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Ministry of Agriculture, Livestock, Land and Irrigation
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Policy Brief

Agricultural Policy Support for Technology Adoption

Main Research Report

Policy Research in the Area of Technology Adoption

MG Consultants (Pvt) Ltd.N0 03, Swarna Place Nawala Road, Rajagiriya

(Available at www.asmp.lk)

Compiled by

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December 2024

AGRICULTURE SECTOR MODERNIZATION PROJECT

No 123/2, Pannipitiya Road, Battaramulla, Sri Lanka

Policy Support for Agricultural Technology Adoption

Agriculture Sector Modernization Project

Ministry of Agriculture, Livestock, Lands and Irrigation

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Executive Summary

Agricultural policy environment for technology adoption has been considered as one of the key elements that needs to be examined comprehensively to understand the context under which the agriculture modernization process proceeds. Accordingly, the Agriculture Sector Modernization Project (ASMP) of the Ministry of Agriculture (MOA) has contracted a policy research assignment to carry out a study on Technology Adoption[1].

The specific objectives set out in the study are, in turn, directed towards on investigation into the constraints of current policy environment, possible policy reforms, and make desired recommendations to support the agriculture modernization process through technology adoption.

Agriculture policy documents published in Sri Lanka (194) and policy documents of selected countries (100) have been collected and reviewed systematically, to make a comparison of documentation of "Technology Adoption" in the agricultural policies.

The results have suggested that 'Development', 'Production', and 'Research' are the keywords in order of prominence, showing the highest frequency in local policy documents. In regional policy documents, 'Research', 'Development' and 'Production' appeared in the order of highest occurrences. It proves that those countries have paid more attention to novel technologies and innovations through research than Sri Lanka when they come up with policy formations.

Sixteen (16) agriculture policy and policy related documents that had been reviewed on technology adoption. It appears that many of the reviewed policies related to technology adoption have little relevance to face new challenges of the agriculture modernization process.

The review implies the need for alternative policy strategies including, facilitation of robust research and development, emphasis for innovative technology adoption, private sector involvement for R&D, preparing farmers for competitive high value market chain, better coordination among government agencies for evidence–based policy formulation, and focus on inadequate implementation strategies and monitoring. At the same time, more pro-active policies are needed to ensure inclusive growth of small farmers and enterprises.

[1] 'Policy Research on Agricultural Technology Adoption' and responds specifically to the given Terms of Reference (TOR) and Procurement Plan Reference No. LK-MOA-PMU-31831-CS-QCBS, carried out by the MG Consultants (Pvt.) Ltd.in 2020

1.Introduction

Smallholders dominate the agriculture sector in Sri Lanka in the plantation sector as well as in the non-plantation sector. About 1.65 million smallholder farmers operate in the non-plantation sector, on average, with less than 2 hectares of farmland, but contribute about 80 percent of the total annual food production. Agriculture policies have encouraged import substitution of basic agricultural commodities to make the country self-sufficient from those items. Hence, the agriculture production structure has remained concentrated on selected food crops and neglected the domestic fruits and vegetable sectors even though growing domestic demand and potential for export growth.

Despite the policy initiatives taken, investments, and technology adoption done in the agriculture sector during the last few decades, the performance of the sector appears to be "below the expectation". It is lagging with relatively low productivity, less investments, low technology adoption, and inadequate penetration into the international markets. Public investments in research and development (R&D) and extension services account for less than three percent of total agriculture expenditure, and in fact, much of this limited budget is spent on the paddy sector. As a consequence of this, the public sector under-investment, generation, and dissemination of new technologies that are critical for productivity enhancement, and profitability improvement in the whole agricultural value chain have fallen behind. Present research and extension systems are often described as "ineffective" because of their supply-driven nature and insufficient demand orientation. Private sector participation in R&D and extension services remains low, especially in the non-plantation crop sector.

Lucrative domestic and international markets are available and emerging for quality agriculture products that can be produced sustainably by the 'Sri Lankan Smallholder Agriculture Sector'. Sector modernization, value chain development, agriculture diversification, undertaking agriculture as a business, and joining with the private sector are extremely essential for smallholders to cater to these markets competitively. In light of these, the adoption of appropriate technologies is of paramount importance for quality agriculture productions, agriculture diversification, sector modernization, value chain development, and making reasonable profits by involved stakeholders through productivity enhancements and capacity building.

Accordingly, the ASMP of the Ministry of Agriculture (MOA) has commissioned policy research, in order to identify knowledge gaps, policy and regulations in consistency to recommend adjustments,

reforms or new policies needed for better Institutions to facilitate technology development, innovations and technology transfer, and technology adoption to make agriculture sector more competitive, responsive to the market demand, sustainable and resilient.

2. The Approach

Agricultural policies adopted in Sri Lanka from the 1970s onwards have had a direct and indirect influence on technology adoption in all crop sectors. Special attention was given in this study to describing the existing coverage, as well as gaps concerning the policy environment triggering the adoption of agricultural technologies.

The approach given below has been followed in the study.

- Review of historical and current agricultural policies with the mission to comprehend why these policies/regulatory functions in the areas of technology generation and adoption failed to achieve the desired goals.
- Identify the major policy/regulatory changes that affected technology adoption.
- Review the effectiveness of present agriculture technology transfer system in Sri Lanka.
- Identify those institutional constraints that inhibit the effectiveness of agricultural extension provision.
- Undertaken a country comparison of technology adoption in the agriculture sector within the scope of South Asia, prominent nations in Asia (e.g. China, Thailand, Vietnam), and in developed countries such as Australia, Canada, the United States, and those in the European Union.
- Provide an account of the policy and regulatory barriers faced by various actors along the value chains with special reference to intellectual property rights in research and development, technology transfer, technology adoption, scale-up, and spill-ins.
- Identify procedures available for the private sector to develop and release new agricultural technology, and the revisions required to encourage private investment in new technology development.

- Propose amendments and/or make suggestions/recommendations for policy/regulatory changes to the regulatory framework in Sri Lanka with the details of responsible authorities to undertake necessary modifications.
- Recommend appropriate policy instruments that the government could use to implement the proposed policy changes to improve agriculture sector competitiveness and sustainability.
- Identify the implementing authorities (relevant Ministries, Departments, or other organizations) and the procedure to be followed to make policy changes/policy formulation a reality.

Multiple information collection procedures have been adopted to gather relevant information from relevant public and private organizations at the national level, provincial level, and within the project boundaries and other stakeholders including project beneficiaries.

Desk reviews, Key Informant Consultations, Semi-structured Interviews, Focus Group Discussions (FDGs), Workshops, Field Surveys, etc. have been used to gather data and first-hand information, required for policy analysis. Qualitative and quantitative analysis have been undertaken.

3 Results:

3.1 Policy Review

Agriculture policies published in Sri Lanka and selected "Regional" (International) countries have been collected and reviewed systematically, to make a comparison of documentation of "Technology Adoption" in the agricultural policies.

National policy documents contain 194 articles that were classified into 17 Categories to reflect different "Policy Themes".

In comparison, the analysis has been limited to 10 major countries (i.e. International), which play predominant role in agriculture, in general, and involved with adoption of various technologies, in the fields of agriculture and agribusiness in particular. Selected countries namely Australia, Canada, China, France, Germany, India, Japan, Pakistan, the United Kingdom, and the United States.

Relevant policy documents have been identified through Thematic Analysis and Keyword Analysis.

The Themes of Policies Considered: Biotechnology and Cleaner Production, Climate change, Credit, Finance, Food, Land, Marketing, Price, Research & Development, and Trade. Keywords of "Technology" and "Adoption" more specifically have been considered.

- In the local category 44 out of 194 policy documents and under the international category 43 out of 100 documents have been identified.
- These policy documents have been further analyzed using the following 34 keywords given in the table 1.

Table 1: Keywords Used in Policy Relevance Analysis

Capacity	Effective	Marketing	Quality
Communication	Efficiency	Modernization	Research
Conservation	Employment	Network	Safety
Control	Extension	Operation	Sustain
Credit	Improvement	Partnership	Utilization
Development	Innovation	Processing	Value Addition
Diversification	Insurance	Production	Value Chain
e-agriculture	Intensification	Productivity	
e-commerce	Investment	Protection	

The results have suggested that 'Development', 'Production', and 'Research' are the keywords in order of prominence, showing the highest frequency in local policy documents. In regional policy documents, 'Research', 'Development' and 'Production' appeared in the order of highest occurrences. It proves that those countries have paid more attention to novel technologies and innovations through research than Sri Lanka when they come up with policy formations.

According to the rank comparison, the lowest rank in local policy documents has been obtained by 'Intensification', 'e-commerce', and 'Modernization'. In regional policy documents, the lowest frequency showed for 'e-agriculture', 'e-commerce', and 'Intensification'. Again, it proved that the local policy-forming agents have not paid much interest in novel technologies of the corresponding area discussed through the policy documents. Surprisingly regional policy documents have not contained innovative technology related terms. Even though these countries are engaged in e agriculture, e commerce and modern agriculture with relative to Sri Lanka, it reveals that these practices have not been executed through policies

National Agricultural Policy Related Documents identified under thematic analysis were used for "content analysis" based on the relevance of contents of those documents with agricultural technology adoption. As a result, 16 documents shown in the following Table 2 have been finally selected for detailed policy analysis.

Table 2: National Policy Documents Reviewed - Related to Technology Adoption:

Sector	No.	Policy / Policy Related Document	Year
Agriculture	1	Sri Lanka National Agricultural Policy – Ministry of Agriculture and Agrarian Services	2007
	2	Ministry of Agriculture - Cooperate Plan 2011-2015	2011
	3	Development of a National Agricultural Policy for Sri Lanka (Not Cabinet approved)	2018
	4	National Agricultural Research Policy and Strategy (CARP) 2018 – 2027	2018
	5	Overarching agricultural policy (Draft)	2019
Livestock	6	National Livestock Development Policy & Strategies	2009
	7	Livestock Master Plan 2011 - 2016	2010
	8	National Livestock Breeding Policy	2010
Spices	9	National export strategy of Sri Lanka 2018-2022 spices and concentrates strategy - Ministry of Development Strategies and International Trade	2017
Sugar Industry	10	Sri Lanka Development Policy for Sugar Industry	2016
Cross-Cutting	11	Sri Lanka E-agriculture Strategy	2016
	12	National Biotechnology and Policy – National Science Foundation	2009
	13	National Policy for Primary Industries of Sri Lanka	2018
	14	National Science & Technology Policy – National Science and Technology Commission (NASTEC)	2008
	15	The National Climate Change Policy of Sri Lanka	2012
	16	National Policy and Strategy on Cleaner Production for the Agriculture Sector	2012

In the policy analysis, three (03) perspectives given below, have been considered for analytical purpose:

(1). Policy Perspective

(2). Technology Adoption Perspective

(3). Agriculture Sector Modernization Project (ASMP) Perspective

i) **Policy Perspective -** In the analysis of policy perspective, the four - steps policy analysis methodology of FAO has been adopted

I) Policy and policy objectives

(II Policy Instrument/s

(III) Policy Implementation

(IV) Monitoring and Evaluation

Although it is desirable to have the four elements in a policy, to proceed from policy formulation to impact evaluation, it is rarely possible to find all the four elements included in most of the policies under review. This analysis provides insight into the extent to of each sub-sector has all elements of the policy implementation cycle. The aim is to find the gaps in policies as shown in Table 3, where possible and suggest improvement.

Table 3 -. Sector-wise findings of the analysis

Sector	No.	Policy & Policy objectives	Policy Instrument/s	Policy Implementation Plan	Monitoring & Evaluation System
Agriculture	1	Sri Lanka National Agricultural Policy – Ministry of Agriculture and Agrarian Services -2007	A	**NA**	NA
	2	Ministry of Agriculture - Cooperate Plan 2011-2015	A	A	A
	3	Development of a National Agricultural Policy for Sri Lanka (Pending Cabinet approved)	A	A	A
	4	National Agricultural Research policy and Strategy (CARP) 2018 – 2027	A	NA	NA
	5	Overarching agricultural policy (Draft)	A	A	A
Livestock	6	National Livestock Development Policy & Strategies	A	A	A
	7	Livestock Master Plan 2011 - 2016	A	A	A
	8	National Livestock Breeding Policy	A	NA	NA

Spices	9	National export strategy of Sri Lanka 2018-2022 spices and concentrates strategy - Ministry of Development Strategies and International Trade	A	A	A
Sugar Industry	10	Sri Lanka development policy for Sugar Industry	A	NA	NA
Cross Cutting	11	Sri Lanka E-agriculture Strategy	A	A	A
	12	National Biotechnology and Policy – National Science Foundation	A	NA	NA
	13	National Policy for Primary Industries of Sri Lanka			
	14	National Science & Technology Policy – National Science and Technology Commission (NASTEC)			
	15	The National Climate Change Policy of Sri Lanka	A	NA	NA
	16	National Policy and Strategy on Cleaner Production for Agriculture Sector	A	A	A

P/S NO - Policy / Strategy Number, A – Available, NA - Not Available

Out of the 16 policies reviewed only 08 policies have been covered all 04 elements of policy analysis and 50% of them do not have policy implementation plan and the M& E plan.

ii) Technology Adoption Perspective

Examining how technology is generated, innovated, transferred, and finally adopted by smallholder farmers and rural agribusiness in the project area on a long-term basis is extremely useful for strengthening technology adoption.

Hence, for the successful adoption of technology, it is crucial to complete the following steps in its adoption process:

(1) Technology Development/Innovation
(2) Transfer of Technology
(3) Adoption

Sector-wise policy-related documents were analyzed under the above three steps and found National Agricultural Research Policy and Strategy (SLCARP) 2018 – 2027 and Sri Lanka National

Agricultural Policy – Ministry of Agriculture and Agrarian Services – 2007 (Agriculture sector) and The National Climate Change Policy of Sri Lanka, 2012 (Cross-cutting category) have respectively scored highest values indicating the level of facilitating technology adoption.

iii) ASMP Perspective:

Thirteen (13) key elements given below, were identified under ASMP as important attributes which would facilitate accomplishment of project objectives.

i) Productivity Improvement,	viii) Private & Public Sector partnerships / Investments for Production,
ii) Diversification,	ix) R&D & Training of Trainers (TOT),
iii) Modernization,	x) Use of ICT in Agric. Modernization,
iv) Post-Harvest Operation, Value Addition and Value Chain Development,	
v) Employment Generation in Modern Agriculture,	xi) Competitiveness,
vi) Market Orientation including Exports,	xii) Sustainability
vi) Education and Transfer of Technology,	xiii) Resiliency & Natural Resource Management

The analysis of selected policies was to ascertain whether these policies are in line with the above thirteen (13) ASMP attributes. National Agriculture Research Policy (2018) is more in line with the ASMP perspective with highest scoring and the National Agriculture policy 2007 has next in line with the second highest score.

The selected policies were further analyzed on sub sector basis.

Agriculture Sub Sector

Five major policies were analyzed for this sector. It appears that none of these policies have focused on specific technology adoption processes that complement and reinforce each other which link to a unified national agricultural extension system, but different Ministries, departments and agencies adopted their own outreach programs for extension.

The overall sector wise comparison of agriculture policies, technology adoption aspect received highest priority 44.4 %, followed by technology transfer 40.2%, and the priority given for technology generation aspect was 20.1%.

Livestock Sector

Three major policies related to livestock sector have been analyzed. The National Livestock Development Policy & Strategies developed in 2006 maintained a balance of priorities for the three aspect of technology adoption.

Similar trend was observed in the Livestock Master Plan (2011) but, priority given for technology generations seems to be lacking. The National Livestock Breeding Policy has concentrated in the technology generation aspect only.

The overall sector wise comparison of livestock policies shows the priority given for technology generation aspects was relatively higher than the agriculture sector policies (42.9%).

Spice Sector

There was only one policy document available for analysis in the spice sector - National Export Strategy of Sri Lanka 2018- 2022 which was developed by the Export Development Board (EDB). Much of the priority provided for technology adoption (45.5%) while only 18.2% given for Technology generation.

Sugar Sector

The Sri Lanka Development Policy for Sugar Industry 2016 has been used for analysis. The priority given for sugar Industry for technology adoption (71.4%) is relatively higher than the technology transfer (28.5%). This indicates that the focus given for sugar industry is for expansion of extent rather than productivity improvement through intensification. There were no evident on strategies for technology generation aspect in this policy.

Cross Cutting Policies

There are several cross-cutting policies that influence the technology adoption areas. Although these policies related not only for agriculture sector technology adoption areas, but also covers wider

aspects of many sectors. For the analysis purpose, policies which are directly influence the agriculture technology adoption were taken into consideration.

E-Agriculture Policy elaborated wider space of technology transfer aspects through strategic communication and information systems.

Policy on Bio-Technology support the application of bio- technology in agriculture modernization process, genetic engineering, mainly in crop and livestock sector, is the area most directly affecting in agriculture that is helpful in productivity improvement. National Biotechnology Policy (2009) document reviewed for analysis stressed that biotechnology applications are complementary not an alternative for many areas of conventional agricultural research.

The National Policy on Primary Industries (2018) revealed that 66.7% priority was given to technology adoption and also emphasized on productivity improvement, adopting Good Agricultural Practices (GAP) and establishes linkages with agriculture producers and processors in the private sector.

National Climate Change Policy revealed with 13 technology adoption related policy instruments that nearly 60% of the policy strategies included priority for technology transfer aspects while less emphasis on technology generation.

National policy and strategy on cleaner production, for agriculture sector (NPSCPA) has been formulated with an objective of achieving sustainable agriculture for national prosperity ensuring food security of the nation through ecologically sound, economically viable and socially acceptable agricultural systems. This policy supports the environment and natural resource management in a sustainable manner. Therefore, the emphasis has been on technology adoption aspect. The priority given for these areas is more than 57%. However, the priority for technology generation is 7.1%.

3.2 Overall, Policy Comparison

a) Local Policy Review

Sixteen (16) policy and policy related documents that had been reviewed on technology adoption are generally in line with national agriculture development goals of productivity improvement, food security, high farm income, input efficiency, sustainable resource utilization, technology transfer and

research and development. However, policies revived are far from adequacy in addressing the current scenario of developments in the agriculture modernization process, hence, the review implies the need for alternative policy strategies including, facilitation of robust research and development, emphasis for innovative technology adoption, private sector involvement for R&D, preparing farmers for competitive high value market chain, better coordination among government agencies for evidence –based policy formulation, and focus on inadequate implementation strategies and monitoring.

It is also observed that one of the key problems associated with agricultural policy formulation is, because of different Ministries, government institutions and cooperation related to agriculture, have different mandates that are not clearly defined or demarcated therefore, often, overlapping policy objectives.

b) Global Review

The global agricultural policy review is an important part of the policy analysis. Lessons learned in the analysis from Asian region countries namely: Philippines, Myanmar, Indonesia, Bangladesh, India, Thailand are given below of their relevance and applicability to Sri Lankan context.

- Philippine: Large number of agricultural technologies are developed in many sectors but sharing these technologies to farmers, commercial entrepreneurs and private sector is greatly inadequate. Therefore, support establishment of a Technology Information Access Facility, Technology Licensing Offices (TLOs) and/or Technology Business Development Offices.
- Facilitate policy environment to encourage public and private sector collaborations, CBOs, Small Farmers and commercial farmers in technology generation, innovations and technology transfer.
- Myanmar: As a policy, establishment of integrated high technology demonstration villages by practicing Good Agricultural Practices (GAP) is encouraged with the intension of increase production and crop diversification for better income.
- Indonesia, - technology transfer of research results through commercialization, developed in the government research institutions through the development of technology incubators,

which opens business opportunities for small, micro and medium enterprises in distributing technology to the users. The second approach is to work directly with the private sector such as research collaborations, where the final results of the study developed jointly, and intellectual property rights belong to those who contribute the most in funding, or governed by a separate agreement.

- India, After the green revolution of India with an objective of food security for all, agricultural policies shifted to focus on modernization of agriculture sector by application of modern technological innovations. It is also emphasized the need for strengthening agriculture research, training and farmer research linkages.
- Other salient feature of the Indian agriculture policies is moving to application of digital technologies enable to efficient information exchange among agriculture producers and trade.
- Vietnam has adopted a policy for quality improvement of agricultural produce through GAP to be a strong market leader and be competitive in the global market. Identification of specific Policy Research in the Area of Technology Adoption concentrated areas for different crops and livestock with associated funding and infrastructure development created a desirable environment for production of quality agricultural produce.
- This strategy could be adopted under Sri Lankan context to develop regional production areas with a potential for competitive market entry.
- Thailand agricultural policies have changed considerably over the time to address the current need of the sector. The two policies promoting Smart Agriculture and the issue –based policies are greatly shape the agricultural sector in Thailand. These strategies cover wide range of issues related to agriculture some of the policies suggested in the policy documents are relevant to Sri Lankan context.
- Bangladesh: Agricultural policies are geared toward food security, improved land productivity and income gain for small farmers. The policy support provided for livestock and diversification of crops also helped them to gain more income for farmers on a regular basis. The three main policy documents are:

  1) Agricultural Production Policy
  2) Agricultural Extension Policy
  3) Agriculture Research Policy

The strong land utilization policy which set out the guideline for land use is very much relevant to Sri Lankan context.

3.3 Data Analysis of the Field Verification on Technology Adoption

The noticeable drop in the agriculture sector productivity could be recovered if technological techniques could be employed in the fields. Farmers have diverse perceptions on adapting new technologies to pursue their livelihood. In-order to acquire the necessary information to study the field verifications that need to be established, by implementing meaningful policy interventions and regulatory measures field research has been carried out on a sample of 650 farmers from eight provinces in Sri Lanka including 14 districts (Northern Province- Jaffna, Vavuniya, Kilinochchi, Mullaitivu; North-Central- Anuradhapura, Polonnaruwa; Central- Matale; Eastern- Ampara, Batticaloa; North-Western- Kurunegala; Western- Gampaha; Sabaragamuwa- Kegalle and Uva Provinces- Badulla, Monaragala.

Farmer interviews and field inspection was carried out to obtain the required information using a semi structured questionnaire to explore the farmer perceptions and attitudes on quality attributes, barriers and key instruments of technology adoption.

The questionnaire consisted of fields related to the general information of the farmers and most importantly it contained a total of 102 statements aiming to assess the farmer perceptions on technology adoption based on the following aspects,

- Quality attributes,
  - Crop Produce- 14 statements
  - Livestock Produce – 12 statements
- Barriers/Constraints/Problems on Production and Quality Management- 41 statements
- Key Policy Instruments – 25 statements

Each of the above aspects were subjected to Factor Analysis based on the scores obtained by each statement. Then they were classified into several categories as supported by literature.

- Quality Attributes of the final products
  a) Crops
  b) Livestock

- Barriers/Constraints/Problems on Production and Quality Management
    a. technical feasibility (TF)
    b. Economic feasibility (EF)
    c. Social, cultural and ethical acceptability (SE)
    d. Infrastructure compatibility (IC)
    e. Human Resources (HR)
    f. Institutional and Government Acceptance (IG)
    g. Environmentally sound (ES)

- Key Policies & Policy Instruments
    a. Product Related Policies
    b. External Services Related Policies
    c. Price Policies
    d. Agrochemical Related Policies

For each statement under each category and sub-category, was ranked from 0 -10 (from 'unimportant' to 'extremely important) based on the values given by the farmers.

3.3.1 Results:

Taking as a percentage from the whole sample, majority of the farmers (34%) grow other crops but not paddy, but 21% of the farmers are sole paddy farmers. Paddy and more than one crop are grown by 18% of the farmers whereas livestock farming is very low. Total livestock farming or livestock with any other product does not seem as a popular option among the farmers. However, the overall explanation is that there is very less involvement of farmers (1%) in farming segments including complicated combinations of farming options. E.g. – "Paddy, other crop growing and livestock farming" has the least number of farmers involved.

<u>Farmer Perceptions on Quality Attributes:</u>

- Out of the Crop Produce Quality Attributes the farmers were more concerned about the "Level of maturity, Impurities, and Freshness", whereas the least concerns were regarding the "Colour, shape and size of the Product" when arranged in the descending order based on the Mean Attribute Score given by the farmers.

- Quality Attributes of Livestock Produce- SNF content in the product (milk), Smell and Colour of the product were the farmers' highest prioritized quality attributes, whereas they were least concerned about the Storability, Hygiene and the Content of pesticides of the final product.

Farmer Perceptions on Barriers / Constraints / Problems on Production & Quality Management-

- Adverse climatic effects and natural disasters' have scored the highest mean and the lowest was 'Illegal activities such as ransom and tips'.
- final outcome can be concluded as that "Technical Feasibility" and "Environmental Concerns" were identified as the major constraint and farmers have a very less problematic mindset about the "Social, Cultural and Ethical Acceptability" of the novel technologies to be launched.

Farmer Perceptions on Key Policy Instruments

Given that "Key Policy Instruments" are extremely important, when introducing such modifications to the agriculture sector, it is also important to know which areas the farmers consider as better above others. When introducing modifications to the agriculture sector farmers' perspective has been analyzed as per the scores given by the farmers on different policy instruments and found the followings were the main aspects that the farmers have prioritized from the key instruments.

Key Policy category	Highly valued Policy Instrument	Low valued Policy Instrument
Product related policies	Product Insurance	Waste Disposal Mechanism
External services related policies	Irrigation Water	Farm Energy / Fuel, & Support Migrated Labour
Price Policies	Information on Market/ Price Conditions, & Output Price Guarantee	Fines / Penalties on Misconduct
Agrochemical related policies	Fertilizer Subsidy	None

These key policies were in need of higher concern in case of implementing new technologies to the farmers.

Therefore, all responsible parties should pay higher attention on the priorities of farmers when developing the technologies. At the same time proper systems should be established to control the damage which could happen from adverse climatic conditions.

Though the farmers have no high concern even Garbage disposal, management processes and health and sanitary conditions should be monitored in an orderly manner prior to introducing these novel technologies to the farmers. The farmers should be equipped with the knowledge and instruments required to implement the novel technologies.

The confidence should be established in them about the positive aspects of the modern ways of farming techniques. So, the frequency of training and awareness programs would be intensifying. The support of the authorities should be within the range of the farmer requirements for the betterment of the farmers' as well as the projects' output. Therefore, a close look at the farmer's needs and interests would assist in understanding the mindset of the end users. With that background laid, the technologies can be successfully implemented among the farmers.

4. Conclusions

4.1 Policy Compatibility and Synergies

The 16 agriculture policies related to technology adoption are generally compatible in terms of agricultural productions objectives. Almost all these policy documents have been prepared before the initiation of agriculture productivity improvement, but the major content of these policies are largely compatible with agriculture modernization context.

However, most of these policies are "inadequate" to address efficient use of inputs and natural resources with special emphasis to develop a market-oriented production system.

The other major concerns of all these policies are need for strengthening research-extension and farmer linkages for application of modern technologies for productivity improvement and obtaining higher income from farming. It was also observed the weak linkages and coordination among ministries, agencies and private sector in the process of technology adoption.

It is useful to provide some reflections on the formulation process and implementation of these policies by various agencies.

First, it appears that the conceptual level of policy formulation generally led toward agriculture production but, less on value chain development. This uni-focal perception of agriculture policies often effected the related other sectors such as technology generation, market orientation and profitability.

The second issue is the concern of ministerial domain of administration and mandates of agencies within the agricultural sector. Sometimes conflicting interest between ministries such as Ministry of Agriculture and Ministry of Livestock create problems in promoting livestock industry in paddy lands. Therefore, the coordination between ministries, and agencies regarding the mandates and establishment of accountability in adhering to the policies seems to be an issue in formulating and implementing any agricultural policy.

Thirdly, policy making, planning and decision-making functions are vested at the ministry level but the regional or local level officers are responsible for implementing the plans. Therefore, inadequate participatory regional policy making for agricultural development underscore the efficiency of the policy at regional level.

Forth, the evidence-based policy making is vital for developing relevant policies. The use of database and facts considered for policy formulation often limited to government agencies. However, the policy makers more often do not consider huge potential of involving private sector, NGOs and farmer organizations which could enrich policies that could be applied to all stakeholders.

The policies reviewed in this exercise dwell on technology adoption process and concerns, there are generic areas for concern as follows;

- Dominance of rice production - The agricultural policy documents mainly focus on production increase specially, rice production giving lesser emphasis to other agricultural enterprises. Therefore, the policy prescriptions for input - supply extension services, research and marketing of produce are directed to rice.

- Diversification of commercialization – Although, policy documents state diversification and commercialization of agriculture as a common objective. But very little emphasis is given in terms of location specific agricultural enterprises, research and extension, supply chain management, processing storage and marketing of produce.
- Inadequate crop and livestock integration – the policies regarding these aspects are limited and implemented by individual ministries without proper coordination and sharing responsibilities.
- Involvement of private sector – the policies that have been revealed for this exercise largely focus on roll of public sector agencies. Although the policies state that private sector is important for a vibrant agricultural sector, often the present policy directions are limited and less supported as to how the vibrant private sector, farmer organizations and NGOs get involved and play a more active role, particularly in technology transfer.
- Contract farming and value chain – The policies reviewed indicated that agriculture pursued as an individualistic production system. The individual farm base is becoming economically and technically unsound and no longer profitable. The policies do not support the emerging new forms of farming such as contract growing for the private sector for high-value products.
- Subsidies for agriculture inputs – The subsidy schemes for spices production and fertilizer for rice cultivation gave rise to several positive and negative effects. It is seen that fertilizer subsidy is formulated with good intentions. However, without any rigorous analysis of its possible effect on other crop productions and sustainability of profitable production systems.

5 Recommendations

It appears that many agriculture policies reviewed related to technology adoption have little relevance to face new challenges of the agriculture modernization process. Therefore, it is necessary to update and review key policies and put them into proper perspective. At the same time, more pro-active policies are needed to ensure inclusive growth of small farmers and enterprises.

The policy recommendation proposes for technology adoption;

The following policy recommendations are made by the study at policy formulation and implementation, under Technology Development, /Innovation, Technology Transfer and Technology Adoption. (A separate Matrix on policy recommendation is attached).

5.1) Technology Development/ Innovation

Formulation

- Coordination between and among government ministries and research institutions, private sector and farm organizations for policy formulation, planning, implementation, and monitoring.
- Facilitate institutional reforms to strengthen research and development efforts at the national level, involving universities, research institutes, and the private sector to promote close collaborative research.

Implementation

- Strengthen research-extension and farmer linkage platform for effective participation of all concerns in technology generation, transfer, and adoption process.
- Policies to provide incentives for technology generation and commercialization for both researchers and institutions.

5.2) Transfer of Technology

Formulation

- Establish a grass root level general agriculture extensions system with trained agriculture extension agents to serve small farmer operations mobilized and monitored at the divisional level.
- Create multidisciplinary technical teams at the provincial level to serve specific production zones and cropping systems.

Implementation

- The policy environment for promoting e-agriculture strategies proposed by MOA for technology generation, improving research capabilities, and access to reliable information using ICTs.

- Application of various communication channels and media for timely dissemination of agriculture information and improve accessibility to the public domain.

- Policies for application and maintain high-quality standards, certification of products, processes, and management systems in the value chain.

5.3) Technology Adoption

Formulation

- Policy for promotion of new alternative agri-business ventures in high-potential areas with technical and financial assistance.

Implementation

- Policies to ensure agriculture research extension programs are in line with National Agricultural Policy priorities.

- Special extension systems for promoting high-value crop development in specific areas involving the private sector, farm organization, and value chain actors for promoting export-oriented production systems.

6.Policy Recommendation Matrix for Technology Adaption

Technology Adoption	Gaps / Negative Effects / Main Issues	Policy Recommendations	Policy Instruments / Strategies	Responsible Authorities
(1) Technology Development / Innovation				
Formulation	The lack of a coordinated policy plan led to policy conflicts and inconsistencies	Coordination among government ministries and research institutions, private sector, and farm organizations for policy formulation, planning, implementation and monitoring	Develop a Coordination Mechanism by consultation of relevant Stakeholders	MOA, Ministry of Trade, Chamber of Commerce, CARP, DOA, Department of Agrarian Development
	Lack of policy environment for collaborative R&D initiatives between relevant institutions thus lack opportunities for sharing technology and resources	Facilitate Institutional reforms to strengthen R&D efforts at the national level. Promote collaborative research programs.	Assess the capacities of R&D Institutions and Universities to dentify Gaps, Provide Institutional reforms to facilitate collaborations	DOA, Universities, CARP, Private Sector Agriculture Ventures
Implementation	Need policy instruments to get involved all partners in the technology generation, transfer, and adoption process.	Strengthen research-extension and farmer linkage platform for effective participation of all concerns in process.	Identify Strengths and Weaknesses of present systems, Facilitate Participatory Planning involved in all concerns, Joint Monitoring	DOA, Research and Extension Divisions, DAP&H
	Inadequate policies for rewarding research and extension for their extraordinary achievements.	Policies to provide incentives for technology generation and commercialization for both researchers and institutions.	Identify technological advancement areas and technologies which need incentives. Develop Incentive Schemes for technology generation and commercialization which is self-sustained	MOA

Technology Adoption	Gaps / Negative Effects / Main Issues	Policy Recommendations	Policy Instruments / Strategies	Responsible Authorities
(2) Transfer of Technology				
Formulation	Present Divisional Level extension is unable to make a reasonable coverage of extension. Policy to create grass root level extension system to cater to small farmers which were abolished long time ago	Establish a grass root level general agriculture extensions system with trained agriculture extension agents to serve small farmer operations mobilized and monitored at the divisional level	Recruit agriculture extension agents with knowledge of agriculture. Train and develop skills of extension agents and Initiate grass-root level extension system monitored by Divisional level	MOA, DOA
	Current technology transfer systems do not equip to serve this sector.	Create multidisciplinary technical teams at the provincial level to serve specific production zones and cropping system	Formation of multidisciplinary technical teams at the Provincial Level	DOA, PDOA, DAP&H
Implementation	Lack of Policies to integrate E-Agriculture into the agriculture sector.	The policy environment for promoting E-agriculture strategies proposed by MOA for technology generation, improve research capabilities and access to reliable information using ICTs	Identify Trained Staff for managing E-agriculture platform at DOA. Prepare Action Plan by DOA, Stakeholder Consultation for implementation, Establish Protocol.	MOA, DOA, HARTI, Private ICT companies.
	Timely dissemination of relevant information to the technology transfer process is vital for effective extension service. Current systems do not fulfill this requirement.	Application of various communication channels and media for timely dissemination of agriculture information and improve accessibility to the public domain.	Preparation of information packages, Identifying medium for dissemination, Establishing trained staff for interactive communication through various medium	DOA, DAP&H
	The current policies do not adequately address	Policies for application and maintain high-	Establish quality standards for products	DOA, Seed Certification,

	quality standards and guidelines for certification of products, processes, and unaware end users	quality standards, certification of products, processes, and management systems in the value chain	and processes, Make aware of quality standards and product procedures for target groups	Organic Certification, Modern Trade

Technology Adoption	Gaps / Negative Effects / Main Issues	Policy Recommendations	Policy Instruments / Strategies	Responsible Authorities
(3) Technology Adoption				
Formulation	Current policies do not adequately support agribusiness ventures such as protected agriculture, rapid multiplication, and product processing	Policy for Promotion of new alternative agri-business ventures in high potential areas with technical and financial assistance	Identification of alternative agribusiness ventures, provide technical and financial assistance for agribusiness ventures in high potential areas	DOA, PDOA, Private Sector Agriculture Businesses
Implementation	It appears inconsistency of extension policy with national agriculture policy priorities.	Policies to ensure agriculture research extension programs are in line with National Agricultural Policy priorities	Identify national agriculture priorities and align research & extension programs accordingly	DOA
	Current general extension systems may not adequately cater to this sector as it demands specific technologies approaches and collaborations	Special extension systems for promoting high-value crops development in specific areas involving the private sector, farm organizations, and value chain actors for promoting export-oriented production systems.	Identification and mapping of specific areas for high-value crops, Identification of specific cropping systems, promoting private sector for investment through incentives, Connect farmer organizations with the private sector. Establish Special extension systems for identified areas	DOA, Farmer Organizations, Chamber of Commerce, EDB

7.Reference:

Research Report on "Policy Research in the Area of Technology Adoption" submitted by the MG Consultants Pvt., Nawala, Rajagiriya, undertaken for the Agriculture Sector Modernization Project, Ministry of Agriculture, December 2020, available at www.asmp.lk