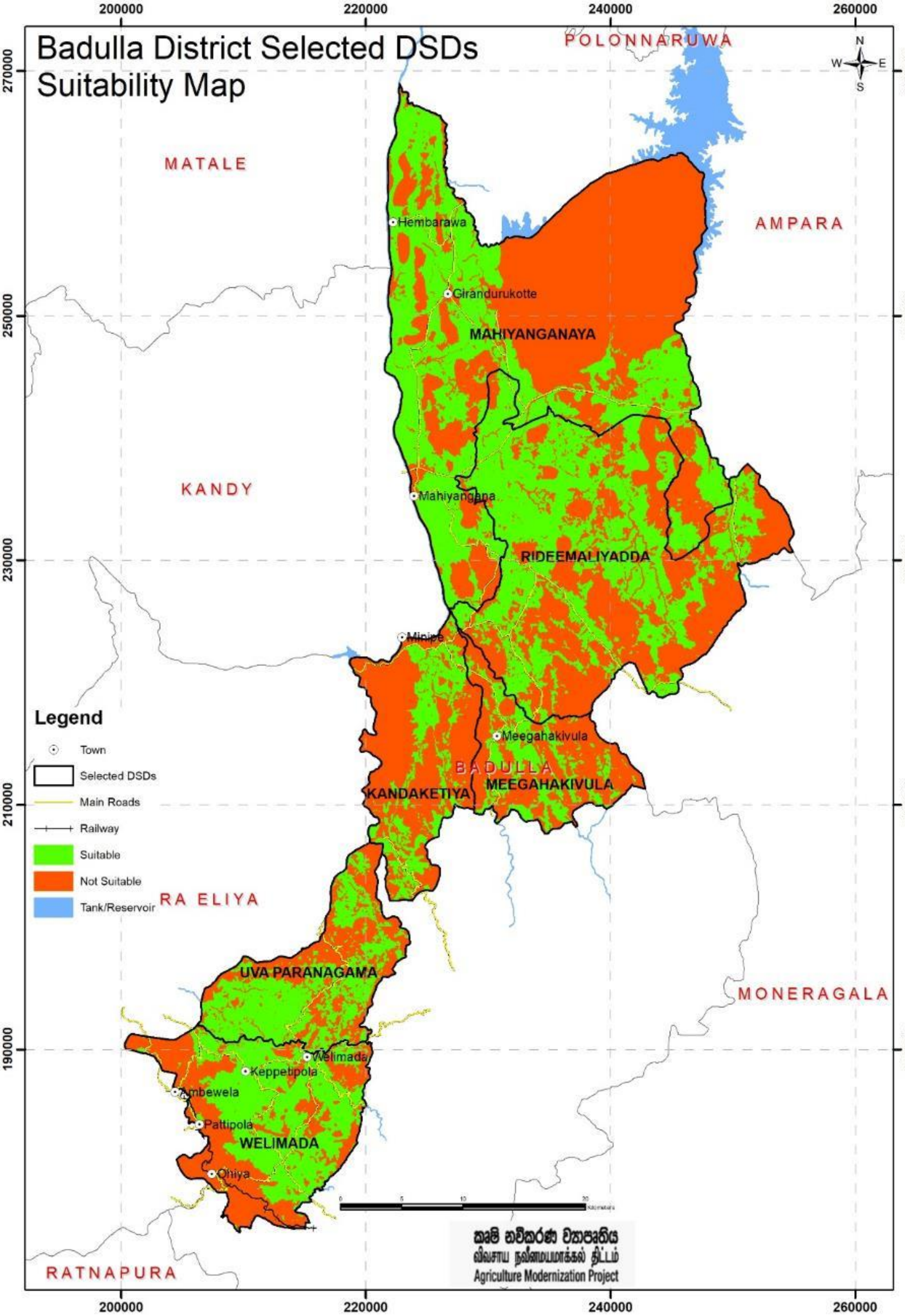
<table>
<tr><th>Physical Infrastructure Requirement</th><th>Note on feasibility options</th></tr>
<tr><td>Access roads</td><td>As per the filed visits undertaken to pilot clusters and potential lands for new clusters and expansion of existing clusters, the required access roads rehabilitation is minimum. Concrete and gravel roads were seen more frequently. Gravel roads are proposed based on necessity and its impact to the cluster/s.
Road Kilometrage by Province and District 2019
<table>
<tr><th>Province/ District</th><th>Class A</th><th>Class B</th><th>Class C</th><th>Class D</th><th>Express-ways</th><th>Total</th></tr>
<tr><td>Central</td><td>409</td><td>1,338</td><td>1,666</td><td>578</td><td>-</td><td>3,991</td></tr>
<tr><td>Kandy</td><td>184</td><td>563</td><td>929</td><td>352</td><td>-</td><td>2,027</td></tr>
<tr><td>Matale</td><td>105</td><td>283</td><td>301</td><td>177</td><td>-</td><td>866</td></tr>
<tr><td>Nuwara Eliya</td><td>120</td><td>492</td><td>436</td><td>49</td><td>-</td><td>1,097</td></tr>
</table>
Class A – Roads connecting national capital with provincial capital.
Class B – Minor roads connecting other important towns
Class C – Agricultural and local roads (12 ft width)
Class D – Graveled roads (8 – 10 ft)
Sources: RDA and PRDA</td></tr>
</table>

<table>
<tr>
<td>Water Irrigation System</td>
<td>It is proposed to provide micro irrigation package for all farmers except Avocado farmers as described under each crop category. The main water sources and water supply methods up to the selected/potential lands
1. Mahaweli river and its water streams
2. Surface water (Agro Wells) – since the rainfall is high, the surface water availability and its usage for agriculture is greater. It is persuaded to use common agro wells. However, it is not recommended to construct agro wells but pumping facility can be given to the existing agro wells based on its absolute necessity.
3. Ground Water (Tube Well)
<table>
<tr><th>Yield (l/min)</th><th>Udunuwara (%)</th><th>Kundasale (%)</th><th>Harispattuwa (%)</th></tr>
<tr><td>0 -100</td><td>80</td><td>83.33</td><td>46.67</td></tr>
<tr><td>100 - 1000</td><td>18.3</td><td>13.6</td><td>33.33</td></tr>
<tr><td>>1000</td><td>1.7</td><td>2.7</td><td>20</td></tr>
</table>
Source: National Water Supply and Drainage Board, Kandy
Ground water potential is higher in Harispattuwa DSD compared to the rest under previewed.</td>
</tr>
<tr>
<td>Processing Centre</td>
<td>The processing centre needs to be designed based on machinery and production process flow required to meet the agreed value chain assessment and product certification.

It is more focus to rehabilitate and use abounded government building rather than construction of new buildings. Depending on distance from farmlands to the processing centre and usability of same machineries, a common processing centre for few crop clusters can be established. Below mentioned component are to be included in a processing premises.
Crop receiving, weighing, acceptance and pre-treatment section. Washing, intermediate drying or cooling and initial sorting are considered as pre-treatment.
Processing Section – Machineries are to be installed considering the productivity, worker convenience, effective process flow and space availability.</td>
</tr>
</table>

	Storing facility – Pest control measures, proper ventilation, maintaining of required temperature and RH are going to be considered in order to enhance shelf life of products. Auxiliary buildings • General Office for PUC with facilities for meetings and training sessions. • Marketing Outlets • Worker sanitary facilities • Compost making facilities • Machinery maintenance section • Store room – Manging inventory Rooftop solar power generation under "Net Plus" scheme is proposed. This will reduce the operation cost and ensure the operation of critical processing steps even at a power outage.

3.4 Badulla District



3.4.1 Agricultural Analysis

The way of analysis is same as previous districts but the results are different. Here the variation of Agro ecological zones is little bit high comparatively to other three districts i.e., Kandy, Vavuniya and Kilinochchi. Ecological zones variation is extended from Low country Dry zone (DL) to Upcountry Wet zone (WU). That means the cultivable crop range is higher.

Table 36: Current practices and remedies to overcome drawbacks

Crop	Current Practices	Suggestions to improve	Ultimate goal
Seed potato	Scientific agricultural approach not available. Yield of seeds is poor.	Proper training on land selection, preparation and soil analysis. Address to Crop physiology and introduce "Haulm Killing".	Achieve the potential yield with high percentage of seeds.
Chili	All practices are very poor and not in scientific way.	Introduce all agricultural practices to do in scientific way. Start model field with all very correct agricultural practices.	Achieve the potential in all aspects.
Avocado (Hass)	Commercial cultivation not available.	Introduce a model farm easily encourage farmers to follow the correct practices. Start model field with all very correct agricultural practices.	Achieve the potential yields and expected quality.
Vegetable	Pilot project not available.	Introduce all agricultural practices to do in scientific way.	Achieve potential yields and expected quality.

Table 37: Agro ecological analysis of Badulla district

DSD	Agro ecological zone	Rain fall – mm	Soil type	Terrain
Mahiyangana	DL1c, IL2	900 – 1600	RBE, LHG Latasolic	Rolling, hilly, undulating
Rideemaaliyadda	IL2, IM1a, IU2	1600 – 2100	RBL, RYP, LHG, Mountain Regosol, Lithosol	Very steep & Hilly, Rolling, undulating

Kandaketiya	IL2, IM1a, IM1c, IU3c	1300 – 1600	RYP, LHG, RBL	Very steep, Hilly Rolling, Undulating
Meegahakiula	IL2, IM1a, IM1c, IU2	1300 – 2100	Mountain Regosol, Lithosol, RBE, LHG	Very steep, Hilly.
Welimada	IM1a, IU3b, IU3c, WU3	1300 – 1800	RYP with prominent A1 horizon, RYP with dark B horizon	Hilly, rolling, very steep.
Passara	IM1a, IM2b, IU2, IU3c	1600 - 2400	RYP, LHG, RB Latasolic, LHG, IB, Lithosol soils.	Steeply dissected, Hilly and Rolling, Very Steep.
Haldummulla	DL1a, IM2a IM2b, IU3a, IU3b, IU3c, WU3	1100 - 1800	RBE, LHG, RYP with prominent A1 horizon, RYP with dark B horizon.	Rolling and Undulating, Hilly, rolling, very steep, Steeply dissected, Hilly and Rolling,

According to the table 37 different DSDs of Badulla district has different soil types and Rainfall patterns. That means the vegetation of the area must be different according to the soil types and rain fall patterns. Therefore, the crop cultivation of district may be varied in different DSDs.

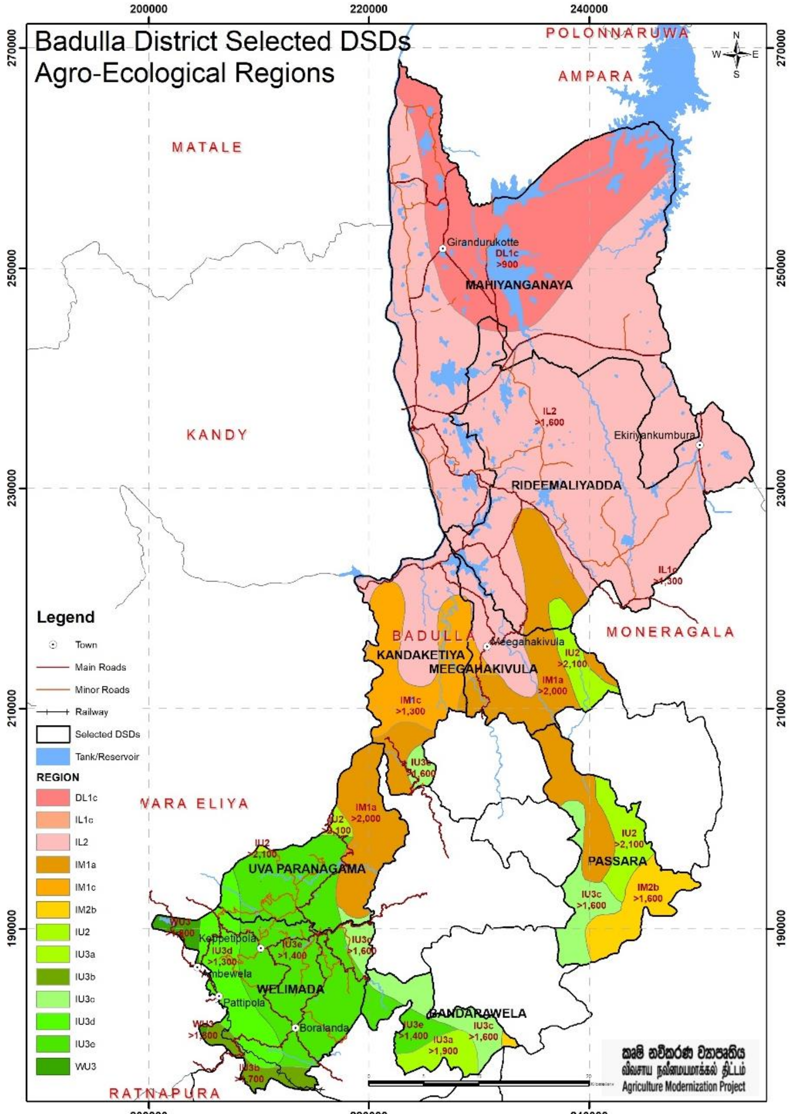


Figure 97: Badulla District Selected DSDs Agro-Ecological Region Map

3.4.2 Agri-business and Value Chain Analysis

13. Chili value chain

Refer 2 of Chapter 3.1.2.

14. Avocado value chain

Refer 12 of chapter 3.3.2.

Green gram/Cowpea value chain

Refer chapter 3.5.2.

15. Vegetable Cluster (Carrot and leeks) value chains

The vegetable supply chain, even for high value vegetables, are very fragmented in Sri Lanka. In this fragmented supply chain farmers are generally the price takers and margins are predominantly determined by middlemen and collectors. It has also been observed that linkages between growers/farmers, processors and exporters are very weak. Currently majority of farmers are selling their produce to the local aggregators/collectors or the middle man at the price determined by the middle man. The major source of price information to farmers are these collectors and aggregators, therefore farmers have very limited alternatives to sell their produce to other stakeholders (like processors and exporters) along the value chain. These collectors/aggregators are further linked to processors and exporters which in turn offer prices based on domestic or international market. Due to the presence of these middle men farmers are not realizing true price of their produce and major part of the margins are transferred to middle man (collector and aggregators). This inefficiency and ineffectiveness in market linkages, has restricted the growth of fruits and vegetables sector in the country.

Structure of the traditional vegetable value chain has a large number of intermediaries between the producer and the consumer and hence the addition of marketing margins of all these intermediaries has resulted in the producers receiving a very low price and the consumers compelled to pay a high price for the vegetables. vegetable value chain consists of at least seven types of stakeholder segments, which were named as: the input suppliers to the producers, the producers, agri business companies, the collectors, the transporters and finally the trade as in wholesalers and retailers.

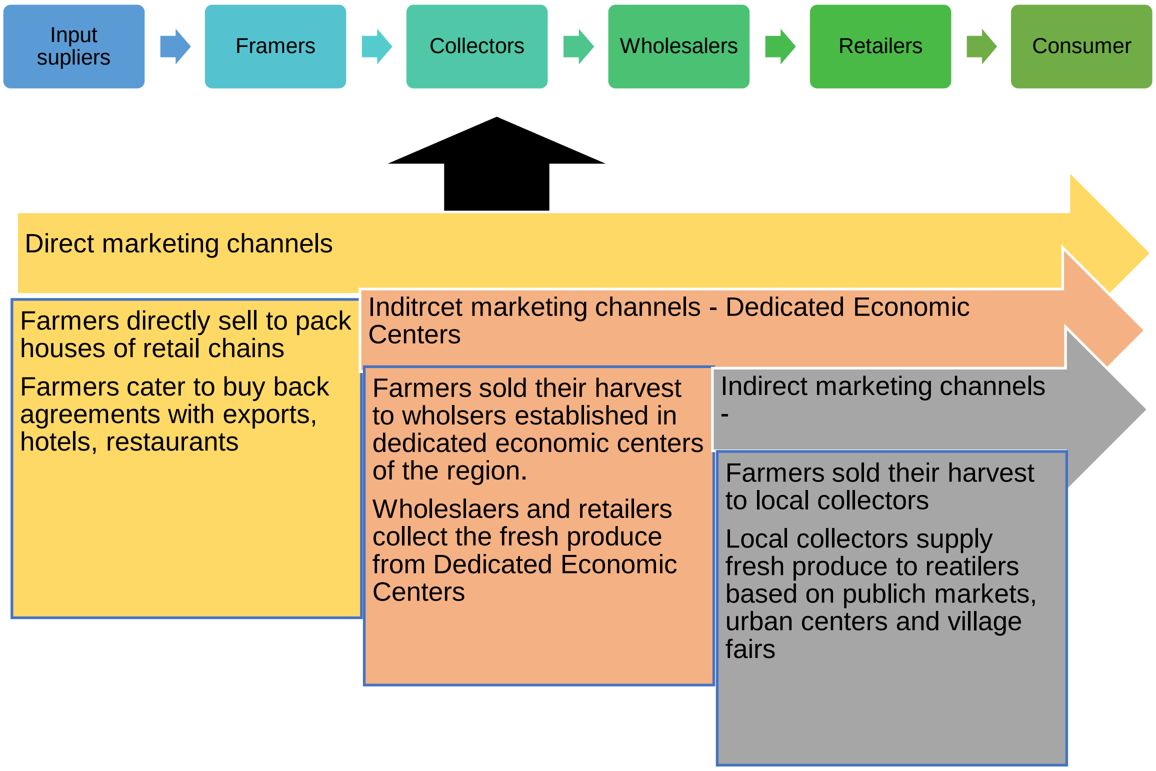


Figure 98: Value chain map for Carrot and Leeks

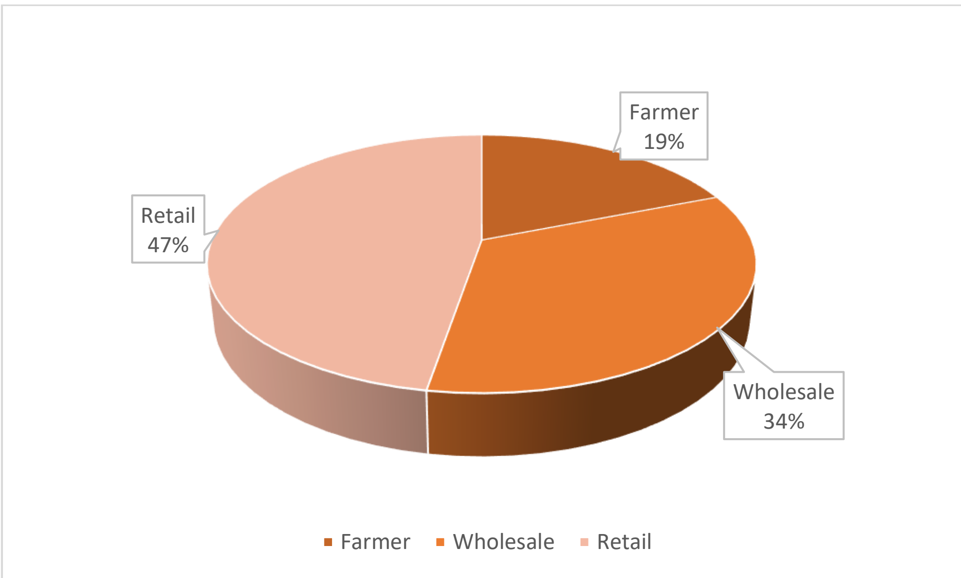
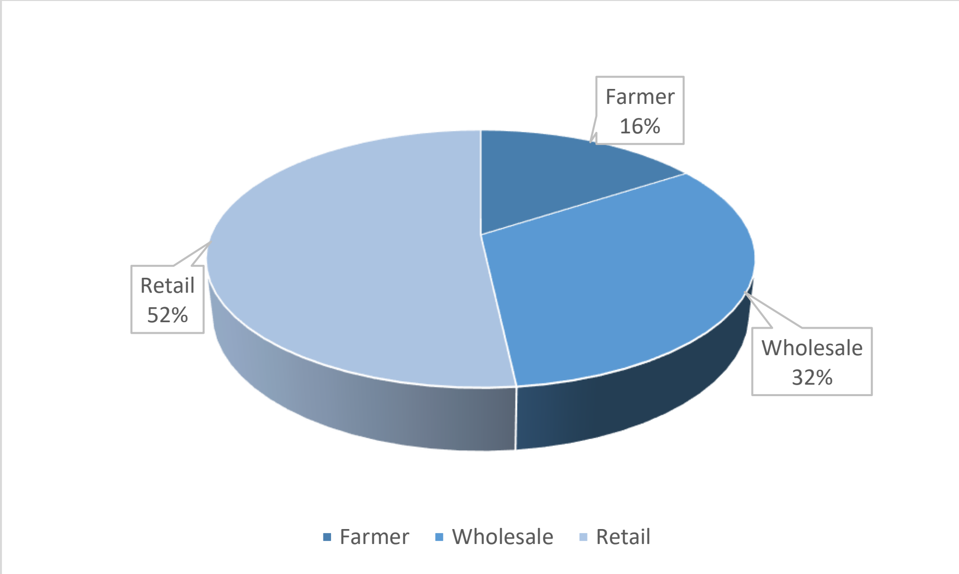


Figure 99: Income share among the carrot value chain actors


Farmer
16%
Wholesale
32%
Retail
52%
Farmer Wholesale Retail


GOODHARVEST


GOODHARVEST
SAFE
FRESH
SOCIALLY RESPONSIBLE
SL-GAP CERTIFIED

Figure 100: Carrot value chain – Picture analysis

16. Maize Seed Production Cluster

Separate feasibility report prepared, submitted and approved.

Developed value chains for Badulla District are given in table 5.

17. Seed Potato Production Cluster

Introduction

Sri Lankans consume 228,000MT of potatoes annually (Dept. of Census and Statistics, 2020), and the per capita consumption of potato has increased by more than 5 Kg in the last 14 years. Potato demand is fulfilled by both local production and imports. However, so far only 35 percent of the requirement is fulfilled via local production. On the supply side, farmers require approximately around 15,000MT of quality seed potatoes annually to meet the production. At present, the public sector produces 10 percent from the total seed potato requirement and another 10 percent is imported to the country. The balance 80 percent is generated by farmers themselves as self-seeds.

Potato has become an increasingly popular agricultural crop, especially among upcountry farmers, due to amplified consumer demand over the years and its shorter lifespan compared to other field crops. Both these reasons have placed potato at the top as a good cash crop in the country.

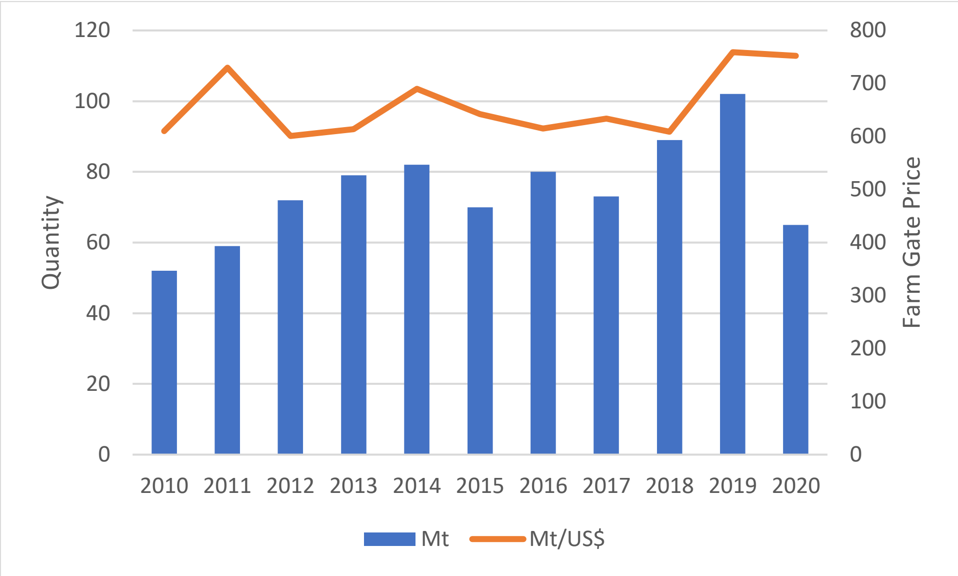


Figure 101: Potato production and the farm gate price

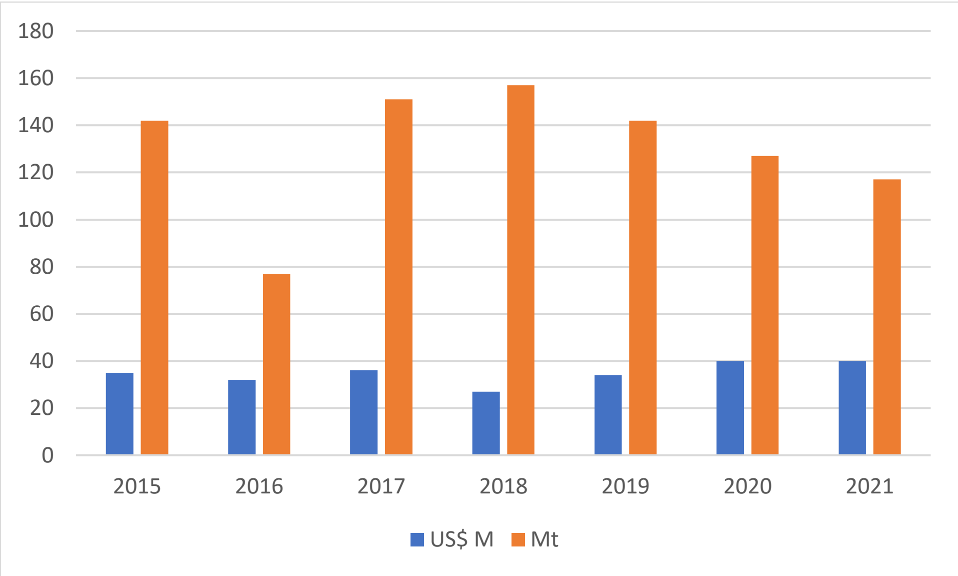


Figure 102: Value and volume of Potato Imports to Sri Lanka

Potato cultivation, a generations old practice among the farmers of Badulla and Nuwara Eliya districts and limited amounts in Jaffna. Even though, the crop shows lucrative prospects high cost of production limit the farmers returns. Specially, ad hoc government policy on potato imports and taxes significantly effects on both farmers and consumers.

Unfortunately, due to the high cost of production, potato cultivation is becoming more and more challenging for farmers. Only the seed accounts for more than 50 percent of the total cultivation cost due to the shortage of quality seed potatoes at a reasonable price. Seed potato production begins with mini tubers and then by producing Generation 0 (G0). Since this is a technical as well as capital intensive aspect, a majority of farmers could not afford this process.

None of the private companies are involved in producing quality seed potatoes in Sri Lanka. Instead, importation of seed potatoes is solely handled by private entities. A major portion of imports arrives from the Netherlands. The US and France also contribute in lesser quantities. Sri Lanka imports 'Class A' type seed potatoes to the country and according to the Dutch General Inspection Service, Class A refers to certified Generation 9 (G9) which is recommended to be cultivated only once in a season. Therefore, Class A is not recommended to generate self-seeds. The price of an imported seed box weighing 50kg is around Rs.16,000 to Rs.18,000. Interestingly, the price of a locally-produced quality seed box ranges between Rs.7,000 and Rs.10,500 depending on the certification. A farmer requires 14 to 16 seed boxes to cultivate an acre.

Most common seed potato varieties are Granola (a potato hybrid developed by Solana, Germany, is a very well-known variety in Asian countries. It produces high yields of quality tubers and a well-suited variety to cultivate in Welimada and Nuwaraeliya, Sri Lanka) and Red La Soda (high yielding variety of attractive appearance which was developed in the USA in 1948. A popular variety in Jaffna and can be cultivated in Yala season in up-country under proper control of fungal diseases).

Figure 103: Potato varieties: Granola and Red La Soda

About 80% of the potato cultivation depends on farmer's seeds or smaller size potatoes, consumption type used as seeds. Farmer-based informal seed systems are generally unable to maintain the expected quality and resulted low yield.

seeds produced through such systems are easily prone to diseases. Farmers even used to slice both local and imported seeds unnecessarily to cover the total seed requirement. This increases diseases quite frequently. Also, farmers retain some portion from the first harvest of the imported seed potatoes to use as seeds for the next season. Therefore, the ultimate result could be the reduction of total productivity at the national level, thereby creating an adverse environment for both local potato farmer and consumer communities.

Currently, G0 production is carried out by the government sector on a large scale while a limited farmer group is involved on a small scale. However, those farmers are scattered within the major production areas. The government allocates 50 percent subsidy (50 percent cash contribution from the government and 50 percent from the farmer) for all farmers without a systematic mechanism.

Even the public sector pays minimum attention and supervision on those activities. On the contrary, it is not feasible to supervise each and every farmer at once. So, there should be a proper mechanism to allocate subsidies rather than providing them for the sake of enhancing productivity.

Even though we have a Seed Act, it has to be further strengthened to enhance local seed production and distribution. Farmers produce seeds from imported seeds and then sell it to others on a large scale without a certification.

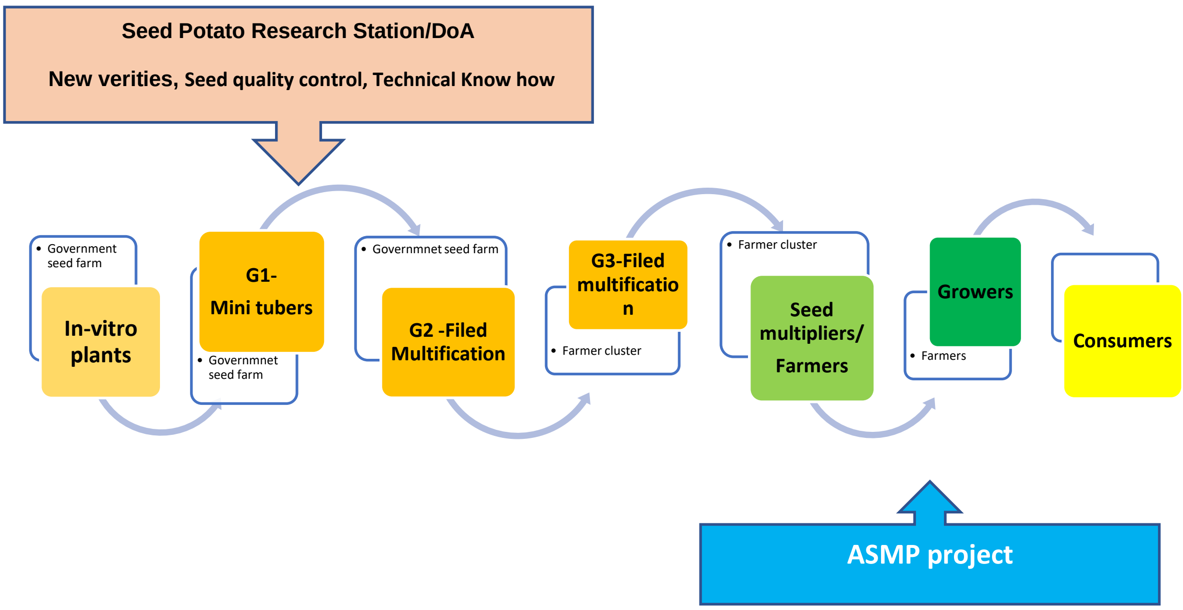


Figure 104: Seed potato value chain

Figure 105: Steps of seed potato value chain based on the filed observations

Value chain development

Currently huge gap existing in demand and supply of quality seed potato. Therefore, strengthening the existing seed potato value chain, establish networks among the potential partners and commence the seed potato cultivation as a business venture is essential subsector. The formation of viable public–private partnerships for quality seed potato production in the country is an approach to overcome this issue (Kuruppu et al., 2020).

Potentials and possibilities on G0 seed production remains with the government own seed potato research station, Seetha Eliya where infrastructure and expert knowledge is readily available. At the same time, it is not feasible for commercial level private sector companies to enter into G0 production since the cost of production is comparatively higher than that of the government. For government, the cost of production is around Rs. 4.00 per G0 tuber and the market price is Rs. 6.00. However, for the private sector, the cost of production is more than Rs. 6.00 per tuber and the expected market price ranges between Rs. 10.00 and Rs. 12.00 per tuber.

Nevertheless, there is a possibility of forming partnerships related to Generation 1 (G1) seed potato production. This is a very good area for private entities to invest. Currently, the government farm located at Seetha Eliya produces G1 in 20 poly tunnels. G1 production is expected to increase by establishing another 25 poly tunnels in the farm. This is a far better opportunity for the private sector to enter into the industry. Apart from Seetha Eliya, there are other government seed potato production farms in Meepilimana, Udaredella, Pidurutalagala and Kandapola. G1 production is feasible in those farms as well. If farmers are able to access locally-produced quality G1 seed potatoes, then they can reduce their per acre seed cost by 10 percent compared to imported seeds.

ASMP project initiated the G1 seed production pilot cluster in Wakkadahinna, Welimada. Project aims to expand the cluster, facilitating 300 farmers to cultivate G1 seeds. Further, Framer cluster will form PUC, and the PUC will be produced G1 seeds in 300Ac in Welimada area and the expected production is around 3600Mt.

This would be promising public–private partnership in the agriculture sector. All partnerships mutually share benefits and risks. But this has to be crafted through a proper legal agreement. Without a proper agreement, partners would not show any interest. Therefore, the proper legal environment is a must to form realistic partnerships in Sri Lanka, especially related to agriculture inputs.

3.4.3 Technological Analysis

3.4.3.1 Dry Chili Production

3.4.3.1.1 Land Preparation

Already discussed under Kilinochchi district chili cluster.

3.4.3.1.2 Water Management

The water requirement for chili as an average is 4.50 mm/day. Required irrigation water capacity depends on application efficiency of selected irrigation method and soil condition (vertical and horizontal water penetration). The average annual rainfall in Badulla district is 6 mm/day.

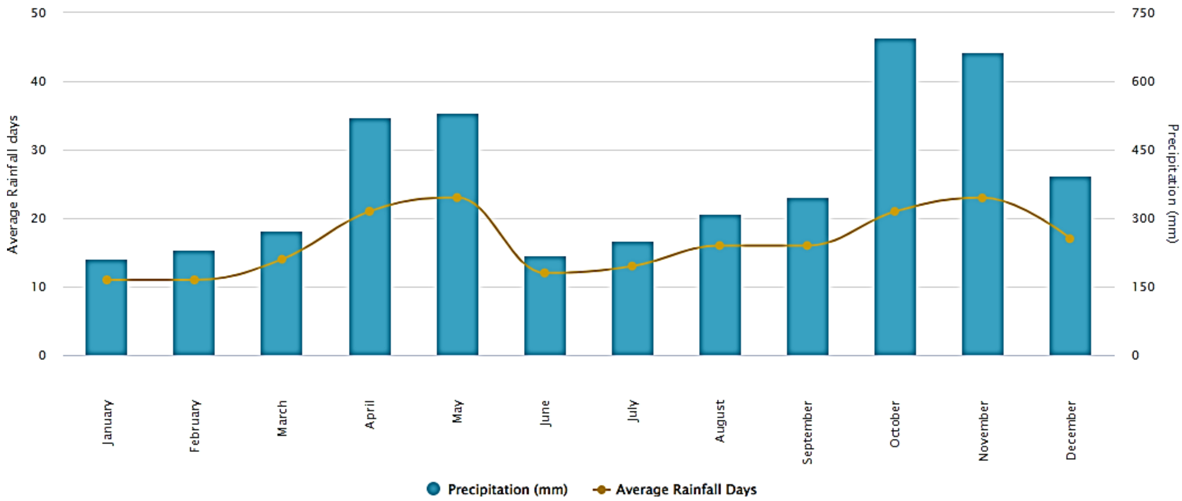


Figure 106: Monthly average rainfall in Badulla district

It is advisable to start chili cultivation in October. However, irrigation system with a reliable water source is a must as chili plant expose to dry weather from February to April and June to September.

Table 38: Effectiveness of Irrigation Methods for Chili cultivation

Irrigation Method	Surface Irrigation	Sprinkler Irrigation	Drip Irrigation
Water application efficiency	50%	70%	85%
Weed Pressure	High	Low	Minimum
Favorable for diseases	High	Low	Minimum
Required water pressure	Not applicable	High	Low
Fertigation	Not possible	Not always	Possible
Recommendation	Not recommended	Recommended if drip irrigation is not possible	Recommended.

Drip irrigation uses plastic tubing which is designed and manufactured with precision water emitters spaced at regular distances along the length of the tubing. The emitters are engineered to release a specific amount of water which is 2 l/h at 1 bar pressure. Drip tape can be practices but less durable compared to tubes. Water for drip irrigation systems must be free of solid particles which can clog the emitters. Thus, filtering systems are highly recommended.

The recommended drip irrigation system can be used to supply the required plant nutrients by using a fertigation unit.

3.4.3.1.3 Weed and Pest Management

Already discussed under Kilinochchi district chili cluster.

3.4.3.1.4 Harvesting

Already discussed under Kilinochchi district chili cluster.

3.4.3.1.5 Processing

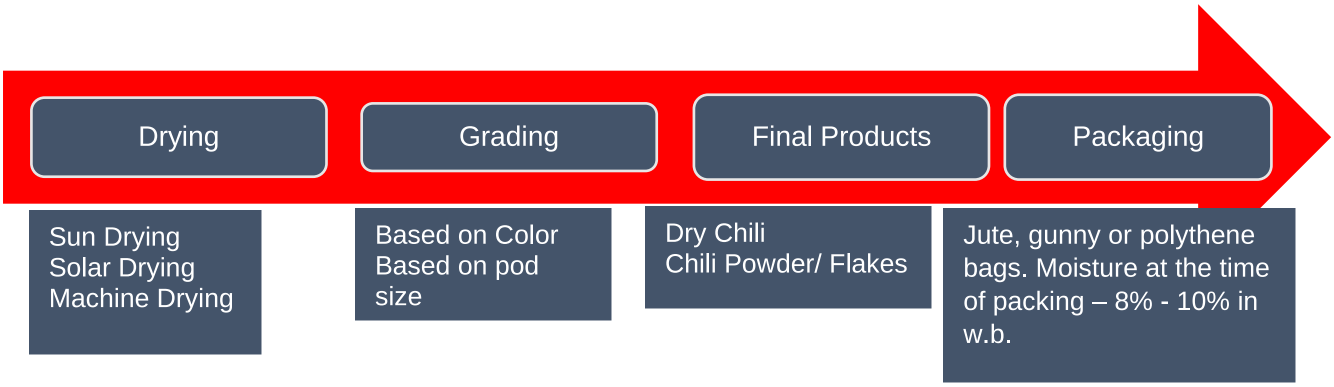


Figure 107: Processing of Chilli

Process	Note on feasibility options
Drying	• Introducing a solar tunnel dryer for intermediate drying and initial withering – Reduce required thermal load and minimize mould formation and spreading. • Either batch or continues type chili dryer. • Using electricity as the thermal power source will be convenient and cost effective for the farmer company. – Heat Pump • Having chili flattens system will reduce drying duration as well as texture shrinkages. • The desired moisture content at the dryer mouth is 8 % in w.b. • Inlet hot air temperature needs to be maintained at 50 – 60 ^{0}C. • Better to have a positive temperature gradient.
Grading & Sorting system	• Grading/sorting is based on pods colour and size. • Considering the current manual operation (hand picking), the investment on a colour sorter will be paid back within one year. (Kindly refer the workings under Kilinochchi district chili cluster) • Secondaries can be used for making chili powder, flakes or paste.

Packing & storing	• Jute, gunny or polythene bags can be used for packing depending on packing density decided by the selected marketing channels i.e., wholesale or retail marketing. • Ascertained storing bulk density of dry chili at 10% moisture is 18 kg/square feet at storing height of 6 feet. • The moisture content at the time pf packing should be around 8% - 10% in w.b. • Evaluation of existing government buildings and lands are being evaluated for a chili processing centre in Badulla district. • Designed features of chili processing centre have been discussed under Kilinochchi district chili cluster.

3.4.3.2 Hass Avocado Cluster

3.3.3.2.1 Understanding the requirement of technical inputs

Sri Lankan Avocado production in year 2017 was 10,100 metric tons *(DOA, Sri Lanka)* at an average yield of 1,400 kg per acre. Avocado hardly find in large scale lands but popular a s a home garden. Avocado production in Badulla district is around 1,091 ton/annum (10% of national annual production) *(source : 07._Fruit_-_pg_65-77_-final.xls (live.com))* .

Malwatte valley plantations has started cultivating Hass variety in large extent. Their planting density is 120 plant per acre.

Technological interventions are required to minimize post-harvest loss and increase the shelf life.

3.3.3.2.2 Potential technical inputs for Avocado farming

Activity	Description
Land Preparation	After land clearance, it is required to follow soil conservation practices. Planting density is 100 plants per acre. Intercropping is possible with less plant density. Dig size is 60 cm x 60 cm x 60 cm. Mamoties and crowbars can be used for digging planting holes. Considering the land availability in Badulla district, either distributing 50 plants among farmers where they can cultivate the same managing their existing lands or finding out or allocating ½ acre land per farmer to develop as a cluster can be done.

Micro Irrigation — Annual water requirement is about 1200 mm to 1300 mm (3.5 mm to 4mm per day). Availability of land and terrain restrict the application of micro irrigation facilities. Thus, the cultivation is going to be in rainfed. Badulla district annual rainfall and its variation throughout a year won't be an issue. If water is going to be irrigated, the required watering pattern is 10 l/plant at every 4 – 5 days.

Harvesting — Maturity level for avocado fruit is 4 – 6 weeks. Avocado wont ripe until it is plucked. Identification of proper maturity level for harvesting minimize post-harvest losses in greater extent. Fruits are harvested using a picking-pole attaching a net bag to prevent possible damage due to falling. After harvesting, the avocado fruit must be carefully transferred from the picking bag into the field crates in order to avoid mechanical injuries, especially bruising.

3.3.3.2.3 Processing

As per designed value chain assessment, it is planning to sell the harvested avocado as fresh fruits. Extracted avocado oil has a great foreign market potential. Avocado pulp processing can be undertaken based on demand.

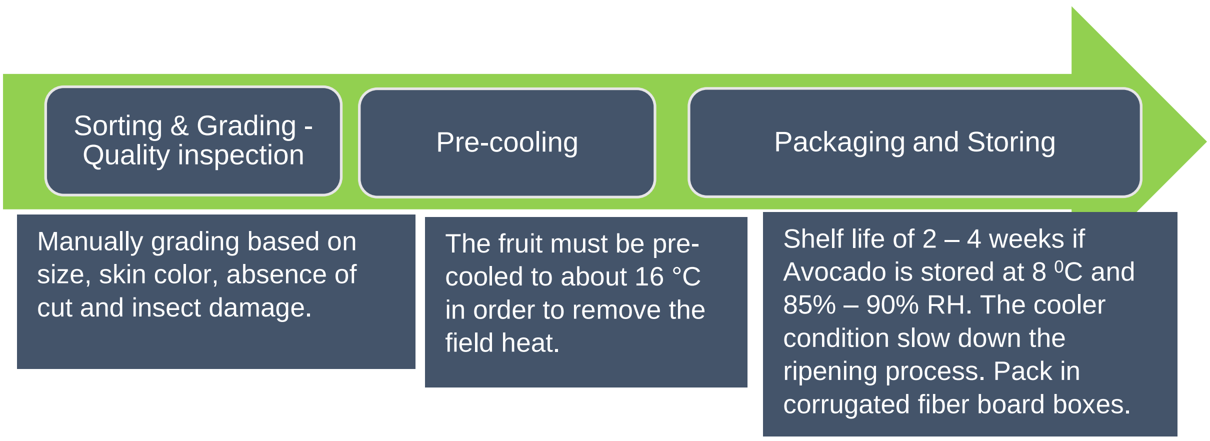


Figure 108: Processing of Avocado

Note: Artificial ripening is not yet practiced among farmers/ traders. However, keeping fruits at the collection points accelerates the ripening process due to heat buildup and ethylene liberated from other ripening fruits. Hot water treatment is recommended in order to control disease during storage and the marketing of fresh fruit.

Exposure to the sun will tend to increase the pulp temperature, which accelerates ripening and shortens the shelf life of the fruit. Evaporative or refrigerated cooling technology can be applied for pre-cooling which helps to increase the shelf life. Harvesting matured unripe fruits provide a better shelf life.

Table 39: Recommended storage conditions for specific avocado cultivars

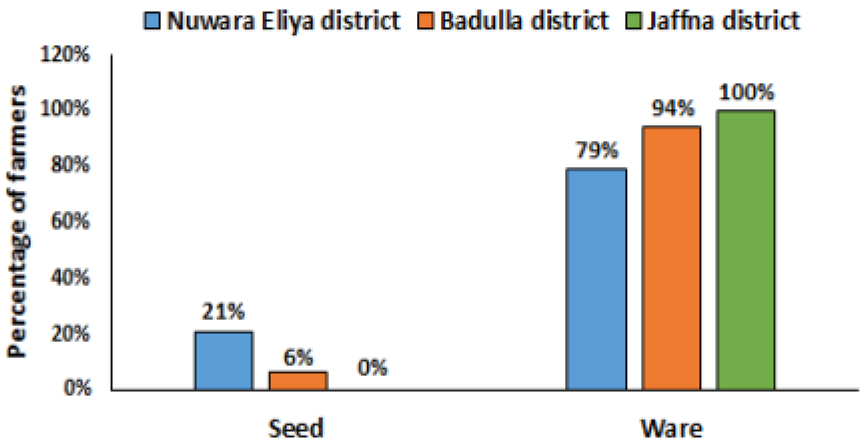
Cultivar	Ripe or unripe	Temperature	Relative humidity	Duration
'Booth 1' (Guatemalan x West Indian hybrid)	Unripe	4.5 °C	85 to 90%	2 to 4 weeks
'Booth 1'	Unripe	4 °C	90 to 95%	4 to 8 weeks
'Fuchs' (West Indian)	Unripe	12.8 °C	85 to 90%	2 weeks
'Fuchs'	Unripe	10 to 13 °C	85 to 90%	2 weeks
'Fuerte' (Mexican x Guatemalan hybrid)	Unripe	5.5 to 8 °C	85 to 90%	3 to 4 weeks
'Fuerte'	Ripe	2 to 5 °C	85 to 90%	1 to 2 weeks
'Fuerte'	Ripe	3 to 7 °C	85 to 90%	2 to 4 weeks
'Hass' (Guatemalan x Mexican hybrid)	Unripe	5.5 to 8 °C	85 to 90%	3 to 4 weeks
'Hass'	Ripe	2 to 5 °C	85 to 90%	1 to 2 weeks
'Hass'	Ripe	3 to 7 °C	85 to 90%	2 to 4 weeks

[a]Source: Kader[92]

3.4.3.3 Seed Potato Cluster

3.4.3.3.1 Understanding the requirement of technical inputs

Annual Sri Lankan Potato production is about 80,000 metric tons and annual seed requirement is 15,000 metric tons. At present, the public sector produces 10 % from the total seed potato requirement and another 10 % is imported to the country. The balance 80 % is generated by farmers themselves by reusing some of their previous crop as seed potatoes for the next year *(Source: How to improve the seed potato industry in Sri Lanka | PotatoPro)*. Only around 6% out of the total potato production in Badulla district goes for seeds.



Source: M.S.A. Mohamed, D.L. Wathugala, W.A. Indika and M.K.S. Madushika, 2021

Figure 109: Production purpose of potato

Higher generating seeds by farmers is mainly due to cost of quality seeds. As per the information, 50% of the potato production cost goes for quality seeds. The information implies that potato farmers can't achieve the potential yield due to higher usage of substandard seeds. National potato yield is 16 MT/Ha but the potential is 34 MT/Ha. It needs to be targeted at least 25 MT/Ha.

Quality seeds – G0 or G1 generation, higher germination rate. The main technology gap in seed potato production is the absence of adequate cold storing facilities. Thus, with deterioration of seed quality, the usage of substandard quality potato seeds by farmers (higher generation) and reducing yield are inevitable. It is viscous cycle to break.

3.4.3.3.2 Potential technical inputs for Seed potato farming

Activity	Description
Land Preparation	Ploughing up to 30 cm depth is required. Disc ploughs and harrows can be used.
Micro Irrigation	Both drip and sprinkler Irrigation systems can be used. 1 m height, 5 m wetting radius and 300 - 400 LPH are technical requirement of sprinkler head.
Weed Management	Using inter-cultivator machine for mechanized weed management. Using of poly mulch will bring better results.
Harvesting	Machine potato harvesters are available. But due to low land extent in Badulla, the manual harvesting will be more viable. Expose to sun causes the greening of potatoes.

3.4.3.3.3 Processing

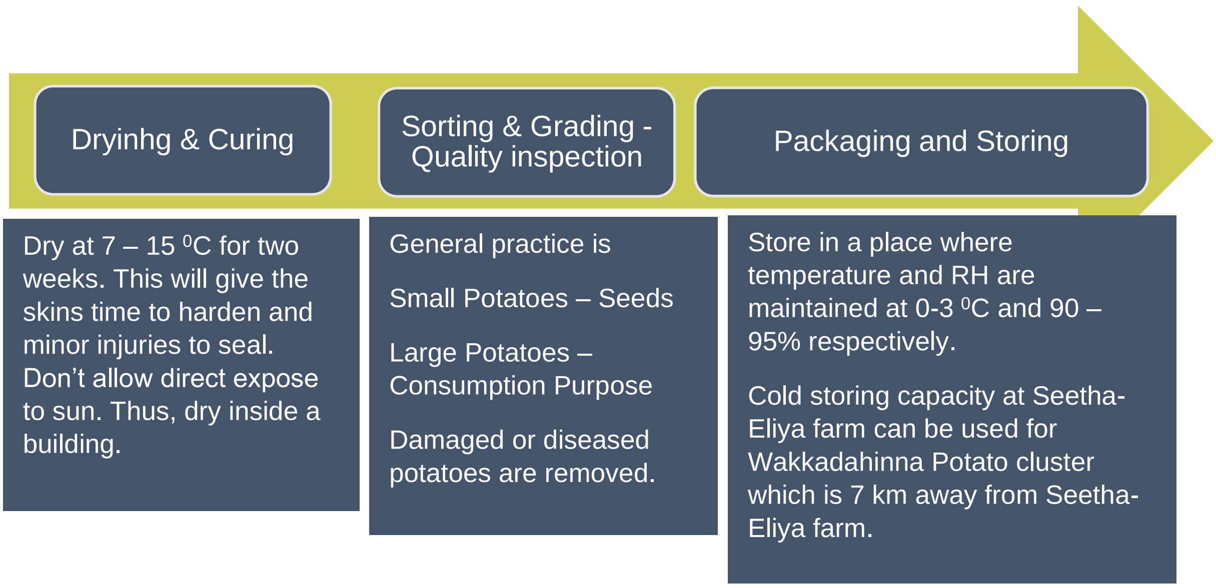


Figure 110: Processing of Seed Potatoes

Note: It is advisable use ventilated stackable plastic crates instead of gunny or nylon bags during storing time period.

The application of diffuse light storing (DLS) technology needs to be tested for potato storing. DLS is a low-cost storing practice which retard the physiological growth of potato seeds by controlling indirect light level and ventilation. The self-life of potatoes under DLS facility is about 5 to 6 months while it is 9 to 10 months with cold storing facility. But DLS is more economical option compared with cold stores.

3.4.4 Analysis on physical infrastructure

<table>
<tr><th>Physical Infrastructure Requirement</th><th>Note on feasibility options</th></tr>
<tr><td>Access roads</td><td>
As per the filed visits undertaken to pilot clusters and potential lands for new clusters and expansion of existing clusters, the required access roads rehabilitation is minimum. Tar and gravel roads were seen more frequently. Gravel roads are proposed based on necessity and its impact to the cluster/s.
Road Kilometrage by Province and District 2019
<table>
<tr><th>Province/ District</th><th>Class A</th><th>Class B</th><th>Class C</th><th>Class D</th><th>Express-ways</th><th>Total</th></tr>
<tr><td>Uva</td><td>471</td><td>693</td><td>1,689</td><td>682</td><td>-</td><td></td></tr>
<tr><td>Badulla</td><td>267</td><td>432</td><td>1,109</td><td>406</td><td>-</td><td></td></tr>
<tr><td>Moneragala</td><td>204</td><td>261</td><td>580</td><td>276</td><td>-</td><td></td></tr>
</table>
Class A – Roads connecting national capital with provincial capital.
Class B – Minor roads connecting other important towns
Class C – Agricultural and local roads (12 ft width)
Class D – Graveled roads (8 – 10 ft)
Sources: RDA and PRDA
</td></tr>
<tr><td></td><td>
It is proposed to provide micro irrigation package for all farmers except rainfed avocado farmers as described under each crop category. The main water sources and water supply methods up to the selected/potential lands
1 Mainly Badulu and Uma Oya and irrigation channels
<table>
<tr><th>Province</th><th colspan="2">Major Schemes</th><th colspan="2">Medium Schemes</th><th rowspan="2">Total Extent (ha)</th></tr>
<tr><th>District</th><th>No of Schemes</th><th>Extent (ha)</th><th>No of Schemes</th><th>Extent (ha)</th></tr>
<tr><td>Uva</td><td>10</td><td>11,180</td><td>39</td><td>8,622</td><td>19,802</td></tr>
<tr><td>Badulla</td><td>4</td><td>4,159</td><td>13</td><td>4,335</td><td>8,494</td></tr>
<tr><td>Moneragala</td><td>6</td><td>7,021</td><td>26</td><td>4,287</td><td>11,308</td></tr>
</table>
</td></tr>
</table>

<table>
<tr>
<td>Water Irrigation System</td>
<td>
Minor Schemes

<table>
<tr><th>Province</th><th colspan="4">No of Irrigation Schemes</th><th colspan="3">Extent (ha)</th></tr>
<tr><th></th><th colspan="2">Working</th><th colspan="2">Abandoned</th><th colspan="3">Working</th></tr>
<tr><th>District</th><th>Tank</th><th>Anicut</th><th>Tank</th><th>Anicut</th><th>Tank</th><th>Anicut</th><th>Total</th></tr>
<tr><td>Uva</td><td>544</td><td>3,948</td><td>279</td><td>120</td><td>4,104</td><td>15,000</td><td>19,104</td></tr>
<tr><td>Badulla</td><td>259</td><td>3623</td><td>128</td><td>73</td><td>1,946</td><td>12,813</td><td>14,759</td></tr>
<tr><td>Moneragala</td><td>285</td><td>325</td><td>151</td><td>47</td><td>2,158</td><td>2,187</td><td>4,345</td></tr>
</table>

More depends on minor irrigation schemes. Rainfed cultivation is about 49%. It is important to invest on water conservation practices – micro irrigation, rain water harvesting …etc. Due to availability of tanks, the water bed may be at an upper level. Thus, installation of tube wells is an option.

2 Agro/tube wells – It is persuaded to use common agro wells. However, it is not recommended to construct agro wells but pumping facility can be given to the existing agro wells based on its absolute necessity. As per finding from farmer discussions, 70% of existing water pumps are engine driven.

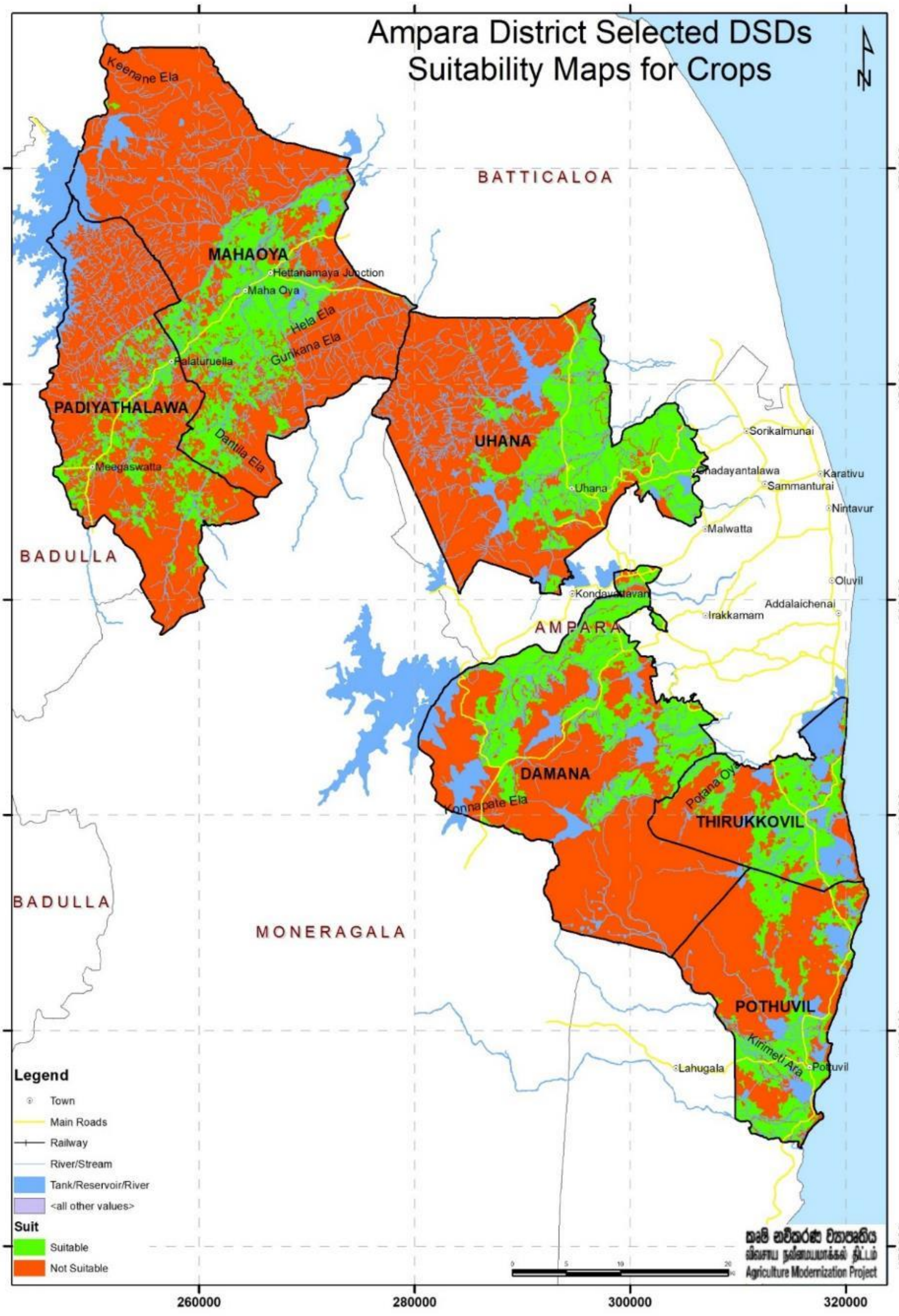
Summary of District Wise Distribution of Groundwater Aquifers

<table>
<tr><th>Province
District</th><th>Total Area
(ha)</th></tr>
<tr><td>North Central</td><td>1,065,857</td></tr>
<tr><td>Anuradhapura</td><td>721,225</td></tr>
<tr><td>Polonnaruwa</td><td>344,632</td></tr>
<tr><td>Uva</td><td>766,567</td></tr>
<tr><td>Badulla</td><td>287,208</td></tr>
<tr><td>Moneragala</td><td>479,359</td></tr>
</table>

Source: The Preparatory survey on the project for improvement of agricultural production and productivity in dry zone areas in Sri Lanka
</td>
</tr>
<tr>
<td>Protecting farmlands from wild elephants.</td>
<td>Electric fences and other destructive measure are not going to promote. Instead of that bio fencing (Lime cultivation with honey bees, cultivating thorny plants…etc) and using splashing lights are proposed.</td>
</tr>
<tr>
<td>Processing Centre</td>
<td>The processing centre needs to be designed based on machinery and production process flow required to meet the agreed value chain assessment and product certification.
It is more focus to rehabilitate and use abounded government building rather than construction of new buildings. Depending on distance from farmlands to the processing centre and usability of same machineries, a common processing centre for few crop clusters can be established. A land and building belong Paddy</td>
</tr>
</table>

	Marketing Board located in Karamatiya GN division has been already identified for maize seed production cluster. Below mentioned component are to be included in a processing premises. Crop receiving, weighing, acceptance and pre-treatment section. Washing, intermediate drying or cooling and initial sorting are considered as pre-treatment. Processing Section – Machineries are to be installed considering the productivity, worker convenience, effective process flow and space availability. Storing facility – Pest control measures, proper ventilation, maintaining of required temperature and RH are going to be considered in order to enhance shelf life of products. Auxiliary buildings • General Office with facilities for meetings and training sessions. • Marketing Outlets • Worker sanitary facilities • Compost making facilities • Machinery maintenance section • Store room – Manging inventory Rooftop solar power generation under "Net Plus" scheme is proposed. This will reduce the operation cost and ensure the operation of critical processing steps even at a power outage.

3.5 Ampara District



3.5.1 Agricultural Analysis

Ampara district comes under dry zone and different Divisional Secretary divisions have different soil types and annual rainfall also slightly different. Here the variation of Agro Ecological Zones is extended from Low country Dry Zone (DL) to Intermediate Low Country (IL). Here the range of cultivable crops are not extended as Kandy and Badulla but little bit higher than the Kilinochchi and Vavuniya.

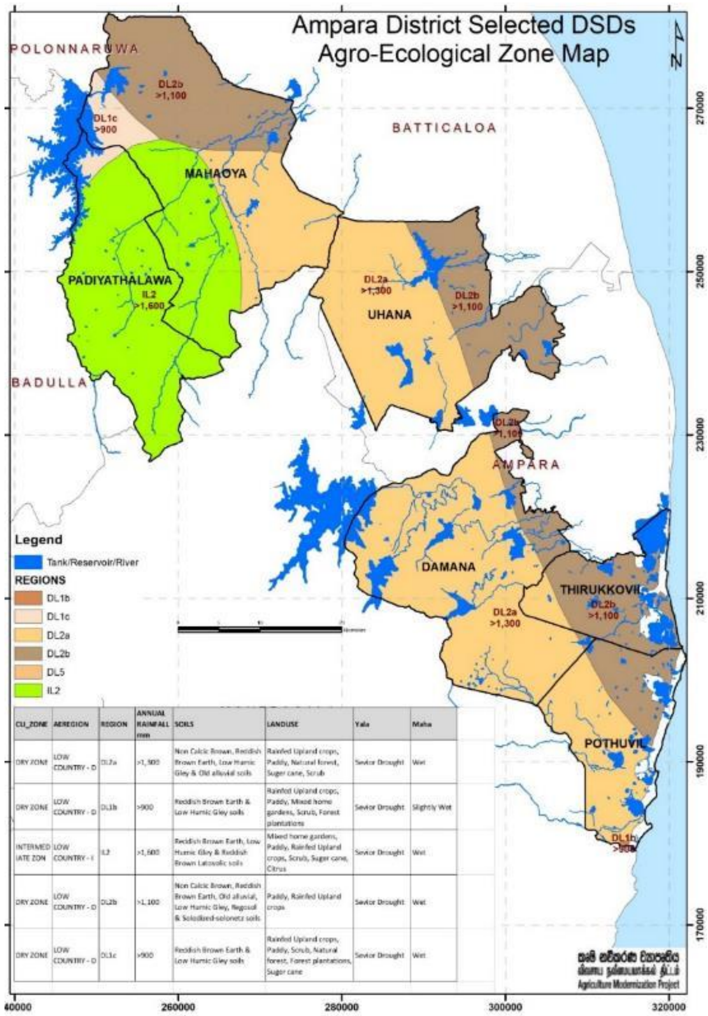
Table 40: Current practices and remedies to overcome drawbacks

Crop	Current situation	Suggestions to be introduced	Ultimate goals
Hybrid Maize seed	Not experience on Hybrid seed production	Give proper trainings on all scientific agricultural practices. Introduce all implements relevant for better results.	Potential yield and quality.
Sour sop	Apply only general practices.	All agricultural practices in scientific way including pruning and pollination.	Potential yield and quality.
Chili	All practices in general way.	All agricultural practices in modern way.	Potential yield and quality
Jumbo Peanut	Never practice soil analysis or proper land preparation.	Follow proper training module and introduce appropriate technology and implements.	Achieve the target of potential yield as well as the quality expected.

Table 41: Agro ecological analysis of Ampara district

DSD	Agro ecological zone	Rainfall - mm	Soil type	Terrain
Padiyathalawa	DL1c, IL2	900<	RBE, LHG	Rolling, Hilly, Undulating
Mahaoya	DL1c, DL2a, DL2b, IL2	900 – 1,600	RBE, LHG, NCB, Old Alluvial	Rolling, Undulating, flat
Thirukkoivil	DL2a, DL2b	1,100 – 1,300	RBE, LHG	Undulating & flat
Pothuwil	DL1b, DL2a, DL2b	900 – 1,300	RBE, LHG, NCB, Old Alluvial	Undulating & flat

According to the table 41 different DSDs of Ampara district has slightly different soil types and Rainfall patterns. That means the vegetation of the area must be different according to the soil types and rainfall patterns. Therefore, the crop cultivation of district may be slightly varied in different DSDs.



CLI_ZONE	AEREGION	REGION	ANNUAL RAINFALL mm	SOILS	LANDUSE	Yala	Maha
DRY ZONE	LOW COUNTRY - D	DL2a	>1,300	Non Calcic Brown, Reddish Brown Earth, Low Humic Gley & Old alluvial soils	Rainfed Upland crops, Paddy, Natural forest, Suger cane, Scrub	Sevior Drought	Wet
DRY ZONE	LOW COUNTRY - D	DL1b	>900	Reddish Brown Earth & Low Humic Gley soils	Rainfed Upland crops, Paddy, Mixed home gardens, Scrub, Forest plantations	Sevior Drought	Slightly Wet
INTERMEDIATE ZON	LOW COUNTRY - I	IL2	>1,600	Reddish Brown Earth, Low Humic Gley & Reddish Brown Latosolic soils	Mixed home gardens, Paddy, Rainfed Upland crops, Scrub, Suger cane, Citrus	Sevior Drought	Wet
DRY ZONE	LOW COUNTRY - D	DL2b	>1,100	Non Calcic Brown, Reddish Brown Earth, Old alluvial, Low Humic Gley, Regosol & Solodized-solonetz soils	Paddy, Rainfed Upland crops	Sevior Drought	Wet
DRY ZONE	LOW COUNTRY - D	DL1c	>900	Reddish Brown Earth & Low Humic Gley soils	Rainfed Upland crops, Paddy, Scrub, Natural forest, Forest plantations, Suger cane	Sevior Drought	Wet

Figure 111: Ampara District Selected DSDs Agro-Ecological Region Map

3.5.2 Agri-business and Value Chain Analysis

18. Hybrid maize seed value chain

Separate Feasibility report submitted.

19. Hybrid Chili value chain

Refer 2 of Chapter 3.1.2

20. Jumbo peanut value chain

Refer 1 of Chapter 3.1.2.

Mung Bean Value chain

Introduction

Vigna radiata (Vigna radiata L.) botanically known as mung bean, belongs to the family of Leguminaceae. Mung bean is a very popular short term legume crop in Sri Lanka. A dry environment is favorable for this crop and in Low country dry and temperate zones are ideal. There are both local and improved mung bean varieties are cultivated. But now most farmers are advised and farmers tended to grow improved varieties which are introduced by the department of Agriculture. Those are MI 5, MI 6, MIMB 7, AARI". Heeng mung, brown are the local varieties and they are not prominently cultivated. MI5 - The seeds are green. Rhombus oblong shape. 1000 seeds weight is about 58g. Harvest can be done 60-65 days after planting. Yield is 1.5MT per hectare. Suitable for "Yala" and "Maha" season. MI 6 - The seeds are light green. Rhombus shape. 1000 seeds weight is about 60gm. Harvest can be obtained in 55-65 days after planting. Suitable for "Yala", "Maha" and mid-season. Yield is 1.8 – 2.0 MT per hectare. MIMB 7 - The seeds are light green. Rhombus shape. 1000 seeds weigh about 60-65 grams. Harvest can be obtained in 55-60 days after planting. Suitable for "Yala", "Maha" and mid-season. Yield is 1.8 – 2.0 MT per hectare. AARI - The seeds are dark green. Cylindrical shape. 1000 seeds weight is about 56 grams. Harvest can be done 60-65 days after planting. Yield is 1.7MT per hectare.

When it comes to the nutritional profile of green gram, green gram is a protein rich staple food. It contains about 25 percent protein, which is almost three times that of cereals. It supplies protein requirement of vegetarian population of the country. It is consumed in the form of split pulse as well as whole pulse, which is an essential supplement of cereal-based diet (Post harvest profile of Grean gram). Apart from that, Mung is considered to be a food with high nutritional value as it is full of other nutrients including minerals and vitamins. Also, germinating seeds are considered as ideal source of the bulk of vitamins and minerals.

Table 42: Nutritional composition of green gram

Calories	-	30 kcal
Carbohydrates	-	5.9g
Total fat	-	0.2g
Protein	-	3g
Vitamin C	-	13.2mg
Vitamin K	-	33µg
Thiamin	-	0.1mg
Riboflavin	-	0.1mg

Folate	-	61µg
Iron	-	0.9mg
Magnesium	-	21mg
Phosphorus	-	54mg
Copper	-	0.2mg
Mangenese	-	0.2mg

In addition to being an important source of human food and animal feed, Green gram also plays an important role in sustaining soil fertility by improving soil physical properties and fixing atmospheric nitrogen. It is a drought resistant crop and suitable for dryland farming and predominantly used as an intercrop with other crops. In Sri Lanka, green gram consumption has been increasing over the years as an alternative source of protein which complementary to our staple diet.

This figure shows, the production of green gram over 10 years in Sri Lanka.

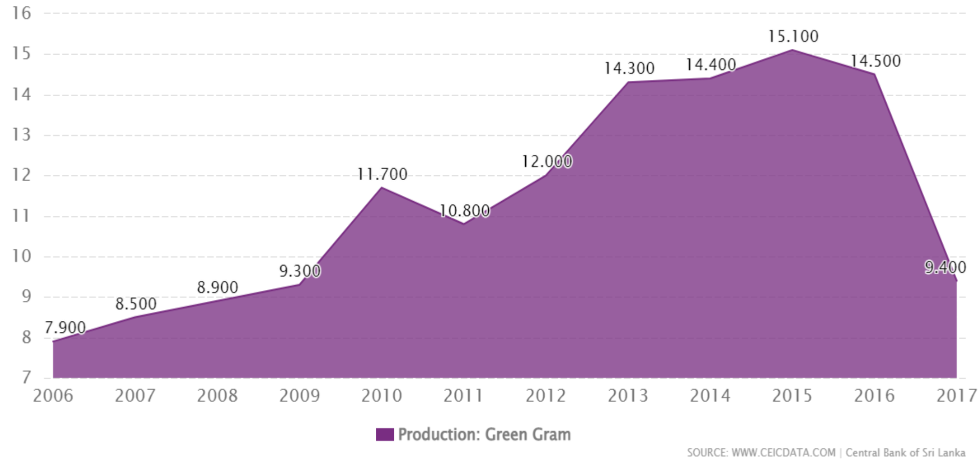


Figure 112: Production of Green Gram in Sri Lanka

Sri Lanka cultivates green gram as an intercrop. Framers are connected to several procurements to sell their harvest. Companies like, “CBL (Ceylon Biscuit Limited), Maliban” purchase thee green gram harvest from the farmers directly for the cereal production: “Samaposha, Ranposha, Yahaposha”. Apart from that, more marketing actors are involved to reach the production towards the consumer. Through this chapter you will able to cover the issues in green gram value chain, importance of green gram value chain, market share for each main value chain actors and value additions that have been done using green gram.

Importance of promoting green gram value chain

A value chain describes the steps that firms must take in order to add value to a product or service. It includes all the many tasks required to get a product to a client, from concept creation to distribution. activities involving raw materials, production, management, logistics, and marketing. Value chains help break down all the activities that go into producing a good or service and understanding areas of cost savings and differentiation. With a value chain, we can optimize efforts, eliminate waste, and improve profitability. The value chains help provide useful insights that can bring greater value to the end customer. Being a part of an efficient value chain can increase a farmer's revenue, in their opinion. Farmers will be informed of the current prize scales. However, there are occasions when taking part in a well-run value chain will result in a more steady and predictable income rather than a higher one.

Promoting the value chain helps to discover its difficulties, flaws, and strengths and opens up more options. Without middlemen in the value chain process, framers can go straight to the ultimate actor, which increases their profit. Industries will identify the market gap and the opportunities to develop more products using green gram which can achieve high demand in export market. Value chain aims to give a company a competitive advantage by boosting output while containing costs. With the findings of green gram value chain, policymakers will make better decisions and because it will encourage businesses to create more effective and affordable products.

Issues in green gram value chain

Fluctuation in prices of seeds and other inputs critically influence on green gram cultivation. Producers often face increase in cost of production of Green Gram due to fluctuation in price of seeds. Unexpected huge harvest and unexpected low harvest. Favorable weather conditions and cause a huge harvest resulting low price in the market and unexpected bad weather conditions create a negative impact on the harvest, resulting a high price. This situation makes a problematic situation in keeping the green gram market sustain.

A portion of non-mechanized harvesting typically results in losses following harvest caused by human handling techniques. Harvesting and grading all are done by themselves without using machines, this may result poor quality output and farmers are paid less amount for them. The farmers in the cluster adhere to a set of regional practices that are not productivity. This leads to low production, which directly affects a farmer's net income. Farmers do not regularly use simple tools like weighing scales and moisture meters plus at the farm level, there are no facilities for cleaning, grading, or sorting. Adoption of food safety and quality standards.

Fluctuation of the yield, prices, input supplies as well as rainfall significantly effect on green gram market.

Farmer training on good agricultural practices, application of appropriate technology, especially on harvesting, threshing, storage and distribution is essential for smooth functioning of the value chain. Farmer training, especially effective training, development of their farm business needs to be considered as important components in development programs. Lack of market intelligence, poor or limited market access were the key factors which trapped farmers into viscous cycle of agribusiness poverty. In general, farmers are price takers, large number of farmers based on few agro-ecological zones produce green gram as 3rd season crop or between Yala and Maha seasons.

Poor post-harvest chain management was identified as critical issue in green gram value chain. None availability of proper harvesting (manual harvesting is common), threshing, cleaning, grading, packaging and storage make considerable losses to the harvest. Due to inadequate storage facilities at rural setting, farmers loose a substantial quantity of their produce by way of discards, spoilage, rodents etc. Farmers are also forced to sale their produce just after harvest due to lack of storage facilities. Transportation facilities at producers' level were limited or inadequate. Recent fuel crisis crippled the distribution channels and made farmers more vulnerable.

Due to inadequate transportation facilities at villages level, producers' sale their green gram to traders directly from their farm or in the village, which offer them lesser price than prevailing in the markets. transportation costs for getting commodities to market are extremely expensive. Lack of Marketing Information: Due to lack of information regarding arrivals and prices prevailing in other markets, producers market the green gram in the village and nearby market at lower price, which can be avoided. Farmers are not informed about market prices. Some farmers sell their produce to dealers at the village level because they are not getting paid fairly.

Way forward

Excess production: When there is a surplus of the production, the government can purchase the excess amount of bulk and store for the future consumption under proper storage conditions and supply them to the market when the requirement rises

Capacity building: Encourage farmers with knowledge expertise and financial expertise to go for machines is the idle way to lower the effect of this issue Educate farmers in processing and packaging methods. Helping farmers get a higher price of their produce by presenting it in a more appealing way to customers.

Proper training will improve their skill for better marketing of their produce. They should be trained how to get market information and factors on which prices are determined. For e.g., size, color of grains.

By stabilizing farmers' positions in the value chain or shielding them from unforeseen price changes, policies can be made stronger to help farmers.

Postharvest management: Practicing primary sorting and fruit grading treatments, avoiding rough handling and using proper packaging systems may help to avoid the loss.

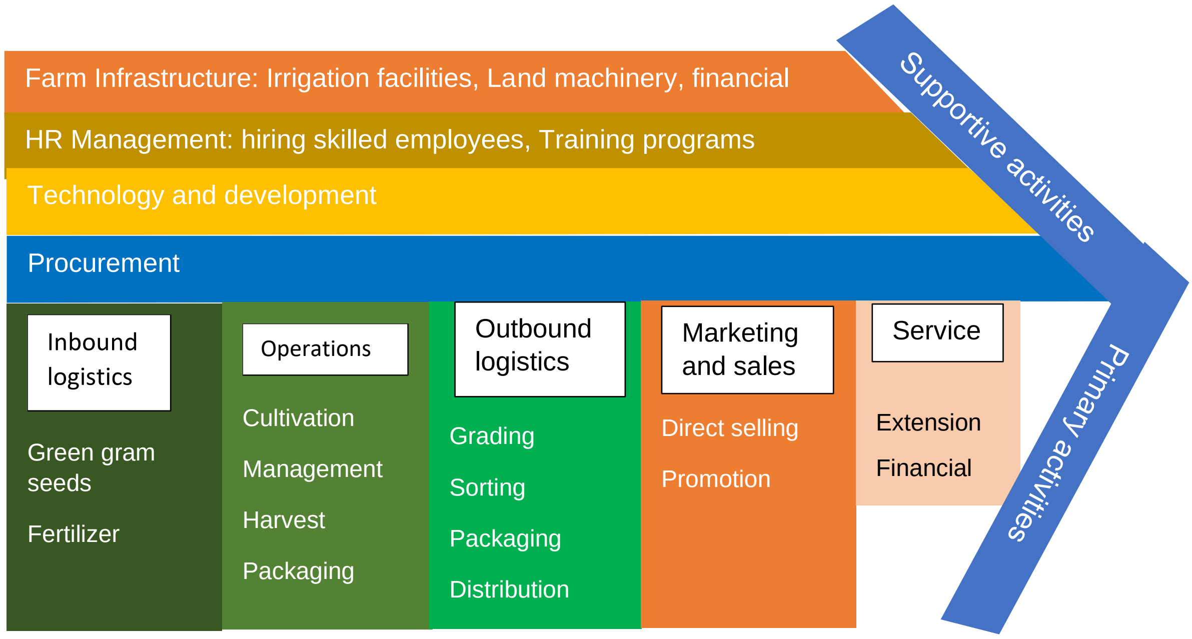
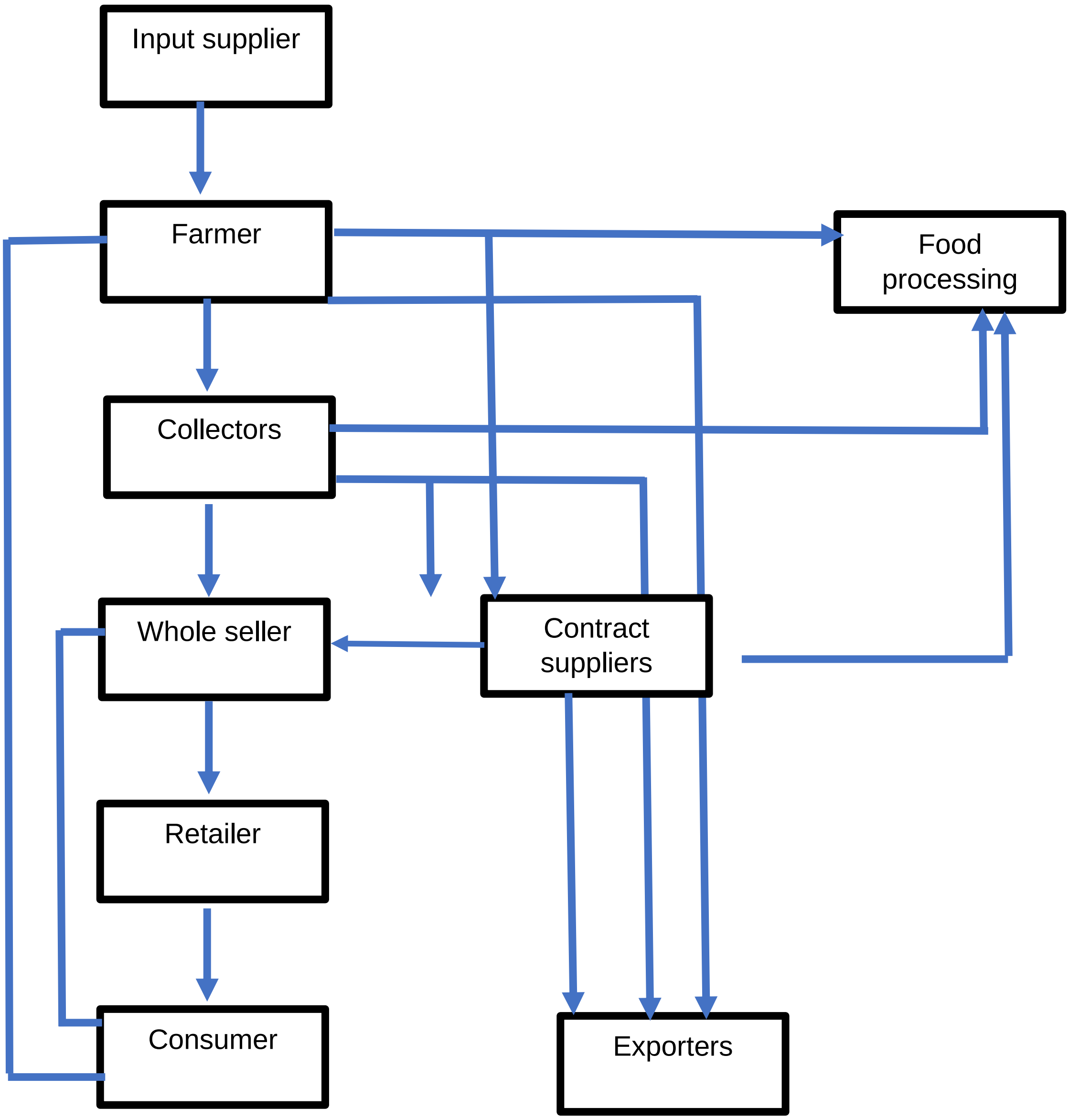
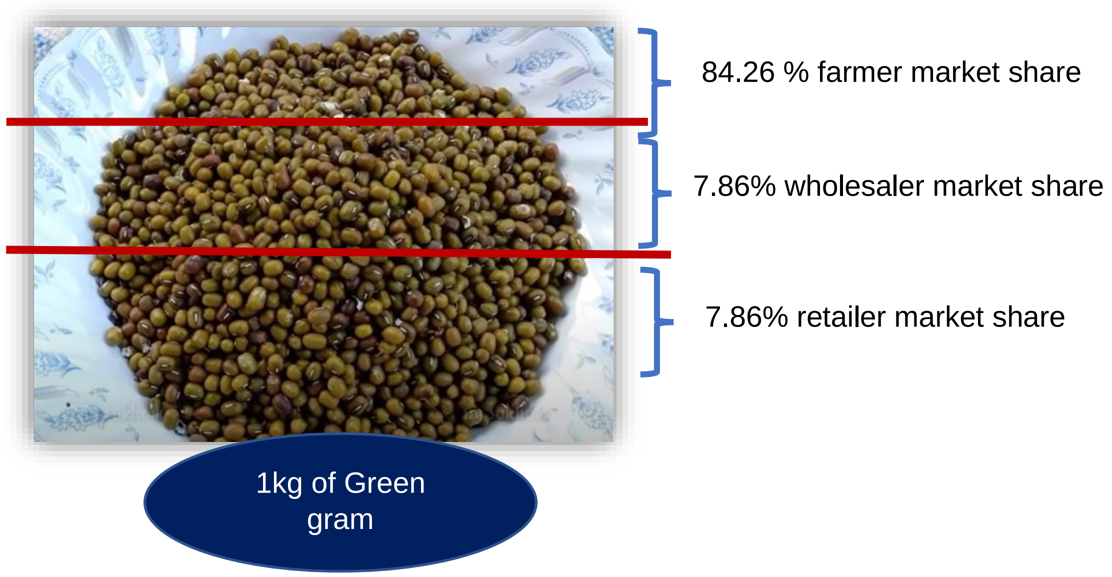
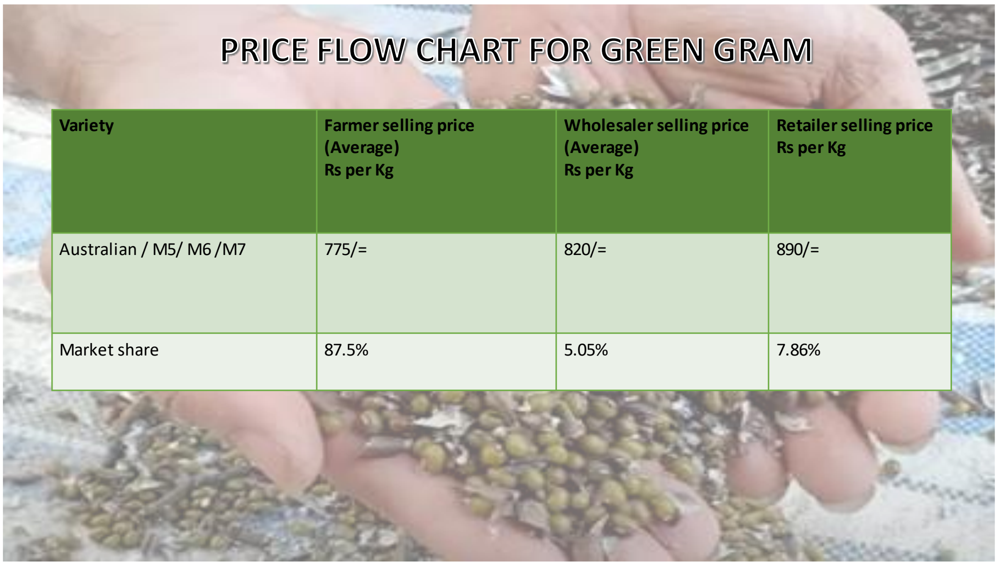


Figure 113: Value chain model for the green gram



Market share





PRICE FLOW CHART FOR GREEN GRAM

Variety	Farmer selling price (Average) Rs per Kg	Wholesaler selling price (Average) Rs per Kg	Retailer selling price Rs per Kg
Australian / M5/ M6 /M7	775/=	820/=	890/=
Market share	87.5%	5.05%	7.86%

Figure 114: Income distribution Green Gram

Value added products

Cereals

Most cereals are made up using pulses. Products like “Samaposha”, “Yahaposha, are common outputs which use green gram as a main ingredient.

Cereal Porridge

cereal porridge is an extremely heathy dessert which is a combination of different kinds of grains. It is a good source of bulk of nutrients.

Split Mung bean

Sometimes it is known as green mung dhal which has been split but not skinned. Most Sri Lankans use this as an alternative for dhal. This high in protein and fiber and it has the added advantage of cooking quickly.

Mung bean sprouts

Mung bean sprouts, commonly known as bean sprouts or moong beans, are made from soaked mung beans. Although green gram has several advantages, sprouting it makes it even more nutrient-dense because it increases the number of vitamins and minerals it contains.

Cosmetics products [face scrubs, face cleansers]

Green gram or moong dal is a highly potent beauty ingredient. It not only has several health benefits, but we can also add it to our beauty regime to deal with skin problems such as acne and dry skin.

Cowpea Value chain

Introduction

Cowpea is one of the main legumes cultivated by Sri Lankan farmers. Copwpea comes from "Febacaea" family and genus of "Vigna". Botanical name is *Vigna unguiculata* (L). This annual herbaceous crop well adapted to relatively dry environment. According to the Sri Lankan climate, Hambantota, Rathnapura, Badulla, Monaragala, Anuradhapura, Kurunegala, Puttalam, Batticaloa, Ampara and Polonnaruwa are the main growing areas. It's kind of a drought- tolerant and warm-weather crop and has the ability to fix atmospheric nitrogen through its root nodule. Optimum temperature for cultivation is 20 ^{0}C- 30 ^{0}C. Cowpea can be grown on wide range of soil Ph. These ranges are sandy loam to clay ranging from acidic to basic (Ph 4.5-8.0) and sandy to clay loam soil and well drained with ph of 6-7. This plant is highly sensitive plant for water logging conditions. (Som & Hazra) Cowpea seeds are the edible part of the tree. It contains all essential nutrients such as protein, fat, carbohydrates, water and minerals such as calcium and irons. Also, it is commercially important part. Seeds have variability in size and shapes and have various colors including white, brown, maroon, cream and green color. When consider the Sri Lankan context white cowpea and brown cowpeas (red cowpea) are available in the market.

Background and Importance of promoting cowpea value chain

Cowpea has high protein content and it includes other essential nutrients. This cereal has higher demand among the rural people as well as the urban people. When consider the current situation of nutritional deficiencies among the Sri Lankan citizen, according to the health sector data malnutrition and protein deficiencies are increasing among the people. In this case, cowpea can play a major role to prevent protein deficiencies among the people with its high protein content. But the thing is market price of cowpea is very high. According to the CBSL data, average yield is around 1000 Metric Ton/ ha. In 2022 market price is 1kg of white cowpea is around Rs.1200 And price of 1kg red cowpea is around Rs.1000.

In line with current situation in the country economic crisis, covid-19 pandemic situation due to the increase market prices and decrease average yield. With this crisis situation fertilizer and agro-chemical prices were increased, transport cost was also increased. It affects for the primary producers' behaviors in their farming activities. If consider the previous average yield data, time to time pest and disease due to the decrease yield and increase market price. Most of the primary producers have not knowledge about value added products. Most of the Sri Lankan farmers are doing cowpea cultivation with other crops. Therefore, value chain analysis of cowpea is important for prevent price gap which build in each step and decrease the market price. Other than that, introduce cowpea value added products to the Sri Lankan market and expand cowpea distribution channels.

Analysis of the cowpea value chain

In general, dried cowpea is not processed and it can be consumed directly after harvesting.
Actors and their functions in cowpea value chain

- Input suppliers: Input suppliers are the people who provide inputs to the farmers. Agro-chemicals, finance, seeds and equipment are the major inputs for cowpea cultivation. They may be a government sector or private sector input suppliers. DOA is the main government input supplier. They provide quality seeds, fertilizer at low price. Prominent non-government organization is farmers' organization in the village. It provides financial supports and equipment like things. CIC, Hayles are popular private sector input suppliers. Micro level financial supporters are public and private banks, regional banks, NGOs. Some seed companies import cowpea seeds and farmers who want import seeds, they can get seeds from those companies.
- Primary producers/ Farmers: In commercial level cowpea farmers use large lands. Land preparation, farming and harvesting activities are done by the primary producers. Some cowpea farmers directly sell to the local customers. Otherwise, they sell to the whole sellers, retailers, and collectors of value-added forms producing companies.
- Collectors: They act as a bridge between primary producer and consumer. They manage their own transport, own storage facilities. They influence for the price volatility in the market. They directly purchase the harvest from the farmers. Sometimes collectors may be whole sellers or retail sellers.
- Whole sellers: They purchase bulk amount of harvest at the farm gate. Grading, storing, packing, and marketing activities are done by them. They put the harvest economic centres, retail shops or value-added products producing companies.
- Retailers: They sell their own harvest or which is bought from farmers. Their target group is day to day consumers. Retail shops, village and urban fairs are the main marketing channels.
- Consumer: Most of the consumers are local consumers. Because export sector is not well developed. The amount paid by the consumer is shared among all stakeholders in the cowpea value chain.

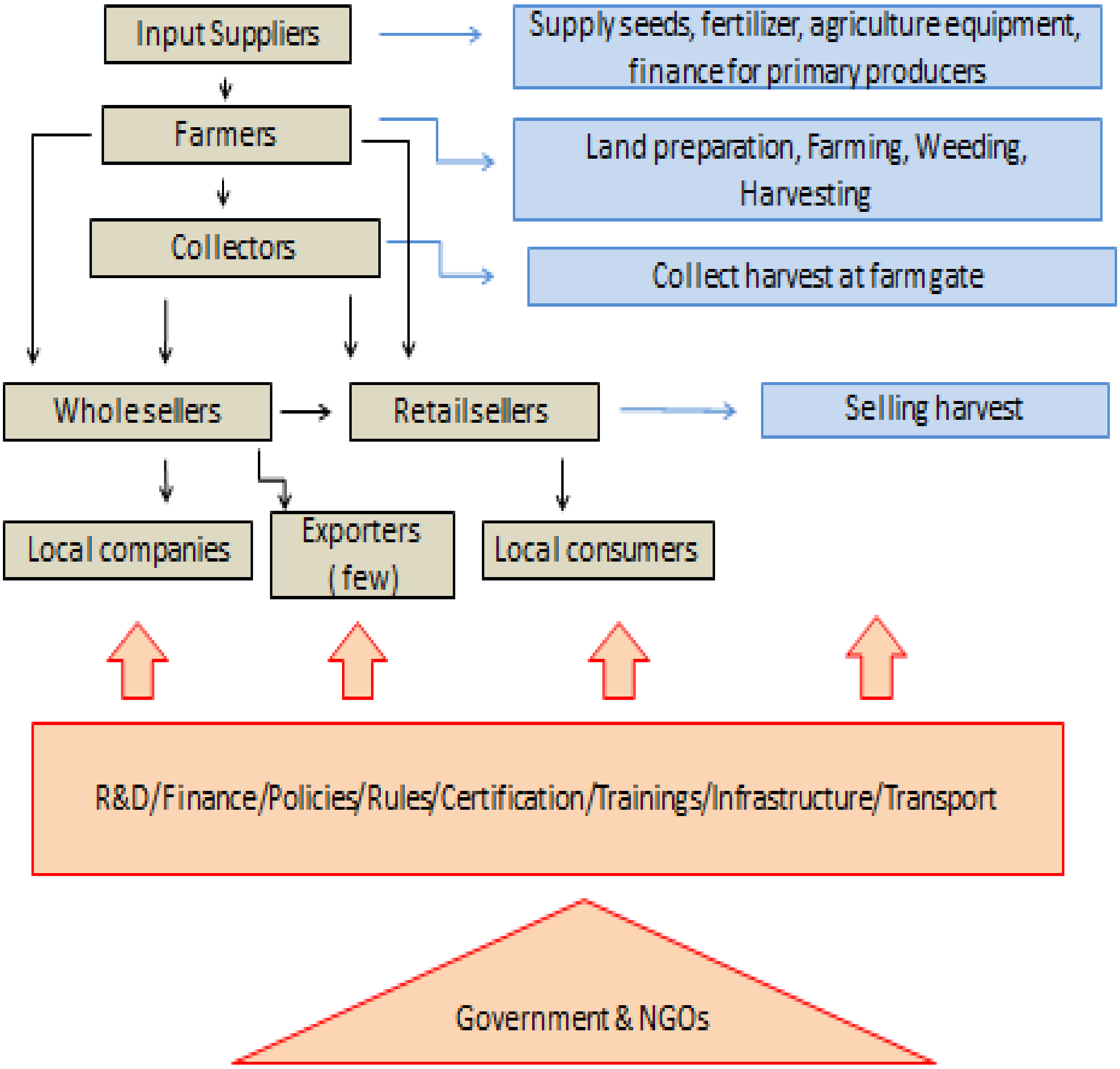


Figure 115: Road map of Cowpea Value Chain

Main supportive activities

- Infrastructure development: In the present, roads in cowpea cultivation areas are in good conditions for transport. Most of the villages are connected by carpet roads. Some villages connected with highways. The highway provides excellent link to market.
- Research and Technology development: DOA, HARTI, seed producing companies, government and private institutions are conducting research and technology development activities for chili cultivation. Produced hybrid varieties, introduced new agro-chemicals, and analyses problems which are facing primary producers, things like activities are done under R& D activities.
- HR management: Ministry of Agriculture, DOA and HARTI like government organizations and NGOs conduct training program to improve farmers' skills and knowledge.

- Procurements: National and International funds give some subsidiaries to the farmers to improve their livelihood. Other than that, formal and non-formal financial suppliers provide financial services to enhance productivity.
- Figure 116: Supportive activities in cowpea value chain (by author)

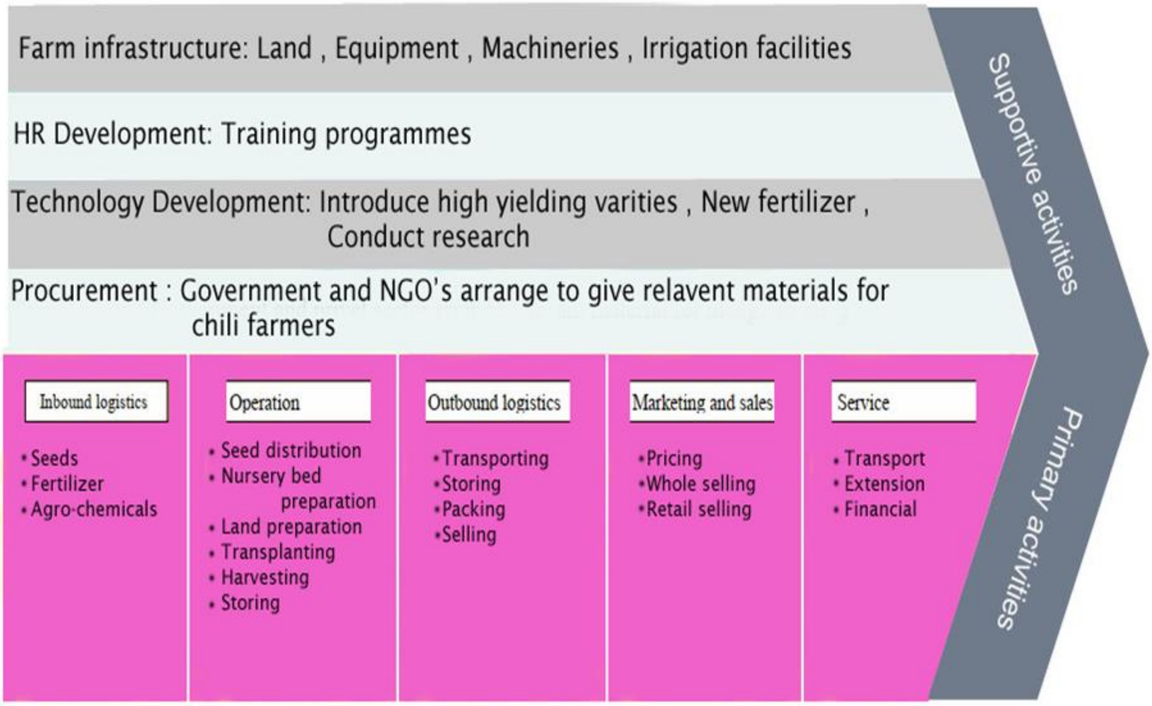


Figure 116: Value chain map

Main supportive Rules

Food safety rules: Food safety rules influence for the production step in value chain specially, if produce value added products. When consider the Sri Lankan market, cowpea mixed with other cereals and grind this mixture and consume as extra meal. It called as a "Posha"

- Government contribution: Food control Administration unit responsible for ensuring food safety and safe production of foods. Ministry of health, Ministry of fisheries and Aquatic resources, and Ministry of Agriculture are the ministries which are due to control food safety rules and regulations. According to the Food Act No.26 of 1980, all food business needs to be registered with the food authority of area.
- Certification: The product certification (The SLS Marks Scheme), systems certification such as ISO 9001, ISO 14001, GMP, ISO22000 etc, providing training, providing laboratory services, and providing information services are some of the services thus provided. (Unit, p. SL FOOD SAFETY PROFILE)

Agricultural practices rules

- GAP: It includes practices in primary production to ensure safety and quality of food products and minimize the negative impact on the environment as well as the workers' health.
- ICM and IPM: Should be followed by farmers to ensure environmental, economic and social sustainability.

Analysis the sub value chains – value added products of cowpea

In Sri Lankan market white cowpea and red or brown cowpea packets are available. Other than that cowpea includes as an ingredient of some value-added products. Value added products which are made from only using cowpea are not available in the Sri Lankan market.

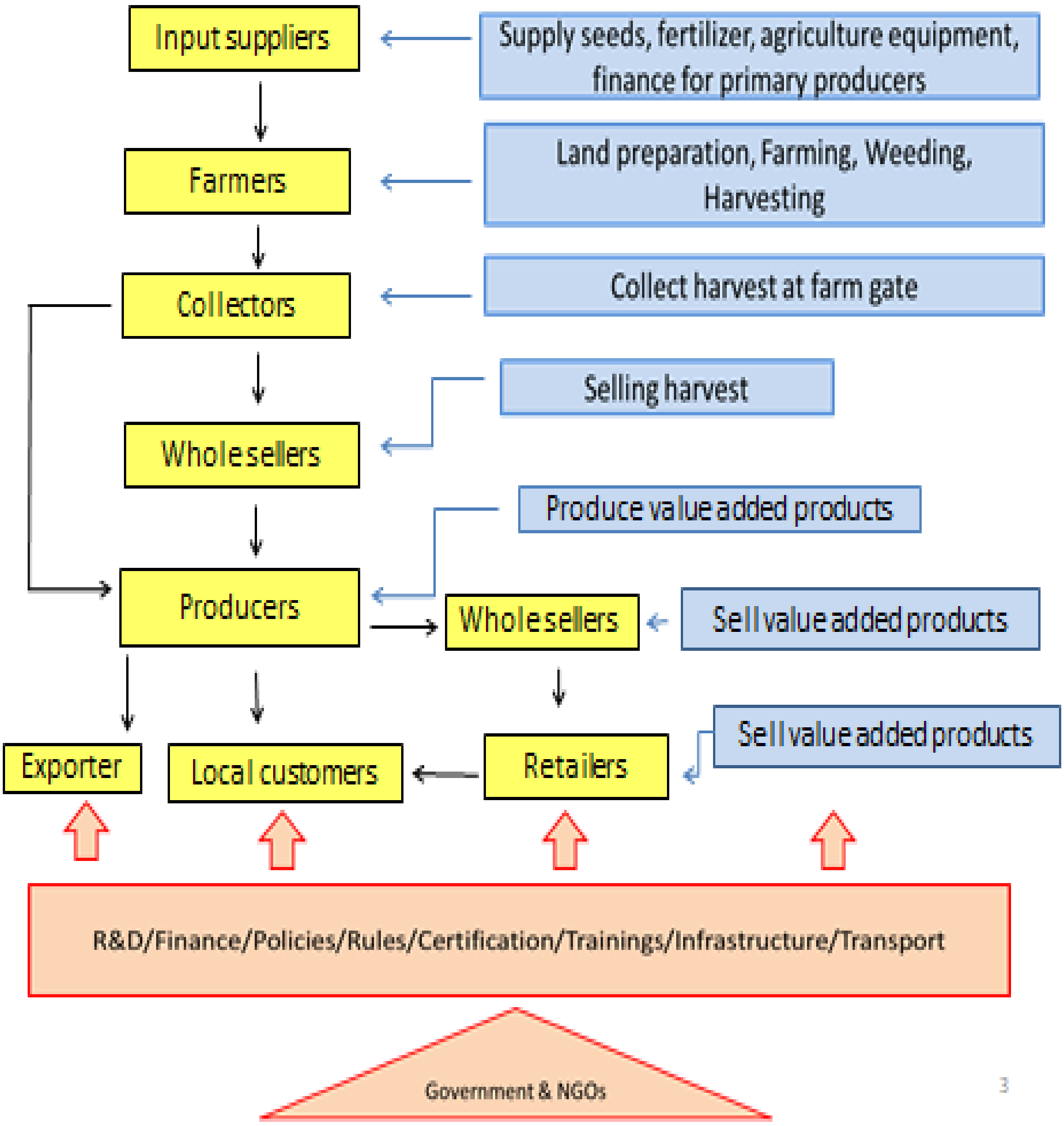


Figure 117: Cowpea value added products value chain (Created by author)

Economic analysis of white cowpea and brown cowpea

Figure 118: Break down cost

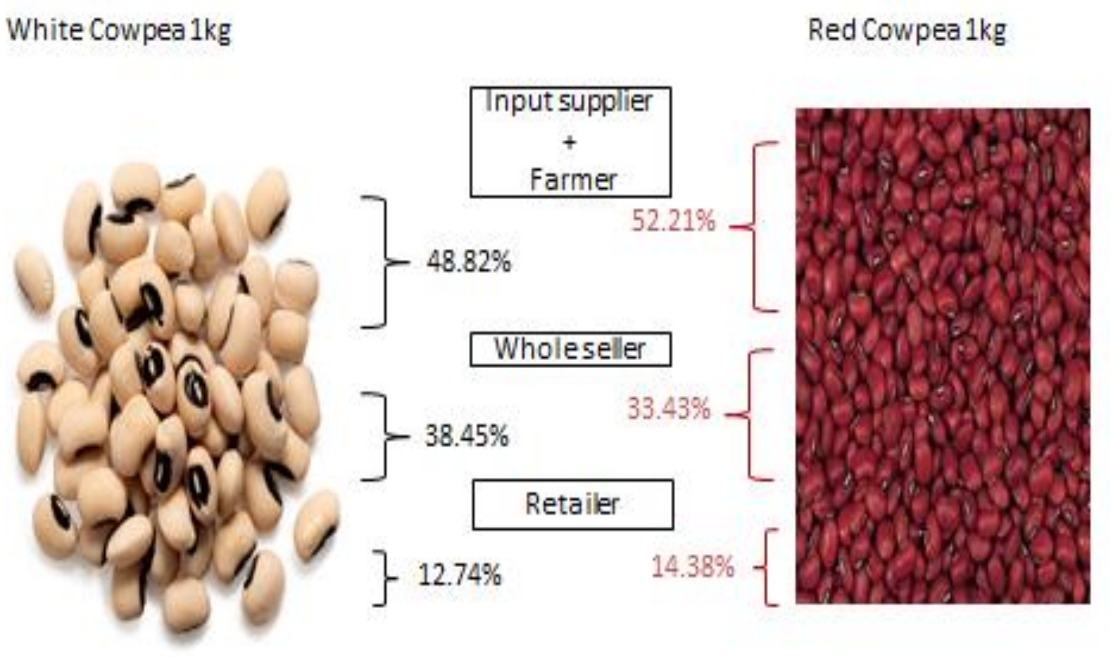


Figure 118: Break down cost

Common issues characterizing the fresh green chili value chain

Seed production or seed collection:

- Farmers should be purchase seeds every season. Nowadays, seed cost is high.
- Some seeds are lower quality seeds.

Land preparation and transplanting

- Machinery and labor cost is high
- Climate change
- High labor requirement

Farming (DOA, DOA)

- Barriers for use agro- chemicals
- High fertilizer cost

Harvesting

- Post-harvest losses
- Lack of storage facilities

Selling

- Has not proper linkage between primary producers and consumers
- Lack of value addition

Building a roadmap for cowpea value chain upgrading

Under this section, describe what are the upgrading -strategies in cowpea and value-added products value chains. We can create a value in each step of value chain to upgrade it. These creative values are directly affected for the productivity enhancements and market development.

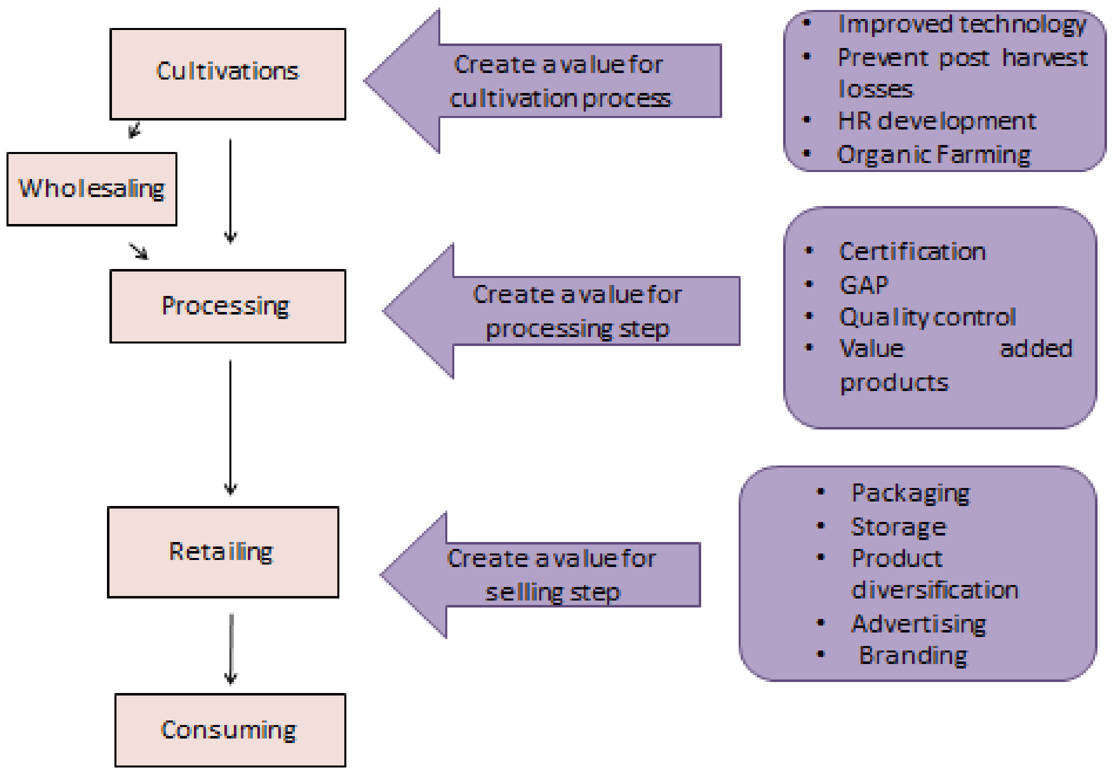


Figure 119: Roadmap for value chain upgrading cowpea and its' sub value chain

21. Soursop Value Chain

Introduction

Anona muricata is a fruit crop which grows up to 1000m in elevation. It prefers warm, humid climates and around 18°C temperature and more than 1500mm rainfall. Therefore, it's primarily found lying around central part of the country, mainly in Kandy district (Ratnayake, Kumar, & Kariyawasam, 2020). *Annona* which is also referred to as Graviola in European region is an underutilized, tropical fruit crop in Sri Lanka which belongs to the family *Annonacea.* (Ratnayake, Kumar, & Kariyawasam, 2020)

Annona species grown in Sri Lanka include Atemoya (*Annona atemoya*), Bullock's heart (*Annona reticulata*), Soursop (*Annona muricata*), and Sugar apple (*Annona squamosa*). (Heenkenda, Gunathilaka, & Iswara, 2009) (Figure 120) By considering the relative significance of biological composition, Soursop is mostly recommended as superior quality *Annona* species for commercial cultivation (Dilrukshi, Dharmadasa, Abeysinghe, & Abhayagunasekara, 2020).

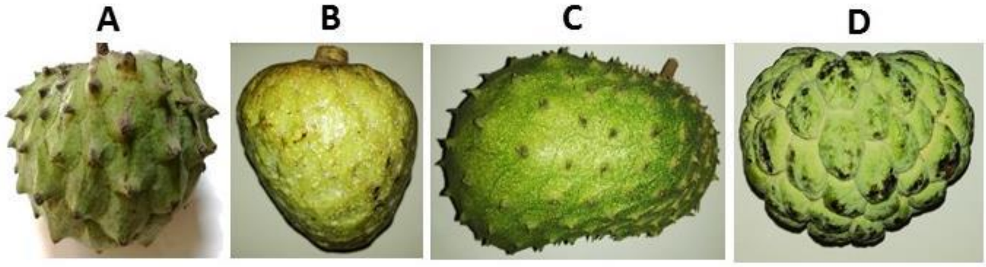


Figure 120: Annona species A: Atemoya (*Annona atemoya*), B: Bullock's heart (*Annona reticulata*), C: Soursop (*Annona muricata*) and D: Sugar apple (*Annona squamosa)*
Source: (Wijesinghe, Kumara, & Kumara, 2021)

Annona is having a significant ethylene (C_2H_4) production and high rate of respiration during fruit ripening. (Prasanna, Rao, & Krishnamurthy, 2000). As a result of the high postharvest losses, *Annona* has a short postharvest life and poor marketable quality (Wijesinghe, Kumara, & Kumara, 2021). Atemoya has the longest post-harvest life (8 days) of any *Annona* species. None of the other three species survive more than 6 days. (Wijesinghe, Kumara, & Kumara, 2021). However, there are restrictions for Soursop utilization due to seasonal availability, unavailability, pollination defects, and a lack of long-term storage facilities without affecting their sensory attributes.

Pollination is a basic factor in every plant in production of its harvest. Usually, the main pollination agent of all flowering crops are the insects. Among insects, bees are the major population responsible for pollination. But when considering the Soursop, the pollination agents are few varieties of ants, but not the bees. Therefore, the presence of the ants in the field is a crucial factor for successful pollination. In commercial level cultivations, this pollination by insect is not much effective and doesn't give proper harvest. Therefore, artificial pollination is doing for Soursop in commercial level cultivations to take a good harvest and quality, regular shaped fruits. Pollination should be done in the morning to take a good harvest. Each fruit weighs between 0.5 and 2 kg and the tree produce up to 10 tons per acre, when the pollination is successful (National Academy of Science, 1978). Pruning should be done to maintain the plant height at 3-3.5m to get a good harvest and to increase the productivity of the plant.

Harvesting is done based on the maturity level. To identify the correct level of maturity to be harvested, the peal color of the fruit, the appearance of the spines and distance between the spines are considered. Harvesting should be done before 10 am or after 3 pm and should not be harvested in rainy days. The fruits get ripen within 3-5 days of harvesting. Post-harvest handling should be done with much attention without exposing to direct sunlight. The harvesting should be done together with the stalk of the fruit and the peal of the fruit should not be damaged during post-harvest handling. Carefully handled fruits should be transported by packing in wooden or Fiber board boxes.

Sorting should be done to remove the fruits which are having mechanical damages, insect damages, and irregular shape. Similar sized fruits should be sort in similar cartons. Dieback is a fungal disease which can be seen in Soursop cultivations. Apart from that, mealy bug damage is the common pests that attack the Soursop cultivations reducing the quality of the harvest.

The nutritional profile of Annona consist with carbohydrates (23.05%), proteins (7.41%), ash (2.22%), and fiber (24.73%).It also rich in minerals such as phosphorus, calcium, magnesium, potassium, and sodium, with a higher potassium content (1.29 to 1.35%). (Degnon, et al., 2013).Apart from that, they are rich in a wide range of alkaloids, flavonoids, phenolic compounds, essential amino acids, pigments and vitamins.

Table 43: Bioactive compounds and antioxidant capacity of Soursop

Soursop	Total Antioxidant Capacity (TAC)	Total Phenolic Content (TPC)	Total Flavonoid Content (TFC)
Roots	194.98 mg TE/g DW (root extract)	73.10 mg GAE/g	317.22 mg RE/g DW
Leaves	122.67 mg TE/g DW (leaf extract)	55.18 mg GAE/g	181.94 mg RE/g DW
Bark	114.64 mg TE/g DW	22.82 mg GAE/g	201.17 mg RE/g DW
Ripen fruit	1.95 mg TE/g DW	1.19 mg GAE/g	<2 mg RE/g DW
Unripen fruit	2.01 mg TE/g DW	0.68 mg GAE/g	<3 mg RE/g DW
Seeds	4.89 mg TE/g DW	3.96 mg GAE/g	<2 mg RE/g DW

TPC – Total phenolic content; GAE- Gallic Acid Equivalents; DW-Dry Weight; FW-Fresh Weight.

Source: (Dilrukshi, Dharmadasa, Abeysinghe, & Abhayagunasekara, 2020)

All of these compounds help to demonstrate various therapeutic activities like antifungal, anti-diabetic, anti-parasitic, anti-microbial, anti-tumor, antimalarial and antioxidant activities in human bodies. (Dilrukshi, Dharmadasa, Abeysinghe, & Abhayagunasekara, 2020) The bark, leaves, root, and fruit-seeds of the *A. muricata* tree are all used in natural medicine in the tropics (Degnon, et al., 2013). Soursop' leaves, roots, and bark contained high levels of TAC, TPC, and TFC. Therefore, starting value-added leaf, root, and bark products is encouraged.

Importance of promoting the Soursop value chain

Soursop is a good source of nutrition and having numerous health effects when comparing with the other kinds of fruits. Soursop is also high in anti –oxidants and most importantly It is well known to have medical characteristics such as those that combat cancer, diabetes mellitus, herpes, depression, and bacteria including *Staphylococcus aureus* and *Vibrio cholera* (Shashikala & Mahendran, 2019).

Because of the seasonal availability, shorter post-harvest life, scarcity of harvest and less facility for long term storage without altering sensory qualities, the Soursop production and consumption had not subjected to exploit the full potential in Sri Lanka. The demand from the foreign countries for tropical Soursop is very high due to its unique flavor and aroma. As Sri Lanka is a tropical country, and much land is available which suitable for the cultivation purposes, The Soursop production can be done in larger extent to exploit the potential in the global and foreign market.

Apart from that, many of the fruits of Soursop losses due to poor post-harvest handling and storage. By promoting value added products of Soursop it can reduce the post-harvest losses and can increase the effective use of this valuable fruit. Therefore, it’s worth enough to promote the Soursop value chain to address these prevailing issues and take the maximum use of this valuable fruit for not only the people in Sri Lanka, but also the people all over the world.

Common issues characterizing the Soursop value chain

The Soursop value chain is having issues from the input supply stage. When considering about the planting materials, good quality plants are a common issue, Sri Lanka. Apart from the planting materials, availability of land resource with proper infrastructure facilities in the cultivable area is another common issue that faces by the Soursop growers. When considering about the season and the area of cultivation, there’s a difference in size and the taste of the Soursop. The dry zone Soursop is rather small in size and good taste while the Soursop originated from wet zone are large in size and low in taste. Therefore, in processing the quality of the final product is affected by the quality of the fruits.

Another issue is that, the Soursop cultivation land cover in Sri Lanka is small and due to seasonality of the Soursop fruit. Sufficient quantity of raw Soursop is not available to continue value additions year-round. Although the commercial scale cultivators and home gardens have enough fruits in the season, the facilities are not available for the small-scale producers to cold store or process and preserve in the season. Therefore, a larger portion of the harvest in the season is loss without any use. Another issue is that, the large-scale food processors have to bear a high transportation cost to collect raw Soursop from the faraway places of the country. In addition to that, with the production costs, their end product is not viable in local market. Therefore, they look for foreign market and loss the opportunity of entering the local market.
The raw material costs in the Soursop value added production is relatively high. In the value-added process bottling and packaging costs are high and therefore with the production cost, the product is not viable in local market. As a super fruit, there's a high demand for Soursop value added products in the international market. From USA, UK Australia, Hong Kong, Netherland and Spain like countries, the demand for tropical Soursop value added products are very high. But the exporters face difficulties in supplying regularly because of the production process irregularity and with the problem of finding raw materials.

The government support to overcome the barriers in the Soursop value chain is also very low. With the high cost of testing reports for exports, custom approval delays, high currier charges, High cost for quality standard certifications for small scale producers and unavailability of financial facilities suitable for the producers are some issues that face by the value chain actors in the Soursop value chain. Another issue is that, the rural growers face difficulties in finding out buyers for their final produce in rural areas. Usually, the urban collectors don't prefer to go for long distance in rural areas to buy produce in smaller quantities from growers due to the high transportation cost with the economic crisis. Therefore, their produce is not getting a good price and they sell it to a nearest retail shop at a lower price.

Because of the improper pollination, the fruits grow in irregular shape and mealy bug damages the fruit. With this issue the grower losses a greater part of his harvest and the harvest will be in less quality that is not viable for commercial processing and sales in local market.

Analysing the Soursop value chain

When analyzing the cut flower value chain, the main actors are the input suppliers, farmers, local collecting agents, processors, exporters, Retailers and wholesalers. The value chain actors are concentrated in one end of the value chain. There are many customers for the Soursop produce but few players are there in other end for growing and processing purposes.

Input suppliers

Input suppliers provide the planting materials, equipment, fertilizers, chemicals, packaging materials, irrigation supply equipment etc. to the growers. The major input suppliers are Department of Agriculture, Ministry of Agriculture, CAP Green Forest Pvt. Ltd., SAAP (Smallholder Agribusiness Partnership Program), CIC Holdings PLC, Hayley's agriculture etc.

Growers

Growing Soursop is commercially done in areas of Central province mainly in Kandy district. Apart from that, commercial level Soursop cultivations are scattered in Ampara, Badulla, and Monaragala districts. Small and medium scale cultivations are scattered all around the country. The main tasks of the growers include preparing the land, planting, pruning, pollination, pest and disease management, irrigation, fertilization, harvesting, sorting and storage. To take a good harvest, the farmers usually pay more attention to artificial pollination and pruning and training the plants.

After harvesting well- matured fruits, they are sorted according to their sizes and then packed in plastic crates, wooden crates or in poly sacks. The transportation is done by the buyer at farm gate. The buying price is decided either by the collecting agent or by the farmer. Closeness to market outlets, credibility, high prices and timely payment are the factors consider by farmers in selecting a buyer.

Collecting agents

The agents or supervisors from the processing companies visit the villages and a quality checkup of the produce is done at the farm itself. Then collect the produce from the growers and store in boxes according to the transporting guidelines and then transport it to the processing plant. Otherwise, the local collectors from the area collect the harvest from each farmer and transport it to the wholesalers or to the processing plant.

Collectors have different buyers other than processing plants such as Pettah- Manning Commission Traders, Town wholesalers, Supermarket collecting centers, public market retailers and fair retailers. Collectors get price information from the traders and they may members of the trade associations. Major marketing problems faces by the collectors are poor quality of the fruit, lack of storage facilities and inadequate credit facilities.

Wholesalers

Usually, wholesalers receive Soursop from local collectors as well as directly from the farmers. They usually send their own vehicle to the farm and transport to the market. They use to sort the fruits again by removing damaged, irregular shaped fruits and store and distribute to the local area retailers. Lack of reliable suppliers, high post-harvest losses and lack of storage facilities are some problems faces by the wholesalers.

Retailers

Retailer purchase fruits from Wholesalers, Dedicated Economic Centers or otherwise directly from local producers. In super markets, they buy directly from the local area producers after sorting and sell to the consumer.

Exporters

The Soursop fruits and leaves are exporting in two ways, as dried raw fruits and leaves and also as value added products. When considering about the value-added products, the exporters process their Soursop harvest collected from the farmers by themselves and produce various foods and beverages and export to the countries worldwide. Mainly, the fruits and leaves are processed for value additions. The farmers provide their harvest to the processing plants under an agreed stable price for the year or under the market price. The farmers get a good income from the harvest with less middleman involvement in the value chain. Fresh beverages, carbonated beverages, dehydrated teas, Snacks and wines are some value-added products that export by the processing companies.

Consumers

Both the local and foreign consumers are including in the Soursop value chain in Sri Lanka. Local consumers usually consume the fresh raw Soursop which is bought from the retail shops or super markets. The consumers in Colombo district are having the chance to consume value added product also. The foreign consumers get the chance to consume the few of the dehydrated raw Soursop and more of the value-added end products of Soursop.

Government contribution

Under the Ministry of Agriculture contribution, a social and economic development project is done to empower the Soursop cultivation in Sri Lanka, targeting the Monaragala District. Under the Smallholder Agribusiness Partnership Programme (SAPP) women's social and economic development through Soursop cultivation is being promoted.

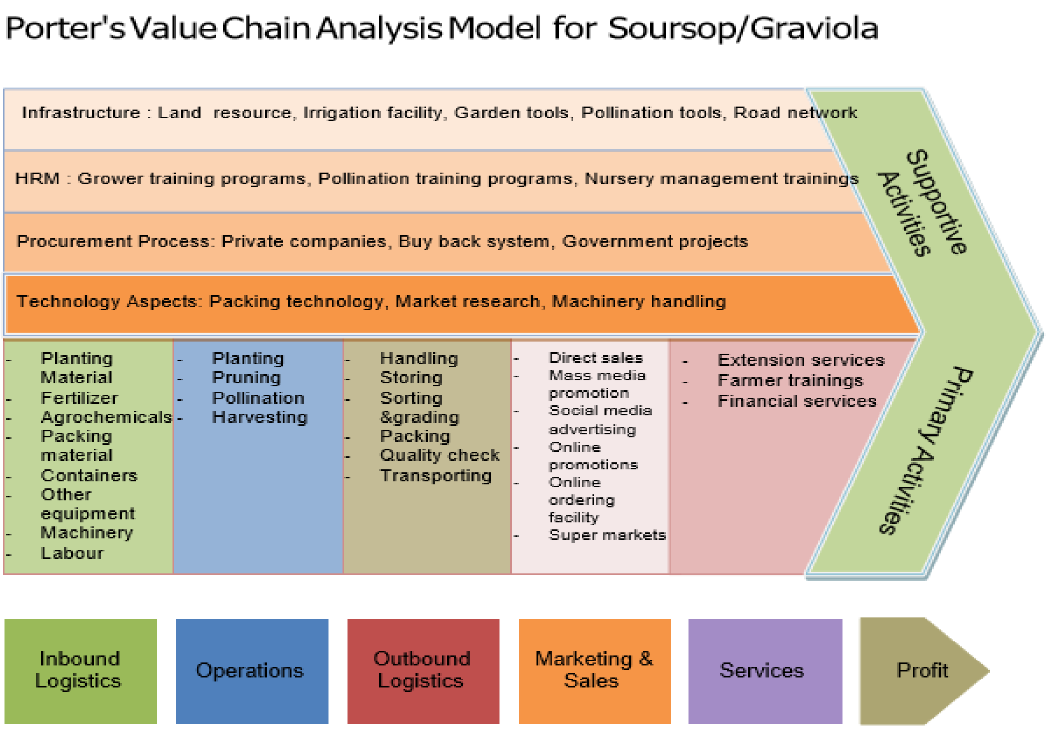


Figure 121: Value chain model for the Soursop

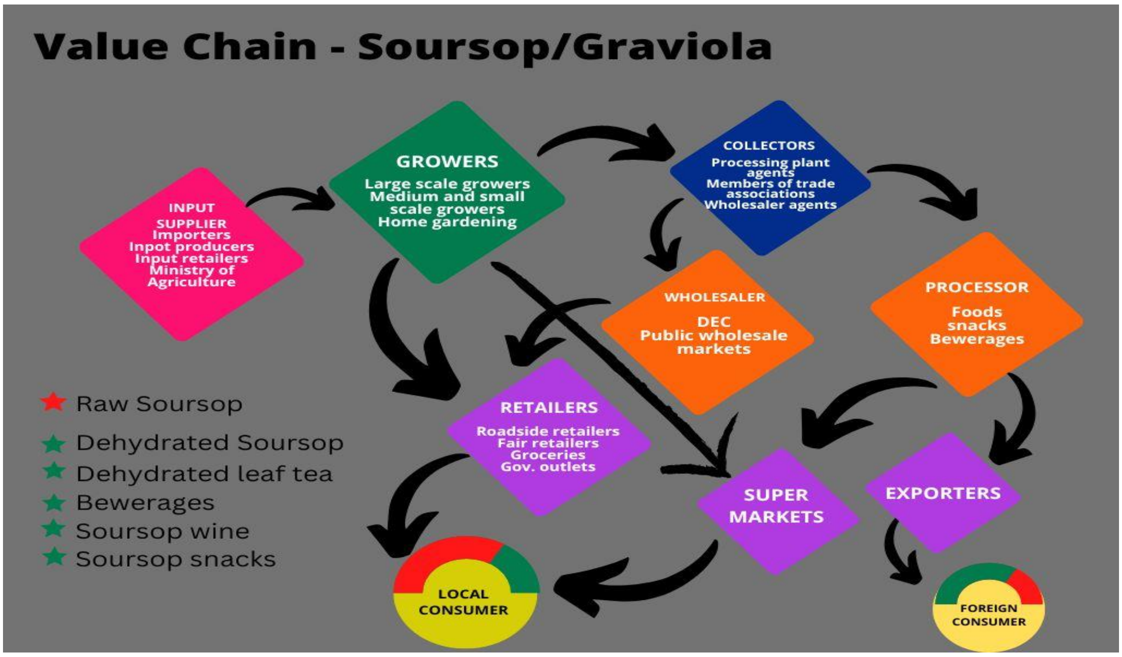


Figure 122: Value chain map

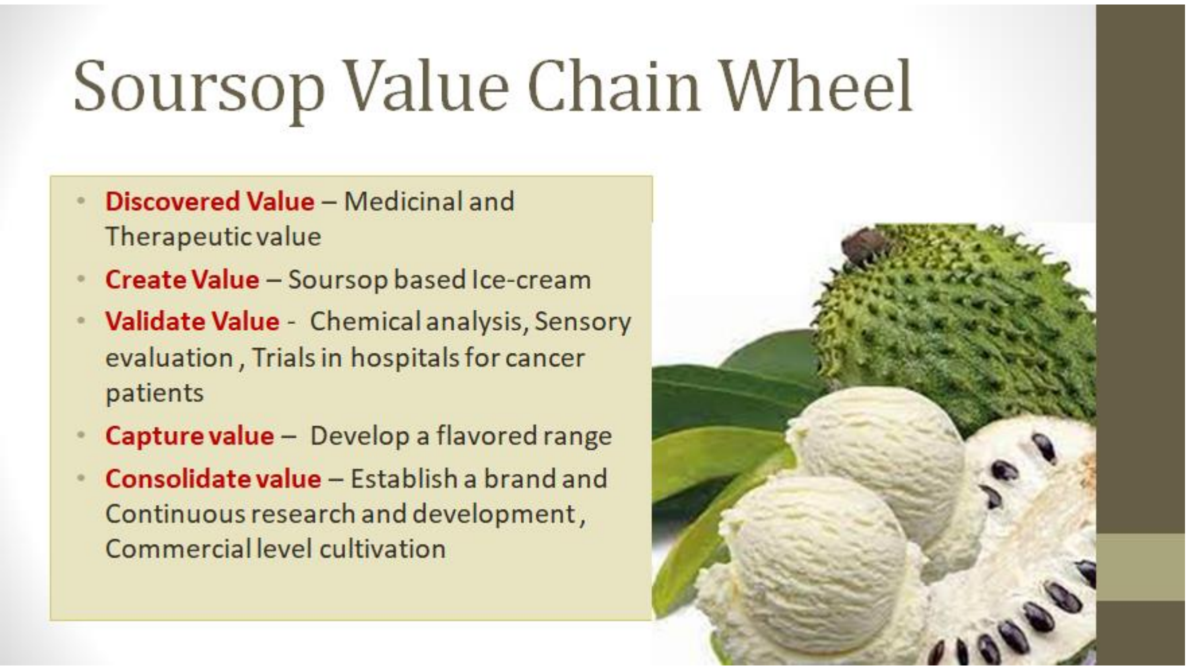


Figure 123: Value creation wheel for Soursop

In the cost analysis, the family labour costs are included in the production cost. The seasonal differences of prices affect farmer's profit to a greater extent. Although the farmers share in the retails price is 47% as shown, this is lower in case of value chains towards Colombo as the transportation costs are higher. Also, during the peak harvesting period, the farmer's share rapidly reduces, since retail and producer prices are reduced while production costs generally remain same throughout the year.

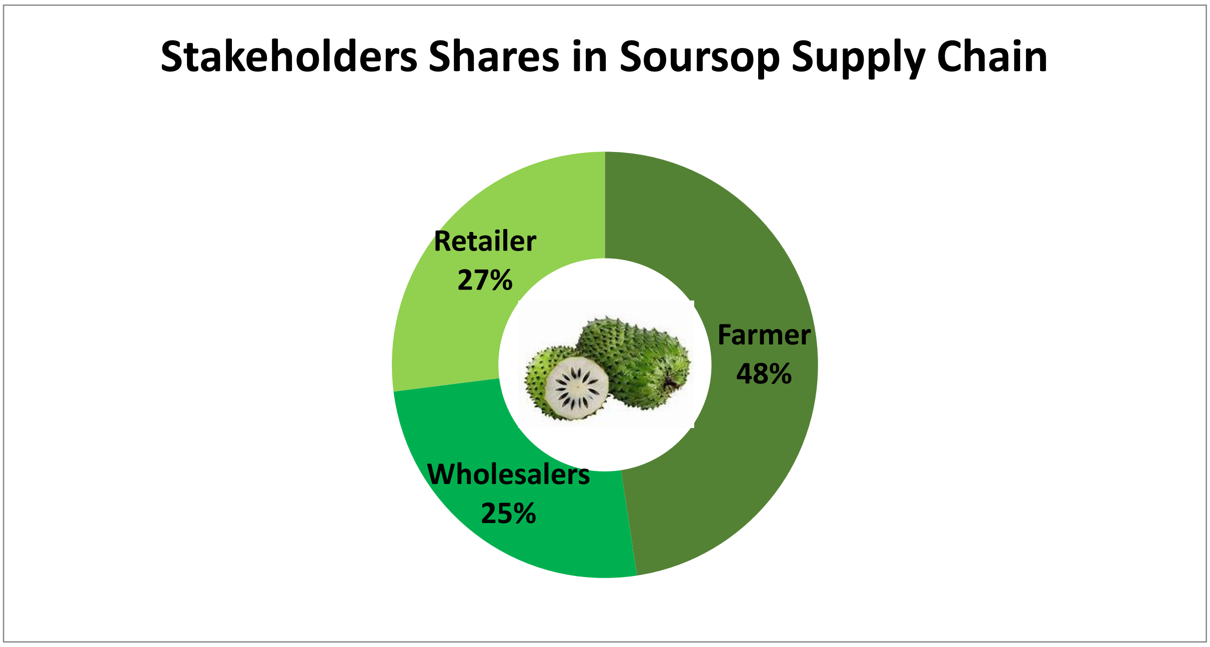


Figure 124: Stakeholder share in Soursop

Value added products

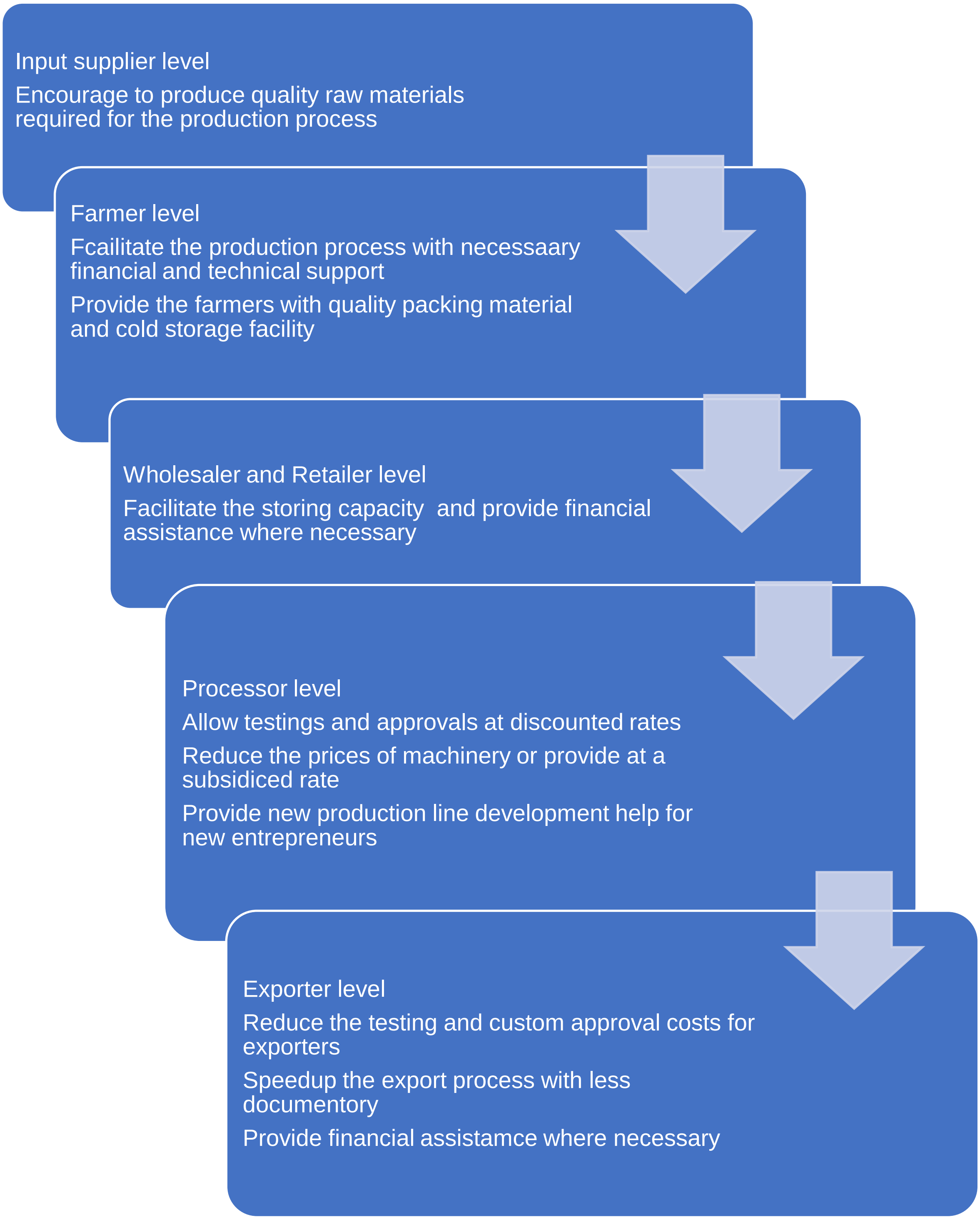


Figure 125: Building a roadmap for Soursop value chain upgrading

Value additions are done by using the fruit, peal, leaves and stems of Soursop. The production is done by using high quality Soursop which grown in various parts of the country in commercial level. Products developed are Bottled juice, Carbonated drinks, Dehydrated fruit, Wine, Organic ice cream and Herbal Tea.

Figure 126: Value Chain Developed by the author

Lime Value Chain

Lime VCs have a significant potential to diversify agricultural production and improve producers' income, complementing the production of rice and other cereals. Agricultural VCs that can contribute to inclusive and sustainable development, such as fruits VCs were the main focus. In this regard, lime production is among the VCs that best combine this potential with the opportunities offered by the growing demand in the national but also regional and international markets. Existing but underutilized lime value chains of Ampara district were selected to upgrade through introducing appropriate technology, product development, commercialization and market interventions.

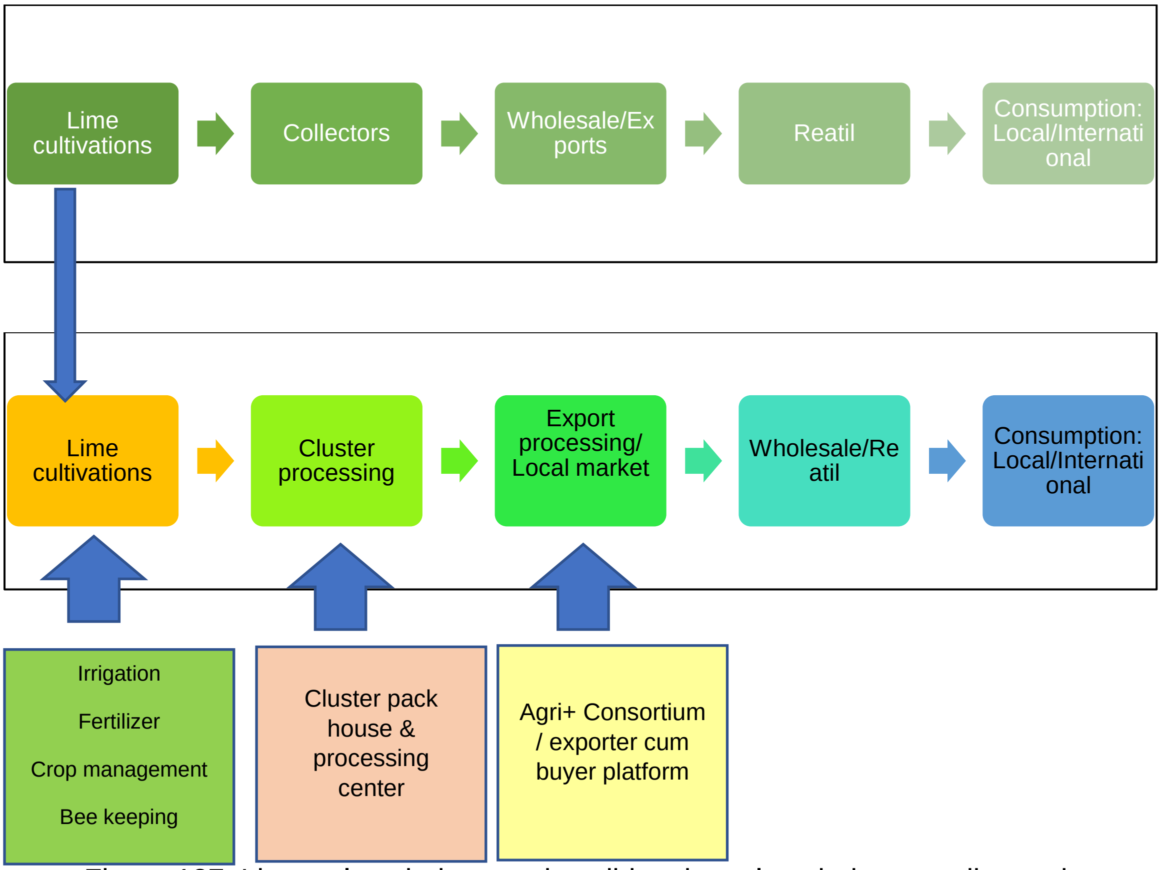


Figure 127: Lime value chain map describing the value chain upgrading pathway

Lime VCs are relatively simple in terms of their structures and functional aspects. Lime VC includes production of fresh lime mainly and few value-added forms using traditional technology. Lime pickle, being prepared in an artisanal way directly by producers.

Figure 128: Existing lime cultivations of Padiyathalawa, Ampara district

In Sri Lanka, fresh limes (*Citrus aurantfolia*) have a year-round demand as they are used for a variety of purposes such as domestic cooking, food processing, indigenous medicine, cosmetics and health care products. The majority of the fruit is consumed fresh, both nationally and internationally. In 2019, the area under lime cultivation in Sri Lanka was 10,238 ha; and the total production was 16727 tonnes. The quantity of lime and lemon exported is 600 tonnes, earning foreign exchange of USD 647,000 for the country. Lime is a seasonal fruit. Peak production falls between mid-April to mid-July in the dry zone areas. During this time the price drops to as low as 0.4 USD/kg, causing lime growers to leave the fruit unharvested, because the price is not sufficient to recover the cost of production. However, the price of lime rises to as much as 3.75-6.25 USD/kg during the off-season, making it unaffordable to consumers. Lime is identified as one of the high priority crops by the National Committee of Post-harvest Technology and Value Addition.

Lime industry is growing significantly, making the product available throughout the year during both peak and off seasons continues to be a challenge. On the one hand, the market surplus of lime should be overcome; on the other hand, a year-round marketing strategy should be ensured. To achieve this, limes that are picked in peak season but not immediately required, need to have their life extended so that they can be used during off-season. Pre-storage treatment will enhance the shelf life of fresh lime.

Black lime

Black lemon is a spice used in Middle Eastern dishes. It is made by boiling fresh lime fruits in salt water and sun drying until the insides turn black. The outside color varies from tan to black. Dried lime is sold whole or ground. Dried limes are usually used in legume, seafood or meat dishes. They are pierced, peeled or crushed before adding them to the dish. After cooking they become softer and edible. They can also be powdered and added to rice dishes. Powdered black lime is also used as an ingredient in Persian Gulf-style baharat (a spice mixture which is also called kabsa or kebsa). It is a traditional ingredient of Arabic and Persian cooking.

Figure 129: Potential value-added products

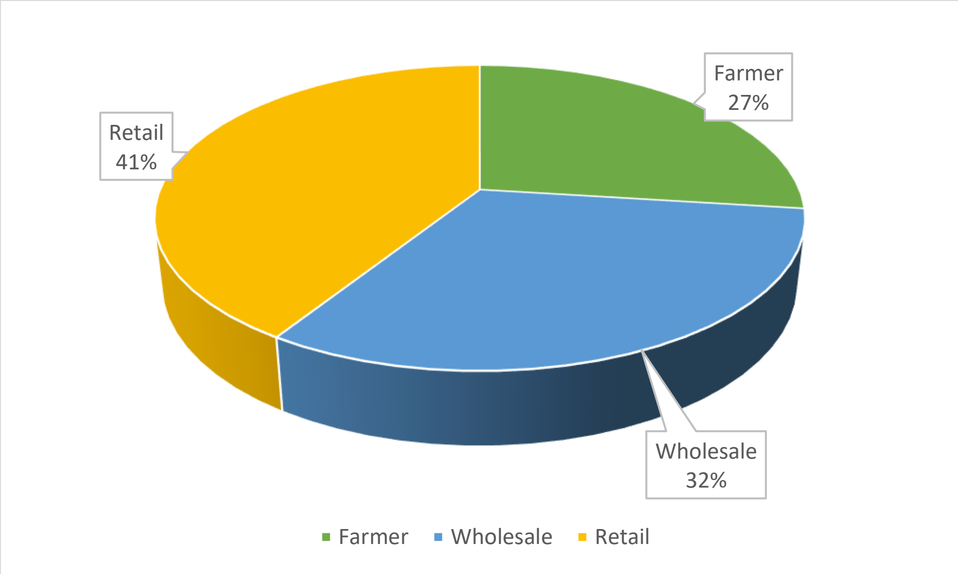


Figure 130: Income share of the value chain actors

Honey Bee Value Chain

Introduction

In many developing countries including Sri Lanka poverty and food security are major challenges. To address the challenges of poverty and food insecurity, governments in developing countries are taking several actions on development in the agricultural sector. In Sri Lanka, the agriculture sector contributes 7.4% of the national GDP and more than 70% of people depend on the agricultural sector and related sectors. (Administration, 2021).

Value chain is a market-oriented approach promoted support small-scale rural farmers and other stake holders in the agricultural sector (Mitchell, Keane, & Coles, 2009). All activities in the chain are directed towards the market. In addition, systemic competitiveness—all stakeholders can benefit from improved chain performance—is one of the benefits of the value chain approach. Thus, effective value chains can play a key role in tackling poverty and food insecurity in developing countries (A. R. Dossou1, Adanguidi, K. N. Aoudji, & C. Gbedomon, 2021)

Apiculture is a sector that has critical importance in the environment and bio-diversity. It fulfills the pollination of the plants. (Belete & Ayele, 2020) Other than the environmental importance beekeeping provides sustainable livelihood to many small-scale farmers and other rural and non-rural stakeholders in sub-Saharan Africa (A. R. Dossou1, Adanguidi, K. N. Aoudji, & C. Gbedomon, 2021). Beekeeping provides various products such as honey, wax, pollen, royal jelly, bee venom, etc. which are used in both food and for therapeutic use (Kacaniova, 2012). The diverse uses of these products by humans provide a market with huge potential and represent an important source of income for beekeepers and traders, as well as for their households.

In Sri Lanka, apiculture is an important income-generating source for the rural population. there are farmers in Sri Lankan rural areas who grow crops benefiting honeybees which drives their production increase. There are no statistical data on traditional beekeeping in Sri Lanka. In ancient times there was no beekeeping for commercial purposes wild honey was used for their need. With the development of agriculture and economics beekeeping sector was developed as a commercial sector. Annually Sri Lanka is producing 25 metric tons of bee honey for domestic production where 150 metric tons were exported in 2018.

The objective of this study is to identify strategies of developing a sustainable value chain for bee honey and other related products in Sri Lanka. The study was built on the value chain framework in Sri Lankan bee honey production.

Importance of promoting Bee Honey Value Chain

The value chain describes the entire range of activities required to bring a product from the input-supply stage, through the different phases of production, to its final market destination, including its disposal after use (A. R. Dossou1, Adanguidi, K. N. Aoudji, & C. Gbedomon, 2021). All activities in the value chain are directed toward the market and all the stakeholders will be benefitted from the improved value chain approach. Also, a developed value chain decreases poverty and food insecurity in a country.

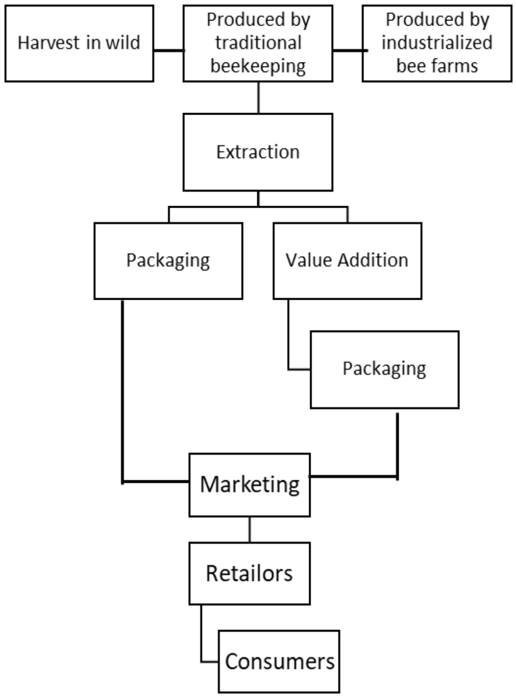


Figure 131: Actors of Bee honey Value chain in Sri Lanka

Sri Lanka is still depending on wild honey production other than industrialized honey production. Therefore, Sri Lanka is lacking in fulfilling the needs of consumers. Presently, governmental and non-governmental organizations have emerged and engaged in commercial beekeeping enhancement. The main actors of the bee honey value chain in Sri Lanka are wild honey collectors, beekeepers, intermediary sellers, value addition processors, retailers and consumers.

By promoting each stage of above value chain in figure 01 bee honey industry can be developed with greater extent. Other than the bee honey industry by-products of bee honey can be used to improve the economy of the wild bee honey collectors and the beekeepers.

Common issues of characterizing the Bee honey value chain

The main issue of characterizing the bee honey value chain in Sri Lanka is there are not many value additions that cannot be seen in the country. Ancient bee honey collectors of Sri Lanka are the indigenous people in Dambana and Mahiyangana areas. They are not familiar with the data collection methods and modern research methods therefor there are lack of data on traditional bee honey collectors.

In modernized beekeeping and semi modernized bee keeping the main issue is input suppliers are not connected to the main market. Honey boxes and other main equipment were mainly prepared by the farmers on their own and few of equipment can be purchased from the mechanical input suppliers. Individual entrepreneurs’ partners and the companies who were engaged in the bee honey production does not have any specific financial market for collecting capital.

One of the main issues of characterizing bee honey value chain in Sri Lanka is whole sale and the retail market cannot be differentiated separately because most of the final consumers are the patients of the indigenous doctors. And their consumption pattern also varies from each other during their consumption patterns.

In Sri Lanka several companies can be identified as the bee honey retailors. Baraka, Saraketha, Ceylon Bee honey, Nature Bee and Edenborough are the some of companies retailing as their product and some of the companies are not only selling raw bee honey but also sell value added bee honey products on their product stalls.

Analyzing the Bee honey Value Chain

Sri Lankan bee honey value chain actors can be identified as follows, Input suppliers, wild honey collectors, bee keepers, companies, whole-sellers, retailers and consumers. In this value chain, each stake holder contributes value chain by adding value to the final product. To determine the sustainability of beekeeping it is essential to analyze the profitability of each actor in the value chain. To calculate the profitability of a beekeeping cost for honey production should be calculated. As in table 44, the cost of production for 4.5 liters of bee honey will be 10,500 LKR.

Table 44: Cost of production for 4.5l of bee honey in 01 day

Item	Cost (LKR)
Input suppliers	
Honeycomb box	2500
Honey collectors/Beekeepers	
Labor	2000
Materials	1000
Wholesalers/Retailors	
Packaging	3000
Marketing	2000
Total	10,500

The cost was calculated for the modernized and semi-modernized bee honey production, not for wild bee honey production. As in table 44, each actor in the value chain was contributing to the cost of the final product. Also, the revenue of bee honey production is distributed to each actor. The share of the revenue for each actor in the value chain is called as the value breakdown of the bee honey value chain.

Figure 132: Value Chain breakdown for farm Bee honey

Figure 133: Value Chain breakdown for Wild Bee honey

<u>Road map for value chain upgrading</u>

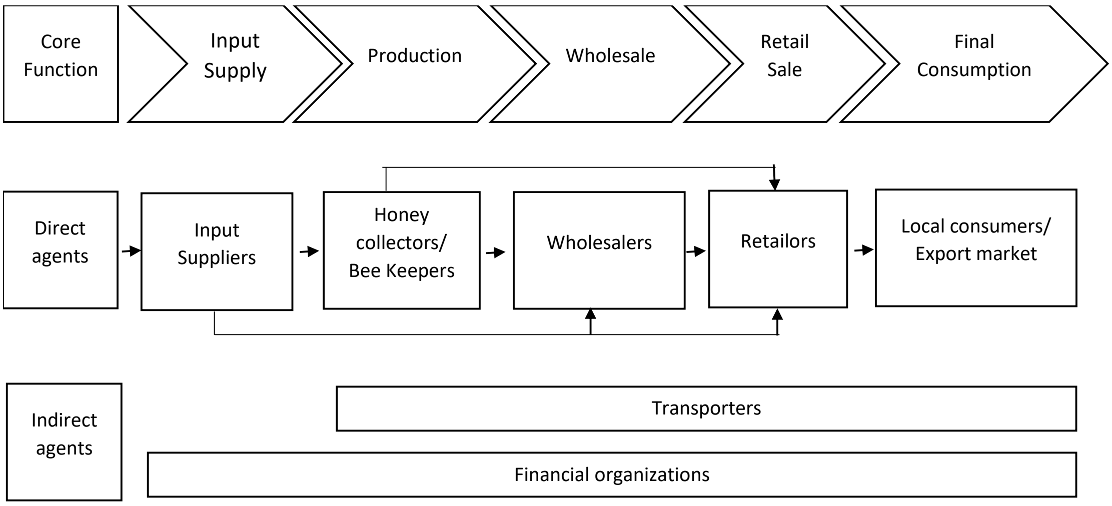


Figure 134: Value Chain map of Bee honey in Sri Lanka

Input suppliers

Input suppliers are the basic support providers in the bee honey value chain. Input suppliers contribute for the foundation of the value chain and they comprise organizations and or individuals' entrepreneurs engaged in the construction and supply of beekeeping equipment to interested producers. (M.T. Uddin, M.Z.I. Kamal, & M. Kamruzzaman, 2021).

Producers (Beekeepers)

Major actors of the value chain who utilize the limited resources and manage them to produce high-quality honey production. The beekeepers either sell honey directly to the local consumers or to wholesalers or to processors.

Processors

The actors who buy crude bee honey from beekeepers or wholesalers and add value through processing and supply value-added honey to the market.

Companies

Companies are the brand name that distributes bee honey and value-added bee honey products to the market under a specific brand name.

Wholesalers

These are the actors who buy bee honey in large quantities and resell them to retailers as bulk. They demand their products by collecting the bee honey from beekeepers and storing it and reselling them.

Retailers

Retailers are the value chain actors who buy the products from wholesalers or companies and sell them to the final consumers. The grocery stores, supermarkets, shopping centers and ayurvedic shops are the major retailers prevalent in the market. (M.T. Uddin, M.Z.I. Kamal, & M. Kamruzzaman, 2021).

Consumers

Consumers are the final value chain operators. There are two main types of consumers in a value chain. They are crude honey consumers and processed honey consumers. In Sri Lanka, bee honey is used as the processed product for medical concerns.

Value additions of Bee Honey

Value addition of bee honey was done by different actors of value chain actors in the bee honey value chain. The beekeepers who are selling bee honey directly to the consumers add value to the bee honey through their packaging and selling methods. Some beekeepers are selling their bee honey as extracted bee honey for 3200/= rupees per kilo of bee honey.

Figure 135: Crude bee honey in Sri Lanka

Figure 136: Comb honey product in Sri Lanka

Some beekeepers sell their honey without extracting honey from the bee come. This type of bee honey costs more than ordinary bee honey. It is around 3500-4000/= LKR per 1 kilogram of bee honey.

Bee honey processors are adding value to the bee honey by adding several materials to the bee honey and preserve them in anaerobic condition. Main ingredients used in bee honey processing Garcinia mixed honey, Cinnamon mixed, Garlic mixed, Bee Pollen, Cashew in honey, Pumpkin seeds in honey, gooseberry mixed, moringa mixed, *Centella* mixed, and Bee Balm. Also, nonalcoholic drinks are produced using bee honey as a sweetener.

Figure 137: Honey with cashew and cinnamon

Figure 138: Pollen in honey

Improvement of bee honey value chain in Sri Lanka

Table 45: SWOT analysis for Sri Lankan Bee honey value chain

Strengths	Weaknesses
• Land resources • Conditions for bee keeping • Labor • Entrepreneurship	• Beekeepers not united • Capital • Demand power • Equipment
Opportunities	**Threats**
• Local demand • International market • Tourism	• Diseases • Pesticides

To overcome the weaknesses of beekeeping farmers will have to unite and build farmers' unions to apply subsidies for capital and equipment. To reduce the threats to beekeeping organic farming is the best method.

To improve the bee honey value chain in Sri Lanka there are several key initiatives have to be taken. At first bee keepers needed to unite as one organization, association, or trade union to discuss their drawbacks. Establishing these type of organizations farmers can request subsidies from the government, collect working capital as an organizational fund, invest funds to purchase machinery to increase the quality of production, and to add value to raw honey. Also, Sri Lankan honey farmers needed improve their B2B communication to increase their market share in the local and international markets. By following above measures farmers can enhance the quality and the quantity of bee honey production Sri Lanka.

Conclusions

The study concludes that bee honey production in Sri Lanka has enormous opportunities to boost the livelihood of Sri Lankan stakeholders. The bee wild bee honey production and beekeeping in Sri Lanka most full fill the bee local honey consumption. The study exposed that lack of capital, lack of credit, and lack of government intervention results in the drawbacks in the bee honey value chain in Sri Lanka. Moreover, government and nongovernment organizations should provide scientific and economic knowledge to stakeholders to increase the quality and quantity of their production.

Value chains developed for Ampara district are given in table 4.

3.5.3 Technological Analysis

3.5.3.1 Dry Chili Production

3.5.3.1.1 Land Preparation

Already discussed under Kilinochchi district chili cluster.

3.5.3.1.2 Water Management

The water requirement for chili as an average is 4.50 mm/day. Required irrigation water capacity depends on application efficiency of selected irrigation method and soil condition (vertical and horizontal water penetration). The average annual rainfall in Ampara district is 4.5 mm/day.

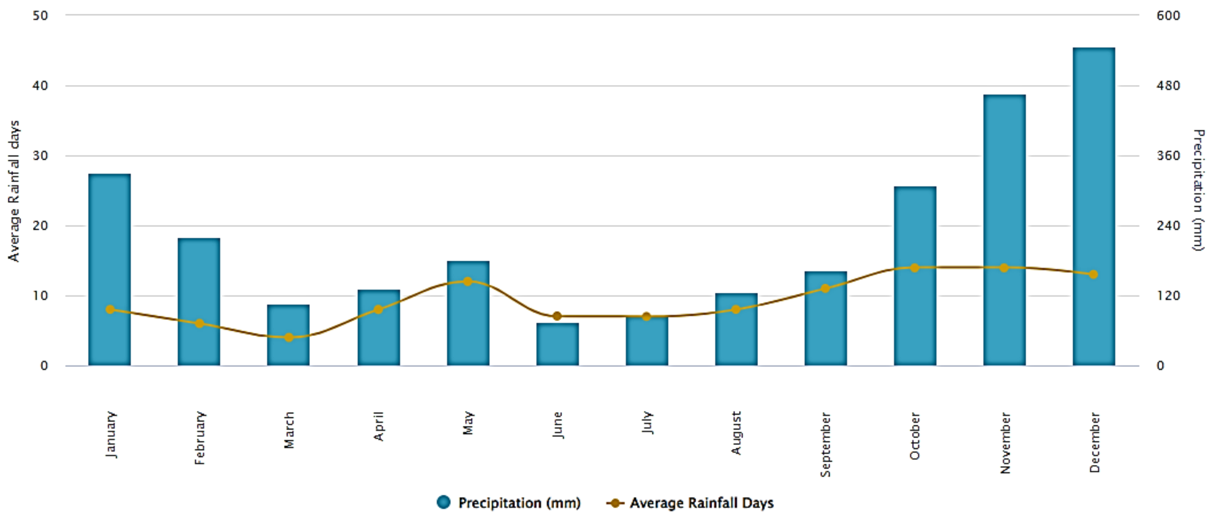


Figure 139: Monthly average rainfall in Ampara district

(Source - [What is weather like in Ampara, Eastern Province, LK (worldweatheronline.com)](worldweatheronline.com))

It is advisable to start chili cultivation in October. However, irrigation system with a reliable water source is a must as chili plant expose to dry weather from February to April and June to September.

Table 46: Effectiveness of Irrigation Methods for Chili cultivation

Irrigation Method	Surface Irrigation	Sprinkler Irrigation	Drip Irrigation
Water application efficiency	50%	70%	85%
Weed Pressure	High	Low	Minimum
Favorable for diseases	High	Low	Minimum
Required water pressure	Not applicable	High	Low
Fertigation	Not possible	Not always	Possible

Recommendation	Not recommended	Recommended if drip irrigation is not possible	Recommended

Drip irrigation uses plastic tubing which is designed and manufactured with precision water emitters spaced at regular distances along the length of the tubing. The emitters are engineered to release a specific amount of water which is 2 l/h at 1 bar pressure. Drip tape can be practices but less durable compared to tubes. Water for drip irrigation systems must be free of solid particles which can clog the emitters. Thus, filtering systems are highly recommended.

The recommended drip irrigation system can be used to supply the required plant nutrients by using a fertigation unit.

3.5.3.1.3 Weed and Pest Management

Already discussed under Kilinochchi district chili cluster.

3.5.3.1.4 Harvesting

Already discussed under Kilinochchi district chili cluster.

3.5.3.1.5 Processing

Figure 140: Processing of Chilli

Process	Note on feasibility options
Drying	• Introducing a solar tunnel dryer for intermediate drying and initial withering – Reduce required thermal load and minimize mould formation and spreading. • Either batch or continues type chili dryer.

	• Using electricity as the thermal power source will be convenient and cost effective for the farmer company – Heat Pump • Having chili flattens system will reduce drying duration as well as texture shrinkages. • The desired moisture content at the dryer mouth is 8 % in w.b. • Inlet hot air temperature needs to be maintained at 50 – 60 ^{0}C. • Better to have a positive temperature gradient.
Grading & Sorting system	• Grading/sorting is based on pods colour and size. • Considering the current manual operation (hand picking), the investment on a colour sorter will be paid back within one year. (Kindly refer the workings under Kilinochchi district chili cluster) • Secondaries can be used for making chili powder, flakes or paste.
Packing & storing	• Jute, gunny or polythene bags can be used for packing depending on packing density decided by the selected marketing channels i.e., wholesale or retail marketing. • Ascertained storing bulk density of dry chili at 10% moisture is 18 kg/square feet at storing height of 6 feet. • The moisture content at the time pf packing should be around 8% - 10% in w.b. • Evaluation of existing government buildings and lands are being evaluated for a common processing centre in Ampara district. • Designed features of chili processing centre have been discussed under Kilinochchi district chili cluster.

3.5.3.2 Jumbo Peanut Cluster – Thirukkovil DSD

3.5.3.2.1 Understanding the requirement of technical inputs

In Sri Lanka, peanut crop is mainly cultivated in Dry and Intermediate Zones and the annual cultivation extent was 15,752 ha with the production of 27,602 t pods. Ampara contribution for national ground nut production is about 10% while the highest contribution is from Monaragala district (19%) *(Department of Census and Statistics, 2020).*

Peanuts having a seed mass of more than 70g per 100 seeds are considered as Jumbo peanuts. Six peanut varieties, namely, Tissa, Walawa, Indi, Tikiri, ANKG1 and Lanka Jumbo have been recommended by the Department of Agriculture (DOA) for general cultivation and all those varieties have been developed at Grain Legumes and Oil Crops Research and Development Centre, (GLORDC) Angunakolapelessa. The average yield of new peanut variety was (1.25 ton/acre), higher than that of Lanka Jumbo (1 ton/acre) and Walawa (850 kg/acre), and the potential yield was 1.5 ton/acre. (Jeewani et al., 2020*).*

Learning from Pilot Cluster in Kilinochchi district

However, discussions had with farmers in Kilinochchi revealed that the actual yield from the pilot project was around 300 kg per acre mainly due to low seed germination rate and absence of proper irrigation and water draining facilities. It was further noticed that Jumbo peanut quality has been well below the standard mainly due to absence of well-designed and engineered drying and storing facilities.

Note: Kilinochchi farmers have sold 2,550 kg of deshelled jumbo peanuts to C.W Mackie and out of that 1,800 kg was rejected and returned due to presence of warms.

3.5.3.2.2 Land Preparation

Already discussed under Kilinochchi district Jumbo Peanut cluster.

3.5.3.2.3 Water Management

The total water requirement for Groundnut production is 500 – 800 mm per annum (1.5 mm to 2.5 mm/day) (*Water and Soil requirements – Fao,org*). The highest water requirement which is 50 mm per week for groundnut is at the fruiting stage (Source: [Timing critical in watering peanuts | Farm Progress]). The average rainfall in Kilinochchi is about 4.27 mm/day with highest and lowest average values of 15mm/day and 1mm/day respectively. Considering the past irrigation applications, thoughts of field experts, regional climate conditions, soil type, water availability and water requirement, sprinkler irrigation method is recommended.

Arranging sprinklers with 2m height in 5m-by-5m distances and operating the same at 1.5 to 2 bar pressure with flow rate of 800 l/h rate has been tested successfully in Sri Lankan context.

3.5.3.2.4 Seeding

Locally designed and fabricated machines are available for seeding cum ridge formation. Approximately these type machine can be used for seeding 3 acres per day.

3.5.3.2.5 Weed Management

Weeds are a major problem for peanuts especially during the first 4-8 weeks. They reduce yields by competition for water, fertilizer and sunshine. Weeds increase the threat on pest as well. Peanut is inherently a poor weed competitor and emphasis on cultural practices such as good land preparation and crop rotation are best recommended practices to farmers. Inter cultivator machine cab ne used for managing weeds.

3.5.3.2.6 Harvesting

Already discussed under Kilinochchi district Jumbo Peanut cluster.

3.5.3.2.7 Processing

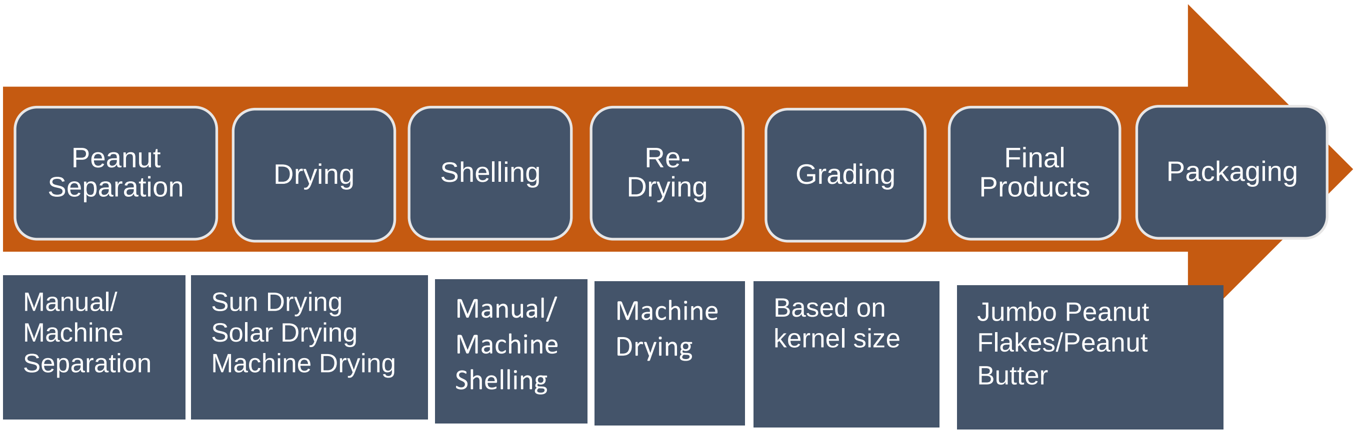


Figure 141: Processing of Jumbo Peanut

3.5.3.2.8 Jumbo Peanut separation

Currently ground nut separation from roots is taking place manually. Workers are paid at Rs. 35/kg. Locally available separator machine has an output around 1 ton/h.

3.5.3.2.9 Drying

Already discussed under Kilinochchi district Jumbo Peanut cluster.

3.5.3.2.10 Shelling and Grading

Already discussed under Kilinochchi district Jumbo Peanut cluster.

3.5.3.2.10 Storing

Already discussed under Kilinochchi district Jumbo Peanut cluster.

3.5.3.3 Soursop Cluster – Padiyathalawa and Uhana DSDs – Cluster expansion

3.5.4.3.1 Understanding the requirement of technical inputs

The potential yield of soursop is about 7 tons per acre.

Technological interventions are required to minimize post-harvest loss and increase the shelf life.

3.5.3.2.2 Potential technical inputs for Avocado farming

Activity	Description
Land Preparation	After land clearance, it is required to have a deep plough followed with harrowing. Dig size is 50 cm x 50 cm x 50 cm. Mamoties and crowbars can be used for digging planting holes. Note: In the pilot project, 200 plants were planted in ½ acre. It is better to further evaluate the same as general planting density is 160 – 200 plants per acre.
Micro Irrigation	Required annual rainfall is 1000 mm to 2500 mm. Either drip or mini sprinklers can be used. The required emittance from drip is 5 l per hour. Watering about 10 minutes in every two days will provide the required water demand. However, the required watering time will depend on soil moisture content. Ensure that water stress is prevented. Note: About 1 m height sprinklers were used in the pilot.
Weed control	Bio mulching can be tested. Organic soursop is a requirement of potential buyers.
Harvesting	Harvest takes place when the color changes to a slightly yellowish-green. Once harvested, the fruit softens in 4–7 days and has a shelf life of another 3–5 days. The optimal edible stage is 6–7 days after harvest. A selective harvesting needs to be practiced.

3.5.3.2.3 Processing

As per designed value chain assessment, it is planning to sell the harvested soursop as fresh fruits and pulp.

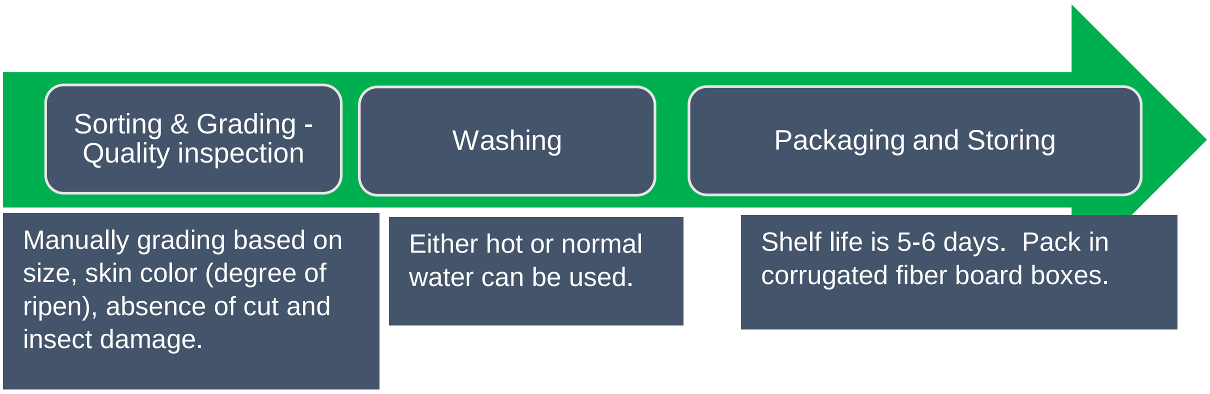
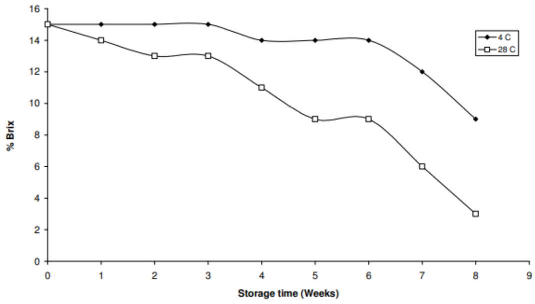


Figure 142: Processing of Soursop

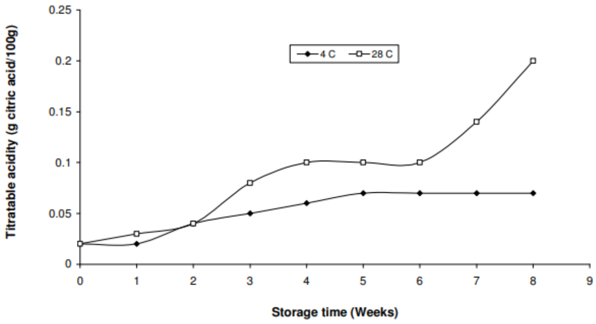
Note: Artificial ripening is not yet practiced among farmers/ traders. However, fruit ripe within 3 to 4 days after plucking when they are kept in ambient condition.

Enriched pulp, sweetened or unsweetened, can be processed and stored frozen for use in various products. The pulp making process is already mentioned under passion fruit. However, a detailed study by undertaking factory visits and discussion with experts is required in soursop pulp making process.

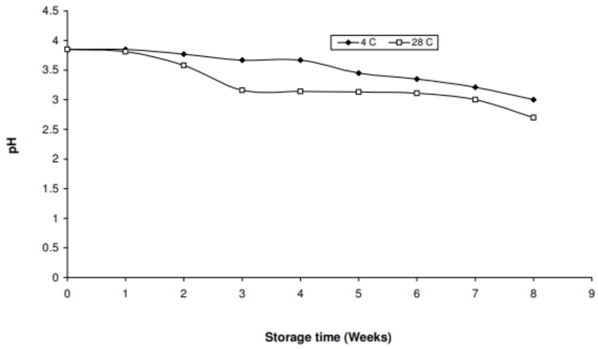
Experiments have been done to study the qualitative benefits of storing soursop in frozen (4 ^{0}C) vs ambient condition (28 ^{0}C).



Variation of soluble sugar level (Brix value)



Variation of acidity level



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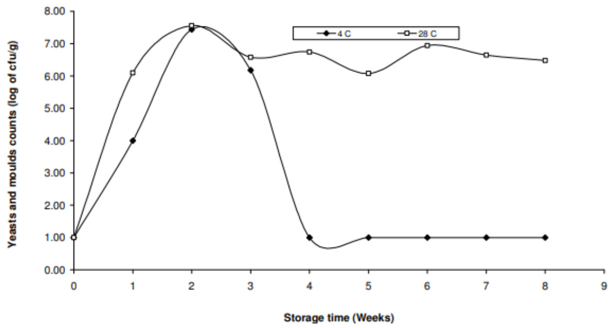
Variation of pH value



Variation of mold formation

Storing at 4 ^{0}C is more beneficial than at 28 ^{0}C.

During stakeholder meeting, it was discussed whether buyers can supply freezer trucks for transporting the harvest. Further discussions with buyers are to be conducted. Converting unusable container boxes to cold rooms is another potential option.

3.5.4 Analysis on physical infrastructure

<table>
<tr><th>Physical Infrastructure Requirement</th><th>Note on feasibility options</th></tr>
<tr><td>Access roads</td><td>
As per the filed visits undertaken to pilot clusters and potential lands for new clusters and expansion of existing clusters, the required access roads rehabilitation is minimum. Tar and gravel roads were seen more frequently. Gravel roads are proposed based on necessity and its impact to the cluster/s.
Road Kilometrage by Province and District 2019
<table>
<tr><th>Province/ District</th><th>Class A</th><th>Class B</th><th>Class C</th><th>Class D</th><th>Express-ways</th><th>Total</th></tr>
<tr><td>Eastern</td><td>620</td><td>551</td><td>889</td><td>272</td><td>-</td><td>2,334</td></tr>
<tr><td>Batticaloa</td><td>206</td><td>61</td><td>355</td><td>44</td><td>-</td><td>666</td></tr>
<tr><td>Ampara</td><td>273</td><td>282</td><td>319</td><td>128</td><td>-</td><td>1,002</td></tr>
<tr><td>Trincomalee</td><td>141</td><td>209</td><td>216</td><td>100</td><td>-</td><td>666</td></tr>
</table>
Class A – Roads connecting national capital with provincial capital.
Class B – Minor roads connecting other important towns
Class C – Agricultural and local roads (12 ft width)
Class D – Graveled roads (8 – 10 ft)
Sources: RDA and PRDA
</td></tr>
<tr><td>Water Irrigation System</td><td>
It is proposed to provide micro irrigation package for all farmers except rainfed avocado farmers as described under each crop category. The main water sources and water supply methods up to the selected/potential lands
Mainly Madura Oya and irrigation channels
<table>
<tr><th>Province</th><th colspan="2">Major Schemes</th><th colspan="2">Medium Schemes</th><th rowspan="2">Total Extent (ha)</th></tr>
<tr><th>District</th><th>No of Schemes</th><th>Extent (ha)</th><th>No of Schemes</th><th>Extent (ha)</th></tr>
<tr><td>East</td><td>21</td><td>103,109</td><td>56</td><td>23,210</td><td>126,319</td></tr>
<tr><td>Batticaloa</td><td>7</td><td>20,868</td><td>15</td><td>5,861</td><td>26,729</td></tr>
<tr><td>Ampara</td><td>9</td><td>66,907</td><td>20</td><td>13,103</td><td>80,010</td></tr>
<tr><td>Trincomalee</td><td>5</td><td>15,334</td><td>21</td><td>4,246</td><td>19,580</td></tr>
</table>
Minor Schemes
<table>
<tr><th rowspan="2">Province</th><th colspan="4">No of Irrigation Schemes</th><th colspan="3">Extent (ha)</th></tr>
<tr><th colspan="2">Working</th><th colspan="2">Abandoned</th><th colspan="3">Working</th></tr>
<tr><th>District</th><th>Tank</th><th>Anicut</th><th>Tank</th><th>Anicut</th><th>Tank</th><th>Anicut</th><th>Total</th></tr>
<tr><td>East</td><td>741</td><td>50</td><td>393</td><td>51</td><td>16,605</td><td>330</td><td>16,935</td></tr>
<tr><td>Batticaloa</td><td>132</td><td>4</td><td>110</td><td>14</td><td>3,075</td><td>213</td><td>3,288</td></tr>
<tr><td>Ampara</td><td>181</td><td>46</td><td>87</td><td>37</td><td>3,539</td><td>117</td><td>3,656</td></tr>
<tr><td>Trincomalee</td><td>428</td><td>0</td><td>196</td><td>0</td><td>9,991</td><td>0</td><td>9,991</td></tr>
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</td></tr>
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<tr>
<td></td>
<td>
Agro wells – It is persuaded to use common agro wells. However, it is not recommended to construct agro wells but pumping facility can be given to the existing agro wells based on its absolute necessity. As per finding from farmer discussions, 70% of existing water pumps are engine driven.
Summary of District Wise Distribution of Groundwater Aquifers
<table>
<tr><th>Province
District</th><th>Total Area
(ha)</th></tr>
<tr><td>East</td><td>962,242</td></tr>
<tr><td>Batticaloa</td><td>248,329</td></tr>
<tr><td>Ampara</td><td>449,551</td></tr>
<tr><td>Trincomalee</td><td>264,362</td></tr>
</table>
Source: The Preparatory survey on the project for improvement of agricultural production and productivity in dry zone areas in Sri Lanka

Water reliability is higher as mainly depends on major irrigation systems. Agriculture feasibility is high in case of water availability.
</td>
</tr>
<tr>
<td>Protecting farmlands from wild elephants</td>
<td>Electric fences and other destructive measure are not going to promote. Instead of that bio fencing (Lime cultivation with honey bees, cultivating thorny plants…etc) and using splashing lights are proposed.
Pig nets also proposed against attacks from pigs which is frequent in Ampara district.</td>
</tr>
<tr>
<td>Processing Centre</td>
<td>The processing centre needs to be designed based on machinery and production process flow required to meet the agreed value chain assessment and product certification.
It is more focus to rehabilitate and use abounded government building rather than construction of new buildings. Depending on distance from farmlands to the processing centre and usability of same machineries, a common processing centre for few crop clusters can be established. A land and building belong Paddy Marketing Board located in Karamatiya GN division has been already identified for maize seed production cluster.

<u>Below mentioned component are to be included in a processing premises</u>.
Crop receiving, weighing, acceptance and pre-treatment section.
Washing, intermediate drying or cooling and initial sorting are considered as pre-treatment.
Processing Section – Machineries are to be installed considering the productivity, worker convenience, effective process flow and space availability.</td>
</tr>
</table>

	Storing facility – Pest control measures, proper ventilation, maintaining of required temperature and RH are going to be considered in order to enhance shelf life of products. Auxiliary buildings • General Office with facilities for meetings and training sessions. • Marketing Outlets • Worker sanitary facilities • Compost making facilities • Machinery maintenance section • Store room – Manging inventory Rooftop solar power generation under "Net Plus" scheme is proposed. This will reduce the operation cost and ensure the operation of critical processing steps even at a power outage.

3.6 Economic Analysis

3.6.1 Introduction

As the economic viability and the project sustainability depend on how the interference of ASMP project improves the livelihood of the farmers, financial feasibility plays a vital role in this regard. Therefore, financial analysis of the project interference was carried to check the feasibility. Primary data for the analysis were collected through focused group discussions that comprised of officials of Department of Agriculture (DoA), private sector companies and most importantly farmers. Secondary data sources were collected from available sources of Department of Agriculture, FAOSTAT etc. In analyzing the data, Benefit Cost ratio, Net Present Value (NPV), Internal Rate of Return (IRR), breakeven yield, per unit cost and gross margins were calculated. Outcomes are evaluated under different scenarios such as "with project" and "without project" scenarios.

3.6.2 Jumbo Peanut

In analyzing the data, Benefit Cost ratio, Net Present Value (NPV), Internal Rate of Return (IRR), breakeven yield, per unit cost and gross margins were calculated. Outcomes are evaluated under different scenarios such as "with project" and "without project" scenarios. Following assumptions were made before the analysis.

- Prices do not change from year to year
- Price of ground nut with shell – 530 Rs./Kg
- Price of jumbo peanut with shell – 900 Rs./Kg
- Price of jumbo peanut with shell -1900 Rs./Kg

- Discount rate is 16%

Results strongly suggest that benefit are greater than cost so that it generates positive outcomes. NPV is positive and greater benefits are generated through the provision of new technologies provided by the ASMP. IRR is also greater in with project scenario than that of without project scenarios. If farmers sell their products without shells, it leads to generate more monthly income. The highest monthly income can be achieved if farmers sell processed products.

Table 47: Financial Indicators

Indicator	Without Project (with shell)	Without Project (without shell)	With Project (With Shell)	With Project (Without Shell)
B/C	1.19	1.33	1.61	2.30
NPV	617,976.16	1,109,076.16	3,608,364.24	7,643,569.24
IRR	92%	158%	88%	177%
Payback Period	1	1	1	1
Gross Margin	16%	25%	38%	56%

The gross margin is higher in with project scenario in comparison to without project scenario. Unit cost of production is lower with the interference of the project. In the case of with project scenario, the payback period is one year in comparison to two years in without project scenario.

Table 48: Financial Indicators

Year	Without Project (with shell)				Without Project (without shell)			
	Breakeven yield	ROI with Shell	Per unit cost with shell	Monthly Income with shell	Breakeven yield	ROI without shell	Per unit cost without shell	Monthly Income without shell
0	333.33				222.22			
1	1,365.06	107.68	819.04	20,820.00	910.04	172.33	819.04	33,320.00
2	1,176.61	92.82	705.97	20,820.00	784.41	148.54	705.97	33,320.00
3	1,015.09	80.07	609.05	20,820.00	676.73	128.15	609.05	33,320.00
4	874.15	68.96	524.49	20,820.00	582.76	110.36	524.49	33,320.00
5	753.79	59.46	452.28	20,820.00	502.53	95.16	452.28	33,320.00
Overall		308.99				554.54		

On average, the farmers' cost of production per unit is less with technologies that are going to be provided by ASMP as the yield substantially increases. Return on investment is also higher in with project scenario. Farmer monthly income becomes 10.8 times higher with the interference of the project. If deshelling machined are provided, they can earn the highest income as the price for deshelled jumbo peanut is substantially higher and the demand for deshelled products is also higher.

Table 49: Financial Indicators

Year	With Project (With Shell)				With Project (Without Shell)			
	Breakeven yield	ROI with Shell	Per unit cost with shell	Monthly Income with shell	Breakeven yield	ROI with Shell	Per unit cost with shell	Monthly Income with shell
0	1,220.00				642.11		1,121.84	
1	1,228.56	104.20	847.28	122,896.67	646.61	191.28	1,129.71	225,605.00
2	1,058.95	89.82	730.31	122,896.67	557.34	164.88	973.75	225,605.00
3	913.58	77.49	630.05	122,896.67	480.83	142.24	840.07	225,605.00
4	786.73	66.73	542.57	122,896.67	414.07	122.49	723.43	225,605.00
5	678.41	57.54	467.87	122,896.67	357.06	105.63	623.83	225,605.00
Overall		295.77				626.52		

Qualitative Analysis

Qualitative analysis suggests that growing jumbo peanut cultivation is easy as it doesn't demand high skills in cultivation. Scaling up can be done with a low to medium level feasibility. Overall feasibility is at low to medium level.

Table 50: Results of the qualitative analysis of Jumbo Peanut

Criteria	Average Score	Overall Feasibility (difficult to cultivate)
Criterion 01 Cultivation costs (Skills, money, technology)	2.7	Low to medium
Criterion 02 Cultivation quality (difficulties for high quality cultivation)	3	Medium
Criterion 03 Processing costs (Skills, money, technology needed for processing)	3	Medium

Criterion 04 Scaling up (difficulty getting high quality supply)	3	Medium
Criterion 05 Infrastructure costs (assets needed across entire value chain)	2.5	Low
Overall	2.8	Low to medium

3.6.3 Chili

The following assumptions were made when analyzing the data:

- Agronomic practices, cost of production and the yield do not differ from season to season
- Prices do not change from year to year
- Discount rate is 16%

The results of the analysis suggest that the cultivation of chili under new technologies is highly feasible and generate higher benefits to the farmers. The Benefit- Cost ratio is 4.11 compared 1.53 in without project scenario. The NPV is positive and gross margins are higher with the investment. Unit cost reduces up to about Rs 49 whereas it is very high in traditional cultivation. Income per month four times higher than that of traditional cultivation. Breakeven yield is Rs.3262 as the price of chili in both cases considered to be the same.

Table 51: Financial Indicators

Indicator	Without project	With project
B/C	1.53	4.11
NPV	1,916,383.60	14,860,063.60
IRR	1.48	2.61
Gross Margin	34.84	75.65
Break Even Yield	3,262.00	3,262.00
Per Unit Cost	203.88	48.93
Income per month	58,450.00	418,450.00

Overall return on investment is higher in with project scenario.

Table 52: Return on Investment (ROI)

Year	Without project	With project
1	159.11	273.95
2	137.14	236.13

3	118.32	203.72
4	101.89	175.43
5	87.86	151.28
Overall	504.31	940.51

The main objective of investing in chili cultivation is production of dry chili where 5 kilograms of green chili produce 1 kg of dry chili. If assume that the farmer receives 300Rs/kg of green chili and 1200Rs/kg dry chili.

	With Project	**Without Project**
Production	20000kg per acre	4800kg per acre
Income from green chili per year	6,000,000	1,440,000
Income from dry chili per year	4,800,000	1,152,000

If the objective is to increase the dry chili production, farmers should receive at least more 1500Rs./kg or more than that. Then the farmers have an incentive to go for dry chili.

Qualitative Analysis

According to qualitative analysis, chili is an easy crop to cultivate.

Table 53: Results of the qualitative analysis of Chilli

Criteria	**Average Score**	**Overall Feasibility (difficult to cultivate)**
Criterion 01 Cultivation costs (Skills, money, technology)	3	Medium
Criterion 02 Cultivation quality (difficulties for high quality cultivation)	2.5	Low
Criterion 03 Processing costs (Skills, money, technology needed for processing)	2.6	Low to medium
Criterion 04 Scaling up (difficulty getting high quality supply)	1.7	Low
Criterion 05 Infrastructure costs (assets needed across entire value chain)	2	low
Overall	2.36	Low

3.6.4 Pomegranate

<u>Assumptions</u>

- Prices do not change from year to year
- Discount rate is 16%

The results of the analysis suggest that the cultivation of pomegranate using new technologies and technical knowhow which will be provided through is highly feasible and generate higher net benefits to the farmers. The Benefit- Cost ratio is 15.94 compared 9.51 in without project scenario. The NPV is positive and gross margins are higher with the investment. IRR is 103% and 108% with and without project scenarios respectively.

Table 54: Financial Indicators

Indicator	Without Project	With Project
B/C	9.51	15.94
NPV	47,406,112.50	104,300,468.00
IRR	108%	103%

Average cost of producing a kilogram of pomegranate reduces substantially with the time and at the latter stages of the production the average cost per kilo is around Rs.31 whereas it is very high in traditional cultivation. Gross margins are also higher modern cultivation.

Table 55: Financial Indicators

Year	Without Project				With Project			
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	Gross Margin	Break Even Yield	Per Unit Cost	Income per month
0		974.29				2,688.57		
1		745.34				1,214.29		
2		1,025.95	1,020.12			1,534.29	716.00	
3	84.04	1,128.67	239.42	346,660.67	88.45	1,715.71	173.30	766,166.67
4	91.21	1,243.11	131.85	752,485.17	93.11	2,045.71	103.32	1,613,166.67
5	92.05	1,498.37	119.19	1,012,595.00	97.42	1,020.00	38.64	2,250,500.00
6	92.91	1,504.09	106.35	1,149,761.67	97.67	1,037.14	34.92	2,538,250.00
7-15	93.62	1,504.09	95.71	1,287,261.67	97.90	1,037.14	31.43	2,827,000.00
	89.48				93.73			

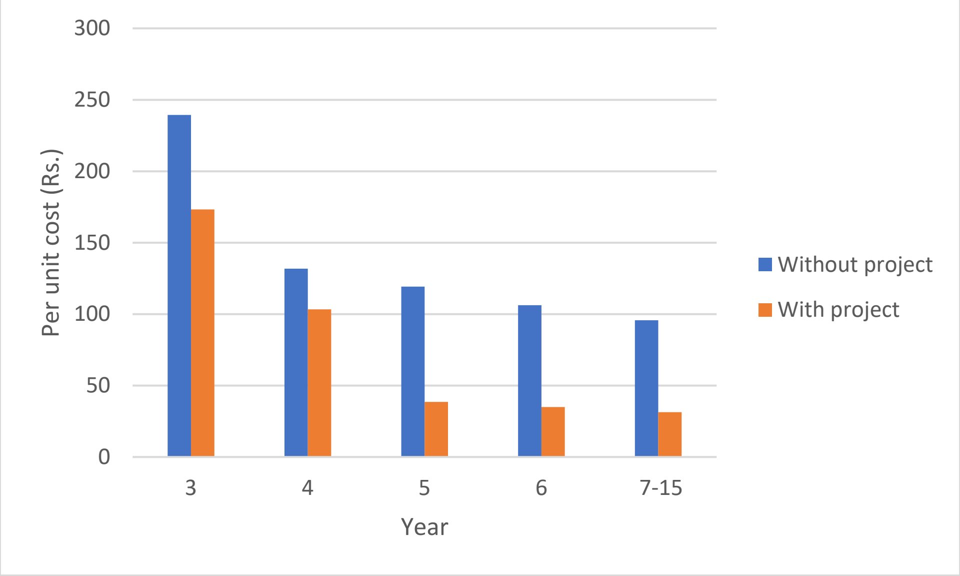


Figure 143: Cost of production per kilogram of pomegranate

Income per month is four times higher than that of traditional cultivation. Breakeven yield is 1034.14kg at the latter stages of the production.

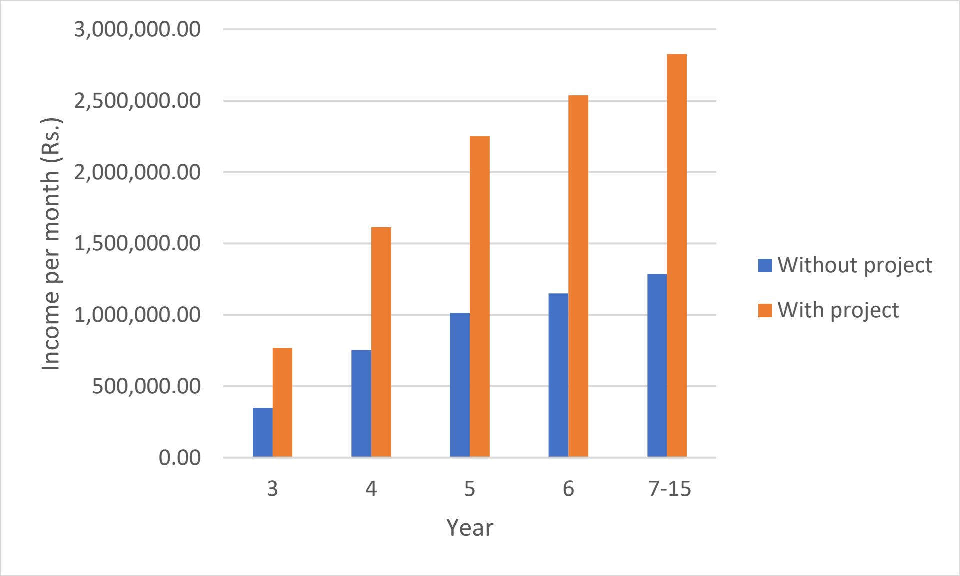


Figure 144: Farmer's net income per month

Farmers receive very high income per month with advancement of the production. However, traditional cultivation does not provide such benefits to the farmers. Overall return on investment is 5542 in "with project scenario" in comparison to 6951.04 in "without project scenario".

Table 56: ROI in with and without project scenario

Year	Without Project ROI	With Project ROI	Year	Without Project ROI	With Project ROI
2	36.81	46.43	10	514.15	409.18
3	390.98	313.14	11	441.67	351.50
4	730.86	567.78	12	380.52	302.83
5	848.09	683.04	13	328.42	261.37
6	829.45	663.56	14	283.12	225.32
7	801.80	638.10	15	244.62	194.84
8	690.82	549.78	Overall	6,951.04	5,542.00
9	595.69	474.07			

As the pomegranate cultivation is more profitable, with the availability of intermediate buyers who facilitate farmers with selling their products, pomegranate farmers could earn a favorable income consistently. However, the popularity of pomegranate cultivation is less among farmers although it secures higher demand and higher prices. In terms of financial benefits, pomegranate is found to be the most suitable crop which generates an income one year after crop establishment, yet most of farmers reported to be unaware of the economical merits of pomegranate cultivation.

Sensitivity Analysis

This section describes the different scenarios and their outcome with respect to changes in price and yield. The scenarios are:

1. Best Case Scenario – 10% increase in price and yield
2. Worst Case Scenario – 10% reduction in price and yield

Best Case Scenario - 10% increase in price and yield

Table 57: Financial Indicators

Indicator	Without Project	With Project
B/C	11.50	19.29
NPV	58,531,714.68	127,669,287.95
IRR	121%	115%
Payback Period	3	3

The results of the sensitivity analysis under best case scenario shows that operate farmers better off more as a result of increase in yield and price. Farmer’s net income per month increases by around 500000Rs-600000Rs. per month. However, the payback period is the same.

Table 58: Financial Indicators

Year	Without Project				With Project			
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	Gross Margin	Break Even Yield	Per Unit Cost	Income per month
0		974.29				2,688.57		
1		745.34				1,214.29		
2	43.80	1,025.95	927.38		60.55	1,534.29	650.91	
3	86.81	1,128.67	217.65	433,285.67	90.45	1,715.71	157.55	948,079.17
4	92.74	1,243.11	119.86	925,735.17	94.31	2,045.71	93.93	1,976,991.67
5	93.43	1,498.37	108.35	1,243,595.00	97.87	1,020.00	35.12	2,735,600.00
6	94.14	1,504.09	96.68	1,409,636.67	98.08	1,037.14	31.75	3,083,987.50
7th - 15th	94.73	1,504.09	87.01	1,576,011.67	98.27	1,037.14	28.57	3,433,375.00
Overall	91.31				94.82			

Table 59: Return on Investment

Year	Without Project	With Project
	ROI	ROI
2	60.96	65.08
3	488.69	387.49
4	899.13	695.83
5	1,041.56	830.27
6	1,016.92	806.23
7	981.66	774.97
8	845.78	667.70
9	729.31	575.76
10	629.48	496.95
11	540.74	426.89
12	465.87	367.78
13	402.09	317.43
14	346.63	273.65
15	299.49	236.59
Overall	8,582.36	6,783.70

Worst Case Scenario - 10% decrease in price and yield

Table 60: Financial Indicators

Indicator	Without Project	With Project
B/C	7.70	12.91
NPV	37,340,091.48	83,157,249.95
IRR	94%	91%
Payback Period	3	3

In the worst-case scenario where the price and yield are reduced by 10%, farmers are still better off meaning that it will not badly affect the farmers in the long run. They are able to continue without a difficulty as they earn a substantial monthly income.

Table 61: Financial Indicators

Year	Without Project				With Project			
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	Gross Margin	Break Even Yield	Per Unit Cost	Income per month
0		974.29			92.26	2,688.57		
1		745.34				1,214.29		
2	16.04	1,025.95	1,133.47		41.07	1,534.29	795.56	
3	80.29	1,128.67	266.02	268,285.67	85.74	1,715.71	192.56	601,579.17
4	89.15	1,243.11	146.49	595,735.17	91.50	2,045.71	114.80	1,283,991.67
5	90.19	1,498.37	132.43	803,595.00	96.82	1,020.00	42.93	1,811,600.00
6	91.25	1,504.09	118.17	914,636.67	97.13	1,037.14	38.80	2,044,487.50
7th 15th	92.12	1,504.09	106.35	1,026,011.67	97.41	1,037.14	34.92	2,278,375.00
Overall	87.01				92.26			

Table 62: Return on Investment

Year	Without Project	With Project
	ROI	ROI
2	14.95	29.55
3	302.59	245.87
4	578.61	451.92
5	673.04	549.83
6	659.83	534.48
7	639.08	514.27
8	550.62	443.08

9	474.79	382.07
10	409.80	329.77
11	352.03	283.28
12	303.29	244.06
13	261.77	210.65
14	225.66	181.59
15	194.97	157.06
Overall	5,475.09	4,418.56

Qualitative Analysis

Qualitative analysis suggests that pomegranate can be cultivated with low to moderate difficulty. Maintaining the cultivation quality is a must.

Table 63: Results of the qualitative analysis of Pomegranate

Criteria	**Average Score**	**Overall Feasibility (difficult to cultivate)**
Criterion 01 Cultivation costs (Skills, money, technology)	3	Medium
Criterion 02 Cultivation quality (difficulties for high quality cultivation)	3.5	Medium to high
Criterion 03 Processing costs (Skills, money, technology needed for processing)	2	Low
Criterion 04 Scaling up (difficulty getting high quality supply)	2.5	Low
Criterion 05 Infrastructure costs (assets needed across entire value chain)	2.5	Low
Overall	2.7	Low to medium

3.6.5 Passion Fruit

Following assumptions were made before the analysis:

- Prices do not change from year to year

- Discount rate is 16%

Results strongly suggest that benefit are greater than cost so that it generates positive outcomes. NPV is positive and greater benefits are generated through the provision of new technologies provided by the ASMP. IRR is also greater in with project scenario than that of without project scenarios.

Table 64: Financial Indicators

Indicator	Without project	With Project
B/C	1.79	4.35
NPV	1,380,354.03	9,858,605.58
IRR	76%	204%
Payback Period	2	1

The gross margin is 70 % in with project scenario in comparison to 42 in without project scenario while the breakeven yield is 1912.91Kg. Unit cost of production is 45.28 rupees.

Table 65: Financial Indicators

Year	Without Project					With Project				
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI
0		1,643.75					5,393.75			
1	53.43	1,327.34	149.04	40,604.17	79.85	87.36	1,327.34	53.09	244,604.17	146.59
2	63.56	1,912.91	54.65	88,989.17	150.84	87.85	1,912.91	51.01	368,989.17	190.61
3	59.19	1,912.91	61.21	73,989.17	108.20	87.85	1,912.91	51.01	368,989.17	164.44
Overall	41.94				238.89	70.22				401.64

On average, the farmers' cost of production per unit is less with technologies that are going to be provided by ASMP as the yield substantially increases. Return on investment is also higher in with project scenario.

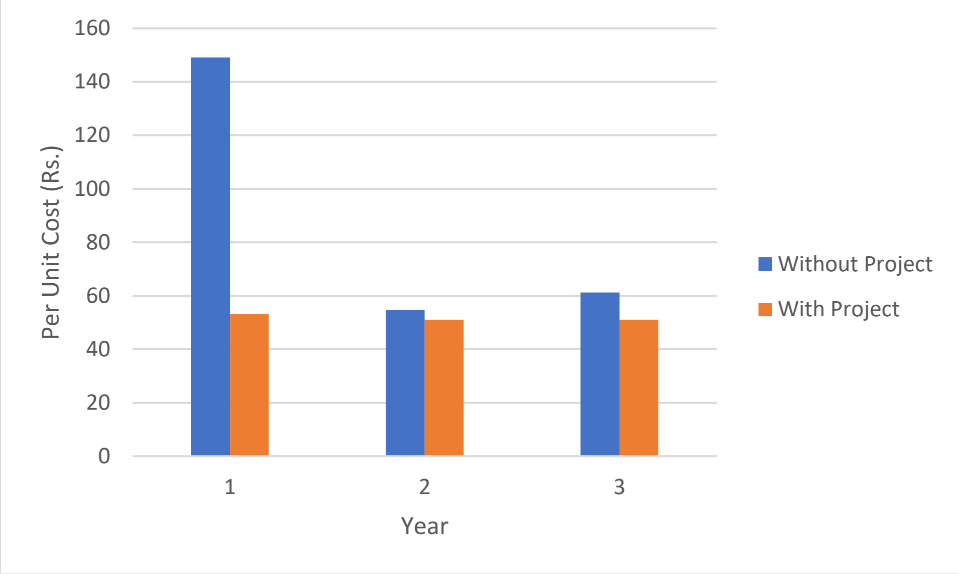


Figure 145: Cost of production per kilograms

It is really important that farmers' income should increase as a result of adoption of new technologies provided by ASMP. Accordingly, the results suggest that monthly net income become four times higher due to technologies.

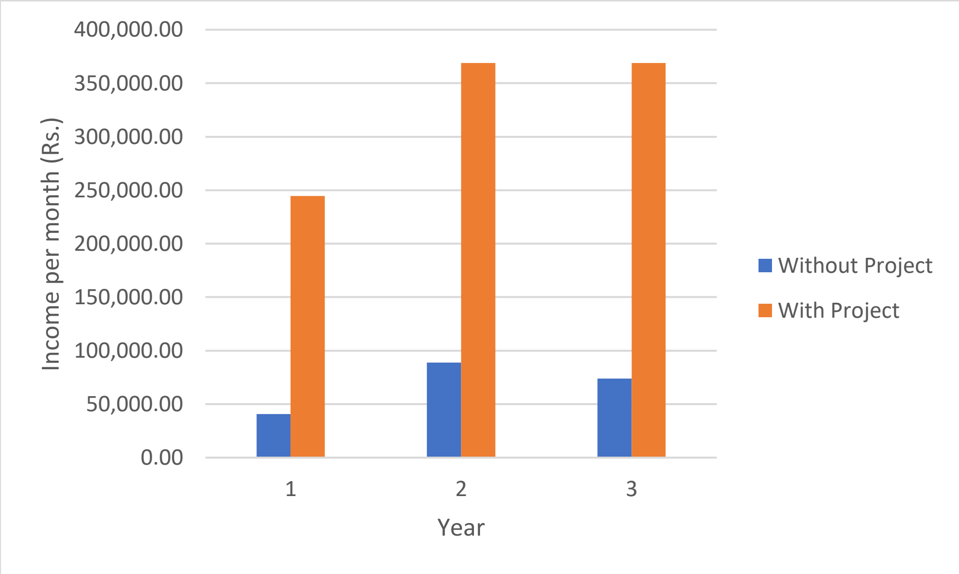


Figure 146: Farmers' monthly net income

Sensitivity Analysis

This section describes the different scenarios and their outcome with respect to changes in price and yield. The scenarios are;

1. Best Case Scenario – 10% increase in price and yield
2. Worst Case Scenario – 10% reduction in price and yield

Results of the sensitivity analysis reveal that farmers become better off with this scenario. Farmers' monthly net income increases up to 493,489.17 Rs.

Table 66: Financial Indicators

Indicator	Without Project	With Project
B/C	1.79	4.35
NPV	1,380,354.03	9,858,605.58
IRR	76%	204%
Payback Period	2	1

The unit cost of production also reduces with this scenario while ROI become greater. Gross margin also increases up to 77% from 70%.

Table 67: Financial Indicators

Year	Without Project					With Project				
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI
0		1,643.75					5,393.75			
1	17.89	1,327.34	135.49	7,710.42	15.16	90.25	1,327.34	48.27	327,604.17	196.33
2	69.89	1,912.91	49.69	118,389.17	200.68	90.63	1,912.91	46.37	493,489.17	254.92
3	66.27	1,912.91	55.65	100,239.17	146.59	90.63	1,912.91	46.37	493,489.17	219.93
Overall	44.25				262.42	77.03				571.18

Worst Case Scenario

In the worst-case scenario, payback period increases up to 3 years in without project scenario implying that traditional farmers face high risk if price and yield reduces.

Table 68: Financial Indicators

Indicator	Without Project	With Project
B/C	1.20	2.91
NPV	349,056.03	5,627,885.58
IRR	22%	124%
Payback Period	3	1

In comparison to traditional farmers, the farmers having modern technologies still earn a sufficient income per month even in this worst-case scenario.

Table 69: Financial Indicators

Year	Without Project					With Project				
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI
0	16.71	1,643.75					5,393.75			
1	(22.66)	1,327.34	165.59	(6,539.58)	(12.86)	85.43	1,327.34	58.99	207,604.17	124.42
2	55.02	1,912.91	60.73	62,389.17	105.75	86.01	1,912.91	56.68	313,489.17	161.94
3	49.62	1,912.91	68.01	50,239.17	73.47	86.01	1,912.91	56.68	313,489.17	139.71
Overall	16.71				66.36	65.69				326.07

Qualitative Analysis

Qualitative analysis suggests that growing passion fruit is not easy as it demands high skills in cultivation. Maintaining the quality is difficult in passion fruit cultivation. Special attention should be paid to this aspect. When exporting the product, it has to meet the standards. Difficulty of meeting the standards is at a medium level. Scaling up also is at medium difficulty level. Overall feasibility is at medium level.

Table 70: Results of the qualitative analysis

Criteria	Average Score	Overall Feasibility (difficult to cultivate)
Criterion 01 Cultivation costs (Skills, money, technology)	3	Medium
Criterion 02 Cultivation quality (difficulties for high quality cultivation)	4.2	High
Criterion 03 Processing costs (Skills, money, technology needed for processing)	2.5	Low
Criterion 04 Scaling up (difficulty getting high quality supply)	3	Medium
Criterion 05 Infrastructure costs (assets needed across entire value chain)	3	Medium
Criterion 6 Meeting standards	3	Medium
Overall	3.1	Medium

Further success of the project may depend on the following factors

1. Strong farmer-buyer relationship
2. Continuous supply of raw materials to processing industries
3. Availability of high-quality planting materials even after the project
4. Harvesting of fruits at correct stage of maturity
5. Improvement of post-harvest practices
6. Improvement of transport infrastructures to transport farm product to processing plants and markets
7. Remove the inconsistencies and weaknesses in the supply chain
8. Improve the linkages in the supply chain

3.6.6 Mango

As the mango production is planned to be implemented in Vavuniya district with high demand variety named Tom EJC, the implementation must be financially feasible and economically viable. As the economic profit is the main target of any producer, the mango production must generate economic profits and proper maintenance of the crop and continuous supply of mangoes should be assured. Otherwise, the whole effort of mango will be wasted. Therefore, assessing the financial feasibility is crucial as the ASMP intends to invest on the mango production by providing capital requirements.

Assumptions

- Prices do not change from year to year
- Discount rate is 16%

Table 71: Financial Indicators

Indicator	Without Project	With project
B/C	3.49	6.72
NPV	4,012,993.50	15,312,624.00
IRR	32%	41%
Payback Period	5	4

According to the indicators estimated in financial analysis, both with project and without project scenarios generate positive outcomes to farmers. Benefit-Cost ratio is greater than one in both scenarios while NPV is positive. IRR values are 32% and 41 in without project and with project scenarios respectively. More benefits are gained through the modernization project by the farmers.

Table 72: Financial Indicators

Year	Without Project				With Project			
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	Gross Margin	Break Even Yield	Per Unit Cost	Income per month
0		1,617.14				2,460.00		
1		422.86				181.43		
2		422.86				181.43		
3	54.29	571.43	160.00	19,791.67	86.50	270.00	94.50	100,916.67
4	77.14	571.43	80.00	56,250.00	93.25	270.00	47.25	217,583.33
5th to 15th	88.34	582.86	40.80	128,833.33	96.63	270.00	23.63	450,916.67
Overall	71.39				85.12			

The gross margin is 85.12% in with project scenario in comparison to 71.39% in without project scenario while the breakeven yield varies from 270kg to 582.86kg. Unit cost of production reduces from year to year in both scenarios.

Table 73: Return on Investment (ROI)

Year	Without Project	With project
	ROI	ROI
3	25.72	131.12
4	62.94	243.46
5	124.31	435.07
6	107.07	374.75
7	92.45	323.56
8	79.65	278.78
9	68.68	240.39
10	59.28	207.48
11	50.92	178.23
12	43.87	153.56
13	37.87	132.53
14	32.64	114.25
15	28.20	98.71
Overall	677.87	2,586.59

Farmers' monthly income increases with the improved technologies and new varieties. Initially, farmers receive a very low income starting from the third year. However, it gradually increases up to Rs 450,916.67 in the fifth year from Rs. 100,916.67 income in the third year. The income increases by 4.5 times with introduction of new technologies in mango cultivation.

Sensitivity Analysis

Two scenarios were considered in sensitivity analysis. They are 10% increase in price and yield (best case scenario) and 10% decrease (worst case scenario) in price and yield.

Best Case Scenario

According to the sensitivity analysis base on the best-case scenario, it is evident that farmers who cultivate mango using new technologies and new varieties, benefit highly if the price and yield increase by 10%. Payback period remains the same as in the original scenario.

Table 74: Financial Indicators

Indicator	Without Project	With Project
B/C	4.23	8.13
NPV	5,193,495.38	19,090,230.00
IRR	37%	46%
Payback Period	5	4

Gross margins increase and unit cost of production further reduces.

Table 75: Financial Indicators

Year	Without Project				With Project			
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	Gross Margin	Break Even Yield	Per Unit Cost	Income per month
0		1,617.14				2,460.00		
1		422.86				181.43		
2		422.86				181.43		
3	62.22	571.43	145.45	27,447.92	88.84	270.00	85.91	125,416.67
4	81.11	571.43	72.73	71,562.50	94.42	270.00	42.95	266,583.33
5th to 15th	90.37	582.86	37.09	159,458.33	97.21	270.00	21.48	548,916.67
Overall	76.35				87.71			

Very large ROI values are observed with this scenario.

Table 76: Return on Investment

Year	Without Project	With Project
	ROI	ROI
3	35.66	162.96
4	80.07	298.29
5	153.86	529.63
6	132.52	456.19
7	114.42	393.88
8	98.58	339.36
9	85.01	292.63
10	73.37	252.58
11	63.03	216.97
12	54.30	186.93
13	46.87	161.34
14	40.40	139.08
15	34.91	120.17
Overall	877.28	3,224.70

Worst Case Scenario

In the case of worst-case scenario where price and yield are decreased by 10%, the payback period increases up to 5 years in with project scenario.

Table 77: Financial Indicators

Indicator	Without Project	With Project
B/C	2.83	5.45
NPV	2,944,920.38	11,894,790.00
IRR	26%	35%
Payback Period	5	5

Financial risk to the traditional farmers is high when compared to “with project” scenario.

Table 78: Financial Indicators. ROI also reduces substantially

Year	Without Project				With Project			
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	Gross Margin	Break Even Yield	Per Unit Cost	Income per month
0		1,617.14				2,460.00		
1		422.86				181.43		
2		422.86				181.43		
3	43.56	571.43	177.78	12,864.58	83.33	270.00	105.00	78,750.00
4	71.78	571.43	88.89	42,395.83	91.67	270.00	52.50	173,250.00
5th to 15th	85.61	582.86	45.33	101,125.00	95.83	270.00	26.25	362,250.00
Overall	64.68				81.63			

Table 79: Return on Investment

Year	Without Project	With Project
	ROI	ROI
3	16.72	102.32
4	47.44	193.85
5	97.57	349.52
6	84.04	301.06
7	72.56	259.94
8	62.52	223.96
9	53.91	193.12
10	46.53	166.68
11	39.97	143.19
12	34.44	123.36
13	29.72	106.47
14	25.62	91.79
15	22.14	79.30
Overall	497.45	2,009.26

Qualitative Analysis

Qualitative analysis suggests that mango can be cultivated easily meaning that it is highly feasible. Maintaining the cultivation quality is a must. The results also suggest that it has low to moderate market opportunity.

Table 80: Results of the qualitative analysis

Criteria	Average Score	Overall Feasibility (difficult to cultivate)
Criterion 01 Cultivation costs (Skills, money, technology)	2.7	Low to medium
Criterion 02 Cultivation quality (difficulties for high quality cultivation)	3.5	Medium to high
Criterion 03 Processing costs (Skills, money, technology needed for processing)	1.7	Low
Criterion 04 Scaling up (difficulty getting high quality supply)	3	Medium
Criterion 05 Infrastructure costs (assets needed across entire value chain)	2	Low
Criterion 6 Meeting standards	2.5	Low
Overall	2.6	Low

3.6.7 Papaya

As the papaya production is planned to be implemented with high demand variety named Tainung, the implementation must be financially feasible and economically viable. As the economic profit is the main target of any producer, the papaya production must generate economic profits and proper maintenance of the crop and continuous supply of raw materials should be assured. Otherwise, the whole effort of papaya will be wasted. Therefore, assessing the financial feasibility is crucial as the ASMP intends to invest on the papaya production by providing capital requirements.

Assumptions

- Prices do not change from year to year
- Discount rate is 16%

According to the indicators estimated in financial analysis, both with project and without project scenarios generate positive outcomes to farmers. Benefit-Cost ratio is greater than one in both scenarios while NPV is positive. Higher benefits are generated with the new technologies and variety that are going to be introduced by ASMP. IRR values are 205% and 117% in without project and with project scenarios respectively.

Table 81: Financial Indicators

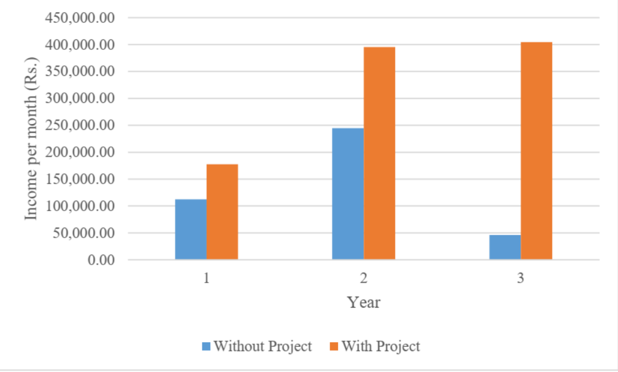
Indicator	Without Project	With Project
B/C	1.95	2.32
NPV	3,033,161.83	6,572,598.65
IRR	205%	117%
Payback Period	1	2

The gross margin is 48.83% in with project scenario in comparison to 56.86% in without project scenario while the breakeven yield varies from 13,875.00kg in “without project scenario” to 18,982.81kg. Unit cost of production is very low in modern cultivation.

Table 82: Financial Indicators

Year	Without Project					With Project				
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI
0		8,300.00					23,737.50			
1	54.83	13,875.00	36.13	112,300.00	174.94	58.37	18,982.81	33.30	177,447.92	96.66
2	71.68	14,500.00	22.66	244,666.67	328.53	78.02	16,701.16	17.58	395,325.59	185.61
3	33.72	13,575.11	53.03	46,032.58	53.33	79.83	15,326.16	16.13	404,492.26	163.84
Overall	48.83				456.80	56.86				346.11

Farmers’ monthly income increases with the improved technologies and new varieties. As the profitable cultivation can be continued only up to 3 years, second year of cultivation generates the highest profits in papaya cultivated using modern technologies. Although in project management perspective, ROI is greater in without project scenario, the monthly benefits generate with the project is greater.



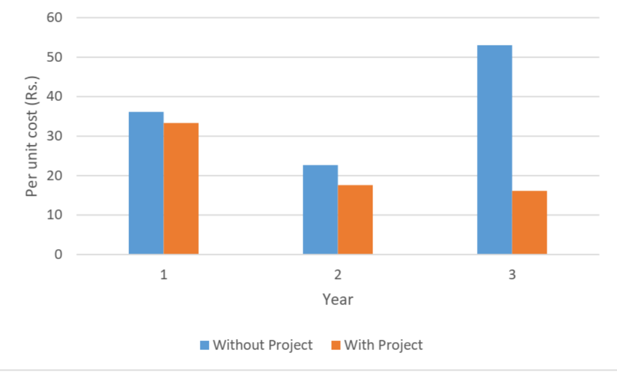


Figure 147: Net income per month

Figure 148: Cost of production per kilogram

Sensitivity Analysis

In the sensitivity analysis, two scenarios as best case (10% increase in price and yield) and worst case (10% decrease in price and yield) were used.

Best Case Scenario

Results of the analysis reveal that payback period is 1 year in comparison to 1 and 2 years in base case scenario with respect to traditional cultivation and modern cultivation. Although IRR is lower in with project scenario, other indicators show the expected results to go ahead with the project. Prices received by the farmer is 80 Rs./kg. If the farmer receives at least higher price such as 130 Rs./kg with the quality improvement through project, IRR also would be greater in the “with project” scenario.

Table 83: Financial Indicators

Indicator	Without Project	With Project
B/C	2.36	2.80
NPV	4,337,680.49	9,000,050.81
IRR	274%	155%
Payback Period	1	1

All the other indicators increase with the best-case scenario in both “without project and with project” scenarios.

Table 84: Financial Indicators

Year	Without Project					With Project				
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI
0		8,300.00					23,737.50			
1	62.67	13,875.00	32.85	155,308.00	241.94	65.60	18,982.81	30.28	241,287.92	131.43
2	76.59	14,500.00	20.60	316,346.67	424.78	81.84	16,701.16	15.98	501,725.59	235.57
3	45.22	13,575.11	48.21	74,704.58	86.54	83.33	15,326.16	14.67	510,892.26	206.94
Overall	57.71				653.27	64.35				473.94

Worst Case Scenario

In this scenario, although NPV is positive and higher and B/C ratio is greater in comparison to without project scenario, IRR is lower. The payback period becomes two years with the interference of the project.

Table 85: Financial Indicators

Indicator	Without Project	With Project
B/C	1.58	1.877601366
NPV	1,852,883.05	4,376,332.41
IRR	140%	81%
Payback Period	1	2

Table 86: Financial Indicators

Year	Without Project					With Project				
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI
0		8,300.00					23,737.50			
1	44.24	13,875.00	40.15	73,388.00	114.33	48.61	18,982.81	37.00	119,687.92	65.19
2	65.04	14,500.00	25.17	179,813.33	241.45	72.87	16,701.16	19.53	299,058.92	140.41
3	18.17	13,575.11	58.92	20,091.25	23.27	75.10	15,326.16	17.93	308,225.59	124.85
Overall	36.82				279.05	46.74				230.45

Qualitative Analysis

Results of the qualitative analysis reveal that papaya can be cultivated with low to moderate level difficulty. Attention should be given to when maintaining cultivation quality and scaling up.

Table 87: Results of the qualitative analysis

Criteria	Average Score	Overall Feasibility (difficult to cultivate)
Criterion 01 Cultivation costs (Skills, money, technology)	2.5	Low
Criterion 02 Cultivation quality (difficulties for high quality cultivation)	3	Medium
Criterion 03 Processing costs (Skills, money, technology needed for processing)	2.6	Low to medium
Criterion 04 Scaling up (difficulty getting high quality supply)	3	Medium
Criterion 05 Infrastructure costs (assets needed across entire value chain)	2.5	Low
Criterion 6 Meeting standards	3	Medium
Overall	2.76	Low to medium

3.6.8 Banana

As the banana production is planned to be implemented with a local Cavendish variety named Embun, the implementation must be financially feasible and economically viable. As the economic profit is the main target of any producer, the banana production must generate economic profits and proper maintenance of the crop and continuous supply of raw materials should be assured. Otherwise, the whole effort of banana will be wasted. Therefore, assessing the financial feasibility is crucial as the ASMP intends to invest on the banana production by providing capital requirements.

Assumptions

- Prices do not change from year to year
- Discount rate is 16%

According to the indicators estimated in financial analysis, both with project and without project scenarios generate positive outcomes to farmers. Benefit-Cost ratio is greater than one in both scenarios while NPV is positive. Higher benefits are generated with the new technologies and variety that are going to be introduced by ASMP. IRR values are 17% and 34% in without project and with project scenarios respectively.

Table 88: Financial Indicators

Indicator	Without Project	With Project
BC	1.23	1.68
NPV	907,177.89	3,052,587.40
IRR	17%	34%
Payback Period	3	3

The gross margin is 48.67% in with project scenario in comparison to 34.49% in without project scenario while the breakeven yield varies from 3118.46 to 1107.69kg. Unit cost of production records the lowest in modern cultivation.

Table 89: Financial Indicators

year	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI
0		4,186.54					13,417.31			
1		3,118.46					4,688.46			
2	62.47	2,972.31	48.79	53,600.00	87.81	50.22	3,942.31	21.15	43,091.67	22.03
3	68.68	3,156.92	40.71	75,000.00	106.00	86.62	4,126.92	17.40	289,315.83	127.59
4	66.84	3,156.92	43.11	68,933.33	83.90	85.83	4,126.92	18.42	270,758.33	102.82
5	81.29	1,107.69	24.32	52,133.33	54.71	93.88	1,107.69	7.95	184,170.00	60.31
Overall	34.49				168.21	48.67				182.63

Farmers' monthly income increases with the improved technologies and new varieties. During the period of 2nd and 3rd year, the highest profits generate in banana cultivated using modern technologies. So is the case with ROI where it is greater with project. The monthly benefits generated with the project is about four times greater.

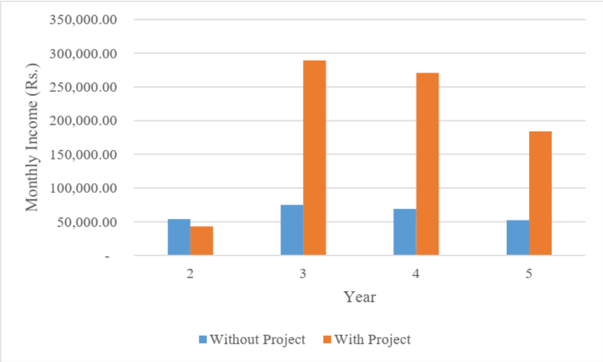


Figure 149: Net income per month

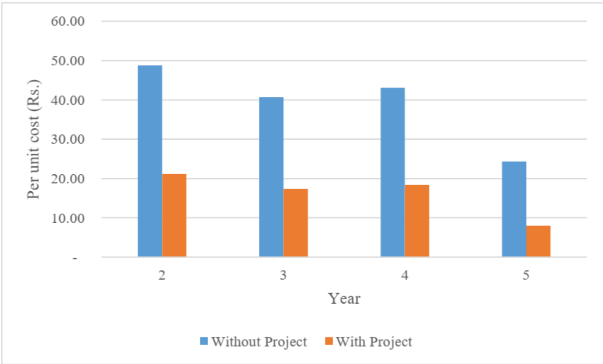


Figure 150: Cost of production per kilogram

Sensitivity Analysis

Sensitivity analysis was done under two scenarios where best-case scenario represents increase in yield and price by 10% and worst-case scenario was considered as decrease in yield and price by 10%.

Best Case Scenario

Although both modern and traditional famers get better of as result of the increase price and yield, more benefits are earned by the modern farmers who adopt the new technologies provided by the ASMP.

Table 90: Financial Indicators

Indicator	Without Project	With Project
BC	1.48	2.03
NPV	1,387,681.91	4,641,394.98
IRR	32%	47%
Payback Period	3	3

Table 91: Financial Indicators

Year	Without Project					With Project				
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI
0		3,730.77					13,661.54			
1		3,615.75					8,419.23			
2	59.94	3,839.05	63.01	62,228.33	114.40	77.28	7,126.92	35.74	262,559.67	131.81
3	68.02	3,900.58	50.31	89,875.67	142.54	81.95	7,126.92	28.39	350,647.67	151.87
4	66.14	3,900.58	53.26	82,535.00	112.72	81.95	7,126.92	28.39	350,647.67	130.78
Overall	32.60				186.12	50.70				261.34

Worst Case Scenario

In the worst-case scenario, traditional farmers face a huge problem when looking at the financial indicators. However, farmers who receive assistance from ASMP still survive without much difficulty.

Table 92: Financial Indicators

Indicator	Without Project	With Project
BC	1.00	1.33
NPV	440,754.57	1,510,338.28
IRR	0%	18%
Payback Period	5	3

Table 93: Financial Indicators

Year	Without Project					With Project				
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	ROI
0		3,730.77					13,661.54			
1		3,615.75					8,419.23			
2	39.12	3,839.05	70.02	26,720.33	49.12	65.46	7,126.92	39.72	146,351.67	73.47
3	51.40	3,900.58	55.89	44,683.67	70.87	72.57	7,126.92	31.54	204,311.67	88.49
4	48.54	3,900.58	59.18	39,853.67	54.43	72.57	7,126.92	31.54	204,311.67	76.20
5	17.24	3,900.58	95.17	8,803.67	10.37					
Overall	0.29				1.25	25.07				85.04

Qualitative Analysis

Results of the qualitative analysis suggest that banana cultivation is least challenging. Meaning that it has high feasibility to cultivate.

Table 94: Results of the qualitative analysis

Criteria	Average Score	Overall Feasibility (difficult to cultivate)
Criterion 01 Cultivation costs (Skills, money, technology)	2.3	Low
Criterion 02 Cultivation quality (difficulties for high quality cultivation)	2.5	Low

Criterion 03 Processing costs (Skills, money, technology needed for processing)	1.7	Low
Criterion 04 Scaling up (difficulty getting high quality supply)	2	Low
Criterion 05 Infrastructure costs (assets needed across entire value chain)	2.3	Low
Criterion 6 Meeting standards	2.3	Low
Overall	2.2	Low

3.6.9 Avocado

As the avocado production is planned to be implemented in Kandy and Badulla districts with high demand variety named Hass, the implementation must be financially feasible and economically viable. As the economic profit is the main target of any producer, the avocado production must generate economic profits and proper maintenance of the crop and continuous supply should be assured. Otherwise, the whole effort of avocado will be wasted. Therefore, assessing the financial feasibility is crucial as the ASMP intends to invest on the avocado production by providing capital requirements.

Assumptions

- Prices do not change from year to year
- Discount rate is 16%

Table 95: Financial Indicators

Indicator	Without Project	With Project
B/C	2.82	3.16
NPV	2,247,337.65	6,069,572.85
IRR	17%	19%
Payback Period	8	4

According to the indicators estimated in financial analysis, both with project and without project scenarios generate positive outcomes to farmers. Benefit-Cost ratio is greater than one in both scenarios while NPV is positive. IRR values are 17% and 19% in without project and with project scenarios respectively. Payback period in with project scenario is 4 whereas it is 8 in without project scenario.

Table 96: Financial Indicators

Year	Without Project				With Project			
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	Gross Margin	Break Even Yield	Per Unit Cost	Income per month
1		537.87				275.16		
2		553.95		(6,924.33)		275.16		(10,318.33)
3		622.72		(7,784.00)		313.36		(11,751.11)
4	23.58	1,146.29	114.63	4,421.42	77.02	574.60	103.43	72,202.36
5	58.35	999.62	62.48	17,504.75	86.75	530.16	59.64	130,119.03
6	66.23	1,012.95	50.65	24,838.08	89.40	530.16	47.71	167,619.03
7	76.90	1,039.62	34.65	43,254.75	91.16	530.16	39.76	205,119.03
8-15	91.34	1,039.62	13.00	137,004.75	93.37	530.16	29.82	280,119.03
Overall	64.51				68.31			

The gross margin is 91.34% in with project scenario in comparison to 93.37% in without project scenario while the breakeven yield varies from 1146.29kg to 530.16kg. Unit cost of production reduces from year to year in both scenarios. However, per unit cost further reduces with the investment made by the ASMP.

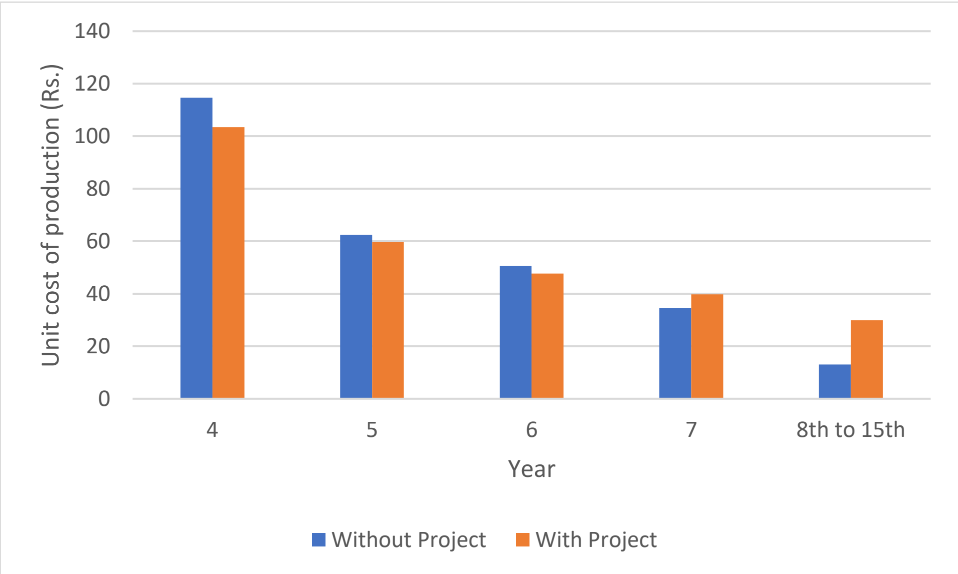


Figure 151: Cost of production per kilogram

Farmers' monthly income increases with the improved technologies and new varieties. Initially, farmers receive a very low income starting from the fourth year. However, it gradually increases up to Rs 280,119.03 in the eighth year from Rs. 72,202.36 income in the fourth year.

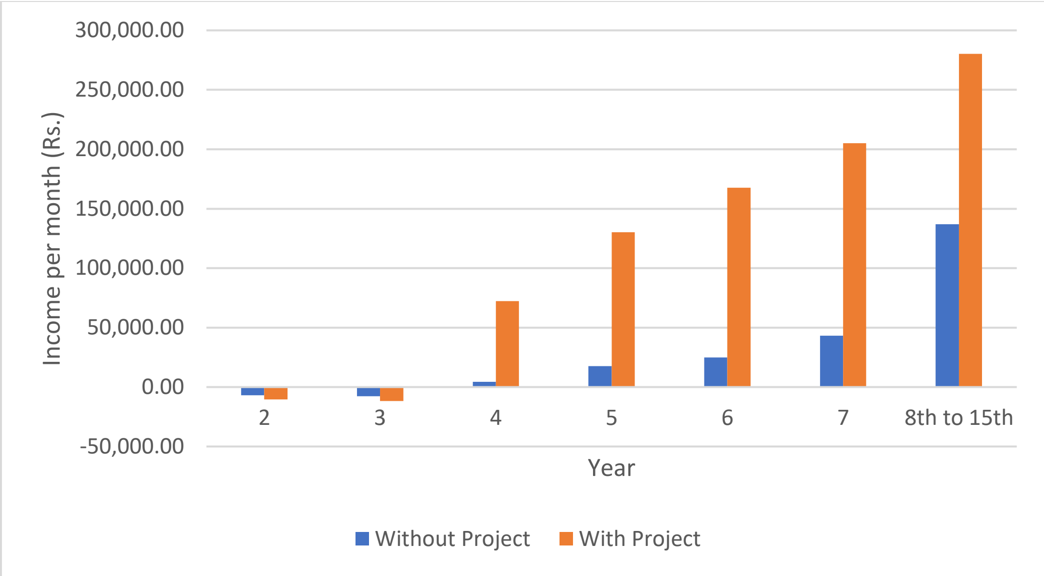


Figure 152: Net income per month

Although in project management perspective, ROI is greater in without project scenario, the monthly benefits generate with the project is greater.

Table 97: Return on Investment

Year	ROI	ROI
4	5.61	26.08
5	19.15	42.89
6	23.41	48.32
7	35.20	51.54
8	96.06	61.33
9	82.83	52.88
10	71.49	45.64
11	61.42	39.21
12	52.91	33.78
13	45.67	29.16
14	39.37	25.13
15	34.01	21.72
Overall	430.52	346.00

Sensitivity Analysis

By taking two scenarios, the sensitivity analysis was done. Those two scenarios are;

1. Best Case Scenario where it was assumed that yield and price increased by 10 percent

2. Worst Case Scenario where it was assumed that yield and the price decreased by 10 percent

In the best-case scenario, all the financial indicators improved in the traditional cultivation and the modern cultivation. However, effect is stronger in modern cultivation.

Table 98: Financial Indicators

Indicator	Without Project	With Project
B/C	3.41	3.82
NPV	2,978,937.75	7,935,569.85
IRR	20%	23%
Payback Period	8	4

Income per month increases substantially and rise in come in with project scenario is higher. Gross margin increases up to 74% from 68% of the base category. However, ROI with project scenario is less than the without project scenario.

Table 99: Financial Indicators

Year	Without Project				With Project			
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	Gross Margin	Break Even Yield	Per Unit Cost	Income per month
0		3,480.00				3,826.67		
1		537.87				275.16		
2		553.95		(6,924.33)		275.16		(10,318.33)
3		622.72		(7,784.00)		313.36		(11,751.11)
4	36.84	1,146.29	104.21	8,358.92	81.00	574.60	94.03	91,889.86
5	65.58	999.62	56.80	23,804.75	89.05	530.16	54.22	161,619.03
6	72.09	1,012.95	46.04	32,713.08	91.24	530.16	43.38	206,994.03
7	80.91	1,039.62	31.50	55,067.25	92.70	530.16	36.15	252,369.03
8th to 15th	92.84	1,039.62	11.81	168,504.75	94.52	530.16	27.11	343,119.03
Overall	70.67				73.81			

Table 100: Return on Investment

Year	With Project	Without Project
	ROI	ROI
4	10.61	35.35

5	26.05	53.61
6	30.83	59.14
7	44.81	62.26
8	118.15	72.93
9	101.88	62.89
10	87.93	54.28
11	75.54	46.63
12	65.08	40.17
13	56.17	34.67
14	48.42	29.89
15	41.84	25.82
Overall	570.68	460.83

In the Worst-Case Scenario of sensitivity analysis, still the modern farmers perform well and the payback period remains the same. However, traditional farmers are at a risk to a certain extent as their payback period increases up to 9 years.

Table 101: Financial Indicators

Indicator	Without Project	With Project
B/C	2.28	2.56
NPV	1,585,413.75	4,381,289.85
IRR	13%	15%
Payback Period	9	4

As usual performance of other financial indicators also reduces with the worst-case scenario.

Table 102: Financial Indicators

Year	Without Project				With Project			
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	Gross Margin	Break Even Yield	Per Unit Cost	Income per month
0		3,480.00				3,826.67		
1		537.87				275.16		
2		553.95		(6,924.33)		275.16		(10,318.33)
3		622.72		(7,784.00)		313.36		(11,751.11)
4	5.66	1,146.29	127.37	858.92	71.62	574.60	114.92	54,389.86

5	48.58	999.62	69.42	11,804.75	83.64	530.16	66.27	101,619.03
6	58.31	1,012.95	56.28	17,713.08	86.91	530.16	53.02	131,994.03
7	71.48	1,039.62	38.50	32,567.25	89.09	530.16	44.18	162,369.03
8th to 15th	89.30	1,039.62	14.44	108,504.75	91.82	530.16	33.13	223,119.03
Overall	56.18				60.87			

Table 103: Return on Investment

Year	Without Project	With Project
	ROI	ROI
4	1.09	20.92
5	12.92	33.71
6	16.70	37.71
7	26.50	40.05
8	76.08	47.42
9	65.60	40.89
10	56.62	35.29
11	48.64	30.32
12	41.91	26.12
13	36.17	22.55
14	31.18	19.44
15	26.94	16.79
Overall	303.72	254.43

Qualitative Analysis

Qualitative analysis suggests that growing avocado is not easy as it demands high skills in cultivation. Maintaining the quality is difficult in avocado cultivation as it demands high skills. Sri Lankan farmers do not have much experience in avocado cultivation. Special attention should be paid to this aspect. When exporting the product, it has to meet the standards. Difficulty of meeting the standards is at a medium level. Scaling up also is at medium difficulty level. Overall feasibility is at medium level meaning that difficulty of cultivation is somewhat high.

Table 104: Results of the qualitative analysis

Criteria	Average Score	Overall Feasibility (difficult to cultivate)
Criterion 01 Cultivation costs (Skills, money, technology)	3.5	Medium to high

Criterion 02 Cultivation quality (difficulties for high quality cultivation)	4	High
Criterion 03 Processing costs (Skills, money, technology needed for processing)	2.5	Low
Criterion 04 Scaling up (difficulty getting high quality supply)	3	Medium
Criterion 05 Infrastructure costs (assets needed across entire value chain)	2.5	Low
Criterion 6 Meeting standards	3	Medium
Overall	3.08	Medium

Although the project is financially feasible, the following aspects need to be considered in avocado cultivation.

1. The variety that is to be cultivated is new to Sri Lanka and therefore proper technology package is a must
2. Maintenance of the field and correct agronomic practices especially pruning of the plant is vital
3. To sustain a chain there is a need to set out a mechanism for value addition, governance, and networking both vertically and horizontally among chain actors
4. The major constraints that producers in developing countries that limit value chain development are; market access restrictions, weak infrastructures, lack of resources, lack of an enabling environment offering institutional, unavailability of resources and inefficient and ineffective coordination and current cooperatives they are no providing support in terms of production technics, marketing, sorting and grading for in value chains. Therefore, every value chain actor should pay especial attention to these.
5. Need to have a proper agreement with buyers to sustain the industry. Strong market linkages are necessary.

3.6.10 Cassava

If cassava production is to be implemented in Kandy district, the implementation must be financially feasible and economically viable. The production of cassava must generate economic profits to the farmer and continuous supply cassava should be assured. Otherwise, the whole effort of cassava will be to no purpose. Therefore, assessing the financial feasibility is crucial as the ASMP intends to invest on the cassava production by providing capital requirements.

<u>Assumptions</u>

- Agronomic practices, cost of production and the yield do not differ from season to season
- Prices do not change from year to year
- Discount rate is 16%

Table 105: Financial Indicators

Indicator	Without Project	With Project
BC	1.36	1.86
NPV	1,155,689.26	4,495,169.26
IRR	63%	57%
Gross Margin	26.32	46.37
Break Even Yield	7,293.47	7,293.47
Per Unit Cost	45.58	45.58
Income per month	150,000.00	320,000.00
Payback Period	1	1

According to the financial analysis, cassava farmer's benefits are greater than cost and the NPV is a positive value in both with and without project scenarios. However, benefits are higher in with project scenario. The gross margin is 46.37 % in with project scenario in comparison to 26.32 in without project scenario while the breakeven yield is 7293.47Kg. Unit cost of production is 45.28 rupees. The price per kilogram of cassava is around 80 rupees. However, exporters agree to provide a price of 120 rupees per kilogram. Farmers receive Rs.150,000 per month even without the project. However, it will be more than doubled with interference of the ASMP project. However, the greater benefits of the farmer depend on the producer buyer agreements and continuous supply of the product based on the buyer's demand. Overall return on investment is higher in with project scenario.

Table 106: Return on Investment (ROI)

Year	Without Project ROI	With Project ROI
1	80.07	74.91
2	69.02	64.57

3	59.54	55.70
4	51.28	47.97
5	44.22	41.36
Overall	204.13	767.15

Qualitative Analysis

Cassava is an easy crop to cultivate according the results of the qualitative analysis. It has low to moderate market opportunity. Overall feasibility is also low to moderate. Only the export demands high standards.

Table 107: Results of the qualitative analysis

Criteria	**Average Score**	**Overall Feasibility (difficult to cultivate)**
Criterion 01 Cultivation costs (Skills, money, technology)	2.3	Low
Criterion 02 Cultivation quality (difficulties for high quality cultivation)	1	Low
Criterion 03 Processing costs (Skills, money, technology needed for processing)	2.3	Low
Criterion 04 Scaling up (difficulty getting high quality supply)	2.5	Low
Criterion 05 Infrastructure costs (assets needed across entire value chain)	2	Low
Criterion 6 Meeting standards	3	Medium
Overall	2.18	Low

If the project is to be more successful, the following factors should be considered as cassava value chain holds many opportunities for everyone although the benefits are greater.

1. Value-added products and by product utilization should be promoted. For example, there are many avenues such as;
    a. cassava starch which can be added as an ingredient for making paper and clothing textiles

   b. cassava flour which can be used to make cakes, bread, and biscuits
   c. cassava chips which can be used for animal feed
   d. cassava stem can be used as material for biofuel and to produce partisan boards
2. Continuous supply of cassava to the meet the industrial and export demand
3. Infrastructure such as road from farmer field to a purchasing point should be improved
4. Hydro cooling or forced air cooling can be done to reduce the post-harvest losses

3.6.11 Carrot

Assumptions

- Agronomic practices, cost of production and the yield do not differ from season to season
- Prices do not change from year to year
- Discount rate is 16%
- Potential yield is 16000 kg/ac

Traditional farmer obtains 6000kg per acre whereas the expected yield is 16000kg per acre. However, as some farmers obtain around 12000kg per acre, all these yields were considered in analyzing the data. It is expected that carrot all the farmers can reach to at least 12000kg per acre with the project scenario. However, farmers can reach up to 16000kg per acre maximally. The results of the analysis suggest that the cultivation of carrot under new technologies is highly feasible and generate higher benefits to the farmers. The NPV is positive and gross margins can go up to 83% with the new technologies provided by the ASMP. It is also matter to be considered here is that cost of production per unit is decreases with the project interference.

Table 108: Financial Indicators

Indicator	Without Project	With Project	With Project
	Yield=6000kg/ac	Yield=12000kg/ac	Yield=16000kg/ac
B/C	1.92	2.76	3.68
NPV	2,825,711.80	7,511,711.80	11,435,711.80
IRR	210%	140%	202%
Payback Period	1	1	1

Table 109: Financial Indicators

Indicator	Without Project Yield=6000kg		With Project Yield=12000kg		With Project Yield=16000kg	
	Year 0	Year 1-5	Year 0	Year 1-5	Year 0	Year 1-5
Gross Margin	48.01	54.46	63.81	77.23	72.86	82.92
Break Even Yield	1,266.67	2,732.20	5,266.67	2,732.20	5,266.67	2,732.20
Per Unit Cost	63.33	136.61	131.67	68.31	98.75	51.23
Income per month		81,695.00		231,695.00		331,695.00

Monthly income increases substantially with the modern facilities and technologies and return on invest also increases.

Table 110: Return on Investment

Without Project	With Project	With Project
Yield=6000kg	Yield=12000kg	Yield=16000kg
ROI %	ROI %	ROI %
221.87	151.33	216.65
190.91	130.22	186.42
165.11	112.62	161.23
141.89	96.78	138.56
123.83	84.47	120.92
743.61	475.42	723.78

Qualitative Analysis

Carrot is a very easy crop to cultivate. Cost of production will have to be reduced. According to the results it is at a medium level.

Table 111: Results of the qualitative analysis

Criteria	Average Score	Overall Feasibility (difficult to cultivate)
Criterion 01 Cultivation costs (Skills, money, technology)	3	Medium
Criterion 02 Cultivation quality (difficulties for high quality cultivation)	2.3	Low

Criterion 03 Processing costs (Skills, money, technology needed for processing)	1	Low
Criterion 04 Scaling up (difficulty getting high quality supply)	2	Low
Criterion 05 Infrastructure costs (assets needed across entire value chain)	2	Low
Overall	2.09	Low

3.6.12 Seed Potato

The production of seed potato must generate economic profits to the farmer and continuous supply seed potato should be assured. Otherwise, the whole effort of cassava will be to no purpose. Therefore, assessing the financial feasibility is crucial as the ASMP intends to invest on the seed potato production by providing capital requirements.

Assumptions

- Agronomic practices, cost of production and the yield do not differ from season to season
- Prices do not change from year to year
- Discount rate is 16%

According to the available data and farmer's perspective, in traditional seed potato production, farmers obtain 8000kg of potato as the yield in which 5000kg are kept as seeds and the rest of the 3000kg are kept for consumption purposes. The potatoes kept for consumption purposes are large tubers. However, farmers can obtain up to 12000kg of potatoes per acre. Out of these 12000kg, 8000kg are kept seed purposes and the rest is used for consumption. The normal price paid by the department of agriculture is around 300 Rs./kg. However, according to the farmers it can go up 500 Rs./kg. Therefore, in the financial analysis, several scenarios were considered.

1. With project scenario
   Condition => Price = 300 Rs./kg and Seed Yield = 5000kg (traditional cultivation)
2. Without project scenario

Under with project scenario, followings conditions were considered

Condition 1 => Price = 300 Rs./kg and Seed Yield = 8000kg (with given technologies)

Condition 2=> Price = 400 Rs./kg and Seed Yield = 8000kg (with given technologies)

Condition 3=> Price = 500 Rs./kg and Seed Yield = 8000kg (with given technologies)

Table 112: Financial Indicators

Indicator	Without Project Price=300 Yield=5000	With Project Price=300 Yield=8000	With Project Price=400, Yield=8000	With Project Price=500 Yield=8000
B/C	1.28	1.56	2.08	2.59
NPV	1,061,984.00	2,808,584.00	5,427,784.00	8,046,984.00
IRR	104%	58%	106%	153%
Payback Period	1	2	1	1

Financial analysis shows that B/C ratio is greater than one in every scenario and condition. However, greater benefits to the farmer provide with the technologies provided to increase yield up to potential. When price received by the farmers is higher, their benefits become even greater with the "with project" scenario.

Table 113: Financial Indicators

Indicator	Without Project Price=300 Yield=5000		With Project Price=300 Yield=8000		With Project Price=400 Yield=8000		With Project Price=500 Yield=8000	
	Year 0	Year 1-5	Year 0	Year 1-5	Year 0	Year 1-5	Year 0	Year 1-5
Gross Margin	21.62	27.73	35.74	54.83	51.81	66.13	61.45	72.90
Break Even Yield	1,000.00	3,613.33	5,000.00	3,613.33	5,000.00	3,613.33	5,000.00	3,613.33
Per Unit Cost	60.00	216.80	187.50	135.50	187.50	135.50	187.50	135.50
Income per month		125,000.00		200,000.00		266,666.67		333,333.33

Cost production per unit is 135.50 Rs./Kg while income per month increases with project interference. More than 200000 Rs./ month could be obtained due to improved technologies and improved income.

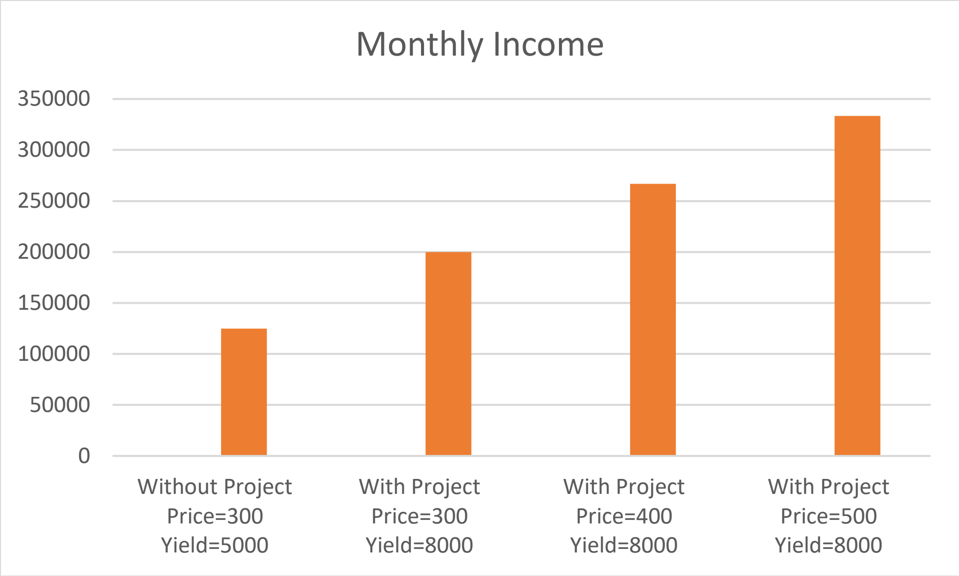


Figure 153: Monthly Income with and without project scenario

If the farmers can sell their product at 400 Rs./kg or 500 Rs/kg, the return on investment is also higher than that of without project scenario.

Table 114: ROI in different scenarios

Year	**Without Project Price=300 Yield=5000**	**With Project Price=300 Yield=8000**	**With Project Price=400 Yield=8000**	**With Project Price=500 Yield=8000**
	ROI %	**ROI %**	**ROI %**	**ROI %**
1	119.53	75.63	121.60	167.57
2	103.03	65.19	104.81	144.44
3	88.89	56.24	90.42	124.61
4	76.54	48.43	77.87	107.31
5	66.01	41.76	67.15	92.53
Overall	353.99	187.24	361.85	536.47

Qualitative Analysis

Growing seed potato in open environment is not difficult and overall feasibility of cultivation is low to medium meaning that it’s easy for farmers to cultivate seed potato.

Table 115: Results of the qualitative analysis

Criteria	Average Score	Overall Feasibility (difficult to cultivate)
Criterion 01 Cultivation costs (Skills, money, technology)	2.3	Low
Criterion 02 Cultivation quality (difficulties for high quality cultivation)	3.2	Medium
Criterion 03 Processing costs (Skills, money, technology needed for processing)	2.2	Low
Criterion 04 Scaling up (difficulty getting high quality supply)	2.3	Low
Criterion 05 Infrastructure costs (assets needed across entire value chain)	3.2	Medium
Overall	2.64	Low to Medium

3.6.12 Soursop

Findings

The results of the analysis suggest that the cultivation of soursop using new technologies and technical knowhow which will be provided through is highly feasible and generate higher net benefits to the farmers. The Benefit- Cost ratio is 3.35 compared 2.38 in without project scenario. The NPV is positive. IRR is 26% and 26% with and without project scenarios respectively. The payback period is 5 years in both scenarios.

Table 116: Financial Indicators

Indicator	Without Project	With Project
B/C	2.38	3.35
NPV	2,885,431.16	8,727,672.82
IRR	25%	26%
Payback Period	5	5

Average cost of producing a kilogram of soursop reduces substantially with the time and at the latter stages of the production the average cost per kilo is around Rs.30.00 whereas it is somewhat high in traditional cultivation. Gross margins are also higher in modern cultivation. Income per month also is higher than that of traditional cultivation.

Table 117: Financial Indicators

Year	Without Project				With Project			
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	Gross Margin	Break Even Yield	Per Unit Cost	Income per month
0		1,810.00				5,993.33		
1		800.12				1,335.23		
2	(5.01)	840.12	315.04	(1,002.92)	37.38	1,001.90	187.86	14,952.50
3	28.39	859.28	214.82	8,517.92	56.31	1,048.57	131.07	33,785.83
4	63.50	912.62	109.51	39,684.58	78.50	1,075.23	64.51	98,119.17
5	74.68	1,012.62	75.95	74,684.58	85.73	1,141.90	42.82	171,452.50
6th-15th	80.53	1,012.62	58.42	104,684.58	91.08	1,248.57	26.76	318,785.83
Overall	57.91				70.11			

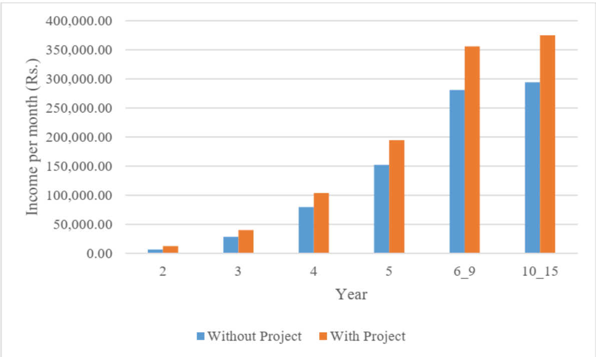


Figure 154: Net income per month

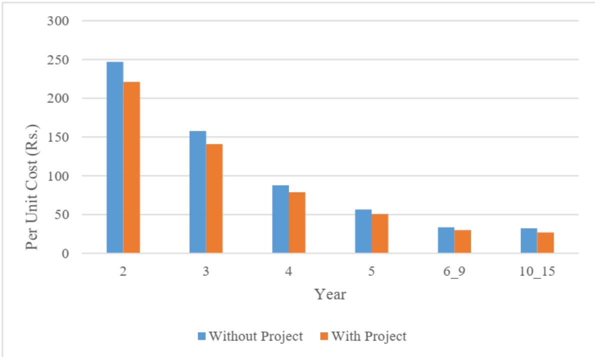


Figure 155: Cost of production per kilogram

Farmers receive very high income per month with advancement of the production in comparison to traditional cultivation. Overall return on investment is 526.54 in “with project scenario” in comparison to 485.41 in “without project scenario”.

Table 118: Return on Investment (ROI)

Year	ROI	ROI
2	(1.65)	7.41
3	12.07	14.45

4	48.41	36.15
5	78.56	54.47
6	94.85	87.23
7	81.90	75.32
8	70.56	64.89
9	60.84	55.96
10	52.52	48.30
11	45.11	41.49
12	38.87	35.74
13	33.55	30.85
14	28.92	26.60
15	24.99	22.98
Overall	526.54	485.41

Sensitivity Analysis

Under best case scenario where price and yield are increased by 10%, IRR in both traditional and modern cultivation become equal. However, benefits are greater in with project scenario. Payback period also becomes equal in both type of cultivation.

Best Case Scenario

Table 119: Financial Indicators

Indicator	Without Project	With Project
B/C	2.88	4.05
NPV	3,931,709.96	11,341,870.42
IRR	31%	31%
Payback Period	5	5

Monthly income of the farmers having modern knowledge and technologies increase more than two times in with project scenario. Gross margin also increases up to 75.30%. Only the ROI is slightly less in with project scenario than that of without project scenario.

Table 120: Financial Indicators

Year	Without Project				With Project			
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	Gross Margin	Break Even Yield	Per Unit Cost	Income per month
0		1,810.00				5,993.33		
1		800.12				1,335.23		
2	13.21	840.12	286.40	3,197.08	48.25	1,001.90	170.78	23,352.50
3	40.82	859.28	195.29	14,817.92	63.89	1,048.57	119.16	46,385.83
4	69.83	912.62	99.56	52,809.58	82.23	1,075.23	58.65	124,369.17
5	79.08	1,012.62	69.04	95,684.58	88.20	1,141.90	38.93	213,452.50
6th - 15th	83.91	1,012.62	53.11	131,984.58	92.63	1,248.57	24.32	392,285.83
Overall	65.22				75.30			

Table 121: Return on Investment (ROI)

Year	Without Project	With Project
	ROI	ROI
2	5.25	11.58
3	20.99	19.84
4	64.42	45.82
5	100.65	67.81
6	119.59	107.34
7	103.25	92.68
8	88.96	79.85
9	76.71	68.86
10	66.21	59.43
11	56.88	51.05
12	49.00	43.98
13	42.29	37.96
14	36.46	32.73
15	31.50	28.28
Overall	724.07	630.80

Worst Case Scenario

In the worst-case scenario where price and yield are decreased by 10%, payback period becomes 6 years in both cases while IRR and B/C ratio are greater in with project scenario.

Table 122: Financial Indicators

Indicator	Without Project	With Project
B/C	1.92	2.71
NPV	1,938,797.96	6,362,446.42
IRR	18%	20%
Payback Period	6	6

Per month income reduces substantially in traditional cultivation if price and yield reduce by 10%.

Table 123: Financial Indicators

Year	Without Project				With Project			
	Gross Margin	Break Even Yield	Per Unit Cost	Income per month	Gross Margin	Break Even Yield	Per Unit Cost	Income per month
0		1,810.00				5,993.33		
1		800.12				1,335.23		
2	(29.65)	840.12	350.05	(4,802.92)	22.69	1,001.90	208.73	7,352.50
3	11.60	859.28	238.69	2,817.92	46.06	1,048.57	145.63	22,385.83
4	54.93	912.62	121.68	27,809.58	73.45	1,075.23	71.68	74,369.17
5	68.75	1,012.62	84.38	55,684.58	82.38	1,141.90	47.58	133,452.50
6^{th} - 15^{th}	75.96	1,012.62	64.91	79,984.58	88.99	1,248.57	29.73	252,285.83
Overall	48.04				63.10			

Table 124: Return on Investment (ROI)

Year	Without Project	With Project
	ROI	ROI
2	(7.89)	3.65
3	3.99	9.58
4	33.92	27.40
5	58.58	42.40
6	72.47	69.03
7	62.57	59.61
8	53.91	51.36
9	46.49	44.28
10	40.12	38.22
11	34.47	32.83

12	29.70	28.29
13	25.63	24.41
14	22.10	21.05
15	19.09	18.18
Overall	357.05	353.86

Qualitative Analysis

Qualitative analysis suggests that growing soursop is not easy as it demands high skills in cultivation. Maintaining the quality is difficult in soursop cultivation. Special attention should be paid to this aspect. When exporting the product, it has to meet the standards. Difficulty of meeting the standards is at a medium level. Scaling up also is at medium difficulty level. Overall feasibility is at medium level.

Table 125: Results of the qualitative analysis

Criteria	Average Score	Overall Feasibility (difficult to cultivate)
Criterion 01 Cultivation costs (Skills, money, technology)	3	Medium
Criterion 02 Cultivation quality (difficulties for high quality cultivation)	4	High
Criterion 03 Processing costs (Skills, money, technology needed for processing)	2.7	Low to medium
Criterion 04 Scaling up (difficulty getting high quality supply)	3	Medium
Criterion 05 Infrastructure costs (assets needed across entire value chain)	2.5	Low
Criterion 6 Meeting standards	3	Medium
Overall	3.03	Medium

3.7 Institutional Analysis & Stakeholder Capacity Gap Analysis

The institutional analysis mainly focused to identifying the importance of stakeholder participation in the agricultural development interventions and networking mechanisms especially in the select areas for ASMP/ EU cluster development programs.

As aware there are number public sector and private sector institutions/individuals involved with on-farm development and off farm development programs aimed to facilitate the small farm productivity, marketing, value addition and increased household income while enhancing the lifestyle of the people engaged in agriculture.

This analysis expects to achieve the following outputs:

- Create awareness and increase farmers understanding towards the importance and need for collective approach through an established organizational system (farmer company)
- Identify, screen and mobilize small producers under select Crop Value Chains and register as beneficiaries in the proposed development interventions under ASMP/EU program
- Develop and establish business plan and action plan for sustainable producer – market operations/ management through farmer companies established in the select regions.
- Empower small farmers to collectively enhance negotiation power under one Agri produce trading platform.

Table 126: Institutional systems involved in agricultural development in select districts

Institutions (Public/ private)	Assigned functions	Expected intervention	Remarks
Department of Agriculture (Provincial and Central Govt.)	Agriculture extension/ training/ field activities through ARPA, Farmer leaders, maintain data information.	Assist to identify & select farmers, promote farmers adopt productive technologies, motivate farmers to form farmer companies.	Agriculture extension for all districts covered by Provincial Govt. DOA central Govt. officials are limited to major irrigation systems in the districts
Department of Agriculture (Regional	Research development for crop production practices, nutrient	Communicate with FO members, regular dialogue with	RARC found in Kandy, Badulla (G/kotte), Kilinochchi.

Agriculture Research & Development Center (RARDC)	requirement/ application, mitigation methods for pest/ disease problems, identification explore suitable crop types for the region	extension staff, private investments in agriculture production/ marketing, processing/ value addition.	
Department of Agrarian Development (Central Govt.)	Empowering Agrarian development Act. Managing paddy land act. Distribution of fertilizer for registered farmers. Farm machinery services for farmers.	Assist identification, screening farmers in select area as per set criteria.	Formal FOs established and registered under DADs. DAD office covers number of GNDs accommodates AI, TA, and other relevant offices for farmer support services.
Irrigation Department (ID)	Facilitating water distribution from major irrigation reservoirs by forming FOs for Water management.	Assist to identify and mobilize farmers for seed production, cluster formation, FC establishment.	ID interventions found in Kilinochchi, and Badulla, districts where cluster farmers selected were benefitted by irrigation tanks. Managed/ maintained by ID
District/ divisional secretariat	Head of District Agri Committee ensure FO representation and mitigation of problems	Assist to settle ant disputes on land ownership, identify infrastructure facilities for shared services, connect with GNDs, Development officers to facilitate CVC interventions and FC formation.	Controls over the all-district level development activities. The program implementation should be in concurrence with District secretariat where reporting mechanism to be followed.
Mahaweli Authority of Sri Lanka (MASL)	Development of major irrigation systems and settlement of communities in select	Make available lands for agriculture purposes, small farm allotment legally	The authority areas are noted in districts such as Vavuniya, (system L) and Ampara (Padiyathalawa)

	land areas for irrigated agriculture with diverting Mahaweli water.	distributed, supply of irrigation water through well designed canals. Facilitated with community centers/ market infrastructure, etc.	
PPMU/PMU	Project implementation partners- coordination monitoring and provide guide line for selection of CVC, perpetration of CDP FC formation	Implementation support and facilitate training, cluster development formation of FC, market linkages.	Determines the crop value chains/ existing pilot POs on scale up for the district areas based on the feasibility assessment.
Farmer Organizations	Partner of the program. Main body of the farmers in particular Agrarian area. Deal with irrigation water distribution, off farm development activities, hold periodical or seasonal meetings dissemination of information.	The project expects fullest cooperation and commitment of the members/ FOs to design develop and prepare CDPs and formation of FCs with select cluster farmers.	The farmers identified in all districts found with established FOs registered with DADs in respective areas.
Input suppliers	Dealing with CVC related fertilizer, pesticides, seeds, planting materials. Trained & registered under Reg. of Pesticides/DOA. Act as an advisor to farmers.	Assist the program development interventions especially the agronomic and CVC technology by supplying right products.	Dealer network recognized in all district areas and locations where farmers were identified. Most of the dealers are informal credit suppliers where the harvest is considered as collateral
Logistic/ machinery services.	Shared services under FOs	Assist cluster development interventions by	All district areas have farm machinery hiring services mostly individual machinery

	Hired services Private machineries suppliers	supplying machinery and equipment for land preparation, planting, harvesting post-harvest processing to increase efficiency and cost competitivity of FC.	owners There no shared services other than the DAD machinery hiring which is not sufficiently supplied during peak seasonal activities.
Market network (Seed production/ supply through DOA seed certification services)	Seed producers/ processers/ traders in the district area.	Assist the program through buy back options and marketing/ distribution jointly with FC	Market services such as HARTI Seed production programs noted in Vavuniya, Ampara where majority involved in seed paddy and few farmers for groundnut, black gram
Market network (commercial)	Industrial partners involved in food manufacturing, feed manufacturing and other value addition	Graded products not suitable for seeds need to be marketed in diverse industry segments.	Private sector Agribusinesses. Exporters, Modern retailers, Economic centers, Food processing industries

Status of Farmer Organizations in the select districts

The farmer centered institutional systems in the region is largely focused on Farmer organizations those legally empowered under the act of Agrarian services department. The FOs involve mainly for rehabilitation work of water distribution channels, issue of certified seed, fertilizer for paddy, determine the seasonal paddy/ other field crops cultivation, and distribution of irrigation water during cultivation seasons. This practice enables the rice growing farmers to implement the activities especially land preparation, planting, irrigation, harvesting according to the agreed time table. The practice was strongly established and adhered under major and minor irrigation settlement schemes where the process is administratively monitored by DADs and Irrigation department (irrigation Management Division--IMD) coordinated by district secretariats and responsibilities of implementing the seasonal crop calendar entrusted under respective FOs. However, this approach is not observed as seasonal requirement and the farmers in the select areas are not bound to cultivate any select crops but they informally decide particular crops depending on the market price factor where they always in the loss due to excessive supply of produce during the season. However, the farmers problem of market access and farm gate price is yet to be solved where the small farmers in the areas are continue to operate individually and continue to live as the dependents of collector/trader networks who determine the farm gate price.

Farmer based organizational challenges -- Summary of information				
Badulla	Ampara	Vavuniya	Kilinochchi	Kandy
Institutional challenges				
Limited representation of young farmers (Vavuniya Papaya cluster & Mango noted higher No.of youths)				
Poor availability of capital				
Dependent on rural informal lending agents/village collectors. Continued in the viscous cycle				
Access formal banking practices continued to be a barrier for individual farmers				
Irregular Training/technology transfer reflected by low productivity				
Inadequate institutional interventions led to poor organizational/collective actions				
Continued traditional crop/market practices. Knowledge gap compared to market forces				
Poor capacity to understand the market systems. Poor planning negotiation ability.				
Poor interaction among the members/individuals.				
Insufficient Member participation for decision making leading to issues on transparency				
Insufficient market information and lack of capacity to use of Agri Business Apps/web pages etc.				
Price takers due to lack of organized/collective approaches/ systems.				
Tendency for moving to high price offer – Continued to be price followers				
Lack of knowledge on agribusiness/commercial farming operations.				
Limited interest for interaction with each other as organized body.				
Insufficient farmer-institutional interactions at the village level hindered the development interventions.				
Inadequate capacity for business communication/poor mindset for commercialized farming				
Ignorance on diverse market segments with increasing demand for premium price segments				
Insufficient support by institutional systems to enhance the business capacity of farmers.				
Violation of establish producer/market linkages/agreements/buy back arrangements				
Inadequate managerial capacity. Farmer skills/knowledge on select crop types.				
Technology barrier. Awareness/knowledge on improved/productive technologies				
Reluctant to accept/adoption of improved/new technology due to inadequate exposure				
Scarcity of experienced technical staff under DOA/PDOA.				
Awareness/skills on legal aspects, market needs post-harvest operations quality assurance systems, are missing				

The analysis identified varied FOs, established under diverse national institutional portfolio to support the small farmer productivity improvement/ market promotion activities focused to sustainable livelihood income for households. However, the mandated tasks are different to each other.

Table 127: Types of FOs in the region

Type of FBO	Institution responsible	Specialized to manage
Farmer organization (FO)	Dept. of Agrarian Development	Agric. resource
Farmer organization (FO)	MASL	Water management
Tea Small holder Dev.Org.	TSHDA	Commodity
Export Production Village (peoples) Co.	SLEDB	Commodity (export)
Farmer companies (FC)	ROC.	Commodity
Agriculture cooperatives	Department of Coop Development	Commodity
Producer organizations (PO)	Dept. of Agric.	Commodity
Participatory irrigation management. committees	Irrigation Department	Water management

Source: Information from district meetings

The discussions with FOs in the district area identified that majority of FOs are poorly operated where expected member support/services for productivity development and market entry is limited or not performed. The main benefit the registered farmers received through FOs are fertilizer at subsidized rates for paddy cultivation.

The discussions revealed that FOs collaborating with Irrigation Department and, MASL are actively involved in seasonal water distribution for irrigated crop cultivation mainly the paddy. The FOs though registered under respective Agrarian centers in the area, are more closely work with irrigation department particularly forming Participatory Irrigation Management (PIM) committees for seasonal distribution of irrigation water through identified distributor/field channels connected to farm lands. Such FOs are observed under major irrigation systems and minor irrigation systems available in the districts Ampara, Badulla, Vavuniya and Kilinochchi where irrigation water is supplied to the paddy cultivation.

The Irrigation department also maintain cost effective irrigation water distribution system for agriculture through lift irrigation method that using solar power to operate the pumps. The system provides irrigation water to highland allotments for seasonal cropping and helping the community to increase their land utilization for agriculture production and income generation. This intervention was observed operating under Iranamadu reservoir irrigation system in Kilinochchi district. However, the farmers are still unable to capture the sellers' market due to individual approach on production and marketing.

The discussions with PDOA and EDB revealed that identified groups of farmers for select CVCs were promoted to establish link with exporters/ leading processing & marketing companies for buy back of farm produce at predetermined prices are not sustained due to insufficient capacity of farmers to understand the business ethics, lack of ability for negotiations, highly informal way of transaction with regional trader networks, inadequate awareness of market opportunities and way of access. The interviews with farmers in Nadunkerny area revealed that Papaya production and marketing system with pack house operation supported under ILO is not benefitted the farmers as expected due to inadequate capacity of FO to operate and maintenance and lack of proper mentoring and capacity enhancement programs to empower the farmers with business orientation. This resulted the farmers to revert in to the traditional product /market practices with collector/trader network.

According to farmers the export market link was withdrawn after few months of operation due to quality issues emerged with disease epidemic in the plantations where advisory support from expert institutions were delayed due to inadequate communication, delay in finding the relevant expert, and obtaining a prompt solution for the problem.

The farmers in Northern districts indicated that Cooperative movement was the only savior for them to continue with agricultural production and marketing of produce especially in Northern areas, especially during the conflict period before 2009. However, the opening of road/rail networks have given free hand for the farmers to deal with open trade entities and market their produce individually but high price fluctuation. At present COOP also facing heavy competition from outside market forces and the coop need to be change their strategies for competitive marketing under current free market situation.

Overdependence on subsidies and handouts combined with poor market access and lack of commercial orientation had made them in to a taker rather than makers of their own future. The FOs have no planned interventions/ programs to improve the on-farm productivity and market access for CVC in the district area. This resulted the loss of member confidence for FOs but still they prefer to hold the membership as the benefits of especially the fertilizer at subsidized rates.

The farmer community though aware of the institutional systems available in the area and grass root level offices at their doorsteps to serve the needs of farming population/on farm development and off farm development activities, the FOs are not organized to facilitating the needs members especially related to on-farm and marketing activities.

PDOA and DOA are the main agriculture extension providers for farming activities under individual farm lands. However, according to farmers there is no regular programs or interactive sessions specially to promote innovative farming approaches/technologies pertaining to CVCs. On the other hand, the farmers have the attitude of waiting for something to come to their door steps and deliver. There is no system/methodology even through FOs or societies to be initiative to obtaining the services by proactive manner may be due to lack of proper awareness, poor communication capacity, and lack of leadership within the cluster, FO or Society.

Farmers make their own decisions depending on the market prices achieved during the previous season. It was also noted the private sector seed/other input suppliers in the regions and especially in the village level are more active to market their produce to farmers prompted with advisory support and demonstrations, communicating with individuals/group of farmers.

The FO under various institutional systems promote training activities, seasonal cultivation plans, seasonal water distribution plan through major irrigation tanks focused on paddy cultivation. The services available for other field crops are constrained at FO level where farmers mainly depend on the private sector input services and their representatives working in the field.

FOs focused on paddy identified as traditional organization registered under DAD. The FOs under MASL and Irrigation Department formed with paddy farmers to address irrigation & other input requirement and operations are limited to particular area boundaries under purview of respective authorities. Also, the scope of the FOs has no intervention for marketing.

FOs registered under Cooperative Societies act, formed under diverse categories that include Agriculture, fisheries, and financial, social sectors. Cooperatives are proven success in Northern areas. However, the procedural and administrative systems under cooperative movements have become a barrier to penetrate market competition especially for CVC development interventions. The cooperatives are mostly consumer service oriented and not market oriented where they fail sustain most of agribusinesses.

The farmers in the regions had a wealth of expertise/ knowledge on crop production that brought in by generations of farming is an opportunity to be considered for further improvement. The experience shared were mostly traditional practices of farming continued for generations. However, it was noted if these practices were supported with scientific way of doing the on –farm productivity of select value chains could be remarkably enhanced.

The FOs are still shown remote or traditional way of farming where improved systems of digital information services are not used for learning or solving problems related to farming activities.

The institutional arrangement for formal financing though established in the regions and farming areas the small farmers still depend on the informal lenders. The farmers unable to deal with formal financial institutes due to a list of documentation that small farmers cannot fulfil or purposefully avoid considering lengthy procedure and legal bindings. The farmers have noted the difficulties of filling claims payments and delays in payments.

The members of the FOs discussed the trend for deepening trap of collector /trader network due to poor financial situation of the households and lack of capacity to meet the requirement of formal banking systems that essentially ask for varied documentary evidence and lengthy procedures for official lending, where individual farmers have no capacity to support. This led the farmers to depend more on informal lending systems at the village level operated by the collector/trader networks. The farmers noted there is an artificially built fear psychosis or fear mentality among the members that forced to supply entire harvest to the trader network.

FOs are not aware of emerging new insurance schemes and still depend on existing insurance systems operated through Agriculture insurance Board and Agrarian services which delayed the payment, low level of compensations for crop failures and damages. The proposed program will introduce modern insurance systems that has payment systems for crop stage wise damages/failures computed through cloud images. Existing and proposed CVCs such as Chili, Passion fruit, Ground nut, Papaya, Avocado, and Maize are considered for the cloud-based insurance program.

FOs have great opportunity to transform into farmer companies through federations or own evolution. However, the process require capacity building and financial support as many of the farmers in the organizations are reluctant to share with initial seed funding for formation of companies. This attitude relates to lack of trust where the FC once formed will ensure the increase of farm income and share capital of the members.

Pilot programs implemented by PPMU in relevant districts

The study observed the ASMP /PPMU have intervened and established number of producer organizations where those members represented for FOs registered under DAD. However, establishment of POs are mainly coupled with CVC and further interventions by the EU project will facilitate the formation of FC (PUC).

Table 128: Details of POs established under the ASMP-EU districts

District	CVC	PO	No. of Farmers
Ampara	Organic Soursop	To be registered with DOA	100
	Ground nut	Registered with DOA	100
	Chili	To be registered with DOA	221
Badulla	Seed Potato	Registered with DOA	80
Kandy	Chili	Registered with DOA	221
Kilinochchi	Jumbo Peanut (Seed)	Registered with DOA	30
	Jumbo Peanut (com)	Registered with DOA	314
	Passion fruit	Registered with DOA	100
	Chili	To be registered	94
Vavuniya	Chili	Registered with DOA	275
Total			**1535**

Source: Information gathered from PMU and relevant PPMUs- (compiled by IDE/ASMP-EU)

The farmers were encouraged to form Farmer Producer Organization (POs) as a pilot program under ASMP-EU districts have mobilized 1535 individuals and already established 07 POs registered under DOA. The PPMUs in select areas have identified the need for further capacity building for the POs and move towards the formation of FC/ PUCs under each CVC clusters with scale up farmer representation and extents for future sustainability.

In some district areas the POs were established in 2020 and continue to operational through an executive committee formed at the inception of POs. However, the observations during the meetings noted that the POs are yet to show their collective marketing approaches.

The current operation still follows the traditional way where some POs the executive committee member appointed collect the produce and sell to the linked market. This indicate the marketing practice is not yet changed as envisaged by the formation of POs and way forward for making the PUCs.

In some districts the POs were formed and initial training and implementation support provided through PPMU/ PMU. However, the inadequate training ~~of~~ and lack of knowledge dissemination programs the adoption of technology related to improved value chain activities were hindered and demonstrational effort was not achieved as expected in the pilot programs. It is proposed to be addressed the challenges and mitigation measures under the scale up activities through ASMP-EU program.

Though the FOs or POs have organized member services/management activities that include regular executive committee meetings, annual general meetings, financial reporting, etc.as per the Act of Agrarian services of Sri Lanka, the much-needed farmer development interventions for empowering and commercialization of CVCs are yet to be captured in the promotion of legally empowered farmer companies for district CDP/ ATDP.

The discussions revealed that the major concern of the members was farm gate price and lack of market access. Further it was noted that the produce is marketed individually and there is no established mechanism/system to collective marketing.

The producers are highly depending on village level traders and their networks in the vicinity, where individually approaching the market entities beyond this network is not feasible as volumes are very low. The village collector system continued for generations where producers as individual entities deprived of bargaining with market entities.
It was noted lead farmers within several farming communities dominate the produce collection and marketing within clusters/ POs established. Their main motivation is to get higher price through village level collectors.

The PO under pilot clusters and societies are linked to formal marketing channels but the farmers are failed to supply the quality or buyers are failed to fulfill the predetermined schedules of purchasing which lead to break up the linkages. Institutional systems though promoted the marketing of produce through different buy back arrangements are yet to achieve the sustainable producer-market access. It has been a perennial problem where individual approach has made advantage for the collector – trader network exploiting small farmers in the regions.

It was noted that there is limited opportunities for access the information related to technology, crop models, varietal improvements, increase entrepreneurship skills, etc, due to inadequate interaction among the members, lack mechanism in the FO/PO, inadequate accessibility to relevant institutional systems, lack of organized communication system among the farming community.

The farmers under established POs, individually operate their own bank accounts mostly savings in state banks and few in private banks. Financial activities with RDB, SANASA, Cooperative banks, discussed as producer friendly options where flexibility in credit and savings is observed.

The POs have no awareness on the current developments in agriculture insurance that facilitate the crop stage wise coverage based on loss of harvest. Record keeping at farmer level or organizational level is not adequately maintained and become a barrier for the individuals to deal with formal banking systems where historic data related to achievements/financial records of own crop enterprises are missing.

However, it was noted that there are farmers with leadership characteristics and organizing abilities coupled with wealth of knowledge on farming of select CVC and POs proposed for scale up under the ASMP-EU program, identified as entrepreneur farmers/ leaders that the proposed interventions could further improve and proceed for formation of FCs for sustainable value chain operations.

The institutional analysis shows great number of gaps between producers and market forces where farmers/ FO/ POs are less matured or less capable for coordination/ interaction among the farmers, value chain actors, and large number of formal/ informal institutes that involved in on farm/off farm development interventions under select value chains. The feasibility will focus to consolidate farmers through training, communication that mobilize, empower encourage collective farmer action in select CVC and envisaged to promote the establishment of PUCs registered under ROC.

3.8 Outreach and Communication

The farmers in the select areas informed that they use different sources of agriculture information that related to production, input supply, technology, marketing, and value addition, development programs, etc. for on farm and off activities in the district areas. The reliable and main information source according to farmers was department of Agriculture especially Provincial DOA.

The rural level farmers are well aware of the DAD services where extension support for on farm activities are extended through Agriculture instructors, KRUPANISAs, Development officers attached to a particular GNDs covering number of villages. The DADs are mainly attracted by farmers for obtaining subsidized fertilizer especially for paddy farming, shared machinery for agricultural activities, seed and inputs supplied through various development programs. However, the farmers indicated their dissatisfaction due to poor connectivity as there is no scheduled field visits or farmer meetings at field levels to guide improve and empower farmers through capacity building programs.

The irrigation Department was highlighted as the source of information especially for the FOs engaged in irrigation system in identified Divisional areas of Kilinochchi, Vavuniya, Badulla and Ampara districts where farmers were organized for maintaining irrigation distribution for seasonal crop cultivation. The irrigation management division closely monitor the FOs especially for distribution of irrigation water to paddy cultivation and maintenance of field canals at respective FOs. However, farmers are still not preformed up to the expectations due to inadequate managerial skills, lack of capacity for coordination among the member farmers and institutional systems, financial issues, etc.

The FOs have closely networked with MASL unit manager areas where information related to seasonal cultivation programs, input supply, seed availability and technology interventions are promoted for improved farming and market access.

The paddy growing farmers under irrigation systems informed that the information related to seasonal crop production activities disseminated at the “Kanna” (Seasonal) meetings where farmers in the respective Agrarian areas are gathered to make the decision for crop calendar, water distribution schedule, inputs supplies, harvesting patterns related to select crops by the participating members and officials. Information related to financial services/ credit facilitations also discussed and informed during this meeting.

The farmer discussions identified that all FOs though received technology and other information regarding the seasonal production the awareness on markets and market access knowledge is limited. Also, the information flow related to new development in line with existing crops, and emerging crops are minimum due to insufficient capacity of FOs (financially and managerially).

The FOs not intervened for collective marketing approaches for particular directives or buyback arrangements for crops cultivated by its members. It is still the individually selling at farm gate or transporting to market places identified.

It was noted that in all Kanna meetings the priority is given for paddy cultivation and as such it was mentioned the information related to other crops are least discussed creating a communication gap between farmers and other value chain actors within the select CVC.

There is increasing trend was observed where majority of farmers preferred to discuss their on-farm problems and requirements/ solutions of on-farm activities with private sector input suppliers and retail dealers.

It was noted that there are many misleading information communications by private sector dealers as per the discussions with FOs and farmers in the select district areas. The DOA under registrar of pesticides have made attempts to technically empowering the private sector input dealers and certify them as trained dealers for agro inputs trading/ supplies. The program envisaged that PUC to be trained and certified for agro input dealer network to support the farmer members of the PUC and provide competitive price for the farmers.

The farmers are strongly linked with these dealer networks where some leading companies are providing extension services for farmers by physically visiting and implementing training/demonstration but mainly to promote their own products. However, yet there are wide gaps noted during the meetings with FOs and farmers in select areas.

As informed by DOA there are many ICT and mobile platforms, (Apps) include integrated agriculture advisory, food crop forecasting, marketing, pesticide registration, plant protection, research information management, soil testing, natural resources management, plant genetic resources, plant quarantine, weather forecasting and advisory, land use and soil conservation mapping., are still underutilized in rural farming areas even though they have smart phone options.

Yet there is wide gap observed within farmer clusters where usage of such applications is restricted due to lack of knowledge on how to use and how to get the information and communicate with source as required. In rural agriculture areas the problem of data reception also a limiting factor for use of ICT technology packages.

There are more than 30 digital apps/ websites/ Facebook pages are in operation where mobile phones with smart option could browse as convenient and access the information most economically and rapidly.

Agriculture Websites/Apps		
Krushi.lk	Krushi Upadeshana seva	Krushi talks
Krushi Lanka	Modern Agriculture Implements	Agriculture World
Sahana Krushi Piyasa	Agriculture discussions	Agriculture Group
Dakshina krushi Nawadoya	Krushi Guru	Agriculture for life
Krushi Radio	Matara Krushi Puwath	Agriculture Machinery
Krushi TV	Waduramba krushi	Agriculture Information
Govi Mithuru	Krushikarma Sevaya	Worldwide Agriculture Export-
Crop doctor	Agriculturist of Mahaweli Authority	Lanka Agriculturist
SriLanka Exporters	General Agriculture group	Agrihelp/Export Agri help
Agriculture Information SriLanka AgriBiz	Srilanka Community Farming	Agstat.lk

Source: Consultant survey

It was observed that farmers in the district area owns mobile phones but only few are using smart phones. Also, the district population identifies more youth has employed in industrial and manufacturing sector compared to more aging people are engaged in agriculture production. This leads to low use of mobile apps in the area. The discussions revealed that most of the app are unknown to farmer community.

The extension staff at the field are conversant with these apps when in need they interact with farmers in the field. However, the increasing cost of mobile data access is another limiting factor where the farmers as well as officials are reluctant to use these apps.

Mobile communication is used by farmers mainly with collector networks/ traders/ visiting to farm gate or dedicated economic centers where contacts are established to obtain the daily prices of produce during the crop seasons. Young farmers with smart phones noted that the You-tube applications have useful information that provide them opportunities. Increasing ICT interventions in commercial agriculture by large companies are likely to influence the youth farmers to gradually adopting ICT platform for farming and marketing activities. However, it was observed that youth are mostly preferred to be employed in non-agriculture sector leading to aging population to be in agriculture that hindered the use of mobile apps.

DOA extension & Training division has established traceability mechanism for select fruits/vegetables by QR coding under GAP certification program to facilitate export supplies by ensuring the quality/food safety standards required by the international markets. These systems may encourage the farmers in other regions to embrace to penetrating the export markets directly or indirectly. The POs registered under DOA confirmed to obtain the GAP certification through DOA which is a positive sign of moving towards increased information received through digital sources. The system observed in operation in all district areas but still with small number of farmers and select crops those of outside the list of crops identified under ASMP-EU interventions.

The FOs mainly use hand written or printed notices pasted in village boutiques, GNDs offices, shared service centers or places where people gather to conduct the meetings, events to disseminate the information relevant on farm or off farm development interventions or other important matters related to agriculture activities.

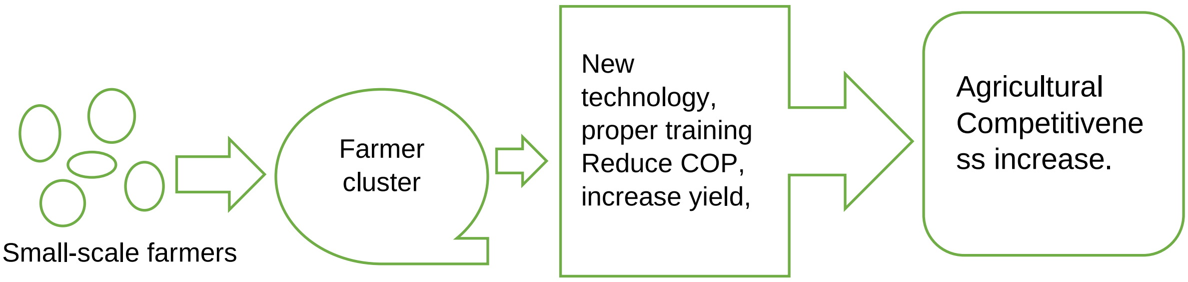
The farmer discussions revealed the sharing information individually during the leisure meetings/road side meetings each other considered an effective way of information dissemination in the villages. However, there are instances of mis communication and spreading distorted information among the farmers.

The farmers are aware of call center application (1920) that linked to all land/mobile service providers and made easy access to farmers to connect with relevant agriculture advisor to find solutions, required information etc, by instant connection. The farmers although show that they are aware, on this application but it was found that the usage is limited to few people.

CHAPTER 4: RATIONALE

4.1 Rationale for overall design considerations and lessons learned

ASMP is based upon market – led approach. Hence the design follows a market driven approach to support small scale farmers to increase their competitiveness to be in local as well as global markets.



To achieve the target of increasing the agricultural competitiveness, we should finish the work as small scale working or individual working and fragmentation. Best solution for this is organizing as a producer group or a company. As an organization, the capacity of dealing with market leaders as well as the exporters going up. Direction of the public institutes can also easily get as a group.

Capacity building is required for smarter, precision agriculture, farm business management, for large number of farmers. Targeting 6,000 beneficiaries from minimum of 20 clusters is a huge target. Prepare a training schedule to achieve this target. First training officers, farmer leaders training and farmer training and other are in using new technology such as videos prepared and published one, eg. YouTube etc. Developing WhatsApp groups, technical trainings can be shared easily the technical problems of farmers can be shared easily and find the solution. Only little bit expensive training method going to be implemented is “exposure visits”.

The main new technology is improving the agricultural knowledge of farmers and their family members. Larger portion of the effort of project should be allocated to farmer training. From the agronomy point of view the training content should be with following items namely:

- Cultivation site and crop selection.
- Land preparation.
    - Ploughing depth and importance of maintaining depth.
    - Proper tools to be used.

  - Proper time for land preparation.
- ❖ Crop physiology (basic things)
  - Importance of the sunlight.
  - Time of plant food production in leaves.
  - Plant food assimilation in fruits.
  - Other requirements for plant food production.
  - Nutrient requirement for production.
  - Soil nutrient including micro nutrient.
  - Soil structure and relationship with organic matter and water holding capacity and nutrient exchange capacity.
- ❖ Harvesting technology as well as post-harvest technology.

The design cannot be implemented in isolation way, must have clusters or companies. Potential investment and collaboration with new technologies will be followed by preparation of cluster development plans during the period of implementation. Lessons learned from pilot projects of ASMP, the FOs takes longer periods to adopt to the new situation. Some organizations have only names, they do whatever the individuals want. Reasons for this was poor training and the lack of proper monitoring system. Although the first rotation of the passion fruit cultivation almost finished, formation of Farmer Company not yet started. Farmers do not have clear idea about the pruning and pollination and never practiced. A new set of intermediate persons created and the farmers never sell their products to the relevant companies as promised. Situation of the Jumbo Peanut cultivation also same, formation of Farmer Company not yet started. Storing facility for their product has not yet been improved. Germination percentage of the seeds has been dropped due to the use of poor storing facility. Poor storing has effect to their commercial product also (so many insect attacks).

Cluster development process begun with the series of stakeholder consultations along with the filed level focus group with farmers of each district. Selection of suitable crops, locations, farmers and value chain structure based on the analysis of climate, soil and demographic data. Special emphasis has paid to identify high value export-oriented crops and/or import substitutions crops. Most importantly, farmers willingness, experience and capacity were considered for finalizing the crops and locations. Pilot clusters and its success stories as well as problems and issues were considered prior to recommend the expansion process. Table 90 explain the details of papaya pilot cluster established in Vavuniya district.

Further, problems and issues which hinder the success of cluster development were identified and aimed to develop strategic interventions to manage the problems. Table 131 explain the present status of the key issue of each district and level of severity.

Table 129: details of pilot clusters of the Kilinochchi district

Location		GNDs	Crops	Extent of Cultivation (ac)	No of Farmers	Investment/ Farmer (Rs Mn)	Other Investments /Cluster	Buyers	Production (Monthly/ Seasonal/ Annual)	Income (Monthly/ Seasonal/ Annual)
Kilinochchi	Karachchi	Thiruvayaru, Ampaalnagar, Kirishnapuram, Malayalapuram, and Vivegananthanagar	Jumbo Peanut	120	140	0.30	0.00	C W Makkies	650 kg/ ac/ Season	Rs 500,000/ ac/ Season
	Karachi and Kandawalai	Kumarasamipuram, Punnaineeravi, Karukkaikkulam, and Mayilvaganapuram	Chilli	150	300	1.10	0.00	NA	NA	NA
	Karachchi	Akkarayan, Skanthapuram, Unionkulam, and Konavil	Passion fruit	50	100	0.89	0.00	Cargills	275 kg /ac/ Month	Rs 25,000/ ac/ Month

Table 130: Details of pilot papaya cluster in Vavuniya district

Vavuniya	Vavuniya North	Sannasiparanthan and Sinnadampan	Papaya	25	50	0.35	0.00	Private	1,500 kg/ ac/ Month	Rs 100,000/ ac/ Month
	Vavuniya and Vavuniya South	Palamoddai, Maruthamadu, and Ausadappittiya	Chilli	150	300	1.10	0.00	NA	NA	NA

Table 131: Lessons Learnt – Experiences of the pilot clusters

Crop/Location	Agronomic perspective	Engineering perspective	Agribusiness & value chain perspective	GIS perspective (Locational suitability)	Institutional	Economic	Safeguards
Chili- Vavuniya	Nursery preparation is very poor. Ploughing depth not up to the standard. Fertigation schedule not up to the standard due to poor soil analysis. Record keeping also very poor.	1. An ineffective usage of given technical package was noticed in some instances. E.g. – pest control nets, two door entrance, uneven water and fertilizer application due to uneven bed height. 2. Absence of chili drying facility with the pilot cluster.	Price driven market entry – Green chili Conventional market channels No value addition motive – dry chili No records on production, sales, prices, etc.		POs are established but still farming activities/marketing operations are individually implemented. Limited networking/coordination between relevant institutions/members. Regular meetings are not adequately implemented. POs have no action plan or business plan related to seasonal/annual production to capture diverse market access	High harvest High monthly income Low farm gate price in comparison to market price No tendency to dry chili production No proper idea on cluster mechanism	Low focus on female farmers during selection. There were evidences related to land ownerships
Jumbo peanut - Kilinochchi	Ploughing depth not up to the standard.	Substandard seed quality due to absence of	Limited yield, issues of grain filling, poor		Producer organizations established. But farmers operate individually as	Low maintenance of the crop	-

	Germination of seeds very poor. Fertilizing also not up to the standard due the lack of soil analysis information.	processing machineries and storing facilities.	postharvest management, storage pests No records on production, sales, prices, etc		there is no established action plan determining the collective cultivation as required by the market entity. Observed poor transparency in marketing of produce where recognized individual/s in the cluster dominated by collecting produce from surrounding farmers and supplying to buyer. Poor member participation in collective decision making specially the quality/grading and pricing.	therefore, yield red No proper idea on cluster mechanism	
Passion fruit - Kilinochchi	Proper record keeping was not there. Application of the agricultural practices also very poor.	-	Limited yield – not following artificial pollination		POs established. There is no collective system implemented for gather the harvest and deliver to linked market. An individual from the executive committee act as collector and delivery	Not properly pruned leading to yield loss No proper idea on cluster mechanism	Processing centre at Akkarayan has used Asbestos for as ceiling materials which are not suitable for food

					of produce to agreed buyer or outside buyer. There is no transparency noted in this regard and no grassroots member participation in making such decisions. An indication of poor sustainability of PO as continued market failures.		processing places
Soursop - Ampara	No proper training and follow up regarding the cultivation practices especially pruning and pollination.	Selection of micro irrigation system. Sprinkler (1m height) vs mini sprinkler or drip irrigation.	Limited yield – not following artificial pollination	Didn't received exiting farmer list. No proper selection criteria for cluster. 100 farmers selected from 20 GNDs for cluster development.	Farmers promoted to establish PO. The members identified are still operating individually and fell far short of expected results especially the participatory and collective member approach towards organized commercial body.	Scattered plantations No proper record keeping	-
Chili - Kandy	Area selection also not according	An ineffective usage of given	Limited & irregular yield,	Existing chilli farmer lands are	The farmer members grouped by GNDs and	According to the observations,	High soil eroding

	to the standard. Especially the **Pasbage Korale** is not suitable for Dry Chili cultivation. Tea and the Natural Forest are the only crops recommended for that area. Micro irrigation systems were not installed properly.	technical package was noticed in more instances. E.g. – pest control nets (height less than 9 ft), uneven water and fertilizer application due to uneven bed height. Not connecting drip tape to the main water line (Ulapane sub cluster) …etc.	Difficult to process - dry	Sloppy, no proper soil conservation measures apply, Proposed area of Doragala & Ihalagama GNDs are not suitable for Chilli. There are many reasons • high elevation (more than 1200 m) • continuous rainfall throughout the year Low temperature & high humidity	found that the on-farm activities are recorded/ maintained as guidelines and knowledge provided under initial trainings. However, the insufficient follow-up on technical financial and managerial capacity building programs the majority of members are observed individually working. Also, there is no seasonal production plan established for collective farming and marketing of Chili. Interventions in this regard from institutional mechanisms are not adequately provided.	issues related to maintenance, place of cultivation etc. No proper idea on cluster mechanism	locations and flooding areas have been used for cultivation of Chilli in Galabada, Ulapne and Gampola
Seed potato	Poor record keeping and past data not available.	Though the question was raised to PPMU, it was unable to know the total	No records on production, sales, prices, etc Following conventional	Didn't received selected farmer list for prepare geo database.	Grass root level members are not sufficiently included or interacted. Collective decision making is not	Expectation from the ASMP is for storage facility, no new	No transparent farmer selection can be observed

		expenditure on infrastructure and technical package as at to date. (Budget vs actual expenditure ….?)	farming, no idea on yield and modernization		observed. Few members identified as Seed potato growers committee work in isolation.	technology adopted According to them, they take 5000kg for seed potato and 3000 for consumption. No huge price difference between seed potato and potato for consumption No proper idea on cluster mechanism	















Figure 156: Photo story: Corrective measures need to reach the expectations of the crop clusters

4.2 Kilinochchi District

4.2.1 Rationale for the selection of the crops / technologies / best practices &, integrating vegetable / fruit / herbs

In this report the method selecting the suitable crops to each agro ecological regions were done by using secondary data, information gathered through stakeholder meetings and field observations. The profile of the ASMP operating districts were analysed resulting the facing of number of challenges. Commonly, following observations were made about the agricultural activities in selected districts.

When concerning the secondary data basically forces on Natural Resources Management Centre (NRMC) information based. Thereby crops recommendations could adjust with the agro-ecological regions levels basis.

The highly variable agro-ecological zones in the region make it a suitable production area for a wide variety of crops. A number of food crops are cultivated by smallholder farmers with the economic, social, and nutritional importance varying with agro-ecological zone in identified EU districts.

In accordance with the crop recommendation of DoA for different areas of the country, a large list of recommendation was there and the finding out most suitable crops were the challenge for us. As per the several discussions having among our group members the following schedule was prepared to implement and achieve the target.

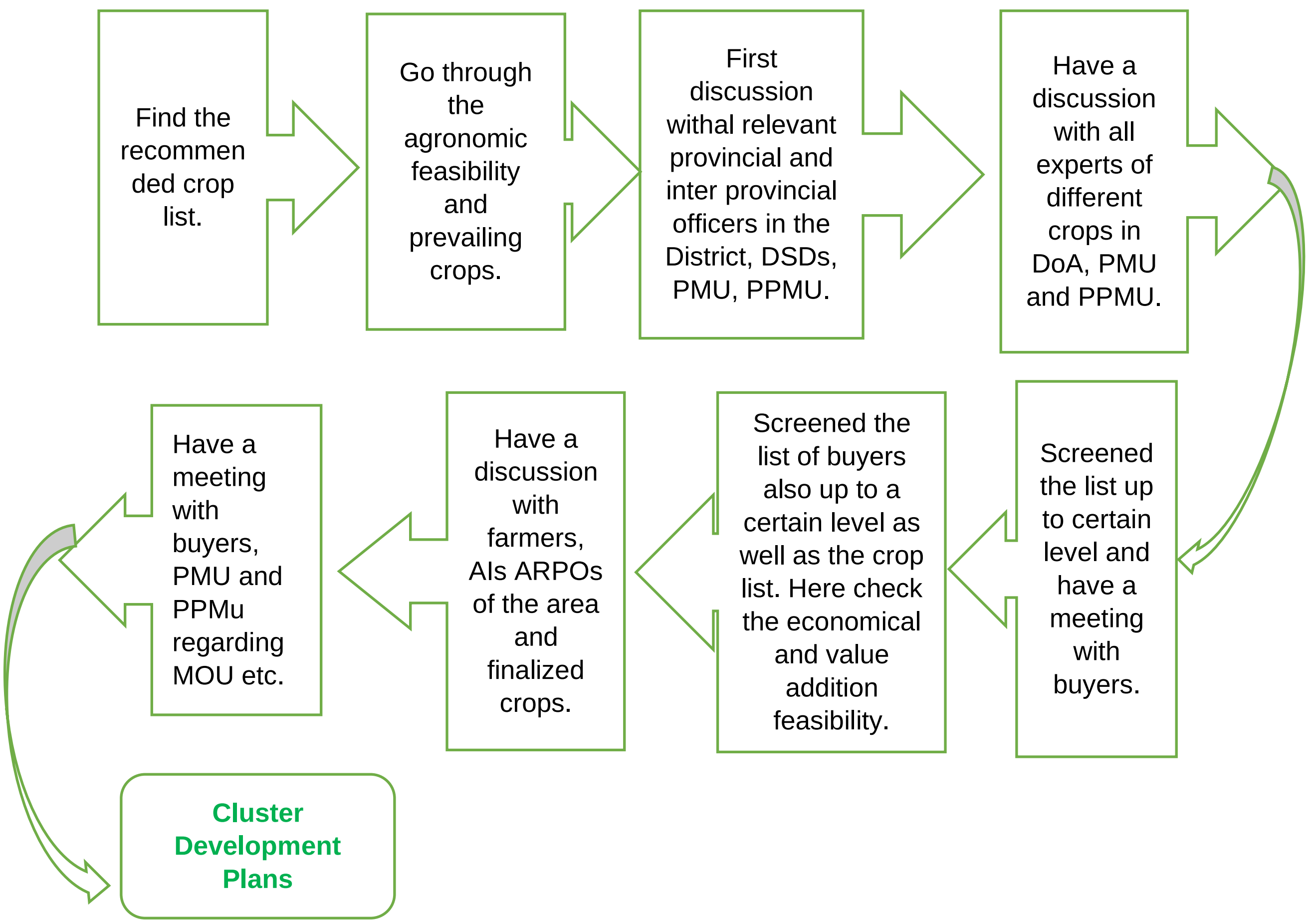


Figure 157: Cluster Development Process

Table 132: Tentative Crop list for Kilinochchi District

DSD	Agro Ecological zone	Crop –(Perennial)	Crop –(Seasonal)
Kandawalai	DL3, DL4	Passion fruit, Banana (Ambul), Jathropa	Jumbo peanut, Chili (dry), Black gram, Low country Vegetable.
Karachchi	DL1f, DL3, DL4	Passion fruit, Banana (Ambul), Jathropa.	Jumbo peanut, Chili (dry), Black gram, Low country Vegetable.
Pachchilaipalai	DL3, DL4	Cashew, Moringa, Jathropa.	
Poonakari	DL3, DL4	Cashew, Pomegranate Moringa, Jathropa.	

Feasibility: Agro-climate, Soil fertility and Structure, Farmer experience on crop, Land availability, Water availability and quality, Willingness of retail chains & hotels, Demand from both local and export market, Opportunity for Women and families, Food security, Substitution to minimize imports.

Table 133: Final Crop list for Kilinochchi District

DSD	Main Crop	Inter Crop /Rotational crop
Kandawalai/ Karachchi	Jumbo Peanut, Chili dry	Black gram
Karachchi	Passion fruit	Black gram
Pachchilaipalai	Pomegranate	Chili
Feasibility: Agro-climate, Soil fertility and Structure, Farmer experience on crop, Land availability, Water availability and quality, Willingness of retail chains & hotels, Demand from both local and export market, Opportunity for Women and families, Food security, Substitution to minimize imports.		

Table 132 is the initial crop list identified by our team and after going through the feasibility process found the final crop list to be cultivated in the Kilinochchi district (Table 133).

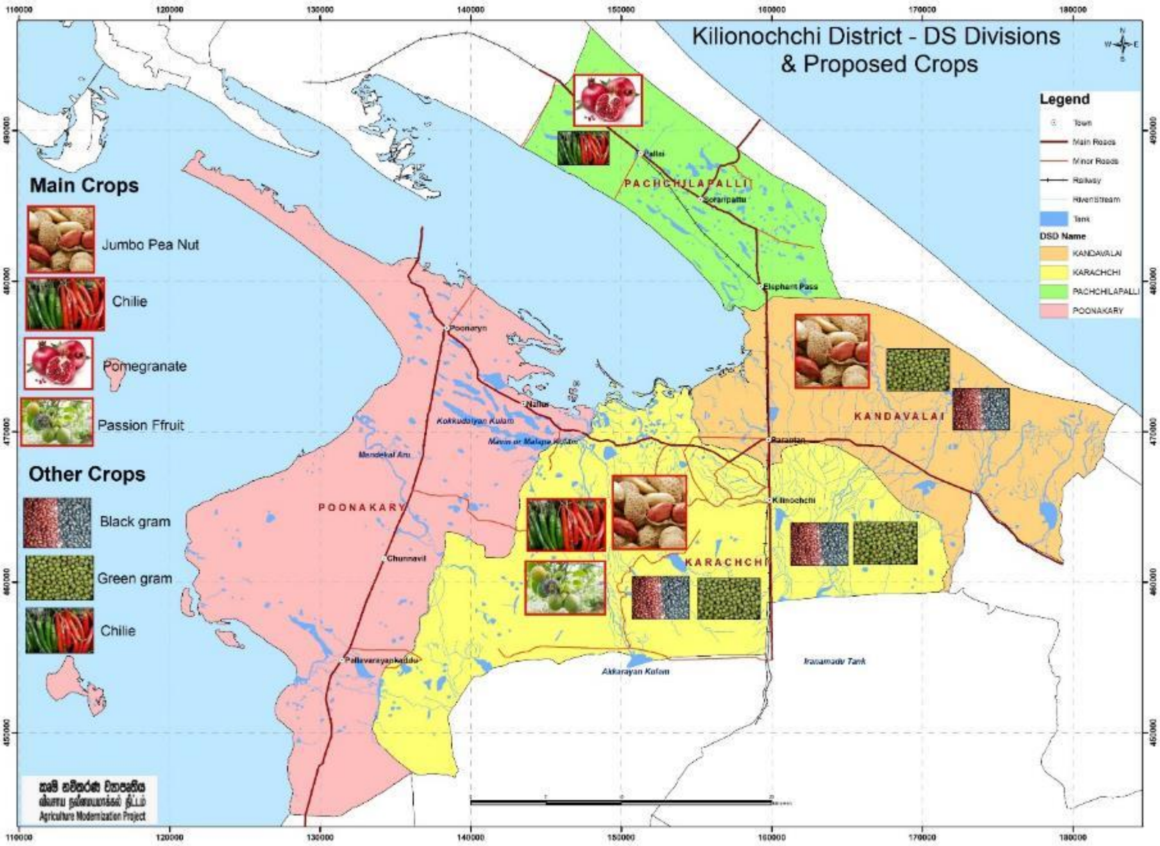


Figure 158: Kilinochchi District Selected Crops with DSs

4.2.2 Rationale for value chain selection & interventions

Value chain establishment, selection of crops, processing and value adding options based on feasibility analysis. Feasibility analysis based on primary production, market, stakeholder, enabling environment and stature feasibility. Figure 159 explain the overall district feasibility.

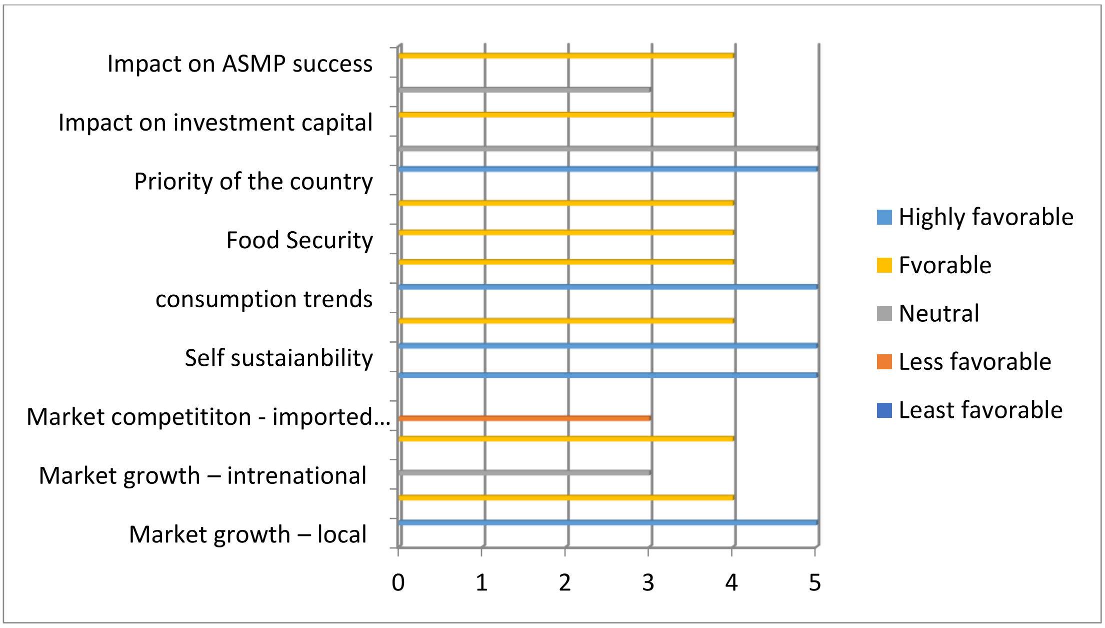


Figure 159: Overall district feasibility status for the selected crop clusters

4.2.3 Rationale for Technological developments

Cluster	Proposed technological improvement	Remarks
Chili	Introducing micro irrigation facilities	- Due to higher dependency on rainfed cultivation, a considerable drop in cultivated land extent and yield in Yala season compared to Maha is noted. Providing micro irrigation facility reduces the water demand an increases potential cultivation in Yala season. This will give an increase of annual production and productivity.
	Introducing higher drying capacity chili dryers	- Capacities of existing chili dryers are low. 450 kg/batch and 800 kg/batch. The drying/retention time is around 12 to 15 hours per batch. - The expected cluster yield is about 3 million kilos of green pods. Thus, the required drying duration varies from 50,000 h to 28,125 h assuming that 50% of total harvest would be dried. - With proposed higher capacity dryer (5 ton/batch), it is expected to complete the drying process within 6,000 hours.
	Introduction of intermediate solar tunnel dryer.	- Reduce mould formation due to removing of surface moisture and minimize 2nd and 3rd quality grades thereon. - With intermediate drying, it is ascertained that required machinery drying is reduced by 5 h/batch. Thus, the expected total saving is 150 h/season. Potential saving by reducing electricity is Rs. 250,000/season.
	Introducing heat pump for as thermal energy source	- The fuel cost (Kerosene) on drying of existing dryers are Rs. 94/kg and 127/kg. - With heat pump, the electricity cost on drying is ascertained at Rs. 25/kg.
	Introducing colour sorting to remove dried	- Current manual sorting output is 20 kg/man day (ref: drying process at Anuradhapura – DOA).

	chili with white patches and small size pods.	- The investment on a colour sorter will be paid back within one year.
Jumbo Peanut	Introducing micro irrigation facilities.	- Due to higher dependency on rainfed cultivation, a considerable drop in cultivated land extent and yield in Yala season compared to Maha is noted. Providing micro irrigation facility reduces the water demand an increases potential cultivation in Yala season. This will give an increase of annual production and productivity.
	Providing drying and storing facilities	- Due to primitive drying and improper storing, the post-harvest loss (pest attack) is greater. The seed germination drops less than 50% resulting yield loss about 500 kg/acre. - It is expected to mitigate the issue by providing better drying and storing facilities.
	Mechanizing the depodding process	- Manual depodding is paid at Rs. 35/kg. One worker can manage 50 kg per day. The machinery depodding output is 1 ton/h.
	Mechanizing jumbo peanut harvesting Process	- 20% product loss in field is expected to recover.
Pasion Fruit	Providing machinery and technology for pulp making	- Will increase the shelf life by 20 days. - Pulp cab used for various products – Value addition.
Pomegranate	Pre-cooling and providing cold storing facility	- Shelf life is expected to be increased by 6 weeks. - Thus, reduce post-harvest losses while maintaining the qualitative aspects.

4.3 Vavuniya District

4.3.1 Rationale for the selection of the crops / technologies / best practices &, integrating vegetable / fruit / herbs

In accordance with the crop recommendation of DoA for different areas of the country, a large list of recommendation was there and the finding out most suitable crops were the challenge for us. As per the several discussions having among our group members the following schedule was prepared to implement and achieve the target.

Process of Feasibility study for suitable crops is same as chapter 4.1 and the final crop list for Vavuniya district is as per the table 135.

Table 134: Tentative Crop list for Vavuniya District

DSD	Agro Ecological zone	Crop –(Perennial)	Crop –(Seasonal)
Vavuniya	DL1b, DL1e, DL1f	Sweet Orange, Passion fruit, Jack fruit, Jathropa.	Jumbo Peanut, Chili (dry). Black gram, Low country Vegetable.
Vavuniya North	DL1b, DL1e, DL1f	Sweet Orange, Passion fruit, Jack fruit, Jathropa.	Jumbo Peanut, Chili (dry). Black gram, Low country Vegetable.
Vavuniya South	DL1b, DL1e	Sweet Orange, Passion fruit, Jack fruit, Jathropa	Jumbo Peanut, Chili (dry). Black gram, Low country Vegetable.
Vengadacheddikulam	DL1b, DL1f, DL3	Sweet Orange, Passion fruit, Jack fruit, Jathropa	Jumbo Peanut, Chili (dry). Black gram, Low country Vegetable.
Feasibility: Agro-climate, Soil fertility and Structure, Farmer experience on crop, Land availability, Water availability and quality, Willingness of retail chains & hotels, Demand from both local and export market, Opportunity for Women and families, Food security, Substitution to minimize imports.			

Table 135: Final Crop list for Vavuniya District

DSD	Main Crop	Inter Crop /Rotational crop
Vavuniya	Hybrid Maize seeds	Black gram
Vavuniya North	Mango (Tom EJC) Papaya (Tainung)	Jumbo Peanut, Black gram
Vavuniya South	Chili	Black gram
Vengadacheddikulam	Hybrid Maize seeds	Black gram
Feasibility: Agro-climate, Soil fertility and Structure, Farmer experience on crop, Land availability, Water availability and quality, Willingness of retail chains & hotels, Demand		

from both local and export market, Opportunity for Women and families, Food security, Substitution to minimize imports.

Table 135 is the initial crop list identified by our team and after going through the feasibility process found the final crop list to be cultivated in the Vavuniya district (Table 135).

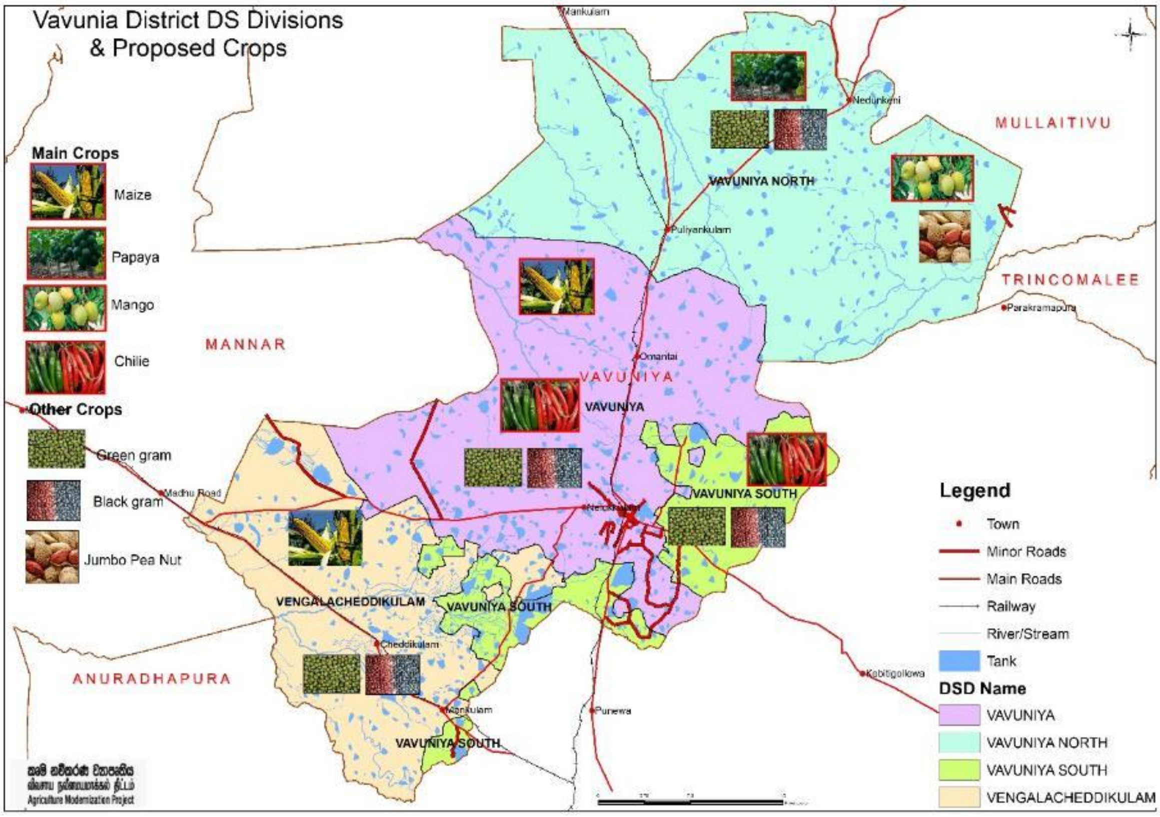


Figure 160: Vavuniya District selected crops and DSs

4.3.2 Rationale for value chain selection & interventions

Value chain establishment, selection of crops, processing and value adding options based on feasibility analysis. Feasibility analysis based on primary production, market, stakeholder, enabling environment and stature feasibility. Figure 161 explain the overall district feasibility.

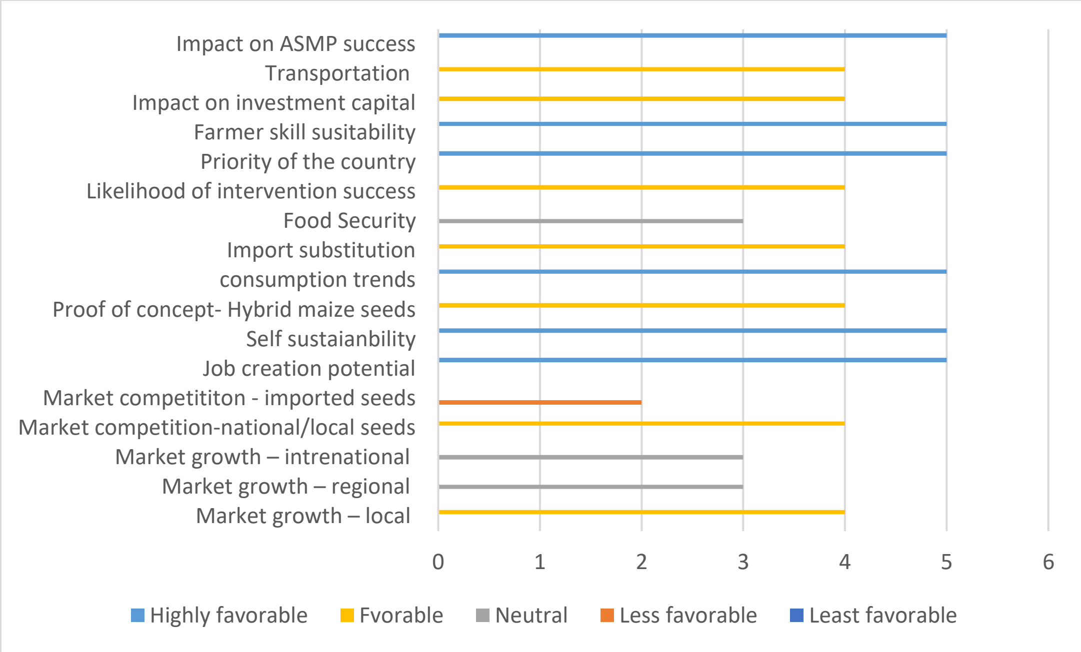


Figure 161: Overall district feasibility for crops, value chain establishment and value addition

4.3.3 Rationale for Technological developments

Cluster	Proposed technological improvement	Remarks
Chili	Introducing micro irrigation facilities	- Due to higher dependency on rainfed cultivation, a considerable drop in cultivated land extent and yield in Yala season compared to Maha is noted. Providing micro irrigation facility reduces the water demand an increases potential cultivation in Yala season. This will give an increase of annual production and productivity.
	Introducing higher drying capacity chili dryers	- Capacities of existing chili dryers are low. 450 kg/ batch and 800 kg/ batch. The drying/retention time is around 12 to 15 hours per batch. - The expected cluster yield is about 3 million kilos of green pods. Thus, the required drying duration varies from 50,000 h to 28,125 h assuming that 50% of total harvest would be dried. - With proposed higher capacity dryer (5 ton/ batch), it is expected to complete the drying process within 6,000 hours.

	Introduction of intermediate solar tunnel dryer.	- Reduce mould formation due to removing of surface moisture and minimize 2nd and 3rd quality grades thereon. - With intermediate drying, it is ascertained that required machinery drying is reduced by 5 h/batch. Thus, the expected total saving is 150 h/season. Potential saving by reducing electricity is Rs. 250,000/ season.
	Introducing heat pump for as thermal energy source.	- The fuel cost (Kerosene) on drying of existing dryers are Rs. 94/kg and 127/kg. - With heat pump, the electricity cost on drying is ascertained at Rs. 25/kg.
	Introducing colour sorting to remove dried chili with white patches and small size pods.	- Current manual sorting output is 20 kg/man day (ref: drying process at Anuradhapura – DOA). - The investment on a colour sorter will be paid back within one year.
Mango (TJC)	Introducing micro irrigation facilities.	- Due to higher dependency on rainfed cultivation, Fruit plants can be undergone water stress which retards plant growing and ultimately reduces the expected yield.
	Providing drying and storing facilities	- Due to primitive drying and improper storing, the post-harvest loss (pest attack) is greater. The seed germination drops less than 50% resulting yield loss about 500 kg/acre. - It is expected to mitigate the issue by providing better drying and storing facilities.
	Pre-cooling and providing cold storing facility. IQF technology if economically viable.	- Current shelf life of mango is about 2 to 3 weeks in a cold environment. IQF can enhance shelf life even up to 2 years without deteriorating the fruit quality. This will expand the market accessibility.
Papaya	Hot water treatment and providing cold storing facility	- Current shelf life is 5 to 7 days. It can be increased up to 2 – 3 weeks by providing cold storage. - Post-harvest loss mainly due to poor handling and poor storing facilities is more than 45%.

4.4 Kandy District

4.4.1 Rationale for the selection of the crops / technologies / best practices &, integrating vegetable / fruit / herbs

In accordance with the crop recommendation of DoA for different areas of the country, a large list of recommendation was there and the finding out most suitable crops were the challenge for us. As per the several discussions having among our group members the following schedule was prepared to implement and achieve the target.

Process of Feasibility study for suitable crops is same as chapter 4.1 and the final crop list for Kandy district is as per the table 137.

Table 136: Tentative Crop list for Kandy District

DSD	Agro Ecological zone	Crop –(Perennial)	Crop –(Seasonal)
Doluwa	WM2a, WM2b, WU2a, WU2b, IU2	Herbs – Medicinal, Banana (Ambun), Nurseries for Urban Home gardens.	Chili (seeds) MICH HY1, Tomato, Cherri tomato, Tuber crops (Yams)/ Cassava
Pasbage korale	WM1a, WM2a, WU1	Avocado (Hass), Mandarin, Banana (Ambun), Anthrium	Cheri Tomato/ Tomato.
Udapalatha	WM2a, WM2b, WU2b	Avocado (Hass), Mandarin. Banana (Ambun), Anthrium	Cheri Tomato/ Tomato.
Pathahewahata	IM3a, IM3c, IU2	Avocado (Hass), Mandarin	Tuber crops (Yams)/ Cassava, Nai Miris
Yatinuwara	WM2b, WM3a	Orchid and Anthurium (protected houses), Tissue culture plantlets production. Nurseries for Urban Home gardens	Tuber crops (Yams)/ Cassava, Nai Miris
Feasibility: Agro-climate, Soil fertility and Structure, Farmer experience on crop, Land availability, Water availability and quality, Willingness of retail chains & hotels, Demand from both local and export market, Opportunity for Women and families, Food security, Substitution to minimize imports.			

Table 137: Final Crop list for Kandy District

DSD	Main Crop	Inter Crop / Rotational crop
Doluwa	Cassava and Avocado (Hass)	Yams, Vegetable (Beans)
Pasbage korale/ Udapalatha	Avocado (Hass) Chili	Yams
Medadumbara/ Kundasale	Banana Ceylon Cavendish (Ambun)	Vegetable (Tomato) Supplementary crop (Jack fruits)
Gangaihala	Chili	
Feasibility: Agro-climate, Soil fertility and Structure, Farmer experience on crop, Land availability, Water availability and quality, Willingness of retail chains & hotels, Demand from both local and export market, Opportunity for Women and families, Food security, Substitution to minimize imports.		

Table 136 is the initial crop list identified by our team and after going through the feasibility process found the final crop list to be cultivated in the Kandy district (Table 137).

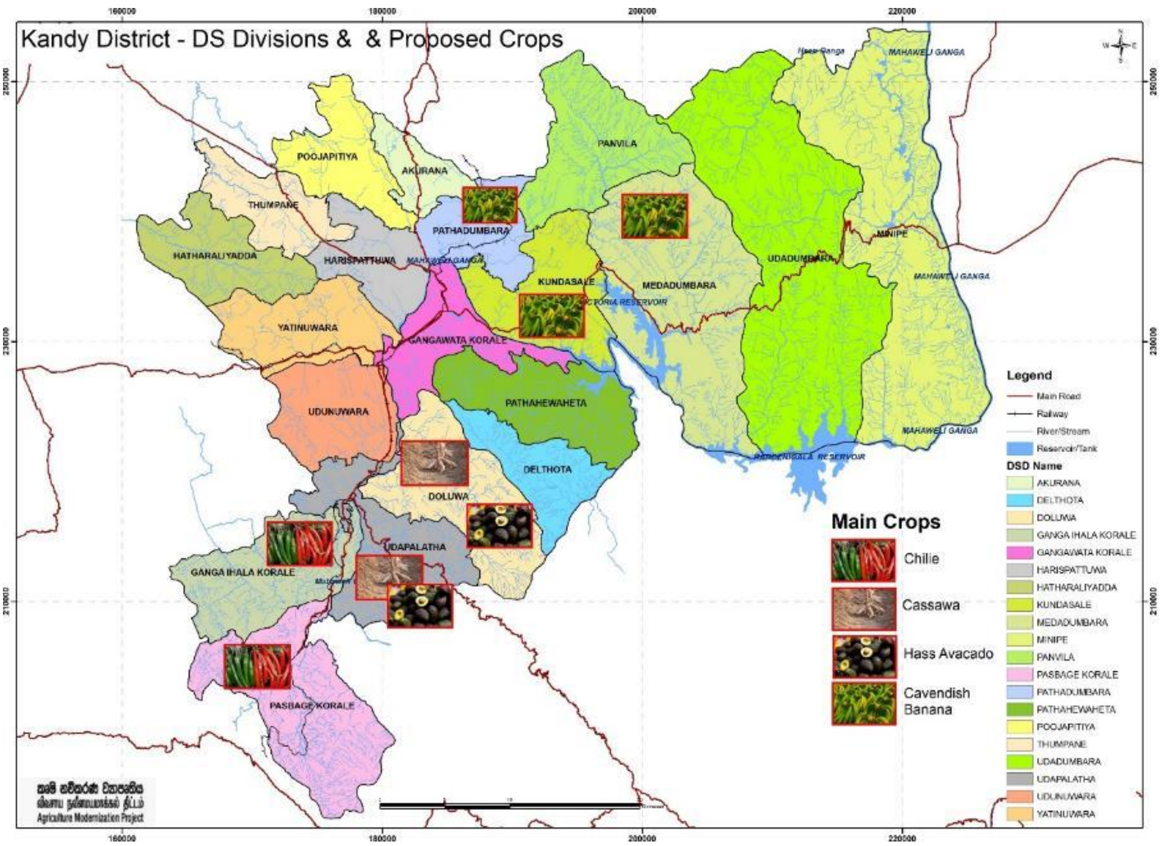


Figure 162: Kandy District selected crops and DSs

4.4.2 Rationale for value chain selection & interventions

Value chain establishment, selection of crops, processing and value adding options based on feasibility analysis. Feasibility analysis based on primary production, market, stakeholder, enabling environment and stature feasibility. Figure 163 explain the overall district feasibility.

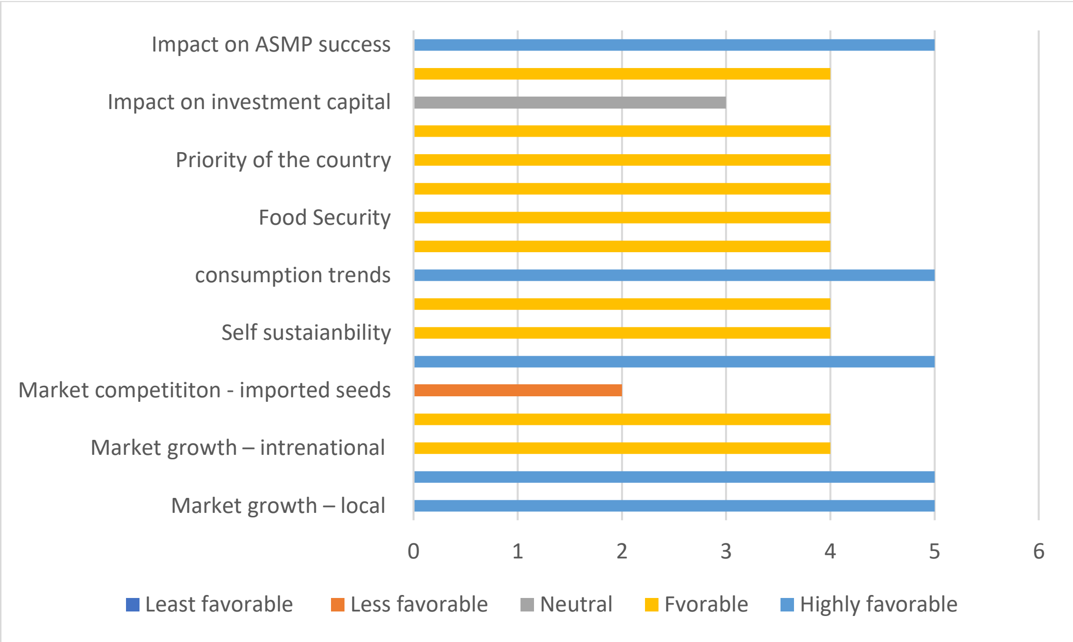


Figure 163: Overall district feasibility -Kandy

4.4.3 Rationale for Technological developments

Cluster	Proposed technological improvement	Remarks
Chili	Introducing micro irrigation facilities	- Due to higher dependency on rainfed cultivation, a considerable drop in cultivated land extent and yield in Yala season compared to Maha is noted. Providing micro irrigation facility reduces the water demand an increases potential cultivation in Yala season. This will give an increase of annual production and productivity.
	Introducing higher drying capacity chili dryers	- Capacities of existing chili dryers are low. 450 kg/batch and 800 kg/batch. The drying/ retention time is around 12 to 15 hours per batch. - The expected cluster yield is about 3 million kilos of green pods. Thus, the required drying duration varies

		from 50,000 h to 28,125 h assuming that 50% of total harvest would be dried. - With proposed higher capacity dryer (5 ton/batch), it is expected to complete the drying process within 6,000 hours.
	Introduction of intermediate solar tunnel dryer.	- Reduce mould formation due to removing of surface moisture and minimize 2nd and 3rd quality grades thereon. - With intermediate drying, it is ascertained that required machinery drying is reduced by 5 h/batch. Thus, the expected total saving is 150 h/season. Potential saving by reducing electricity is Rs. 250,000/ season.
	Introducing heat pump for as thermal energy source.	- The fuel cost (Kerosene) on drying of existing dryers are Rs. 94/kg and 127/kg. - With heat pump, the electricity cost on drying is ascertained at Rs. 25/kg.
	Introducing colour sorting to remove dried chili with white patches and small size pods.	- Current manual sorting output is 20 kg/man day (ref: drying process at Anuradhapura – DOA). - The investment on a colour sorter will be paid back within one year.
Hass Avocado	Evaporative or refrigerated cooling technology	- It is expected to increase shelf life up to 2 -4weeks by providing pre-cooling and storing in an environment where 8 ^{0}C temperature and 85% – 90% RH is maintained.
	Oil extraction	- Further study on oil extraction technology is required if it is decided to produce avocado oil depending on finding an interested buyer.
Banana (Ambon) – Ceylon Cavendish	Evaporative or refrigerated cooling. Introducing IQF technology depending on the select market and its economically feasibility.	- Current shelf life is 3 - 4 days. It can be increased up to 3– 4 weeks by providing cold storage and vacuum polythene pack. - With IQF technology, the shelf life can be increased even up to 24 months.

	Vacuum polyethene packing	
Cassava	Introducing mechanical harvesters	- It could be found that labour requirement for manual harvesting is 22 – 50-man days/ha in global context. - With mechanizing the process, labour output can be increased to 1 – 4-man days/ha. - Cultivating on edges needs to be undertaken for mechanized harvesting.

4.5 Badulla District

4.5.1 Rationale for the selection of the crops / technologies / best practices &, integrating vegetable / fruit / herbs

In accordance with the crop recommendation of DoA for different areas of the country, a large list of recommendation was there and the finding out most suitable crops were the challenge for us. As per the several discussions having among our group members the following schedule was prepared to implement and achieve the target.

Process of Feasibility study for suitable crops is same as chapter 4.1 and the final crop list for Badulla district is as per the table 139.

Table 138: Tentative Crop list for Badulla District

DSD	Agro Ecological zone	Crop – (Perennial)	Crop –(Seasonal)
Bandarawela	IU3a, IU3c, IU3e	Orange (Ehime, Bibila Sweet), Avocado (Hass), Roses, Jasmine	Chili, Naimiris
Welimada	IM1a, IU3b, IU3c, IU3d, IU3e	Avocado (Hass)	Potato (Seeds), Carrot, Leeks, Naimiris
Rideemaaliyadda	IL2, IM1a, IU2	Orange (Ehime, Bibila Sweet), Soursop. Passion fruit (any variety), Avocado (Hass)	Cassava, Kollu, Finger Millet
Kandaketiya	IL2.IM1a, IM1c, IU3c	Soursop, Passion fruit (any variety)	Maize (Seeds), Cassava, Kollu, Finger Millet

Haldummulla	DL1a, IM2a, IM2b, IU3a, IU3b, IU3c, WU3	Avocado (Hass), Orange (Ehime, Bibila Sweet), Anthurium, Roses, Jasmine	Naimiris
Feasibility: Agro-climate, Soil fertility and Structure, Farmer experience on crop, Land availability, Water availability and quality, Willingness of retail chains & hotels, Demand from both local and export market, Opportunity for Women and families, Food security, Substitution to minimize imports.			

Table 139: Final Crop list for Badulla District

DSD	Main Crop	Inter Crop /Rotational crop
Mahiyangana/ Rideemaliyadda	Chili (dry)	Green gram
Welimada/ Uva Paranagama	Avocado (Hass), Potato (Seed), Vegetable (Leeks and Carrot)	Yams, Vegetable (alternate crop for Potato)
Kandaketiya/ Meegahakivula	Hybrid Maize seed	Vegetable seed
Feasibility: Agro-climate, Soil fertility and Structure, Farmer experience on crop, Land availability, Water availability and quality, Willingness of retail chains & hotels, Demand from both local and export market, Opportunity for Women and families, Food security, Substitution to minimize imports.		

Table 138 is the initial crop list identified by our team and after going through the feasibility process found the final crop list to be cultivated in the Badulla district (Table 139).

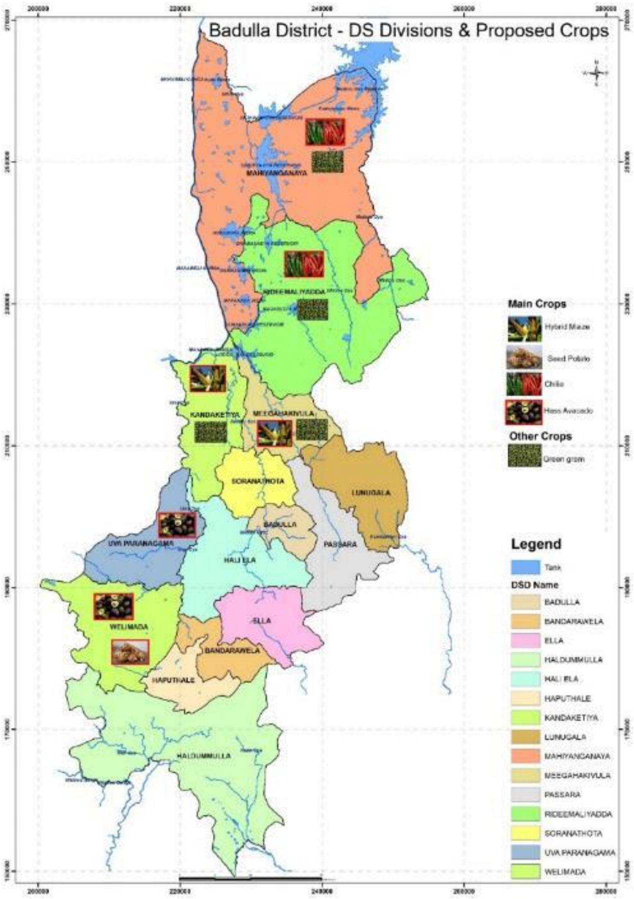


Figure 164: Badulla District selected crops and DSs

4.5.2 Rationale for value chain selection & interventions

Value chain establishment, selection of crops, processing and value adding options based on feasibility analysis. Feasibility analysis based on primary production, market, stakeholder, enabling environment and stature feasibility. Figure 165 explain the overall district feasibility.

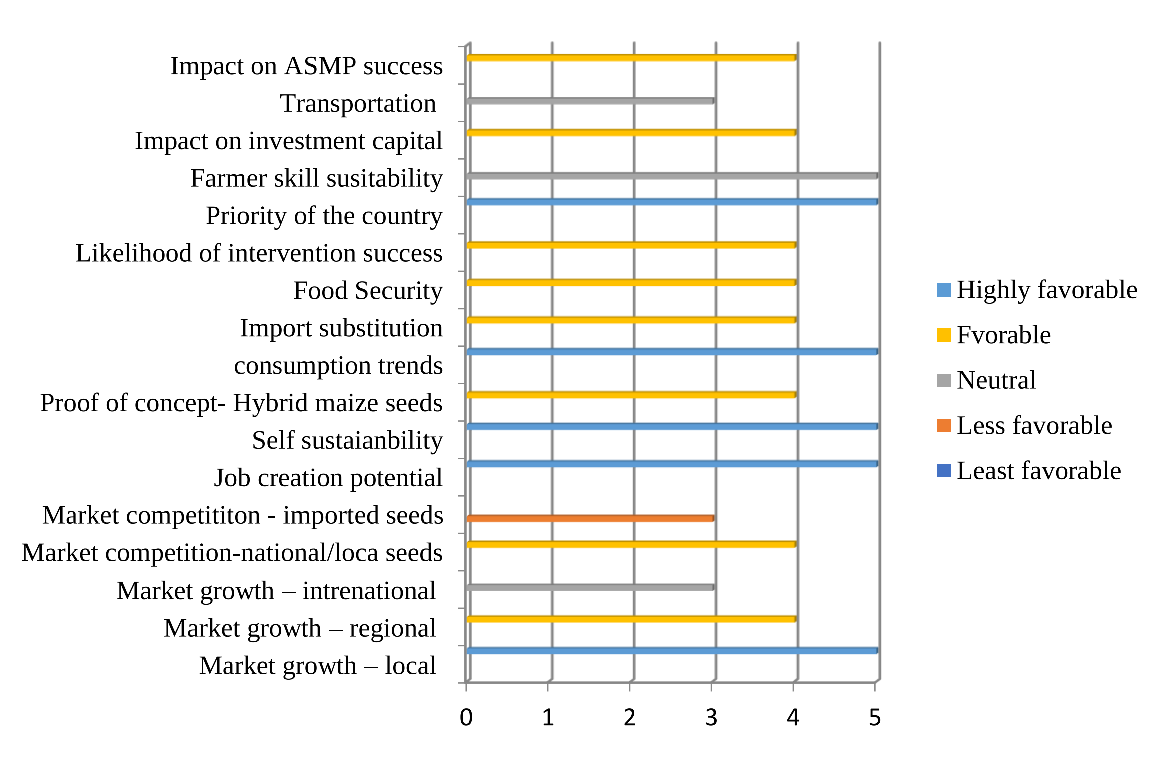


Figure 165: Overall district feasibility - Badulla

4.5.3 Rationale for Technological developments

Cluster	Proposed technological improvement	Remarks
Chili	Introducing micro irrigation facilities	- Due to higher dependency on rainfed cultivation, a considerable drop in cultivated land extent and yield in Yala season compared to Maha is noted. Providing micro irrigation facility reduces the water demand an increases potential cultivation in Yala season. This will give an increase of annual production and productivity.
	Introducing higher drying capacity chili dryers	- Capacities of existing chili dryers are low. 450 kg/batch and 800 kg/batch. The drying/retention time is around 12 to 15 hours per batch. - The expected cluster yield is about 3 million kilos of green pods. Thus, the required drying duration varies from 50,000 h to 28,125 h assuming that 50% of total harvest would be dried.

		- With proposed higher capacity dryer (5 ton/batch), it is expected to complete the drying process within 6,000 hours.
	Introduction of intermediate solar tunnel dryer.	- Reduce mould formation due to removing of surface moisture and minimize 2nd and 3rd quality grades thereon. - With intermediate drying, it is ascertained that required machinery drying is reduced by 5 h/batch. Thus, the expected total saving is 150 h/season. Potential saving by reducing electricity is Rs. 250,000/season.
	Introducing heat pump for as thermal energy source.	- The fuel cost (Kerosene) on drying of existing dryers are Rs. 94/kg and 127/kg. - With heat pump, the electricity cost on drying is ascertained at Rs. 25/kg.
	Introducing colour sorting to remove dried chili with white patches and small size pods.	- Current manual sorting output is 20 kg/man day (ref: drying process at Anuradhapura – DOA). - The investment on a colour sorter will be paid back within one year.
Hass Avocado	Evaporative or refrigerated cooling technology	- It is expected to increase shelf life up to 2 -4weeks by providing pre-cooling and storing in an environment where 8 ^{0}C temperature and 85% – 90% RH is maintained.
	Oil extraction	- Further study on oil extraction technology is required if it is decided to produce avocado oil depending on finding an interested buyer.
Potato	Seed Potato	- Providing cold storing facilities to enhance the shelf life of seed potatoes. The applicability of Diffused Light Storing (DLS) technology needs to be tested.

4.6 Ampara District

4.6.1 Rationale for the selection of the crops / technologies / best practices &, integrating vegetable / fruit / herbs

In accordance with the crop recommendation of DoA for different areas of the country, a large list of recommendation was there and the finding out most suitable crops were the challenge for us. As per the several discussions having among our group members the following schedule was prepared to implement and achieve the target.

Process of Feasibility study for suitable crops is same as chapter 4.1 and the final crop list for Ampara district is as per the table 141.

Table 140: Tentative Crop list for Ampara District

DSD	Agro Ecological zone	Crop –(Perennial)	Crop –(Seasonal)
Padiyathalawa	DL1c, IL2	Soursop, Passion fruit, Orange (Bibila sweet), Lime, Beekeeping	Green gram (seeds), Black gram, Sesame, Pineapple
Mahaoya	DL1c, DL2a, DL2b, IL2	Soursop, Passion fruit, Orange (Bibila sweet), Lime, Bee keeping	Green gram (Seeds), Black gram, Sesame, Pineapple
Ampara	DL2a, DL2b	Guava (red flesh), Lime, Jathropa, Banana (Kolikuttu, Ambul)	Maize (seeds), Chili (dry chili), Cassava, Green gram, Black gram, Sesame, Kollu
Uhana	DL2a, DL2b	Pomegranate, Lime, Jathropa, Banana (Kolikuttu, Ambul).	Maize (seeds), Chili (dry chili), Cassava, Green gram, Black gram, Sesame, Kollu
Damana	DL2a, DL2b	Pomegranate, Lime, Jathropa, Banana (Kolikuttu, Ambul).	Maize (seeds), Chili (dry chili), Cassava, Green gram, Black gram, Sesame
Eragama	DL2a, DL2b	Pomegranate, Lime, Jathropa	Jumbo Peanut / Ground nut
Thirukkovil	DL2, DL2b	Pomegranate, Lime, Jathropa	Jumbo Peanut / Ground nut
Feasibility: Agro-climate, Soil fertility and Structure, Farmer experience on crop, Land availability, Water availability and quality, Willingness of retail chains & hotels, Demand from both local and export market, Opportunity for Women and families, Food security, Substitution to minimize imports.			

Table 141: Final Crop list for Ampara District

DSD	Main Crop	Inter Crop /Rotational crop
Padiyathalawa/ Mahaoya	Hybrid Maize seed	Green gram, sesame Processing (Lime and Beekeeping)
Padiyathalawa/ Uhana	Soursop	Green gram, sesame
Thirukkovil	Jumbo peanut	Green gram, Sesame
Damana/ Pottuvil/ Thirukkovil	Chili - dry	Green gram, Black gram, Sesame
Feasibility: Agro-climate, Soil fertility and Structure, Farmer experience on crop, Land availability, Water availability and quality, Willingness of retail chains & hotels, Demand from both local and export market, Opportunity for Women and families, Food security, Substitution to minimize imports. **Lime and bee keeping, only for value addition purpose.**		

Table 140 is the initial crop list identified by our team and after going through the feasibility process found the final crop list to be cultivated in the Ampara district (Table 141).

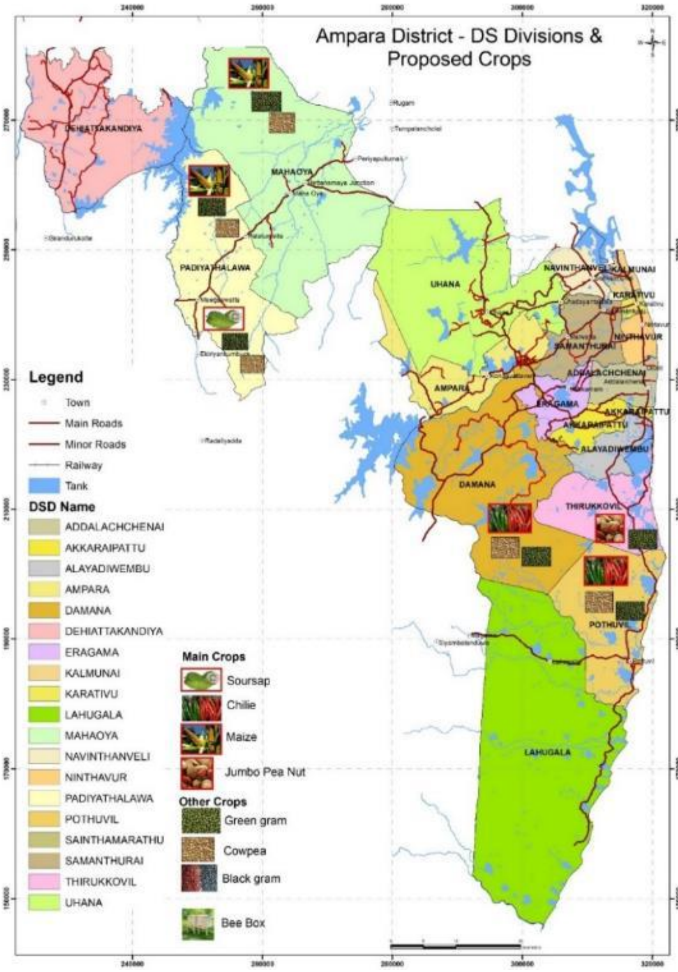


Figure 166: Ampara district selected crops and DSs

4.6.2 Rationale for value chain selection & interventions

Value chain establishment, selection of crops, processing and value adding options based on feasibility analysis. Feasibility analysis based on primary production, market, stakeholder, enabling environment and stature feasibility. Figure 167 explain the overall district feasibility.

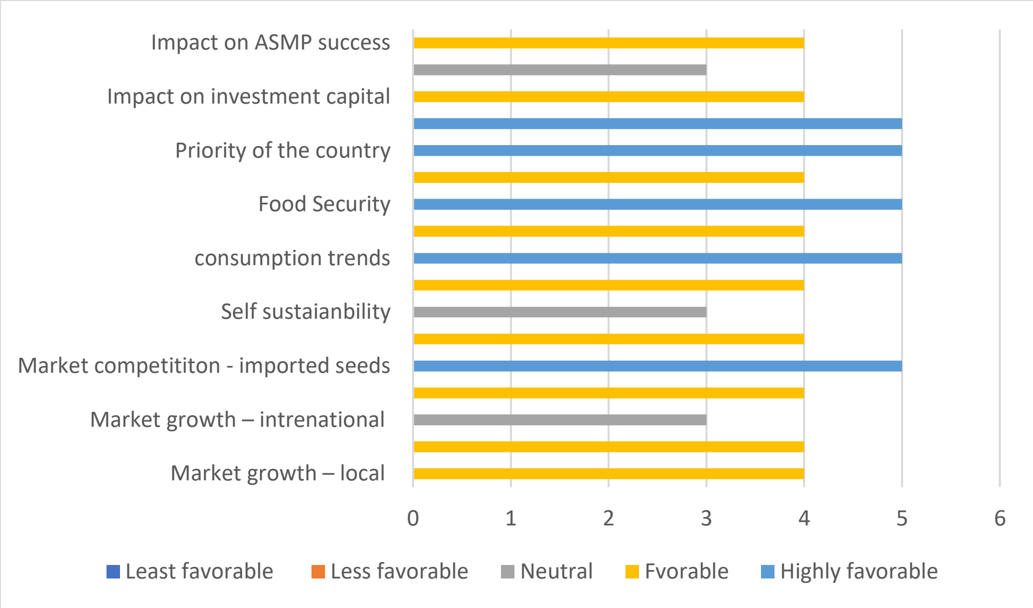


Figure 167: Overall district feasibility for crops, processing and value addition

4.6.3 Rationale for Technological developments

Cluster	Proposed technological improvement	Remarks
Chili	Introducing micro irrigation facilities	- Due to higher dependency on rainfed cultivation, a considerable drop in cultivated land extent and yield in Yala season compared to Maha is noted. Providing micro irrigation facility reduces the water demand an increases potential cultivation in Yala season. This will give an increase of annual production and productivity.
	Introducing higher drying capacity chili dryers	- Capacities of existing chili dryers are low. 450 kg/batch and 800 kg/batch. The drying/retention time is around 12 to 15 hours per batch. - The expected cluster yield is about 3 million kilos of green pods. Thus, the required drying duration varies from 50,000 h to 28,125 h assuming that 50% of total harvest would be dried. - With proposed higher capacity dryer (5 ton/batch), it is expected to complete the drying process within 6,000 hours.

	Introduction of intermediate solar tunnel dryer.	- Reduce mould formation due to removing of surface moisture and minimize 2nd and 3rd quality grades thereon. - With intermediate drying, it is ascertained that required machinery drying is reduced by 5 h/batch. Thus, the expected total saving is 150 h/season. Potential saving by reducing electricity is Rs. 250,000/season.
	Introducing heat pump for as thermal energy source.	- The fuel cost (Kerosene) on drying of existing dryers are Rs. 94/kg and 127/kg. - With heat pump, the electricity cost on drying is ascertained at Rs. 25/kg.
	Introducing colour sorting to remove dried chili with white patches and small size pods.	- Current manual sorting output is 20 kg/man day (ref: drying process at Anuradhapura – DOA). - The investment on a colour sorter will be paid back within one year.
Jumbo Peanut	Introducing micro irrigation facilities.	- Due to higher dependency on rainfed cultivation, a considerable drop in cultivated land extent and yield in Yala season compared to Maha is noted. Providing micro irrigation facility reduces the water demand an increases potential cultivation in Yala season. This will give an increase of annual production and productivity.
	Providing drying and storing facilities	- Due to primitive drying and improper storing, the post-harvest loss (pest attack) is greater. The seed germination drops less than 50% resulting yield loss about 500 kg/acre. - It is expected to mitigate the issue by providing better drying and storing facilities.
	Mechanizing the depodding process	- Manual depodding is paid at Rs. 35/kg. One worker can manage 50 kg per day. The machinery depodding output is 1 ton/h.
	Mechanizing jumbo peanut harvesting Process	- 20% product loss in field is expected to recover.

Soursop	Providing a favourable storing facility. Providing machinery and technology for making soursop pulp.	- Increased of shelf life - Maintaining the qualitative and nutrient aspects of soursop. - A further study is required if the pulp making is going to be considered.

4.7 Financial Rationale

4.7.1 Jumbo Peanuts

Groundnut is one of the popular legumes and oil crops cultivated in Sri Lanka with high containment of edible oil, protein, fats, energy, minerals and vitamins. It is commonly used in the confectionery and oil production industry, and animal feed industry as a good energy and fat source. It is also well known for its ability to fix nitrogen in soil through absorbing atmospheric nitrogen enhancing the soil fertility.

It contains high oleic acid and low palmitic acid so that it reduces the risk of cardio-vascular diseases. Consumption of groundnut also help reduce the triacylglycerol and blood glucose levels and promotes a healthier ratio of High Density Lipo-protein (HDL) to Low Density Lipo-protein (LDL).

In Sri Lanka, peanut crop is mainly cultivated in Dry and Intermediate Zones and its production in the year 2020 is over 35000 metric tons without shell.

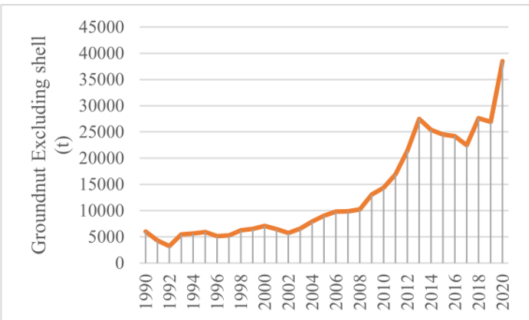


Figure 169: Groundnut production without shell

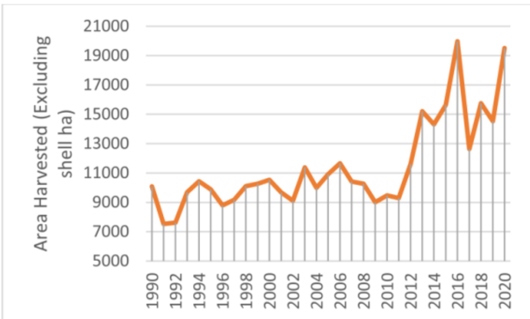


Figure 168: Groundnut area harvested

Source: FAOSTAT

Six peanut/ groundnut varieties, namely, *Tissa, Walawa, Indi, Tikiri, ANKG1* and *Lanka Jumbo* have been introduced by the Department of Agriculture (DOA) for general cultivation and their yield potential ranges from 2t/ha to 3t/ha. Area harvested in Sri Lanka currently is more than 19,000ha.

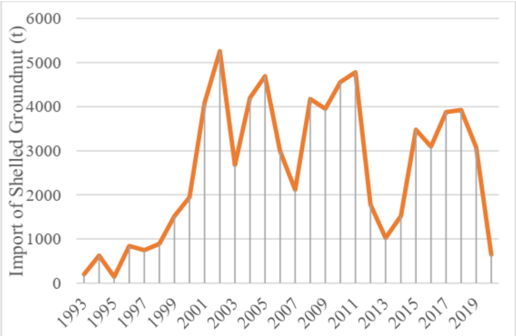
Peanut is cultivated mainly in Moneragala, Mallaitivu, Vavuniya, Kurunegala, Puttalum, Ampara, Trincomalee and Polonnaruwa and their contribution to the total production is 19%, 13%, 13%, 13%, 8%, 5%, 5% and 5% respectively.

Table 142: Average Groundnut production

District	Average Production (t) [2015-2019]	Contribution (%)
Moneragala	4978	19
Mullaitivu	3319	13
Vavuniya	3305	13
Kurunegala	3302	13
Puttalam	1985	8
Ampara	1378	5
Trincomalee	1245	5
Polonnaruwa	1237	5

Source: Sovis et al (2020)

Sri Lanka has imported an average of 4000 metric tons in 2017 and 2018 after which the import shelled has declined. Interestingly Sri Lanka was able to export around 160 metric tons in 2018 and the amount has decreased subsequently.



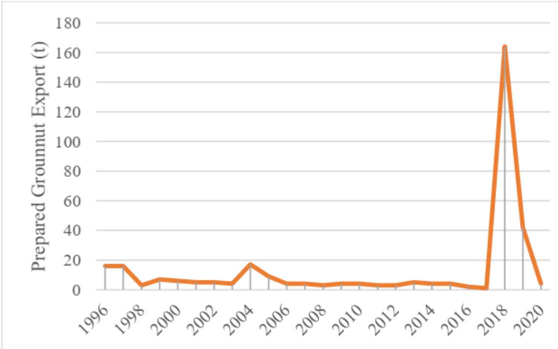


Figure 171: Groundnut imports

Figure 170: Prepared groundnut export

Source: FAOSTAT

According to the existing evidence, Sri Lanka has achieved self-sufficiency in the production of peanuts with a record harvest of 64,000 metric tons doubling the country's annual demand of 30,000 metric tons by the end of 2021 as the newly introduced variety jumbo peanuts have become a popular high yielding food crop in the country replacing the imported variety. This has helped to save much needed foreign exchange spent to import jumbo peanuts.

4.7.2 Chili

As Sri Lankan people like Indians prefer spicy foods, Chili, especially dry chili, has been an essential element in the Sri Lankan diet for centuries. The annual production of chili varies from 65,000 to 80,000 tons and it is insufficient to cater to the country's chili requirement, particularly the dry chili demand. The average annual chili production of the country is about 70,000 tons. The national average of yield is around 5 - 7 t/ha at farmer-field level. The main reasons for such low yield levels are high incidence of pests and disease, moisture stress, use of inferior quality seeds, poor crop management and high input costs. The annual national requirement for dry chili is around 55,000-60,000 tons, however, annual local dry chili production is limited to about 5,000-7,500 tons.

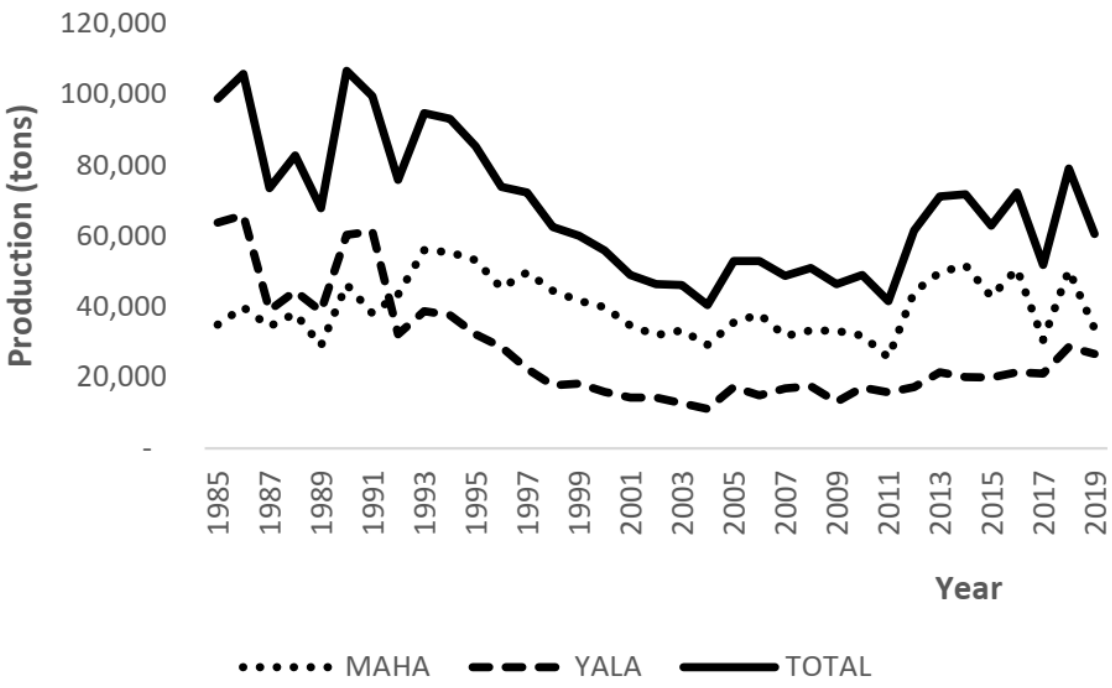


Figure 172: The Chili Production of Sri Lanka
Source: HARTI (2022)

As a result, chili has become an import-dependent commodity over the last few decades. About 50,000-55,000 tons of dry chili amounting to over Rs. 14 billion, is annually, imported. In addition to the colossal amount of foreign exchange spent on importing dry chili, chili seed imports also involve a drain on foreign exchange. Therefore, the country should take necessary initiatives and find strategies to increase the local dry chili production by increasing chili seed production and intensifying dry chili production due to the current shortage in foreign exchange.

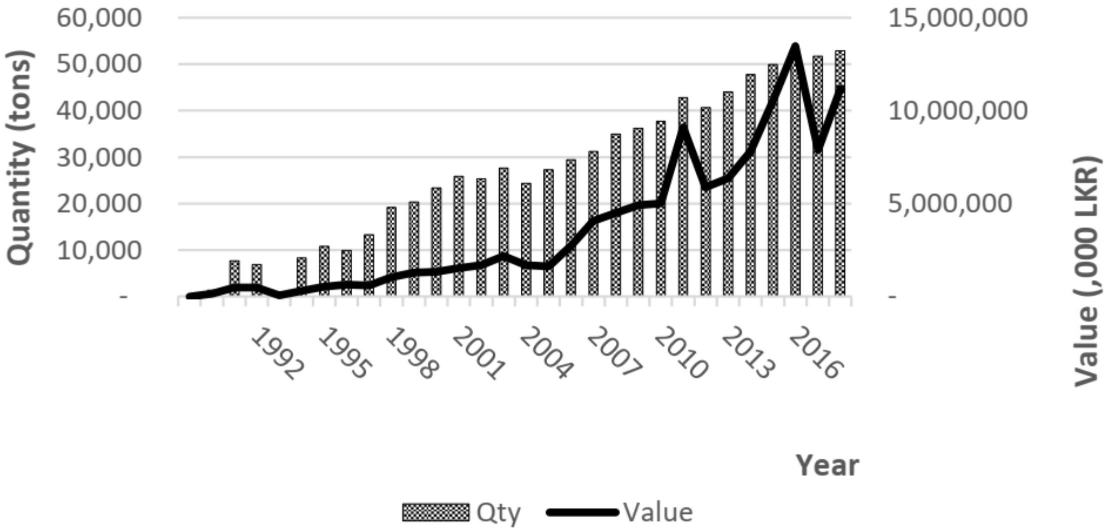


Figure 173: Dry Chili Imports

Source: HARTI (2022)

One of the most positive steps to promote the production of dry chili in the country is to promote the cultivation of local hybrid varieties such as MICH HY 1 which has a yield potential of 32 t/ha of green chili and MICH HY 2 which has yield a potential of 35 t/ha of green chili. Other varieties such as MI-1, MI-2, KA-2, Arunalu, MI-Hot, MI-Green, Galkiriyagama Selection, MI-waraniya 1, MICH-3 and MIPC-1 have a potential yield of 10-15 t/ha as green chili.

At present, the average extent under chili is limited to around 13,000 ha (varying from 10,000-15,000 ha over the period from 2014-2019), of which 2/3 of the crop is cultivated in the Maha season as rain-fed cultivation in the uplands.

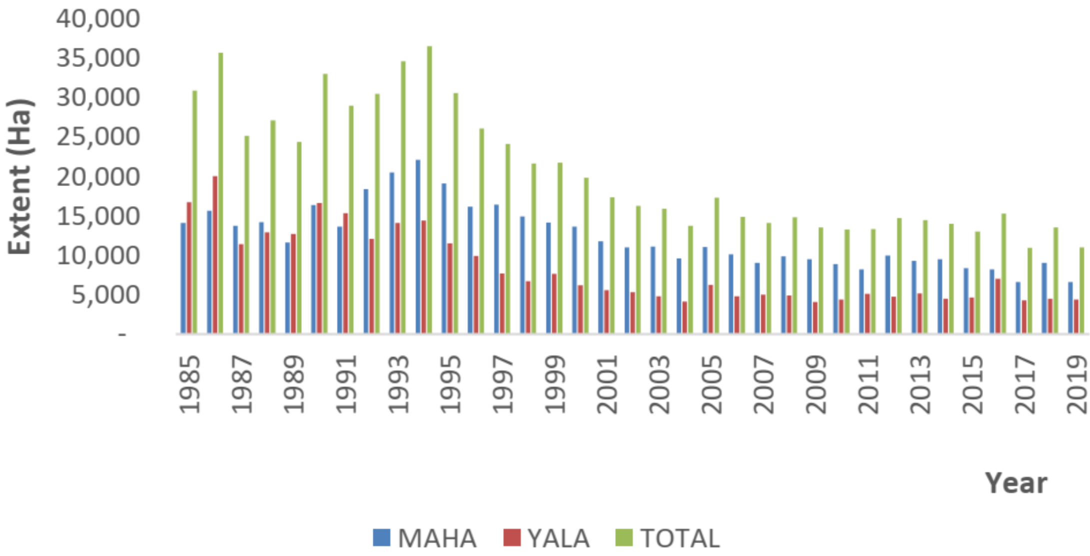
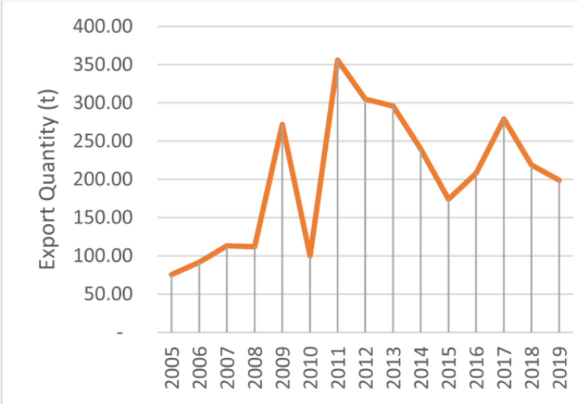


Figure 174: Cultivation Extent under Chili

Source: HARTI (2022)

Although Sri Lanka is an important dependent country for chili, it exports about 75 tons to 350 tons to foreign countries earning maximum of 180 million rupees in 2017.



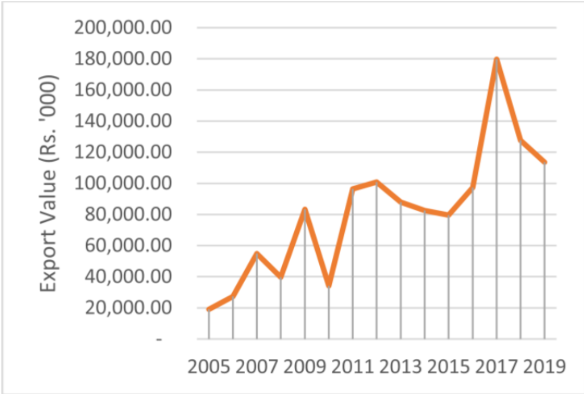


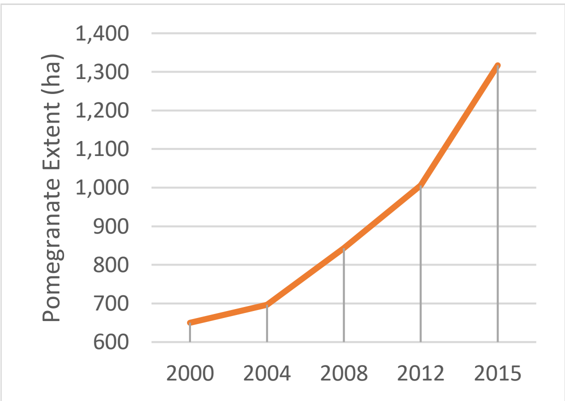
Figure: Volume of chili exports

Figure: Export earnings from chili

Source: FAOSTAT

4.7.3 Pomegranate

In Sri Lanka, pomegranate cultivation can be seen mainly in dry zones and it takes six-eight years to get the maximum harvest from a pomegranate tree. The extent of cultivation is about 1,678 ha and 66,404 metric tons of harvest could be expected. Available data suggest that the extent of cultivation of pomegranate has been rising and as a result, production also has risen production of pomegranate.



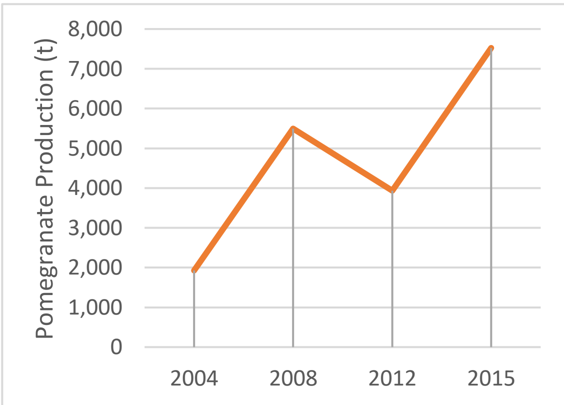


Figure 176: Extent of pomegranate cultivation

Figure 175: Pomegranate production

Source: STDF_PPG_576_SL_Feasibility study -web.pdf (standardsfacility.org)

There are three recommended local varieties of pomegranate namely Imali, Daya and Nayana. Nimali has become the most popularly grown variety as it has preferable economical attributes such as high yield, soft seeded and sweet fruit taste except yellow in peel colour and pale pink arils. Average yield is about 5.71 t/ha per year or 5.7 kg/plant and average fruit weight of variety Nimali is about 200 g. Variety Daya is also similar to Nimali having soft seeds, sweet taste and yellow colour peel. Compared to the other varieties, variety Nayana has bigger fruits with high juice content with hard seeds. Depending on the conditions, about 300 pomegranates can be plucked from one tree per year. Pomegranate can be stored below 50 ^{0}C for about seven months.

4.7.4 Passion Fruit

Passion fruit (*Passiflora edulis*) is a very famous fruit in modern society. Because of its nutrients and health benefits, such as prevention of cancer, controlling blood pressure and preventing hyperlipidemia. It has a huge demand in both local and international markets. The average annual production of the country was 900 mt (2015) and the productivity was low, around 2-3 mt/ha. Present passion fruit production extent in Sri Lanka is about 1,000 ha. Passion fruit is traditionally cultivated in Hambantota, Galle, Kalutara and Monaragala Districts in larger extent and further recommended for Gampaha, Kurunegala, Rathnapura and Colombo Districts. Although passion fruit is very profitable and viable fruit crop in the market, number of farmers who apply new technologies and turn up for commercial cultivation are very less. Potential yield of the recommended varieties is around 15,800 kg/ha

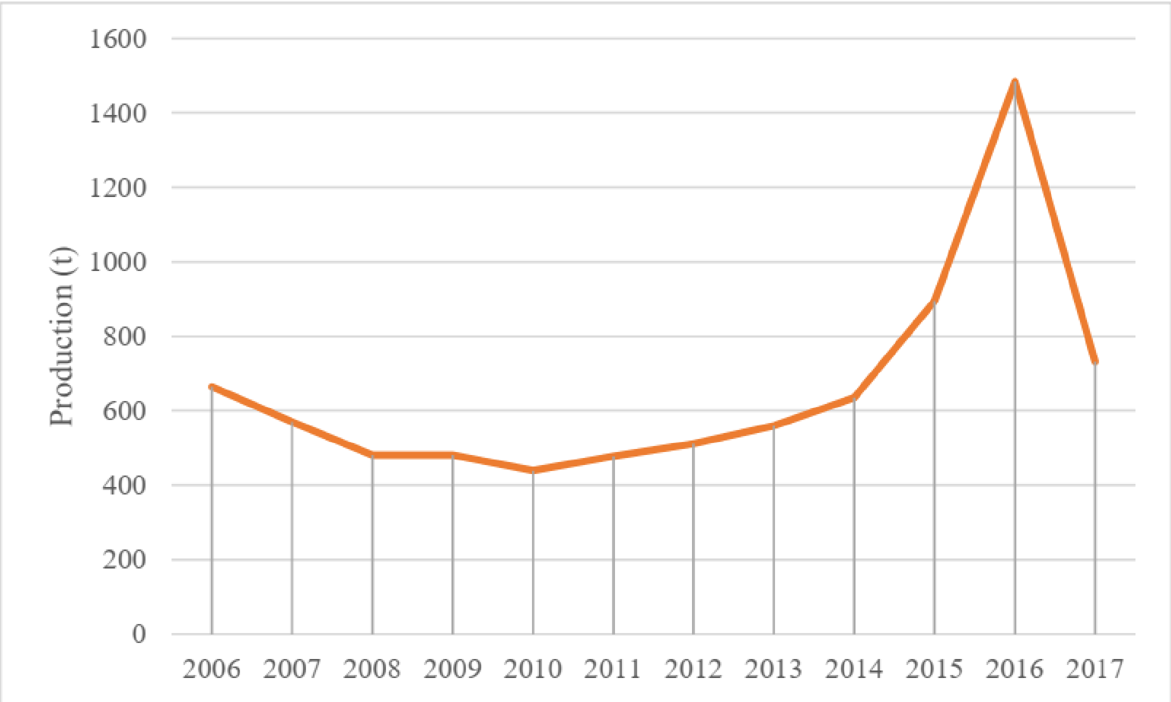


Figure 177: Volume of Passion fruits produced

Source: Dharmasiri and Jayalal (2019)

Figure shows the production of passion fruit in Sri Lanka since 2006. It has steadily grown between 2006 and 2014. An average 500 tons are recorded during this period. In 2014, the production is 635 tons it has increased sharply until 2016 when the production of passion fruit reached to 1484MT.

World demand for passion fruit is high in East Asian and EU markets. EU market growth is around 8-33%. Middle East market has the highest demand for passionfruit. Its growth rate is 33%. However, East Asian market is shrinking. World Market size for passion fruit, soursop and jackfruit is 5 billion US$. By 2016 Sri Lanka has earned less than 25 million US$ per month.

4.7.5 Mango

Mango is one of the important fruit crops and it is adaptable to a wide range of climate, from wet tropical to dry subtropical. However, the seasonal production is directly attributed to the rainfall patterns of the country. Therefore, the fruits are usually harvested from April to July in the wet zone while they are harvested from October to January in the dry zone It has excellent exotic flavors and health promoting activities. Mango fruits are rich source of phenolic compounds, ascorbic acid, carotenoids, exhibit good antioxidant and ant proliferating activity. Mango is one of the most cultivated fruits in Sri Lanka and a considerable amount of foreign exchange is earned by exporting raw and processed mango products due to strong aroma, intense peel coloration, delicious taste and high nutritional value. Present extent under mango cultivation in Sri Lanka is about 27,500ha around 96,500 tons per annum.

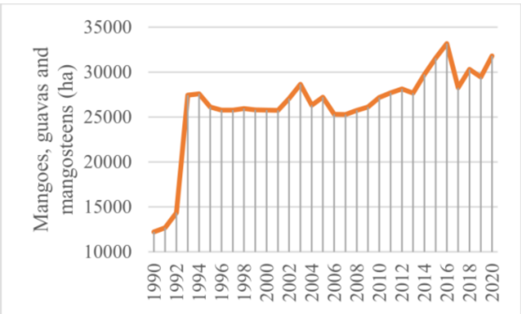


Figure 179: Cultivated extent of Mangoes, Guavas and Mangosteen

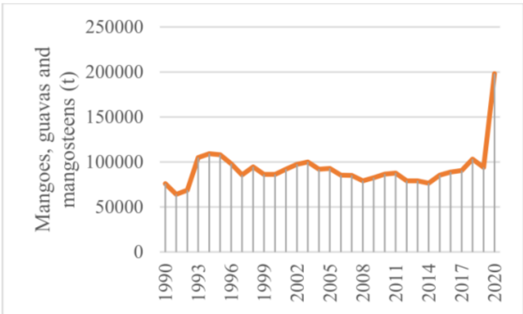


Figure 178: Production of Mangoes, Guavas and Mangosteen

Source: FAOSTAT

At present Sri Lanka exports about 80,000 tons. Mango has the largest market size in EU followed by USA, East Asia and Middle East. EU and USA have over 33% market growth for mango whereas Middle East has 8%-33% growth. However, East Asia market is shrinking for mango. Market size for mango and guava has a 5 billion US$ market size in the world market and is growing at a rate of 33%. However, Sri Lanka export low volumes in comparison to other countries and growth rate is very low. Main destinations of mango exports are Germany, USA, Switzerland, Netherlands, Japan and Signore. According to the data available in Department of Agriculture, 10 types of mango varieties are commonly grown in Sri Lanka. They are Karuthacolomban, Willard, Vellaicolomban, Ambalavi, Chembatan, Malwana, Bettiamba, Giraamba, Peterpras and Dampara.

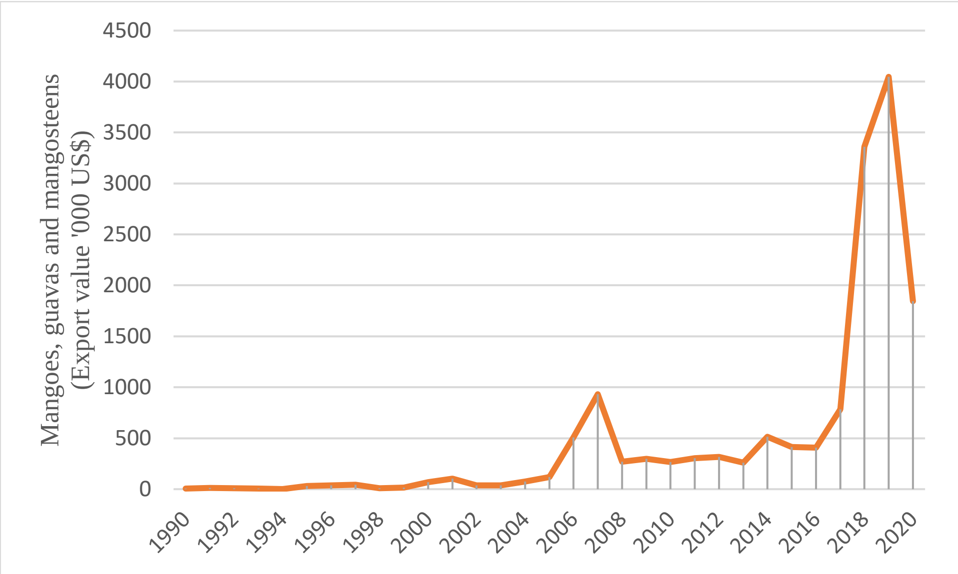


Figure 180: Export earnings of Mangoes, Guavas and Mangosteen

Source: FAOSTAT

In the case of mango production, there are many limitations related to production, post-harvest practices, Export, processing, market, capacity building etc. For example, limited availability of quality planting materials, high cost of production due to high dependence on imported inputs and lack of technical knowledge on mango plantation, lack of cold infrastructure facilities, high post-harvest losses, high processing cost, lack of market information, seasonal production of exportable variety of mangoes, limited production base of exportable variety of mangoes etc. are some of those limitations. Therefore, ASMP expects to provide new technologies, knowledge on modern farm practices and technical knowhow by investing more than one million rupees for a farmer. Anyhow the investment is made to increase the farm productivity and increase export earnings and income per farmer. Thus, the investment should be financially feasible generating positive outcomes.

4.7.6 Papaya

Papaya is one such fruits which have good demand across all sectors of population and cultivated main in Kurunegala, Kalutara, Rathnapura, Gampaha, Galle, Anuradhapura, Puttalam, Hambantota and Badulla. Generally, papaya bears fruits throughout the year. The fruit is consumed mostly in fresh form and processed form. Proper management practices are needed to get the maximum benefits from the papaya cultivation. For example, warm temperature and moisture stress causes reduction in yield. Papaya requires a regular irrigation at 60 % moisture depletion in soil. During moisture stress period, moisture is going very below this level leads flower drops and sterility. Thus, continuous irrigation with drip system may overcome both flowers drop and water scarcity in dry period. Extent of papaya production is 6178ha and 6665ha in 2019 and 2020 respectively. During those two years, the yield of the papaya is recorded as 78843 tons and 130684 tons respectively.

With the development of new varieties and introduction of new technologies, yield of papaya increased and papaya export potential also increased. For example, Sri Lanka exported 13172 tons and the trend in export of papaya is positive. After 2015, papaya exports have risen sharply

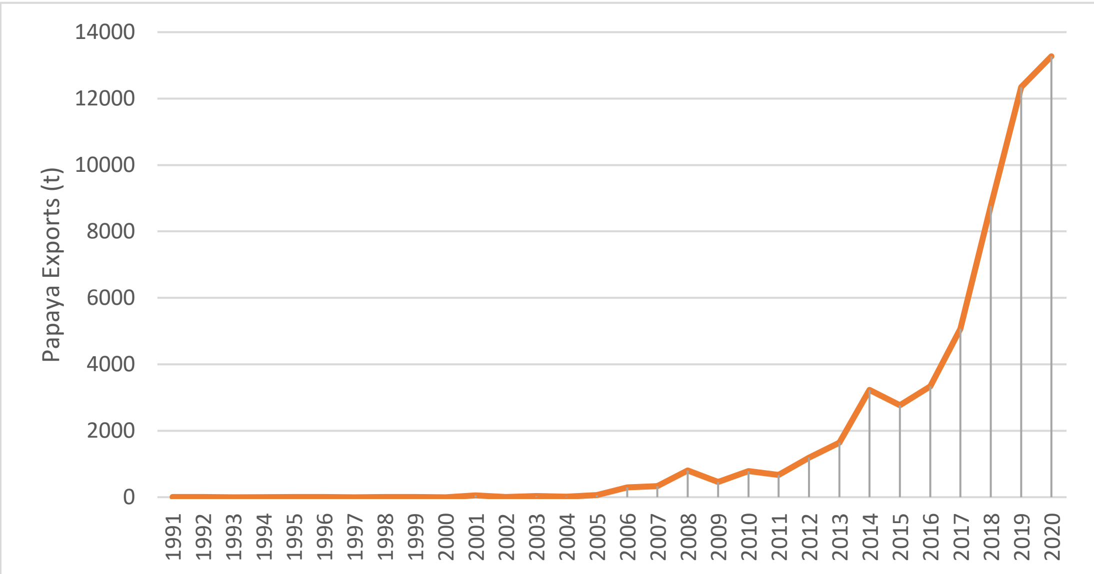


Figure 181: Papaya Export volume

Source: FAOSTAT

In the case of export earnings, a sharp increase in export earning can be noted from the year 2015. In the year 2019, the export earnings from papaya were recorded as 7,025,000 US$ although it reduced to 5,806,000 US$ in 2020 due to COVID 19 pandemic.

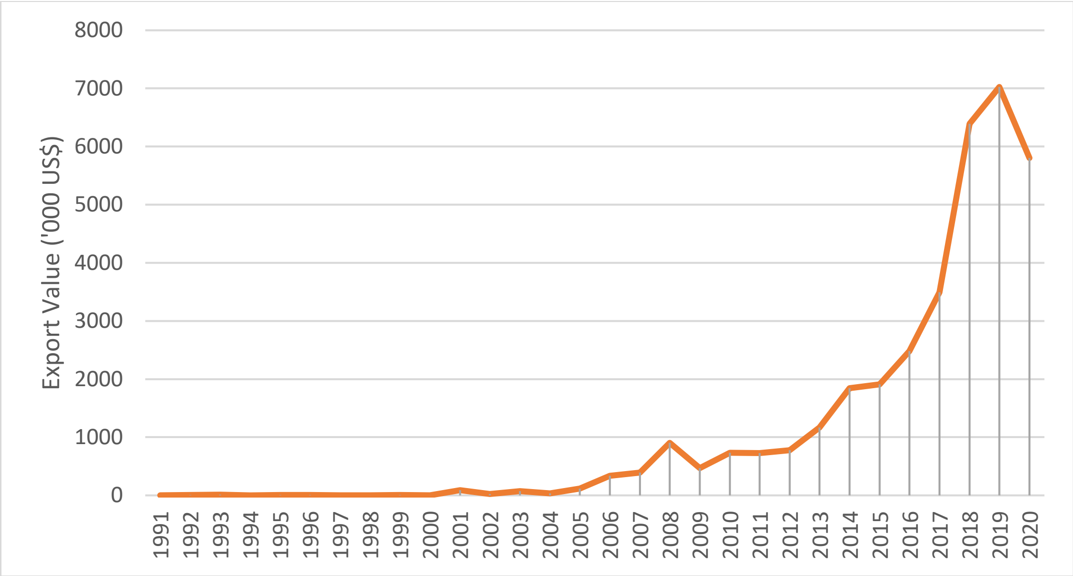
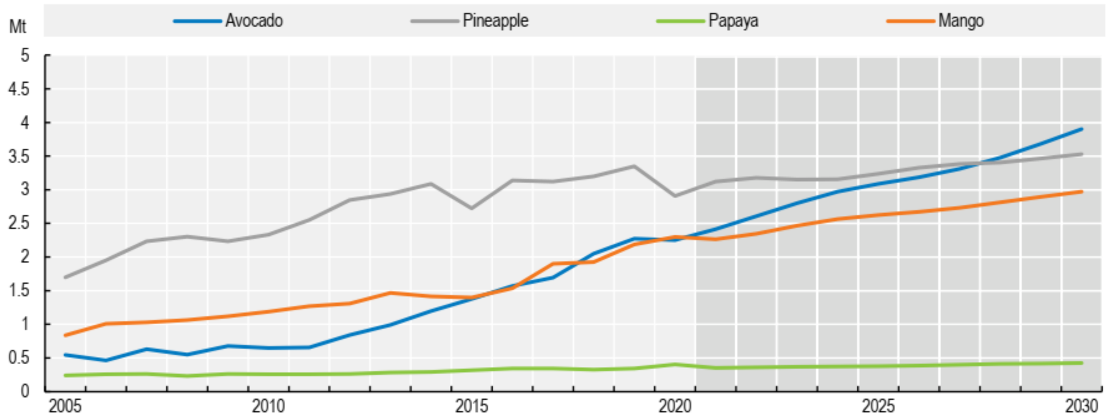


Figure 182: Export earnings from papaya

Source: FAOSTAT

When observing the world scenario, global papaya production is projected to rise by 2.5% p.a., to 18 million tons in 2030. The strongest growth is expected to be experienced in Asia, the leading producing region globally. Asia's share of world production is set to rise to 60% by 2030. The key importers of papayas are the United States and the European Union. The global supply of papayas remains around 500,000 tons.



Source: FAO (2021). FAOSTAT Trade Indices Database, http://www.fao.org/faostat/en/#data/TI; OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

4.7.7 Banana

Banana is one of the prominent fruits grown in Sri Lanka and at present, approximately 54 percent of the total land extent of fruits are used to cultivate Banana. It is also the most widely consumed fruit in Sri Lanka. Banana generates high economic gains to farmers throughout the year. Kurunagala, Rathnapua, Hambantota, Monaragala, Ampara and Jaffna are the major districts that cultivate banana.

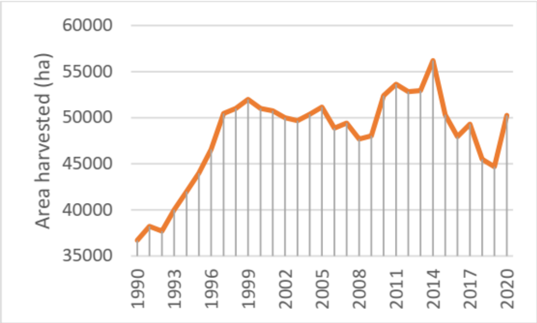


Figure 184: Banana area harvested

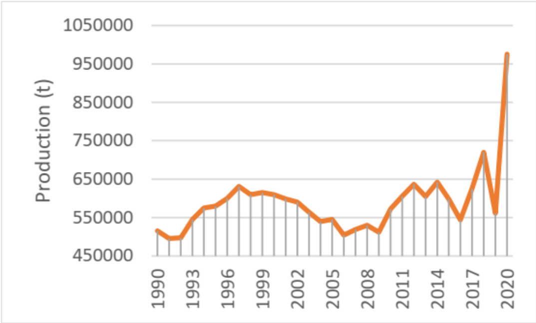


Figure 183: Banana production

Source: FAOSTAT

Nearly 60,000 hectares of land is under banana cultivation in the country and they produce around 780,000 metric tons of banana annually. At present, banana output per hectare is 13 metric tons and it is very low when compared to major banana growing countries of the world where average productivity is recorded as 45-50 metric tons per hectare. The post-harvest losses are very high amounting to 35-45 per cent of total production. Export volume is also very low.

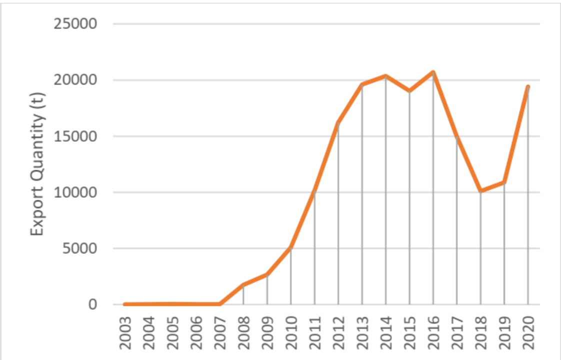


Figure 186: Quantity of Banana exported

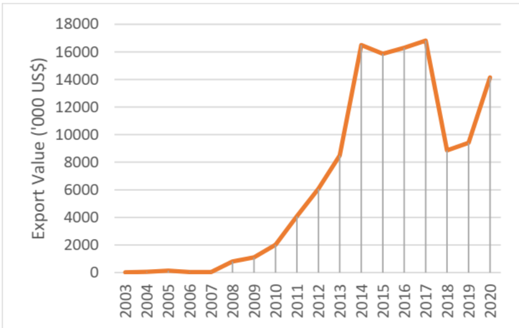


Figure 185: Export earnings from Banana

Source: FAOSTAT

Bananas are mostly imported by EU, East Asia and Middle East. Those countries account for more than 70% of banana trade in the world. Import growth in these markets is 0-8%. EU and USA have a large market share with respect to banana. EU itself accounts for 6 billion US$ market share. Bananas have the largest market opportunity in Middle East Market with a growth rate of over 33%. However, market is smaller overall than other markets. East Asia market has less than 2 billion market shares with a higher growth rate ranging from 8% to 33%. World market size for banana is more than 14 billion US$. In Sri Lanka, banana export is smaller in scale (less than 50 million US$) but has over 33% growth rate.

4.7.8 Avocado

Avocado is one of the popular fruit crops grown and consumed in Sri Lanka. Avocado generally grows in the wet zone of the country. The crop is tolerant to rainfall during flowering, and it is with less demand for crop husbandry practices. The pest and disease problems to the crop is minimum. Hence it has become popular among Sri Lanka as a permanent crop that is cultivated in their home gardens. Presently, avocado is successfully grown in the districts of Kegalle, Kandy, Matale and certain areas of Bandarawela and Nuwara Eliya. The other potential areas where avocado could be grown are Gampaha, Colombo and Kurunegala. Apart from the wet zone, avocado can be grown in the intermediate zone as well as its yield potential in the intermediate zone is equally as good as in the wet zone.

At present, the total acreage under avocado is around 3800 hectares. Although it is popular as a home garden crop, plantation sector of Sri Lanka has made an attempt to grow avocado on a large scale. At present the yield of avocado remains around 20000 metric tons.

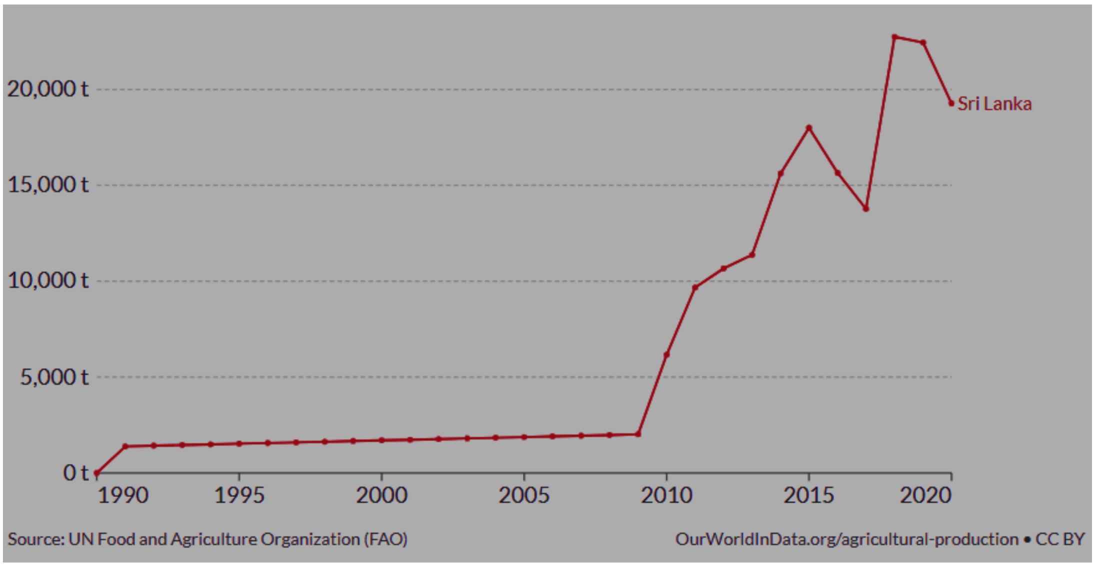
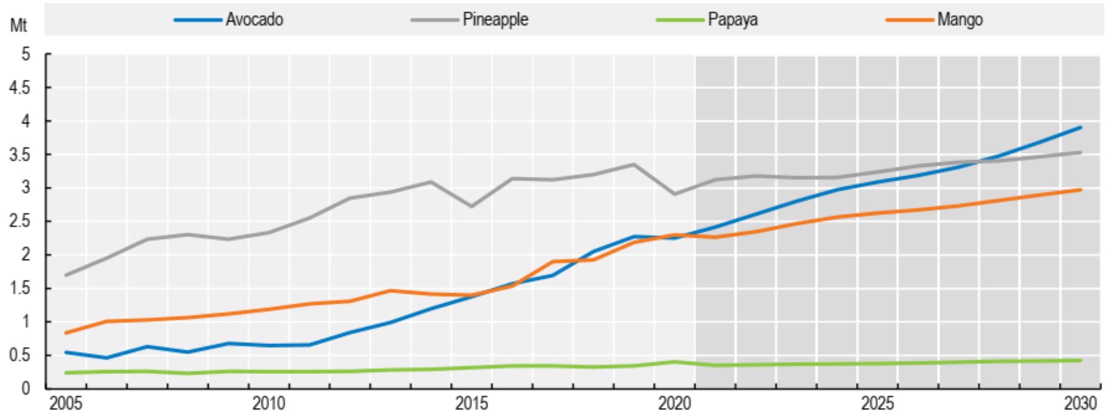


Figure 187: Avocado production

Source: OurWorldData.org/agricultural-production



Source: FAO (2021). FAOSTAT Trade Indices Database, http://www.fao.org/faostat/en/#data/TI; OECD/FAO (2021), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

Although the Department of Agriculture supplies quality and certified planting material productivity of the avocado remains low as modern management practices are seldom followed. While precise figures are not currently available, away-from-home consumption of tropical fruits, especially avocados can account for a substantial share of total consumption in key import markets such as EU. Demand for avocado globally has grown rapidly although there is some reduction in demand due to COVID 19 pandemic. OECD/FAO (2021) has projected that Production reaches 12 million tons by 2030 – more than three times its level in 2010. Ample global demand and lucrative export unit prices continue to be the main drivers of this growth, stimulating substantial investments in area expansion in both major and emerging production zones. Avocado will be the second best-selling tropical fruit in the world in 2030. The United States and the European Union are expected to remain the largest importers. According to OECD/FAO (2021) these regions will be responsible for 40% and 31% of global imports in 2030 despite the growing trade with other regions such as China and the Middle East. By 2025 export value of avocado is projected to be 17.91 (www.statista.com).

As the data suggested by the FAO/OECD (2021), with the increasing demand for avocados from the world, Sri Lanka also can get benefited by increasing its production level and export volumes. Although Sri Lankan export income from avocados has reached a maximum of 425,000 US$ in 2019 it has declined up to 217,000 US$ in 2020 due to COVID 19 pandemic. However, as the world demand for avocados is projected to be increasing in coming years, Sri Lanka also can increase its export income from avocados with proper management of crop choosing highly demanded varieties such as Hass Avocado.

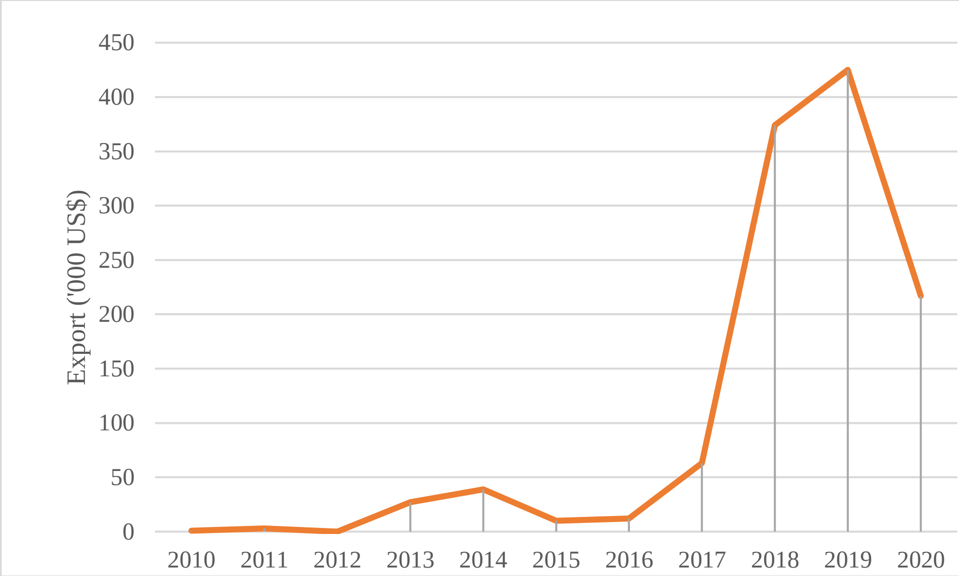


Figure 188: Avocado Exports

Source: FAOSTAT

It is evident that Production/export revenue from avocados within the country remains drastically below its competitive potential. Therefore, a proper guided intervention is needed to uplift the industry. Initiatives should be taken to supply good quality planting material and assist in covering the high startup cost. Introduction of the best plucking technology is a must in achieving the production targets and minimizing the waste. As the value chain is not developed sustainably to secure farmer supply and industry interests, development of proper value chain is a must. Steps should be taken to minimize supply and price inconsistency and provide latest irrigation technologies to improve the productivity.

To fulfill most the requirements, ASMP plans to interfere with avocado production in Sri Lanka by clustering farmers, providing technology and infrastructure facilities with a greater intention to promote avocado exports

4.7.9 Cassava

Cassava is mainly cultivated in Sri Lanka's tropical and subtropical regions. It supplies food to one billion people worldwide. Cassava is an important crop for several reasons. First, it contributes to solve food problems as it grows well and produces good yields under severe conditions such as drought, heat stress, complex conditions in the climate and soil. Second, it is a useful crop that can be processed into a wide variety of products including meal, beer, cassava chips. Third, it can be used an animal. Sri Lanka is having a huge potential for cultivating Cassava as it can be grown in many parts of the country. It is one of the most important sources of energy for the calorie deficient low-income population. Cassava is also gaining more importance by becoming an important biofuel crop. In Sri Lanka, cassava is mainly grown for direct human consumption rather than for commercial applications although a sound local market exists. Cassava is largely imported by East Asia and the market share is more than 70%. Recently, exporting of cassava tubers became an attractive industry in Sri Lanka due to the high demand especially from middle-east countries. However, evidence suggest that market in these countries is shrinking and world market size is also shrinking.

Cassava roots are much more perishable than other major tuber crops and they get deteriorated quickly after harvesting. This deterioration occurs due to physiological and microbiological changes, especially where there are delays in marketing. Hence more consideration should be taken to extend the shelf life of this crop by exploring its potential to be used in value-added products development which would positively impact economical aspects as well as enhance consumer demand.

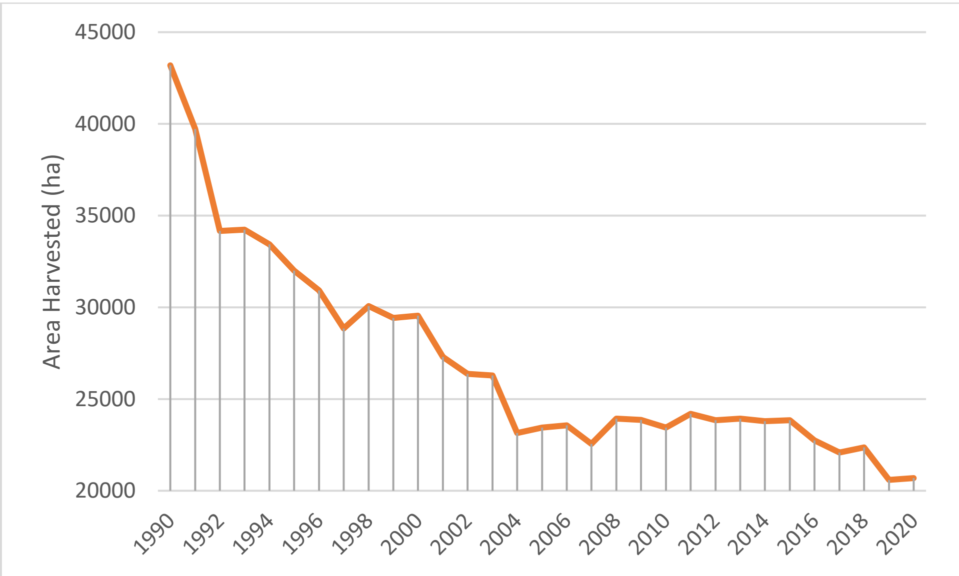


Figure 189: Cassava area harvested

Source: FAOSTAT

Although it has many uses and potential, the cassava cultivated extent has reduced over the years and current production lies between 20000 tons and 25000 tons. However, cassava production has gained some momentum due to introduction of new varieties and its production is currently 300,000 metric tons.

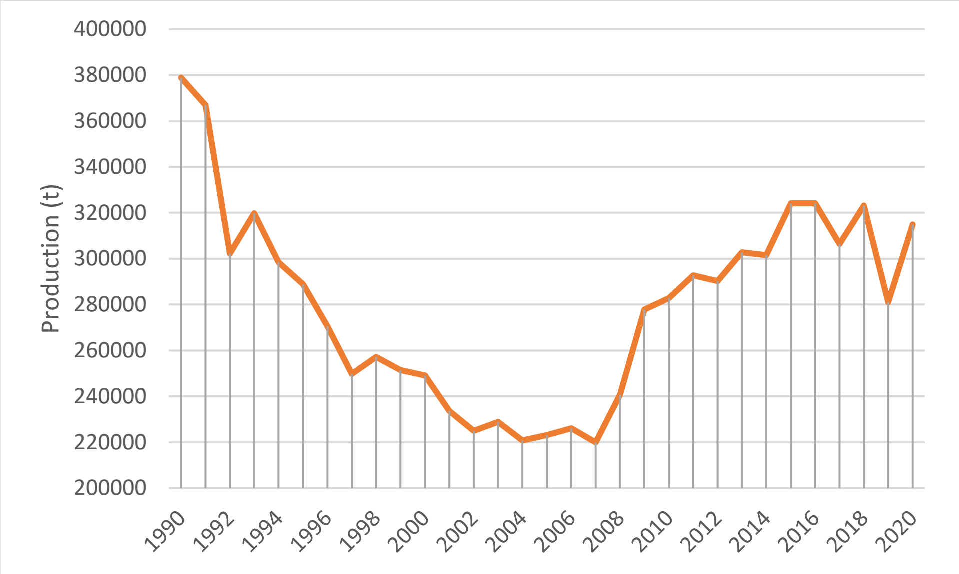


Figure 190: Cassava Production

Source: FAOSTAT

Cassava as an export crop records more than 33% growth and at present, Sri Lanka exports around 6000 metric tons. Export earnings from cassava exceeds 3.5 million US$.

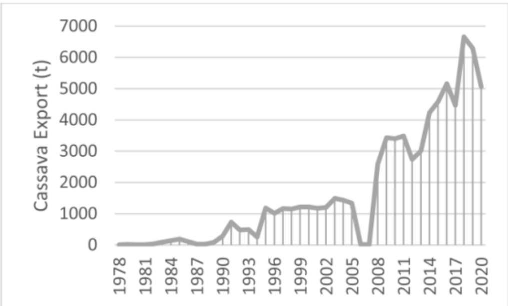


Figure 192: Volume of Export

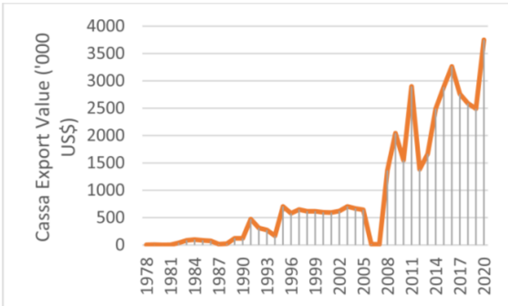


Figure 191: Export earnings from cassava

Source: FAOSTAT

Cassava is largely imported by East Asia (more than 70%) although the market is shrinking. World market size for cassava is also shrinking.

4.7.10 Carrot

Carrot is a biennial herbaceous root vegetable and its consumption part is taproot. It is grown in Nuwara Eliya, Welimada, Badulla, Bandarawela and Matale. Although carrot can be grown well in cool area of up-country regions, it can be cultivated in all the agro-ecological zones. Takiis, New Kuroda, Cape market are some of the varieties cultivated in Sri Lanka. Consumption of carrot has antioxidant benefits, cardiovascular benefits, anti- cancer benefits, benefits for vision etc. average yield of carrot is 35-40t/ha.

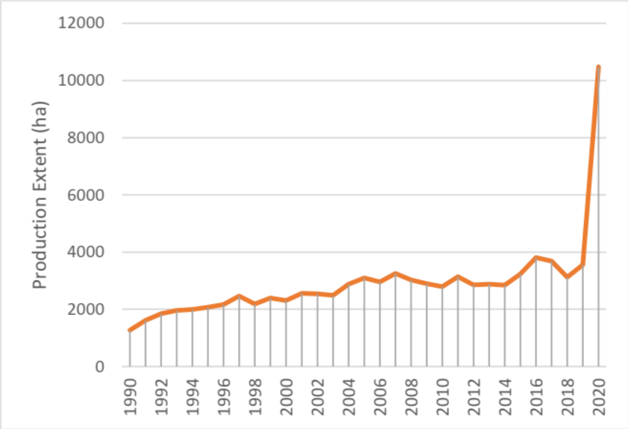


Figure 193: Cultivated extent of carrot

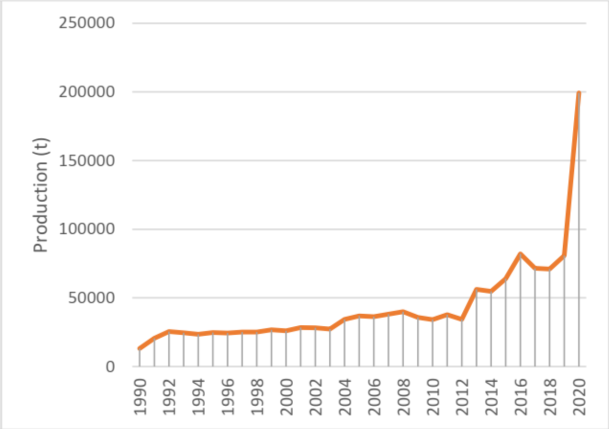


Figure 194: Production volume of carrot

Source: FAOSTAT

According to the data available at FAOSTAT (2022), Sri Lankan extent of carrot and turnip cultivation is less than 4,000ha and it has increased up to 10,500ha during 2020. As a result of the increase in land extent, yield of carrot also has increased up to 200,000 metric tons in 2020. Before 2020, the yield of carrot has remained below 100,000 metric tons.

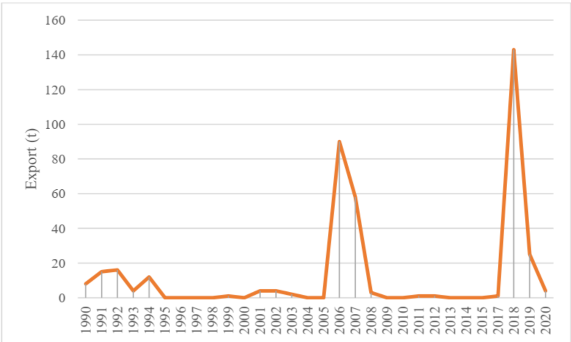


Figure 196: Export volume of carrot

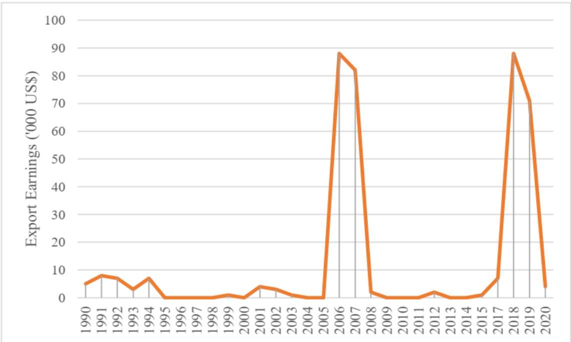


Figure 195: Export earnings from carrot

Source: FAOSTAT

Sri Lanka also has exported a little amount to other countries. For example, Sri Lanka has exported about 140 metric tons in 2018 earning about 90,000 US$.

4.7.11 Seed Potato

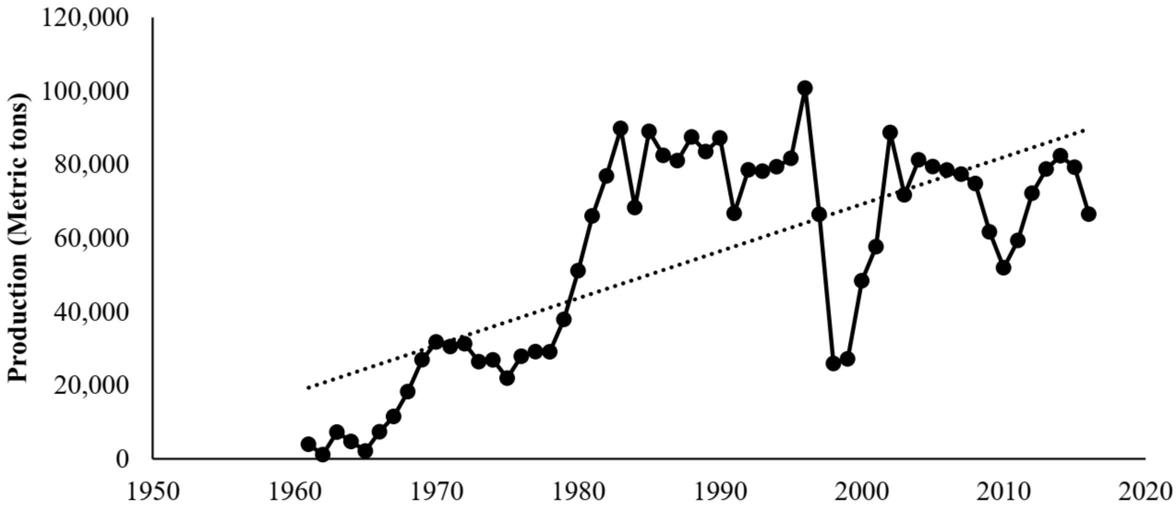


Figure 197: Extent of potato cultivation in Sri Lanka

Source: Pavithira (2018)

According to data available at the Census and Statistics Department, on average, Sri Lankans consume 228,000 metric tons of potatoes annually, and the per capita consumption of potato has increased by more than five kilograms in the last two decades. Although the requirement is as such, the annual production of potato has researched up to maximum around 100000 metric tons.

The rest of the requirement is fulfilled by importing potatoes. For example, as a country Sri Lanka produces around 80000 metric tons and import about 140000 metric tons per year.

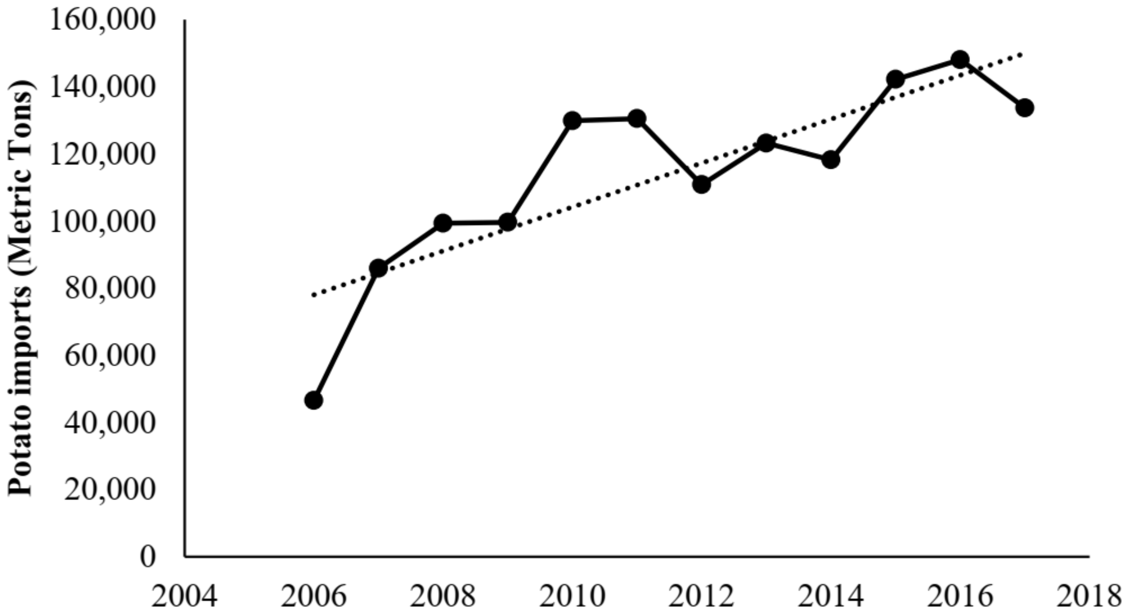


Figure 198: Volume of Potato import
Source: Pavithra (2018)

On average farmers need around 15,000MT of quality seed potatoes annually to meet the production requirement. However, currently, the public sector produces 10% from the total seed potato requirement and another 10 percent is imported to the country. The balance 80 percent is generated by farmers themselves as self-seeds. In 2020, Sri Lanka has spent 2.8 million dollars in importing seed potatoes.

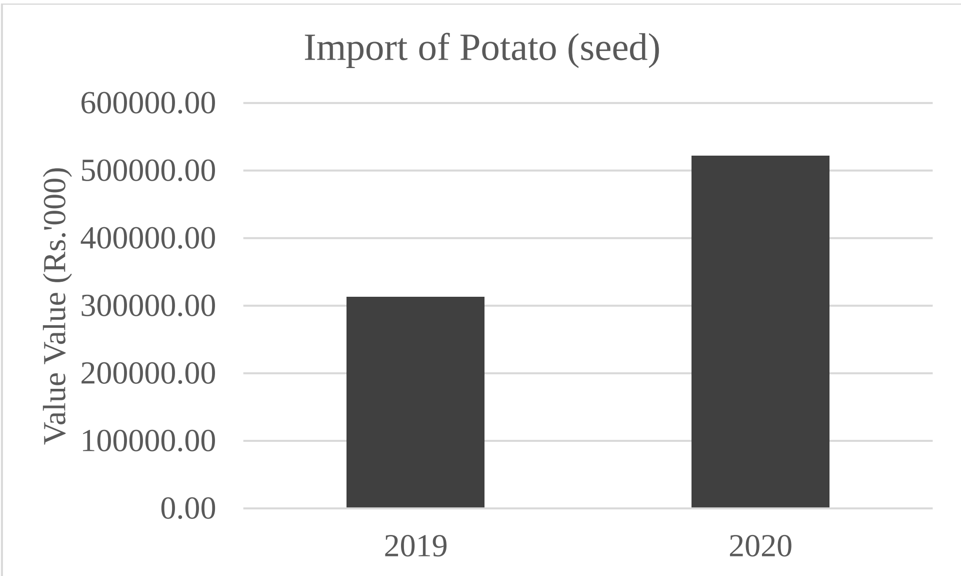


Figure 199: Expenditure on seed potato imports
Source: AgStat (2021)

Although the demand for potato within the country is high, cost of production of potato is also high. Only seeds account for more than 50% of the total cost of production of potato. If the farmers themselves produce seed potato, majority of the farmers couldn't afford as it is a technical and capital-intensive aspect. None of the private companies is involved in producing quality seed potatoes in Sri Lanka. Instead, importation of seed potatoes is solely handled by private sector. The price of an imported seed box weighing 50kg is around Rs.28,000 to Rs.32,000. Interestingly, the price of a locally-produced quality seed box is around Rs.16,000 at present. As the farmers suffer from high prices of imported seeds, they have been forced to use their own seeds which are of low quality. Farmers are generally unable to maintain the expected quality of the seed due to unavailability of storage facilities. Farmers even used to slice both local and imported seeds unnecessarily to cover the total seed requirement. This increases diseases quite frequently. Also, farmers retain some portion from the first harvest of the imported seed potatoes to use as seeds for the next season. Therefore, the ultimate result could be the reduction of total productivity at the national level, thereby creating an adverse environment for both local potato farmer and consumer communities.

Thus, ASMP takes an initiative to introduce farmer cluster system whereby it intends to produce 1500MT of seed potatoes per year saving around 2 million dollars to the country.

4.7.12 Soursop

Soursop fruit is commercially used as fresh fruit, in beverages (juice, cordial, nectar), dried snack, Jams, jellies, chutney, in dairy products for flavoring, in production of medicine, fertility drugs, insecticides, herbal medicines, etc. Soursop leaves (dried broken leaves as well as powder) are mainly used for herbal drinks in countries like USA. Soursop is known for its health benefits as it contains very high amounts of antioxidants that neutralize harmful compounds called free radicals which can cause damage to body cells. There is research evidence that indicate consumption of it reduces risks of heart disease, cancer and diabetes. The fruit is believed to be effective against bacteria, help reduce inflammations, to stabilize blood sugar levels. In addition to diversity of its uses, soursop finds a steady market due to its specific taste that attracts regular consumer segment. Some of the contained faced by the farmers are lack of quality planting material and technologies, inadequate facilities for value addition and processing and disorganized marketing system and week farmer organizations. Fruits of soursop are available for about 6 months of the year.

The demand for soursop is high across the globe but Sri Lanka is lagging behind due to lack of development/interest. Availability of well-established overseas market is a key strength in soursop cultivation. Soursop is mainly imported by East Asia and European Union. EU markets have 8-33% export growth for the crop. However, USA imports less than EU. Middle East market has the highest demand for soursop with over 33% growth while demand in the East Asian market is shrinking. World market size for soursop, passion fruit and jackfruit is less than 5 billion US$. By 2016 Sri Lankan earning from soursop, passion fruit and jackfruit is less than 25 million US$.

4.8 Rationale for Institutional Development, Outreach and Communication

Development intervention on small farm agri-production essentially involves value chain approaches that influenced by expanding market segments and consumer behaviour & consumption patterns. It is further strengthened by increasing purchasing power of the emerging market segments especially in the Asian region.

The value chain approach considered a great mechanism that networking multiple actors to achieve increased value for each operations strengthening the negotiation/ entrepreneurship capacity of smallholder farmers.

As information becomes more accessible through various dissemination mechanisms/ devices for stakeholders throughout the agriculture value chain, people are gradually moving toward more efficient ways of producing agricultural products, increasing incomes, and capturing more value by linking fragmented markets.

Key benefits include increases in productivity and income for farmers and efficiency improvements in aggregating and transporting products. Although elements of the agriculture platform are emerging in developing countries, the full potential has yet to be realized.

Farming organizations and cooperatives provide farmers with a broad range of information, as well as institutional links to large-scale suppliers and distributors. These organizations give farmers a collective voice and more visibility in the agricultural value chain. Many of these organizations started out by providing information and services through leaflets, radio, and internet sites, but they are increasingly using the ICT platform to provide tailored information to farmers.

These organizations are used to supplement and support existing face-to-face trainings for farmers. Smallholder farms are often disadvantaged compared with larger enterprises because of their inability to leverage economies of scale in procuring inputs, marketing their goods, and sharing machinery and knowledge. Successful agricultural cooperatives and farmer groups have solved this problem by enabling small farmers to pool their resources and improve their bargaining power vis-à-vis (Eg. Japan, India).

It is the key aim of the ASMP to transform disconnected farmers in to commercial agricultural clusters that have inbuilt and sustained capacity to adapt technologies and innovate. Research, development and extension are the traditional elements.

Within international extension practice, four different process approaches have been used:

i. Transfer of technologies,
ii. Adoption of best practices by farmers;
iii. Adaptation of the technologies by farmers and researchers to suit their own needs;
iv. Co-innovation amongst all players in research, development, extension and farming.

Transformational change is more likely to be achieved when co-innovation is the status amongst the agricultural industry – this is the ultimate aim for ATDPs

Discussions with farmers and institutional network in the district level identified that majority of institutions engaged in agricultural development focus on increasing production and productivity by playing a facilitator role to promote private sector agribusinesses to invest and establish partnerships with small farm agriculture households to assure the sustainable market access.

However, the pilot scale partnership established under ASMP/ PPMU noted it has not sustained for long due to insufficient interventions of relevant institutional networks coupled with lack of market orientation and failure to work closely and negotiating price, quality and volumes by farmer-buyers.

Throughout the study it was noted that number of POs were established under ASMP/PPMU pilot interventions to provide more market access and related business skills facilitating the producer –market negotiation for competitive marketing.

The institutional programs especially training and skills development were not continued or regularly implemented up to level where farmers could improve their business skills. The regional trainings were implemented adhoc or insufficient to achieving the required business skills. In some areas there were no exposure given to producers to gain first hand field experience related to select CVC. This was proven as farmers indicated that the traditional way of production and marketing is continued even after the formation of CVC based POs provided with inputs for improved technology adoption with basic class room type training.

In this regard the envisaged project interventions to improve the farm productivity and income levels need to be addressed in a holistic approach where CVC are integrated with business orientation/ capacity enhancement towards the formation of a farmer centered business mentoring for competing with private sector businesses under one platform.

The pilot programs implemented by PPMUs on identified clusters proposed to scale up has initiated action to establish and register the POs under DOA. The clusters were given training on farm business activities and entrepreneurship orientation. The POs were trained to maintain farm records, meeting minutes, financial management, established market access for increased farm income and sustainable way forward.

However, the observations identified there still gaps and challenges faced by the farmers as individually and collectively with regard to production, marketing and administrative aspects.

CHAPTER 5: CLUSTER DEVELOPMENT OUTLINE

5.1 Agricultural development strategy

Rapid discussions and meetings had with personnel of DoA, Department of Agrarian Development, Irrigation Department, and DSDs who are moving with farmers in particular areas and farmers in same area, identified their knowledge about farming and methods they use for farming. As a result of those discussions and sessions significant gaps could be identified. Those gaps could be directly influence to the productivity, quantity as well as the quality of products. This may directly influence to their income and lifestyles. Summary of the gaps identified and suggestions to fulfill those gaps are in table 143.

Table 143: Identified gaps in different Agricultural practices and remedies to narrow gaps

Agriculture practice	Gaps Identified		Remedy to fulfil gaps
Crop selection	No proper methods	Following the neighbour farmers and market prices	Link to the market as a company and get the market opportunities. Increase awareness and capacity building for crop selection
Ploughing depth	Some are aware	No proper implementation/ capital to use. Inadequate use of right types of machinery and equipment	Proper training with correct expertise. Introduce relevant machinery and implements supported with shared services for the farmer companies.
Proper bed preparation	Lack of understanding on the importance of recommended practices	Labour cost is very high, no proper machinery and implement to use.	Proper training with correct expertise. Introduce relevant machinery and implement to farmer companies.
Nursery preparation	Poor awareness on proper nursery techniques and	Some farmers use trays because those are supplied free of charge.	Consider this as a serious issue and implement a good training and demonstration sessions. Find suitable

	following traditional methods.		farmers and implement with supplying relevant assistance.
Soil analysis and plant nutrients	Inadequate knowledge on the importance of soil analysis and plant nutrients requirements.	Lack of access to link with relevant service providers (soil testing facilities).	Train all farmers and teach them how to obtain soil analysis report with fertilizer recommendation. In addition to that well-equipped farmer companies to check at least Soil and water pH and Electrical Conductivity.
Irrigation	Insufficient awareness on efficient irrigation techniques Majority are using flood irrigation.	No idea about the soil aeration. Capital is the main issue to use proper irrigation methods.	Proper training on water requirement, soil aeration, fertilizer leaching etc. and introduce proper irrigation methods with crop water requirements.
Fertigation	Lack of knowledge on the plant nutrients requirement and application frequencies.	High cost and inadequate capital	Proper training and introduction of suitable fertigation methods through irrigation systems.
Crop Physiology (Very Important technical practise). About 40% yield increment can be expected.	More than 90% have not recognized the importance	Inadequate technology transfer and demonstration programmes	Introduce of the technology and practices to induce crop physiological characteristics to increase the yield. Training and awareness and adaptation.
Weed management	Most farmers have idea about the damage from weeds.	All try to use weedicide, Neither manual control due to high cost no mechanical control	Introduce inter cultivators for weeding and earthing up. Introduction of integrated weed management such as poly-mulch, early land

		because not availability.	preparation, micro irrigation. etc
Pest and disease management.	No idea to demarcate insect and natural enemies. No interest on IPM, due to lack of awareness.	Only trust on chemical application.	Introduce IPM methods with proper training. Establishment of demonstration plant for Neem oil extraction at Thirukkovil. Preparation of evidence-based documentary for IPM practices by each crop
Harvesting	Lack of availability of machineries for selected crops.	High cost of manual harvesting and post-harvest operations Pilot programmes introduced pod separation and de-husking machineries on shared service base for peanut	Introduction of suitable and cost-effective machineries for selected crops.
Post harvesting	No any technology is applied for selected crops Technical know-how on crop maturity for harvesting, manual pod separation, de-shelling, sun drying, improper storing, unsuitable packaging materials, etc	Under ASMP pilot projects, certain post-harvest machineries such as pod separators, de-shelling, decorticators, graders, storing, etc for ground nuts	Machinery to be introduced especially for washing, pre-cooling, drying, sorting, coating, cold storage, packaging, etc.
Value addition	Insufficient value addition	Lack of proper market access including industrial interests	Introduction of value addition technologies, machineries, with sustainable market access.

Storing	Not adhered to proper storing practices	Lack of storage facilities Inadequate knowledge on storage practices and techniques	Awareness and required shared facilities should be given to the farmer companies.
Marketing	No proper marketing access.	Marketing is dominated by local collectors and trader networks Under pilot programs, market linkages have been established for jumbo peanut (CW Macky), Passion fruit (Cargill's), Seed Potato (DOA)	Introduce market linkages to PUCs with MOUs and Forward sales agreements. Strengthening the farmer negotiation capacities

Fulfill above gaps (Table 143) proper training module and other technical parts implementation are in Farmer organization development & stakeholder capacity building strategy chapter and physical infrastructure development strategy respectively.

5.2 Kilinochchi District

5.2.1 Selected Clusters

As per the direction given by PMU, conducted several stakeholders' sessions as mentioned in chapter 2.4, different 4 clusters selected with maximum of 1,200 beneficiaries each in Ampara, Badulla, Kandy Kilinochchi and Vavuniya as given in chapter 4. This is only brief outline and after getting the approval of review committee, 4 Cluster Development Plans will be produced. Actual gaps between technology what is being used and potential will be identified and introduce the necessary recommendations to narrow the gaps. Identify current level of awareness of farmers as well as officers who involve in these project activities and introduce proper training programmes to improve the knowledge of all beneficiaries as well as officers and all these will be mentioned in detailed in CDPs.

Final crop clusters selected as per the feasibility is given in chapter 4.

5.2.2 Value Chain Development Strategy

Participatory approach applied to identify key value chain actors and develop mechanism for the value chain development strategy. Upstream value chain actors were identified through the farmer selection process for the crop clusters. Upstream of each value chain will be established with the recommended crops. Downstream of the value chains will be established through the identified buyers/ exporters/ processors. Two interactive platforms were concluded with promising partners for the selected value chains.

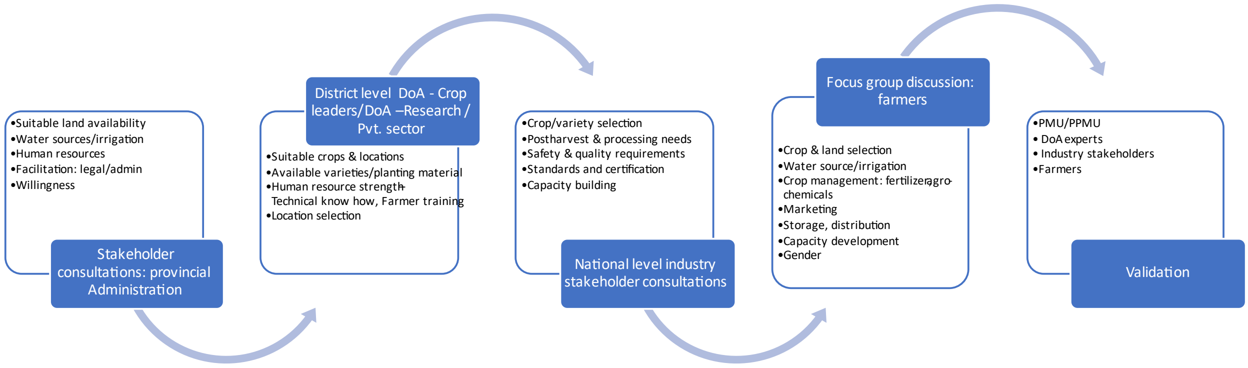


Figure 200: Value chain development process

Table 144: Agri+ Consortium for Kilinochchi

Stakeholder category	Expectations: crop	Remarks
Cargills Ceylon Plc.	Dried red chili of all clusters Passion fruit – Kilinochchi processing center	Cargills is willing to discuss about the Quality requirements - SLGAP, postharvest handling, packaging and transport arrangements with the cluster management Price decision based on their formula but negotiable Awareness training will be able to be arranged upon request
C.W. Mackey PLC	Jumbo peanut: 90 Mt/Yr required	Interventions needed on Technology transfer, reach expected yield levels, deshelling, storage, seed quality, etc. Poor quantity supply & quality of the nuts is main issue

MAA	Pomegranate	Willing to join the proposed consortia and sign MOU Willing to facilitate to obtain the Fair-Trade certificate for farmers Willing to provide freezer trucks for transporting semi processed fruits (frozen pulp) Farmers have to work with forward contract agreements with them

5.2.3 Improving Cluster Sustainability

Enhancing cluster sustainability by meeting triple bottom lines (3 Ps – People, Profit & Planet) is a key component in selection of technologies and manufacturing process.

Sustainability Concern	Proposed Initiative/s
People	1 Providing improved workstation – ergonomics improvements, following ISO 45001 standards – All processing centres 2 Employee training and awareness on machinery operations and routine maintenance – All processing centre and farm machineries. 3 Providing sanitary facilities – All processing centres. 4 Introducing process automation for labour intensive and repetitive works – colour sorting for removing white spots chili pods, depodding and deshelling machinery for jumbo peanut.
Profit	1. Farm mechanization – all cultivations (land preparation, seeding, weed management, micro irrigation facilities, and harvesting). 2. Generation of solar electricity and sell to the national grid – Processing centres and pump houses. 3. Productivity improvements – Introduction of higher capacity chili dryers. 4. Introducing of solar mobile units for off grid solar pumping in adjoining farmlands.

	5. Achieving competitive price edge by improving product quality by following GAP certification and correct manufacturing processes – Improving germination of Jumbo peanuts, reducing post-harvest loss of Passion fruit and Pomegranate, improving market accessibility/ expansion by enhancing product shelf life. 6. Product diversification. Eg: Passion pulp 7. Selling jumbo peanut shells as a biomass for thermal applications after densifying (making briquettes) Selling price of briquettes – Rs. 36/kg Selling price of peanut shells – Rs. 12 – 14/kg Detail of interested buyer – Mr. Prakash, Samprox International (Pvt) Ltd – 077 3322111 8. Digitizing farming, processing and marketing and integrate same to a common web base platform – facilitate for online monitoring, evaluations and to use as a marketing tool – use for all clusters.
Planet	1. Harnessing solar thermal energy by introducing solar tunnel dryers – Intermediate drying for chili processing. 2. Reducing the chemical usage for managing weeds by introducing bio mulch – Fruit clusters in Kilinochchi district. 3. Compost making. 4. Rainwater harvesting

5.3 Vavuniya District

5.3.1 Selected Clusters

Identify current level of awareness of farmers as well as officers who involve in these project activities and introduce proper training program to improve the knowledge of all beneficiaries as well as officers and all these will be mentioned in detail in CDPs. Final selected crop clusters for Vavuniya district are given in chapter 4.

5.3.2 Value Chain Development Strategy

Value chain development strategy for Vavuniya district based on participatory stakeholder consultations, establishment of Agri+ exporter/buyer consortium and PUC led value addition. Table 145 describe the planned Agri+ consortium for the Vavuniya district.

Table 145: Agri+ Consortium for Vavuniya

Stakeholder category	Expectations: crop	Remarks
Cargills Ceylon Plc.	Dried red chili of all clusters Fresh mango -TJC	Quality requirements, postharvest handling, packaging and transport arrangements are willing to discuss with the cluster management Price decision based on their formula but negotiable Awareness training will be able to arrange upon request
C.W. Mackey PLC	Jumbo peanut: 90 Mt/Yr required	
CBL (Ceylon Biscuits)	Papaya - fresh, Mango - fresh Chili – dried and organic	Willing to join the proposed consortia and sign MOU Willing to facilitate for Organic certification Regular, agreed supply is essential Willing to facilitate the farmer training, infrastructure development

5.3.3 Improving Cluster Sustainability

Sustainability Concern	Proposed Initiative/s
People	1. Providing improved workstation – ergonomics improvements, following ISO 45001 standards. – All processing centres

	2. Employee training and awareness on machinery operations and routine maintenance. – All processing centre and farm machineries. 3. Providing sanitary facilities – All processing centres. 4. Introducing process automation for labour intensive and repetitive works – colour sorting for removing white spots chili pods.
Profit	1. Farm mechanization – all cultivations (land preparation, seeding, weed management, micro irrigation facilities, and harvesting). 2. Generation of solar electricity and sell to the national grid – Processing centres and pump houses. 3. Introducing of solar mobile units for off grid solar pumping in adjoining farmlands. 4. Productivity improvements – Introduction of higher capacity chili dryers. 5. Achieving competitive price edge by improving product quality by following GAP certification and correct manufacturing processes. – Reducing post-harvest loss of Papaya and Mango, improving market accessibility/expansion by enhancing product shelf life. 6. Digitizing farming, processing and marketing and integrate same to a common web base platform – facilitate for online monitoring, evaluations and to use as a marketing tool – use for all clusters.
Planet	1. Harnessing solar thermal energy by introducing solar tunnel dryers – Intermediate drying for chili processing. 2. Reducing the chemical usage for managing weeds by introducing bio mulch – Fruit clusters in Vavuniya district. 3. Compost making. 4. Rainwater harvesting.

5.4 Kandy District

5.4.1 Selected Clusters

Identify current level of awareness of farmers as well as officers who involve in these project activities and introduce proper training program to improve the knowledge of all beneficiaries as well as officers and all these will be mentioned in detail in CDPs. Final crop clusters selected for Kandy is given in chapter 4.

5.4.2 Value Chain Development Strategy

Value chain development strategy for Kandy district based on participatory stakeholder consultations, establishment of Agri+ exporter/ buyer consortium and PUC led value addition. Table 146 describe the planned Agri+ consortium for the Kandy district.

Table 146: Agri+ Consortium for Kandy

MAA	Jackfruit	Willing to join the proposed consortia and sign MOU Willing to facilitate to obtain the Fair-Trade certificate for farmers Willing to provide freezer trucks for transporting semi processed fruits (frozen pulp) Farmers have to work with forward contract agreements with them
Fruits and vegetable exporters association	Avocado: Hass variety Jack fruit Ambon Banana	Cassava has a good demand but the markets prices vary
CAP Green	Ripe Jack fruit – frozen pulp – 1000 kg Casava – fresh yam – 1000 Kg/week	Quality requirements, postharvest handling, packaging and transport arrangements are willing to discuss with the cluster management Cluster organic certification Awareness training on crop management, pruning, artificial pollination, pest and disease management, etc are essential

		components and company willing to arrange from their side
Lassana flora	Hass Avocado – Fresh fruits	Fresh fruits for exports Willing to facilitate to obtain standards/certificates

5.4.3 Sustainability Concerns and Strategies

Sustainability Concern	Proposed Initiative/s
People	1. Providing improved workstation – ergonomics improvements, following ISO 45001 standards – All processing centres 2. Employee training and awareness on machinery operations and routine maintenance – All processing centre and farm machineries. 3. Providing sanitary facilities – All processing centres. 4. Introducing process automation for labour intensive and repetitive works – colour sorting for removing white spots chili pods.
Profit	1. Farm mechanization – all cultivations (land preparation, seeding, weed management, micro irrigation facilities, and harvesting) - Introducing mechanized cassava harvesting. 2. Generation of solar electricity and sell to the national grid – Processing centres and pump houses. 3. Productivity improvements – Introduction of higher capacity chili dryers. 4. Looking for product diversification – Different Cassava based products. 5. Achieving competitive price edge by improving product quality by following GAP certification and correct manufacturing processes. –Reducing post-harvest loss of Hass avocado, Banana and Cassava, improving market accessibility/expansion by enhancing product shelf life. 6. Digitizing farming, processing and marketing and integrate same to a common web base platform. – facilitate for online monitoring, evaluations and to use as a marketing tool. – use for all clusters. 7. Waste management – waste to product Banana stem can be used to extract banana fibre, liquid fertilizer and compost.

Planet	1. Harnessing solar thermal energy by introducing solar tunnel dryers – Intermediate drying for chili processing. 2. Reducing the chemical usage for managing weeds by introducing bio mulch – Fruit clusters in Kandy district. 3. Compost making.

5.5 Badulla District

5.5.1 Selected Clusters

Identify current level of awareness of farmers as well as officers who involve in these project activities and introduce proper training program to improve the knowledge of all beneficiaries as well as officers and all these will be mentioned in detail in CDPs. Final crop clusters selected for Badulla is given in chapter 4.

5.5.2 Value Chain Development Strategy

Value chain development strategy for Badulla district based on participatory stakeholder consultations, establishment of Agri+ exporter/ buyer consortium and PUC led value addition. Table 147 describe the planned Agri+ consortium for the Badulla district.

Table 147: Planned Agri+ Consortium for Badulla

Stakeholder category	**Expectations: crop**	**Remarks**
Cargills Ceylon Plc.	Dried red chili of all clusters Carrot & leeks	Cargills is willing to discuss about the Quality requirements, postharvest handling, packaging and transport arrangements with the cluster management Price decision based on their formula but negotiable Awareness training will be able to be arranged upon request
Lassana flora	Hass Avocado – Fresh fruits	Fresh fruits for exports Willing to facilitate to obtain standards/ certificates

5.5.3 Sustainability Concerns and Strategies

Sustainability Concern	Proposed Initiative/s
People	1. Providing improved workstation – ergonomics improvements, following ISO 45001 standards. All processing centres 2. Employee training and awareness on machinery operations and routine maintenance. All processing centre and farm machineries. 3. Providing sanitary facilities. All processing centres. 4. Introducing process automation for labour intensive and repetitive works – colour sorting for removing white spots chili pods.
Profit	1. Farm mechanization – all cultivations (land preparation, seeding, weed management, micro irrigation facilities, and harvesting) - Introducing mechanized cassava harvesting. 2. Generation of solar electricity and sell to the national grid – Processing centres and pump houses. 3. Productivity improvements – Introduction of higher capacity chili dryers. 4. Looking for product diversification – Different Cassava based products. 5. Achieving competitive price edge by improving product quality by following GAP certification and correct manufacturing processes. Reducing post-harvest loss of Hass avocado, Seed potato, improving market accessibility/ expansion by enhancing product shelf life. 6. Digitizing farming, processing and marketing and integrate same to a common web base platform – facilitate for online monitoring, evaluations and to use as a marketing tool – use for all clusters.
Planet	1. Harnessing solar thermal energy by introducing solar tunnel dryers – Intermediate drying for chili processing 2. Reducing the chemical usage for managing weeds by introducing bio mulch – Fruit clusters in Badulla district 3. Compost making

5.6 Ampara District

5.6.1 Selected Clusters

Identify current level of awareness of farmers as well as officers who involve in these project activities and introduce proper training program to improve the knowledge of all beneficiaries as well as officers and all these will be mentioned in detail in CDPs. Final crop clusters selected for Ampara district is given in chapter 4.

5.6.2 Value Chain Development Strategy

Value chain development strategy for Ampara district based on participatory stakeholder consultations, establishment of Agri+ exporter/ buyer consortium and PUC led value addition. Table 148 describe the planned Agri+ consortium for the Ampara district.

Table 148: Planned Agri+ Consortium for Ampara

Stakeholder category	Expectations: crop	Remarks
Cargills Ceylon Plc.	Dried red chili of all clusters	Cargills is willing to discuss about the Quality requirements - SLGAP, postharvest handling, packaging and transport arrangements with the cluster management Price decision based on their formula but negotiable Awareness training will be able to be arranged upon request
CAP Green	Soursop – fresh fruit - 1000Kg/week Soursop – dehydrated leaves	Quality requirements, postharvest handling, packaging and transport arrangements are willing to discuss with the cluster management Cluster organic certification Awareness training on crop management, pruning, artificial pollination, pest and disease management, etc are essential components and company willing to arrange from their side
C.W. Mackey PLC	Jumbo peanut: 90 Mt/Yr required	Interventions needed on Technology transfer, reach expected yield levels, deshelling, storage, seed quality, etc. Poor quantity supply & quality of the nuts is main issue

5.6.3 Sustainability Concerns and Strategies

Sustainability Concern	Proposed Initiative/s
People	1. Providing improved workstation – ergonomics improvements, following ISO 45001 standards – All processing centres 2. Employee training and awareness on machinery operations and routine maintenance – All processing centre and farm machineries. 3. Providing sanitary facilities – All processing centres. 4. Introducing process automation for labour intensive and repetitive works – colour sorting for removing white spots chili pods, depodding and deshelling machinery for jumbo peanut.
Profit	1. Farm mechanization – all cultivations (land preparation, seeding, weed management, micro irrigation facilities, and harvesting). 2. Generation of solar electricity and sell to the national grid – Processing centres and pump houses. 3. Productivity improvements – Introduction of higher capacity chili dryers. 4. Introducing of solar mobile units for off grid solar pumping in adjoining farmlands. 5. Achieving competitive price edge by improving product quality by following GAP certification and correct manufacturing processes. – Improving germination of Jumbo peanuts, reducing post-harvest loss of Soursop, improving market accessibility/expansion by enhancing product shelf life. 6. Market expansion by making passion pulp. 7. Dehydrating Soursop leaves and sell for its medicine value. 8. Selling jumbo peanut shells as a biomass for thermal applications after densifying (making briquettes) Selling price of briquettes – Rs. 36/kg Selling price of peanut shells – Rs. 12 – 14/kg Detail of interested buyer – Mr. Prakash, Samprox International (Pvt) Ltd – 077 3322111 9. Digitizing farming, processing and marketing and integrate same to a common web base platform. – facilitate for online monitoring, evaluations and to use as a marketing tool. – use in all clusters.
Planet	1. Harnessing solar thermal energy by introducing solar tunnel dryers – Intermediate drying for chili processing.

	2. Reducing the chemical usage for managing weeds by introducing bio mulch – Fruit cluster in Ampara district. 3. Compost making

5.7 Physical Infrastructure development strategy for EU Districts

Infrastructure Development	Strategy
Access roads	- Encourage selecting farmers from the vicinity area avoiding farmers being scattered. Thus, the required access road rehabilitation is less. - Processing hubs are going to be located in areas where road access is available. - Minor rehabilitations are going to be undertake base on its absolute necessity and impact to the cluster. - Gravel roads with well drainages are encouraged.
Irrigation facilities	- Encourage the use of common water sources. - Electric pumps instead of engine driven pumps are to be encouraged where applicable. - Water conservation is going to be highlighted – micro irrigation methods. - Facilitate on rainwater harvesting where required and applicable. - More focus on avoiding water clogging at the time of land preparation, levelling, making furrows and raised beds, etc. - Active partnership of regional irrigational officers to the project is welcome. It will optimise the use of existing irrigation facilities. irrigation schemes, open channels, etc.
Improving grid connectivity – Connecting to the national grid	Farmer companies can have an extra income by connecting off grid solar powered irrigation systems with national grid and selling surplus of electricity generated under “net metering” or “net plus” schemes.
Processing hubs and storing facilities	- Considering the current economic context of the country, rehabilitation of abounded government buildings to be used as processing centres is encouraged. - Hiring commercial warehouses is an option. - Converting discarded containers for cold rooms.

	- Agreements with buyers on providing freezer trucks for temporary storing and transport. The operational cost will be borne by the farmer company. - Based manufacturing process and ability to use common machineries, it is proposed to have common processing hubs rather than having processing hubs for individual clusters. - Training individual farmers on harvest at correct maturity level in order to have an extended shelf life. The practice reduces the dependency on cold stores facilities mainly for fresh fruits.

5.8 Farmer Organization Development and Stakeholder Capacity Building Strategy

The farmer organizational development and capacity building strategies will focus to establishment of farmer companies and empowering them to operate and sustain by interacting with highly competitive agri-businesses in local and global consumer markets.

5.8.1 Farmer Organization Development Strategies

The FO/FC development process will initiate by undertaking a rapid assessment of existing institutional models and their operational environment such as geographical, commercial and policy to determine the way forward. The assessment will be carried through the inception process of the project feasibility, CDP development where training and capacity development requirements will be lined up.

The organizational capacity will be enhanced to build confidence through training, established mechanisms for operating, systems, preparation of business plans, legally register as farmer companies and promoting business partnerships for sustainable agribusiness venture.

The farmer mobilization is initiated through the awareness and group discussions facilitated by district coordinators/cluster coordinators in liaison with PPMU in respective districts. The DOA, DAD, MASL or Irrigation department will be consulted and interacted to assure the proper identification and enrollment of farmers willing to participate in the formation of farmer companies under respective CVC based CDPs.

During the initial meeting it is expected to identify farmer leaders who are willing to participate in the program and having overall acceptance by other farmers' as well informed/trusted personality within the select cluster area.

Considering the established farmer selection criteria and coordination with PPMU, the selection of farmers will start with enrolling willing members through awareness sessions at field level. The cluster coordinators and district coordinators in cooperation with relevant PPMUs/ DOAs/ MASL/ IDs will involve in the farmer identification/ selection program for respective CVCs.

In this regard selection of best of farmers those who are energetic, intelligent, knowledgeable, and devoted farmers willing to undertake and implement the program to be carefully identified screened and listed in coordination with relevant institutional networks.

The list of farmers mobilized and identified will be documented and further coordinated with DOA extension officers/ DAD officials/ MASL or Irrigation Department for its credibility and reliability to assure the establishment of sustainable FC.

The Farmers mobilized and each screened lists under each CDP will be encouraged and made essential to attend all training events, exposure visits implemented as a part of capacity building activity for FO and members.

The farmers once formed to a group will be facilitated to hold group meeting and explore the existing status of organizational activities, conflicts, financial aspects, rights/obligations. The group discussions will further address the operating principles, development of constitution and induce the group to start thinking on independent operation.

According to ASMP EU district program it was noted to accommodate 300farmers per CDP as target. In this regard initially a work plan to be developed for existing pilot scale cluster programs implemented by PPMUs and proposed new cluster programs identified for the EU-districts.

According to the ASMP –EU requirements, the number of CDPs proposed was 4 per district and total will be 20 CDPs for identified CVCs for all districts.

Farmers for the awareness/ training events will be invited through assigned cluster coordinators in each district and particular district coordinator, who will intervene with relevant district officials from DOA, DAD, ID, MASL and respective GND.

The awareness training will be conducted in groups of 50 farmers each where two programs to be scheduled for each training. The 300 farmers (per cluster) to be covered in 3days for introducing the institutional development program through participatory approach. During the initial capacity building programs, the Farm Business School training will be implemented for improving the farmer capacity on entrepreneurship skills.

The awareness program will present and explain the project activities related to formation of Farmer Company, discuss the need for such companies (farmer interaction/discussion), collect farmer details/ mobile numbers, creating WhatsApp group (as an initiation to ICT platforms), Select CVC & institutional relevance, selection of farmers, and farmers' leaders (6 per cluster).

The list of members and capacity building activities program related to FC formations will be discussed and shared with PPMU and PMU as appropriate.

The PO development will include initial group formation under select CVC those already registered or proposed to register under DOA, MASL as appropriate. This will provide the foundation for initiate group activities and expose to steps of formation of farmer companies through active participation of farmers. At this stage the farmers will be trained and demonstrate to prepare plan for input supply, access to capital, cultivation program, training requirement, business linkages and services.

The number of POs formed under each CDP will federated to achieve greater focus to sustainable market access that undertake business planning, business operation, increased capacity for business negotiation, training, value addition, consolidation and marketing.

As sustainable strategy the FCs will be promoted to establish synergies with sector associations, chambers, and other business associations that operate as national body involved in CVC/ sector strategies, R&D and creating power for government lobbying on behalf of its members.

5.8.2 Stakeholder Capacity Building Strategy

The discussions with farmers and representatives identified that they have continued to perform with monthly meetings and annual meetings as per the constitution guidelines to satisfy the authorities under which they are registered.

However, lack of proper planning and value chain development program interventions the member participation was limited. There are FOs with shared service facilities such as collecting centers, semi processing facilities, etc, where it requires support for improve managerial and operational capacities with procedural systems to ensure sustainability and transparency.

The POs established under PPMU pilot programs have undergone training on farm business and entrepreneurship aspects. However, the discussions revealed that continued training on further capacity enhancement for the POs to self-manage the business operation is observed important.

The financial management/ knowledge observed low. The networking with formal financing institutions appeared to be minimum and the members' credit requirements are individually dealt with PFIs, as required. The organizational interventions are constrained due to lack of proper financial literacy.

Poor market access at the farm gate has caused income loss to the farmer. The reports highlight that post-harvest loss as the important issue for the farm producers where computed loss up to consumer will reach to 40%. This loss could be an accumulated effect of the farmers selling individually to trader network where each lot will incur damage during transport/ handling several sales/ changing points.

It was noted that at the FO level scarcity of shared facilities especially collection/ grading/ sorting and established procedures for collective use of such facilities have influenced the farmers to operate individually.

The farmers participated at the discussions highlighted they are willing to participate and operate as a group but due to inadequate guidance, and support through institutional systems they are forced to continue as individuals.

There are instances where over supply of produce due to insufficient market knowledge where most of farmers/FOs are poor planners where assumption related crop cultivation pattern sticks to previous seasons prices which become failure due to oversupply of produce.

At producer level there is no mechanism to add value to the produce harvested and individually farmers are unable to afford the cost of machinery and equipment for the purpose. Further the non-availability of storage facilities has made the situation worse.

In view of the above it is recognized the importance of improving the FO capacity through enhanced knowledge building, skills development through established business plan, collective approach for post-harvest and market operations, introduced with transparent and sustainable financial procedures considered necessary areas to be addressed in formation of Farmer companies.

5.9 Strategy for Communication and Outreach

The ASMP–EU program interventions expected to design, establish, operate and transfer, innovative technology package through Agriculture technology Demonstration Parks (ATDP) to support the Farmer companies mentored and established for select CVC in five district areas.

In this regard it is clear that the beneficiaries should be made to understand the objectives of the program, implementation, benefits of new technology, expected support/ contribution from beneficiaries, which essentially require an attention for communication and outreach component.

The strategy for Communication and outreach would include identification of training needs, preparation of contents and carryout the awareness and training activities. The filed discussions identified that status related to institutional systems are almost similar and the challenges and needs are not varied where FOs are the main organized system available for farmers. However, in some areas the FOs are comes under purview of MASL and Irrigation Department where majority of FOs are registered under Agrarian Development department where it was highlighted the connectivity and development intervention not effectively facilitated.

Further the PPMU in the select district intervened to promote and establish POs for select CVC and the study identified 07 such POs as pilot programs in ASMP/EU districts. However, the expected results were yet to evaluate. The discussions with such POs and member farmers found that the operational mechanisms were not shown any major improvements in terms of PO operations, member services, business activities or market related functions. It was observed the expected matureness was not achieved due to inadequate business skills.

The factors considered for situation assessment of clusters include;

Geographical distribution and location of FOs and CVC.

Awareness and existing institutional networks, access to ICT base resources, support services, Extension and advisory support from institutional network

Membership, farmer distribution, maturity level, functionality of FOs.

Level of knowledge and experience, CVC opportunities and challenges, market access/relationship with agribusinesses.

Capability of farmer leaders, members in the FOs.

The communication outreach and training identify the sequence of activities noted below:

Awareness sessions –mobilizing farmers

Registration of farmers

Situation analysis

Identify training needs

Develop training plan/schedule, development of training materials, etc,

Integrate program activities with existing extension and advisory team.

Table 149: Framework for training activity

Description	Numbers
No.of farmers to be trained	6000
District	05
Farmers/district	1200
Clusters/district	04
Farmers/cluster	300
Farmer leaders/cluster	5
Farmers/leader	60
Cluster Coordinator per district	4
District Coordinator per district	01

CHAPTER 6: ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACTS AND IMPACT MANAGEMENT FRAMEWORK

6.1 Preliminary assessment of environmental and social impacts of ASMP

With the preliminary assessment of all types of impacts triggered by ASMP could be generalized under (i) typical generic cultivation related impacts, (ii) typical generic construction impacts which can be mitigated with good cultivation and engineering practices, (iii) impacts which will be arising due to operational activities which can be mitigated by implementing proper measures and (iv) specific impacts that can arise due to engineering interventions proposed for some activities and hence require careful planning.

In general, following are the lists of broad positive and negative impacts that are very likely to arise from the activities funded by ASMP.

Overall positive impacts of the project

- Introduce new technologies to increase the yield of proposed crops
- Improve and increase local agricultural products (volumes and quality)
- Productive Land preparation methods (modern and best land preparation techniques)
- Import substitution and saving of forex
- Conservation and Management of Water resources and water accessibility will be improved
- Improve disease control efficiency and introduction of new disease control techniques
- Reduce use of weedicides and pesticides and use Integrated Pest Management methods
- Enhancement of productivity and Quality of production
- Reduce postharvest losses and introduction of sustainability measures for post-harvest operations
- Increases sustainable farm income and reduce poverty level
- Create new employment opportunities
- Identify international market opportunities
- Benefits of development of FPOs. Training, awareness and capacity building of Farmers'
- Improve Business professionalism
- Increase the Legal compliance
- Sustainable farm income will be increased

- Training and awareness will strengthen skills, talents, and knowledge to undertake and manage all activities of commercial organization
- Community empowerment and reduce marginalization special cases like in Nedunkerni Papaya Cluster
- Gender equality

6.2 Negative Impacts with Severity by each district

In terms of implementing the proposed crop clusters in Kilinochchi, Vavuniya, Ampara, Kandy and Badulla districts, following potential environmental and social impacts with its severity given would be arise. For a better implementation of the cluster, following impacts should be avoided or mitigated.

Table 150: Impact Matrix with Severity by each Crop in Kilinochchi

#	Potential Negative Impact	Impact Severity (High, Moderate and Low)				Remarks
		Jumbo Peanut	Chilli	Passion Fruit	Pomegranate	
1	Reduction of Water Resources (impact on water table) and increase vulnerability towards Climate change including issues related water rights	Moderate	Moderate	Moderate	High	Kilinochchi existing water levels are very low. Climate change vulnerability of Kilinochchi is higher. Practice of conventional farming will increase stress level of water table. However, crop water requirement is not considered here. Jumbo peanut and Chilli clusters in Karachchi are proposed under Lift irrigation where PID consent should be obtained. Pomegranate in Palai will have severe water scarcity.
2	Lack of knowledge on basic harvest and postharvest practices lead	High	High	Moderate	Moderate	Harvesting and Post-harvesting losses are very high due to primitive practices. This will have an impact on the volume of

	to low quality of product and high amount of waste					the yield and the quality of production. Existing Jumbo peanut cluster shows poor post-harvest practices and Pomegranate is a new crop cluster.
3	Removal of trees	Low	Low	Low	Low	Potential tree removals will be very low. Maximum of efforts will be taken to avoid tree removals
4	Exposing and damaging of physical cultural resources (PCR)	Low	Low	Low	Low	Already identified monuments are recorded and can be recognized. But there will be many unidentified monuments specially areas which will be considered during CDP stage
5	Spreading of Invasive Alien Species	Moderate	Moderate	Low	Moderate	Land clearing, disposal of overburden, introduction of new species, etc may lead to increase in spreading. Spreading of *parthenium hysterophorus* in Northern area is very high
6	Contamination of water, land and air during usage of chemicals (pesticides, weedicides.)	Moderate	Moderate	Moderate	Moderate	Automated fertigation and watering system will reduce the magnitude of this. Further, implementation of IPM will drastically reduce the amount of chemicals

7	Blocking of surface drainage paths leading to localised flooding and ponding of water	High	Moderate	Moderate	Low	There are considerable low land areas in Northern province where those are very susceptible to temporary inundation. Jumbo peanut will be very susceptible for localize flooding. Sandiness of the soil and heat in Palai, pomegranate will have low impact
8	Solid Waste Disposal, degradable, non-degradable, chemical, etc including operational stage	Low	Moderate	Low	Low	Solid waste generation due to operational activities will be a key factor which may lead to consider EPLs
9	Spread of crop related diseases among other flora species	Low	Moderate	Moderate	Low	Wind directions and speed in Palai area may have higher possibility of spreading crop diseased than other area as ground cover is high
10	Health hazard such as CoVID-19, Snake Bites, exposure to chemical, etc	Low	Low	Low	Low	Snake bites and exposure to chemicals will be critical and due to poor awareness of the people health hazards can be aggravated.
11	Impacts on ecosystems and bio-diversity (fauna and flora)	Moderate	Moderate	Moderate	Low	Kilinochchi district is predominantly very high forest areas.

12	Greenhouse gas emission which results climate change including cultivation activities and operational activities of processing centres	Moderate	Moderate	Moderate	Moderate	Use of diesel and fossil fuels for operations will have greater impact on Climate change. Measures such as stack-heigh changes, different fuel types with low carbon emission, sustainable energy sources, etc can be explore
13	Exclusion of vulnerable groups in the beneficiary selection	Low	Low	Low	Low	Biasness and poor transparency by the FOs during selection of Farmers will lead to this. Dominance of existing FOs executive committees and Officials may lead to biasness and which will have an impact social cohesion. Existing FOs in Badulla observed to be having such conflicts among members.
14	Receive double benefits which leads miss opportunities to needy groups	Low	Low	Low	Low	Single family receiving double benefits from the project should be avoided with proper farmer selection
15	Livelihood impacts during engagement in cultivation activities	Low	Low	Low	Low	Opportunity cost and loss of productive time due to engagement in ASMP activities will be a matter if the return is low

16	Labour influx for proposed infrastructure improvement activities	Moderate	Moderate	Moderate	Moderate	Influx of labour for infrastructure development such as possessing centres, rural roads, etc need to be managed to avoid community issues. Further, use of local labour should be given priority to gain maximum benefit to the community
17	Reduction in social cohesion due to biasness within the project	Moderate	Moderate	Moderate	Moderate	Farmer selection, land selection, distribution of benefit packages, etc are highly sensitive which can create imbalances of harmony in the community

Table 151: Impact Matrix with Severity by each Crop in Vavuniya

#	Potential Negative Impact	Impact Severity (High, Moderate and Low)				Remarks
		Maize Seed	Chilli	Papaya	Mango - TJC	
1	Reduction of Water Resources (impact on water table) and increase vulnerability towards Climate change including issues related water rights	High	High	High	Moderate	Vavuniya existing water levels are very low. Climate change vulnerability of Vavuniya is higher. Practice of conventional farming will increase stress level of water table. Mango TJC in System L- MASL will be supported with Mahaweli irrigation water and existing agro wells. Crop water requirements are not considered here.
2	Lack of knowledge on basic harvest and postharvest practices lead to low quality of product and high amount of waste	High	High	High	Moderate	Harvesting and Post-harvesting losses are very high due to primitive practices. This will have an impact on the volume of the yield and the quality of production. Papaya in Nedunkerni is a somewhat established group.
3	Exposing and damaging of physical cultural resources (PCR)	Low	Low	Low	Low	Already identified monuments are recorded and can be recognized. But there will be many unidentified

						monuments specially areas such as Vavuniya
4	Spreading of Invasive Alien Species	Moderate	Moderate	Moderate	Moderate	Land clearing, disposal of overburden, introduction of new species, etc may lead to increase in spreading. Abundance of *parthenium hysterophorus,* Ginigrass, Katu Andara, etc is high
5	Contamination of water, land and air during usage of chemicals (pesticides, weedicides.)	Moderate	Moderate	High	High	Automated fertigation and watering system will reduce the magnitude of this.
6	Solid Waste Disposal, degradable, non-degradable, chemical, etc including operational stage	Low	Moderate	Low	Moderate	Solid waste generation due to operational activities will be a key factor which may lead to consider EPLs
7	Health hazard such as CoVID-19, Snake Bites, exposure to chemical, etc	Low	Low	Low	Low	Snake bites and exposure to chemicals will be critical and due to poor awareness of the people health hazards can be aggravated.
8	Damage to wildlife Specially impacts to	Moderate	Moderate	Moderate	Moderate	Vavuniya South, and Vavuniya North are also considerably severe. Chilli, Papaya and Mango-TJC

	elephants roaming in the area					areas have wild elephant threat to certain extent
9	Greenhouse gas emission which results climate change including cultivation activities and operational activities of processing centres	Moderate	Moderate	Moderate	Moderate	Use of diesel and fossil fuels for operations will have greater impact on Climate change. Measures such as stack heigh changes, different fuel types with low carbon emission, sustainable energy sources, etc can be explore
10	Exclusion of vulnerable groups in the beneficiary selection	Moderate	Moderate	Moderate	High	Biasness and poor transparency by the FOs during selection of Farmers will lead to this. Dominance of existing FOs executive committees and Officials may lead to biasness and which will have an impact social cohesion. Papaya farmer group in Nedunkerni has very impressive inclusion of vulnerable group which includes widows, disable farmers, etc
11	Receive double benefits which leads miss	Low	Low	Low	Low	Single family receiving double benefits from the project should be

	opportunities to needy groups					avoided with proper farmer selection
12	Livelihood impacts during engagement in cultivation activities	Low	Low	Low	Low	Opportunity cost and loss of productive time due to engagement in ASMP activities will be a matter if the return is low
13	Labour influx for proposed infrastructure improvement activities	Low	Low	Low	Low	Influx of labour for infrastructure development such as possessing centres, rural roads, etc need to be managed to avoid community issues. Further, use of local labour should be given priority to gain maximum benefit to the community
14	Reduction in social cohesion due to biasness within the project	Low	Low	Low	Moderate	Farmer selection, land selection, distribution of benefit packages, etc are highly sensitive which can create imbalances of harmony in the community

Table 152: Impact Matrix with Severity by each Crop in Kandy

#	Potential Negative Impact	Impact Severity (High, Moderate and Low)					Remarks
		Hass Avocado	Chilli	Cassava	Banana – Ceylon Cavendish	Jack fruit	
1	Soil erosion and siltation	High	High	High	High	High	Soil erosion in Kandy is a critical issue. Slop, topography and intensive agriculture in the area has resulted a severe soil erosion. As a result, many water resources being subjected to siltation. Kandy district is highly susceptible for landslide. Kundasale, Medamahanuwara, Theldeniya, Medadumbara, Ganga Ihala Korale, etc observed to be having high erosive potentials. Abandoned Tea estates used for chilli are having high-rate erosion.
2	Lack of knowledge on basic harvest and postharvest practices lead to low quality of	High	Moderate	High	High	High	Harvesting and Post-harvesting losses are very high due to primitive practices. This will have an impact on the volume of the yield and the quality of production

	product and high amount of waste						
3	Exposing and damaging of physical cultural resources (PCR)	Low	Low	Low	Low	Low	In general, Kandy has a very great history. Therefore, probability of PCR is high
4	Contamination of water, land and air during usage of chemicals (pesticides, weedicides.)	Moderate	Moderate	Moderate	Moderate	Moderate	Automated fertigation and watering system will reduce the magnitude of this.
5	Impaired water quality due to pollutants including silt	Moderate	Moderate	High	High	High	Topography of each district will be a critical factor. As mentioned above, erosive rate in Kandy is higher.
6	Blocking of surface drainage paths leading to localized flooding and ponding of water	Low	High	Low	Low	Low	Proposed locations in Gampola for Chilli cluster observed to paddy/abandoned paddy lands where ponding during rainy reason could be observed
7	Solid Waste Disposal, degradable, non-degradable, chemical,	Low	Moderate	Moderate	Moderate	Moderate	Solid waste generation due to operational activities will be a key factor which may lead to consider EPLs.

	etc including operational stage						Potentials for processing of Hass Avocado under ASMP has lean chances as it requires long term for harvest
8	Health hazard such as CoVID-19, Snake Bites, exposure to chemical, etc	Low	Low	Low	Low	Low	Snake bites and exposure to chemicals will be critical and due to poor awareness of the people health hazards can be aggravated. Presence of Leech is very high.
9	Damages from Wild animals	Low	Low	Moderate	Moderate	Moderate	Wild animals such as Monkey, Macau, Peacock, Porcupine, Wild bow, etc highly destructive in areas like Kundasale, Medamahanuwara, Theldeniya, Medadumbara, etc
10	Greenhouse gas emission which results climate change including cultivation activities and operational activities of processing centres	Moderate	Moderate	Moderate	Moderate	Moderate	Use of diesel and fossil fuels for operations will have greater impact on Climate change. Measures such as stack heigh changes, different fuel types with low carbon emission, sustainable energy sources, etc can be explore
11	Exclusion of vulnerable groups in	Moderate	Moderate	Moderate	Moderate	Moderate	Biasness and poor transparency by the FOs during selection of Farmers will

	the beneficiary selection						lead to this. Dominance of existing FOs executive committees and Officials may lead to biasness and which will have an impact social cohesion.
12	Receive double benefits which leads miss opportunities to needy groups	Low	Low	Low	Low	Low	Single family receiving double benefits from the project should be avoided with proper farmer selection
13	Livelihood impacts during engagement in cultivation activities	Low	Low	Low	Low	Low	Opportunity cost and loss of productive time due to engagement in ASMP activities will be a matter if the return is low
14	Labour influx for proposed infrastructure improvement activities	Low	Low	Low	Low	Low	Influx of labour for infrastructure development such as possessing centres, rural roads, etc need to be managed to avoid community issues. Further, use of local labour should be given priority to gain maximum benefit to the community
15	Reduction in social cohesion due to biasness within the project	Moderate	Moderate	Moderate	Moderate	Moderate	Farmer selection, land selection, distribution of benefit packages, etc are highly sensitive which can create

							imbalances of harmony in the community

Table 153: Impact Matrix with Severity by each Crop in Badulla

#	Potential Negative Impact	Impact Severity (High, Moderate and Low)					Remarks
		Maize Seed	**Chilli**	**Vegetable (Leeks and Carrot)**	**Hass Avocado**	**Seed Potato**	
1	Soil erosion and siltation	High	Low	High	Moderate	High	Soil erosion in Badulla is a critical existing issue due to Agricultural activities. Slop and intensive agriculture in the area has resulted a severe soil erosion. As a result, many water resources being subjected to siltation. Specially, Kandaketiya, Rideemaliyadda and Meegahakiula are having high erosive rate. Chilli cluster area is a flat terrain in general and erosive forces are lower magnitude.
2	Lack of knowledge on basic harvest and postharvest practices	High	Moderate	Low	High	High	Harvesting and Post-harvesting losses are very high due to primitive practices. This will have an impact on

	lead to low quality of product and high amount of waste						the volume of the yield and the quality of production
3	Contamination of water, land and air during usage of chemicals (pesticides, weedicides.)	High	High	High	Moderate	High	Automated fertigation and watering system will reduce the magnitude of this. Use of chemicals in Badulla district is comparatively higher than other districts which indicates the level residues added to the surface water sources.
4	Impaired water quality due to pollutants including silt	High	High	High	High	High	Topography of each district will be a critical factor. As mentioned above, erosive rate in Badulla is higher and already a siltation of waterbodies is problem identified.
5	Solid Waste Disposal, degradable, non-degradable, chemical, etc including operational stage	Low	Moderate	Low	Low	Low	Solid waste generation due to operational activities will be a key factor which may lead to consider EPLs
6	Spread of crop related diseases among other flora species	Moderate	Low	Moderate	Moderate	Moderate	Wind directions and speed in slopy areas specially in Badulla may have

							higher possibility of spreading crop diseased than flat terrain
7	Damage to wildlife Specially impacts to elephants roaming in the area	Moderate	Moderate	Moderate	Low	Low	Maize Seed Cluster is bordered to Victoria-Randenigala-Rantembe Sanctuary and therefore, movement of wild animals in the cluster area is higher. Further, Girandurukotte and Alawathugoda - Getalagamuwa vegetable cluster areas are also closer to Horton Plains National Park (less than 500m) where possibility is higher
8	Impacts on ecosystems and bio-diversity (fauna and flora)	High	High	High	High	High	Highest bio-diversity of Sri Lanka is in Badulla district.
9	Greenhouse gas emission which results climate change including cultivation activities and operational activities of processing centres	Moderate	Moderate	Moderate	Moderate	Moderate	Use of diesel and fossil fuels for operations will have greater impact on Climate change. Measures such as stack heigh changes, different fuel types with low carbon emission, sustainable energy sources, etc can be explore

10	Exclusion of vulnerable groups in the beneficiary selection	Moderate	Moderate	High	Moderate	High	Biasness and poor transparency by the FOs during selection of Farmers will lead to this. Dominance of existing FOs executive committees and Officials may lead to biasness and which will have an impact social cohesion. Seed Potato and Vegetable clusters will have a high possibility for such biasness and will exclude most needed
11	Receive double benefits which leads miss opportunities to needy groups	Low	Low	High	Low	High	Single family receiving double benefits from the project should be avoided with proper farmer selection. Seed Potato and Vegetable clusters will have a high possibility for such biasness in selection of farmers
12	Livelihood impacts during engagement in cultivation activities	Low	Low	Low	Low	Low	Opportunity cost and loss of productive time due to engagement in ASMP activities will be a matter if the return is low
13	Labour influx for proposed	Low	Low	Low	Low	Low	Influx of labour for infrastructure development such as possessing centres, rural roads, etc need to be

	infrastructure improvement activities						managed to avoid community issues. Further, use of local labour should be given priority to gain maximum benefit to the community
14	Reduction in social cohesion due to biasness within the project	Moderate	Moderate	High	Moderate	High	Farmer selection, land selection, distribution of benefit packages, etc are highly sensitive which can create imbalances of harmony in the community. Seed Potato and Vegetable clusters will have a high possibility for such biasness.

Table 154: Impact Matrix with Severity by each Crop in Ampara

#	Potential Negative Impact	Impact Severity (High, Moderate and Low)					Remarks
		Maize Seed	**Chilli**	**Soursop**	**Jumbo Peanut**	**Lime/ Bee honey**	
1	Soil erosion and siltation	Moderate	Low	Moderate	Low	Moderate	Proposed areas for Maize Seed and Soursop are undulating areas where disturbances on topsoil will lead to soil erosion. Jumbo peanut and Chilli areas are flat terrains
2	Reduction of Water Resources (impact on water table) and	Moderate	High	Moderate	High	Moderate	Padiyathalawa, Mahaoya, Uhana and Eggaloya are consist of many surface waterbodies in addition to Agrowells.

	increase vulnerability towards Climate change including issues related water rights						However, Thirukkovil and Komari are mainly based on Agro-wells
3	Lack of knowledge on basic harvest and postharvest practices lead to low quality of product and high amount of waste	High	High	High	High	High	Harvesting and Post-harvesting losses are very high due to primitive practices. This will have an impact on the volume of the yield and the quality of production
4	Contamination of water, land and air during usage of chemicals (pesticides, weedicides.)	Moderate	Moderate	Moderate	Moderate	Moderate	Automated fertigation and watering system will reduce the magnitude of this.
5	Impaired water quality due to pollutants including silt	Moderate	Moderate	Moderate	Low	Moderate	Topography of each district will be a critical factor.
6	Solid Waste Disposal, degradable, non-degradable, chemical,	Low	Moderate	Moderate	Low	Moderate	Solid waste generation due to operational activities will be a key factor which may lead to consider EPLs

	etc including operational stage						
7	Health hazard such as CoVID-19, Snake Bites, exposure to chemical, etc	Low	Low	Low	Low	Low	Snake bites and exposure to chemicals will be critical and due to poor awareness of the people health hazards can be aggravated.
8	Damage to wildlife including elephants	Moderate	Moderate	Moderate	Moderate	Moderate	Almost all the areas are having the same significance of wild animal issues. Many places elephant fencing is available. However, bio-fencing type additional remedy could reduce the level of impact
9	Greenhouse gas emission which results climate change including cultivation activities and operational activities of processing centres	Moderate	Moderate	Moderate	Moderate	Moderate	Use of diesel and fossil fuels for operations will have greater impact on Climate change. Measures such as stack heigh changes, different fuel types with low carbon emission, sustainable energy sources, etc can be explore
10	Exclusion of vulnerable groups in the beneficiary selection	Moderate	Moderate	Moderate	High	Moderate	Biasness and poor transparency by the FOs during selection of Farmers will lead to this. Dominance of existing FOs executive committees and Officials may lead to

							biasness and which will have an impact social cohesion. Thangawelayuthapuram in Thirukkovil observed to be somewhat low cohesiveness
11	Receive double benefits which leads miss opportunities to needy groups	Low	Low	Low	Low	Low	Single family receiving double benefits from the project should be avoided with proper farmer selection
12	Livelihood impacts during engagement in cultivation activities	Low	Low	Low	Low	Low	Opportunity cost and loss of productive time due to engagement in ASMP activities will be a matter if the return is low
13	Labour influx for proposed infrastructure improvement activities	Moderate	Moderate	Moderate	Low	Moderate	Influx of labour for infrastructure development such as possessing centres, rural roads, etc need to be managed to avoid community issues. Further, use of local labour should be given priority to gain maximum benefit to the community
14	Reduction in social cohesion due to biasness within the project	Moderate	Moderate	Moderate	High	Moderate	Farmer selection, land selection, distribution of benefit packages, etc are highly sensitive which can create imbalances of harmony in the community

6.3 Impacts on physical cultural resources (PCR)

Many districts have rich in cultural heritage and requires particular attention to mitigate any negative impacts on PCRs that can take place either directly or indirectly during project implementation. PCRs such as historic buildings, monuments, temples and monastic complexes. For Kilinochchi, and Kandy, cultural heritage buildings and properties have been inventoried and mapped by both the Department of Archaeology and the Central Environmental Authority and a historic building code is in practice which requires historic buildings to adhere to conservation guidelines when any change is implemented.

6.4 Social Assessment

Screening of subprojects for assessing their potential Involuntary Resettlement impacts will be carried out by the respective implementing agency/regional project offices during the preparation using the Social Screening Format. Based on the screening data on the extent of likely impacts, subproject safeguard requirements will be only B and C category as defined below. The project will not support any A category subprojects.

- Not significant (**Category B**) – If, as a result of the sub-project, fewer than 200 people will be physically displaced from housing or lose less than 10% of their productive (income-generating) assets, Abbreviated Resettlement Plans are prepared commensurate to their impacts;
- No resettlement effect (Category C) – If the subproject does not require temporary or permanent land acquisition, and there are no impacts involving the loss of land, structures, crops and trees, businesses or income, no resettlement plan is required. This category also includes temporary but not significant impacts which will have to be mitigated as a part of construction management in consultation with the Affected Persons by the Contractor.

6.5 Health and Safety (Public and Occupational)

Health and safety of workers and the public should be designed into Cultivation, constructions, and operational activities. It is cheaper and easier to prevent risks to workers as well as the public before starts on site by proper planning, training, site induction, worker consultation and incorporating strict safety procedures in construction plans. The proposed project interventions will mostly involve small to medium scale activities. As such, extreme dangers posed by working in environments such as great heights, deep water and involving dangerous chemicals and radioactive material will not be present. Potential dangers associated with ASMP sites will include exposure to chemical, snake bites, falling from moderate heights, vehicle/ pedestrian accidents, falling into trenches, breathing dust and other air pollutants, back aches caused by handling heavy material, suffering hearing loss from noise etc and can be mitigated with following safety guidelines.

EA for each cluster should mandatorily include a risk assessment as to what are the hazards involved in the work site, who might be harmed and how seriously, how likely this harm might happen and what actions are required to eliminate or reduce the risk and incorporate such measures in the EMP and clearly set out in the tender documents. All sub-projects must observe health and safety regulations, hence during implementation it is important to check if these control measures are put in place and are meeting the legal requirement.

6.6 District Level EHS Feasibility

6.6.1 Kilinochchi District

Topography, Soil types, availability of lands, Agro-ecological zones, terrain, availability of water sources, erosive forces, willingness of farmers, social capitals, etc are potential factors considered in assessing the environmental and social feasibility in Kilinochchi. Accordingly, certain selected areas in Karachchi, Kandawalai and Pachchilaipalai are suitable. However, experience of the farmers, and forest areas in close proximity will hinder the potentials. Avoiding forest areas including buffer zones will enable environmental sustainability. Water resources in the district has severe stress and therefore, water conserving methods should be introduced in terms of using water resources in a sustainable manner. Selection of farmers in these areas should be carefully and transparently carried out to reduce the biasness which will lead to issues in social cohesiveness. Wild animal such as Monkey's in Palai is somewhat severe and proactive measures for such would reduce the crop damages. Proper and transparent selection criterions should be followed from the beginning to achieve social indicators such as female engagement.

6.6.2 Vavuniya District

In Vavuniya district, topography and terrain, soil types, agro-ecological zones, availability of water sources, willingness of farmers, experience in farmers, social capitals, etc are in favour of establishing crop clusters selected for Vavuniya, Vavuniya South, and Vavuniya North. However, Vavuniya district has more than 40% of Forest Cover in total, which needs to be considered during selection of lands and farmers. Water resources in the district has severe stress and therefore, water conserving methods should be introduced in terms of using water resources in a sustainable manner. However, selected areas in MASL system L would have both surface and ground water resources. Selection of farmers in this area should be carefully and transparently carried out to reduce the biasness which will lead to issues in social cohesiveness. In addition, human-elephant conflict and damages to cultivations are higher in

Vavuniya South, Vavuniya North, and some parts of Vavuniya. Hence, precautionary measures should be implemented in advance. Proper and transparent selection criterions should be followed from the beginning to achieve social indicators such as female engagement.

6.6.3 Kandy District

Considering environmental and social factors such as proximity to wildlife conserve areas and forest reserves, land use, soil type, agro-ecological zones, topography and terrain, availability of water, willingness of farmers, availability of lands, social capital, etc establishment of selected crop clusters in Pasbage Korale, Ganga Ihala Korale, Doluwa, Udapalatha, Pathadumbara, Medadumbara and Kundasale would be feasible. However, these potential areas are observed to be having high-rate soil erosion due to its terrain. Many areas selected for Chilli in Ganga Ihala Korale, Pasbage Korale and Udapalatha are having serious soil erosion level as abandoned tea estates have been converting for chilli. Furthermore, some areas in Ganga Ihala Korale have ponding areas where chilli cultivation would not be suitable. All these areas are highly susceptible for landslides. Chilli cultivation in Ganga Ihala Korale would not be feasible. Therefore, implementing serious/ proper erosion control measures from the commencement will reduce the erosive forces and impact due to soil erosion can be reduced up to greater extent. Victoria-Randenigala-Rantembe Sanctuary observed to be bordered to Medadumbara. Therefore, selection of lands and farmers should avoid selecting farmers in the border areas to reduce the edge effects due to Cultivation. In addition, human-elephant conflict and wild animal damages to cultivations are higher. Hence, precautionary measures should be made. Furthermore, selection of farmers in this area should be carefully and transparently carried out to reduce the biasness especially political biasness which will lead to issues in social cohesiveness.

6.6.4 Badulla District

Considering environmental and social factors such as proximity to wildlife conservation areas and forest reserves, land use, soil type, agro-ecological zones, topography and terrain, availability of water, willingness of farmers, availability of lands, social capital, etc establishment of crop clusters in Kandaketiya, Meegahakiwula, Girandurukotte, Rideemaliyadda, Uva Paranagama, and Welimada would be feasible. However, these potential areas are observed to be having high-rate soil erosion as per the literature due to heaving agricultural practices, soil types, and terrain. Therefore, implementing serious/ proper erosion control measures from commencement will reduce the erosive forces and impact due to soil erosion can be reduced up to greater extent. Horton Plains National Park is closer to

Boralanda areas where Seed Potato and Vegetable cluster is proposed while Victoria-Randenigala-Rantembe Sanctuary found to be bordered to Kandaketiya and Rideemaliyadda areas. Therefore, selection of lands and farmers should avoid selecting farmers in the border areas to reduce the edge effects due to Cultivation. In addition, human-elephant conflict and damages to cultivations are higher. Hence, precautionary measures should be made. Furthermore, selection of farmers in these areas should be carefully and transparently carried out to reduce the biasness which will lead to issues in social cohesiveness special attention should be paid on Seed Potato and Vegetables clusters.

6.6.5 Ampara District

Potential areas in Ampara district have favourable soil type, agro-ecological zones, availability of water, topography & terrain, farmers willingness, support from DOA, experience in agriculture. Areas selected in Padiyathalawa, Mahaoya, Uhana, Eggaloya, Thirukkovil and Potuvil are closer to several wildlife and forest areas namely, Maduruoya National Park, Galoya National Park, and Lahugala National Park. Potential impact on surrounding forest areas including NPs should be minimized. Further, proper measures should be taken to protect from elephants and other wild animals. Silt-trapping methods should be applied during land preparation to avoid silt being carried to adjoining streams, canals, rivers specially Padiyathalawa, and Mahaoya. Water conserving methods should be introduced in terms of using water resources in a sustainable manner. Selection of farmers in this area should be carefully and transparently carried out to reduce the biasness which will lead to issues in social cohesiveness.

CHAPTER 7: ESTABLISHMENT OF GEO-DATABASED

Development of a Geo-Database that are to be established in selected Clusters within the five districts namely Kandy, Badulla, Ampara, Kilinochchi and Vavuniya under the ASMP-EU clusters. Started from planning stage, continue with the project implementation and finally to analyses the impact of the project activities comparing status of the locations before and after project interventions. Under this project there are 4 clusters from each district and 300 farm plots in each cluster will select for implementation of project activities.

Following DSDs and cluster areas were selected for cluster development plan with the consultation of PMU staff, EU consultants, relevant stake holders, farmers and using different information such as forest cover, land use, soil, climatic zones, water availability, wildlife areas, topographic and topology information for developed suitability maps for identified different crops for each cluster.

After established crops in the field GIS data collection will be start for each farm lands. Time frame attached for different crops from 5 districts. There are 2 type of field crops namely

New clusters

- Hybrid maize – Ampara, Badulla & Vavuniya
- Hass Avocado – Kandy & Badulla
- Cassava – Kandy
- Local Cavendish (Banana) – Kandy
- Mango (Tom –JC) Vavuniya
- Vegetable –Badulla
- Pomegranate –Kilinochchi
- Chilli – Ampara, Badulla

Scale up Clusters

- Soursop – Ampara
- Jumbo Peanut - Ampara & Kilinochchi
- Chilli – Vavuniya, Kandy, Kilinochchi
- Passion Fruit – Kilinochchi
- Papaya – Vavuniya

Table 155: Primary and Secondary Data collection and GPS survey for main crops

Schedule 2022 - 2023

			2022		2023					
Se no	**Crop**	**District**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**
1	Hybrid Maze	Ampara								
2		Badulla								
3		Vavuniya								
4	Hass Avocado	Kandy								
5		Badulla								
6	Cassava	Kandy								
7	Banana	Kandy								
8	Mango	Vavuniya								
9	Vegetable	Badulla								
10	Pomegranate	Kilinochchi								
11	Chilli	Ampara								
12		Badulla								
13		Vavuniya								
14		Kandy								
15		Kilinochchi								
16	Soursop	Badulla								
17	Jumbo Peanut	Ampara								
18		Kilinochchi								
19	Passion Fruit	Kilinochchi								
20	Papaya	Vavuniya								
21	Seed Potato	Badulla								

Scale up clusters

Drone survey will be carried out after crop establishment

Development of database for farm-level data

Based on the database design farm level data base will be implemented to store and manage Also a set of user-friendly forms will be developed for hassle free data entry and editing purposes.

A team of field officers will be deployed to capture the GPS location of each farm plot and other related data (identified during the planning stage) about farmers, plot details, existing crops, etc. Unique identification numbers will be assigned to these plots as required. Primary data will be collected from District Office and Secondary Collection from field investigation. Data collection formats are given in Annex 7.

Spatial analysis & GIS Product Development

Database will be developed for each farm clusters and finally developed for each crop. After development of 1st phase database (primary and secondary Data) monthly data will be collected for update each far plots such as fertilizer inputs, harvest data and other related data. It is important to clearly identify the spatial analysis, monitoring and reporting requirements of project planners and consultants. Based on these requirements Geo-database designers will be able to identify available data such as base maps, thematic maps & other related data to fulfill the analytical requirements.

Also, to develop new spatial data (i.e. drone imagery based land use maps) to support Agronomy and Agro Business this need identification is essential.

Google Earth Pro is an excellent free desktop application for inquiry-based activities. Therefore, farm locations, with farm attributes, will be exported to Google Earth to increase usage of spatial data. Also, photographs and videos, showing agriculture activities, will be linked to selected farm locations for demonstration purposes.

CHAPTER 8: CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion

8.1.1 Agronomy

After having several rapid discussions with different stakeholders, identified 20 clusters with different crops to be cultivated. Ascertain all gaps between current situation and the potentials, recommendations have been made to narrow those gaps. Awareness and direction of farmers highly depend on the attitude and activeness of officers who closely work with farmers. Some extension officers are real business oriented and his farmers also follow him and going towards success.

As per the all most all small-scale farmers are facing, these farmers also have the same problem of marketing prices for their products and scarcity of capital for investing on modern technology. Initially the projects like ASMP can help farmers for their capital scarcity and later the special loan schemes with low interest rates should be introduced. Formation of farmer companies also very important to find markets with reasonable farm gate prices. In addition to that, value addition approaches can be introduced to these farmer companies. Then they can stop selling their products as raw material.

Observed some draw-backs of the pilot projects conducted by ASMP in all five districts. The overall observation was very poor record keeping. Site and land selection also not good and has not followed proper criteria. Observed that proper agricultural practices have not been followed. Soil analysis process has not been followed for all pilot clusters. Soursop clusters in Ampara and Badulla are going to be abandoned. Proper trainings on pruning and pollination have not been given or not monitored. Worst case could be seen in Chili cluster in Kandy district. Pasbage korale was a one area selected but the area is not suitable for Chili (dry) cultivation at all. That area belongs to WM_{1a} and WU_1 which are having 3,300< mm annual rainfall. Recommended crops for this area are Tea and Natural forests.

8.1.2 Agri-business and Value Chain

Crops and landscapes selection are critical to establish the upstream of the value chain. ASMP EU component aimed to facilitate the crop establishment, introduction of technology, micro irrigation systems, compost making, initiation and establishment of PUCs, establish cluster-based post-harvest processing and marketing centers to strengthen the crop cluster operations. Further, there were pilot clusters established in project districts based on the recommendations of separate feasibility study. Figures on details of pilot clusters appeared in chapter 4 and 5 explain the pilot clusters of each project districts.

Further, lessons learnt shown in Chapter 4 explain the status of each district and issues of pilot clusters. Poor seed quality critically affected the jumbo peanut production in pilot clusters, especially crop yield of 3 seasons affected badly. There were 23 registered jumbo peanut seed farmers, unfortunately the certified seed production process was not monitored and consequences were the poor-quality seeds, poor returns and disappointment of the buyer. Further, seed storage facilities were not established within the cluster and available seed storage facility of DoA located far away from farm lands. Fuel crisis crippled the farmers efforts on seed storage.

Papaya cluster of Vavuniya performing well and farmers manage to secure expected returns. In contrast, new crops for the Vavuniya district will open up new avenues, especially hybrid maize seed production. Vavuniya seed producers' association, along with registered seed producing farmers may receive new opportunity. Horticultural crops recommended for Northern province, will ensure long-term returns to the cluster community.

Kandy and Badulla, heavily utilized agricultural lands of the central highlands will experience new interventions with the project arrival. Soil degradation, erosion, poor land management, and rapidly changing climate badly affected on the progress of pilot clusters; chili, passion fruit, etc. On the other hand, most of the processing facilities established in and around the district would be added advantage.

Ampara, being one of the key agricultural producers to the country, its contribution along with experienced farmers would add flavor to the project.

Issue of macro pests; monkey, wild boar, peacock, giant squirrel, hedgehog, birds were common in all locations. Farmers use own procrastinatory measurers to manage the issue but crop damage is around 25-30%. In general, market orientation is poor among the farmer community.

8.1.3 Institutional Development

The farmer based Institutional systems (production oriented or financial oriented) though promoted the marketing of produce through different buy back arrangements the farmers are yet to achieve the sustainable producer-market access. It has been a perennial problem where individual approach has made advantage for the collector – trader network exploiting small farmers in the regions. It was observed that institutions serving the FOs are lack information on market access where their main mandate is to promote crop production or resource maintenance in the agriculture activities in select areas.

Producer organizations developed under ASMP/ PPMUs in the select district indicated the need for further support to achieve the expected capacities to perform commercial operations competitively with other business entities relevant to select CVCs.

The farmers indicated their dissatisfaction due to poor connectivity with relevant institutional mechanisms where agriculture information/ technology/ problem solving communication is constrained leading to loss of productivity and income.

The FOs and farmers also to be hold responsible for not utilizing the available ICT platforms through their mobile smart phones to obtain required technology and connectivity with relevant institutional systems/expert advisory services.

There is increasing trend was observed where majority of farmers preferred to discuss their on-farm problems and requirements/ solutions of on-farm activities with private sector input suppliers and retail dealers.

The study identifies the need for transform disconnected farmers in to commercially oriented cohesive groups systematically mentored to enhance capacity and skills to adopt technologies and innovative business approaches for sustainable market access and increased farm income.

The existing FOs and POs have limited capacity for managing agribusiness activities due to inadequate expertise/ knowledge/ skills. The FOs/ POs and farmers required to build confidence by providing training on business practices/ entrepreneurship development creating an environment for promoting partnerships for sustainable agribusinesses through established farmer companies.

8.1.4 Technological Development

Farming is not something new for Sri Lankans as they were used for a self-sufficient farming from their ancestry. But farming as a business is something to developed. They have to face supply and demand situation which is either natural or artificial more often than not. Both farmer and the end consumer were hammered with said supply and demand situation.

Farmers are not in a position to decide the price whereas become price takers. Thus, farming as a business is not sustainable at all in the context explained.

Processing and value addition to their harvest will be the way forward. This will provide a room to cater for a defined market in terms of quality and quantity. Farmers can extend their boundaries to meet even foreign market as well. Thus, introduction of processing and storing facilities for the harvest and end products will be the key initiative in the ASMP.

District Wise Technological Feasibility

Criteria	District				
	Kilinochchi	Vavuniya	Kandy	Badulla	Ampara
Availability of 4W Tractors per 1000 acres	11.4	11.1	2.1	3.6	11.4
Availability of 2W Tractors per 1000 acres	2.5	9.8	13.4	37.6	35.0
Availability of Threshers Machines per 1000 acres	1.4	2.9	12.4	8.7	3.0
Availability of Combined Harvesters per1000 acres	0.9	1.5	0.5	1.5	3.6
Availability of Water Pumps per 1000 acres	84.6	109.8	4.8	42.6	6.8
Land Extent (< 40 Perches) Share - %	0.28	0.29	2.76	0.82	0.78
Dependency on Rainfall - (%)	55.0	45.0	52.0	49.0	35.0
Cultivation extent (%) under Agro & Tube Wells	8.0	18.0	3.0	2.0	1.0
Availability of Agricultural Roads vs Total Road Network - %	36.0	70.0	63.0	68.0	45.0
Potential for a common processing Centre (depending on selected crops and value chain assessment) - No. of Centres	4.0	3.0	2.0	4.0	3.0
Suitability - Conclusion based on above criteria	4	1	5	3	2

Figure 201: Graphical Feasibility of Technological development

8.1.5 Financial Assessment

With the objectives of improving agricultural livelihood through enhancing agricultural productivity, market-oriented production targeting especially export market, value chain improvement, improving production and market infrastructure and capacity building. The Agriculture Sector Modernization Project (ASMP) was started in Sri Lanka. It is evident that market oriented and export-oriented crop production systems generate higher to the farmer and foreign exchange to the country. This kind of objective could be achieved through supporting smallholder farmers to produce commercial and marketable commodities while responding to the market requirements. It could also move towards increased commercialization through value addition and adopting diversification strategies and low-cost strategies. Therefore, ASMP expected to conduct five feasibility studies covering five district and prepare cluster development plans based on the feasibility studies.

The feasibility study was conducted covering 12 crops selected through prefeasibility study. Data were collected from primary and secondary sources to conduct the study. The results of the economic feasibility analysis suggest that selected crops in each district are economically feasible with project scenario. Qualitative results of the analysis suggest that cost of production and cultivation quality should highly be considered as the analysis shows crop cultivation is somewhat challenging. More specifically, benefits are greater in all the crops than the costs with different outcomes of IRR and NPV. In some crops, IRR is lower than that of without project scenario.

8.1.6 Environmental and Social Safeguards

In general, the proposed crop clusters in Kandy, Badulla, Vavuniya, Ampara and Kilinochchi Districts will have a significant positive impact on agriculture communities by enhancing their economic conditions and prosperity while it has an influence on national economy at the national level which outweigh the potential negative impacts. Environmentally and socially, establishing proposed crop clusters in the above districts is feasible subjected to the conditions laid down in chapter 6.6.

Soil erosion in Kandy, Badulla and Ampara will be critical which requires special attention. Proper cultivation practices would reduce the level of erosion. Furthermore, in general, wild animal issues specially elephant threat on the cultivation will be matters in every district as mostly the potential areas are closer to forest or wildlife protected areas. In addition, water scarcity will be a serious concern for Ampara, Vavuniya and Kilinochchi.

Farmer selection criterions established by the project observed to be not properly implemented in the northern districts. Focus of selecting female farmers in all districts observed to be lack. Transparent farmer selection and possess of legal ownership for lands will mostly reduce social issues. However, proposed area for Papaya cluster in Nedunkerni (Vavuniya North) will have a great positive impact on many vulnerable groups including women headed, widows, and disable groups. Further, most of the farmers in the area are youth. This will be a model cluster for ASMP.

8.1.7 Geo-information System

Geo Information database development is the most important part of the agriculture sector. GIS can be used for selection of suitable lands, crop selection, monitoring of all inputs and yield and analyze cost benefits and finally Geo database can be used for product marketing. Agriculture Sector modernization project consultant team visited all districts and discussed with relevant parties such as Provincial agricultural staff, DOA staff and farmers for identified most suitable crops for each districts and by using GIS and different thematic layers (Latest land use maps, Agro-ecological zonation map, Soil, Forest cover, Wildlife area and latest monthly rainfall data etc) for selection of the most suitable area for different crops with consultation with experts to finalized most suitable crops for each districts and identified seasonal crops for each cluster to sustain farmers until they are getting harvest from permanent crops. Based on the database design farm level data base will be implemented to store and manage baseline and monthly data for all clusters. Also, a set of user-friendly forms will be developed for hassle free data entry and editing purposes.

Finalized crops and field implementation programme, a Geo database will be developed with all farm level baseline data, farm level agricultural data (initial), farm level monthly data and each farm blocks have to be visited and collect GPS data locational information, land preparation cost, planting date, fertilizer inputs, harvesting dates and yield etc. with the most appropriate method for easy access to all decision making, monitoring and marketing. Finally designing the database for user interfaces will be developed

Table 156: Crop Suitability for different DSDs in Vavuniya District

Crop	Area	Soil type			Rainfall			Farmers experience			Environmental			Social			Overall Suitability
		Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	
Hybrid Maize Seeds	Vavuniya/ Vengadacheddikulam	√			√				√		√			√			**Most suitable**
Chilli	Vavuniya Vavuniya South	√			√			√			√			√			**Most suitable**
Papaya	Vavuniya North	√			√			√			√			√			**Most suitable**
Mango Tom EJC	Vavuniya North	√			√				√		√			√			**Most suitable**

Table 157: Crop Suitability for Different DSDs in Kilinochchi District

Crop	Area	Soil type			Rainfall			Farmers experience			Environmental			Social			Overall Suitability
		Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	
Jumbo Peanut	Kandaveli/ Karachchi	√			√			√			√			√			**Most suitable**
Chili	Kandaveli/ Karachchi	√				√		√			√			√			**Most suitable**
Passion fruit	Karachchi	√			√			√			√			√			**Most suitable**
Pomegranate	Pachchilaipalli	√				√			√		√			√			**Most suitable**

Table 158: Crop Suitability for Different DSDs in Kandy district

Crop	**Area**	**Soil type**			**Rainfall**			**Farmers experience**			**Environmental**			**Social**			**Overall Suitability**
		Most suitable	**Suitable**	**Not suitable**	**Most suitable**	**Suitable**	**Not suitable**	**Most suitable**	**Suitable**	**Not suitable**	**Most suitable**	**Suitable**	**Not suitable**	**Most suitable**	**Suitable**	**Not suitable**	
Avocado (Hass)	Doluwa, Pasbage korale/ Udapalatha	√			√			√				√		√			**Most suitable**
Banana --Ceylon Cavendish (Ambun)	Madadumbara	√			√			√				√		√			**Most suitable**
Chili	Udapalatha/ Gangaihala korale		√			√			√			√		√			**Suitable**
Chili	Pasbage korale			√			√			√			√		√		**Not Suitable**
Cassava	Doluwa/ Udapalatha	√			√			√			√			√			**Most suitable**

Table 159: Crop Suitability for Different DSDs in Badulla District

Crop	Area	Soil type			Rainfall			Farmers experience			Environmental			Social			Overall Suitability
		Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	
Hybrid Maize Seeds	Kandaketiya	√			√			√				√			√		Most suitable
	Meegahakiula	√				√		√				√			√		Most suitable
Chili	Mahiyangana	√			√			√			√			√			Most suitable
	Rideemaaliyadda	√			√			√			√			√			Most suitable
Avocado (Hass)	Welimada/Uva Paranagama	√			√				√			√		√			Most Suitable
Seed Potato	Welimada	√			√			√				√			√		Most suitable
Vegetable (Carrot, Leeks)	Welimada	√			√			√				√			√		Most suitable

Table 160: Crop Suitability for Different DSDs in Ampara District

Crop	Area	Soil type			Rainfall			Farmers experience			Environmental			Social			Overall Suitability
		Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	Most suitable	Suitable	Not suitable	
Hybrid Maize Seeds (Lime and Bee keeping - value addition only)	Padiyathalawa/ Mahaoya	√			√			√				√		√			**Most suitable**
Jumbo Peanut	Thirukkoivil	√			√			√			√			√			**Most suitable**
Soursop	Padiyathalawa/ Mahaoya	√			√			√				√		√			**Most suitable**
Chili	Damana/ Pothuvil/ Thirukkovil	√			√			√				√		√			**Most suitable**

8.2 Recommendations

8.2.1 Agronomy

Several constraints identified during the rapid feasibility study and would like to give following recommendations as remedies. Some farmers have awareness about a few practices but they never have idea about the principle behind those practices. *One demonstration plot for 100 – 150 plots (depend on the spread of the farmers in the cluster).* Eg. DoA research station in Girandurukotte also willing to conduct a demonstration plot with the assistance of ASMP. In addition to that "Lassanaflora" willing to conduct demonstration plot for Avocado (Hass) with the assistance of ASMP.

Constraints identified	Recommendation
Lack of awareness of agricultural practices.	Prepare systematic training module to overcome all agriculture practices and principles behind those
Lack of using of past data like rainfall etc. to uplift their production	Crop physiology, Soil structure, watering and fertigation, IPM, GAP, Organic manure and relationship with soil structure
	The farmer company should be equipped well with modern facilities
Nursery preparation: awareness on importance about nurseries is in very low level. Quality of Chili nurseries what we have seen in Vavuniya is very primitive	Special trainings should be given and separate people should be developed as nursery owners
Knowledge on crop physiology is in zero level	Improve the knowledge on crop physiology at least for farmer leaders
Usage of good quality seed is not in positive manner	Improve the awareness of farmers about the role of a good seed plays
Market and marketing	Create link with market and keep continuing that relationship
Price determination	Work as a group or a company and improve the bargaining power
Quality of own products	Train how to improve the quality and meet buyers' expectation
Infrastructure	Improve the infrastructure facilities
Capital	Initially help them and train them how to manage and invest carefully
Scarcity of implements	Supply or direct them to find those

8.2.2 Agribusiness and Value chain perspectives

Location and farmer selection need to handle with utmost care and attention. Kandy, being central location for both socio-culturally and economically, value chain establishment would not be a challenging task. Seed potato production in Badulla district essentially need to monitor the progress and returns compared with investment prior to make expansion decisions or any modifications.

Issues of pilot clusters in Ampara district essentially need to address and farmer training and monitoring need to consider as an essential component. Measuring of value chain based on the quality and the quantity of the harvest and the contribution of the value chain actors. Therefore, farmer training, application of appropriate technology, follow correct postharvest management practices, collective approach on market development is essential.

Crop raids by wild animals need to manage through sustainable procedures without damage to the wildlife and their habitats. Effective training, exposure and guided market links will help to mitigate the issues and building sustainable value chains.

8.2.3 Institutional Development

Observing the current status, the farmers it is recommended to promote group formation and creating a single platform with equal chances of negotiating with diverse markets /buyers to move away from weak price takers and opportunistic behaviour.

Buyers are reluctant to enter contract agreement with farmers where trust between both parties have eroded due to changing prices, dishonor of agreed supply schedules/qualities, etc. Based on the study it is recommended to create a commercial mindset through well designed institutional set up (Farmer companies) empowered with business skills and market access for CVC in the regions.

Yet there is a wide gap observed within farmer clusters where usage of ICT applications/ platforms is restricted due to lack of knowledge on how to use and how to get the information and communicate with source as required. Also, there is concern over the cost of individual usage of such ICT information systems. In this regard it is recommended to facilitate skills training and establishment of common ICT platform linked to DOA/ Information & Communication Centre.

Recognizing the importance of improving the farmer capacity through enhanced knowledge building, skills development through established business plan, collective approach for post-harvest and market operations, introduced with transparent and sustainable financial procedures considered necessary areas to be addressed in formation and legally register Farmer companies under established CDPs for select CVCs of ASMP-EU districts.

8.2.4 Technological Development

8.2.4.1 Farm Mechanization

Technological adaptation and implementation of farm mechanization has been commenced from 1970s in Sri Lanka. However, its progression is not steady and up to the expectation particularly in cultivating OFC. Nevertheless, two milestones can be identified in country farm mechanization,

1. Introduction of 2W and 4W tractors in 1970s
2. Introduction of combined harvesters during year 2000 – 2010

Timeline of Changes in Mechanization

	1940-	1950	1960	1970	1980	1990	2000	2010	2015
4wt	Introduced/imported since late 1940's and continue to today. Earlier mostly European makes, presently mostly, Indian, Chinese machines. For both ploughing and threshing (wheel treading) of paddy lands. Since 1980, It has been used to plough OFC fields as well.								
2wt				Sri Lankan Designed British Land Master introduced in later 1960's. Thereafter Japanese, Chinese, Indian makes became very popular. Used for ploughing, transportation, threshing etc.					
Threshers (rice)/winnowers				2wt driven threshers for paddy introduced in 1970's. FMRC designed and locally manufactured.					
Threshers (OFC)							From early 2000, green gram and maize threshing machines introduced.		
Combine Harvesters								Introduced for paddy after the war ended	
Water pumps				Mainly driven by 2wt engines introduced in 1970's and has been used extensively since 2000 for OFC's.					

Following crop wise analysis strengthens the above comment OFC:

Table 161: # Mechanization Index = Cost on machinery hire/ Total cost excluding fertilizer

Crop	Previewed district	#Mechanization Index	
		Year 2000	Year 2013
Paddy	Anuradhapura	32%	55%
Chili	Anuradhapura	0%	14%
Red Onion	Puttalam	12%	12%
Potato	Badulla	4%	4%

Source: Dr. Fedrick Abeyratne – 2017 "Small Farm Agriculture Mechanization in Sri Lanka"

It is highly recommended to welcome viable farm mechanization to Sri Lankan agricultural sector. Using land preparation machineries, mechanical seeders, inter-cultivators and harvesting machineries are few potential initiatives. Farm mechanization reduces expenditure, minimizes risk on inability to meet agricultural time lines, improves productivity and at last but not least the encouraging young generation for farming.

8.2.4.2 Measures to reduce post-harvest losses

Post-harvest loss particularly in fruit and vegetable farming is alarmingly high at 30 – 40% in Sri Lankan context. Poor and excessive handling, low farmer knowledge and awareness, less industrial interest in value addition, absence of R & Ds, proper storing and transport facilities are key roots for the higher post-harvest loss.

Through the feasibility report, it is highly recommended to reduce post-harvest losses while enhancing product shelf life by

1. facilitating farmer companies with improved storing facilities and processing technologies.
2. improving buyer and farmer communication on expected product/ crop standards and product collections timelines. – Streamline processing and product collection.
3. encouraging buyers on sharing their assets with farmer companies. E.g., providing freezer truck for temporally storing and healthy transporting.
4. disseminating knowledge to individual farmers on harvesting at correct crop maturity level. Seed harvesting moisture vs germination rate and degree of fruit ripening (banana) at the harvesting stage vs its shelf life is some of examples.
5. Improving product packaging.

8.2.4.3 Improving productivity and machinery utilization factor

It is advisable to select machinery capacity level depending of expected yield and ensuring that there are no any bottlenecks in manufacturing process. Thus, working capacity of each machinery should be tallied. Selection of common machineries improve the utilization factor that helps fast recovery of investment.

It is highly recommended to use process automation where applicable. Automatic controlling of dryer operating parameters, regulating machinery rpm based on crop moisture level in order to minimize mechanical damages and conveyorizing to reduce time and workforce are few potential initiatives.

8.2.4.4 Improving water conservation

A responsible water management needs to be practiced. Farmers don’t have required attention on managing water since no one is paying for irrigated water. Proposed micro irrigation methods and improved farmer knowledge on water requirement and watering pattern for the selected crop will help to conserve water. Improvements in production and productivity in both Yala and Maha seasons are expected from responsible water management.

8.2.4.5 Inculcating energy and resource saving culture among farmers

Energy saving is a passion. It is required to passionate farmers on saving energy, time, resources, space while reducing product waste and defects. Process integration i.e., integrating production management, labor management, energy management, inventory management, machinery management and at last but not least the quality management is highly recommended.

Farmers should train on economical and responsible waste management where product waste can be used as an input material for another product. E.g., Proposed banana fiber extraction from banana trunk, compost making, briquettes from peanut shells.

8.2.5 Financial Assessment

As the economic returns are higher and the future maintenance of crop production is planned to be conducted by the farmers in connection with the Public Unlisted Farmer Company, their ability for direct marketing should be strengthened as the gains from direct marketing is higher. In achieving the results of the project, specific technology package is a must. If we invest only on the crop production without improving yield and considering other aspects such as value addition, processing, diversification strategies and by product utilization the expected benefits will not be able to be harvested. Continuous supply of raw materials by the farmers to the buyers and exporters should be assured.

8.2.6 Environmental and Social Safeguards

- As there are areas which is considered as an upper watershed which generates water supply to down streams, supporting human and natural activities. Therefore, it is recommended to obtain approval for use of such perennial surface waterbodies from relevant regulating agencies such as Irrigation Department and MASL.
- Soil erosion in Badulla and Kandy districts are very high and with activities related to cultivation the erosion rate will aggravated further. Therefore, good soil protection measures should be implemented to mitigate the soil erosion impact and take measures soil improvement measures. Avoid siltation of surface waterbodies in and around the area. Further, due to potentials for landslides, proper geo-engineering measures should be applied where infrastructure improvements are proposed.
- Sedimentation and slippage of earth fills near waterbodies should be strictly controlled as impacts can lead to burial of its breathing roots.
- As there are many Wildlife and Forest areas, abundance of diverse and significant fauna and flora in the area would be very higher. Therefore, it needs to protect flora and fauna including aquatic life as well as their habitats. Lands selection should be carefully and properly done ensuring the Wildlife and Forest areas are not encroached by the Farmers.
- Community forestry and catchment enhancement types of initiatives should be implemented in terms of protecting ground water resources which is highly stressed due to climate change impacts.
- Implementation of integrated pest management practices from land preparation up to marketing is essential and reduce the use of chemicals as much as possible
- Hunting and pouching should be strictly prohibited as there are many forest areas which has very high population of wild animals
- Solid waste, construction debris should not be dump into project location or nearby. Best waste management practices such as segregation, collection, reuse, recycle, etc should be practiced as much as possible
- Burning of vegetation debris cleared from the construction should be strictly prohibited. However, in cultivation activities, burning of slash should be controlled to reduce the impact
- Air pollution, noise, vibration and waste shall be maintained to fulfil the Central Environmental Authority (CEA) regulations.
- Environmental Protection License for each industrial activity should be obtained.

- Modern and innovative measures should be implemented as practicable as possible such as waste management, harnessing solar thermal energy, introduction of bio-gas making methods, bio-diesel making, etc to reduce the amount of greenhouse gas emission due to project activities
- Sustainable solutions for processing activities should be implemented to increase the efficiency and sustainability.
- Initiate research-based quantification of greenhouse gas emission due to proposed activities. Discussions will be initiated with universities such as Sabaragamuwa and Peradeniya for connecting research students

8.2.7 Geo-Information System

- The main task is to select clusters of farmers and the creation of spatial with attribute database for each farmland. Data collection is a collective work for which the entire team of experts and field staff should work together. Project technical staff, district level District Coordinators and Cluster Coordinators will have to play a leading role in the identification of suitable lands, implementation of field activities within the required time duration while monitoring all activities such as farmland instruments which will be given by ASMP. Labour and fertilizer cost, yield and income will be monitored by using GIS in terms of Development of Spatial database.
- Afterwards the creation of spatial database consultants, PMU staff and district level staff bear the responsibility to coordinate with the Geo Information Specialist in order to update Geo Information Database for all clusters.
- Feasibility study report, Preparation of Cluster Development plans and finally development spatial database for implementation of Clusters is of vital importance in the process of time management towards each milestone. Under such circumstance ensuring the sustainability of the GIS system for Development of an efficient geo database system to support decision making, fulfil spatial analysis requirements of ASMP users/consultants, GIS Awareness Programs for selected staff, User Training for access Geo database, Selection of free open-source software for data collection, Selection of GIS software to fulfil project needs, Low-cost database hosting & finally User-friendly interfaces etc. will be developed.

Following assistance and coordination is essential to sustain spatial database with relevant Institute so that the parties involved in this Project will be able to complete their task without delay.

- Documents available with the Client, Baseline survey data and any other data and information relevant to the Study etc
- Contact details of field level operational office
- Digital data and maps from relevant agencies. & Demographic data
- Purchase equipment such as Main server, GPS, GIS Software & Drone images etc.
- Any necessary assistance with respect to local clearances and access procedures

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Agriculture Sector Modernization Project (ASMP)

District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

Stakeholders' Workshop I

Potential agribusinesses and Value chain development for the new districts funded by European Union

Rationale for the Workshop:

ASMP project for new EU districts aim to contact district level feasibility Studies with respect to the establishment of Agriculture Technology Development Parks (ATDPs), and prepare comprehensive crop Cluster Development Plans (CDPs), and to aware the farmers / farmer companies, technically guide the implementation staff about the technical matters regarding the feasibility studies & especially the CDPs during the initial stage of the crop Cluster establishments.

First stakeholder workshop with agri-food industry crowd is aimed to obtain the insights of industry personnel on new trends in global market place, what opportunities available for us to link into global value chains?, problems and issues from farm to plate with reference to our context, suggestions on crops, value additions, safety and quality management, transport and logistics, etc. Comprehensive literature reviews were conducted to identify the Sri Lankan context to understand their potential capacities and gaps relating to value chain development. Industry environmental scanning and Institutional analysis are planning to understand the status of business enabling environment. A workshop with necessary stakeholders is needed to finalise the potential crops, agribusiness ventures, value additions, safety and quality requirements, technological interventions, logistic and postharvest chin management practices.

Objectives of the Workshop:

The objectives of the proposed workshop are threefold:

1. Introducing the concept of the project, objectives and expectations in the context of new project locations/districts with specific focus on the agricultural sector
2. Discussion on potential crops, agribusiness ventures, value additions, safety and quality requirements, technological interventions, logistic and postharvest chain management practices.
3. Identifying recommendations from stakeholder perspectives about the way forward in implementing the crop production clusters, Agriculture Technology Development Parks, capacity building of individual as well as farmer groups, knowledge sharing and information sharing methods

Methodology:

Selection of stakeholders was based on their business engagement and both public and private sector institutions in agriculture sector were purposely selected for the event. Executive level officers were selected across the institutions and stakeholder workshop was planned to conduct via online mode due to the prevailing conditions of the county. First, all participants were invited via telephone calls and later concept of the workshop (annex 1) and agenda (annex 2) was emailed to all invited participants prior to the workshop. Reminders were sent to all invited participants and confirm their participation through the telephone calls. Final list of invited participants were divided into 3 groups; industry, exporters and policy makers.

Further, each sub group was allocated into the breakout rooms and discussions were planned with each group separately and discussions were managed by 2 consultants and facilitated by the note takers. Overall discussion was managed by the agribusiness and value chain specialist. First part of the discussion based on presentations made by ASMP project team and the presentations were on introduction to the project along with brief presentations of each subject specialist. Brief presentation of the subject specialists were selection and development of agricultural value chains, economic analysis of selected value chains, formation of farmer companies, environmental and social safe guard of the project, agronomic perspectives, value addition and formation of farm cluster processing hubs and GIS base decision support system.

Second part of the workshop was begun with the allocating each individual participant into respective breakout room. Three questionnaires, Google forms were shared among the group. Questionnaires were on potential crops; perennial crops, seasonal crops, etc. for the new project districts, potential agribusiness and analysis of institutional environment of the each district. Ten minutes were allocated to each questionnaire and discussions were performed after completing the questionnaire. Discussions were facilitated by the project team. Details of the sessions are as follows;

- All the stakeholders were assigned to three breakout rooms based on the following categories and for each breakout rooms, one facilitator and a note taker was assigned. (Annex 01)

  - Policy Makers: Mr. Chopadithya Edirisinghe & Mr.S.B. Adikari
    Note taker – Ms. Thilini Hansika
  - Exporters: Dr. S.Darmadasa & Mr. G. Prathapasinghe
    Note taker – Ms. Ruwini Bandara
  - Industry Stakeholders: Mr. Arjuna Dissanayake & Prasad Jayaweera
    Note taker – Ms. Sulochana Senevirathne

- **1st Discussion Session: Primary activities of the value chains**

- Ten minutes provided for filling the survey on primary activities of the agri-food value chains

(Survey Link: https://docs.google.com/forms/d/e/1FAIpQLSfx34rBrhNCh3IV3Ksi4-h6unnsTtcTNMNT9lFhy7sPtvRptQ/viewform) (Annex 02)

- Twenty minutes for the discussion: Discussed on the tentative crops, crop clusters, potential agribusinesses, value additions, safety and quality requirements, postharvest chain management, etc.

- **2nd Discussion Session: support activities of the value chain**

  - Ten minutes provided for filling the survey on support activities of the value chain. (Survey Link: https://docs.google.com/forms/d/e/1FAIpQLSdasauSOszLiJB48YV67Gq1GcuMTtODkwf0M9uvjyaTLc0BMA/viewform) (Annex 02)

  - Twenty minutes for the discussion: Discussed on the technological interventions, logistics, networking and market intelligence, farmer companies, capacity building, management of cluster sustainability, food and income security, etc.

- **3rd Discussion Session: Institutional Environment**

  - Ten minutes provided for filling the survey on institutional environment of the agri-food value chains.

  (Survey Link: https://docs.google.com/forms/d/e/1FAIpQLSeohMJQ_87ILzxhMLsdKmSW3rQb0unrQPuaL9QtNWwi6_qsbQ/viewform) (Annex 03)

  - Twenty minutes for the discussion on supportive institutions related to the agri-food value chains.

After all, three discussion sessions; a facilitated discussion was conducted by Prof. D.A.M. De Silva with all the stakeholders on the most effective export oriented, and or import substitution crops/clusters to design cluster development plans, ATDPs, etc.

Results :

Discussion Session 01: Primary activities of the value chains

In the first session, the stakeholders were selected most suitable districts for permanent/semi-permanent crops and for seasonal crops as shown in the following fig.1 and fig.2. Majority of the stakeholders have selected Kandy and Ampara as most suitable districts for the both types of crops.

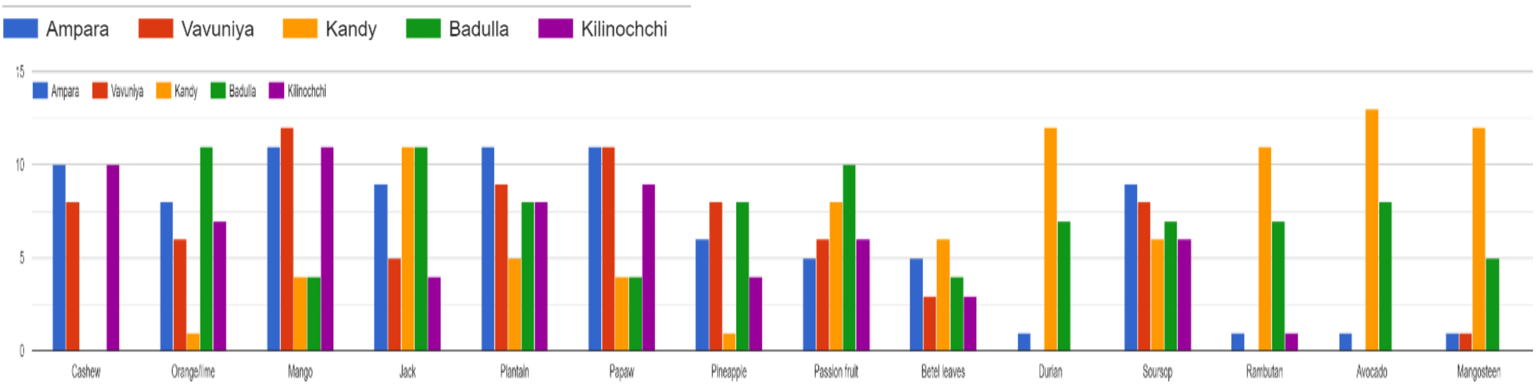

Fig.1 Most Suitable districts for permanent/semi permanent crops

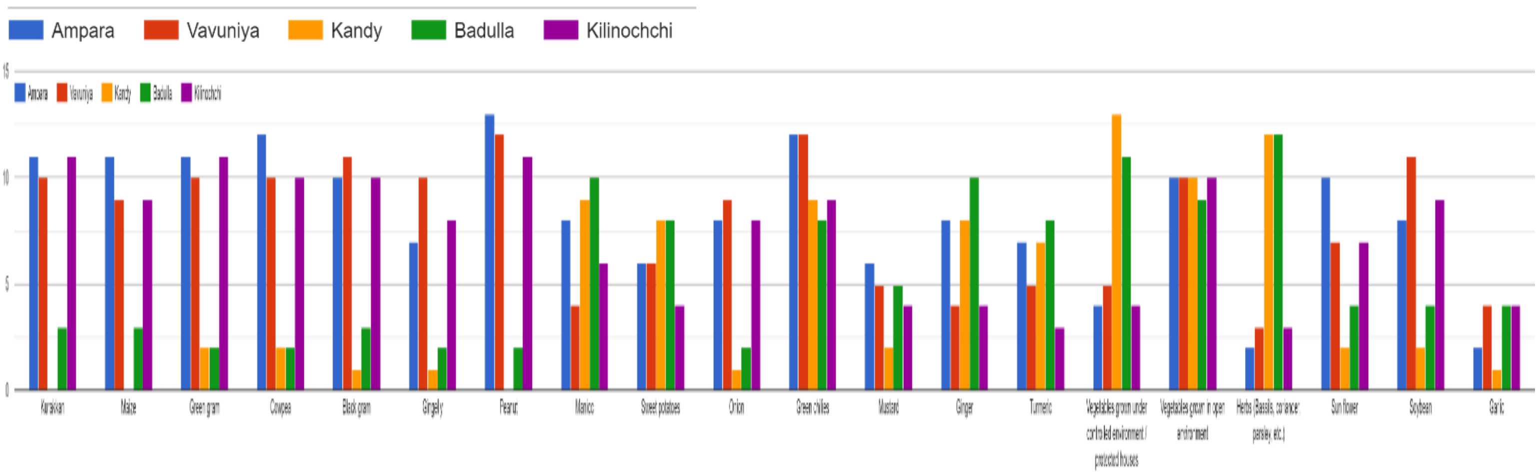

Fig.2 Most suitable districts for Seasonal crops

Further, the stakeholders have suggested that herbals, moringa leaves, soursop leaves, tamarind, rampe, sera etc. also can add to this crop list and Maize and cowpea also mentioned as potential crops in this areas and suggested Anuradhapura district also a potential district to consider.

As potential districts for planting material production, stakeholders have selected Badulla district mainly for seed potato production, tissue cultured banana plants and tissue cultured orchids plants. And also majority of them have selected Kandy district for vegetable seeds and tissue cultured anthurium plants. (Fig.3)

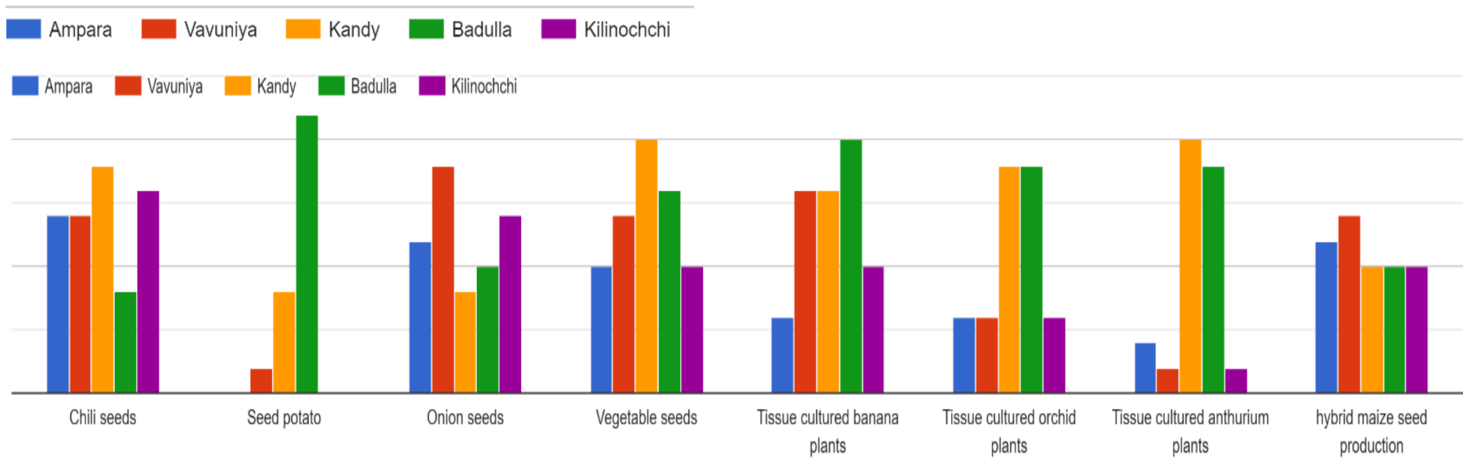

Fig.3 Most suitable districts for the Planting material production

When considering on easy access to the production and input services, majority of stakeholders have selected as Ampara district for labours, Badulla for nurseries and green houses. And further Vauniya district for agro chemicals, chemical fertilizer, organic/compost fertilizer, irrigation technology and machineries (Fig.4).

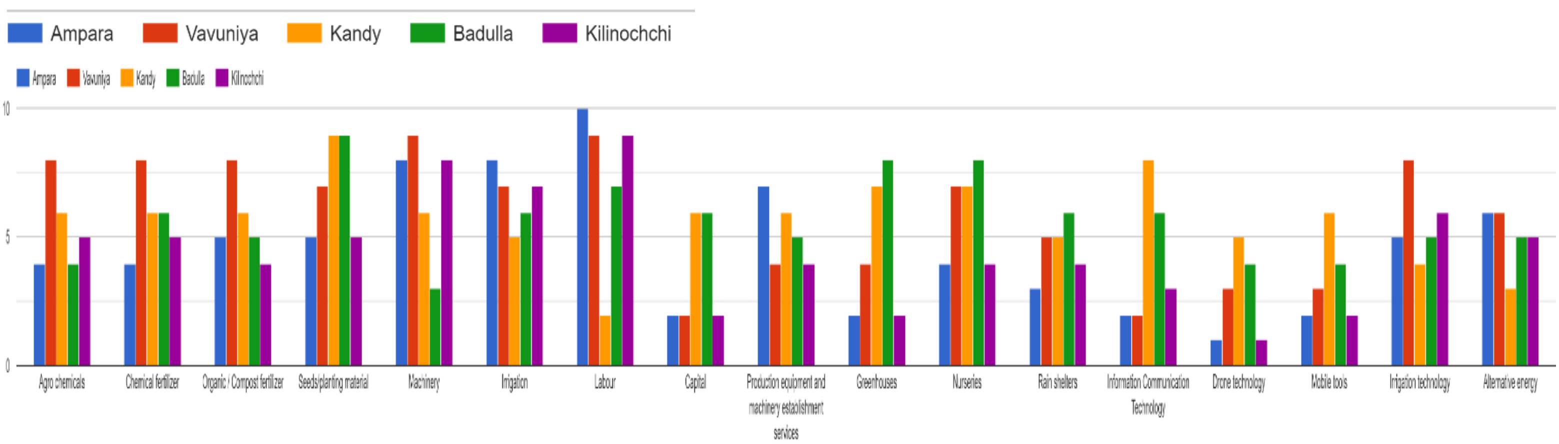

Fig.4 Easy access to the production and input services

Moreover, they have mentioned as lack of inputs services in Ampara and there is no special differences in case of access to inputs among districts. Its a national level problem. And those inputs can supply to any place in the country if the materials are available in the country.

As shown in the fig.5 and fig.6, stakeholders have selected Kandy district is the district which having easy access to the extension, education, and training services and also Badulla district as the most received opportunities for Research and development.

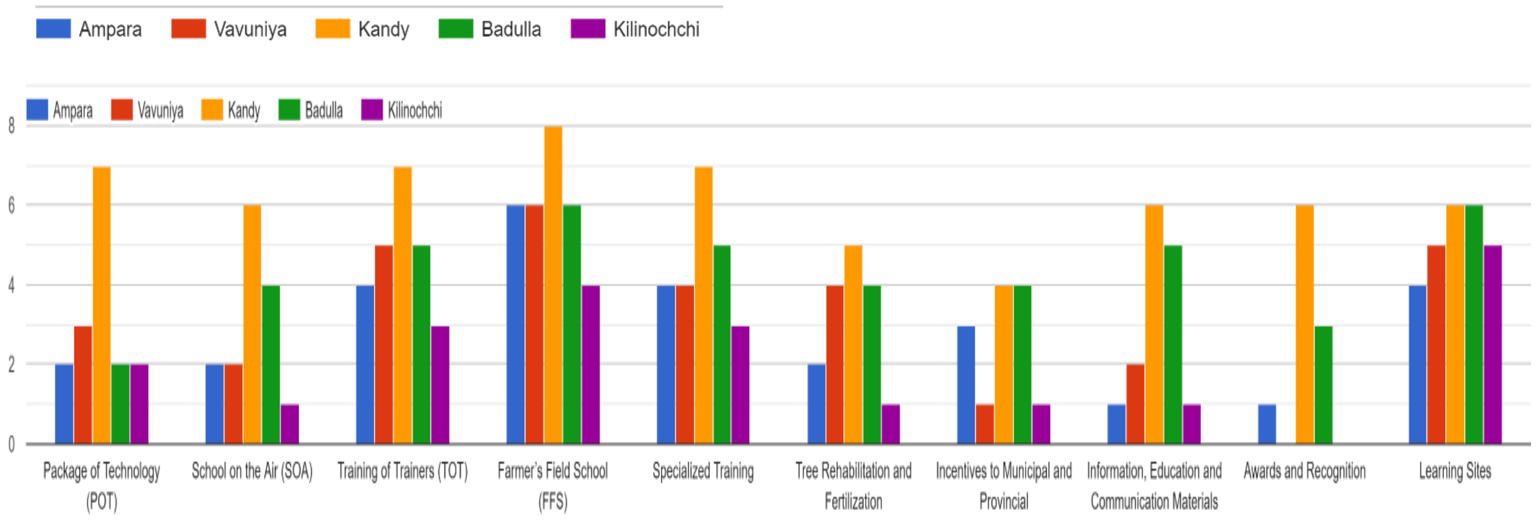

Fig.5 Districts that have easy access to the extension, education, and training services

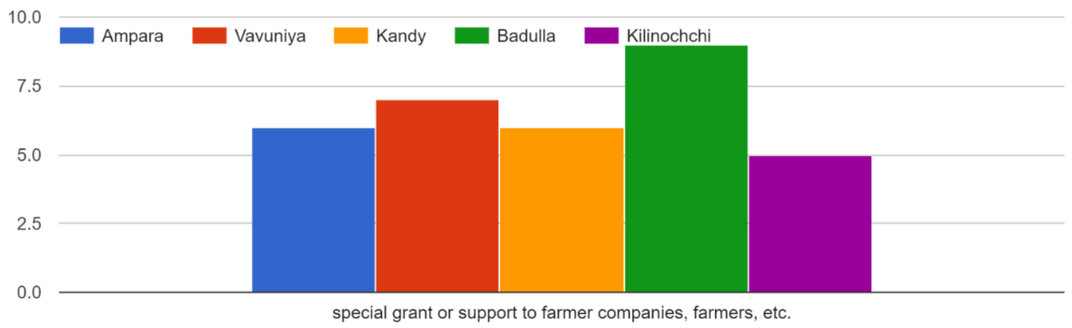

Fig.6 Districts that have received opportunities for Research and development

Majority of stakeholders,Sri lankan GAP and organic certifications were selected as the quality certifications / guidelines you need ASMP to go with each crop (Fig.7). Further, fruits, vegetables and spices selected as most potential value additions (Fig.8)

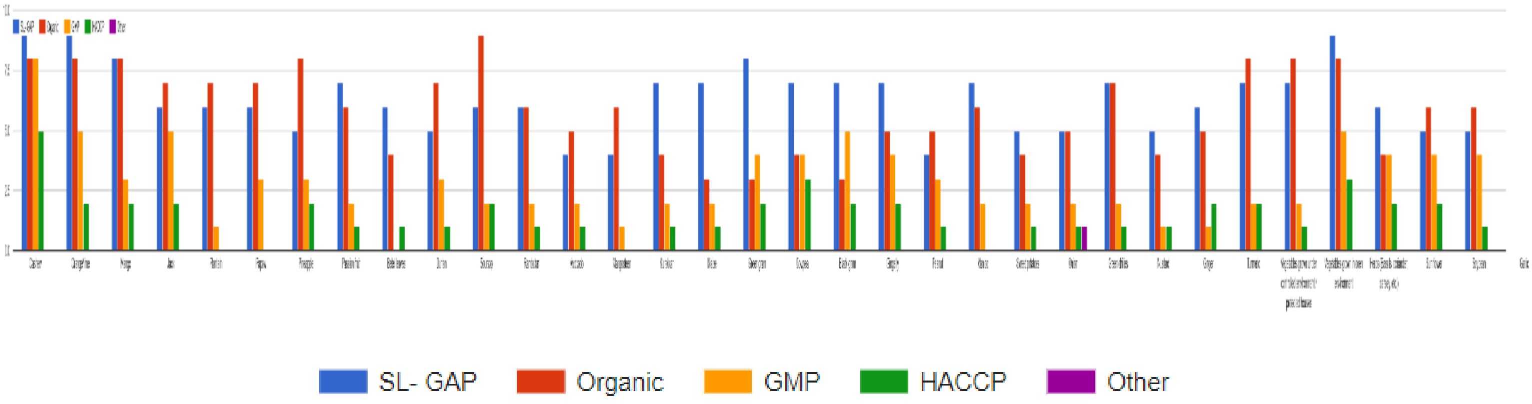

Fig.7 The quality certifications / guidelines you need ASMP to go with each crop

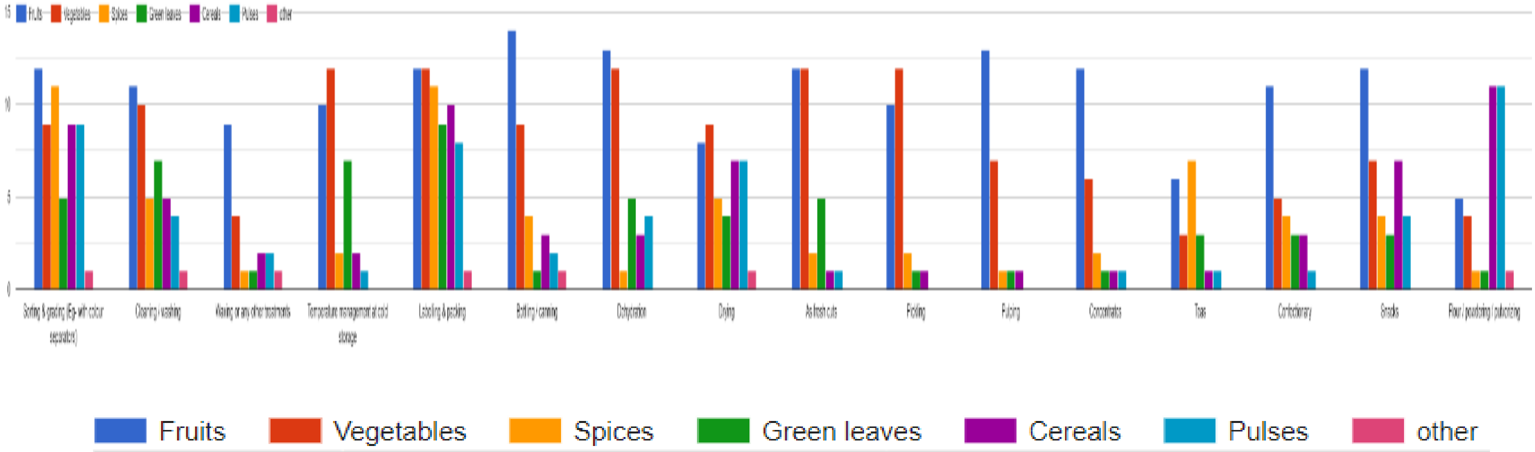

Fig.8 Value addition potential

Discussion Session 02: Support activities of the value chain

Second focus is on support activities of the value chain: Technological interventions, logistics, networking and market intelligence, farmer companies, capacity building, management of cluster sustainability, food and income security, etc. the majority of stakeholders have selected Kandy district for technological intervention, logistics and for networking and market intelligence facilities (Fig.9, Fig.10 and Fig.11).

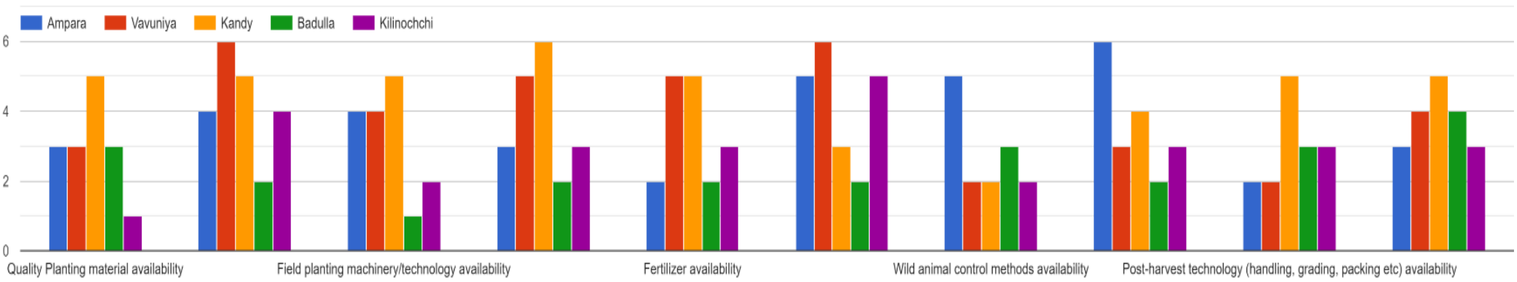

Fig.9 Technological interventions

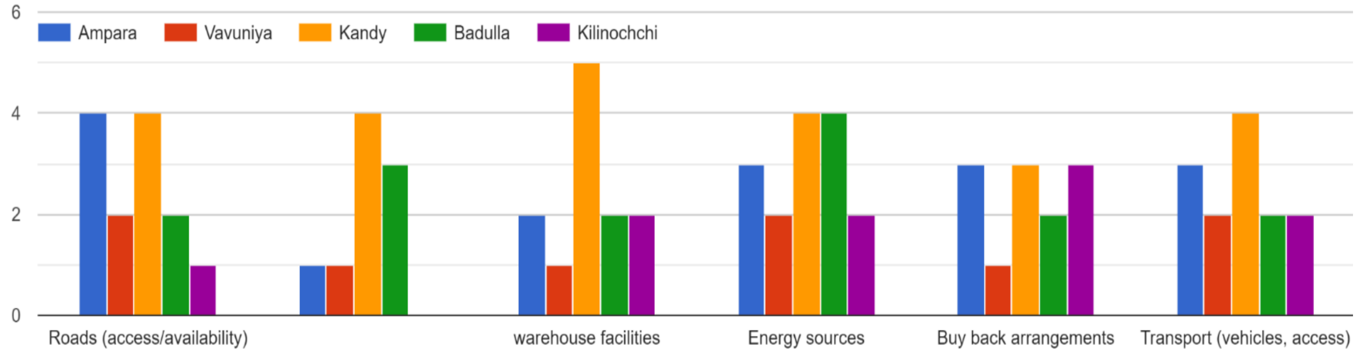

Fig.10 Logistics Facilities

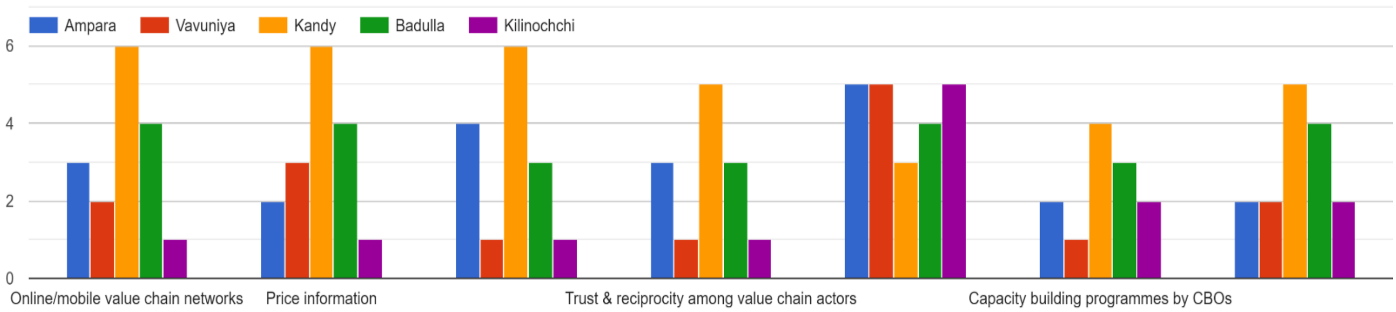

Fig.11 Networking and market intelligence facilities

When considering on the food and income security dimensions, again Kandy district is the choice of majority of stakeholders. (Fig.12)

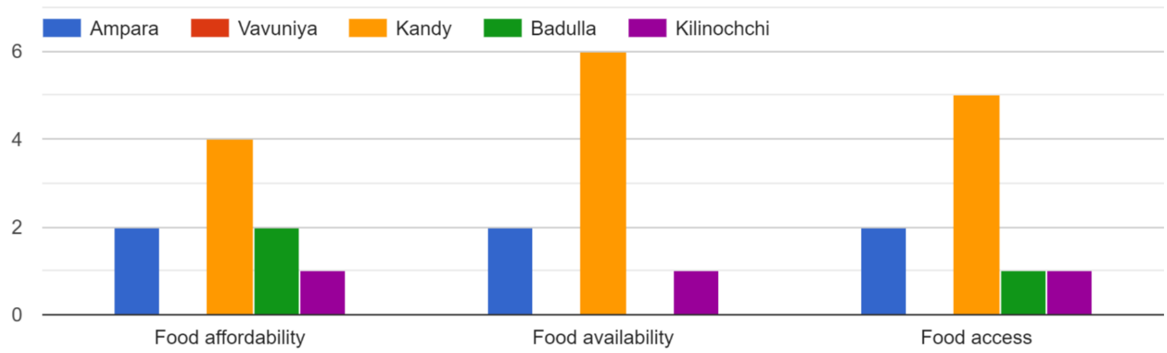

Fig.12 Food and income security dimensions

Discussion Session 03: Institutional Environment

The draft institutional analysis developed by the project team was presented followed by a facilitated discussion between the stakeholders to refine the environmental scanning. As per the majority of stakeholders, most important institutions and easily accessed services also located in Kandy district which is shown in following fig.13 and 14.

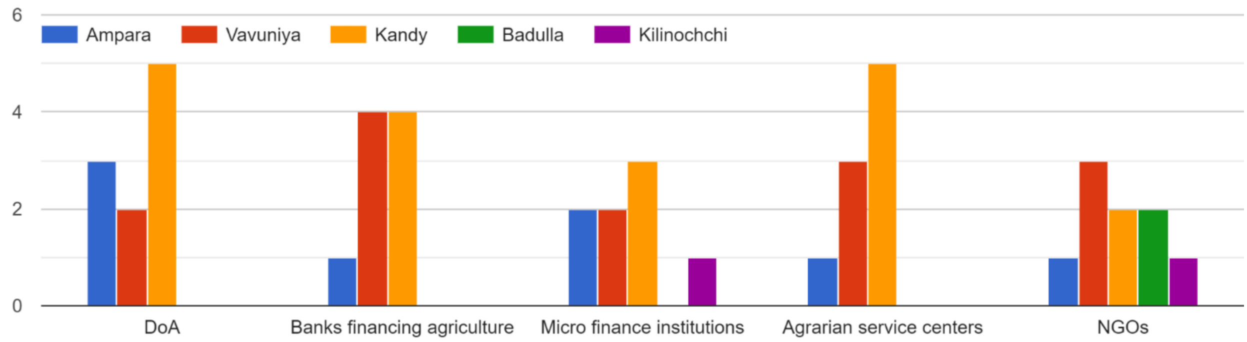

Fig.13 Most important institution/s

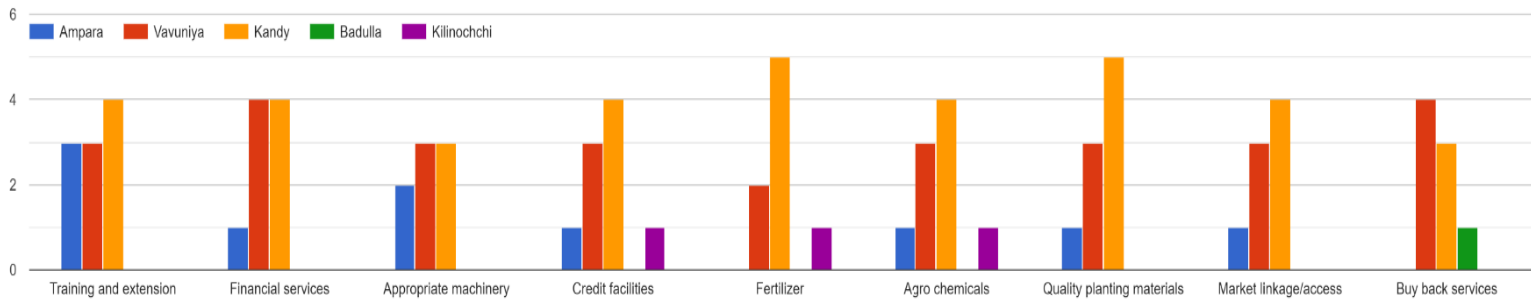

Fig.14 Easily accessed services

The stakeholders have stated that, critical issues of the institutional environment on agribusiness & value chain development as per their view;

- Improper market facilities in Vavuniya District
- Scarcity of technology, Skills, Marketing standard and resources ,
- lack of awareness of the institutes and their services rendered
- Transfer of Scientific Knowledge and Cultural Practices of Growing for all crops
- Most important things are lab facilities, farmer networks, Machinery equipment packing materials, Value addition machineries (tea bags making machines

Further, for the expected services from institutions in each district on agribusiness & value chain development, they have mentioned as;

- Develop a good market, strengthen the farmer communication
- Need all necessary steps in value chain process
-

Special concerns;

- 1. Traceability, authenticity & transparency of export oriented produce, Train farmers from the beginning of the production process on good practices, possibility of allocate NPQS officers throughout the chain
-
- 2. Vegetable production in poly tunnel with uncommon vegetables unlike salad cucumber, bell pepper, cherry tomato (especially Badulla and Kandy districts) and use abandoned tunnels.
-
- 3. Vegetable seed production and tissue culture of planting material in Kandy and Badulla (Anthurium. Pl. Discuss with Dr Shelumi Krisnaraja DG Botanical gardens regarding export potential of floriculture)

- Potential floriculture cluster in Badulla: Roses, Anthurium, Jerbera, Jasmine, etc

- EDB participation on export oriented prodcution
-
- High value herbs and condiments as inter crop for Hass Avacado cluster .
-
- Jackfruit for all districts with IQF – cost?????????
-

Annex 01: Concept note

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விவசாய நவீனமயமாக்கல் திட்டம்
Agriculture Modernization Project

THE WORLD BANK
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Funded by
The European Union

Agriculture Sector Modernization Project (ASMP)

District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

Agenda

Stakeholders' Workshop 1

Potential agribusinesses and Value chain development for the new districts funded by European Union

Date: Wednesday 22th June 2.pm
Place: Via Zoom
Zoom link: Join Zoom Meeting
https://learn.zoom.us/j/64062108027?pwd=MTh4bmR0akd1ZjRLMEtvdmlNRHdxdz09
Meeting ID: 640 6210 8027
Passcode: 8TGc%pY2
Duration: 3 hours
Note: *The Agenda, concept note and the draft programme objectives to be shared with the Stakeholders prior to the event.*

Item	**Time (SL)**	**Duration**	**By**
Introduction	2.00pm	10 Mins	ASMP
Aims and expectations of the stakeholder meeting	2.10 pm	10 Mins	Prof. Achini De Silva, Dept. of Agribusiness Management, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka
Expectations of the economist	2.20pm	05 Mins	Dr. Sampath Dharmadasa
Expectations of the agronomist	2.25pm	05 Mins	Mr. Gamini Prathapasinghe
Expectations of the institutional specialist	2.30pm	05 Mins	Mr. Chopadithya Edirisinghe
Expectations of the engineer	2.35pm	05 Mins	Mr. Arjuna Dissanayake
Expectations of the environmental social safeguard specialist	2.40pm	05 Mins	Mr. Prasad Jayaweera
Expectations of the GIS expert	2.45pm	05 Mins	Mr. S.B. Adikari
Break	***2.50pm***	***05 Mins***	
Discussion session 1 First focus is on **primary activities** of the **value chains**: The tentative crops,	2.55pm	30 Mins (10Mins.	**Breakout room 1: Policy Makers** Mr. Chopadithya **Breakout room 2: Exporters** Dr. S.Darmadasa **Breakout room 3: Industry** Mr. Arjuna

Item	Time (SL)	Duration	By		
crop clusters, potential agribusinesses, value additions, safety and quality requirements, postharvest chain management, etc Tools to be used: Structured questionnaire (google form),will be uploaded to chat thread. Discussion commence after completion of the questionnaire		Questionnaire & 20 Mins. Discussion)	Edirisinghe & Mr.S.B. Adikari Note taker – Hansika Thilini	& Mr. G. Prathapasinghe Note taker – Ruwini Bandara	Dissanayake & Prasad Jayaweera Note taker – Sulochana Senevirathne
Discussion session II Second focus is on **support activities** of the **value chain**: Technological interventions, logistics, networking and market intelligence, farmer companies, capacity building, management of cluster sustainability, food and income security, etc Tools to be used: Structured questionnaire (Google form),will be uploaded to chat thread. Discussion commence after completion of the questionnaire	3.25pm	30 Mins (10Mins. Questionnaire & 20 Mins. Discussion)	**Breakout room 1: Policy Makers** Mr. Chopadithya Edirisinghe & Mr. S.B. Adikari Note taker – Hansika Thilini	**Breakout room 2: Exporters** Dr. S.Darmadasa & Mr. G. Prathapasinghe Note taker – Ruwini Bandara	**Breakout room 3: Industry** Mr. Arjuna Dissanayake & Prasad Jayaweera Note taker – Sulochana Senevirathne
Break	***3.55pm***	***05 Mins***			
Discussion session III Third focus is on **institutional environment** of the agrifood value chains Tools to be used: Structured	4.00pm	20 Mins (10Mins. Questionnaire & 20 Mins. Discussion)	**Breakout room 1: Policy Makers** Mr. Chopadithya Edirisinghe & Mr. S.B. Adikari	**Breakout room 2: Exporters** Dr. S.Darmadasa & Mr. G. Prathapasinghe	**Breakout room 3: Industry** Mr. Arjuna Dissanayake & Prasad Jayaweera

Item	Time (SL)	Duration	By		
questionnaire (Google form) will be uploaded to chat thread. Discussion commence after completion of the questionnaire			Note taker – Hansika Thilini	Note taker – Ruwini Bandara	Note taker – Sulochana Senevirathne
Q& A, way forward	4.20 pm	30 Mins	Q & A – Prof. Achini De Silva Note taker – Anjana Hettige Way forward – Mr. Sanath Wicramathilake		
Wrap up session	4.50pm	10 Mins	ASMP		

Annex 02: Concept

Agriculture Sector Modernization Project (ASMP)

District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

Concept Note for Stakeholders' Workshop 1

Potential agribusinesses and Value chain development for the new districts funded by European Union

Prof. Achini De Silva

2022

Project Title: District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

The ASMP project team would like to invite you to take part in the stakeholder meeting, planned to get your valuable feedback for the potential export oriented agribusinesses and value chain development and or upgrading in new districts funded by EU. The summary of the workshop and the date, time and the zoom link are given below for your kind perusal. Your valuable comments during the stakeholder meeting will be highly appreciated. Contact details of the project lead and the organizers are given below. We kindly requests you to complete the table given in Annex I and return it to us ASAP. Thank you.

Proposed Workshop Date and Time: ***June*** 22, 2022; 2 – 5 pm India

Duration: 3 hours

Place: Zoom only meeting

Zoom Link:

https://learn.zoom.us/j/64062108027?pwd=MTh4bmR0akd1ZjRLMEtvdmlNRHdxdz09

Date : June 22, 2022, 14:00 India Standard Time

Join Zoom Meeting

Meeting ID: 640 6210 8027

Pass code: 8TGc%pY2

ASMP project (new EU Districts):

The Agriculture Sector Modernization Project (ASMP) is comprised of three components. The Component-1, Agriculture Value Chain Development, seeks to promote commercial and export oriented agriculture and this component is implemented by the Ministry of Plantation Industries (MOPI). The Component-2, Productivity Enhancement and

Diversification Demonstration (this particular assignment relates to the Component-2) is implemented by the Ministry of Agriculture (MOA). The Component-2 aims to support smallholder farmers to produce competitive and marketable commodities, improve their ability to respond to market requirements and move towards increase commercialization. The Component-3 focuses on human resource management, and capacity building, logistic requirements, monitoring and evaluation, communication and coordination of the overall Project.

The listed below are the sub-components of the Component-2 of the ASMP implemented under the MOA:

a. **Farmer Training and Capacity Building:** Under this Sub-component, all the non-technical farmer trainings (mainly through ***Farmer Business School – FBS***) are provided to all the member farmers of the ***Farmer Companies (FCs)*** as well as to the selected non-member farmers living around the cluster areas with the aim of improving their soft skills (referring farming as a business), carry out related awareness and exposure visits (local as well as foreign), empowering Farmer Companies providing the related trainings to the lead farmers as well as to the potential second generation young farmers, and providing the assets needed to operate the Farmer Companies.

   All related institutional capacity building activities are carried out under this sub-component in order to establish and empower the Farmer Companies.

b. **Modern Agriculture Technology Parks (ATDPs):** This is the main Sub-component the Component-2 of ASMP. All the crop cluster selection, design, establishment and continuity of crop clusters is ensured under this sub-component. Each individual member farmer of the FC will receive a technology package as a grant under this Sub-component. In addition, farming related collective assets, cluster specific common ***Agro Processing Hubs - APHs*** (mostly one per each cluster), and common ***Urban Marketing Centers - UMCs*** (mostly one per each District – not necessarily), certain technical exposure visits, trainings and awareness, specific technical consultancies will be delivered under this Sub-component.

c. **Production and Market Infrastructure:** Under this Sub-component, Cluster / ATDP specific market infrastructures (Eg. Common APHs, UMCs, ***Compost Making Units - CMUs)***, required irrigation infrastructures, identified market access roads and any other specific supportive infrastructures will be established. In addition, the consultancy assignments related to Engineering Designing and Establishments will be carried out under this sub-component.

d. **Analytical and Policy Advisory Support:** Related Policy Studies as well as required Analytical Studies are carried out under this particular Sub-component. In addition, conducting certain related assessments / evaluations, organizing ***Techno Forums***, ***Policy Forums***, formulation Policy / Strategy briefs / guidelines are carried out.

Project Locations:

ASMP currently works in five provinces namely Northern Province, North Central Province, Uva Province, Eastern Province and Central Province in the implementation of the Component-2. Twelve districts have been selected to implement the Agriculture Technology Demonstration Park concept namely Amara, Anuradhapura, Badulla, Batticaloa, Jaffna, Kandy, Kilinochchi, Mathale, Monaragala, Mullativu, Polonnaruwa, and Vavuniya. Out of the above 12 Districts, this particular assignment relates only to the new ASMP Districts, namely Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya Districts.

Source of funding:

The Democratic Socialist Republic of Sri Lanka has obtained a Credit of US$ 58.63 Million from the World Bank through the International Development Association (IDA) and received Grant of US$ 26 Million from the European Union (EU) for the ASMP of the Ministry of Agriculture.

Rationale for the Workshop:

ASMP project for new EU districts aim to contact district level feasibility Studies with respect to the establishment of Agriculture Technology Development Parks (ATDPs), and prepare comprehensive crop Cluster Development Plans (CDPs), and to aware the farmers / farmer companies, technically guide the implementation staff about the technical matters regarding the feasibility studies & especially the CDPs during the initial stage of the crop Cluster establishments.

First stakeholder workshop with agrifood industry crowd is aimed to obtain the insights of industry personnel on new trends in global market place, what opportunities available for us to link into global value chains?, problems and issues from farm to plate with reference to our context, suggestions on crops, value additions, safety and quality management, transport and logistics, etc.

Comprehensive literature reviews were conducted to identify the Sri Lankan context to understand their potential capacities and gaps relating to value chain development. Industry environmental scanning and Institutional analysis are planning to understand the status of business enabling environment. A workshop with necessary stakeholders is needed to finalise the potential crops, agribusiness ventures, value additions, safety and quality requirements, technological interventions, logistic and postharvest chin management practices.

Objectives of the Workshop:

The objectives of the proposed workshop are threefold:

4. Introducing the concept of the project, objectives and expectations in the context of new project locations/districts with specific focus on the agricultural sector
5. Discussion on potential crops, agribusiness ventures, value additions, safety and quality requirements, technological interventions, logistic and postharvest chain management practices.
6. Identifying recommendations from stakeholder perspectives about the way forward in implementing the crop production clusters, Agriculture Technology Development Parks, capacity building of individual as well as farmer groups, knowledge sharing and information sharing methods

Outcome of the Workshop:

The outcome of the workshop will be a summary report developed by the host. Furthermore, the conclusions and insights drawn from the discussions will help refine the feasibility studies, cluster development plans and capacity building in new project districts.

Format:

The workshop will be half-a-day (approximately 3 hours including breaks).

The workshop WILL BE RECORDED to provide for an accurate representation of views/discussions. The workshop host and the project lead will facilitate the discussions. To ensure maximum engagement of participants, at least 03 break-out rooms will be organised between practitioners, industry experts and the project team.

Agenda:

1. The workshop will begin with a general overview of the ASMP project and the new EU funded districts.
2. First focus is on primary activities of the value chains: The tentative crops, crop clusters, potential agribusinesses, value additions, safety and quality requirements, postharvest chain management, , etc developed by the project team will be presented followed by a facilitated discussion between the stakeholders to refine these.
3. Second focus is on support activities of the value chain: Technological interventions, logistics, networking and market intelligence, farmer companies, capacity building, management of cluster sustainability, food and income security, etc
4. The draft institutional analysis developed by the project team will be presented followed by a facilitated discussion between the stakeholders to refine the environmental scanning
5. A facilitated discussion on the most effective export oriented, and or import substitution crops/clusters to design cluster development plans, ATDPs, etc.
6. Recommendations on the way forward and an exchange of ideas on a common vision for the implementation of the proposed proect will be sought from participants.

Confidentiality of data:

All data that will be obtained in the workshop will be treated with strict confidentiality and will only be used for this research. Any information regarding any respondent or organisation will not be disclosed, and the data collected will be kept in a secure location. The names of the respondents and the organisations will not appear in any publication resulting from this research. After participants have read this information and asked any questions, they will be given a consent form to be completed and signed. Participants will be able to withdraw at any time (even during the workshop), for any reason without explaining the reasons for withdrawing.

Contact Details for any Enquiries –

Workshop Hosts:

Ms. Asoka – policyspecalistasmp@hotmail.com

Mr. Sanath Wickramathilake – sanathwickramathilake@yahoo.com

Prof. Achini De Silva: Email – desilva.achini@yahoo.co.uk / achini@agri.sab.ac.lk

Dr. Sampath Dharmadasa – sampath@uwu.ac.lk

Mr. Gamini Prathapasinghe – gprathapasinghe@gmail.com

Mr. Chopadithya Edirisinghe – chopadithya@gmail.com

Mr. Prrasad Jayaweera - japjayaweera@gmail.com

Mr. Arjuna Dissanayake – arjunauom@gmail.com

Mr. S.B. Adikari – adikari8@gmail.com

Annex 1- Participant Consent Form

Project Title: ASMP Agriculture Sector Modernization Project (new EU districts)

Workshop Host: Prof. Achini De Silva, Dr. Sampath Dramdasa, Mr. Chopadithya Edirisinghe, Mr. Gamini Prathapasinghe, Mr. Prasad Jayaweera, Mr. Arjuna Dissanayake, Mr. S.B. Adikari, Mr. Sanath Wickramathilake

Name of the Workshop Participant:

Email of the Workshop Participant:

Please delete as appropriate.

• I confirm that I have read and understood the information sheet for the above research and what my contribution will be	Yes	No
• I have been given the opportunity to ask questions about my participation	Yes	No
• I agree to take part in the workshop	Yes	No
• I understand that all the information I provide will be treated in strict confidence	Yes	No
• **I agree to the workshop, and my participation, being recorded**	Yes	No
• I understand that I have the right to withdraw from this study at any stage for any reason, and that I will not be required to explain my reasons for withdrawing	Yes	No

Name of the participant:	
Signature:	
Date:	

Annex 03: List of Participants

Policy Makers:

No.	Name	Email	Contact Number	Role
1	Ms. Kumari Meegahakotuwa	kumari5meegahakotuwa@yahoo.com	718570578	Dircetor General, Research, Innoovations, Ministry of Science and Technology
2	Mr. Suresh Demel	E-mail: sureshdemel@yahoo.com	94 712221888	EDB (Agriculture exports: export promotions, Organic & GI, Trade fairs, etc)
3	Ms. MaLani Badddegama	7195008855	112303973	EDB (Agriculture exports: export promotions, Organic & GI, Trade fairs, etc)
4	Mr. Janak Sanjeewa Bdugama		112300731	EDB (Agriculture exports: export promotions, Organic & GI, Trade fairs, etc)
5	Mr. Gamini Weerasinghe	weerasinghe@slsi.lk	776 226 779, +94 711 000 054	Senior Deputy Director at Sri Lanka Standards Institution
6	Ms.NHMS Chithrapala	madusajani@yahoo.com.	94 112 252028/29 Ext: 212 +94 714 471408	Assistant Director of Agriculture (Research). National Plant Quarantine Service
7		-	94 11 2143434 Extensions:	SL Customs Export Division
8	Mr.G.L.Gnanatheva	gnanatheva@doc.gov.lk	011 232 9734/ ext 316	Department of Commerce, Deputy Head of Trade Promotion Division
9	Mr. K. Kanojan	npo@edb.gov.lk	Telephone :94 21 221 5944	Director,EDB Provincial Office North Province
10	Mr. Saranga Wijeyarathne	saranga111@gmail.com	Direct (+94) 773 219 773	Colombo Chamber of Commerce
11	Mr. Nasser Hammad		+94 773 082870	Lanka Fruit & Vegetable Producers, Processors and Exporters Association, Nawam Mawatha, Colombo, Sri Lanka

12	Prof. Dharmadasa	dharmadasarm@gmail.com	702588542	Research Professor/ Director, Industrial Technology Institute
13	Prof. Manjula Magamage	magamage@agri.sab.ac.lk	0716143955 0772445783	Chairman, National Livestock Development Board
14		direoh@health.gov.lk	94 112 694 860	Food Control Administration Unit Ministry of Health
15	Dr. (Mrs) Siddhika G Senaratne	dg@slsi.lk	94 11 2671574	Director General, SLSI
16	Ms. T.T. Upulmalee Premathilaka	cg@imexport.gov.lk	94 112 448311	Controller General, Department of Imports and Exports Control
17	Ms. Menka Wanniarachchi		94 114 651 765	Director Operations, National chamber of exporters
18	Mr. Dilhan De Silva		714433104	central bank
17	Ms. Gayani		718365003	EDB (Agriculture exports: export promotions, Organic & GI, Trade fairs, etc)

Exporters:

No.	Name	Email	Contact Number	Role
1	Mr. A. R. A. Kumara (Proprietor)		+94 523 533498	AJITH CHINESE VEGETABLE SUPPLIER
2	Mr. Indralal Jayantha Alwis (Managing Director)	-	94 312 223898	ALWIS AGRO EXPORTS (PVT) LTD
3	Mrs. Celine Josephine Sujeewa Kuhafa (General Manager)	-	94 11 2940326	BEYOND EXPORTS
4		info@vegiland.lk	0112 248 516	Vegiland Exporters Pvt. Ltd
5	Mr. Upali Ranasinghe (Managing Director) Ms. R. A. Charindi Ranasinghe (Deputy Chairperson)		94 112 224961 94 773 536353	C.R. EXPORTS (PVT) LTD
6		amkfood@sltnet.lk	112855634	A M K Food Export Pvt Ltd
7		info@raviexport.cominfo@raviexport.com	711250283	Ravi Exports (Pvt) Limited
8				
9	Mr. Indika Daraniyagala	indika@fairtradeorganicteas.com	711935834	Greenfield Bio Plantation (pvt) ltd
10	Mr. Udayanga Abesinghe	udayanga@fairtradeorganicteas.com (	-	Greenfield Bio Plantation (pvt) ltd
11	Mrs.Tharanga Abeynayake	-	718933313	Cocotana Coconut Products
12	Mr.Kusumsiri	-	711840769	Rasoda Dairy
14	Managing Director	mahesh@sriposha.lk	0718417497/ 0813124174	Sriposha Lanka Foods (PVT) Ltd Kandy
15	Mr. Eranga Abeywickrama Human Resource Manager (Head Office) Dole Lanka (Pvt) Ltd	Eranga.Abeywickrama@doleintl.com	703703017	Dole Lanka (Pvt) Ltd

16	Mr. Sathis Abeywickrama Managing Director Gurbeula Farms & Restaurants (Pvt) Ltd	usa@eol.lk , copy email to vidarsha@printusagroup.com		Gurbeula Farms & Restaurants (Pvt) Ltd
17	Mr.Janaka Chandana Abeyratne General Manager Samagi Spice Exports Pvt Ltd. Baragama Road Makandura.	samagispice@gmail.com	0412268541/ 0777728787	Samagi Spice Exports Pvt Ltd. Baragama Road Makandura.
18	Ms. Shehani Liyanage, Country Senior Marketing Manager at Upfield, Upfield professionals Sri Lanka. Resmead Place, Colombo 07	shehani.liyanage@upfield.com	769226442	Upfield Sri Lanka

Industry Stakeholders:

No.	Name	Email	Contact Number	Role

1	Mr. Ishafir Izzadeen	izzadeen@aitkenspence.lk izzami65@gmail.com	077779507 / 0772449478	Senior General Manager, Atiken Spence Plantations
2	Mr. Geeth Kumara Dayananada	icco@elpitiya.com	777225453	Senior General Manager, Elpitiya Plantations, Aitken Spence Plantations
3	Mr. Nishan Senewirathne	nishanthas@lalanrubber.com	072259777 0772376209	General Manager, Lalans Rubber co. pvt. Ltd.
4	Mr. Prasanna Hettiaarachchi	prasanna@saaraketha.com	773451768	Founder, Saraketha Holdings
5	Mr. M.S. Andrew	andrew.marcus@maxies.lk	(+94) 70 4931727 (+94) 31 2255555	Quality Manger Maxies & Company (Pvt) Ltd
6	Mr. Nalin Lokuge	nalin@hddes.com	768945225	HDDES Group General Manager
7	Dr. Nelum Vithana	nelum.v@cargillsceylon.com	770283149	Group Manager,Health and Nutrition, Cargills Ceylon PLC
8	Mr.Vikum Nissanka	vikum.n@cargillsceylon.com	0717741333/0767481333	Manager-Product Development, Cargills Ceylon Plc
9	Ms. Chalithra Dissanayake	chalithra.a@lankem.lk	776765673	Manager-Marketing, Lankem Ceylon Plc.
10	Mr. Manjula Doloswala	doloswala@versa.lk	702110293	CEO, Versatile Business Solutions
11	CAN market	canmarket@thecreativeisle.com	+94 71 869 8084	CAN market

12	Tyrell Fernanodo	tyrell@sltnet.lk	00 94 312233773	Director, People's Organisation for Development Import & Export.
13	GOOD Market		077 020 8642	
14	Mr. Chamila Gunarathna		112 308308	(Manager Exports), Atiken Spence Plantations
15	Lanka Canneries (Pvt) Ltd	info@lankacanneries.com	011-2586622	Lanka Canneries (Pvt) Ltd
16	Mr. Randeewa Malalasooriya (Cluster CEO) Ms. Pasani Siriwardena (Business Support Executive)		117 388500 - 4	CBL NATURAL FOODS (PVT) LTD
17	Mr. Priyanthe		718684276	Amazon trading (Pvt) Ltd/ English tea shop
18	Mr. Sudesh Mahanama		342280092	Wijaya Products (PVT) LTD
19	Mr. U.J.Gunawardhana, Assistant Manager, CIC Agri Business, Hingurakgoda	jayasiri@cicagri.com	773570491	CIC Agri Produce Marketing (Pvt) Ltd.
20	Mrs.Dilini Pathirage Quality Assurance Manager Lanka Spice (Pvt)Ltd- Mc Currie Green Foods (Pvt)Ltd	dilini@mccurrie.net hrmccurrie@gmail.com	703033725	Lanka Spice (Pvt)Ltd- Mc Currie Green Foods (Pvt)Ltd
21	Mr.Malinda Rajakaruna Production Manager (Biscuits), Uswatte Confectionery Works (Pvt) Ltd, Millaniya.	malinda.k@uswatteconfectionery.com	777543477	Uswatte Confectionery Works (Pvt) Ltd,
22	Mr. Nishantha Bandara Production Manager Sunquick Lanka Pvt Ltd Munagama, A8 Horana.	nishantha.b@sunquicklanka.com	(070) 337 3006	Sunquick Lanka Pvt Ltd

23	Mr.Clement Fernando		777302899	JH Holdings
24	Mr.Mafaz		077 3623791	Expolanka
25	Mr.Malinda Rajakaruna	malinda.k@uswatteconfectionery.com	777543477	Production Manager (Biscuits), Uswatte Confectionery Works (Pvt) Ltd, Millaniya.

Annex 04: Questionnaire 01

Agriculture Sector Modernization Project (ASMP)District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

Questionnaire 1: primary activities: ASMP

stakeholdermeeting2022@gmail.com (not shared)
Switch accounts

Select the most suitable districts for the following crop cultivation. (permanent/semi permanent crops).

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Cashew	☐	☐	☐	☐	☐
Orange/lime	☐	☐	☐	☐	☐
Mango	☐	☐	☐	☐	☐
Jack	☐	☐	☐	☐	☐
Plantain	☐	☐	☐	☐	☐
Papaw	☐	☐	☐	☐	☐
Pineapple	☐	☐	☐	☐	☐
Passion fruit	☐	☐	☐	☐	☐
Betel leaves	☐	☐	☐	☐	☐
Durian	☐	☐	☐	☐	☐

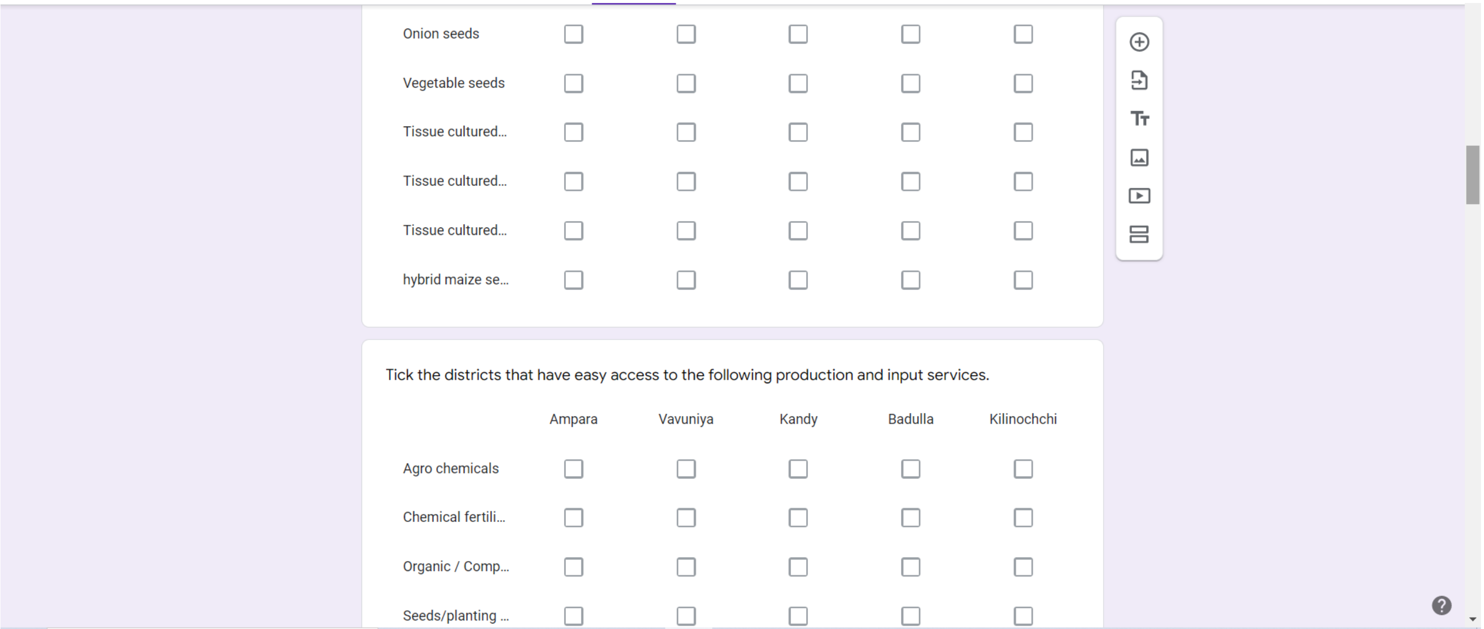
Soursop	☐	☐	☐	☐	☐
Rambutan	☐	☐	☐	☐	☐
Avocado	☐	☐	☐	☐	☐
Mangosteen	☐	☐	☐	☐	☐

Add your remarks on above here.

Long-answer text

Select the most suitable districts for the following crop cultivation. (Seasonal crops)

Cowpea	☐	☐	☐	☐	☐
Black gram	☐	☐	☐	☐	☐
Gingelly	☐	☐	☐	☐	☐
Peanut	☐	☐	☐	☐	☐
Manioc	☐	☐	☐	☐	☐
Sweet potatoes	☐	☐	☐	☐	☐
Onion	☐	☐	☐	☐	☐
Green chilies	☐	☐	☐	☐	☐
Mustard	☐	☐	☐	☐	☐
Ginger	☐	☐	☐	☐	☐
Turmeric	☐	☐	☐	☐	☐
Vegetables gro...	☐	☐	☐	☐	☐
Vegetables gro...	☐	☐	☐	☐	☐
Herbs (Bassils, ...	☐	☐	☐	☐	☐
Sun flower	☐	☐	☐	☐	☐
Soybean	☐	☐	☐	☐	☐
Garlic	☐	☐	☐	☐	☐



Onion seeds	☐	☐	☐	☐	☐
Vegetable seeds	☐	☐	☐	☐	☐
Tissue cultured...	☐	☐	☐	☐	☐
Tissue cultured...	☐	☐	☐	☐	☐
Tissue cultured...	☐	☐	☐	☐	☐
hybrid maize se...	☐	☐	☐	☐	☐

Tick the districts that have easy access to the following production and input services.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Agro chemicals	☐	☐	☐	☐	☐
Chemical fertili...	☐	☐	☐	☐	☐
Organic / Comp...	☐	☐	☐	☐	☐
Seeds/planting ...	☐	☐	☐	☐	☐

Machinery	☐	☐	☐	☐	☐
Irrigation	☐	☐	☐	☐	☐
Labour	☐	☐	☐	☐	☐
Capital	☐	☐	☐	☐	☐
Production equi...	☐	☐	☐	☐	☐
Greenhouses	☐	☐	☐	☐	☐
Nurseries	☐	☐	☐	☐	☐
Rain shelters	☐	☐	☐	☐	☐
Information Co...	☐	☐	☐	☐	☐
Drone technolo...	☐	☐	☐	☐	☐
Mobile tools	☐	☐	☐	☐	☐
Irrigation techn...	☐	☐	☐	☐	☐
Alternative ener...	☐	☐	☐	☐	☐

Add your remarks on above here.

Long-answer text

Tick the districts that have easy access to the following extension, education, and training services.

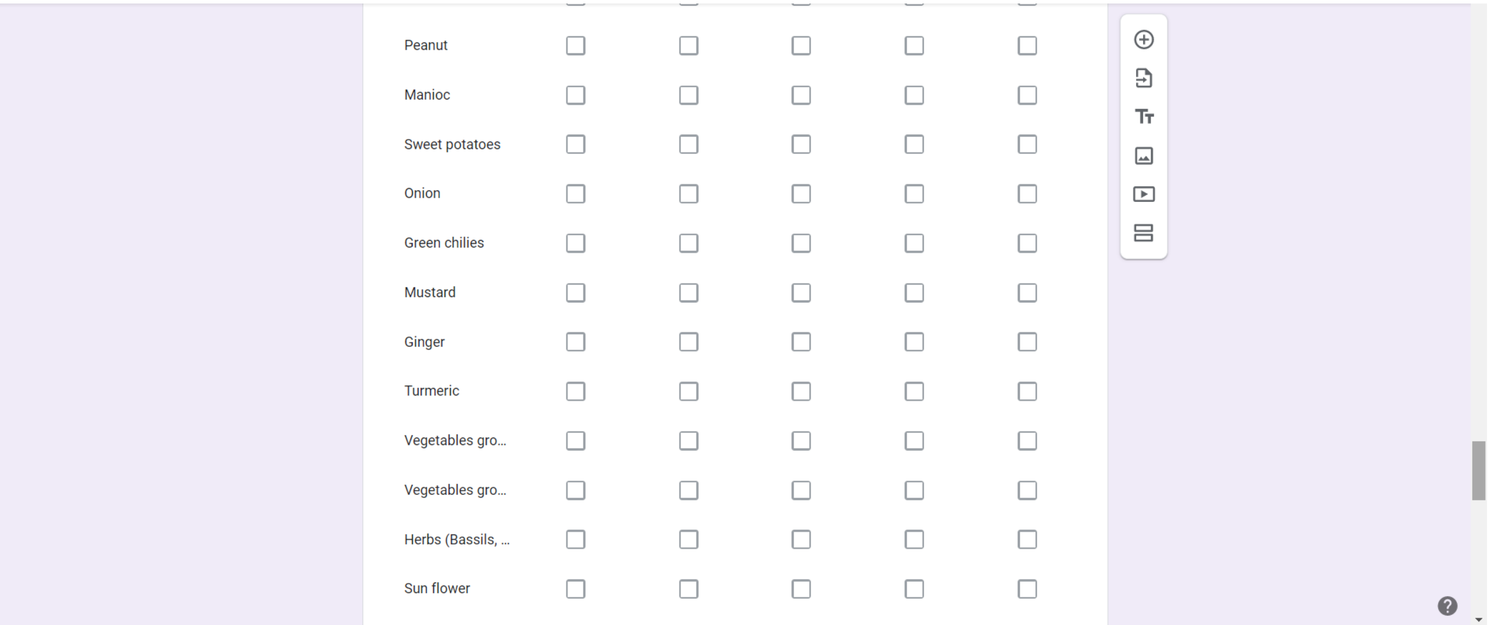
	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Package of Tec...	☐	☐	☐	☐	☐
School on the A...	☐	☐	☐	☐	☐
Training of Trai...	☐	☐	☐	☐	☐
Farmer's Field ...	☐	☐	☐	☐	☐
Specialized Trai...	☐	☐	☐	☐	☐
Tree Rehabilitat...	☐	☐	☐	☐	☐
Incentives to M...	☐	☐	☐	☐	☐
Information, Ed...	☐	☐	☐	☐	☐
Awards and Re...	☐	☐	☐	☐	☐
Learning Sites	☐	☐	☐	☐	☐

Add your remarks on above here.

Long-answer text

Tick the quality certifications / guidelines you need ASMP to go with each crop.

	SL- GAP	Organic	GMP	HACCP	Other
Cashew	☐	☐	☐	☐	☐
Orange/lime	☐	☐	☐	☐	☐
Mango	☐	☐	☐	☐	☐
Jack	☐	☐	☐	☐	☐
Plantain	☐	☐	☐	☐	☐
Papaw	☐	☐	☐	☐	☐
Pineapple	☐	☐	☐	☐	☐
Passion fruit	☐	☐	☐	☐	☐
Betel leaves	☐	☐	☐	☐	☐
Durian	☐	☐	☐	☐	☐
Soursop	☐	☐	☐	☐	☐
Rambutan	☐	☐	☐	☐	☐
Avocado	☐	☐	☐	☐	☐



Peanut	☐	☐	☐	☐	☐
Manioc	☐	☐	☐	☐	☐
Sweet potatoes	☐	☐	☐	☐	☐
Onion	☐	☐	☐	☐	☐
Green chilies	☐	☐	☐	☐	☐
Mustard	☐	☐	☐	☐	☐
Ginger	☐	☐	☐	☐	☐
Turmeric	☐	☐	☐	☐	☐
Vegetables gro...	☐	☐	☐	☐	☐
Vegetables gro...	☐	☐	☐	☐	☐
Herbs (Bassils, ...	☐	☐	☐	☐	☐
Sun flower	☐	☐	☐	☐	☐

Soybean	☐	☐	☐	☐	☐
Garlic	☐	☐	☐	☐	☐

Add your remarks on above here.

Long-answer text

Value addition potential - Tick the suitable crops for the given value added activities.

	Fruits	Vegetables	Spices	Green leav...	Cereals	Pulses	other
Sorting & g...	☐	☐	☐	☐	☐	☐	☐
Cleaning / ...	☐	☐	☐	☐	☐	☐	☐
Waxing or ...	☐	☐	☐	☐	☐	☐	☐
Temperatu...	☐	☐	☐	☐	☐	☐	☐
Labelling &...	☐	☐	☐	☐	☐	☐	☐
Bottling / c...	☐	☐	☐	☐	☐	☐	☐
Dehydration	☐	☐	☐	☐	☐	☐	☐
Drying	☐	☐	☐	☐	☐	☐	☐
As fresh c...	☐	☐	☐	☐	☐	☐	☐
Pickling	☐	☐	☐	☐	☐	☐	☐
Pulping	☐	☐	☐	☐	☐	☐	☐
Concentrat...	☐	☐	☐	☐	☐	☐	☐
Teas	☐	☐	☐	☐	☐	☐	☐
Confection...	☐	☐	☐	☐	☐	☐	☐
Snacks	☐	☐	☐	☐	☐	☐	☐
Flour / po...	☐	☐	☐	☐	☐	☐	☐

Annex 05: Questionnaire 02

Agriculture Sector Modernization Project (ASMP)District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

Questionnaire 02: Support activities(The overall expectation of this particular questionnaire is to analyze existing enabling environment at the provincial level with respect to the input / service availability & the consistency.)

1. Tick the districts which the below mentioned technological interventions can be easily accessed.

Tick all that apply.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Quality Planting material availability	☐	☐	☐	☐	☐
Land preparation machinery/technology availability	☐	☐	☐	☐	☐
Field planting machinery/technology availability	☐	☐	☐	☐	☐
Pest and disease control chemical /(IPM) availability	☐	☐	☐	☐	☐
Fertilizer availability	☐	☐	☐	☐	☐
Irrigation systems / technology avilability	☐	☐	☐	☐	☐
Wild animal control methods availability	☐	☐	☐	☐	☐
Harvesting (combine harvesters) technology availability	☐	☐	☐	☐	☐
Post-harvest technology (handling, grading, packing etc) availability	☐	☐	☐	☐	☐
Processing (drying/dehydration, canning, etc) technology availability	☐	☐	☐	☐	☐

2. Add your remarks on above here

3. Tick the districts which the below mentioned logistic facilities can be easily accessed.

Tick all that apply.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Roads (access/availability)	☐	☐	☐	☐	☐
Cold chain facility (cold storages/cold chamber trucks)	☐	☐	☐	☐	☐
warehouse facilities	☐	☐	☐	☐	☐
Energy sources	☐	☐	☐	☐	☐
Buy back arrangements	☐	☐	☐	☐	☐
Transport (vehicles, access)	☐	☐	☐	☐	☐

4. Add your remarks on above here

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5. Tick the districts which the below mentioned networking and market intelligence facilities can be easily accessed.

Tick all that apply.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Online/mobile value chain networks	☐	☐	☐	☐	☐
Price information	☐	☐	☐	☐	☐
Informal contracts among value chain actors	☐	☐	☐	☐	☐
Trust & reciprocity among value chain actors	☐	☐	☐	☐	☐
Active farmer organizations	☐	☐	☐	☐	☐
Capacity building programmes by CBOs	☐	☐	☐	☐	☐
Management support					

6. Add your remarks on above here

7. Tick the districts which the below mentioned food and income security dimensions can be easily accessed.

Mark only one oval per row.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Food affordability	⬭	⬭	⬭	⬭	⬭
Food availability	⬭	⬭	⬭	⬭	⬭
Food access	⬭	⬭	⬭	⬭	⬭

8. Add your remarks on above here

Annex 06: Questionnaire 03

Agriculture Sector Modernization Project (ASMP)District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

Questionnaire 03-Institutional environment (institutions, services, problems, expected services)

1. Tick the most important institution/s mentioned below in each district with reference to agribusiness and value chain development

Mark only one oval per row.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
DoA					
Banks financing agriculture					
Micro finance institutions					
Agrarian service centers					
NGOs					

2. What are the other important service providing institutions?

3. Tick the easily accessed services from the following in each district.

Mark only one oval per row.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Training and extension					
Financial services					
Appropriate machinery					

4. What are the other services that could be accessed easily?

5. What are the critical problems of the institutional environment on agribusiness & value chain development? (please mention with the district)

6. What are the expected services from institutions in each district on agribusiness & value chain development?

Annex 07: Summary table of the Note taking

Policy-makers	Processors/ exporters	Industry
Dr. Thushara Wickramarachchi- • Throughout the proposal, the export market orientation of the products has not been addressed. • Highly targeted to the agriculture technology demonstration. • Since the major portion of the export market-oriented production is produced by the small-scale farmers, they should be well aware of the plant protection, quarantine	Mr. Jagath (questionnaire 01 discussion) • ASMP has a poor focus on scientific aspect of farming, poor focus on yield and quality of the produce and poor scientific knowledge transfer to the farmers. • Farmer capacity building is very poor in Sri Lanka. • ASMP project targeted on different crops and those crops have different	• For this discussion, around **19** stakeholders participated to express their thoughtful ideas representing the leading Agri-Food industries. • Before the official talks starts, a small chat was there on different high-valued crops/food commodities, such as pumpkin flour, hybrid maize, capsicum ("Nai Mirisi"), etc., • The pumpkin powder is identified as one of the highly valued flour. Further,

rules, and also the export market expectation. **Supportive services-** Dr. Thushara Wickramarachchi- • At the grassroots level, farmers lack extension services and it is not well organized. • Agriculture diplomates can be involved in agriculture extension. • Extension officers should be independent since they have the responsibility of certifying the products. • Maldives and middle-East countries markets are more available for Sri Lankan products and Europe and the East-Asia (Korea, China) markets also can be targeted. • The project should be well connected with the EDB, the Department of Commerce, and the National quarantine center. **Regulations** Dr. Thushara Wickramarachchi- • Each and every product starting from the farm should be monitored by the National plant quarantine center or any officer attached to the National plant quarantine center at all stages of the supply/ value chain.	time lines. Therefore, need to prioritize crops according to the necessity. • Better to target on cash crops/ crops with short life cycle; Ginger/turmeric/garlic/chili/maize. • Also need to target on safety/quality/cost of the product. • Need to source quality seeds and planting materials, pest, and disease control. Mr. Saman Dewage (questionnaire 2) • Some planting materials are unavailable in some districts. (Kandy/Badulla- Flower nurseries> Kilinochchi/Ampara- Mango nurseries) • If SCS certification of DoA is available, then the planting material considered of high quality. • Agro chemicals were available in each district earlier, but now there is a shortage due to the economic recession of the country. • There is a huge shortage of materials (pest control/chemical fertilizer/ Agro chemicals) now in each district studies. • Earlier the government subsidies made fertilizer, Agro chemicals available with the farmers.	the practical issues such as processing issue in producing the pumpkin flour are further highlighted. • Suggestion were given from Mr. Arjuna for formulating clusters to produce Manioc flour specially as a substitute for a wheat flour. Mr. Gemunu answered that the manioc flour has high global demand and more expensive. Therefore, it there is will be a high potential to export. The cultivation can be done areas like Gamapha. • Mr. Gamunu highlighted that the problems arise in Sri Lanka due to the economics of scale specially affected on lack of production. Eg: Sunflower oil production • Mr. Nishantha Jayamanna : There is a possibility to do jumbo peanut production in areas such as angunakolapallassa, Vavuniya like areas with farmer clusters and buy back systems. • Suggestion came from Mr. Arnjuna to mix the moringa powder and white flour (flour enrisched with moringa powder). Mr. Gamunu Jayasundara

• Total traceability should be added • Suggest appointing one person from the project to demonstrate farmers the traceability and to link with the National plant quarantine center. • Suggest adding the system approach to monitor traceability in each stage. • Private-public partnership is suggested to gain the machinery and required equipment. (With Department of Agriculture) • 100% traceability and proper linkage with the National plant quarantine center is required to make the export process more successful.	• Better to provide inputs such as Agro chemicals and fertilizer and fuel for farmers to start their cultivation back. (Immediate need) • As secondary measures need to provide micro irrigation, training on high-tech, high-quality planting materials) Mr. Saman Dewage (questionnaire 3) • All the institutions are important to improve the agriculture sector. (DoA/ agrarian service centers/ micro finance etc). • Institutions need to have good coordination among each other. • By combining primary input + secondary inputs and service providing institutions, a good agri output can be sourced. • DoA should focus more in quality seed and planting material development. We are at a lower level in this area when compared to other Asian countries. • Also, agri finance aspects need to be developed more and should increase farmers' access. • Buy back agreements are not functioning well in Sri-Lanka due to two reasons. ○ Farmers are reluctant to sell to	answered that it's possible for a niche market. • Mr. Gamunu: These days there is a high demand for capsicum "nie miris".there, the clusters have to be formed **Official discussion** The first focus is given to finding out the best crops which can be grown under the project. Different crops were taken one by one and highlighted the potential of cultivating each crop. Further, the stakeholders requested more time to go through the questionnaire and submit it after the end of the session. **<u>Cashew</u>** • Currently, Sri Lanka cashew production is unable to meet the market requirement. Mst of the processors import cashew from Ivory Coast and Vietnam and go back in the Sri Lankan name. • Sri Lankan cashew has more recognition rather than other countries, especially in terms of taste. • Therefore, there is potential

	the company if the market price is higher than the agreed price. ○ If the market price is low, then contract farmers will buy other farmers' harvest too and sell to the company. (Company receives more harvest than agreed). ○ Also, companies need only high-quality product, but farmers want to sell their entire harvest to the company. Expectations are not matching between the farmer and the company. • To avoid this farmers and companies need to strictly adhere the terms and conditions if buy back agreements.	• Mr. Gamunu jayasundara highlighted that, for cashew, the harvesting time is 7 - 8 years. • Best cashew is grown in areas like; Vavuniya, Mannar, Kilinochchi, Wanathawillluwa, etc.) • Supporting institutes; Cashew corporation, cashew research institute, cashew authority) • Since there are very few cashew growers (as the farmers have to wait for a long time to collect the yield) in Sri Lanka the aforementioned institutes are giving their maximum support to the farmers in growing. • The upper top fruit of the cashew also can be used to produce a juice that has a high medicinal value. After the facts about cashew, the stakeholders were directed to focus on food items. Other than cashew; Mr. Jerad: to have 90

		Mt of ground nuts monthly, the land requirement is 30,000 Ac. It was also highlighted that there is no marketing issue in the current scenario for the Sri Lankan food items. However, there is a high cost in the production process which was highlighted as a very serious issue in the industry. Can do the value addition by contracting to avoid the high cost. There are very few fruits that we can dehydrate in Sri Lanka. At the same time, the cost of production is very high. Preservation of foods for off peaks is another good idea **<u>Jackfruit</u>** • Another interesting topic which is popped out is potential for the jackfruit cultivation. • In Sri Lanka, the jackfruit trees are not properly maintained for cultivation. • Thereforer, the products are not up to the standards. • Further, variations in varieties and breeds are there in Sri Lanka. • Thereby it was highlighted the importance of maintaining the

		quality of jackfruit-related products through high-quality panting materials/varieties. • Mr. Nilaatha Jayamanna: Tender jackfruit also has the potential for vegan customers. (annual market value is around 32 billion) Individual Quick Freezing (IQF) is a technology to avoid post-harvest losses. But it was noted that is high-cost work. If it's possible can go to the IFQ. Lower-cost energy alternatives can be newly suggested to overcome that problem **<u>Avocado</u>** • Avocado oil extraction will be having high potential in the world market. • However, one of the problems in Sri Lanka is low economics of scale which resulted in high cost per unit and low production which is enabling to meet the demand. • In Sri Lanka there are around 35 Avacado varieties • But, global markets are demanding verities like "Hass".

		• Avocado paste is also having a huge market **<u>Cocoa</u>** **Mr. Jayasundara:** Local cocoa cultivation can be developed further. Sri Lankan cocoa has 50% cream whereas the other countries' cocoa includes only around 40- 425 cream. Thereby, there is a high potential. The industries with capabilities are waiting to develop it. the problems are with the lack of raw materials. ❖ **Domestically the raw materials can be produced and can supply them to the domestic industries is one of the best ways. It will help to reduce the importation cost to the industries**. **<u>Pineapple</u>** Mr. Vikum Nissanka : Concentrated pineapple also has a high demand. But in Sri Lanka the production negligible.

		Mr. Bhathiya : A common problem for any crop production in Sri Lanka ; • Finding the plant materials (right verity) is a common issue in Sri Lanka for cultivations. • Low productivity • Low economics of scale **<u>Seed Production</u>** Ms. Chalithra: there may be a good market for good quality seeds. Therefore, producing seeds also will be a good option. **<u>Solar pumps:</u>** Mr. Bhathiya: There are practical concerns needed to give attention to when setting up solar pumps. Therefore, can go with a battery system. **<u>Solar drying system</u>**: • Mr. Bhathiya: It's a Sustainable solution and very easy. Whatever the product the best option is solar driers for reducing the moisture level and for drying. • Different systems can be adapted according to the crop

		<u>Growing crops under polytunnels</u> Problem: Polytunnel in the dry zone area is possible or not? Mr. Bhathiya: In dry zone areas, the main issue is controlling temperature. However, the artificial cooling systems have to be used. For a 200m^2 greenhouse area for a month, the minimum energy cost will be Rs. 10,000. For a 400m^2 greenhouse area for a month, the minimum energy cost will be Rs. 15,000 Should think about the energy cost prior to implementing. Diversification of crops (Eg; brokerly, cucumber, beans) cultivated under polytunnel/ greenhouse is very much important. Kandy is suitable for the polytunnel establishment. In the dry zone (Areas such as Kilinochchi, Vavuniya) it is very much important and essential to go to the

		temperature-controlled greenhouses whether it’s a seed production project or a vegetable production project. The correct technology has to be used for a good outcome. **Solar farming**: Mr. Nirmal: Its already available in Sri Lanka Mr. Bhartiya : the panels can be adjusted in order to receive the maximum light. **Seed production** : Mr. Chandana Premaratne: seed production has to be increasd.

Agriculture Sector Modernization Project (ASMP)

District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

Stakeholders' Workshop I

Potential agribusinesses and Value chain development for the new districts funded by European Union

Rationale for the Workshop:

ASMP project for new EU districts aim to contact district level feasibility Studies with respect to the establishment of Agriculture Technology Development Parks (ATDPs), and prepare comprehensive crop Cluster Development Plans (CDPs), and to aware the farmers / farmer companies, technically guide the implementation staff about the technical matters regarding the feasibility studies & especially the CDPs during the initial stage of the crop Cluster establishments.

First stakeholder workshop with agri-food industry crowd is aimed to obtain the insights of industry personnel on new trends in global market place, what opportunities available for us to link into global value chains?, problems and issues from farm to plate with reference to our context, suggestions on crops, value additions, safety and quality management, transport and logistics, etc. Comprehensive literature reviews were conducted to identify the Sri Lankan context to understand their potential capacities and gaps relating to value chain development. Industry environmental scanning and Institutional analysis are planning to understand the status of business enabling environment. A workshop with necessary stakeholders is needed to finalise the potential crops, agribusiness ventures, value additions, safety and quality requirements, technological interventions, logistic and postharvest chin management practices.

Objectives of the Workshop:

The objectives of the proposed workshop are threefold:

1. Introducing the concept of the project, objectives and expectations in the context of new project locations/districts with specific focus on the agricultural sector
2. Discussion on potential crops, agribusiness ventures, value additions, safety and quality requirements, technological interventions, logistic and postharvest chain management practices.
3. Identifying recommendations from stakeholder perspectives about the way forward in implementing the crop production clusters, Agriculture Technology Development Parks, capacity building of individual as well as farmer groups, knowledge sharing and information sharing methods

Methodology:

Selection of stakeholders was based on their business engagement and both public and private sector institutions in agriculture sector were purposely selected for the event. Executive level officers were selected across the institutions and stakeholder workshop was planned to conduct via online mode due to the prevailing conditions of the county. First, all participants were invited via telephone calls and later concept of the workshop (annex 1) and agenda (annex 2) was emailed to all invited participants prior to the workshop. Reminders were sent to all invited participants and confirm their participation through the telephone calls. Final list of invited participants were divided into 3 groups; industry, exporters and policy makers.

Further, each sub group was allocated into the breakout rooms and discussions were planned with each group separately and discussions were managed by 2 consultants and facilitated by the note takers. Overall discussion was managed by the agribusiness and value chain specialist. First part of the discussion based on presentations made by ASMP project team and the presentations were on introduction to the project along with brief presentations of each subject specialist. Brief presentation of the subject specialists were selection and development of agricultural value chains, economic analysis of selected value chains, formation of farmer companies, environmental and social safe guard of the project, agronomic perspectives, value addition and formation of farm cluster processing hubs and GIS base decision support system.

Second part of the workshop was begun with the allocating each individual participant into respective breakout room. Three questionnaires, Google forms were shared among the group. Questionnaires were on potential crops; perennial crops, seasonal crops, etc. for the new project districts, potential agribusiness and analysis of institutional environment of the each district. Ten minutes were allocated to each questionnaire and discussions were performed after completing the questionnaire. Discussions were facilitated by the project team. Details of the sessions are as follows;

- All the stakeholders were assigned to three breakout rooms based on the following categories and for each breakout rooms, one facilitator and a note taker was assigned. (Annex 01)

  - Policy Makers: Mr. Chopadithya Edirisinghe & Mr.S.B. Adikari
    Note taker – Ms. Thilini Hansika
  - Exporters: Dr. S.Darmadasa & Mr. G. Prathapasinghe
    Note taker – Ms. Ruwini Bandara
  - Industry Stakeholders: Mr. Arjuna Dissanayake & Prasad Jayaweera
    Note taker – Ms. Sulochana Senevirathne

- **1st Discussion Session: Primary activities of the value chains**

- Ten minutes provided for filling the survey on primary activities of the agri-food value chains

(Survey Link: https://docs.google.com/forms/d/e/1FAIpQLSfx34rBrhNCh3IV3Ksi4-h6unnsTtcTNMNT9lFhy7sPtvRptQ/viewform) (Annex 02)

- Twenty minutes for the discussion: Discussed on the tentative crops, crop clusters, potential agribusinesses, value additions, safety and quality requirements, postharvest chain management, etc.

- **2nd Discussion Session: support activities of the value chain**

- Ten minutes provided for filling the survey on support activities of the value chain. (Survey Link: https://docs.google.com/forms/d/e/1FAIpQLSdasauSOszLiJB48YV67Gq1GcuMTtODkwf0M9uvjyaTLc0BMA/viewform) (Annex 02)

- Twenty minutes for the discussion: Discussed on the technological interventions, logistics, networking and market intelligence, farmer companies, capacity building, management of cluster sustainability, food and income security, etc.

- **3rd Discussion Session: Institutional Environment**

- Ten minutes provided for filling the survey on institutional environment of the agri-food value chains.

(Survey Link: https://docs.google.com/forms/d/e/1FAIpQLSeohMJQ_87ILzxhMLsdKmSW3rQb0unrQPuaL9QtNWwi6_qsbQ/viewform) (Annex 03)

- Twenty minutes for the discussion on supportive institutions related to the agri-food value chains.

After all, three discussion sessions; a facilitated discussion was conducted by Prof. D.A.M. De Silva with all the stakeholders on the most effective export oriented, and or import substitution crops/clusters to design cluster development plans, ATDPs, etc.

Results :

Discussion Session 01: Primary activities of the value chains

In the first session, the stakeholders were selected most suitable districts for permanent/semi-permanent crops and for seasonal crops as shown in the following fig.1 and fig.2. Majority of the stakeholders have selected Kandy and Ampara as most suitable districts for the both types of crops.

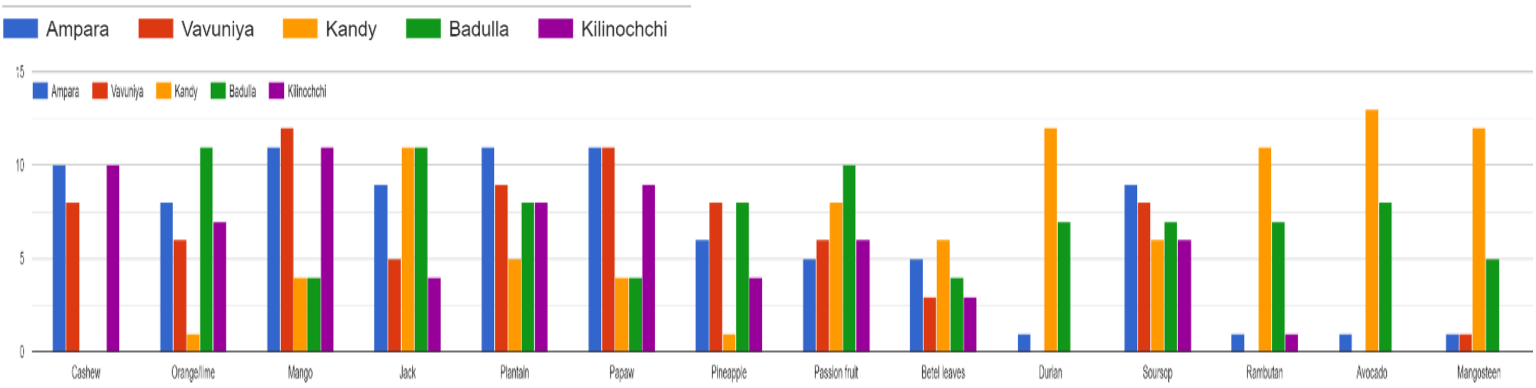


Fig.1 Most Suitable districts for permanent/semi permanent crops

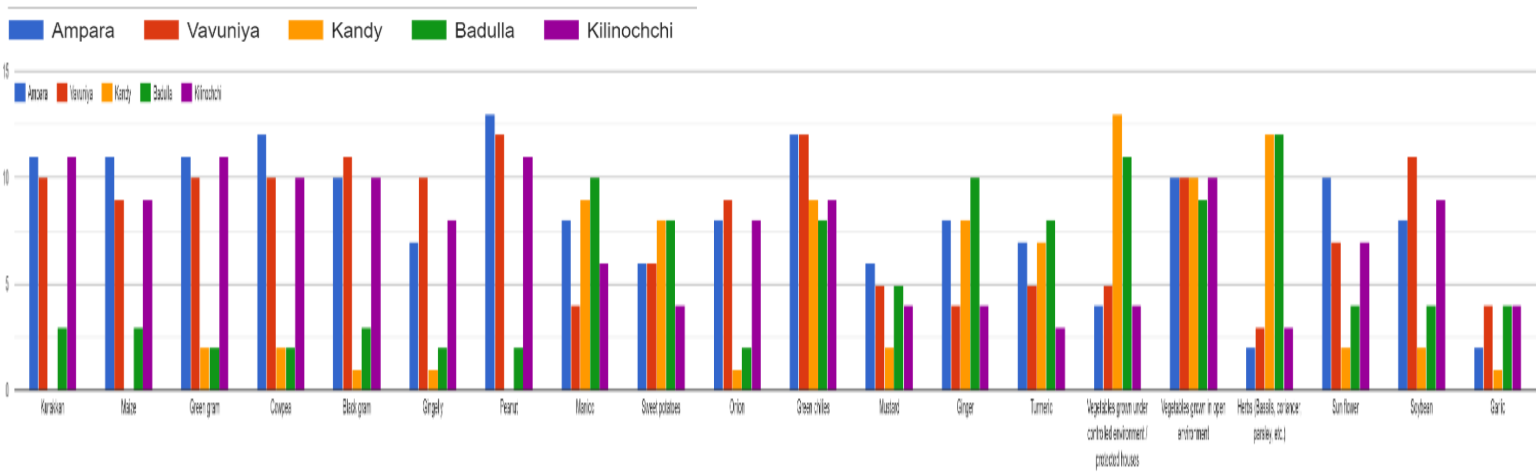


Fig.2 Most suitable districts for Seasonal crops

Further, the stakeholders have suggested that herbals, moringa leaves, soursop leaves, tamarind, rampe, sera etc. also can add to this crop list and Maize and cowpea also mentioned as potential crops in this areas and suggested Anuradhapura district also a potential district to consider.

As potential districts for planting material production, stakeholders have selected Badulla district mainly for seed potato production, tissue cultured banana plants and tissue cultured orchids plants. And also majority of them have selected Kandy district for vegetable seeds and tissue cultured anthurium plants. (Fig.3)

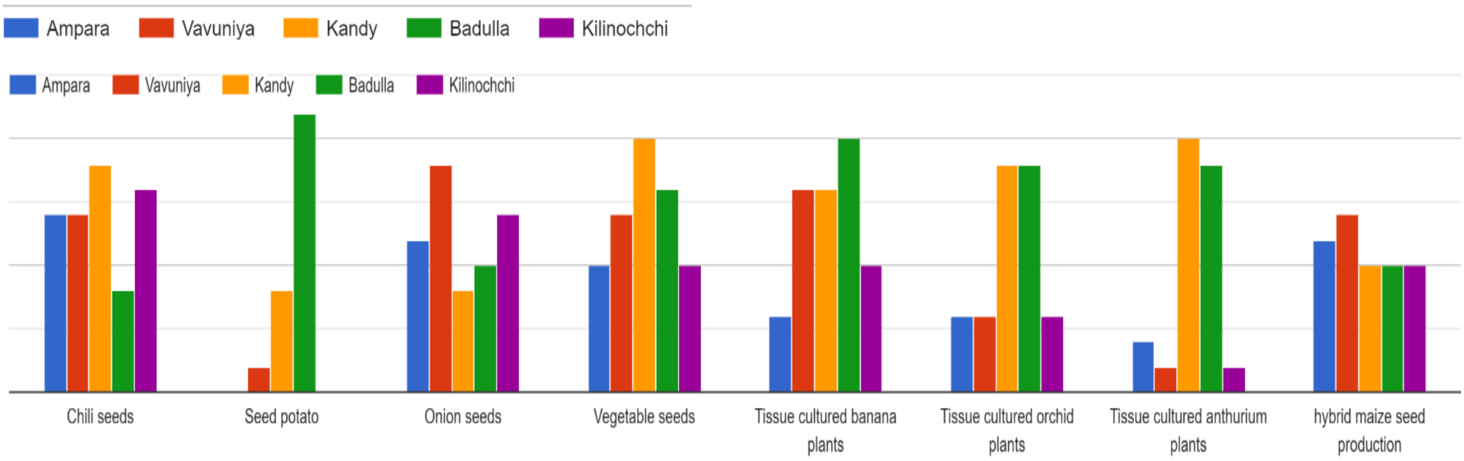


Fig.3 Most suitable districts for the Planting material production

When considering on easy access to the production and input services, majority of stakeholders have selected as Ampara district for labours, Badulla for nurseries and green houses. And further Vauniya district for agro chemicals, chemical fertilizer, organic/compost fertilizer, irrigation technology and machineries (Fig.4).

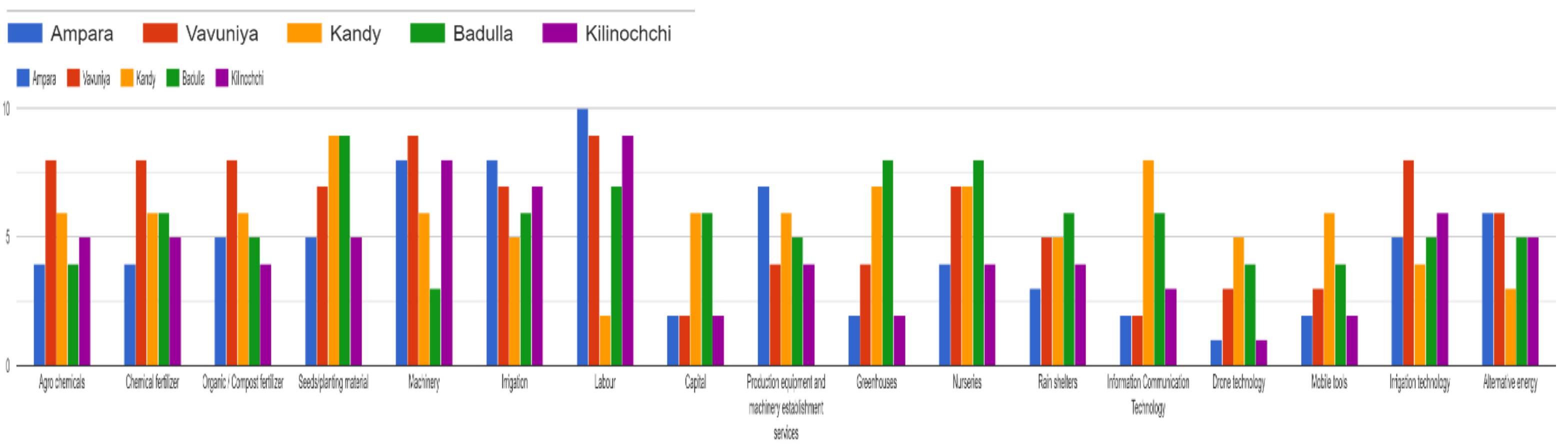


Fig.4 Easy access to the production and input services

Moreover, they have mentioned as lack of inputs services in Ampara and there is no special differences in case of access to inputs among districts. Its a national level problem. And those inputs can supply to any place in the country if the materials are available in the country.

As shown in the fig.5 and fig.6, stakeholders have selected Kandy district is the district which having easy access to the extension, education, and training services and also Badulla district as the most received opportunities for Research and development.

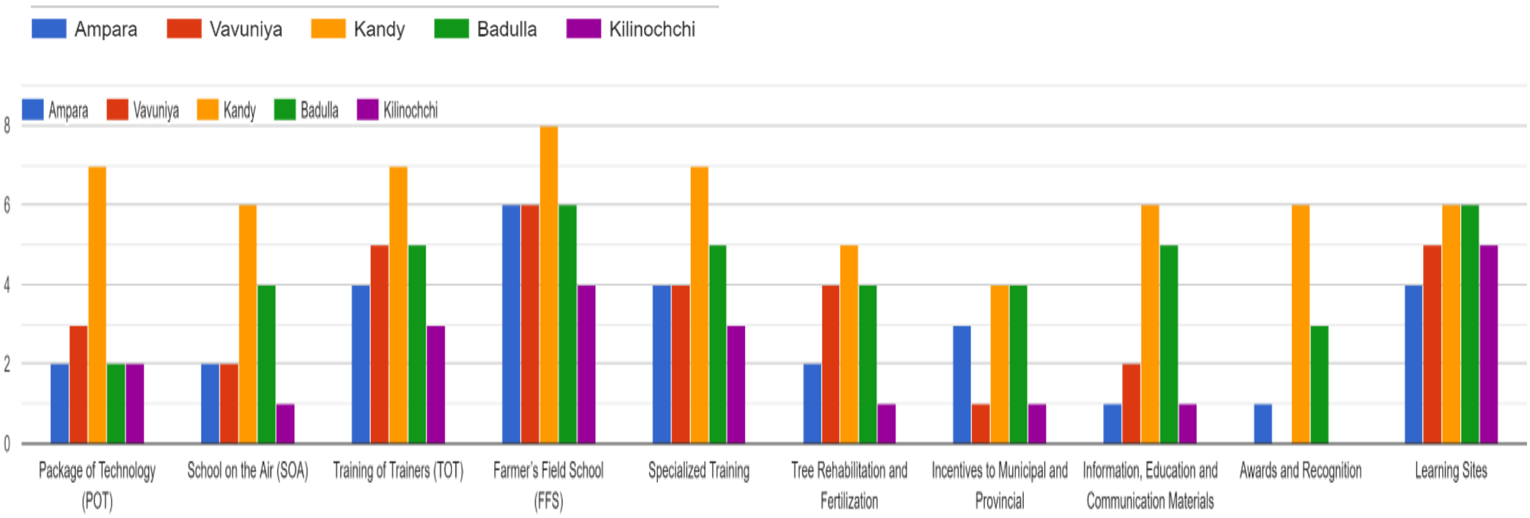


Fig.5 Districts that have easy access to the extension, education, and training services

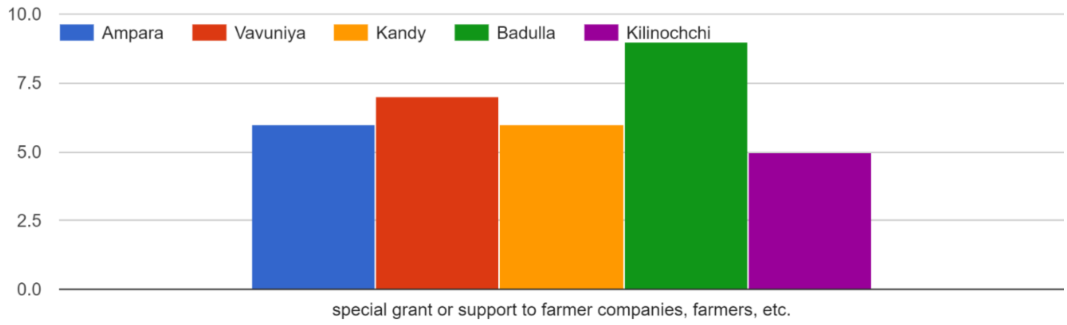


Fig.6 Districts that have received opportunities for Research and development

Majority of stakeholders,Sri lankan GAP and organic certifications were selected as the quality certifications / guidelines you need ASMP to go with each crop (Fig.7). Further, fruits, vegetables and spices selected as most potential value additions (Fig.8)

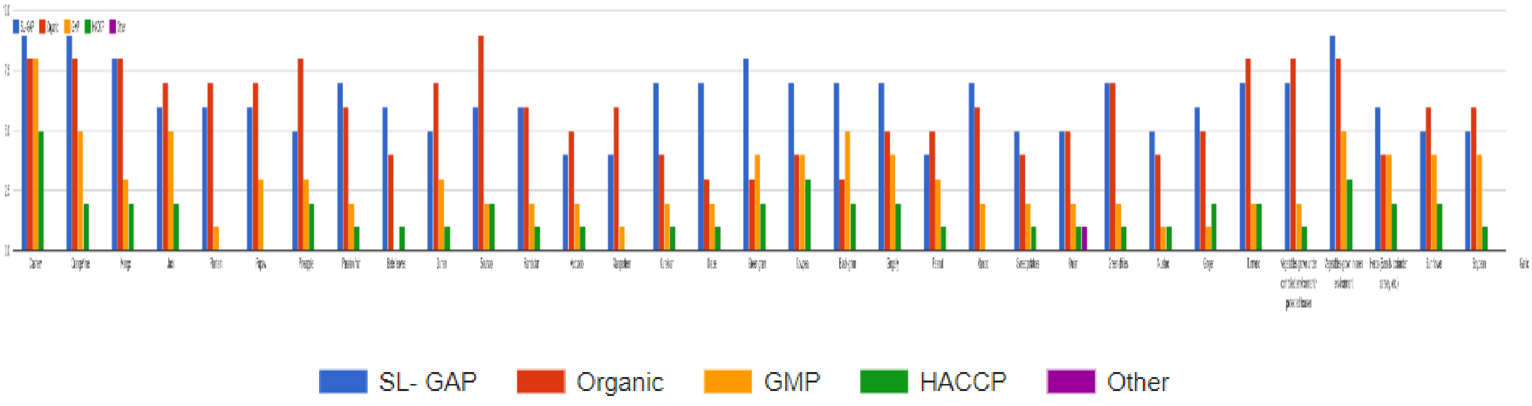


Fig.7 The quality certifications / guidelines you need ASMP to go with each crop

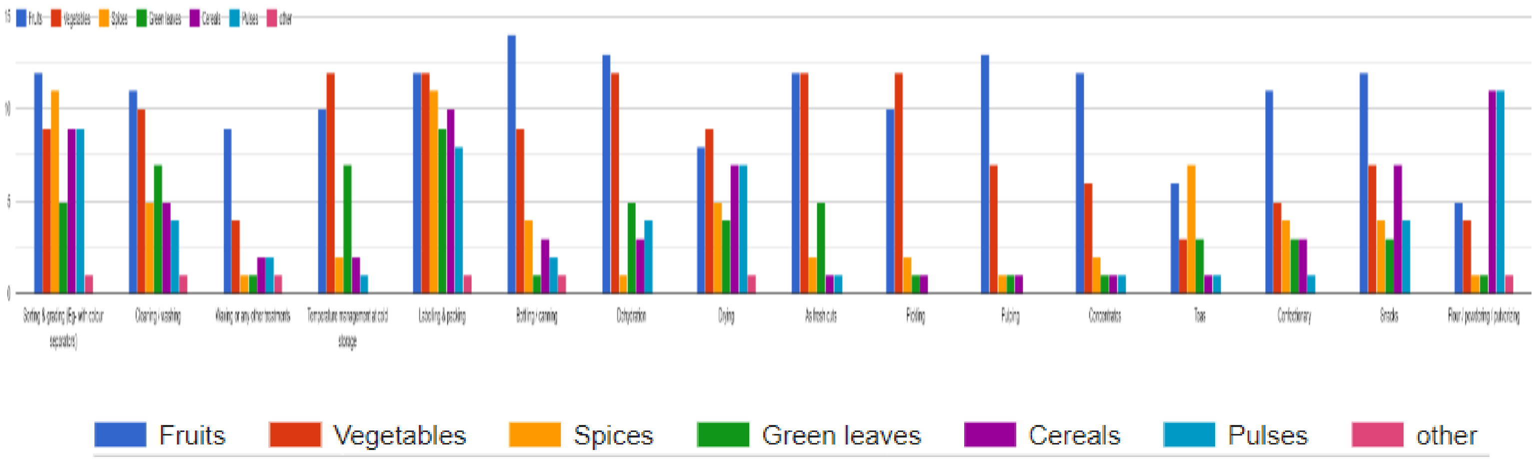


Fig.8 Value addition potential

Discussion Session 02: Support activities of the value chain

Second focus is on support activities of the value chain: Technological interventions, logistics, networking and market intelligence, farmer companies, capacity building, management of cluster sustainability, food and income security, etc. the majority of stakeholders have selected Kandy district for technological intervention, logistics and for networking and market intelligence facilities (Fig.9, Fig.10 and Fig.11).

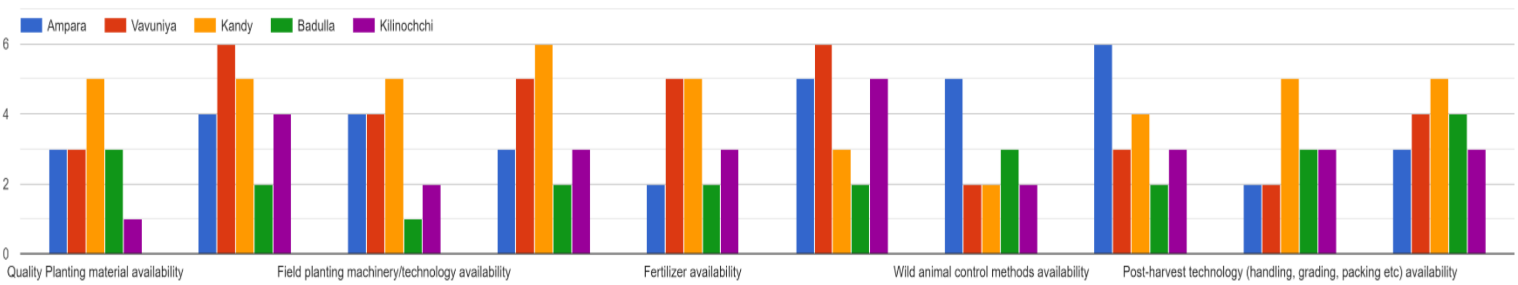


Fig.9 Technological interventions

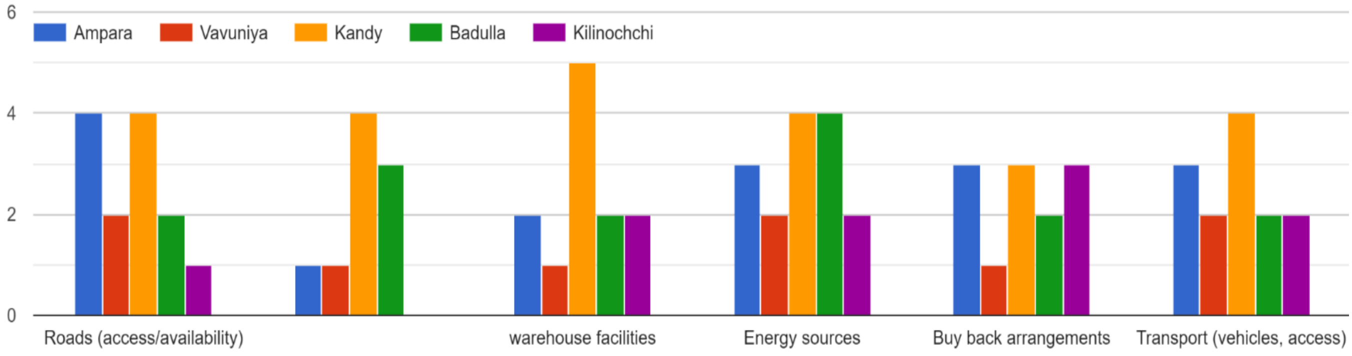


Fig.10 Logistics Facilities

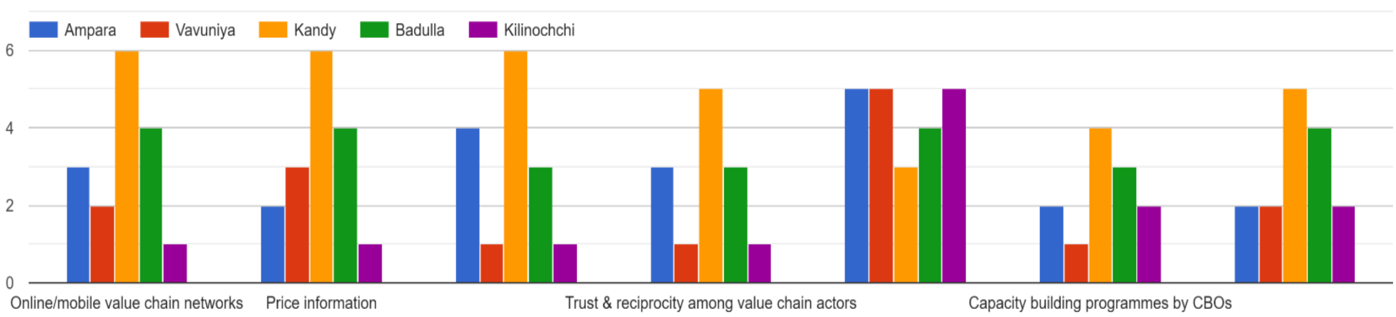


Fig.11 Networking and market intelligence facilities

When considering on the food and income security dimensions, again Kandy district is the choice of majority of stakeholders. (Fig.12)

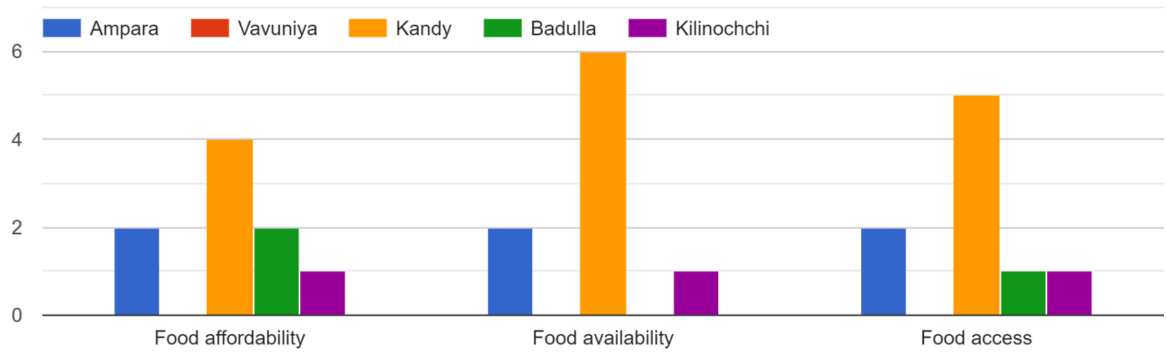


Fig.12 Food and income security dimensions

Discussion Session 03: Institutional Environment

The draft institutional analysis developed by the project team was presented followed by a facilitated discussion between the stakeholders to refine the environmental scanning. As per the majority of stakeholders, most important institutions and easily accessed services also located in Kandy district which is shown in following fig.13 and 14.

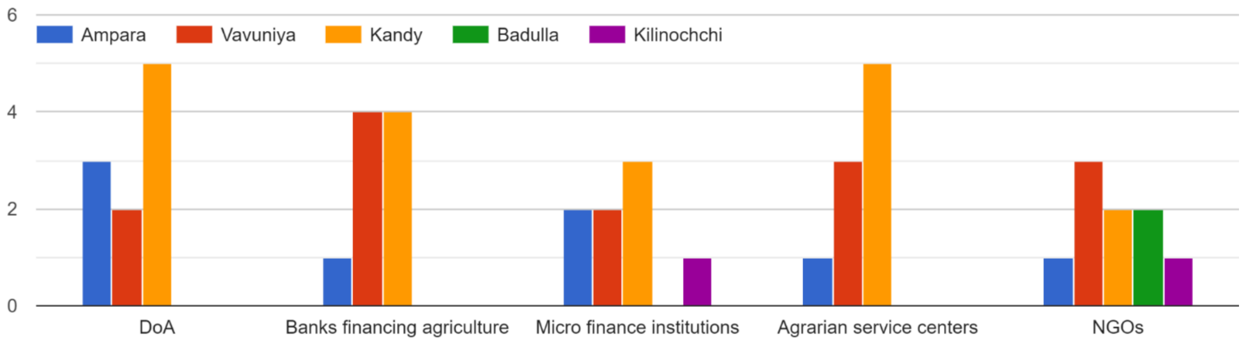


Fig.13 Most important institution/s

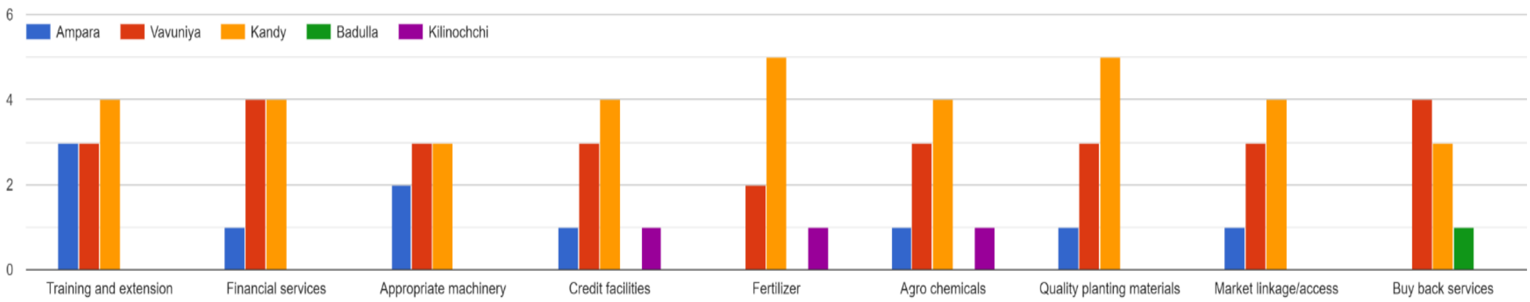


Fig.14 Easily accessed services

The stakeholders have stated that, critical issues of the institutional environment on agribusiness & value chain development as per their view;

- Improper market facilities in Vavuniya District
- Scarcity of technology, Skills, Marketing standard and resources ,
- lack of awareness of the institutes and their services rendered
- Transfer of Scientific Knowledge and Cultural Practices of Growing for all crops
- Most important things are lab facilities, farmer networks, Machinery equipment packing materials, Value addition machineries (tea bags making machines

Further, for the expected services from institutions in each district on agribusiness & value chain development, they have mentioned as;

- Develop a good market, strengthen the farmer communication
- Need all necessary steps in value chain process
-

Special concerns;

- 1. Traceability, authenticity & transparency of export oriented produce, Train farmers from the beginning of the production process on good practices, possibility of allocate NPQS officers throughout the chain
-
- 2. Vegetable production in poly tunnel with uncommon vegetables unlike salad cucumber, bell pepper, cherry tomato (especially Badulla and Kandy districts) and use abandoned tunnels.
-
- 3. Vegetable seed production and tissue culture of planting material in Kandy and Badulla (Anthurium. Pl. Discuss with Dr Shelumi Krisnaraja DG Botanical gardens regarding export potential of floriculture)

- Potential floriculture cluster in Badulla: Roses, Anthurium, Jerbera, Jasmine, etc

- EDB participation on export oriented prodcution
-
- High value herbs and condiments as inter crop for Hass Avacado cluster .
-
- Jackfruit for all districts with IQF – cost?????????
-

Annex 01: Concept note

Funded by
The European Union

Agriculture Sector Modernization Project (ASMP)

District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

Agenda

Stakeholders' Workshop 1

Potential agribusinesses and Value chain development for the new districts funded by European Union

Date: Wednesday 22th June 2.pm
Place: Via Zoom
Zoom link: Join Zoom Meeting
https://learn.zoom.us/j/64062108027?pwd=MTh4bmR0akd1ZjRLMEtvdmlNRHdxdz09
Meeting ID: 640 6210 8027
Passcode: 8TGc%pY2
Duration: 3 hours
Note: *The Agenda, concept note and the draft programme objectives to be shared with the Stakeholders prior to the event.*

Item	**Time (SL)**	**Duration**	**By**		
Introduction	2.00pm	10 Mins	ASMP		
Aims and expectations of the stakeholder meeting	2.10 pm	10 Mins	Prof. Achini De Silva, Dept. of Agribusiness Management, Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka		
Expectations of the economist	2.20pm	05 Mins	Dr. Sampath Dharmadasa		
Expectations of the agronomist	2.25pm	05 Mins	Mr. Gamini Prathapasinghe		
Expectations of the institutional specialist	2.30pm	05 Mins	Mr. Chopadithya Edirisinghe		
Expectations of the engineer	2.35pm	05 Mins	Mr. Arjuna Dissanayake		
Expectations of the environmental social safeguard specialist	2.40pm	05 Mins	Mr. Prasad Jayaweera		
Expectations of the GIS expert	2.45pm	05 Mins	Mr. S.B. Adikari		
Break	***2.50pm***	***05 Mins***			
Discussion session 1 First focus is on **primary activities** of the **value chains**: The tentative crops,	2.55pm	30 Mins (10Mins.	**Breakout room 1: Policy Makers** Mr. Chopadithya	**Breakout room 2: Exporters** Dr. S.Darmadasa	**Breakout room 3: Industry** Mr. Arjuna

Item	Time (SL)	Duration	By		
crop clusters, potential agribusinesses, value additions, safety and quality requirements, postharvest chain management, etc Tools to be used: Structured questionnaire (google form),will be uploaded to chat thread. Discussion commence after completion of the questionnaire		Questionnaire & 20 Mins. Discussion)	Edirisinghe & Mr.S.B. Adikari Note taker – Hansika Thilini	& Mr. G. Prathapasinghe Note taker – Ruwini Bandara	Dissanayake & Prasad Jayaweera Note taker – Sulochana Senevirathne
Discussion session II Second focus is on **support activities** of the **value chain**: Technological interventions, logistics, networking and market intelligence, farmer companies, capacity building, management of cluster sustainability, food and income security, etc Tools to be used: Structured questionnaire (Google form),will be uploaded to chat thread. Discussion commence after completion of the questionnaire	3.25pm	30 Mins (10Mins. Questionnaire & 20 Mins. Discussion)	**Breakout room 1: Policy Makers** Mr. Chopadithya Edirisinghe & Mr. S.B. Adikari Note taker – Hansika Thilini	**Breakout room 2: Exporters** Dr. S.Darmadasa & Mr. G. Prathapasinghe Note taker – Ruwini Bandara	**Breakout room 3: Industry** Mr. Arjuna Dissanayake & Prasad Jayaweera Note taker – Sulochana Senevirathne
Break	***3.55pm***	***05 Mins***			
Discussion session III Third focus is on **institutional environment** of the agrifood value chains Tools to be used: Structured	4.00pm	20 Mins (10Mins. Questionnaire & 20 Mins. Discussion)	**Breakout room 1: Policy Makers** Mr. Chopadithya Edirisinghe & Mr. S.B. Adikari	**Breakout room 2: Exporters** Dr. S.Darmadasa & Mr. G. Prathapasinghe	**Breakout room 3: Industry** Mr. Arjuna Dissanayake & Prasad Jayaweera

Item	Time (SL)	Duration	By		
questionnaire (Google form) will be uploaded to chat thread. Discussion commence after completion of the questionnaire			Note taker – Hansika Thilini	Note taker – Ruwini Bandara	Note taker – Sulochana Senevirathne
Q& A, way forward	4.20 pm	30 Mins	Q & A – Prof. Achini De Silva Note taker – Anjana Hettige Way forward – Mr. Sanath Wicramathilake		
Wrap up session	4.50pm	10 Mins	ASMP		

Annex 02: Concept

Agriculture Sector Modernization Project (ASMP)

District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

Concept Note for Stakeholders' Workshop 1

Potential agribusinesses and Value chain development for the new districts funded by European Union

Prof. Achini De Silva

2022

Project Title: District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

The ASMP project team would like to invite you to take part in the stakeholder meeting, planned to get your valuable feedback for the potential export oriented agribusinesses and value chain development and or upgrading in new districts funded by EU. The summary of the workshop and the date, time and the zoom link are given below for your kind perusal. Your valuable comments during the stakeholder meeting will be highly appreciated. Contact details of the project lead and the organizers are given below. We kindly requests you to complete the table given in Annex I and return it to us ASAP. Thank you.

Proposed Workshop Date and Time: ***June*** 22, 2022; 2 – 5 pm India

Duration: 3 hours

Place: Zoom only meeting

Zoom Link:

https://learn.zoom.us/j/64062108027?pwd=MTh4bmR0akd1ZjRLMEtvdmlNRHdxdz09

Date : June 22, 2022, 14:00 India Standard Time

Join Zoom Meeting

Meeting ID: 640 6210 8027

Pass code: 8TGc%pY2

ASMP project (new EU Districts):

The Agriculture Sector Modernization Project (ASMP) is comprised of three components. The Component-1, Agriculture Value Chain Development, seeks to promote commercial and export oriented agriculture and this component is implemented by the Ministry of Plantation Industries (MOPI). The Component-2, Productivity Enhancement and

Diversification Demonstration (this particular assignment relates to the Component-2) is implemented by the Ministry of Agriculture (MOA). The Component-2 aims to support smallholder farmers to produce competitive and marketable commodities, improve their ability to respond to market requirements and move towards increase commercialization. The Component-3 focuses on human resource management, and capacity building, logistic requirements, monitoring and evaluation, communication and coordination of the overall Project.

The listed below are the sub-components of the Component-2 of the ASMP implemented under the MOA:

a. **Farmer Training and Capacity Building:** Under this Sub-component, all the non-technical farmer trainings (mainly through ***Farmer Business School – FBS***) are provided to all the member farmers of the ***Farmer Companies (FCs)*** as well as to the selected non-member farmers living around the cluster areas with the aim of improving their soft skills (referring farming as a business), carry out related awareness and exposure visits (local as well as foreign), empowering Farmer Companies providing the related trainings to the lead farmers as well as to the potential second generation young farmers, and providing the assets needed to operate the Farmer Companies.

   All related institutional capacity building activities are carried out under this sub-component in order to establish and empower the Farmer Companies.

b. **Modern Agriculture Technology Parks (ATDPs):** This is the main Sub-component the Component-2 of ASMP. All the crop cluster selection, design, establishment and continuity of crop clusters is ensured under this sub-component. Each individual member farmer of the FC will receive a technology package as a grant under this Sub-component. In addition, farming related collective assets, cluster specific common ***Agro Processing Hubs - APHs*** (mostly one per each cluster), and common ***Urban Marketing Centers - UMCs*** (mostly one per each District – not necessarily), certain technical exposure visits, trainings and awareness, specific technical consultancies will be delivered under this Sub-component.

c. **Production and Market Infrastructure:** Under this Sub-component, Cluster / ATDP specific market infrastructures (Eg. Common APHs, UMCs, ***Compost Making Units - CMUs)***, required irrigation infrastructures, identified market access roads and any other specific supportive infrastructures will be established. In addition, the consultancy assignments related to Engineering Designing and Establishments will be carried out under this sub-component.

d. **Analytical and Policy Advisory Support:** Related Policy Studies as well as required Analytical Studies are carried out under this particular Sub-component. In addition, conducting certain related assessments / evaluations, organizing ***Techno Forums***, ***Policy Forums***, formulation Policy / Strategy briefs / guidelines are carried out.

Project Locations:

ASMP currently works in five provinces namely Northern Province, North Central Province, Uva Province, Eastern Province and Central Province in the implementation of the Component-2. Twelve districts have been selected to implement the Agriculture Technology Demonstration Park concept namely Amara, Anuradhapura, Badulla, Batticaloa, Jaffna, Kandy, Kilinochchi, Mathale, Monaragala, Mullativu, Polonnaruwa, and Vavuniya. Out of the above 12 Districts, this particular assignment relates only to the new ASMP Districts, namely Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya Districts.

Source of funding:

The Democratic Socialist Republic of Sri Lanka has obtained a Credit of US$ 58.63 Million from the World Bank through the International Development Association (IDA) and received Grant of US$ 26 Million from the European Union (EU) for the ASMP of the Ministry of Agriculture.

Rationale for the Workshop:

ASMP project for new EU districts aim to contact district level feasibility Studies with respect to the establishment of Agriculture Technology Development Parks (ATDPs), and prepare comprehensive crop Cluster Development Plans (CDPs), and to aware the farmers / farmer companies, technically guide the implementation staff about the technical matters regarding the feasibility studies & especially the CDPs during the initial stage of the crop Cluster establishments.

First stakeholder workshop with agrifood industry crowd is aimed to obtain the insights of industry personnel on new trends in global market place, what opportunities available for us to link into global value chains?, problems and issues from farm to plate with reference to our context, suggestions on crops, value additions, safety and quality management, transport and logistics, etc.

Comprehensive literature reviews were conducted to identify the Sri Lankan context to understand their potential capacities and gaps relating to value chain development. Industry environmental scanning and Institutional analysis are planning to understand the status of business enabling environment. A workshop with necessary stakeholders is needed to finalise the potential crops, agribusiness ventures, value additions, safety and quality requirements, technological interventions, logistic and postharvest chin management practices.

Objectives of the Workshop:

The objectives of the proposed workshop are threefold:

4. Introducing the concept of the project, objectives and expectations in the context of new project locations/districts with specific focus on the agricultural sector
5. Discussion on potential crops, agribusiness ventures, value additions, safety and quality requirements, technological interventions, logistic and postharvest chain management practices.
6. Identifying recommendations from stakeholder perspectives about the way forward in implementing the crop production clusters, Agriculture Technology Development Parks, capacity building of individual as well as farmer groups, knowledge sharing and information sharing methods

Outcome of the Workshop:

The outcome of the workshop will be a summary report developed by the host. Furthermore, the conclusions and insights drawn from the discussions will help refine the feasibility studies, cluster development plans and capacity building in new project districts.

Format:

The workshop will be half-a-day (approximately 3 hours including breaks).

The workshop WILL BE RECORDED to provide for an accurate representation of views/discussions. The workshop host and the project lead will facilitate the discussions. To ensure maximum engagement of participants, at least 03 break-out rooms will be organised between practitioners, industry experts and the project team.

Agenda:

1. The workshop will begin with a general overview of the ASMP project and the new EU funded districts.
2. First focus is on primary activities of the value chains: The tentative crops, crop clusters, potential agribusinesses, value additions, safety and quality requirements, postharvest chain management, , etc developed by the project team will be presented followed by a facilitated discussion between the stakeholders to refine these.
3. Second focus is on support activities of the value chain: Technological interventions, logistics, networking and market intelligence, farmer companies, capacity building, management of cluster sustainability, food and income security, etc
4. The draft institutional analysis developed by the project team will be presented followed by a facilitated discussion between the stakeholders to refine the environmental scanning
5. A facilitated discussion on the most effective export oriented, and or import substitution crops/clusters to design cluster development plans, ATDPs, etc.
6. Recommendations on the way forward and an exchange of ideas on a common vision for the implementation of the proposed proect will be sought from participants.

Confidentiality of data:

All data that will be obtained in the workshop will be treated with strict confidentiality and will only be used for this research. Any information regarding any respondent or organisation will not be disclosed, and the data collected will be kept in a secure location. The names of the respondents and the organisations will not appear in any publication resulting from this research. After participants have read this information and asked any questions, they will be given a consent form to be completed and signed. Participants will be able to withdraw at any time (even during the workshop), for any reason without explaining the reasons for withdrawing.

Contact Details for any Enquiries –

Workshop Hosts:

Ms. Asoka – policyspecalistasmp@hotmail.com

Mr. Sanath Wickramathilake – sanathwickramathilake@yahoo.com

Prof. Achini De Silva: Email – desilva.achini@yahoo.co.uk / achini@agri.sab.ac.lk

Dr. Sampath Dharmadasa – sampath@uwu.ac.lk

Mr. Gamini Prathapasinghe – gprathapasinghe@gmail.com

Mr. Chopadithya Edirisinghe – chopadithya@gmail.com

Mr. Prrasad Jayaweera - japjayaweera@gmail.com

Mr. Arjuna Dissanayake – arjunauom@gmail.com

Mr. S.B. Adikari – adikari8@gmail.com

Annex 1- Participant Consent Form

Project Title: ASMP Agriculture Sector Modernization Project (new EU districts)

Workshop Host: Prof. Achini De Silva, Dr. Sampath Dramdasa, Mr. Chopadithya Edirisinghe, Mr. Gamini Prathapasinghe, Mr. Prasad Jayaweera, Mr. Arjuna Dissanayake, Mr. S.B. Adikari, Mr. Sanath Wickramathilake

Name of the Workshop Participant:

Email of the Workshop Participant:

Please delete as appropriate.

• I confirm that I have read and understood the information sheet for the above research and what my contribution will be	Yes	No
• I have been given the opportunity to ask questions about my participation	Yes	No
• I agree to take part in the workshop	Yes	No
• I understand that all the information I provide will be treated in strict confidence	Yes	No
• **I agree to the workshop, and my participation, being recorded**	Yes	No
• I understand that I have the right to withdraw from this study at any stage for any reason, and that I will not be required to explain my reasons for withdrawing	Yes	No

Name of the participant:	
Signature:	
Date:	

Annex 03: List of Participants

Policy Makers:

No.	Name	Email	Contact Number	Role
1	Ms. Kumari Meegahakotuwa	kumari5meegahakotuwa@yahoo.com	718570578	Dircetor General, Research, Innoovations, Ministry of Science and Technology
2	Mr. Suresh Demel	E-mail: sureshdemel@yahoo.com	94 712221888	EDB (Agriculture exports: export promotions, Organic & GI, Trade fairs, etc)
3	Ms. MaLani Badddegama	7195008855	112303973	EDB (Agriculture exports: export promotions, Organic & GI, Trade fairs, etc)
4	Mr. Janak Sanjeewa Bdugama		112300731	EDB (Agriculture exports: export promotions, Organic & GI, Trade fairs, etc)
5	Mr. Gamini Weerasinghe	weerasinghe@slsi.lk	776 226 779, +94 711 000 054	Senior Deputy Director at Sri Lanka Standards Institution
6	Ms.NHMS Chithrapala	madusajani@yahoo.com.	94 112 252028/29 Ext: 212 +94 714 471408	Assistant Director of Agriculture (Research). National Plant Quarantine Service
7		-	94 11 2143434 Extensions:	SL Customs Export Division
8	Mr.G.L.Gnanatheva	gnanatheva@doc.gov.lk	011 232 9734/ ext 316	Department of Commerce, Deputy Head of Trade Promotion Division
9	Mr. K. Kanojan	npo@edb.gov.lk	Telephone :94 21 221 5944	Director,EDB Provincial Office North Province
10	Mr. Saranga Wijeyarathne	saranga111@gmail.com	Direct (+94) 773 219 773	Colombo Chamber of Commerce
11	Mr. Nasser Hammad		+94 773 082870	Lanka Fruit & Vegetable Producers, Processors and Exporters Association, Nawam Mawatha, Colombo, Sri Lanka

12	Prof. Dharmadasa	dharmadasarm@gmail.com	702588542	Research Professor/ Director, Industrial Technology Institute
13	Prof. Manjula Magamage	magamage@agri.sab.ac.lk	0716143955 0772445783	Chairman, National Livestock Development Board
14		direoh@health.gov.lk	94 112 694 860	Food Control Administration Unit Ministry of Health
15	Dr. (Mrs) Siddhika G Senaratne	dg@slsi.lk	94 11 2671574	Director General, SLSI
16	Ms. T.T. Upulmalee Premathilaka	cg@imexport.gov.lk	94 112 448311	Controller General, Department of Imports and Exports Control
17	Ms. Menka Wanniarachchi		94 114 651 765	Director Operations, National chamber of exporters
18	Mr. Dilhan De Silva		714433104	central bank
17	Ms. Gayani		718365003	EDB (Agriculture exports: export promotions, Organic & GI, Trade fairs, etc)

Exporters:

No.	Name	Email	Contact Number	Role
1	Mr. A. R. A. Kumara (Proprietor)		+94 523 533498	AJITH CHINESE VEGETABLE SUPPLIER
2	Mr. Indralal Jayantha Alwis (Managing Director)	-	94 312 223898	ALWIS AGRO EXPORTS (PVT) LTD
3	Mrs. Celine Josephine Sujeewa Kuhafa (General Manager)	-	94 11 2940326	BEYOND EXPORTS
4		info@vegiland.lk	0112 248 516	Vegiland Exporters Pvt. Ltd
5	Mr. Upali Ranasinghe (Managing Director) Ms. R. A. Charindi Ranasinghe (Deputy Chairperson)		94 112 224961 94 773 536353	C.R. EXPORTS (PVT) LTD
6		amkfood@sltnet.lk	112855634	A M K Food Export Pvt Ltd
7		info@raviexport.cominfo@raviexport.com	711250283	Ravi Exports (Pvt) Limited
8				
9	Mr. Indika Daraniyagala	indika@fairtradeorganicteas.com	711935834	Greenfield Bio Plantation (pvt) ltd
10	Mr. Udayanga Abesinghe	udayanga@fairtradeorganicteas.com (	-	Greenfield Bio Plantation (pvt) ltd
11	Mrs.Tharanga Abeynayake	-	718933313	Cocotana Coconut Products
12	Mr.Kusumsiri	-	711840769	Rasoda Dairy
14	Managing Director	mahesh@sriposha.lk	0718417497/ 0813124174	Sriposha Lanka Foods (PVT) Ltd Kandy
15	Mr. Eranga Abeywickrama Human Resource Manager (Head Office) Dole Lanka (Pvt) Ltd	Eranga.Abeywickrama@doleintl.com	703703017	Dole Lanka (Pvt) Ltd

16	Mr. Sathis Abeywickrama Managing Director Gurbeula Farms & Restaurants (Pvt) Ltd	usa@eol.lk , copy email to vidarsha@printusagroup.com		Gurbeula Farms & Restaurants (Pvt) Ltd
17	Mr.Janaka Chandana Abeyratne General Manager Samagi Spice Exports Pvt Ltd. Baragama Road Makandura.	samagispice@gmail.com	0412268541/ 0777728787	Samagi Spice Exports Pvt Ltd. Baragama Road Makandura.
18	Ms. Shehani Liyanage, Country Senior Marketing Manager at Upfield, Upfield professionals Sri Lanka. Resmead Place, Colombo 07	shehani.liyanage@upfield.com	769226442	Upfield Sri Lanka

Industry Stakeholders:

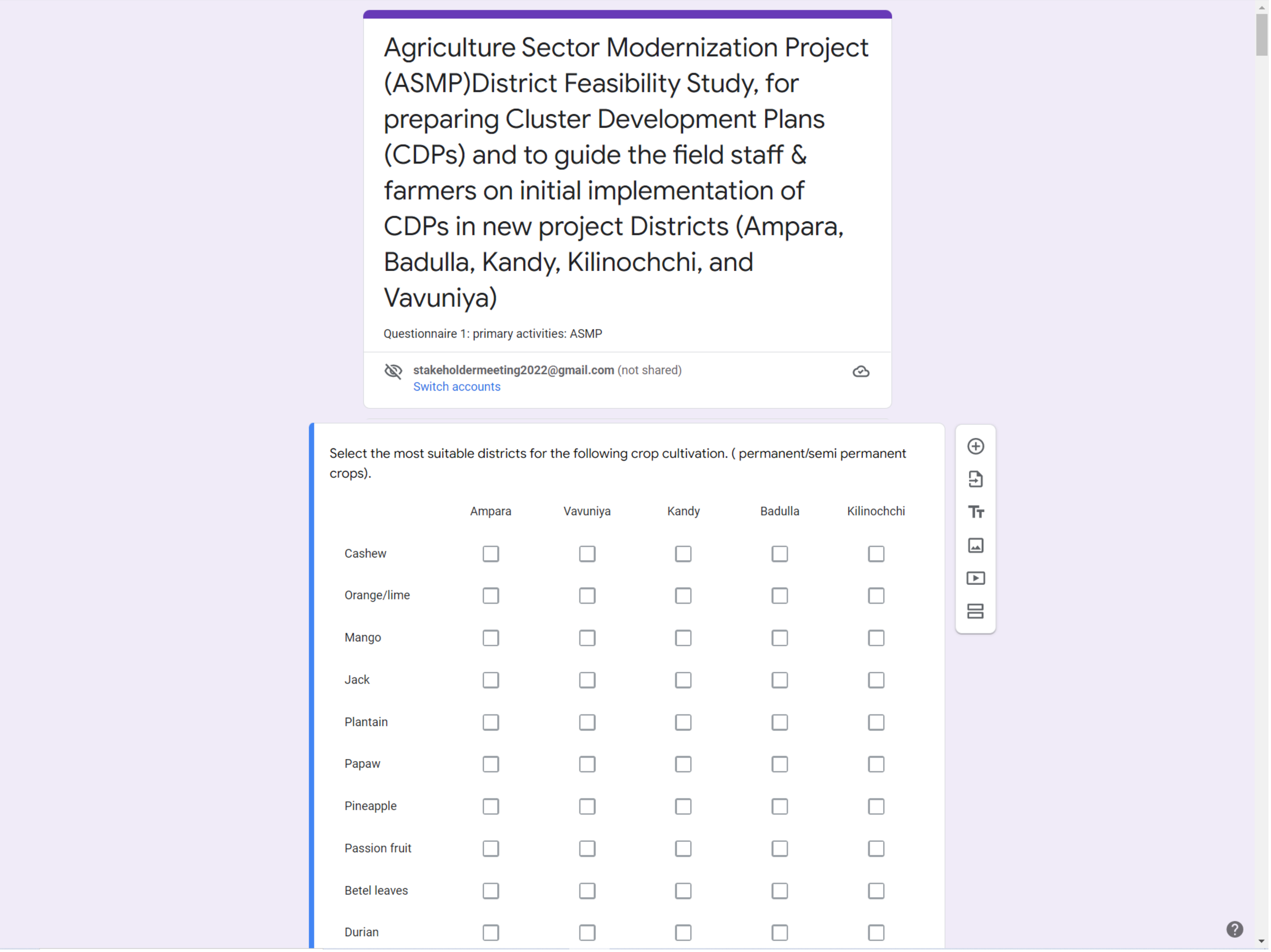
No.	Name	Email	Contact Number	Role

1	Mr. Ishafir Izzadeen	izzadeen@aitkenspence.lk izzami65@gmail.com	077779507 / 0772449478	Senior General Manager, Atiken Spence Plantations
2	Mr. Geeth Kumara Dayananada	icco@elpitiya.com	777225453	Senior General Manager, Elpitiya Plantations, Aitken Spence Plantations
3	Mr. Nishan Senewirathne	nishanthas@lalanrubber.com	072259777 0772376209	General Manager, Lalans Rubber co. pvt. Ltd.
4	Mr. Prasanna Hettiaarachchi	prasanna@saaraketha.com	773451768	Founder, Saraketha Holdings
5	Mr. M.S. Andrew	andrew.marcus@maxies.lk	(+94) 70 4931727 (+94) 31 2255555	Quality Manger Maxies & Company (Pvt) Ltd
6	Mr. Nalin Lokuge	nalin@hddes.com	768945225	HDDES Group General Manager
7	Dr. Nelum Vithana	nelum.v@cargillsceylon.com	770283149	Group Manager,Health and Nutrition, Cargills Ceylon PLC
8	Mr.Vikum Nissanka	vikum.n@cargillsceylon.com	0717741333/0767481333	Manager-Product Development, Cargills Ceylon Plc
9	Ms. Chalithra Dissanayake	chalithra.a@lankem.lk	776765673	Manager-Marketing, Lankem Ceylon Plc.
10	Mr. Manjula Doloswala	doloswala@versa.lk	702110293	CEO, Versatile Business Solutions
11	CAN market	canmarket@thecreativeisle.com	+94 71 869 8084	CAN market

12	Tyrell Fernanodo	tyrell@sltnet.lk	00 94 312233773	Director, People's Organisation for Development Import & Export.
13	GOOD Market		077 020 8642	
14	Mr. Chamila Gunarathna		112 308308	(Manager Exports), Atiken Spence Plantations
15	Lanka Canneries (Pvt) Ltd	info@lankacanneries.com	011-2586622	Lanka Canneries (Pvt) Ltd
16	Mr. Randeewa Malalasooriya (Cluster CEO) Ms. Pasani Siriwardena (Business Support Executive)		117 388500 - 4	CBL NATURAL FOODS (PVT) LTD
17	Mr. Priyanthe		718684276	Amazon trading (Pvt) Ltd/ English tea shop
18	Mr. Sudesh Mahanama		342280092	Wijaya Products (PVT) LTD
19	Mr. U.J.Gunawardhana, Assistant Manager, CIC Agri Business, Hingurakgoda	jayasiri@cicagri.com	773570491	CIC Agri Produce Marketing (Pvt) Ltd.
20	Mrs.Dilini Pathirage Quality Assurance Manager Lanka Spice (Pvt)Ltd- Mc Currie Green Foods (Pvt)Ltd	dilini@mccurrie.net hrmccurrie@gmail.com	703033725	Lanka Spice (Pvt)Ltd- Mc Currie Green Foods (Pvt)Ltd
21	Mr.Malinda Rajakaruna Production Manager (Biscuits), Uswatte Confectionery Works (Pvt) Ltd, Millaniya.	malinda.k@uswatteconfectionery.com	777543477	Uswatte Confectionery Works (Pvt) Ltd,
22	Mr. Nishantha Bandara Production Manager Sunquick Lanka Pvt Ltd Munagama, A8 Horana.	nishantha.b@sunquicklanka.com	(070) 337 3006	Sunquick Lanka Pvt Ltd

23	Mr.Clement Fernando		777302899	JH Holdings
24	Mr.Mafaz		077 3623791	Expolanka
25	Mr.Malinda Rajakaruna	malinda.k@uswatteconfectionery.com	777543477	Production Manager (Biscuits), Uswatte Confectionery Works (Pvt) Ltd, Millaniya.

Annex 04: Questionnaire 01



Agriculture Sector Modernization Project (ASMP)District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

Questionnaire 1: primary activities: ASMP

stakeholdermeeting2022@gmail.com (not shared)
Switch accounts

Select the most suitable districts for the following crop cultivation. (permanent/semi permanent crops).

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Cashew	☐	☐	☐	☐	☐
Orange/lime	☐	☐	☐	☐	☐
Mango	☐	☐	☐	☐	☐
Jack	☐	☐	☐	☐	☐
Plantain	☐	☐	☐	☐	☐
Papaw	☐	☐	☐	☐	☐
Pineapple	☐	☐	☐	☐	☐
Passion fruit	☐	☐	☐	☐	☐
Betel leaves	☐	☐	☐	☐	☐
Durian	☐	☐	☐	☐	☐

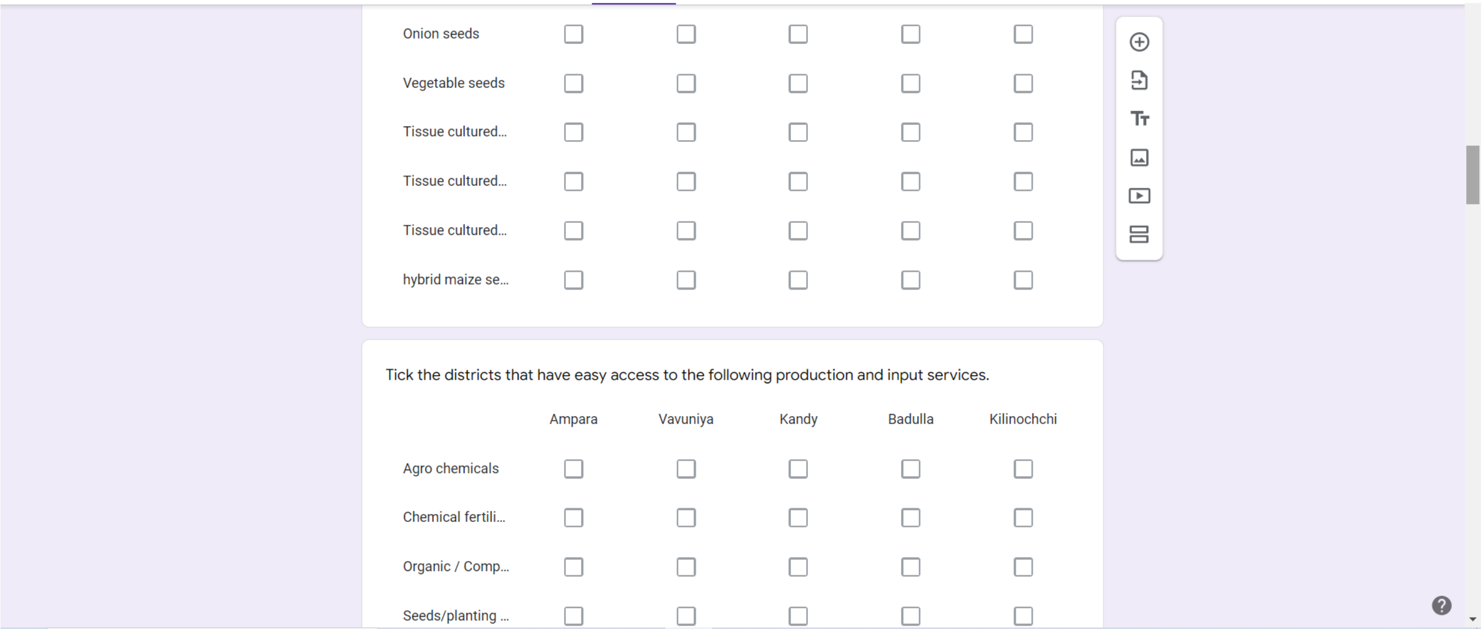
Soursop	☐	☐	☐	☐	☐
Rambutan	☐	☐	☐	☐	☐
Avocado	☐	☐	☐	☐	☐
Mangosteen	☐	☐	☐	☐	☐

Add your remarks on above here.

Long-answer text

Select the most suitable districts for the following crop cultivation. (Seasonal crops)

Cowpea	☐	☐	☐	☐	☐
Black gram	☐	☐	☐	☐	☐
Gingelly	☐	☐	☐	☐	☐
Peanut	☐	☐	☐	☐	☐
Manioc	☐	☐	☐	☐	☐
Sweet potatoes	☐	☐	☐	☐	☐
Onion	☐	☐	☐	☐	☐
Green chilies	☐	☐	☐	☐	☐
Mustard	☐	☐	☐	☐	☐
Ginger	☐	☐	☐	☐	☐
Turmeric	☐	☐	☐	☐	☐
Vegetables gro...	☐	☐	☐	☐	☐
Vegetables gro...	☐	☐	☐	☐	☐
Herbs (Bassils, ...	☐	☐	☐	☐	☐
Sun flower	☐	☐	☐	☐	☐
Soybean	☐	☐	☐	☐	☐
Garlic	☐	☐	☐	☐	☐



Onion seeds	☐	☐	☐	☐	☐
Vegetable seeds	☐	☐	☐	☐	☐
Tissue cultured...	☐	☐	☐	☐	☐
Tissue cultured...	☐	☐	☐	☐	☐
Tissue cultured...	☐	☐	☐	☐	☐
hybrid maize se...	☐	☐	☐	☐	☐

Tick the districts that have easy access to the following production and input services.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Agro chemicals	☐	☐	☐	☐	☐
Chemical fertili...	☐	☐	☐	☐	☐
Organic / Comp...	☐	☐	☐	☐	☐
Seeds/planting ...	☐	☐	☐	☐	☐

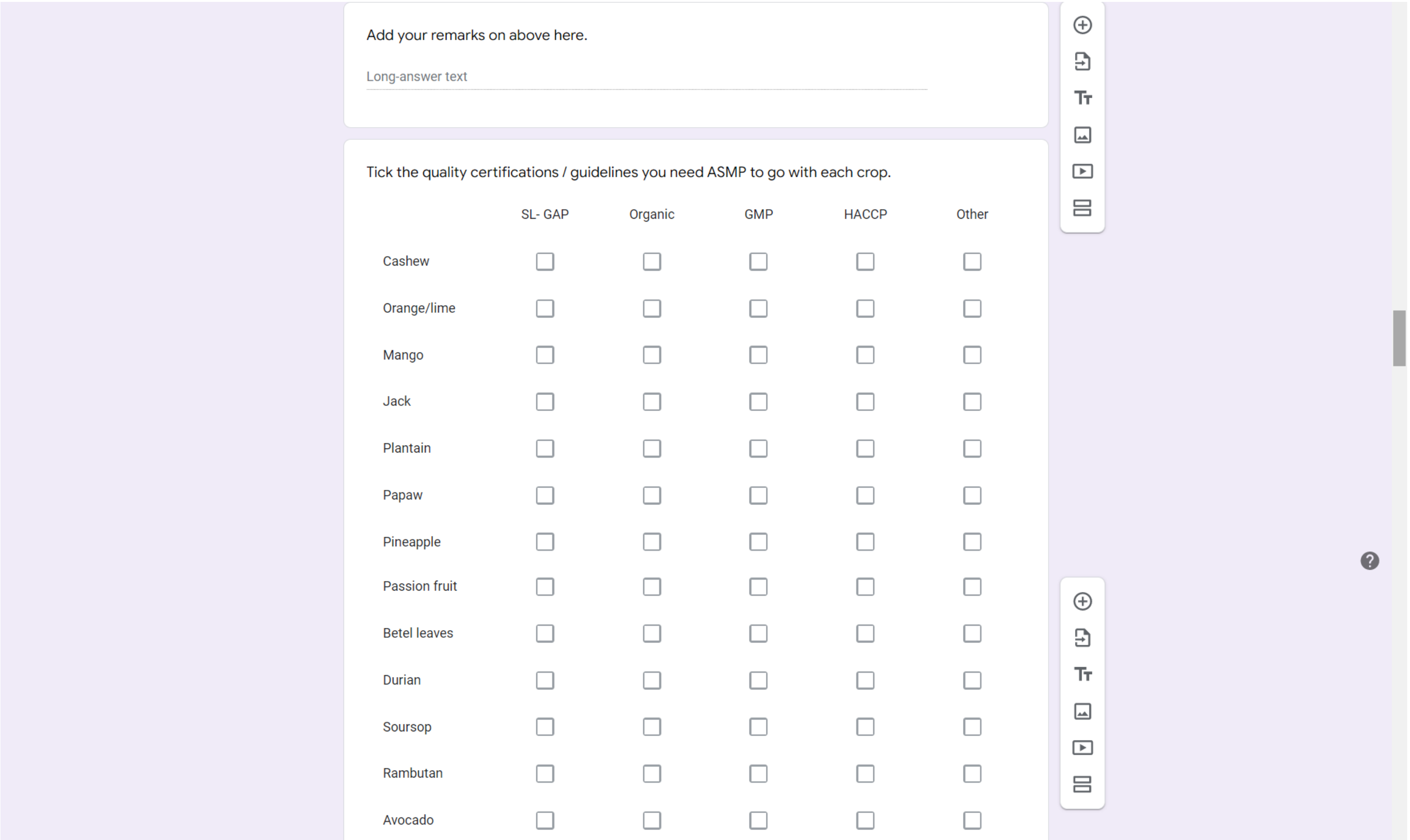
Machinery	☐	☐	☐	☐	☐
Irrigation	☐	☐	☐	☐	☐
Labour	☐	☐	☐	☐	☐
Capital	☐	☐	☐	☐	☐
Production equi...	☐	☐	☐	☐	☐
Greenhouses	☐	☐	☐	☐	☐
Nurseries	☐	☐	☐	☐	☐
Rain shelters	☐	☐	☐	☐	☐
Information Co...	☐	☐	☐	☐	☐
Drone technolo...	☐	☐	☐	☐	☐
Mobile tools	☐	☐	☐	☐	☐
Irrigation techn...	☐	☐	☐	☐	☐
Alternative ener...	☐	☐	☐	☐	☐

Add your remarks on above here.

Long-answer text

Tick the districts that have easy access to the following extension, education, and training services.

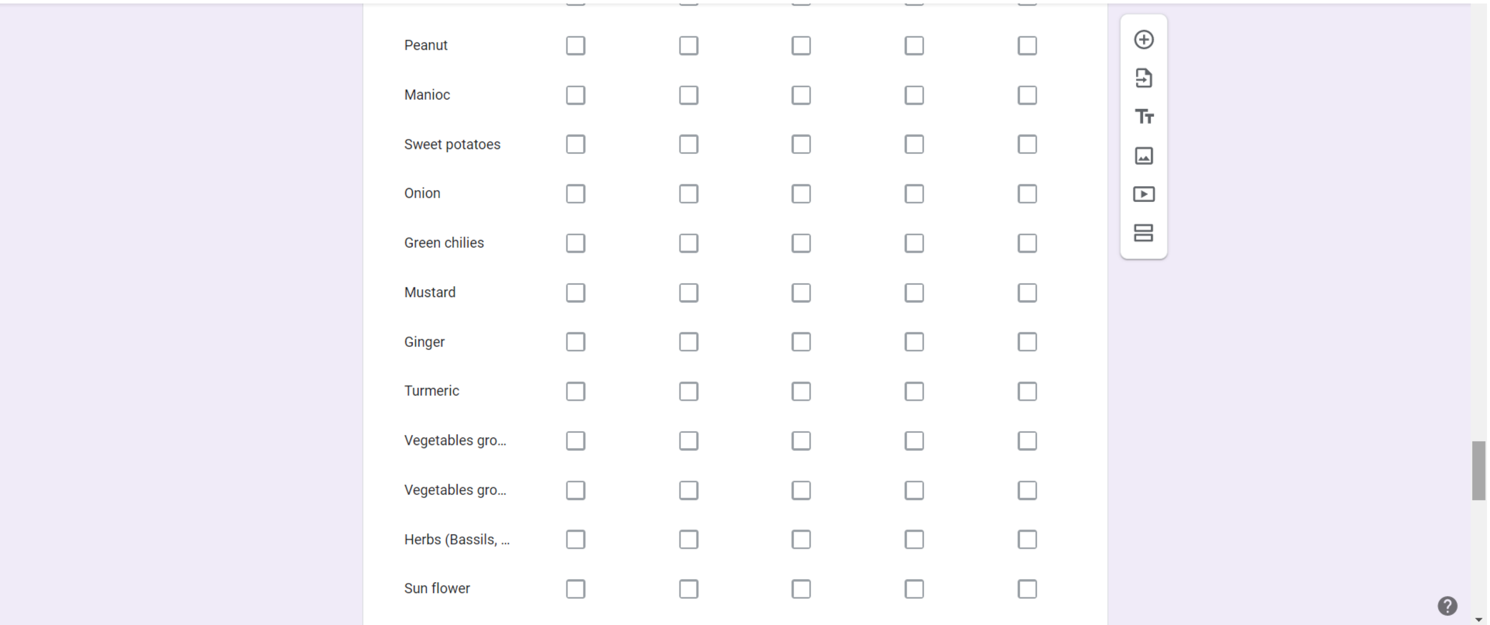
	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Package of Tec...	☐	☐	☐	☐	☐
School on the A...	☐	☐	☐	☐	☐
Training of Trai...	☐	☐	☐	☐	☐
Farmer's Field ...	☐	☐	☐	☐	☐
Specialized Trai...	☐	☐	☐	☐	☐
Tree Rehabilitat...	☐	☐	☐	☐	☐
Incentives to M...	☐	☐	☐	☐	☐
Information, Ed...	☐	☐	☐	☐	☐
Awards and Re...	☐	☐	☐	☐	☐
Learning Sites	☐	☐	☐	☐	☐


Add your remarks on above here.

Long-answer text

Tick the quality certifications / guidelines you need ASMP to go with each crop.

	SL- GAP	Organic	GMP	HACCP	Other
Cashew	☐	☐	☐	☐	☐
Orange/lime	☐	☐	☐	☐	☐
Mango	☐	☐	☐	☐	☐
Jack	☐	☐	☐	☐	☐
Plantain	☐	☐	☐	☐	☐
Papaw	☐	☐	☐	☐	☐
Pineapple	☐	☐	☐	☐	☐
Passion fruit	☐	☐	☐	☐	☐
Betel leaves	☐	☐	☐	☐	☐
Durian	☐	☐	☐	☐	☐
Soursop	☐	☐	☐	☐	☐
Rambutan	☐	☐	☐	☐	☐
Avocado	☐	☐	☐	☐	☐


Peanut
Manioc
Sweet potatoes
Onion
Green chilies
Mustard
Ginger
Turmeric
Vegetables gro...
Vegetables gro...
Herbs (Bassils, ...
Sun flower

Soybean	☐	☐	☐	☐	☐
Garlic	☐	☐	☐	☐	☐

Add your remarks on above here.

Long-answer text

Value addition potential - Tick the suitable crops for the given value added activities.

	Fruits	Vegetables	Spices	Green leav...	Cereals	Pulses	other
Sorting & g...	☐	☐	☐	☐	☐	☐	☐
Cleaning / ...	☐	☐	☐	☐	☐	☐	☐
Waxing or ...	☐	☐	☐	☐	☐	☐	☐
Temperatu...	☐	☐	☐	☐	☐	☐	☐
Labelling &...	☐	☐	☐	☐	☐	☐	☐
Bottling / c...	☐	☐	☐	☐	☐	☐	☐
Dehydration	☐	☐	☐	☐	☐	☐	☐
Drying	☐	☐	☐	☐	☐	☐	☐
As fresh c...	☐	☐	☐	☐	☐	☐	☐
Pickling	☐	☐	☐	☐	☐	☐	☐
Pulping	☐	☐	☐	☐	☐	☐	☐
Concentrat...	☐	☐	☐	☐	☐	☐	☐
Teas	☐	☐	☐	☐	☐	☐	☐
Confection...	☐	☐	☐	☐	☐	☐	☐
Snacks	☐	☐	☐	☐	☐	☐	☐
Flour / po...	☐	☐	☐	☐	☐	☐	☐

Annex 05: Questionnaire 02

Agriculture Sector Modernization Project (ASMP)District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

Questionnaire 02: Support activities(The overall expectation of this particular questionnaire is to analyze existing enabling environment at the provincial level with respect to the input / service availability & the consistency.)

1. Tick the districts which the below mentioned technological interventions can be easily accessed.

Tick all that apply.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Quality Planting material availability	☐	☐	☐	☐	☐
Land preparation machinery/technology availability	☐	☐	☐	☐	☐
Field planting machinery/technology availability	☐	☐	☐	☐	☐
Pest and disease control chemical /(IPM) availability	☐	☐	☐	☐	☐
Fertilizer availability	☐	☐	☐	☐	☐
Irrigation systems / technology avilability	☐	☐	☐	☐	☐
Wild animal control methods availability	☐	☐	☐	☐	☐
Harvesting (combine harvesters) technology availability	☐	☐	☐	☐	☐
Post-harvest technology (handling, grading, packing etc) availability	☐	☐	☐	☐	☐
Processing (drying/dehydration, canning, etc) technology availability	☐	☐	☐	☐	☐

2. Add your remarks on above here

3. Tick the districts which the below mentioned logistic facilities can be easily accessed.

Tick all that apply.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Roads (access/availability)	☐	☐	☐	☐	☐
Cold chain facility (cold storages/cold chamber trucks)	☐	☐	☐	☐	☐
warehouse facilities	☐	☐	☐	☐	☐
Energy sources	☐	☐	☐	☐	☐
Buy back arrangements	☐	☐	☐	☐	☐
Transport (vehicles, access)	☐	☐	☐	☐	☐

4. Add your remarks on above here

____
____
____
____
____

5. Tick the districts which the below mentioned networking and market intelligence facilities can be easily accessed.

Tick all that apply.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Online/mobile value chain networks	☐	☐	☐	☐	☐
Price information	☐	☐	☐	☐	☐
Informal contracts among value chain actors	☐	☐	☐	☐	☐
Trust & reciprocity among value chain actors	☐	☐	☐	☐	☐
Active farmer organizations	☐	☐	☐	☐	☐
Capacity building programmes by CBOs	☐	☐	☐	☐	☐
Management support					

6. Add your remarks on above here

7. Tick the districts which the below mentioned food and income security dimensions can be easily accessed.

Mark only one oval per row.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Food affordability	⬭	⬭	⬭	⬭	⬭
Food availability	⬭	⬭	⬭	⬭	⬭
Food access	⬭	⬭	⬭	⬭	⬭

8. Add your remarks on above here

Annex 06: Questionnaire 03

Agriculture Sector Modernization Project (ASMP)District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

Questionnaire 03-Institutional environment (institutions, services, problems, expected services)

1. Tick the most important institution/s mentioned below in each district with reference to agribusiness and value chain development

Mark only one oval per row.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
DoA	◯	◯	◯	◯	◯
Banks financing agriculture	◯	◯	◯	◯	◯
Micro finance institutions	◯	◯	◯	◯	◯
Agrarian service centers	◯	◯	◯	◯	◯
NGOs	◯	◯	◯	◯	◯

2. What are the other important service providing institutions?

3. Tick the easily accessed services from the following in each district.

Mark only one oval per row.

	Ampara	Vavuniya	Kandy	Badulla	Kilinochchi
Training and extension	◯	◯	◯	◯	◯
Financial services	◯	◯	◯	◯	◯
Appropriate machinery	◯	◯	◯	◯	◯

4. What are the other services that could be accessed easily?

5. What are the critical problems of the institutional environment on agribusiness & value chain development? (please mention with the district)

6. What are the expected services from institutions in each district on agribusiness & value chain development?

Annex 07: Summary table of the Note taking

Policy-makers	Processors/ exporters	Industry
Dr. Thushara Wickramarachchi- • Throughout the proposal, the export market orientation of the products has not been addressed. • Highly targeted to the agriculture technology demonstration. • Since the major portion of the export market-oriented production is produced by the small-scale farmers, they should be well aware of the plant protection, quarantine	Mr. Jagath (questionnaire 01 discussion) • ASMP has a poor focus on scientific aspect of farming, poor focus on yield and quality of the produce and poor scientific knowledge transfer to the farmers. • Farmer capacity building is very poor in Sri Lanka. • ASMP project targeted on different crops and those crops have different	• For this discussion, around **19** stakeholders participated to express their thoughtful ideas representing the leading Agri-Food industries. • Before the official talks starts, a small chat was there on different high-valued crops/food commodities, such as pumpkin flour, hybrid maize, capsicum (“Nai Mirisi”), etc., • The pumpkin powder is identified as one of the highly valued flour. Further,

rules, and also the export market expectation. **Supportive services-** Dr. Thushara Wickramarachchi- • At the grassroots level, farmers lack extension services and it is not well organized. • Agriculture diplomates can be involved in agriculture extension. • Extension officers should be independent since they have the responsibility of certifying the products. • Maldives and middle-East countries markets are more available for Sri Lankan products and Europe and the East-Asia (Korea, China) markets also can be targeted. • The project should be well connected with the EDB, the Department of Commerce, and the National quarantine center. **Regulations** Dr. Thushara Wickramarachchi- • Each and every product starting from the farm should be monitored by the National plant quarantine center or any officer attached to the National plant quarantine center at all stages of the supply/ value chain.	time lines. Therefore, need to prioritize crops according to the necessity. • Better to target on cash crops/ crops with short life cycle; Ginger/turmeric/garlic/chili/maize. • Also need to target on safety/quality/cost of the product. • Need to source quality seeds and planting materials, pest, and disease control. Mr. Saman Dewage (questionnaire 2) • Some planting materials are unavailable in some districts. (Kandy/Badulla- Flower nurseries> Kilinochchi/Ampara- Mango nurseries) • If SCS certification of DoA is available, then the planting material considered of high quality. • Agro chemicals were available in each district earlier, but now there is a shortage due to the economic recession of the country. • There is a huge shortage of materials (pest control/chemical fertilizer/ Agro chemicals) now in each district studies. • Earlier the government subsidies made fertilizer, Agro chemicals available with the farmers.	the practical issues such as processing issue in producing the pumpkin flour are further highlighted. • Suggestion were given from Mr. Arjuna for formulating clusters to produce Manioc flour specially as a substitute for a wheat flour. Mr. Gemunu answered that the manioc flour has high global demand and more expensive. Therefore, it there is will be a high potential to export. The cultivation can be done areas like Gamapha. • Mr. Gamunu highlighted that the problems arise in Sri Lanka due to the economics of scale specially affected on lack of production. Eg: Sunflower oil production • Mr. Nishantha Jayamanna : There is a possibility to do jumbo peanut production in areas such as angunakolapallassa, Vavuniya like areas with farmer clusters and buy back systems. • Suggestion came from Mr. Arnjuna to mix the moringa powder and white flour (flour enrisched with moringa powder). Mr. Gamunu Jayasundara

• Total traceability should be added • Suggest appointing one person from the project to demonstrate farmers the traceability and to link with the National plant quarantine center. • Suggest adding the system approach to monitor traceability in each stage. • Private-public partnership is suggested to gain the machinery and required equipment. (With Department of Agriculture) • 100% traceability and proper linkage with the National plant quarantine center is required to make the export process more successful.	• Better to provide inputs such as Agro chemicals and fertilizer and fuel for farmers to start their cultivation back. (Immediate need) • As secondary measures need to provide micro irrigation, training on high-tech, high-quality planting materials) Mr. Saman Dewage (questionnaire 3) • All the institutions are important to improve the agriculture sector. (DoA/ agrarian service centers/ micro finance etc). • Institutions need to have good coordination among each other. • By combining primary input + secondary inputs and service providing institutions, a good agri output can be sourced. • DoA should focus more in quality seed and planting material development. We are at a lower level in this area when compared to other Asian countries. • Also, agri finance aspects need to be developed more and should increase farmers' access. • Buy back agreements are not functioning well in Sri-Lanka due to two reasons. o Farmers are reluctant to sell to	answered that it's possible for a niche market. • Mr. Gamunu: These days there is a high demand for capsicum "nie miris".there, the clusters have to be formed **Official discussion** The first focus is given to finding out the best crops which can be grown under the project. Different crops were taken one by one and highlighted the potential of cultivating each crop. Further, the stakeholders requested more time to go through the questionnaire and submit it after the end of the session. **<u>Cashew</u>** • Currently, Sri Lanka cashew production is unable to meet the market requirement. Mst of the processors import cashew from Ivory Coast and Vietnam and go back in the Sri Lankan name. • Sri Lankan cashew has more recognition rather than other countries, especially in terms of taste. • Therefore, there is potential

	the company if the market price is higher than the agreed price. ○ If the market price is low, then contract farmers will buy other farmers' harvest too and sell to the company. (Company receives more harvest than agreed). ○ Also, companies need only high-quality product, but farmers want to sell their entire harvest to the company. Expectations are not matching between the farmer and the company. • To avoid this farmers and companies need to strictly adhere the terms and conditions if buy back agreements.	• Mr. Gamunu jayasundara highlighted that, for cashew, the harvesting time is 7 - 8 years. • Best cashew is grown in areas like; Vavuniya, Mannar, Kilinochchi, Wanathawillluwa, etc.) • Supporting institutes; Cashew corporation, cashew research institute, cashew authority) • Since there are very few cashew growers (as the farmers have to wait for a long time to collect the yield) in Sri Lanka the aforementioned institutes are giving their maximum support to the farmers in growing. • The upper top fruit of the cashew also can be used to produce a juice that has a high medicinal value. After the facts about cashew, the stakeholders were directed to focus on food items. Other than cashew; Mr. Jerad: to have 90

		Mt of ground nuts monthly, the land requirement is 30,000 Ac. It was also highlighted that there is no marketing issue in the current scenario for the Sri Lankan food items. However, there is a high cost in the production process which was highlighted as a very serious issue in the industry. Can do the value addition by contracting to avoid the high cost. There are very few fruits that we can dehydrate in Sri Lanka. At the same time, the cost of production is very high. Preservation of foods for off peaks is another good idea **<u>Jackfruit</u>** • Another interesting topic which is popped out is potential for the jackfruit cultivation. • In Sri Lanka, the jackfruit trees are not properly maintained for cultivation. • Thereforer, the products are not up to the standards. • Further, variations in varieties and breeds are there in Sri Lanka. • Thereby it was highlighted the importance of maintaining the

		quality of jackfruit-related products through high-quality panting materials/varieties. • Mr. Nilaatha Jayamanna: Tender jackfruit also has the potential for vegan customers. (annual market value is around 32 billion) Individual Quick Freezing (IQF) is a technology to avoid post-harvest losses. But it was noted that is high-cost work. If it's possible can go to the IFQ. Lower-cost energy alternatives can be newly suggested to overcome that problem **<u>Avocado</u>** • Avocado oil extraction will be having high potential in the world market. • However, one of the problems in Sri Lanka is low economics of scale which resulted in high cost per unit and low production which is enabling to meet the demand. • In Sri Lanka there are around 35 Avacado varieties • But, global markets are demanding verities like "Hass".

		• Avocado paste is also having a huge market **<u>Cocoa</u>** **Mr. Jayasundara:** Local cocoa cultivation can be developed further. Sri Lankan cocoa has 50% cream whereas the other countries' cocoa includes only around 40- 425 cream. Thereby, there is a high potential. The industries with capabilities are waiting to develop it. the problems are with the lack of raw materials. ❖ **Domestically the raw materials can be produced and can supply them to the domestic industries is one of the best ways. It will help to reduce the importation cost to the industries**. **<u>Pineapple</u>** Mr. Vikum Nissanka : Concentrated pineapple also has a high demand. But in Sri Lanka the production negligible.

		Mr. Bhathiya : A common problem for any crop production in Sri Lanka ; • Finding the plant materials (right verity) is a common issue in Sri Lanka for cultivations. • Low productivity • Low economics of scale **<u>Seed Production</u>** Ms. Chalithra: there may be a good market for good quality seeds. Therefore, producing seeds also will be a good option. **<u>Solar pumps:</u>** Mr. Bhathiya: There are practical concerns needed to give attention to when setting up solar pumps. Therefore, can go with a battery system. **<u>Solar drying system</u>**: • Mr. Bhathiya: It's a Sustainable solution and very easy. Whatever the product the best option is solar driers for reducing the moisture level and for drying. • Different systems can be adapted according to the crop

		Growing crops under polytunnels Problem: Polytunnel in the dry zone area is possible or not? Mr. Bhathiya: In dry zone areas, the main issue is controlling temperature. However, the artificial cooling systems have to be used. For a 200m^2 greenhouse area for a month, the minimum energy cost will be Rs. 10,000. For a 400m^2 greenhouse area for a month, the minimum energy cost will be Rs. 15,000 Should think about the energy cost prior to implementing. Diversification of crops (Eg; brokerly, cucumber, beans) cultivated under polytunnel/ greenhouse is very much important. Kandy is suitable for the polytunnel establishment. In the dry zone (Areas such as Kilinochchi, Vavuniya) it is very much important and essential to go to the

		temperature-controlled greenhouses whether it's a seed production project or a vegetable production project. The correct technology has to be used for a good outcome. **Solar farming**: Mr. Nirmal: Its already available in Sri Lanka Mr. Bhartiya : the panels can be adjusted in order to receive the maximum light. **Seed production** : Mr. Chandana Premaratne: seed production has to be increasd.

Agriculture Sector Modernization Project (ASMP)

Establishment of Agri+ Consortia for the new districts funded by European Union

Agenda

Stakeholders' Workshop 2

Potential agribusinesses and Value chain development for the new districts funded by European Union

Date: Thursday 27th October 2022 Time: 2.00 pm
Place: Via Zoom
Zoom link: https://learn.zoom.us/j/61120703443?pwd=WG0zNktkR1hXQ3BHYVdWSHRHNnBSZz09
Join Zoom Meeting
Meeting ID: 611 2070 3443
Passcode: %^sr11LA
Duration: 3 hours
Note: *The Agenda, concept note and the draft programme objectives to be shared with the Stakeholders prior to the event.*

Item	**Time (SL)**	**Duration**	**By**		
Introduction -ASMP /EU component	2.00pm	05 Mins	ASMP-PMU		
Aims and expectations of the stakeholder meeting	2.05 pm	10 Mins	Prof. Achini De Silva Agribusiness & value chain expert		
Proposed farmer clusters/PUCs	2.15pm	10 Mins	Mr. M. Farhad Institutional expert		
Discussion session 1 Expectations of industry stakeholders: ASMP/EU farmer clusters, their produce, safety and quality requirements, logistics, etc	2.25pm	30 Mins	**Breakout room 1:** Prof. Achini De Silva Mr. M. Farhad Note taker – Hansika Thilini	**Breakout room 2: Exporters** Dr. S.Darmadasa & Mr. G. Prathapasinghe Mr. S.B. Adikari Note taker – Ruwini Bandara	**Breakout room 3: Industry** Mr. Arjuna Dissanayake & Mr.Prasad Jayaweera Note taker – Ruwini Basnayake
Discussion session II Establishment of Agri+ consortia: Modes of collaboration, consortia structure and management	2.55pm	30 Mins	**Breakout room 1:** Prof. Achini De Silva Mr. M. Farhad	**Breakout room 2:** Dr. S.Darmadasa & Mr. G. Prathapasinghe Mr. S.B. Adikari	**Breakout room 3:** Mr. Arjuna Dissanayake & Mr.Prasad Jayaweera Note taker –

Item	Time (SL)	Duration	By		
			Note taker – Hansika Thilini	Note taker – Ruwini Bandara	Ruwini Basnayake
Break	***3.25pm***	***05 Mins***			
Discussion session III Develop Road map: **Agri^{+}** consortia	3.30 pm	1 Hr	**Breakout room 1:** Prof. Achini De Silva Mr. M. Farhad Note taker – Hansika Thilini	**Breakout room 2:** Dr. S.Darmadasa & Mr. G. Prathapasinghe Mr. S.B. Adikari Note taker – Ruwini Bandara	**Breakout room 3:** Mr. Arjuna Dissanayake & Mr.Prasad Jayaweera Note taker – Ruwini Basnayake
Q & A / Wrap up session	4.30 pm	30 Mins	Project consultants/ASMP-PMU		
The end	5.00 pm				

Concept Note

Stakeholders' Workshop 2 – Establishment of Exporter/Processor/Buyer Consortia for the new districts funded by European Union

Agriculture Sector Modernization Project (ASMP)

2022

Project Title: District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

The ASMP project team would like to invite you to take part in the second stakeholder meeting, planned to get your valuable feedback for the establishment of exporter/processor/buyer Consortia for the new EU districts of ASMP project funded by European Union. The summary of the workshop and the date, time and the zoom link are given below for your kind perusal. Your valuable comments during the stakeholder meeting will be highly appreciated. Contact details of the project lead and the organizers are given below. We kindly requests you to complete the table given in Annex I and return it to us ASAP. Thank you.

Proposed Workshop Date and Time: ***27th October;*** 2 – 5 pm India

Duration: 3 hours

Place: Hybrid mode: Physical and Zoom meeting

Zoom Link: Zoom link:
https://learn.zoom.us/j/61120703443?pwd=WG0zNktkR1hXQ3BHYVdWSHRHNnBSZz09
Join Zoom Meeting
Meeting ID: 611 2070 3443
Passcode: %^sr11LA

Date : ***27th October*** 14:00 India Standard Time

ASMP project (new EU Districts):

The Agriculture Sector Modernization Project (ASMP) is comprised of three components.

Component-1, Agriculture Value Chain Development, seeks to promote commercial and export-oriented agriculture and this component is implemented by the Ministry of Plantation Industries (MOPI).

Component-2, Productivity Enhancement and Diversification Demonstration (this particular assignment relates to the Component-2) is implemented by the Ministry of Agriculture (MOA).

Component-3 focuses on human resource management, and capacity building, logistic requirements, monitoring and evaluation, communication and coordination of the overall Project.

The proposed workshop focused to facilitate the objectives of the Component-2 that envisaged to support smallholder farmers to produce competitive and marketable commodities, improve their ability to respond to market requirements/quantities and move towards commercialization through the establishment of small farmer cluster companies (Public Unlisted Companies -PUC-) creating a single negotiation platform for healthy agribusiness investments.

The project interventions include

a. Farmer Training and Capacity Building
b. Establish Modern Agriculture Technology Parks (ATDPs
c. Production and Market Infrastructure
d. Analytical and Policy Advisory Support

Project Locations: EU districts**;** Vavuniya, Kilinochchi, Ampara, Kandy and Badulla

Source of funding:

The Democratic Socialist Republic of Sri Lanka has received Grant of US$ 26 Million from the European Union (EU) for the ASMP of the Ministry of Agriculture.

Rationale for the Workshop:

Second stakeholder workshop with Agribusiness Partners is aimed to ascertain the diversity of demand and product characteristics for industries involved in export/food & beverages processing to adjudge the potentials of establishing producer/market linkages (buyer consortia) with the proposed crop value chain-based farmer cluster companies (PUCs) for sustainable ("Private-Private"-2P-) agribusiness partnerships.

Small Farm enterprises in Sri Lanka are constrained to access the diverse market segments that continued to emerge over the decades due to insufficient business orientation and capacities to compete in the market place. There is documentary evidence where small farmers are failed to attract the expanding buyer markets such as expert, food processing, catering/distribution networks, direct consumer marketing, etc, due to individualistic approach at farmer level, lack of business capacity or expertise, irregular production and supply pattern that continued for generations.

The producer/buyer sub contacting interventions implemented under varied partnership program (involved by public/Donor/private) has identified bitter experience of breakaways and dishonouring agreed actions due to varied reasons that associated with farm gate price, buy back volumes, inability of producers to adhere to specifications of produce, poor institutional support for sustainable way forward.

Identifying the challenges and issues in the past actions that promoted the producer/buyback linkages, the ASMP-EU district cluster development program for select crop value chains proposed to facilitate and promote collective small farmer organizations supported by capacity enhancement/mentoring and formation of legally empowered farmer companies (PUCs) to create an enabling environment to establish sustainable Private-Private business partnership under one platform.

The main focus under ASMP –EU interventions is to promote export of agricultural products that include self-sufficiency of select commodities for local consumer markets.

In this regard the project proposes to promote the concept on Exporter/Processor/Buyer Consortia (**Agri$^+$**) to be established with organizational arrangements, based on both local and export collaborative interventions. Network relationships are considered important action especially for leverage PUC by mitigating the limitations arising from size operations, or inexperience and gain access to modern technologies, production or market access.

Key steps envisaged to discuss are;

(a) Identify, establish the strategic alignment of **Agri$^+$** consortium and PUC/Crop VC

(b) Formulating **Agri$^+$** consortium strategy –
(Production/processing/exporting/distribution)

(c) Design and establish the organisational structure for **Agri$^+$** consortium & networking with PUC.

(d) Leveraging on strategic resources and distinctive competences.

(e) Enforcing corporate governance and leadership.

(f) Measuring consortium performance.

Aligning the competitive strategies of independent private sector companies turns into developing a shared vision of their future product/market development activities that makes explicit the reasons underlying the alliance and the advantages that each member can obtain from it. In the start-up stage of **Agri**$^{+}$, the task of assessing strategic alignment is carried out by PMU of ASMP.

Consortia are vehicles for building social relationships and social capital that can be exploited not only at the international level, but also in domestic markets. Indeed, upgrading and enterprise modernization measures can also be facilitated through cooperation between PUCs.

The **Agri**$^{+}$ consortium will influence the producers under PUC to adopt best practices to improve the quality, food safety, traceability, improved management tools, modern communication, etc, and enhanced mechanization of pre and post-harvest operations to increase efficiency productivity for competitive marketing.

Investments are not affordable for individual SAEs, but may become within their reach through joint financial collaboration in the framework of an **Agri**$^{+}$ consortium. PUC members pool together their resources for the joint acquisition of equipment, supplies and services (marketing, logistics, training, technical advice, etc.) and thus achieve, as a group, increased bargaining power that allows them to obtain products and services at better conditions. Furthermore, permanent information exchange between associated PUCs on, for instance, production and human resources management practices contributes directly to collective company upgrading.

Designing the organisational structure of **Agri**$^{+}$ is another important task. It encompasses a number of choices affecting the macrostructure, i.e. the identification of the activities to be carried out at consortium level and of those that will continue to be performed by member firms, and the microstructure, i.e. the identification of the organisational units of the consortia and their roles, tasks and responsibilities. Different options can be identified in terms of distribution of activities at consortium vs. firm level. Preferred s style of structure is light structure where the consortium does not have (or has only to a very limited extent) its own staff and resources, because all of the responsibilities and tasks are distributed among the individual firms

The competitiveness of export consortia depends on the set of strategic resources and distinctive capabilities developed and spread at both **Agri**$^{+}$ and PUC level. Experiences shows that the benefits of consortia are particularly relevant in terms of de

Expected outcomes of Agri$^+$ are, contributed to the enhancement of reputation at both Agri$^+$ and PUC. The development of a ‘common identity’, i. e. creation of the consortium logo, brands, development of common promotional materials, and marketing actions jointly implemented. Development of new business contacts in both domestic and international markets and increasing technical and managerial knowhow are two further areas in which the contribution of the consortia has proved important. The development of ‘relational capital’ encompasses relationships not only with customers, but also with public and private institutions, which are at the basis of the acquisition of financial resources.

The governance structure and mechanisms of the Agri$^+$ also play an important role in enhancing the strategic alignment of member firms and promoting their commitment. In order to achieve equilibrium among the interests of member firms, an effective involvement of all of them in the decision-making process is necessary. All of the partners are therefore expected to participate directly to top management bodies. Initially, involve representatives of the Agri$^+$ and managers of PUCs.

A workshop with potential partners of Agri$^+$ is needed to finalise the potential involvement; signed mutual agreements/MOUs with Agri$^+$ and PUC, contract buyer agreements, agribusiness ventures, value additions, safety and quality requirements, technological interventions, logistic and postharvest chin management practices.

Objectives of the Workshop:

The objectives of the proposed workshop are threefold:

1. Introducing the concept of the Agri$^+$, objectives and expectations
2. Identify, establish and manage the strategic alignment of Agri$^+$ and PUC
3. Design the Agri$^+$ structure and governance mechanism

Outcome of the Workshop:

The outcome of the workshop will be a summary report developed by the host based on the road map developed. Furthermore, the conclusions and insights drawn from the discussions will help refine the **Agri+** in new project districts. The **Agri+** established and producer/market networking established with and MOU, members linked to PUC

Format:

The workshop will be half-a-day (approximately 3 hours including breaks).

The workshop WILL BE RECORDED to provide for an accurate representation of views/discussions. The workshop host and the project lead will facilitate the discussions. To ensure maximum engagement of participants, at least 03 break-out rooms will be organised between practitioners, industry experts and the project team.

Agenda:

1. The workshop will begin with a general overview of the ASMP project, crop clusters PUCs and **Agri+**
2. First focus is on willingness of stakeholders to join the **Agri+** and their concerns
3. Second focus is on design phase of **Agri+**: Structure, functions, responsibilities, governance, etc
4. A facilitated discussion on developing the road map for the **Agri+**
5. Recommendations on the way forward and an exchange of ideas on a common vision for **Agri+**

Confidentiality of data:

All data that will be obtained in the workshop will be treated with strict confidentiality and will only be used for this research. Any information regarding any respondent or organisation will not be disclosed, and the data collected will be kept in a secure location. The names of the respondents and the organisations will not appear in any publication resulting from this research. After participants have read this information and asked any questions, they will be given a consent form to be completed and signed. Participants will be able to withdraw at any time (even during the workshop), for any reason without explaining the reasons for withdrawing.

Contact Details for any Enquiries –

Workshop Hosts:

Name	**Telephone**	**email**
Prof. Achini De Silva	0718307499	desilva.achini@yahoo.co.uk / achini@agri.sab.ac.lk
Mr.M. Farhad –	0714243226	rinzafa@gamil.com
Mr. Gamini Prathapasinghe	0710665011 / 0773295011	gprathapasinghe@gmail.com
Mr. Prrasad Jayaweera	0777198170	japjayaweera@gmail.com
Eng. Arjuna Dissanayake	0777870925	arjunauom@gmail.com
Dr. Sampath Dharmadasa	0719423888	sampath@uwu.ac.lk
Mr. S.B. Adikari	0718167816/0777840220	adikari8@gmail.com
Mr. Sanath Wickramathilake	0774555944	sanathwickramathilake@yahoo.com

Planned crop clusters/PUCs

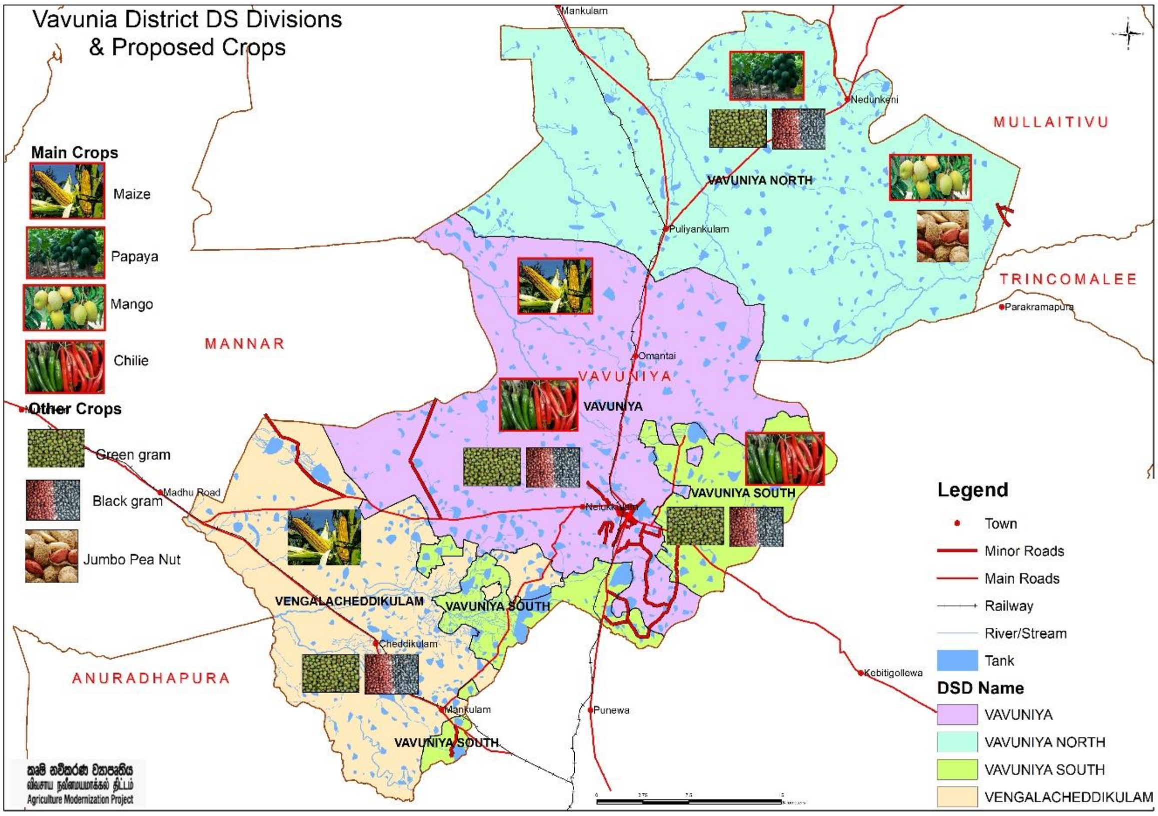


Figure 1: Vavuniya crop clusters

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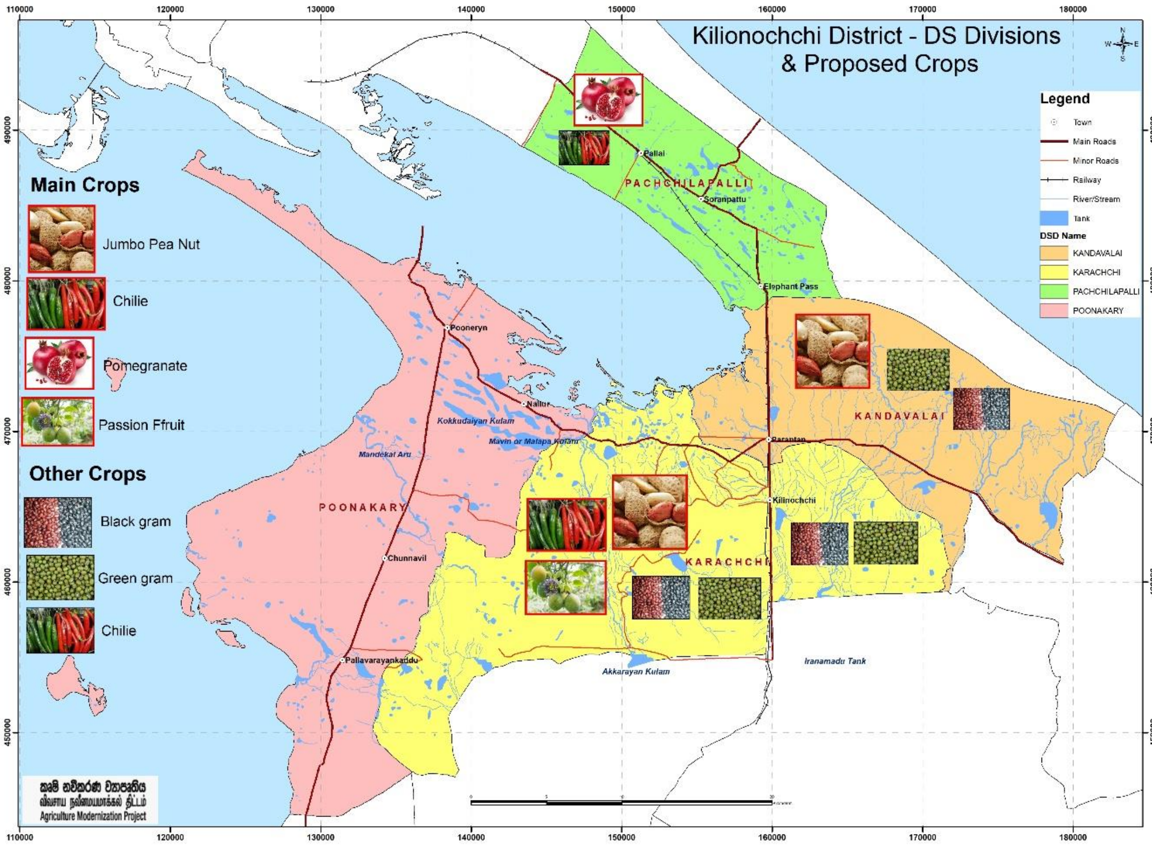

Figure 2: Planned crop clusters of Kilinochchi

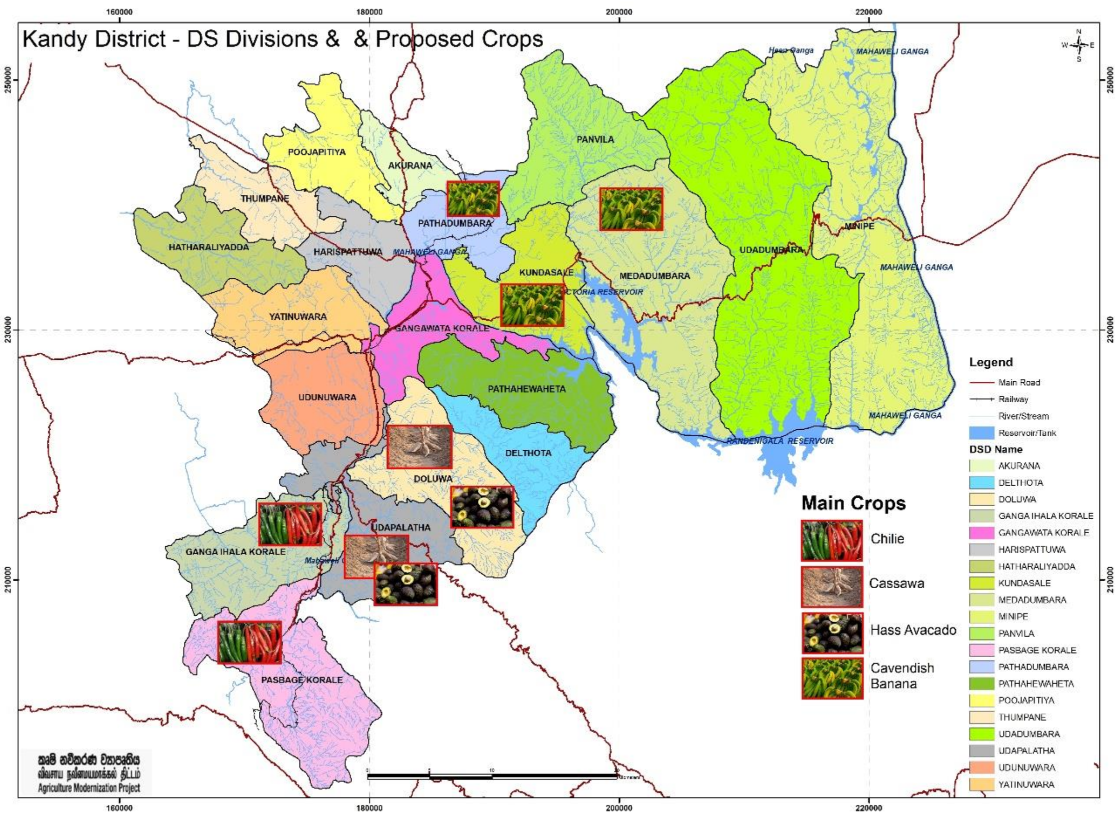

Figure 3: Planned crop clusters of Kandy district

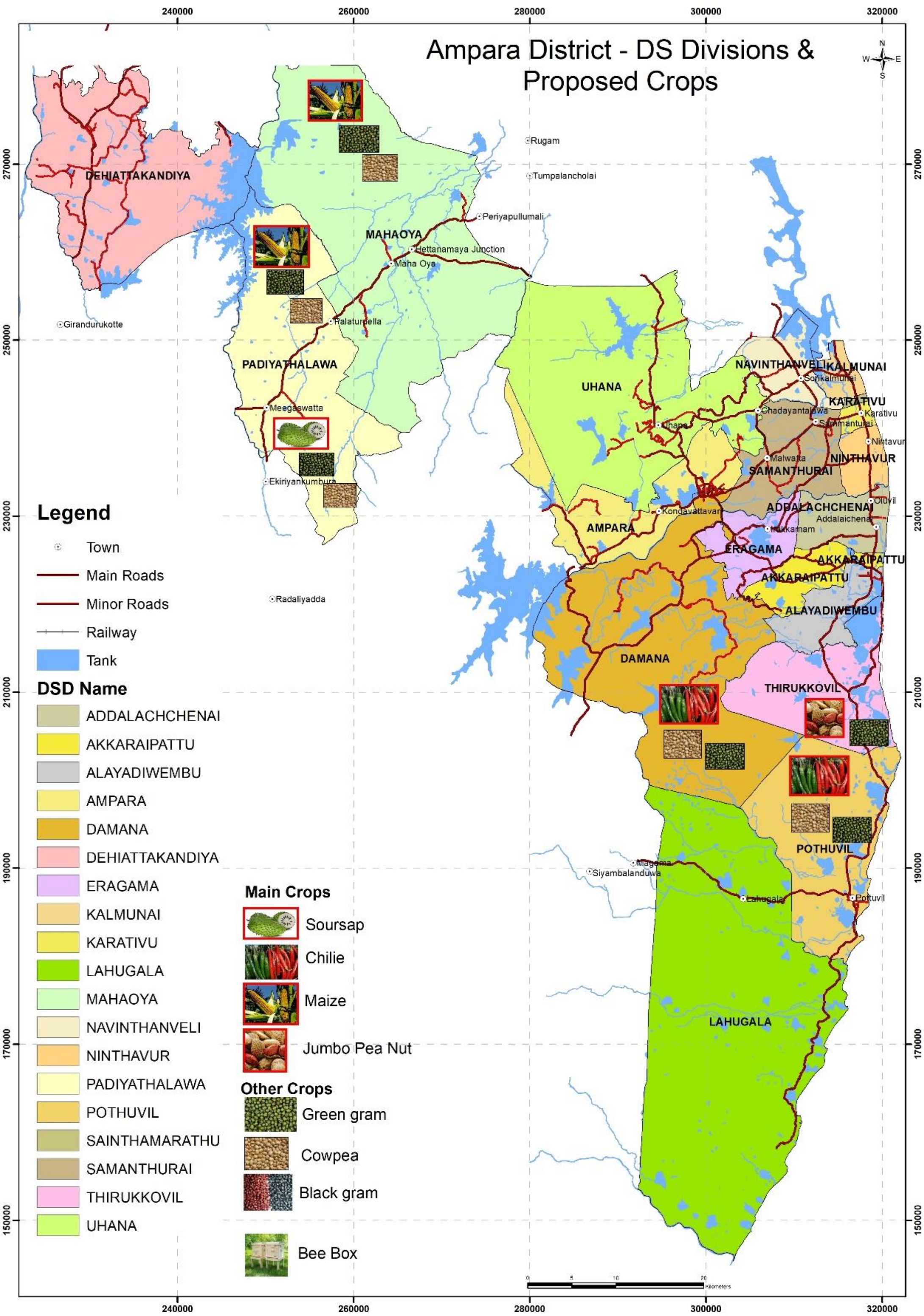

Figure 4: Planned crop clusters of the Ampara district

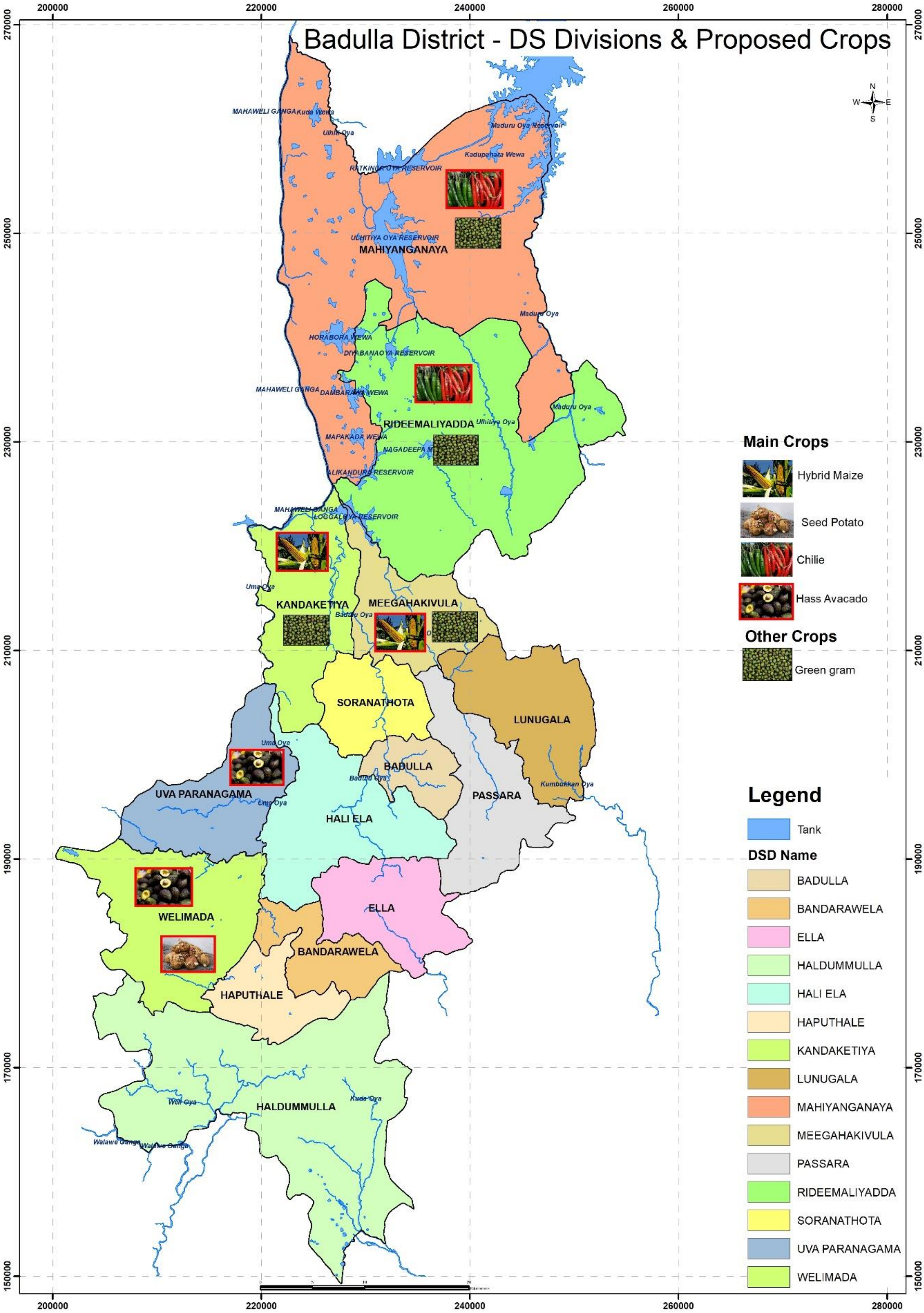

Figure 5: Planned crop clusters of Badulla district

Annex 1- Participant Consent Form

Project Title: ASMP Agriculture Sector Modernization Project (new EU districts)

Workshop Host: Prof. Achini De Silva, Mr. M. Farhad, Mr. Gamini Prathapasinghe, Mr. Prasad Jayaweera, Mr. Arjuna Dissanayake, Dr. Sampath Dramdasa Mr. S.B. Adikari, Mr. Sanath Wickramathilake

Name of the Workshop Participant:

Email of the Workshop Participant:

Please delete as appropriate.

• I confirm that I have read and understood the information sheet for the above research and what my contribution will be	Yes	No
• I have been given the opportunity to ask questions about my participation	Yes	No
• I agree to take part in the workshop	Yes	No
• I understand that all the information I provide will be treated in strict confidence	Yes	No
• **I agree to the workshop, and my participation, being recorded**	Yes	No
• I understand that I have the right to withdraw from this study at any stage for any reason, and that I will not be required to explain my reasons for withdrawing	Yes	No

Name of the participant:	
Signature:	
Date:	

District Feasibility Study, for preparing Cluster Development Plans (CDPs) and to guide the field staff & farmers on initial implementation of CDPs in new project Districts (Ampara, Badulla, Kandy, Kilinochchi, and Vavuniya)

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விவசாய நவீனமயமாக்கல் திட்டம்
Agriculture Modernization Project

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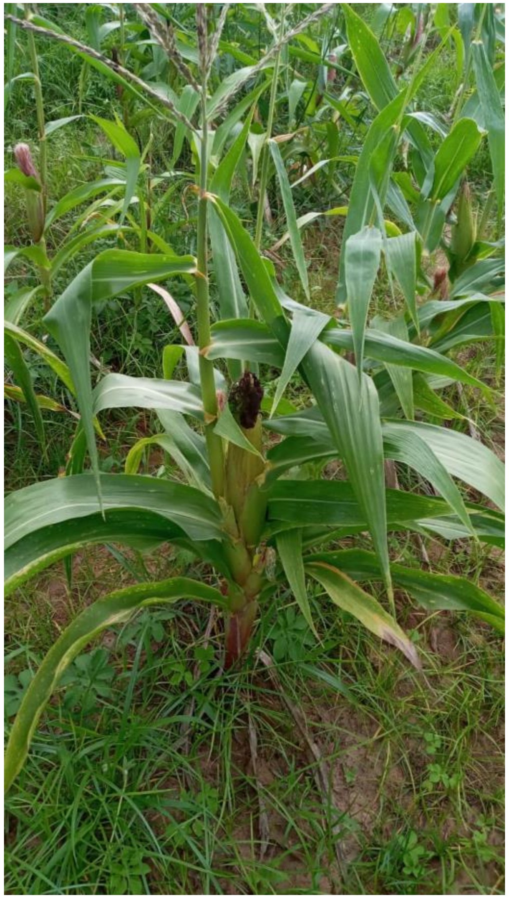
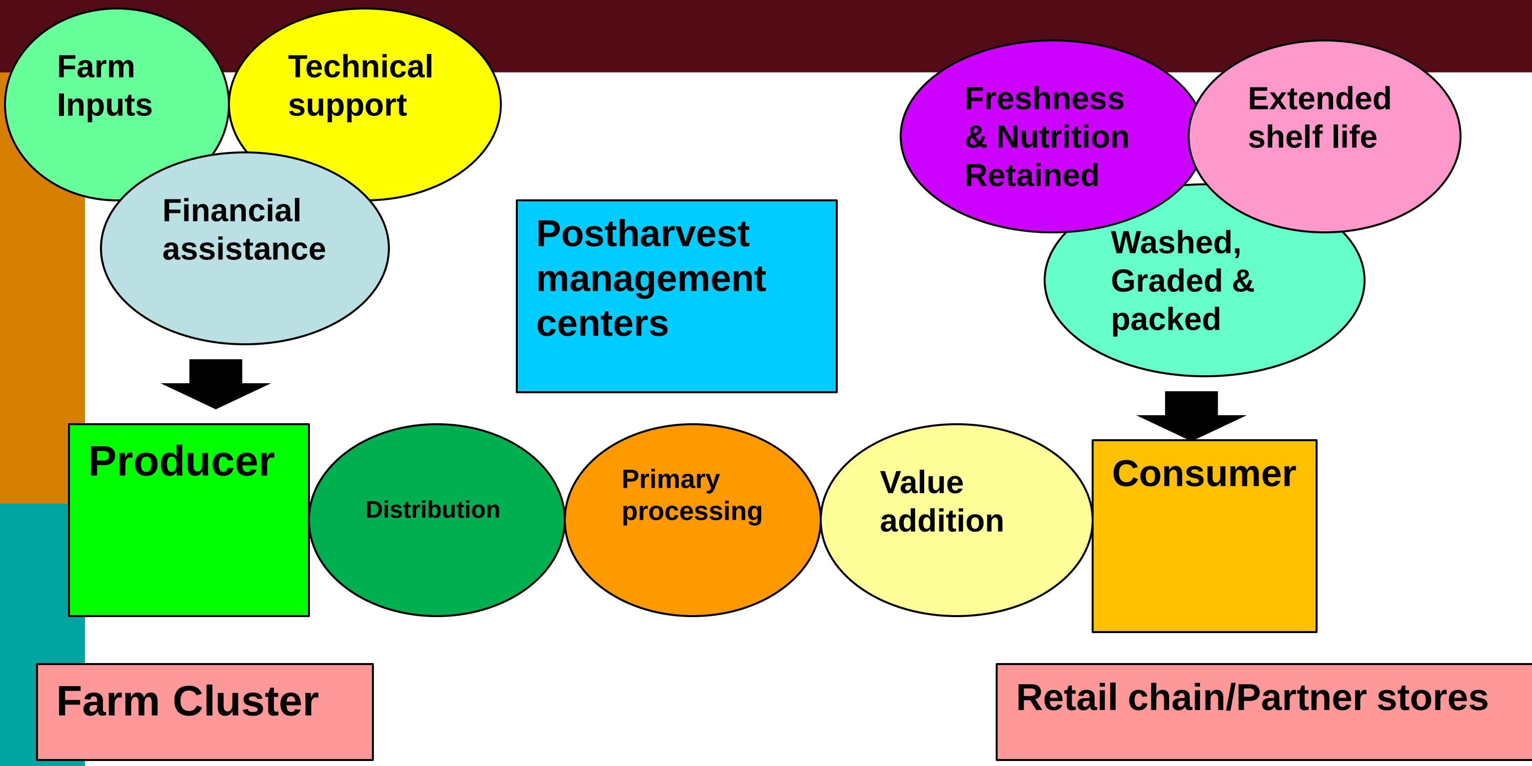
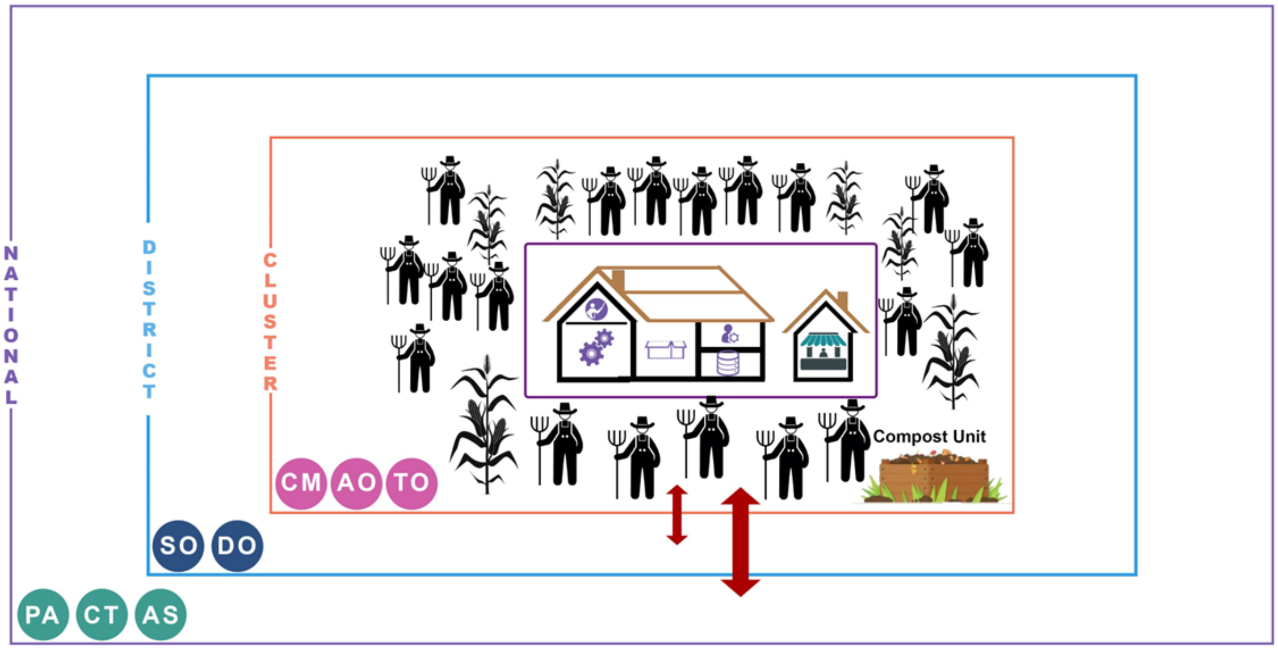


Develop agrifood value chains: concept model



Crop cluster: concept

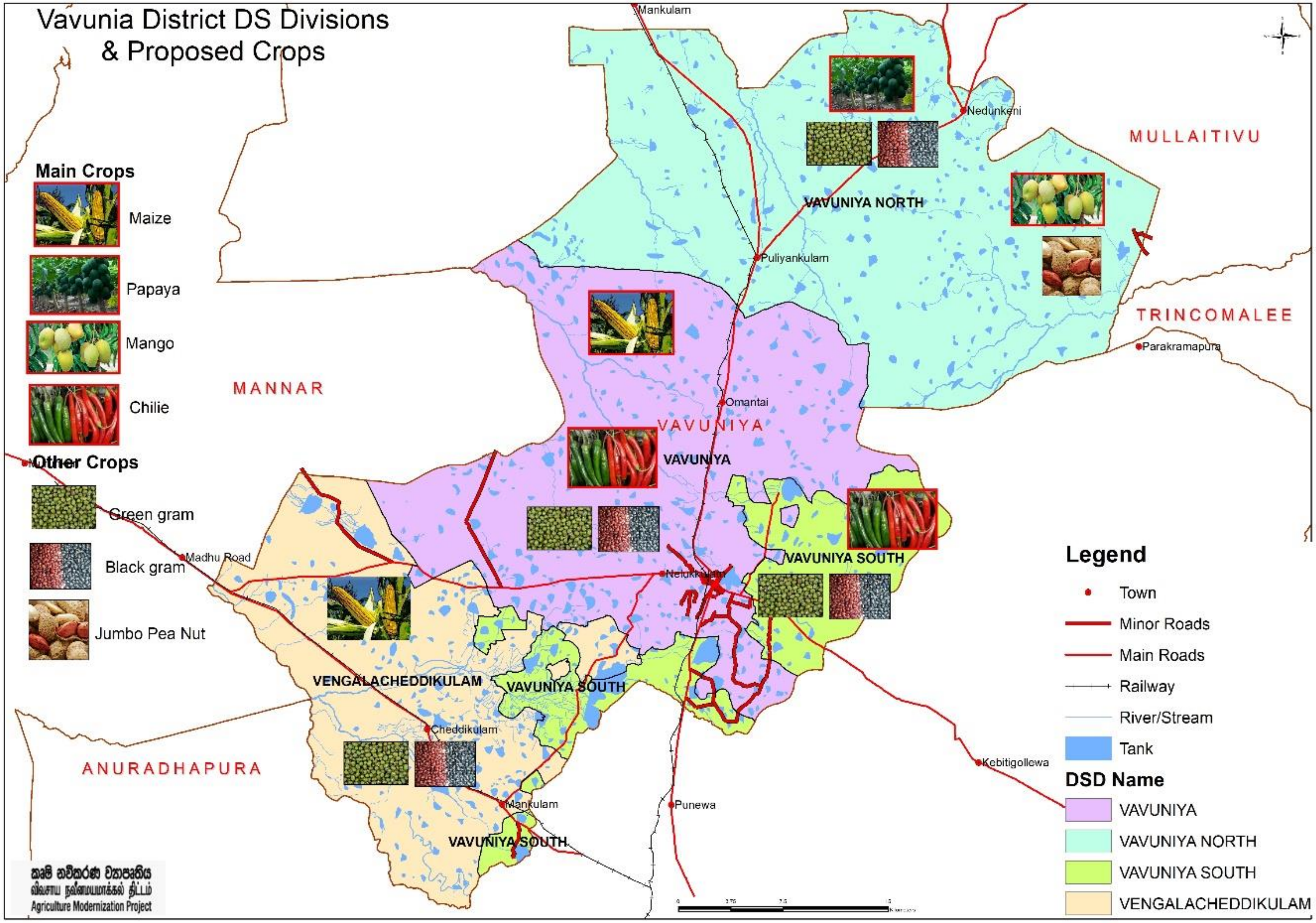


- Cluster Processing Center
- Cluster Pack House
- Cluster Storage
- Cluster Administration Office
- Cluster Training Hub
- Cluster Market

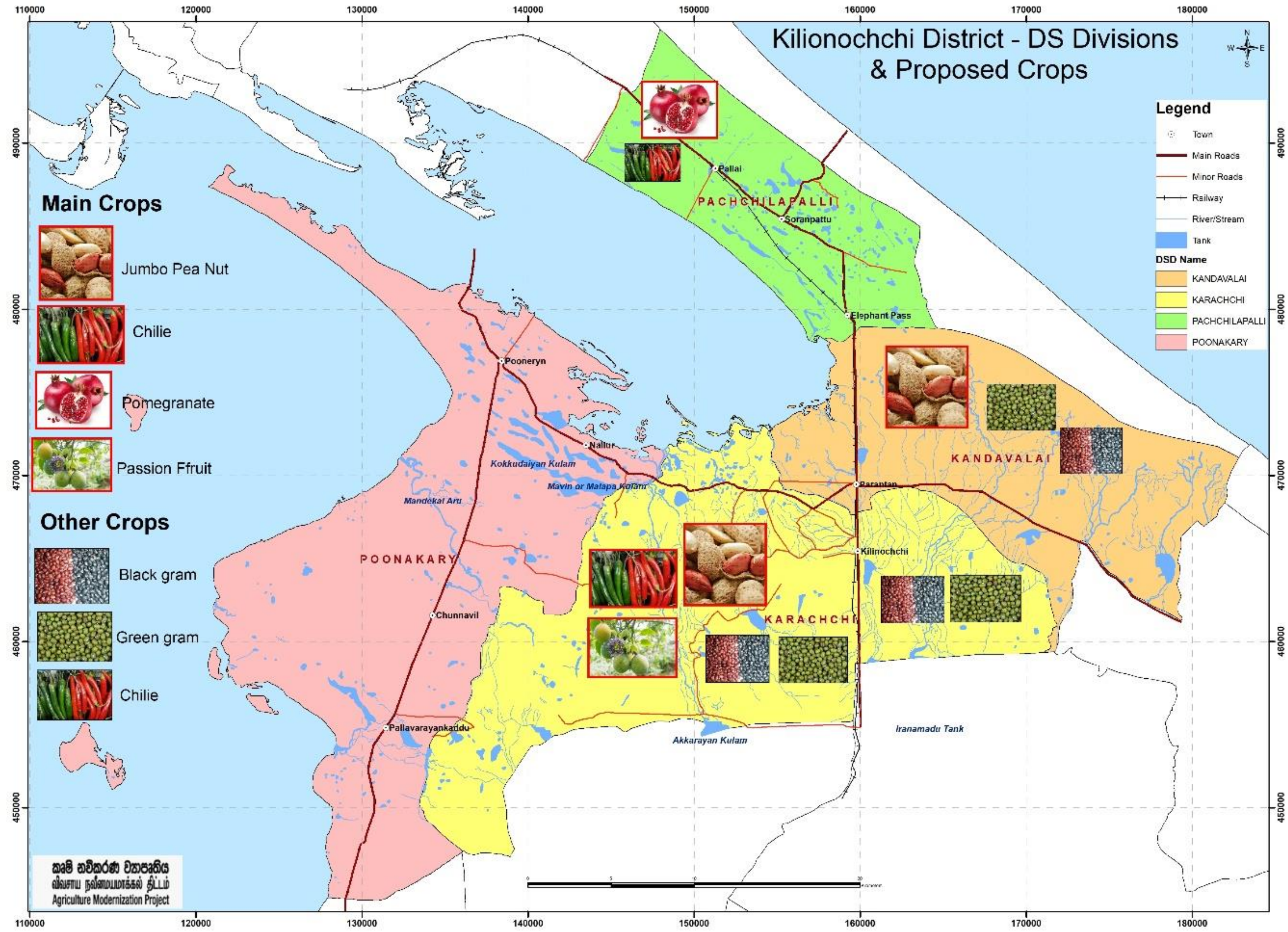
- Cluster Farm Unit
CM - Cluster Mobilization
AO - Agriculture Office
TO - Training & Capacity Building Office
SO - SLGAP/ Safety & Quality Training Office

DO - DPD/ ASMP
PA - PMU/ ASMP
CT - Consultants: Agribusiness & Value-chain Aggronomist, Economist, Engineer, GIS-Experts, Environmental & Social Safe Gard Expert
CT - ASMP Exporter Consortium

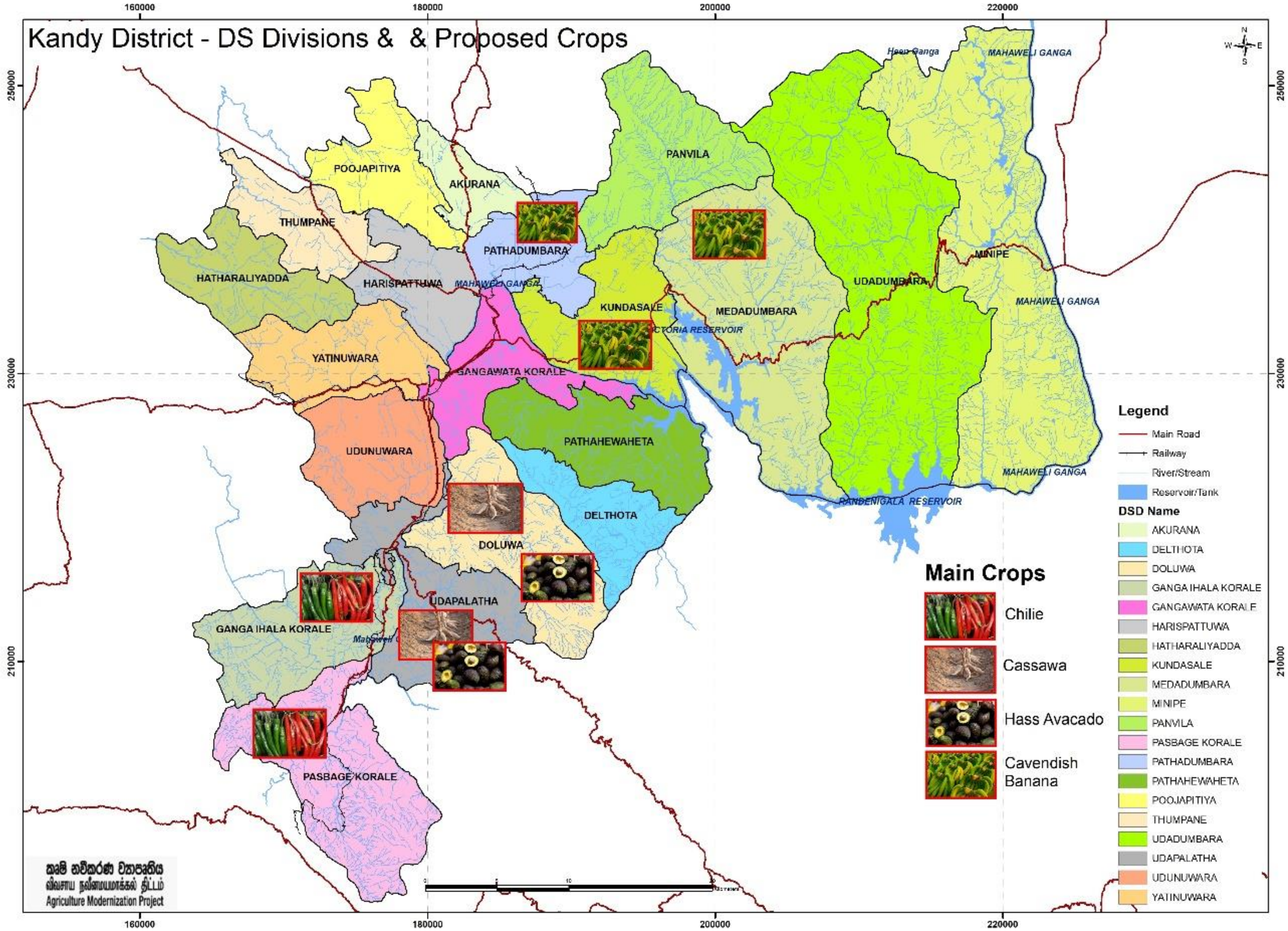
Proposed crop clusters for Vavuniya



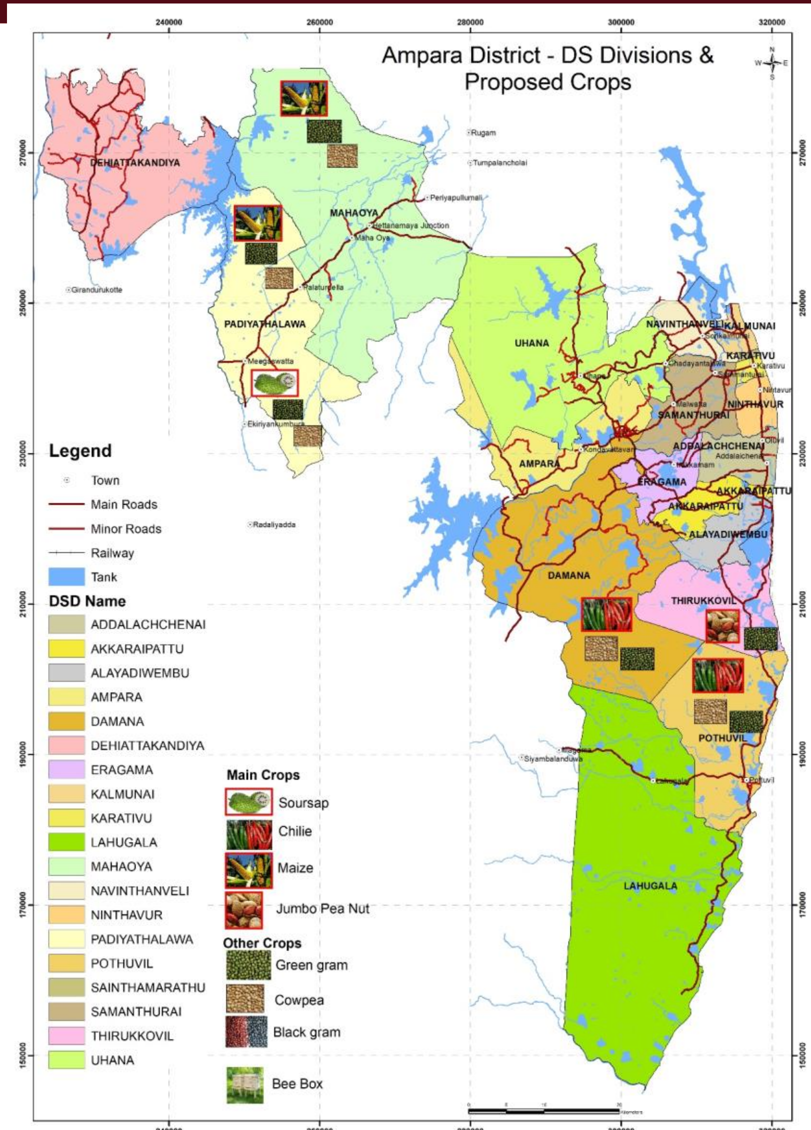
Proposed crop clusters for Kilinochchi



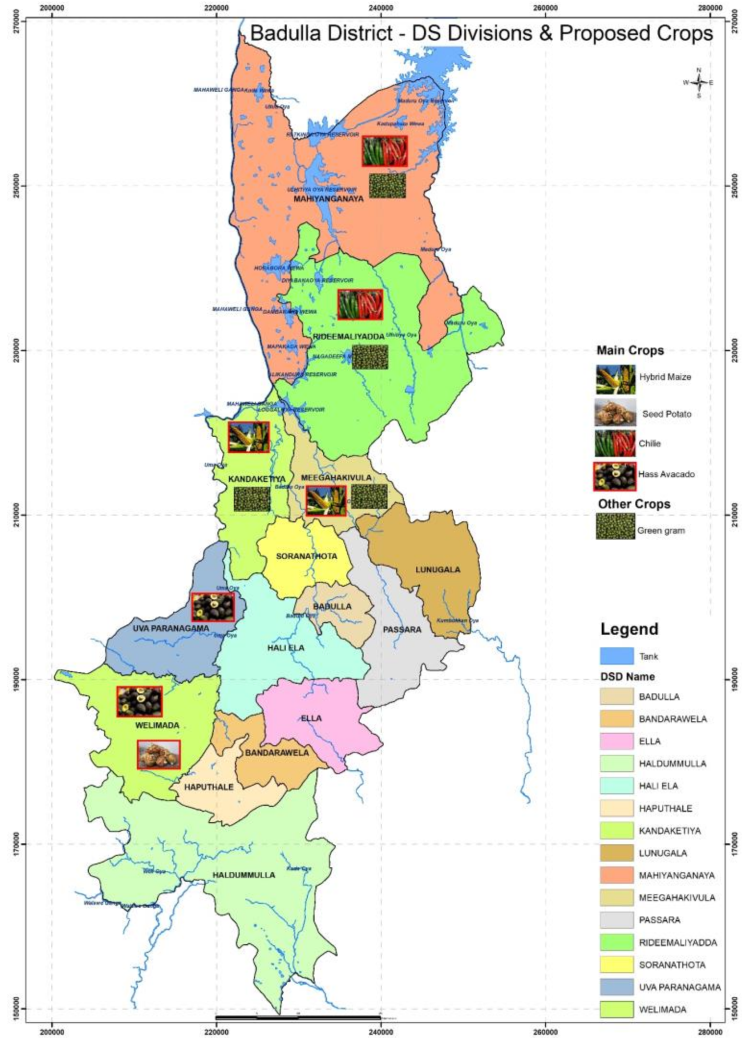
Proposed crop clusters for Kandy



Proposed crop clusters for Ampara



Proposed crop clusters for Badulla



Objective of the workshop

- To explore the potentials of establishing producer/market linkages (consortia) with the proposed crop value chain-based farmer cluster companies (PUCs) for sustainable ("Private-Private"-2P-) agribusiness partnerships
- To promote the concept on Exporter/Processor/Buyer Consortia (**Agri^{+}**) to be established with organizational arrangements, based on both local and export collaborative interventions

Key steps envisaged to discuss :

- (a) Identify, establish the strategic alignment of **Agri$^+$** consortium and PUC/Crop VC
- (b) Formulating **Agri$^+$** consortium strategy – (Production/processing/exporting/distribution)
- (c) Design and establish the organisational structure for **Agri$^+$** consortium & networking with PUC.
- (d) Leveraging on strategic resources and distinctive competences.
- (e) Enforcing corporate governance and leadership.
- (f) Measuring consortium performance

Outcome

- Aligning the competitive strategies of independent private sector companies turns into **developing a shared vision** of their future product/market development activities
- In the start-up stage of **Agri^{+}** , the task of assessing strategic alignment is carried out by PMU of ASMP.

Outcome

- Consortia are vehicles for **building social relationships and social capital**
- **upgrading and enterprise modernization** measures can also be facilitated through cooperation between PUCs
- influence the producers under PUC to adopt **best practices** to improve the quality, food safety, traceability, improved management tools, modern communication, etc, and enhanced mechanization of pre and post-harvest operations to increase efficiency productivity for competitive marketing

Road to Agri^{+} Consortium

- Nominate membership for the consortium
- Design phase of **Agri^{+}**: Structure, functions, responsibilities, and governance
- Establish Pvt.-Pvt. (2P) agribusiness partnerships, enter into MOU
- Facilitate 2P operations, Monitoring the progress/failures and introduce participatory corrective actions
- 2P sustainability status: win win space

Thanks!

Discussion session 1

Expectations of industry stakeholders: ASMP/EU farmer clusters, their produce, safety and quality requirements, logistics, etc

Discussion session II

Establishment of **Agri^{+}** consortia: Modes of collaboration, consortia structure and management

Discussion session III

Develop Road map: **Agri**$^{+}$ consortia:

- Nominate membership for the consortium
- Design phase of **Agri**$^{+}$: Structure, functions, responsibilities, and governance
- Establish Pvt.-Pvt. (2P) agribusiness partnerships, enter into MOU
- Facilitate 2P operations, Monitoring the progress/failures and introduce participatory corrective actions
- 2P sustainability status: win win space

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The European Union

Establishment of Agri$^+$ Consortia for the new districts funded by European Union

IP2 – Second stakeholder workshop

Outcomes

November 2022

Discussion session 1: Expectations of industry stakeholders

Stakeholder category	Expectations	Remarks
Cooperate sector	Regular supply of agreed amounts in expected quality Smooth communication and negotiations with the cluster members	Share technical knowhow, facilitate technology transfer, financially support to obtain the certification, i.e organic, Fairtrade,
Exporters	Quantity demanded may vary with the type of export order, but regular supplies and maintain safety and quality standards are essential Proper postharvest management; harvesting, cleaning, grading, packing, etc.	Share technical knowhow, facilitate technology transfer, financially support to obtain the certification, i.e organic, Fairtrade

Breakout room 1

Stakeholder category	Expectations: crop	Remarks
Cargills Ceylon Plc.	Dried red chili of all clusters Fresh mango -TJC Passion fruit – Kilinochchi processing centre	Quality requirements, postharvest handling, packaging and transport arrangements are willing to discuss with the cluster management Price decision based on their formula but negotiable Awareness training will be able to arrange upon request
CAP Green	Soursop – fresh fruit - 1000Kg/week Soursop – dehydrated leaves Passion fruit – frozen pulp Ripe Jack fruit – frozen pulp – 1000 kg Casava – fresh yam – 1000 Kg/week	Quality requirements, postharvest handling, packaging and transport arrangements are willing to discuss with the cluster management Cluster organic certification Awareness training on crop management, pruning,

		artificial pollination, pest and disease management, etc are essential components and company willing to arrange from their side
JH CEYLON HOLDINGS PVT LTD	Pomegranate Orchid	Company will provide plantlets based on market requirements, organic input (compost), know-how and willing to establish buy-back agreement with the farmer cluster

Breakout Room 2

Stakeholder category	Expectations: crop	Remarks
C.W. Mackey PLC CW MACKIE PLC ESTABLISHED IN 1900	Chili: 90 Mt/month required	Technology transfer, per farmer production and facilitating logistics will be an issue with the farmers. These issues will cause the per kilogram rate expense to go up.
Fruits and vegetable exporters association	Avocado: Hass variety Pineapple: Murusi/MD 2 variety Papaya: Red Lady Jack fruit Moringa (Leaves/fruits and pods) Grekin	Passion fruits also has a very good demand. It is essential to obtain Gap for all the fruit crops cultivated. Cassava has a good demand but the markets prices are low. Market for Kiriala is limited to the ethnic population in middle east. Buy back system is not successful when the market price of the crops increases than the agreed price. Then the suppliers are reluctant to sell their products to the company.

Breakout Room: 3

Stakeholder category	Expectations: crop	Remarks
CBL (Ceylon Biscuits)	Papaya - fresh, Mango - fresh Chilli – dried and oragnic Pomegranate - fresh Cassava - fresh	Willing to join the proposed consortia and sign MOU Willing to facilitate for organic certification of the chilli farmers Regular, agreed supply is essential Willing to facilitate the farmer training, infrastructure development
MAA	Papaya Jackfruit Pineapple Pomegranate Tamarine	Willing to join the proposed consortia and sign MOU Willing to facilitate to obtain the Fair-Trade certificate for farmers Willing to provide freezer trucks for transporting semi processed fruits (frozen pulp) Farmers have to work with forward contract agreements with them
Prima Ceylon	Maize	Willing to join the proposed consortia and sign MOU Willing to share their own hot chilli/Nai miris variety if project interested, share the technical knowhow and offer premium price Highly opposed the maize seed production

Discussion session II:

Establishment of **Agri**$^{+}$ consortia: Modes of collaboration, consortia structure and management

Stakeholder category	Expectations:	Remarks
Epic Lanka Pvt Ltd		Have a virtual marketplace to join buyers and farmers together. An initiative with the SLT mobitel Also provides delivery services to get the products delivered. **https://www.helaviru.lk**

Discussion session III

Develop Road map: **Agri**$^{+}$ consortia

Way forward

1. Identify stakeholders, both representing public and Pvt. sector who are willing and able to join with consortia
2. Establish the strategic alignment of **Agri**$^{+}$ consortium and PUC/Crop VC
3. Formulating **Agri**$^{+}$ consortium strategy – Pvt. – Pvt. partnership (2P): mutually agreed conditions on production, processing, value addition, logistic management, marketing, etc.
4. Each partnership, 2P (PUC of relevant crop cluster + Pvt. sector company) willing to enter into a MOU upon the conditions agreed mutually

5. PMU/EU team assisted filed visits to familiarize the relevant crop clusters, meet the farmers and officials
6. Design and establish the organisational structure for **Agri+** consortium & networking with PUC.
7. Leveraging on strategic resources and distinctive competences: Training, knowledge sharing, input supplies, networking, etc
8. Enforcing corporate governance and leadership – Establishment of PUC and commence the business operations
9. Monitoring the consortium performance: status of buy back agreements, new businesses, partnerships, returns, problems, issues, etc

Annex 2 - Outcome of the Technical discussion with personnel of DOA and other

Fruit crops.

Banana

According to the researchers view Ambul Banana is most eligible due the resistance for Panama disease. Market value comparatively low to other varieties like Kolikuttu but risk is minimum.

Only around 60% of the product can be used for direct consumption as dessert and another 10% is used for consuming in another as fruit drinks etc..

Approximately balance 30% goes to garbage.

There is a big potential for bi products (That wasting 30% can be used for this production)

- Banana cubes as dessert.
- From raw fruits - flour production to mix with wheat flour to reduce the Gluten effect of Wheat.
    - Can be mixed with rice flour also.
    - Good substitute to corn flour(corn flour 1000 Rs/Kg,
Banana flour 250Rs/Kg).
    - Very good up market from the health point of view.
    - In Barawakumbuka (Ambilipitiya), there is a Banana flour producer for CBL.
    - Seven Kgs of raw fruits needed for 1 Kg of flour.
    - Technology is very simple and machinery available in Sri Lanka.

Banana stem can be easily used for nursery planting pots cost effectively. Simple technology with pressing machines available (Dr Sujatha Weerasinghe in UC IRAF). Using of this Banana stems for the other product will be a very good remedial action to overcome the Banana weevil problem.

Cost of production is 50% against the current coir nursery pots (selling price will be around 6 Rs against the 12 Rs of coir one). If we can introduce this, that will be a great support to reduce the Banana weevil insect.

Banana stem → Chop → Wash and dry → Press with the cover of non-woven fabric.

Maize – for seed production

Dry zone low country is ideal for cultivation (DL 1a to DL 1f) in both Yala and Maha seasons and highly depend on the water availability.

Areas with high temperatures not good for specially seed cultivation. This problem can be overcome with the help of sprinkler irrigation system (this may not cost effective).

Parental lines are with DOA and can be purchased (If the requirement is high, purchase orders should be placed minimum four months before the season starts. (eg. Maha season order should be placed before 15th May).

Technology is very easy and not so expensive.

Seed driers are the main machinery needed. The Project Director says he has an idea to import parental lines from Thailand in near future.

Mr.Chandana Premarathna from Land Mark agro said that he has well experienced plant breeders working with him. If we need their assistance they are willing to help. He needs 20 mts of MI 5 hybrid seeds in every season.

ASMP propose to do 500 acres in Kilinochchi and 500 acres in Vauniya for coming Maha season (September 2022).

360 mln rs can be spent for cultivation and 100 mln for other activities.

Cost of the production of Maize I Kg is 250 Rs.

Normal selling price was 1200 rs per Kg but now it has gone up to 3600Rs (18,000 Rs for 5Kg packet).

If we are going to start seed preparation one cluster must be allocated for this purpose and those farmers should not be idled any way. We have to have a proper plan to keep them with us. The DOA propose the periods not cultivate Maize, to utilize vegetable seeds production.

Other advice of DOA is to follow the registered seed producing procedure and sell those production as registered seeds.

Jumbo Peanut

Agro ecological zones with DL1a to DL1f soil types ideal for Jumbo Peanut.

In Kilinochchi district only Karachchi division has proper soil type, DL 1f.

Vavuniya district is more suitable according to the annual rainfall and soil types.

Highly sensitive for fertilizer (Sri Lankan yield is very low).

- Gypsum is compulsory for basal fertilizer application.
- At flowering stage high Ca source needed.
- New technology needed to increase the productivity.
  - ➢ Organic manure and correct NPK ratios.
  - ➢ Micro nutrient also.
  - ➢ Some officers argue that, if we apply adequate quantity of Organic manure no need to apply micronutrient compulsorily.
  - ➢ Sulphur need to be applied.

Bed preparation depend on the soil type.

- ✓ In sandy soils, no need to prepare ridges.
- ✓ Only in other soils need ridge and furrow system.

Harvesting time can be decided only examine the colour of pods, at the optimum maturity the colour of pods start to discolour. At the harvesting time dying of plants cannot be seen in this variety like ‘Thissa’ variety (farmer awareness is very low about this identification).

Yield

GM varieties give 1500 Kgs per Acre but our locally developed varieties give only 600-700 kgs per acre in Maha and 700 - 800 Kgs in Yala.

Machinery need for every moment of the cultivation and processing.

Harvesting, Depoding, Shelling, Sorting, Grading and drying.

Locally fabricated depodiators are there with capacities of 600 kgs and 300 Kgs per hour.

Before storing, the moisture level should be brought down to 8% (some personnel say the requirement is 7% but the experts of DOA say 8% is OK).

According to the CW Mackie, here in local market also have high demand, 1000 Mts per year.

Second grade of this crop can be used for the Chocolate ball preparation also.

Nursery Industry

All most all districts in the country other than Northern Province have nursery industries. This is very profitable with high market potential industry. Therefore this can be introduced to Kilinochchi and Vavuniya districts. Here can be introduced the nursery pot preparation from Banana stems also.

Potato seed production

DOA has developed two varieties namely Sassi and Red la soda

Basic material (very clean material, Tissue culture plants or G zeros) can be brought from government farms and multiplied and produce G1s and G2s.

G1s and G2s can be cultivated in hilly areas during Maha seasons and produce G3s and keep those under proper storing condition to use in Yala seasons in Paddy fields. Production of this is directly for consumption.

A pilot project in Seethaeliya is continuing with ISP technology. This can be scaled up in Badulla district.

Machinery need for planting and harvesting.

20,000 RS per50 Kg is the price of seed potato (now it may have gone up).

Chili seed production

Only 20,000 ft^2 of poly tunnels using for Chili seeds production.

Total annual hybrid seeds requirement of 5000Kg can be produced easily in 500,000ft^2.

That means the total requirement of poly tunnel is 500,000ft^2 and at the moment only 20,000 ft^2 used.

A large number of poly tunnels are idling in Badulla and some other areas and can be converted easily for seed Chili production.

A considerable area can be covered by converting abandoned tunnels with minor repairs.

This 5000 Kgs of seeds enough for the total acreage requirement 10,000 Ha.

This 10,000 Ha enough to produce the total annual country requirement of dry chili (50,000 Mts from 250,000 Mts of raw chili).

Initially 6,000 Ha planned (4000 Ha in 2022) to be cultivated and within 3 years to achieve the target of 10,000 Ha for the self-sufficiency of Dried Chili.

This crop can be cultivated in different areas ($DL1_{a\_e}$, IL and IM soil categories) of the country with the irrigation facility.

Vavuniya and Kilinochchi farmers have proven that the potential raw Chili yield is 45-50 (Dried Chili 9-10) Mts per Ha.

Due to the prevailing situation of the country the raw chili price gone up drastically that affects to the dry chili production.

Because of that reason around 50 number of small scale Solar powered Chili driers are idling.

Urban Agriculture

Very important suggestion came about the improvement of urban agriculture.

Develop entrepreneurs for nursery industry and train them plant seeds in pots and look after those until reproductive phase sell those with fruits at a reasonable price (about 200 Rs. Per pot). This system can be followed for Raw Chili, Tomato and Eggplant. This system will be a great help to overcome the Green chili demand especially in urban areas.

Soil and Soil Nutrients.

Soil sample testing is very important and for the successes of any cultivation balanced soil nutrient and optimum water levels are very important.

We have to seriously think about the ‘P’ level of the soil because it can be accumulated due to less leaching character. If the ‘P’ levels are high, that inhibit the intake of other nutrients.

Sampling

Lands must be categorized according to the slope of lands.

Sample size is around 5-6 samples per Ha is enough from a same level of land.

Test based fertilizer recommendation is compulsory in commercial cultivation.

Ferrous (Fe) deficit is noticed in northern area soils and ferrous sulphate (FeSO4) use as folio application may be the remedy of that.

Nitrogen (NO3) and Phosphorous (P2O5) gives together by DAP (Di Ammonium Phosphate).

DAP not make significant PH changes to soil.

N.B.

Application of TSP by dissolving in water, is not advisable because that dissolved ‘P’ can make bonds with Ca and make Calcium Phosphate which reduce the soil porosity.

IPHT (Institute of Post Harvesting Technology).

Very good market opportunity has been created for different flour products as substitutes for Wheat flour (due to high Gluten content in Wheat flour).

Manioc Flour, Bread fruit flour, Banana flour and Raja ala.

Bread fruit flour has the ‘Anti-oxidant’ effect also.

Edible fruits and Vegetable market from Green hoses collapsed due to prevailing situation in the country.

Mr.Bhathiya Abeywardhana

He started very successful Chili seeds production in Galewela and handed over to ASMP.

Green houses with crops like Cauliflower are being converted to local vegetables like Bean etc.

IPM technology.

IPM technology means application of collective measures (chemical and physical) to control all pest problems.

- Most important thing is awareness of farmers as well as field officers.
- Proper training series, identification and diagnose the problems clearly.
- Identification of harmful insects and natural enemies.

- How to control harmful insects.
- Different training methods to be applied, field trainings, different videos, printed materials.

Sweet Orange (further discussion needed).

Sisila and Arogya varieties cannot be grown in Northern Province.

Bibila Sweet is good for Vauniya and Kilinochchi districts. Now available in Nadunkerni area.

More than nine months need to multiply.

Plants grafted to Wood apple perform well.

Continuous harvesting causes to deforming of fruits.

Pineapple (further discussion needed).

Performance of new variety MD 2 is good.

Laggala and Monaragala have plantations.

New stocks of 70,000 plants going to be imported immediately.

Multiplying from tissue culture plants is very high risky thing.

Shortage of relevant chemicals also a barrier for multiplication.

Mango (further discussion needed).

Proper pruning is very important for better yields and quality of fruits.

TomEJC is highly sensitive for Hormones.

ASMP-EU
Field Data Collection for Feasibility and Cluster Development

1	Code Number	
2	Province	
3	District	
4	DS Division	
5	Local Authority	
6	Region	
7	AI- Range	
8	GS Division	
9	Sex	Male:- Female :-
10	Age Group	
11	Civil Status	1. Married 2. Unmarried 3 Widowed/Divorced
12	How many members in your family	No.
13	If "married" How many children do you have	[ ]
14	Age group of children and no.	1. Below 5 2. Between 6-10 3. Between 11-18 4. Above 18
15	Your Educational Qualification	1= Primary (1-5 grade) [ ] / 2=5-11 grade[ ] / 3= O/L pass [ ] 4= A/L pass [ ] / 5=Diploma [ ] / 6=Degree [ ]
16	Your Spouse Educational Qualification	1= Primary [ ] / 2=5-11 grade[ ] / 3= O/L pass [ ] 4= A/L pass [ ] / 5=Diploma [ ] / 6=Degree [ ]
17	Your Children Education group and no	1= Primary 1-5 grade) [ ][ ] / 2=5-11 grade[ ] ( ) / 3= O/L pass [ ] ( ) 4= A/L pass [ ] ( ) / 5=Diploma [ ] ( ) / 6=Degree [ ] ( )
18	Are you employed	1. No 2.Yes
19	If "Yes", what kind of employment	1. Public [ ] 2. Private [ ] 3 Self Employment [ ] 4 NGO [ ] 1. Labourer/Minor Employee/Similar 2. Teacher/Clerk/Technician/ Similar 3. Doctor/Engineer/Layer/Executive 4. Business/Self Employment 5. Other specific jobs
20	Is your Spouse employed?	1. No 2 Yes
21	If "Yes", what kind of employment	2. 1.Public [ ] 2. Private [ ] 3 Self Employment [ ] 4 NGO [ ] 1. Labourer/Minor Employee/Similar 2. Teacher/Clerk/Technician/ Similar 3. Doctor/Engineer/Layer/Executive 4. Business/Self Employment

<table>
<tr><td></td><td></td><td colspan="4">5. Other specific jobs</td></tr>
<tr><td>22</td><td>How many children are employed</td><td colspan="4">1. No 2 Yes</td></tr>
<tr><td>23</td><td>If “Yes”, what kind of employment (category and No.)</td><td colspan="4">6. 1.Public [ ] 2. Private [ ] 3 Self Employment [ ] 4 NGO [ ]
1. Labourer/Minor Employee/Similar No [ ]
2. Teacher/Clerk/Technician/ Similar No [ ]
3. Doctor/Engineer/Layer/Executive No [ ]
4. Business/Self Employment No [ ]
5. Other specific jobs No [ ]</td></tr>
<tr><td>24</td><td>Ownership of land</td><td colspan="4">1. By owner
2. Rented/Lease land
3. Crown/Government land
4. Other (Specify)</td></tr>
<tr><td rowspan="5">25</td><td rowspan="5">Experience in crop husbandry</td><td colspan="2">1. Maize</td><td colspan="2"></td></tr>
<tr><td colspan="2">2. Horticultural crop (Vegetable/Fruits)</td><td colspan="2">Veg. [ ] Fruits [ ]</td></tr>
<tr><td colspan="2">3. Floriculture</td><td colspan="2"></td></tr>
<tr><td colspan="2">4. Nursery</td><td colspan="2"></td></tr>
<tr><td colspan="2">5. Farm related -Entrepreneurial</td><td colspan="2"></td></tr>
<tr><td>26</td><td>Land Extent ac</td><td colspan="2">High land:</td><td colspan="2">Low Land:</td></tr>
<tr><td>27</td><td>Are you a member of farmer’s organization</td><td colspan="4">1. No. 2 Yes</td></tr>
<tr><td>28</td><td>If “Yes” how many years your membership</td><td colspan="4">Name of organization. Yr.</td></tr>
<tr><td>29</td><td>Are you bearing post of the farmer organization</td><td colspan="4">1. No 2. Yes</td></tr>
<tr><td>30</td><td>If “Yes” what is the position</td><td colspan="4">1. Executive post (President/Chairman/Secretary/Treasure
2. Committee member
3. Others</td></tr>
<tr><td>31</td><td>Type of Labour used</td><td colspan="4">1. Only family labour
2. Hired labour
3. Both family and hired</td></tr>
<tr><td rowspan="7">32</td><td rowspan="7">Pattern of Labour used</td><td>Field operation</td><td>No of Family labour</td><td>No of Hired labour and rate of daily/monthly payment</td><td>Cost (Rs)</td></tr>
<tr><td>Pre weedicide application</td><td></td><td></td><td></td></tr>
<tr><td>Land preparation
Labor
Machinery</td><td></td><td></td><td></td></tr>
<tr><td>Digging and seeding</td><td></td><td></td><td></td></tr>
<tr><td>Weeding and earthing up</td><td></td><td></td><td></td></tr>
<tr><td>Weed control with weedicide</td><td></td><td></td><td></td></tr>
<tr><td>Fertilizer application per acre</td><td></td><td></td><td></td></tr>
</table>

		UREA (amount and cost) TSP (amount and cost) MOP (amount and cost) FYM (amount and cost)			
		Harvesting and drawing			
		Threshing and processing with engine power			
		Threshing and processing manually			
		Drying			
		Transport			
		Any other cost			
33	Yield/ ac (kg)				
34	Price/ Kg (Rs.)				
35	Price/ corn				
36	Number corn per acre				
37	Whom to sell				
38	Any primary processing at home				
39	Any value addition				
40	What other crops grown with Maize				

41	Position on Slope	Bottom	Mid-slope	Upper-Slope
42	Soil Erosion	Low	Medium	High
43	Ground Water Availability	Dug Well	Tube Well	Other (specify)

44	Source of fresh Surface Water	Spring/canal	Tank /Reservoir	Perennial Stream	Seasonal Stream	None

ECOLOGICAL					
Habitat Types in the Project Site (indicate the % of each habitat type)	Natural forest	Degraded forest	Natural scrubland	Degraded scrubland	Riverine forest
	Grassland	Abandoned agricultural land	Marsh	Lagoon	Estuary
	Coastal scrub	Mangrove	Salt marsh	Home-gardens	Other (list)
Habitat types within 500m radius from the site periphery (indicate the % of each habitat type)	Natural forest	Degraded forest	Natural scrubland	Degraded scrubland	Riverine forest
	Grassland	Abandoned agricultural land	Marsh	Lagoon	Estuary
	Coastal scrub	Mangrove	Salt marsh	Home-gardens	Other (list)

Are there any environmentally and culturally sensitive areas within 250m?	Protected Areas	Migratory pathways of animals	Archeological sites	Wetlands	Mangroves strands

Probable Involuntary Resettlement Impacts	Yes	No	Not Known	Details
Is the intervention likely to cause any permanent damage to or loss of housing, other assets, resource use?				
Is the site chosen for this work free from encumbrances and is in possession of the government/community land?				
Are there any non-titled people who are living/doing business on the proposed site/project locations that use for work?				
Is any temporary impact likely?				
Is there any possibility to move out, close of business/commercial/livelihood activities of persons during implementation?				
Is there any physical displacement of persons due to implementation?				
Does this project involve resettlement of any persons? If yes, give details.				
Will there be loss of /damage to agricultural lands, standing crops, trees?				
Will there be loss of incomes and livelihoods?				
Will people permanently or temporarily lose access to facilities, services, or natural resources?				
Are any indigenous people living in proposed locations or affected/benefitted by the project intervention?				
Inclusion of Vulnerable families?				

- Number of Family members engage in farming……………..
- Years of engaging in farming……………
- Type of farming: Paddy/ OFC/Livestock.
- Machinery availability: Tractors….. Ploughs…..water pumps…. sprayers ……other……..
- Relationship with different institutes. DOA,……..Agrarian…….Irrigation……..Banks…….other

Feasibility	Good	Moderate	Poor	Remarks
1. Primary Production Feasibility				

Natural resource variability				
High availability of hybrid maize seed				
Limited knowledge about hybrid maize seed morphology and renewal				
Unclear economic attractiveness to harvester				
Unfamiliarity with hybrid maize seed harvesting for market				
Horticulturists' preference of multiplication in controlled environment				
Uncertain knowledge about hybrid maize seed stable supply				
2. Enabling Environment Feasibility				
Embeddness constraint to reliable supply				
Environmental services' capacity building for to guarantee compliance of legal framework				
No trade barriers to market				
Available subsidy for VC development				
Potential long-term conflicts over landuse				
3. Market Feasibility				
Reliability of supply is key for market participation				
Standard specifications apply to products				
Increased supply might negatively affect pricing				
Recognized buyer is interested				
High potential supply of hybrid maize seed from other sources;				
High demand of hybrid maize seed versus limited supply				
4. Structure Feasibility				
Possibility to make use of external supports				
Well-organized producer associations as a necessary condition for effective participation				
Adequate cold chain management as a necessary condition to control quality				
Necessary to establish a management system to control quality and sustainable exploitation				
5. Stakeholder Feasibility				
Exploring new products and diversifying supply of hybrid seeds				
Promoting and opening market for hybrid seeds products				
Increasing job opportunities and income for women and youth,				

Valorising degraded areas and tribal land as well as biodiversity				
Promoting renewable resources related economic activities				
Sustainable resource exploitation				
Generating fair employment benefits				
Strengthening domestic horticultural sector				
Optimizing use of existing processing and exporting facilities				

1. Field Access Road Condition	Poor		Fair	Good
2. Availability of Grid Connection (Electricity)	No		Yes	Can be provided
3. Availability of Agri Machineries & Processing Facilities				
• Tractors				
• Land Masters				
• Maize Seeders				
• Weeding Machines				
• Maize Thresher (Agrimec Machines)				
• Sprayers				
• Water Pumps	Electrical	Diesel	Petrol	Kerosene
• Poly tunnels – Solar Drying				
• Electricians with a fair knowledge				
• Mechanics with a fair knowledge				

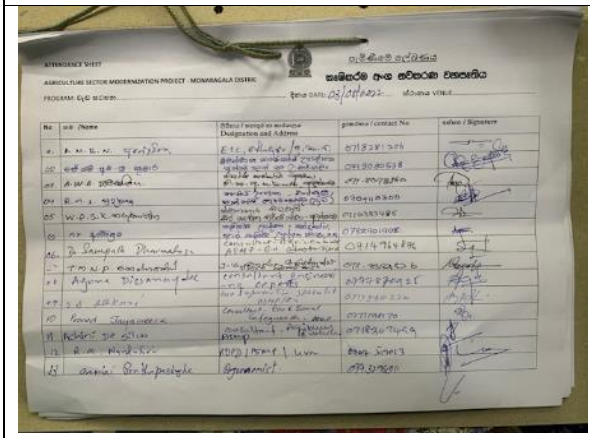
Annex 4 – Photos of Field Works

Badulla District



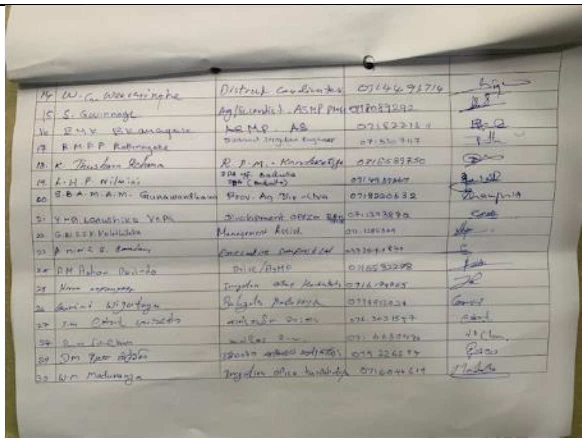


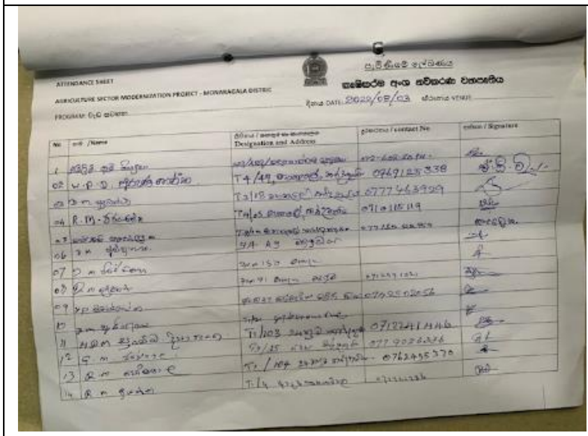


ATTENDANCE SHEET

AGRICULTURE SECTOR MODERNIZATION PROJECT - MONARAGALA DISTRIC





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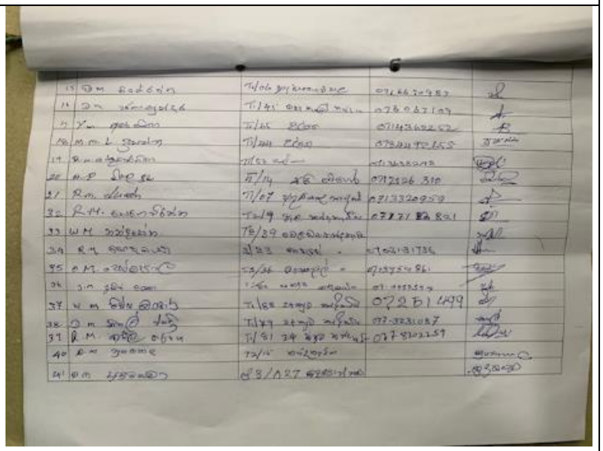

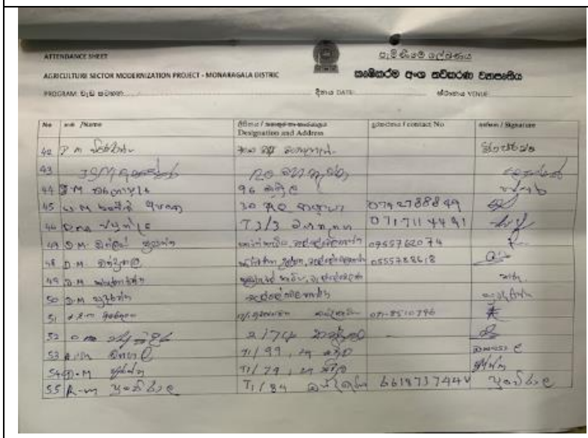

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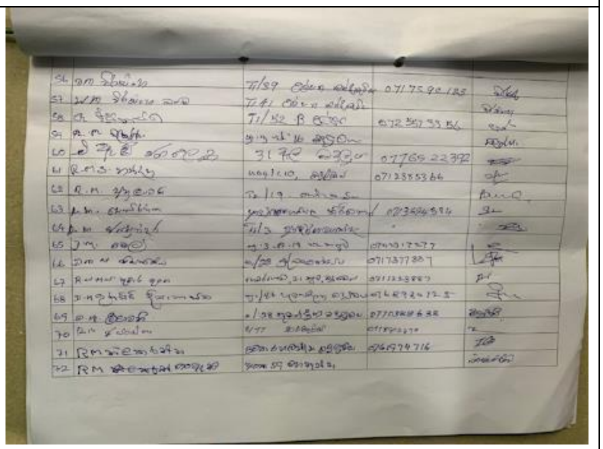
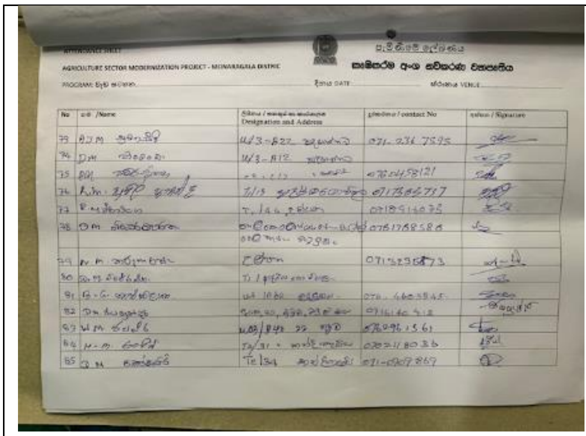
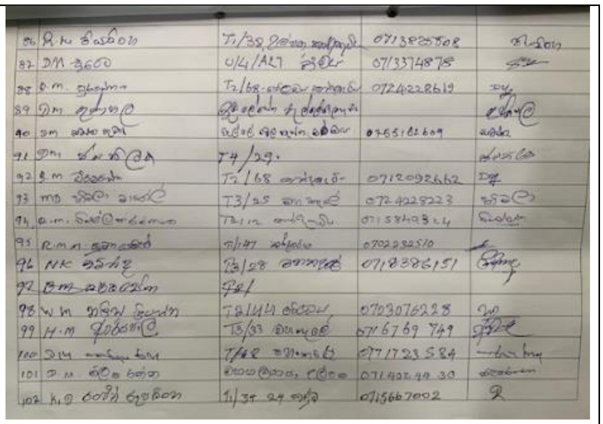
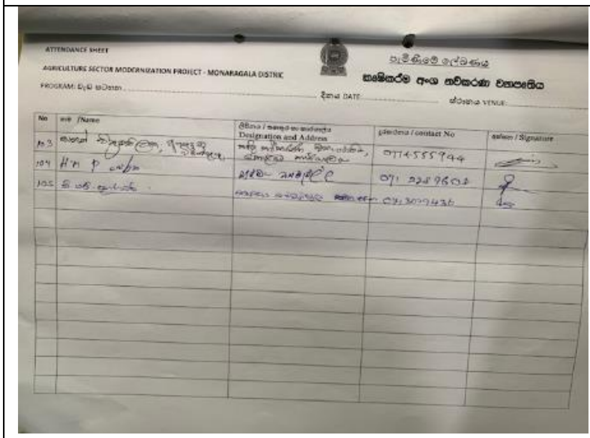
AGRICULTURE SECTOR MODERNIZATION PROJECT - MONARAGALA DISTRIC

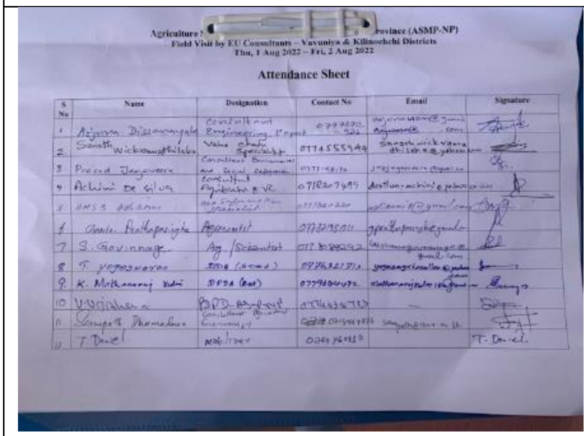








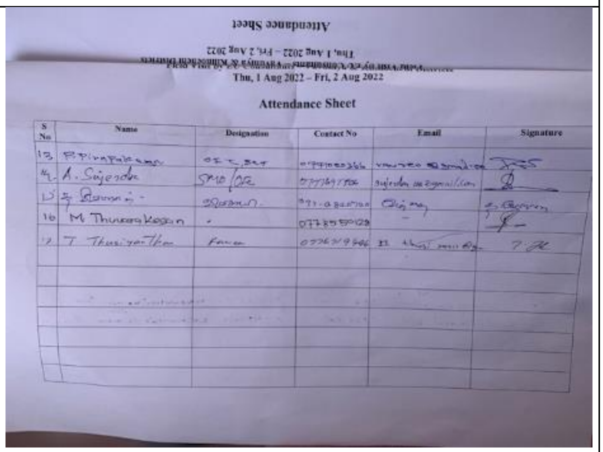
Vavuniya District



Field Visit by EU Consultants – Vavuniya & Kilinochchi Districts
Thu, 1 Aug 2022 – Fri, 2 Aug 2022

Attendance Sheet

S No	Name	Designation	Contact No	Email	Signature



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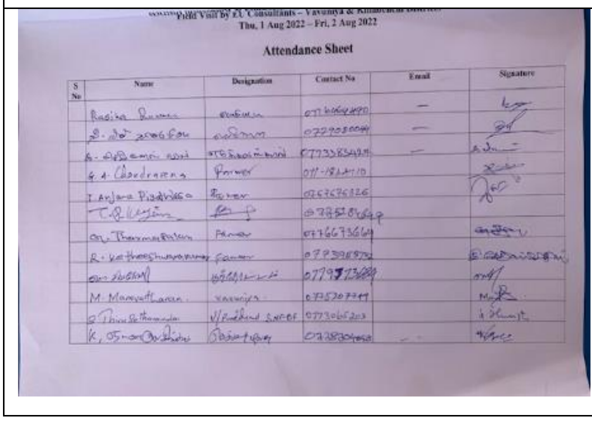


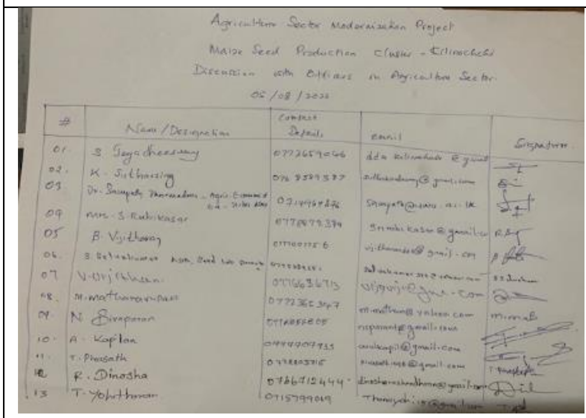
Field Visit by EU Consultants – Vavuniya & Kilinochchi Districts
Thu, 1 Aug 2022 – Fri, 2 Aug 2022

Attendance Sheet

S No	Name	Designation	Contact No	Email	Signature

	
	
Kilinochchi District	
	



Agriculture Sector Modernization Project

Maize Seed Production Cluster - Kilinochchi

Discussion with Officers in Agriculture Sector

05/08/2022

#	Name / Designation	Contact Details	Email	Signature
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04	Mrs. S. Rubikasan	0778879394	Srirubikasan@gmail.com	
05	B. Vijitharan	[illegible]	[illegible]@gmail.com	
06	S. [illegible]	[illegible]	[illegible]	
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09	N. Sivapavan	[illegible]	[illegible]@gmail.com	
10	A. Kapilan	[illegible]	[illegible]@gmail.com	
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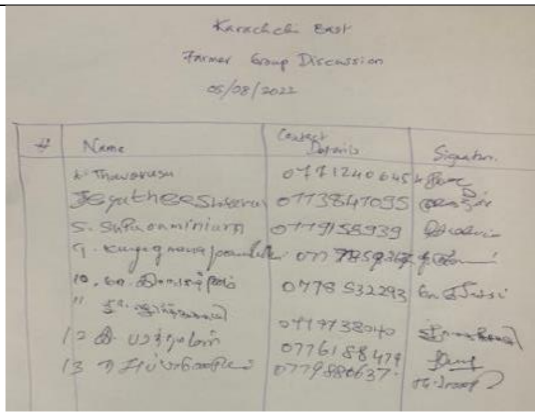
12	R. Dinosha	0766712444	[illegible]@gmail.com	
13	T. Yoharthanan	0715799019	[illegible]@gmail.com	



Karachchi East

Farmer Group Discussion

05/08/2022

#	Name	Contact Details	Signature
	K. Thavarasa	0771240645	
	Jegatheeswaran	0773847095	
	S. Subramaniam	0779158939	
	[illegible]	[illegible]	
10	[illegible]	0778532293	
11	[illegible]	0779738040	
12	[illegible]	0776188479	
13	[illegible]	0779880637	

Ampara District
















MULTI PURPOSE COMMUNITY CENTRE

Annex 5 - POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

Overview of Environmental Legislation

Sri Lanka is one of the leading countries in the South Asian region in enacting environmental legislations. Its concern for environment dates back to over two and a half millennia. The constitution of the Democratic Socialist Republic of Sri Lanka under chapter VI Directive Principles of State policy and Fundamental duties in section 27-14 and in section 28-f proclaim “The state shall protect, preserve and improve the environment for the benefit of the community”, “The duty and obligation of every person in Sri Lanka to protect nature and conserve its riches” thus showing the commitment by the state and obligations of the citizens.

The overall environmental concerns are addressed by the National Environmental Act No. 47 of 1980 (and subsequent amendments by act no 56 of 1988 and act no 53 of 2000). It is the umbrella legislation for environmental protection in the country. In addition, several other sectoral legislative enactments are in place (see section below). The national organization that has the mandate to protect and take measures to safeguard the environment is the Central Environmental Authority. It currently operates in the entire country except in the North Western Provincial Council (NWPC), where the NWPC has enacted a separate statute under the 13th amendment to the Constitution of Sri Lanka and had created a separate provincial institute.

There are several other key national agencies with a mandate for environmental management and protection. The Forest Department, the Department of Wildlife Conservation, Department of Archeology, Department of Coast Conservation and Coastal Resources Management, Disaster Management Center and Geological Survey and Mines Bureau have their regional offices and staff to cater to and monitor the environmental safeguards as per the policies and regulations governing them. In addition, there are several national agencies that are impacting on the environment and adopting environmental safeguards as well. They are the Sri Lanka Land

Development Corporation, Urban Development Authority, Water Supply and Drainage Board, Water Resources Board and Irrigation Department.

The Local Authorities (LA) are also having provisions under their respective acts to safeguards and provide useful facility and maintain the same for the convenience of the public in their respective areas. The Municipal Council (MC) Act No. 19 of 1987 & Urban Council (UC) Act No. 18 of 1987 provide for the establishment of MCs and UCs with a view to provide greater opportunities for the people to participate effectively in the decision-making process relating to administrative and development activities at a local level and it specify the powers, functions and duties of such LAs and provide for matters connected therewith or incidental thereto. These acts contain sixteen and eight parts respectively, several schedules and 327 & 249 sections respectively. The MC act, spell out its status, powers & functions in Section IV, Section V and Section VI in sections 34 to 154 and covers public health, drainage, latrines, unhealthy buildings, conservancy & scavenging, nuisance etc. Further the respective local authorities have mandate regionally to implement the project activities and monitor the progress of compliance work.

The following section outlines the broad legal and institutional framework in Sri Lanka for environmental management and World Bank's environmental safeguards requirements, which will be relevant to the proposed project.

Detail Review of Key Environmental and Social Services Related Legislation

1. The Constitution of Sri Lanka & the 13th Amendment

The Constitution of Sri Lanka contains several provisions, relating to the environment 9 Article 27 (14) and article 28 (f). The 13th amendment to the constitution introduced a new level of institution for environmental protection and management. Therefore, the provincial government also has legislative and executive power, the North Western Provincial Environmental Authority to control, prevent and monitor all environmental related activities.

Application to ASMP*:* Overall responsibility of individuals and organizations to protect and conserve the natural environment. All project proponents/implementers and public are responsible.

2. The National Environmental Act. No. 47 of 1980 & its amendments

The National Environmental Act (NEA) provides conservation and development guidelines for natural resources including water, soil, fisheries resources, forest, flora and fauna in Sri Lanka. It also paved the way for the creation of the Central Environmental Authority (CEA). Further it spells out the creation of an Environmental Council in collaboration with the respective line agencies to advise the CEA (Section7) and provide necessary guidelines to establish District Environmental Agency under the chairmanship of the District Secretary. The NEA is the basic national decree for environmental protection. The three main regulatory tools implemented under the NEA are Environmental Impact Assessment/Initial Environmental Examination, Environment Protection License (EPL) and Schedule Waste Management License supported by standards for discharge and waste disposal guidelines.

It is the key regulatory tool enabling any developer to implement the development activity in line with the NEA and thereby assuring the long-term sustainability of the development undertaken while paying due respect to the environment.

The second regulatory tool under the provisions of the National Environmental Act is the Environmental Protection License (EPL). The EPL procedure has been introduced to prevent or minimize the release of discharges and emissions in to the environment from industrial activities in compliance with national discharge and emission standards, to provide guidance on pollution control for polluting processes and to encourage the use of pollution abatement technology such as cleaner production, waste minimization etc. Here the industries are classified into three lists named A, B and C. List A is comprised of 80 potentially high polluting industries, List B is comprised of 33 medium polluting industries and List C is comprised of low polluting industrial activities. The operational details are given in CEA website (www.cea.lk).

The third regulatory tool deals with the disposal of scheduled waste. The gazette notification No 1534/18 of 1st February 2008 made by the Hon. Minister under section 23A and 23B of the National Environmental Act No. 47 of 1980 is referred to as the

National Environmental (Protection & Quality) regulations No. 1 of 2008. It deals with waste from specific and non-specific sources. The notification has three parts and eight schedules. The Part I deals with the Issue of Environmental protection License for Emission of Disposal of waste. Part II deals on issue of license for the management of scheduled waste (Hazardous Waste) and Part III on General matters including definitions and the effectiveness and validity of the license issued under National Environment (Protection & Quality) regulation No 1 of 1990 published in extraordinary gazette No 595/16 of February 1990. The eight schedules include the tolerance limits, applications, formats for reporting, categorization of non-specific and specific waste etc.

The 1994 amendment delegated the authorization to the local authorities to issue EPL for low polluting industries. The CEA's environmental management functions are holistic and they are very well set out in section IV of the act. Along with the EPL procedures several standards also have been gazette with regard to disposal of effluents to land and water bodies.

Application to ASMP: As per the initial screening, majority of project's activities are not yet finalized and considering the proposed components, project might be fallen under the prescribed categories. Considering the low impacts of project already identified and the present assessment carried out in compliance with WB's Safeguards policies would be sufficient with continuous monitoring during the construction, operation & maintenance phases. However, considering the complexity of the project activities, project might require an environmental assessment. During next phase of the assessment, project will submit the proposal to the CEA and CEA recommendation will be implemented accordingly.

3. State Land Ordinance Act No 13 of 1949

The State Lands Ordinance provides necessary guidelines to:

- The protection of the source, course or bed of any public stream
- The protection of springs, reservoirs, lakes ponds lagoons, creeks, canals, aqueducts etc.
- The construction or protection of roads, paths, railways and other means of internal communication.

- The prevention of the erosion of soil.
- The preservation of water supplies.

In addition, section 75 of the State Land Ordinance highlights on riparian proprietors' activities. The occupier of land or the bank of any public lake or public stream shall have the right to use the water in that lake or stream for domestic purpose and shall not be diverted through a channel, drain or pipe or by means of a pump or other mechanical contrivance but shall be removed in a bucket or other receptacle.

Application to ASMP: This has significant influence on the waterbodies that will come under the project site for improvements by way of bank stabilization, erosion control and other small infrastructure development etc. Some of the project interventions support the mandate of this act by ensuring the protection and preservation of the canals and its banks. Further no supplies of water through the network of canals are proposed and hence none of the project investments are in violation of its provisions.

4. Land Acquisition Act of 1950 (LAA)

LAA of 1950 which has several amendments and the latest being the version of 1986 is the most important legal provision pertaining to the land acquisition process in Sri Lanka. The law governing acquisition of land for public purposes is explained in this act. It provides compensation for acquisition of land, structures and crops only. Therefore, acquisition of lands and properties and any resettlement as part of the project will have to follow this law.

5. Sri Lanka National Involuntary Resettlement Policy (NIRP) of 2001

To ensure that people affected by development projects are treated in a fair and equitable manner, and that they are not impoverished in the process, it is necessary that Sri Lanka adopts a NIRP. Such a policy would establish the framework for project planning and implementation. Subsequently, it will be necessary to prepare guidelines on resettlement planning and implementation to be used by PEAs.

NIRP principles include: (1) involuntary resettlement should be avoided or reduced as much as possible by reviewing alternatives to the project as well as alternatives within the project; (2) where involuntary resettlement is unavoidable, affected people should be assisted to re-establish themselves and improve their quality of life: (3) gender equality and equity should be ensured; (4) APs to be fully involved in selection of relocation sites; (5) replacement land should be an option for compensation in case of loss of land; (6) compensation for loss of land, structures, other assets and income should be based on full replacement cost, including transaction costs; (7) resettlement should be planed and implemented with full participation of provincial and local authorities; (8) affected persons to be integrated into host communities using participatory measures; (9) CPRs and community and public services should be provided to APs, (10) resettlement should be planned as a development activity for the APs; (11) APs who do not have documented title to land should receive just treatment; (12) Vulnerable groups should be identified and given appropriate assistance to substantially improve their living standards; and (12) project executing agencies should bear the full costs of compensation and resettlement.

Application to ASMP: The application of the NIRP to the Project based on its scope, which applies “to all development-induced land acquisition or recovery possession by the State” and its definition of involuntary resettlement as “unavoidable displacement of people arising from development projects that creates the need for rebuilding their livelihoods, incomes and asset bases in another location” does not provide necessary guidance on compensation for temporary impacts during construction, which are the largest envisaged impacts due to the project. According to the NIRP, APs should be fairly compensated upon acquisition and their livelihood is established.

6. The Coast Conservation and Coastal Resources Management Act No.49 of 2011 (Amendment)

The Coast Conservation and Coastal Resources Management Act (CCCRMA) makes provisions for the regulation and control of development activities within the coastal zone as well as formulates and executes schemes of work for coast conservation. Under the section 6 of the act, there is provision to appoint a Coast Conservation Advisory Council (CCAC) which would advise the Coast Conservation and Coastal Resources Management Department (CCCRMD) on all development activities proposed to be implemented in the coastal zone and review its coastal zone management plans. The law specifies that projects located wholly or partly within the coastal zone (the area lying within a limit of three hundred meters landwards of the

Mean High Water line and a limit of two kilometers seawards of the Mean Low Water line and in the case of rivers, streams, lagoons, or any other body of water connected to these either permanently or periodically, the landward boundary shall extend to a limit of two kilometers measured perpendicular to the straight base line drawn between the natural entrance point thereof and shall include waters of such rivers, stream and lagoons or any other body of water so connected to the sea) must undergo the approval process that is laid down in the Coast Conservation and Coastal Resources Management Act irrespective of its size.

Only those projects located totally outside the Coastal Zone will be subject to the approval process laid down in the National Environmental Act. Therefore, any development work taking place within this zone falls under the jurisdiction of CCCRMD. According to the CCA, Director of the CCCRMD has the discretion to request for an EIA/IEE from the project proponent if the initial screening reveals significant impacts in the coastal areas by the project. The process is very much similar to the NEA excepting that the Director of the CCCRMD reserves the right to request for an EIA/IEE depending on the nature and scale of anticipated impacts of the proposed investments rather than on pre-determined prescribed limits as in the NEA and also to make a final decision. The Director is advised by the CCAC on the findings of EIA/ IEEs.

Application to ASMP: The proposed project area includes two districts namely Ampara and Kilinochchi boarded to the Sea and Lagoons. Any activity falling under the jurisdiction of Coastal Zone as prescribed under CCA, approval should be granted by the Director, CCCRMD.

7. Pesticides Act No. 33 of 1980, as amended by the Act No. 06 of 1994 & the Act No. 31 of 2011)

Registrar of Pesticides (ROP) is the legal authority empowered and entrusted on the functions related to the registration and regulation of pesticides in Sri Lanka (appointed under the Control of Pesticides Act No. 33 of 1980, as amended by the Act No. 06 of 1994 & the Act No. 31 of 2011). According to the Act, it is the duty of the ROP to regulate pesticides imported to and produced in Sri Lanka, and to assure their quality and safe use, and to assess and to declare Maximum Residue Limits (MRLs) in agricultural produce. The basis of regulation is the compulsory registration of all pesticide material. The post registration activities are an inherent part of Sections 20-22 of the Control of Pesticides Act, which enables the regulatory process to safeguard food quality, human health and the environment against pesticides. Awareness and legal binding thus created would expect to minimize unscrupulous trade practices and thereby prevent adverse impacts caused due to pesticides.

Application to ASMP: Project has prepared a comprehensive Pest Management Action Plan in complying with the above enactment and the WB's Pest Management Plan. All agronomical practices which are to be undertaken under ASMP should be in-line with Integrated Pest Management Plan. IPM is triggered policy under WB's Operational Policies related to ASMP and from land preparation up to marketing, IPM should be implemented as practicable as possible.

Table 1: Mandates of different conventions related to the control of pesticides

Name of convention	**Area covered**
Rotterdam Convention	Banned and severely restricted pesticides are managed in a form of international information sharing during importation and exportation, which is known as "PIC", Prior Informed Consent Procedure.
Stockholm Convention	Persistent Organic Pollutant (POP) pesticides which are highly toxic and persistent in the environment and have global concerns due to their trans-boundary transport. The global elimination and safe disposal of these types of compounds are the ultimate objectives.
Basel convention	Control of transboundary movement of hazardous waste and their disposal.
Minamata convention	A global treaty to protect human health and the environment from human-induced emissions and releases of mercury and mercury compounds.

8. Plant Protection Act No.35 of 1999

The core activities of the Plant Protection Service can be stated as the control of pests/disease outbreaks, implementation, monitoring and evaluation of field level IPM programs in rice and vegetables managing pests in bulk seed storage in the Department of Agriculture farms through fumigation, conducting research in pest management and pesticides. These mandates revolve around regulatory provisions made under the Plant Protection Act No.35 of 1999. Mitigating PPS was the entrusted division under SCPPC to implement and promote Permanent Crop Clinic Programs (PCCP) in the regional level that was initiated through the support of the Center for Agricultural Bioscience International (CABI).

Application to ASMP: Project has prepared a comprehensive Pest Management Action Plan in complying with the above enactment and the WB's Pest Management Plan. All agronomical practices which are to be undertaken under ASMP should be in-line with Integrated Pest Management Plan. IPM is triggered policy under WB's Operational Policies related to ASMP and any activity propose under agronomical practices should be in complying with these requirements stipulated.

9. Seed Act No. 22 of 2003

The objective of this enactment was to regulate the quality of Seed and Planting materials; and to provide for matters connected with. To safeguard the farmers as well as the seed handlers from malpractices that would harm the seed industry.

Application to ASMP: As there will be seed production activities under ASMP, the entire process of seed production should be in complying the regulations stipulated under this act. Process should be coming under proper Seed Certification programme and any planting material proposed under this programme should be complying with its regulation.

Table 2: Important Services in Agriculture Sector

Name of unit	Mandated Functions
National Plant Quarantine Service (NPQS),	Facilitate the import and export of pest free plants and plant products, for the development of agriculture and related industries in the country.

Plant Genetic Resources Centre (PGRC).	Explore, collect conserve, introduce, evaluate and utilize the diversity of crop genetic resources

National Plant Quarantine Service

The mandate of the National Plant Quarantine Service of Sri Lanka is to facilitate the prevention of, introduction of, eliminate the spread of dangerous alien pests within the country and the establishment of and involvement in domestic pest control programmes; Development of treatment technologies to eradicate pests of quarantine importance; Promotion of the export of healthy plants and plant products, the import and export of pest free plants and plant products for the development of agriculture and related industries in the country. To achieve this, emphasis was given to both research and service-oriented quarantine activities. Phytosanitary certification, inspection and treatment of import and export plants and plant products, testing of detained samples, issuing of import permits for plant and plant products, pest risk analysis, field certification for fruits and vegetables and pack house registration, dissemination of knowledge on all aspects of plant quarantine via training and awareness programs for interested groups are the main activities accomplished in collaboration with national research institutes, universities and institutes and centers of DOA.

NPQS is equipped to carry out the testing of import and export of plant products on insects, pathogens and weeds, by drawing samples as required. It was noted that the major pests identified are parasitic nematodes, common storage pests in seed potato, maize, soya, etc. Pathogens were identified in the samples tested which included; Mucor spp., Rhyzoctonia spp., Erwinia spp., Geotrichum spp., Fusarium spp., Colletotricum spp., Cylindrocarpon spp., Bacillus subtilis and Curvularia spp. Import consignments tested and found to be contaminated with soil and weed seeds will be confiscated and destroyed to avoid any infestation by alien species. This is considered as a potential risk of multiplication and infestation if released undetected. It was noted that a majority of work is focused on potato seed imports and to ensure a high quality of seed is delivered to farmers. A program was established to identify and to investigate the presence of maize wilt causal organism Pantoea stewartii in imported seed lots which may become infested if not protected. In order to increase technical expertise, the NPQS continue to carryout research and development activities through pest surveys, pest risk analysis, weed control research, Pathological research, Entomological research and Quarantine treatment research.

10. Agrarian Development Act. No. 46 of 2000

An Act to provide for matters relating to landlords and tenant cultivators of paddy lands for the utilization of agriculture lands in accordance with agriculture policies; for the establishment of Agrarian Development Councils, to provide for the establishment of a land bank, to provide the establishment of Agrarian Tribunals, to provide for the repeal of the Agrarian Services Act No. 58 of 1979.

Application to ASMP: Conversion of paddy lands including abandoned paddy land to any other land use should be as per the approval of the Commissioner, Agrarian Development Department.

11. The Flood Protection Ordinance Act No.22 of 1955

This act provides room for the Minister to declare any area in the country as flood area. It has provisions to prepare scheme for protection of flood area, creation of flood authority, regulations for management of flood area and acquisition of land for the purpose of the ordinance. The flood authority is usually the District Secretary of the affected area. In case of a large area of a Municipality is coming under flood the Minister may substitute the District Secretary by appointing the Mayor of the Municipality.

Application to ASMP: Overall, knowing the experiences in the past, this need to be considered. Badulla and Kandy are experiencing high intensity rains and subsequent flash floods. Even in Kilinochchi, Ampara and Vavuniya districts have several flood prone areas. The flood mitigation is a primary objective of this project that will facilitate the flood mitigation efforts project and strengthened the storm water management interventions and improve drainage in three cities. In particular to this land, land is recently reclaimed land which is surrounded by canal and there is a pond/water logging area within the site. It is observed that land is potentially a flood prone area.

Therefore, proper drainage system should be established and building design should be looked in to the flooding effect in the future.

12. The Fauna & Flora Protection Ordinance Act No. 49 of 1993 & its amendments

This act provides the protection, conservation and preservation of the fauna and flora of Sri Lanka. Under the Fauna and Flora Protection Ordinance (FFPO), five categories of protected areas are established viz. Strict Nature Reserves, National Parks, Nature Reserves, Jungle Corridors and Intermediate Zones including sanctuaries. According to this Act, any development activity of any description what so ever proposed to be established within a national reserve or within one mile from the boundary of any national reserve, is required to be subjected to EIA/IEE, and written approval should be obtained from the Director General, Department of Wildlife Conservation prior to implementation of such projects. The FFPO follows a similar process as the NEA in conducting scoping, setting the TOR, preparation of EA, review of EA and public consultation and disclosure. The decision of project approval or disapproval is finally granted by the Director General of the Department of Wildlife Conservation.

Application to ASMP*:* Kilinochchi, Vavuniya, Kandy, Badulla and Ampara districts as whole have several important Wildlife designated areas namely Protected Areas (National Parks, Sanctuaries, Reserves, etc). Any cultivation or development related activity falling in or around such areas should be consented by the DWLC.

13. The Sri Lanka Land Reclamation & Development Corporation Act No. 15 of 1968

The Act provides the formation of the Sri Lanka Land Reclamation & Development Corporation (SLLRDC). The latest amendment to this act is the No 35 of 2006 which incorporated section 2A- Prohibiting filling or developing and reclaiming land, section 2B-Declaring areas as low lying marshy or swampy and section 20 C- stipulating that pollution of canal as an offence. In addition, Section 28 of the principal enactment has added new definition– retention areas. The gazette regulations under this act also had declared several areas as wetland.

Application to ASMP: The project supports and enhances the provisions set out in the act through improvement to the canal network for the smooth flow of storm water in the site. Also, the SLLRDC, who implements this act, required to be involved as a designer in the project although none of the SLLRDC acquired areas are found within both project sites.

14. The Urban Development Authority Act No. 41 of 1978

This act has provided provisions to establish the Urban Development Authority (UDA), declaration of areas as urban development area. Its Part II outlines 22-point powers and functions of the UDA. Under Part IV it has power to acquire immovable property and sale of land belonging to the authority. The act provides room to make regulations for the purpose of carrying out or giving effect to the principles and provisions of this law. The amendment brought in Act no 2 of 1980 under special provisions provided room to declare lands urgently require for urban development projects and remedies to affected parties and the uphold the power of Supreme court. The amendment brought under Act No 4 of 1982 in its Part II A describes the planning procedure, appointment of planning committees, preparation of draft development plans, approval of the same also provide room for subsequent amendment. It also provides room to issue permits for development work, and delegation of the powers of the authority and procedures to be followed if activity takes place in contrary to the permit issued. Further the principal enactment amended by the addition of section 29 by adding a schedule, indicating the matters for which provisions may be made in the development plan. The subsequent amendments deal with levies, joint venture development projects etc.

Application to ASMP: Any development activity which are to be proposed should be compatible with UDA regulations applicable to each district, zone, etc

15. The Mines and Mineral Act No.33 of 1992

The Geological Survey and Mines Bureau established under the Mines and Minerals Act No. 33 of 1992. Under this act, mining falls within the purview of the Geological Survey and Mines Bureau (GSMB). Mining and exploitation for minerals, including sand, must be licensed under the act by the GSMB. Mining licenses are issued only to a qualified individuals and companies registered to do business in Sri Lanka. Mining is not permitted within Archaeological Reserves and within specified distance of monuments. New mining licenses are subject to the EIA process, if the type and extent of mining is listed under the EIA regulations. Additionally, the GSMB has power to stipulate conditions including the taking of deposits and insurance for the protection of environment. Regulations made by the GSMB under the act cover a variety of environmental stipulations, criteria and conditions for licensing and operating mines.

This also covers the disposal of mines wastes. The act also deals with the health, safety and welfare of miners. Reclamation of mines is a major problem in Sri Lanka and due to current practice requires the mining enterprise to make a deposit to cover costs of recovery. The deposit however is inadequate for the purpose. Large extents of mined areas, particularly areas mined for clay and sand remain open. Mining rights on public and private land are subject to licensing by the GSMB and all minerals wherever situated belonging to the state. The right to mine particular parcels of public lands may be subject to EIA procedures as well as to lease for permit conditions.

Application to ASMP: Earth and quarry material will be needed for the development work undertaken by the respective implementing agencies either directly or through contractors. In such cases quantities specified need to be extracted and permission from the GSMB is required. Alternatively, the project contractors can procure them from the open market but they will have to make sure that such sources/traders are operating with valid licenses.

16. Local Authorities Acts

The Municipal Council (MC) Act No. 19 of 1987 & Urban Council (UC) Act No. 18 of 1987 provide provisions for the establishment of MCs and UCs with a view to provide greater opportunities for the people to participate effectively in decision making process relating to administrative and development activities at a local level and it specify the powers, functions and duties of such Las and provide for matters connected there with or incidental there to. These acts contain sixteen & eight parts respectively, several schedules and 327 & 249 sections respectively. The MC act, spell out its status, powers & functions in Section IV, Section V and Section VI in sections 34 to 154 and covers public health, drainage, latrines, unhealthy buildings, conservancy & scavenging, nuisance etc. Further the respective local authorities have mandate regionally to implement the project activities and monitor the progress of compliance work.

Application to ASMP: The infrastructure improvement activities funded under ASMP through the LAs comprise of the basic services they ought to render to the public in line with these acts. Subsequently, maintaining this infrastructure would be the prime duty of the local authorities. In addition, majorly, management of solid waste should be in-line with Las mandate.

17. Water Resources Board Act No. 29 of 1964

Main responsibility under this act highlighted are control, regulation and development including the conservation and utilization of the water resources of the country. In addition, the promotion of afforestation, control of soil erosion, prevention of the pollution of rivers, streams and other water sources are also required to be considered. Mainly, the Water Resources Board is the key player of the formulation of national policies relating to the control and use of water resources of the country, as well as coordination of projects undertaken by government departments, local authorities and public corporations relating to the conservation, utilization development of the subterranean water resources of the country and the assessment of the possibilities, benefits and economic feasibilities of such projects.

Application to ASMP: Use of ground water in cultivation or infrastructure development should be seek recommendations from WRB in advance with a proper yield test.

18. Forest Ordinance including Amendments

The Forest Ordinance is one of the oldest ordinances in the country, first enacted in 1887 under which the Forest Department was established in 1887. This act has been amended several times in the past. The Forest Reserves gazetted under the provisions of the ordinance and all proposed reserves that are not gazetted under these provisions but selected for conservation based on biological and hydrological importance should be taken into account in implementation of this project.

Application to ASMP: project interventions especially lands within the purview of Forest Department, should be obtained approval from Forest Department prior to implement the activities. This requires specially when removing trees within the proposed site.

19. National Wetland Policy

The National Policy & strategies on Wetlands (2005) seeks to give effect to National Environment Policy and other relevant national policies, while respecting national commitments towards relevant international conventions, protocols, treaties and agreements on wetland protection to which Sri Lanka is a party. Among the International Conventions, Ramsar Convention on Wetlands of International Importance (1971), the Convention on Conservation of Migratory Species of Wild Animals (1979) and the Convention on Biological Diversity (1992) are significant.

The definition given for Wetlands in the policy is “Areas of marsh, fen, peat and or water, where natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters and may incorporate riparian and coastal zones adjacent to the wetlands and islands or bodies of marine water deeper than six meters at low tide within the wetlands”.

The policy has six sections, Introduction, need for a national policy on wetlands, principles, objectives, policy directions and explanation of key concepts. The policy directions address wetland management, institutional arrangement, inter-sectoral linkages, research, development and education. The local level and national level institutions are proposed to be established. All sectoral development plans should be based on principles of wetland ecosystem management.

Institutional Arrangement to manage wetlands is well established at present. A multi-stakeholder National Wetland Steering Committee has been established in the Ministry of Environment to advise on wetland issues in the country and wetland management unit has been set up at the Central Environmental Authority to oversee and facilitate policy implementation.

Application to ASMP: Project investments identified so far have no direct impacts on wetlands. However, there are a number of freshwater marsh patches and mangrove habitats along some of the canals, respectively. Any impacts to these areas will be identified in the respective project at the time EAs and mitigatory measures will be identified.

20. The Irrigation Ordinance (Chapter 453)

The ordinance in its part VI covers the protection of irrigation works and conservation of water in section 64. The section 65 deals with removal of encroachments. The Part V covers the construction and maintenance of major and minor irrigation schemes in sections 33, 34, 46, 54, 61, 62 and 63.

Application to ASMP*:* Any activity relevant to ID's command areas should be consented by the ID

21. The Antiquities Ordinance

The Antiquities Ordinance (Revised in 1956 & 1998) is the main legislation dealing with Cultural Assets Preservation in Sri Lanka. Section 16 covers Ancient Monuments and their declaration as well as the declaration of specified trees as ancient monuments. According to Section 21, the restoration, repair, alteration or addition in connection with any protected monuments has to be conducted in accordance with the conditions of a permit issued by the Director General of Archaeology, or in accordance with an agreement entered in to under Section 20. Section 24 prohibits or restricts subjects to certain prescribed conditions, the erection of buildings or carrying out mining, quarrying, or blasting operations on any land within the prescribed distance of any ancient monument situated on Crown land or any protected monument. As per the ordinance the Director General of Archaeology "shall cause an impact assessment survey to be undertaken at the expense of the sponsors of such project or scheme to assess the consequences thereof upon the antiquarian, historical or archaeological aspects or value of the land in question or on any antiquities upon it and shall, within such period of time as may be agreed on.

Application to ASMP: Any potential activities closer to places with Importance of Physical Cultural should be approved by the Department of Archaeology.

22. Disaster Management Act No. 13 of 2005

Under the Disaster Management Act No.13 of 2005, there is a provision to establish a National Council for Disaster Management (NCDM). The Act defines "disaster" as an actual or imminent occurrence of a natural or man-made event, which endangers or threatens to endanger the safety or health of any person or group of persons in Sri Lanka, or which destroys or damages or threatens to destroy or damage any property, and inter alia includes:

- An industrial hazard
- A fire
- An explosion
- A chemical accident
- Oils spills including inland oil spills
- Cyclones
- Tsunamis

Disasters may happen as the result of a malfunction of the normal operating procedures or precipitated by the intervention of an outside force such as a cyclone, flood or deliberate acts of arson or sabotage.

The major objective of this act is to protect human life, property and the environment of Sri Lanka from any event defined as a disaster. Therefore, this act plays key role to protect the environment and provides necessary guidelines for the protection of human life, property and the environment of the country.

Major functions of the NCDM include, to formulate a National Policy and Program on the management of disasters which shall provide for the protection of life of the community and environment and the maintenance and development of disaster affected areas; the effective use of resources for preparedness prevention, response, relief, reconstruction and rehabilitation; and the enhancement of public awareness and training to help people to protect themselves from disasters.

Section 10 of the Sri Lanka Disaster Management Act stipulates that "It shall be the duty of every ministry, Government Department and public corporation to prepare a Disaster Management Plan with respect to such ministry, Government Department or public corporation to counter any disaster or impending disaster based on the National Disaster Management Plan and in accordance with such guidelines as may be specified by the National Council for Disaster Management. As per the definition of public corporation provided under Section 25 of the said act, a Disaster Management Plan is compulsory for coal-based thermal power plant operations.

Application to ASMP: Specially, the proposed site situated in a low-lying area which will be a flood prone area in the Division, and within coastal belt which are susceptible to Tsunami and areas susceptible to Wind/cyclones. During the implementation stage, Disaster Management Centre (DMC) should play a major role in recognizing critical drains which are to be rehabilitated/improved and consent of DMC should be obtained prior to implementation of project interventions. In addition, operational of processing hub will have potentials for fires, explosions and chemical spills.

23. Prevention of Mosquito Breeding Act No. 11 of 2007

This act has been passed for the purpose of ensuring the prevention and eradication of all mosquito-borne diseases. Under this act, it shall be the duty of every owner or occupier of any premises to cause, (a) open tins, bottles, boxes, coconut shells, split, coconuts, tyres or any other article or receptacle found in or within such premises, capable of holding water, to be removed, destroyed or otherwise effectively disposed; (b) any well found in the premises and its surroundings to be maintained and kept in good repair so as to make it mosquito-proof and thereby prevent the breeding of mosquitoes; (c) any artificial pond or pool found in such premises to be emptied at least once every week; (d) any casual collection of water within the premises which is conducive to mosquito breeding, to be regularly drained; (e) shrubs, undergrowth and all other types of vegetation, other than those grown for the purpose of food or those which are ornamental, found within or outside any building or structure within the premises used as a dwelling place which has become a breeding place for mosquitoes, to be removed; (f) the removal and destruction of water plants having the botanical name pistiastratiotes and commonly known as “diyaparandal”, “kondepasei”, “telpassy”, “barawa-pasi”, “nanayaviraddi” and of any other water plant, or plants, found within the premises, which may facilitate the breeding of mosquitoes. Hence, this act placed to eradicate or prevent mosquito borne diseases and is mainly targeted at water sources.

Application to ASMP: All project interventions during the construction and operational stages should be comply with Prevention of Mosquito Breeding Act requirements to control or mitigate or avoid generation breeding sites.

24. Occupational Health and Safety

Project interventions involve multifarious activities during construction and operation and maintenance phases. These activities are also associated with problems of occupational health and safety. The problems envisaged during construction and erection stages can mainly be due to exposure to dust, accidents and noise. The problems envisaged during the operation and maintenance phase are accidents, exposure to heat, noise, arc lights, chemicals etc.

The National Policy on Occupational Safety and Health in Sri Lanka is in the drafting stage. The Labour and Labour Relations Ministry in collaboration with 25 ministries, trade unions, employers and other authorities are involved in the drafting with the intention of reducing work place related injuries and other mishaps (Ceylon Daily News; 14th November 2014).

Application to ASMP: All project activities, during construction should comply with Factory Ordinance requirements related to occupational, health and safety and International Labour Organization (ILO) guidelines on the same.

25. Indigenous People of Sri Lanka

Sri Lanka does not have a national policy or a legal framework exclusively on indigenous people. Sri Lankan Constitution guarantees equal rights and privileges to Veddas, which are accorded to any other ethnic community in the country. It does not accord special status to any ethnic, religious, cultural or social group. In addition, Veddas also receive State patronage at times when they raise their grievances with the relevant authorities. However, in popular literature and historical analyses, a group of forest dwellers known as Vedda are considered as indigenous people. Historically, they lived near forest and jungle areas. The Veddas are allowed to engage in their traditional livelihood practices in a limited way ('limited human activities') such as hunting and gathering forest resources. In 2011, a National Action Plan for the Protection and Promotion of Human Rights prepared by the Government, which emphasizes the need for greater attention to the rights of indigenous people. The action plan directs the Ministry of Cultural Affairs and National Heritage to review existing laws, policies, and practices and amend or enact policies to protect the rights of indigenous people by 2016. The government's plan also provides legal support to the indigenous community, measures to conserve their traditional knowledge and traditional medicines, and support to establish a museum on their heritage. In order to create greater awareness about the indigenous community and their culture, the Government has established several cultural centers and documented the history of the Vedda community and their way of life. The Forest Department which is responsible for management of national forest covers have recognized the livelihood needs of forest dwellers and issued ‘permits’ for only identifiable forest dwellers to enter into forest areas and make use of forest resources for livelihood purposes. At present, except in a few locations near forests and national forest covers, majority of Vedda people have been integrated or assimilated with mainstream Sri Lankan society. They communicate with each other in national languages depending on where they live. On the other hand, there is no record of existence of Vedda people in national census or local record, and this fact makes it difficult to do any specific targeted development planning and/or interventions. The Bank has recently carried out a preliminary assessment to ascertain data and information of the presence of IP community, especially Vedda. The assessment reveals that in certain locations near forest areas, a few Vedda households identify themselves as forest dwellers or Vedda. However, the overwhelming majority does not exhibit any recognizable characteristics as IPs and they are fully integrated with the mainstream society having assimilated mainstream values as well. In addition, Sri Lanka’s ethnic groups, such as Tamils, do not consider themselves as ethnic minorities because they enjoy equal rights as all other religious and ethnic groups well integrated and mainstreamed in national political system and governance with demonstrated capability to influence national policies and resource allocations. A national workshop is being planned to review and discuss the findings of the IP study and decide on whether Vedda communities or any other social groups should be recognized as IPs for targeted action, and determine the applicability of triggering of Indigenous People’s Policy (OP 4.10) for Bank financed projects. The Project does not envisage to implement any interventions in the areas which are close to or interfere with the forest reserves and national parks earmarked as territories of the Vedda or any activities that would adversely affect the habitats and the social and cultural practices of the forest dweller populations. Through social screenings and related interventions, the project will ensure to promote greater social equity in outreach, community participation, and involvement of vulnerable groups in planning and service delivery under project activities. The PMUs will implement community consultations in each of the subproject areas to identify opportunities as well as problems and issues in the beneficiary communities associated with project design, and will adopt adequate safeguard measures to address those issues

26. Women Charter of Sri Lanka

The State policy on women in Sri Lanka is articulated in the Sri Lanka Women's Charter of 1993, which is based on United Nation's Convention on the Elimination of all forms of Discrimination against Women (UNCEDAW) and was a collaborative effort of the national machinery and women's NGOs. Seven areas of concern, specific to women in Sri Lanka such as civil and political rights, right to education and training, right to economic activity and benefits, right to healthcare and nutrition, rights within the family, right to protection from social discrimination and right to protection from gender-based violence are addressed in the Charter. In this charter, the Constitution of the Democratic Socialist Republic of Sri Lanka recognizes that gender equality and freedom from discrimination on the grounds of sex is a fundamental right, and provides for its enforcement in the Courts of Law. Political and Civil rights ensure equality of men and women and eliminate discrimination against women in the public and private sectors. Moreover, this was planned to be established for the purpose of examining progress made on the realization of the obligations undertaken by the Charter and for monitoring the achievement of its objectives.

2.3 World Bank Safeguard Policies

Projects and programs funded by IDA resources need to comply with the World Bank's operational policies. Therefore, all sub-projects eligible for funding under this project will be required to satisfy the requirements of the safeguard policies of the World Bank, in addition to conformity with national environmental regulations. The Agriculture Sector Modernization Project (ASMP) undertakes several cultivation, and infrastructure subprojects and they have to be screened and impacts have to be identified. The World Bank OP4.01 discusses the environment assessment process to be followed.

The main environmental safeguard policy to be triggered under this project will be OP/BP/GP 4.01 on Environmental Assessment. The other three environmental safeguard policies namely, OP/BP/GP 4.36 and 4.04 on forestry and natural habitats respectively, have been identified as there will be activities inside such habitats and will be considered to ensure minimal adverse environmental impacts due to the project.

World Bank safeguards policies triggered by the project

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment (OP/BP/GP 4.01)	[**x**]	[]
Natural Habitats (OP/BP 4.04)	[**x**]	[]
Pest Management (OP 4.09)	[x]	[]
Physical Cultural Resources (OP 4.11)	[]	[**x**]
Involuntary Resettlement (OP/BP 4.12)	[]	[**x**]
Indigenous Peoples (OD 4.20, being revised as OP	[]	[x]
Forests (OP/BP 4.36)	[]	[x]
Safety of Dams (OP/BP4.37)	[]	[x]
Projects in Disputed Areas	[]	[x]
Projects on International Waterways (OP/BP/GP	[]	[x]

a. OP 4.01 on Environmental Assessment

This policy is triggered, if a project is likely to have potential (adverse) environmental risks and impacts in its area of influence. The policy requires environmental assessment (EA) of projects proposed for World Bank financing to ensure that they are environmentally sound and sustainable, and thus to improve decision making. EA should take into account the natural environment, human health and safety and social aspects in an integrated way. It should also take into account the variations in project and country conditions, the findings of country environmental studies, national environmental action plans, the country's overall policy framework and national legislation, the project sponsor's capabilities related to the environment and social aspects, and obligations of the country, pertaining to project activities, under relevant international environmental treaties and agreements.

The pollution prevention and abatement measures and emission levels that are normally acceptable to World Bank is described in the *Pollution Prevention and Abatement Handbook*. However, taking into account country's legislation and local conditions, the EA may recommend alternative emission levels and approaches to pollution prevention and abatement for the project.

Project Categorization

When OP 4.01 is triggered, the World Bank classifies proposed projects in to one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts.

(1) A proposed project is classified as Category A, if it is likely to have significant adverse environmental impacts that are sensitive, diverse or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works.

(2) A proposed project is classified as **Category B** if its potential adverse environmental impacts on human populations or environmentally important areas including wetlands, forests, grasslands and other natural habitats are less adverse than those of Category A projects. These impacts are site specific; few if any are irreversible; and in most cases mitigatory measures can be designed more readily than for Category A projects. The scope of an EA for Category B projects may vary from project to project, but it is narrower in scope when compared with Category A projects.

(3)A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. For example, technical assistance projects on institutional development, computerization, and training fall in Category C.

(4)A proposed project is classified as FI when the Bank provides funds to participating national banks, credit institutions and other financial intermediaries (FIs) for on lending at the Fis' risk to final borrowers.

In the case of such projects, the FI screens each sub project proposed for financing, and classifies it in to any one of three categories: A, B or C. FIs must prepare an Environmental and Social Management Framework, following the Bank's consultation and disclosure requirements as in the case of other safeguards documents (e.g., EAs, RAPs, IPPs). The ESMF, including the screening process for categorization of subprojects, must be spelled out in the operational manual.

World Bank OP 4.01 is very clear that for all Category A projects and as appropriate for Category B projects during the EA process, the project sponsor should consult project-affected groups and local non-governmental organizations (NGOs) about the project's environmental aspects and take their views into account. The project sponsor should initiate such consultations as early as possible. For Category A projects, the project sponsor should consult these groups at least twice (a) shortly after environmental screening and before the terms of reference for the EA are finalized, and (b) once a draft EA report is prepared. The EA should particularly incorporate such comments to improve the project's social acceptability and environmental sustainability. In addition, the project sponsor should consult with such groups throughout project implementation, as necessary to address EA related issues that affect them.

ASMP has been placed under environment Category B. Although project activities are expected to be environmentally beneficial in the long-term, implementation of certain activities will have the potential to trigger adverse environmental impacts which are likely to be localized and can be mitigated. Even though the project will operate in known agricultural areas, great care will be taken to address environmental issues at the earliest stage possible in order to minimize their potential impacts.

Environmental Management Plans

According to annex C of the World Bank OP 4.01 an Environmental Management Plan (EMP) is an essential element of EA reports for Category A projects. The EMP should consists of a set of mitigation, management, monitoring, and institutional measures to be taken during implementation and operation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. The plan should also include the actions needed to implement these measures. In preparation of an EMP, the EA consultant should:

a. Identify the set of responses to potentially adverse impacts

b. Determine requirements for ensuring that those responses are made effectively and in a timely manner

c. Describe the means for meeting those requirements.

a. OP 4.04 on Natural Resources

OP 4.04: Natural Habitats seek to ensure that World Bank-supported infrastructure and other development projects take into account the conservation of biodiversity, as well as the numerous environmental services and products which natural habitats provide to human society. The policy strictly limits the circumstances under which any Bank-supported project can damage natural habitats (land and water areas where most of the native plant and animal species are still present). Specifically, the policy prohibits Bank support for projects which would lead to the significant loss or degradation of any Critical Natural Habitats, whose definition includes those natural habitats which are either: legally protected, officially proposed for protection, or unprotected but of known high conservation value. In other (non-critical) natural habitats, Bank supported projects can cause significant loss or degradation only when there are no feasible alternatives to achieve the project's substantial overall net benefits; and acceptable mitigation measures, such as compensatory protected areas, are included within the project. Identification and assessing of impacts to natural resources is generally undertaken as part of EA work. Where significant impacts are anticipated special habitat management plans will be required, depending on the circumstances. Also, it is essential to ensure any formal clearances/approvals are taken from relevant government authorities as per National legislations

This policy has been triggered mainly on precautionary basis because some of the project sites will be within or adjacent to protected natural habitat such as the drinking water reservoirs and roads proposed for improvements in Kandy. Also, in Galle, there are wetlands associated with the natural storm-water drainage network and could possibly be damaged during canal dredging. In Jaffna, there are extensive natural ground water aquifers, naturally formed ponds, salt marshes and shallow lagoon area are associated with the project area which might be impacted due to project interventions such as drainage improvements, urban upgrading, and road rehabilitation. However, major impacts are not anticipated.

b. OP 4.36 on Forests

The forest policy is a follow on from the Natural Habitats policy and applies specifically to all types of natural forests and plantation forests. The key objective of this policy is to assist the borrowing countries to harness the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into economic development and protect vital local and global environmental services that forests provide. The Bank will not finance projects that in the Bank's opinion would involve significant conversion or degradation of critical natural forests or those that contravene applicable international environmental agreements. If a project involves significant conversion or degradation of forests the Bank must determine they are not critical, there are no other feasible alternatives and that comprehensive analysis has been carried out that demonstrates benefits outweigh environmental costs. Identification and assessing of impacts to forests is generally undertaken as part of EA work. Where significant impacts are anticipated special forest management plans will be required, depending on the circumstances. Also, it is essential to ensure any formal clearances/approvals are taken from relevant government authorities as per national legislations. The policy also has strict stipulations on commercial forest harvesting and community aspects on forest management. The policy is usually triggered when projects are expected to have impacts on health and quality of forests, rights and welfare of people who depend on forest resources and those that aim to bring about changes to management, protection and utilization of forests and plantations.

This policy has been triggered mainly on precautionary basis because some of the project sites will be within or adjacent to protected natural habitat such as the drinking water reservoirs and roads proposed for improvements in Kandy.

c. Pest Management (OP 4.09):

The policy has been triggered as expansion, intensification and diversification of agricultural activities under the project could to lead to changes in the application of pesticides for pest and disease control. As per the policy, a separate standalone Pest Management Plans (PMP) has been prepared for the project based on Integrated Pest Management (IPM) principles. The PMP describes the relevant national regulatory framework, current status of pest and disease control, monitoring and supervision mechanism, major experience and problems, and lessons learnt from past projects. It specifies a range of non-chemical methods and a training and monitoring program to facilitate implementation. While a list of all chemicals likely to be used during project activities that meet Bank requirements, and namely, comply with the World Health Organization’s recommended categories, has been included in the PMP, the project will not be procuring pesticides.

d. OP 4.12 Involuntary Resettlement

The World Bank’s Operational Policy on Involuntary Resettlement (OP4.12) is applicable to the project. Involuntary resettlement covers situations where a project must compensate people for loss of land, other assets, livelihoods, or standard of living. World Bank Operational Policies seek to avoid - where feasible - or minimize involuntary resettlement, exploring all viable alternative project designs. Resettlement planning has the objectives of providing displaced persons with a standard of living equal to, if not better than, their pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. The required measures to address the impacts resulting from involuntary taking of land, a RPF is required to ensure that the displaced persons are informed about their options and rights pertaining to resettlement; consulted on and provided with technically and economically feasible resettlement alternatives and provided compensation at full replacement cost. No involuntary resettlement is envisaged under the project. Most project-supported physical interventions are expected to be of relatively small scale at household or village level on existing farmland of households that are participating in the selected sub-projects on a voluntary basis, following consultation. Specific activities would involve, for example some land preparation, construction of small-scale household level green houses, and installation of on-farm irrigation equipment. In addition, the construction of storage facilities, agriculture connectivity roads, markets, and facilities for product processing and others at the level of producer organizations or agribusinesses are likely to require some land and may generate a land acquisition case, if land is not donated voluntarily, purchased through willing-buyer willing-seller arrangements, or cannot be made available from State land. The RPF will guide the land acquisition process and the preparation of sub-project specific Resettlement Action Plans (RAPs) in compliance with the national legal and policy framework for land acquisition and OP 4.12. The RPF has set key principles and procedures for land acquisition, covering documentation, compensation and mitigation principles, a grievance redress mechanism, monitoring and evaluation, and institutional arrangements. All the subprojects that involve construction of agriculture infrastructure and facilities in new lands will be screened in respect of the involuntary resettlement policy, including any community/government owned land required for new constructions is free of squatters/informal settlements and other encumbrances.

Annex 7: Geo-information System establishment Data Collection Formats

Primary Data Collection Format

Primary data collection form

1	Code Number			
2	Province			
3	District			
4	DS Division			
5	GN Division			
6	Local Authority			
7	AI Range			
8	Name			
9	Ethnicity		Sinhalese	SL Tamil
10	Sex		Male	Female
11	Date of Birth		Single	Married
12	Civil Status			
13	NIC Number			
14	Tele Number			
15	email Address			
16	Address			
17	Employment		Government	Private
18	Ownership of land		Owner	Rented/Lease
19	Land Extent (Ac)			
20	Position of slope		Flat	Moderately Slope
21	Source of Surface Water		Spring/ Canal	Perennial Stream
22	Ground Water Availability		Dug Well	Tube Well

Secondary Data collection form

23	GPS Location X	
24	GPS Location Y	
25	Present land use	
26	Type of labor used	
27	Type of Permanent crop	
28	Permanent crop cultivated Area (Ac)	
29	Date of cultivate	
30	Type of Irrigation System	
31	Cost for Irrigation system	
32	Cost for Land preparation	
33	Cost for Fertilizer & chemicals	
34	Yield (kg)	
35	Income (per Year)	
36	type of Seasonal crop	
37	Cultivated Area (Ac)	
38	Date of cultivate	
39	Type of Irrigation System	
40	Cost for Irrigation system	
41	Cost for Land preparation	
42	Cost for Fertilizer & chemical	
43	Yield (kg)	
44	Income (per Season)	
45	income (per Year)	

Annex 8: Stakeholder Consultations meetings

Date	Stakeholder Consultation	Venue
9th June 2022	Kilinochchi and Vavuniya Districts stakeholder workshop	Kilinochchi
	Meeting with Chief Secretary, Northern Province	Jaffna
10th June 2022	Visits to Pilot project sites in Kilinochchi and Vavuniya	Kilinochchi and Vavuniya
22nd June 2022	Agri-business Partners Workshop – National Level	Via Zoom
23rd June 2022	Technical Specialists Workshop – national level	Via Zoom
24th June 2022	Central Province Steering Committee Meeting	Kandy
29th June 2022	Ampara District Stakeholder Consultation including Chief Secretary and District Secretary Ampara	Ampara District Secretariat
30th June 2022	Badulla District Stakeholder Consultation including Chief Secretary and District Secretary Badulla	Badulla
12th July 2022	Technical Specialists Workshop – Crop Specialists	Via Zoom
3rd August 2022	Maize Seed Production Consultation Workshop in Badulla	Kandaketiya Irrigation Department
4th August 2022	Maize Seed Production Consultation Workshop in Vavuniya	SPMDC, Vavuniya
5th August 2022	Maize Seed Production Consultation Workshop in Kilinochchi	DOA, Kilinochchi
19th August 2022	Draft Feasibility Report on Maize Seed Production	PMU-ASMP, Battaramulla
26th August 2022	Maize Seed Production Consultation Workshop in Ampara	Padiyathalawa
27th August 2022	Cros specific Site level discussion in Ampara	Thirukkovil
5th September 2022	Maize Seed Farmer Group Discussions at Kandaketiya	Kandaketiya
20th September 2022	Maize Seed Farmer Group Discussions at Vavuniya	Vavuniya
21st September 2022	Mahaweli System L – Discussions with MASL and Farmers	Ethawetunawewa
	Omanthai Sweet Orange Farmer Group Discussion	Mamadu
	Papaya Cluster Farmer Group Discussion	Nainamadu, Nedunkerni
	Chilli Cluster Farmer Group Discussion	Omanthai
28th September 2022	Stakeholder including Farmer Group Discussions in Badulla – Crop specific farmers	Seethaeliya, Boralanda, Wakkadahinna
29th September 2022	Chilli Cluster Farmer group discussions in Badulla	Girandurukotte and Rideemaliyadda
4th October 2022	Review Committee Meeting on Feasibility Report for Maize Seed Production	PMU, ASMP
5th October 2022	Stakeholders including Farmer Group Discussions with Jambo Peanut, Chilli, Passion Fruit, Pomegranate in Kilinochchi	Karachchi, Kandawalai and Palai

6th October 2022	Stakeholders including Farmer Group Discussions with Jambo Peanut, Chilli, Passion Fruit, Pomegranate in Kilinochchi	Karachchi, Kandawalai and Palai
13th October 2022	Stakeholder consultations including Farmer groups in Kandy	Kandy, Doluwa, Gampola, Medamahanuwara, Theldeniya, Rikillagaskada
14th October 2022	Stakeholder consultations including Farmer groups in Kandy	
27th October 2022	Review Committee Meeting on CDPs for Maize Seed Production Agri-business Partners Workshop National Level	PMU, ASMP Via Zoom