Policy Brief

Policy Support for Productivity growth in the Food Crop Sector of Sri Lanka

Main Research Report

Policy Research on Agricultural Productivity

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(Available at www.asmp.lk)

Compiled by

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December 2024

AGRICULTURE SECTOR MODERNIZATION PROJECT

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Executive summary

Food crop production in Sri Lanka is predominantly undertaken by smallholder farmers in the informal sector. Land, labor, and capital are constraining factors for the sector's growth.

ASMP commissioned a policy research study to identify knowledge gaps, policy and regulatory inconsistencies to improve agriculture productivity and to recommend adjustments, reforms, or new policies needed to make the agriculture sector more competitive, responsive to the market demands, sustainable, and resilient.

The study found technological innovations in increasing land productivity, in the domestic food crop sector, have been low mainly due to the limited availability of technology, particularly in terms of new varieties with high yields and better adaptability, for farmers to adopt. The most significant technological breakthrough in the recent past is the introduction of the chili hybrid variety by the Department of Agriculture.

Government emphasis has largely been on irrigation investments and fertilizer subsidy transfers. Although irrigation and fertilizer are essential inputs for the realization of yields of new varieties, the growth in output due to factor accumulation will eventually taper off unless new technologies are introduced and adopted. Therefore, investment in research and development is essential for long-term growth.

The role of international research agencies such as CGIAR, for agricultural productivity improvement in developing countries, has now been in the interest of a few states. Two international treaties on IPR have a strong bearing on the incentives and rules of germplasm sharing. The private sector and multinational companies are now dominating the seed industry and patenting of plants. Hence, open access to genetic resources and technology spillovers are becoming more constrained. Certain imported technologies are becoming costly and not adaptive. Therefore, the country will need to become more self-reliant in the provision of agricultural R&D. Public research systems have a vital share in creating new knowledge and technology as private, corporate, and non-governmental sectors have limited incentives for innovations, compared to neighboring countries.

Due to the inadequate funding, there is a large setback in the agricultural R&D program in the food crop sector. Policies, programs, human resources, and funding are not in place to undertake new technology research. However, Asian countries such as India, Bangladesh, and Vietnam have made remarkable achievements in adopting new technologies owing to the policies and institutional changes adopted.

This study makes a strong case that an effective public sector research system is critical in bridging the science and research gap for technology generation in Sri Lanka. Several recommendations have been made in this direction.

1. Introduction:

Smallholder farmers predominantly carry out food crop production in the informal sector. The sector is characterized by less abundant land and labour for cultivation. Paddy crop occupies almost 80 percent of the cultivated field crop extent (about 820,000 ha of land). Other field crops primarily constitute a subsidiary food crop sector, mainly comprised of chili, onion, potato, traditional subsistence crops and vegetables cultivated in the highlands and in the lowlands during the dry season. Two different farming systems, namely up country and low country constitute the vegetable sector, primarily for domestic consumption. The fruit crop sector is comprised of perennial crops that are cultivated mainly as intercrops or mixed crops. Currently, the fruit sector occupies about 150,000 ha.

Evidence of the regional country analysis proved that sustainable agricultural growth can only be achieved through increased productivity in the long run, as resources are becoming scarce for production. There are limitations when further increasing land for agriculture, labour is moving out of agriculture, and the cost of capital is increasing. Hence, increasing agricultural output growth can only be achieved through increased Total Factor Productivity (TFP), the amount of output per unit of total factors used in the production process and more efficient use of resources becomes increasingly important as the country begins to face resource constraints in terms of land, labor, and capital.

2.The Study – Approach

The Agriculture Sector Modernization Project implemented by the Ministry of Agriculture, with the objectives of increasing the productivity of smallholder farmers and enhancing commercialization in the food crop sector of Sri Lanka, commissioned a policy research study to identify knowledge gaps, policy and regulatory inconsistencies for the allocation of public agriculture expenditures to improve agriculture productivity and to recommend adjustments, reforms, or new policies needed to make the agriculture sector more competitive, responsive to the market demands, sustainable and resilient.

The study has initiated with the research hypothesis, that the limitations of further increasing land for cultivation coinciding with the labour moving out of agriculture and rising cost of capital, poses the challenges for increasing output growth in the domestic food crop sector. Increasing productivity of inputs is the only option left for achieving output growth.

Output growth of ten crop sectors, over the period from 1990 to 2018, was decomposed into growth due to input growth and Total Factor Productivity (TFP) growth (growth of efficiency of input)

and further decomposed into land expansion growth and growth of factor intensification on land. TFP measures how efficiently agricultural land, labor, capital, and materials (agricultural inputs) are used to produce agricultural output - determinants of productivity growth

Further, the study estimated agricultural growth trends and total and partial factor productivities of key agricultural sub-sectors in Sri Lanka and decomposed the agricultural growth into its sources of agricultural growth to assess the effects of public investments, such as research, extension, rural roads, irrigation, insurance, finance among others on productivity of selected agricultural sub-sectors with a comparison of regional countries.

A policy review including both economy-wide policies and the agriculture sector policies has been undertaken covering the period after the economic liberalization since 1977.

Based on the determinants of productivity growth and the findings of the policy review, the study proposes the required changes in policies and the changes required in prioritizing government expenditure allocations and essential changes in regulations as recommendations.

3.Results of the empirical analysis

Agricultural Productivity Growth

Total Factor Productivity (TFP) – that measures how efficiently agricultural land, labour, capital, and materials (agricultural inputs) are used to produce agricultural output.

Partial Factor Productivity (PFP) : Partial productivity of input (land , labour or capital) indicates that the change of production occurs, in relation to change of each input. (Land Productivity, Labour Productivity etc..)

Total Factor Productivity Growth: that, measures the portion of real output growth not explained by the growth of aggregate inputs used in production.

Analyzing the trend of partial factor productivities; labour and land productivity in agriculture helps to understand the relative endowments of land and labour as well as the possible technologies in relation to labour and land saving technologies for TFP growth.

The study estimated agricultural growth trends and total and partial factor productivity growth of key agricultural sub-sectors namely;

Import-substituting food crop sector and the
export-promoting fruit crop sector

3.1 Findings of Import Substitution Crop Sector

Crops studied in this category are Rice/Paddy, Maize, Other Field Crops namely - Chili, Big Onion, Soybean and Potato. (Time series data of 1990 – 2017 has been used)

Rice/Paddy sub sector

- Paddy (rice), comprises the biggest share in the agricultural GDP (nearly 10%).
- Increasing production over the last few decades brought the country near self-sufficiency (> 90%) in rice and more than 70 % of self-sufficiency in cereal. Owing to the increased cultivated area, especially the proportionately increasing cultivable area under irrigation with new improved high yielding varieties and fertiliser, a continuous growth of the paddy sector has been achieved.
- Average paddy yield increased from 2.5 mt/ha to 4.5 mt/ha, nearly 1.2% growth during maha and 0.9% growth during yala seasons, from 1979 to 2016.
- Sri Lanka has achieved a comparable productivity growth within the region
- Mechanization and increases in land productivity have brought higher labour productivity growth in the sector.
- From 1990 – 2017, Labour use in paddy production per ha has been reduced from 140 to about 40 man-days.
- Total Factor Productivity in the paddy sector shows a stable growth of 1.56% per annum after 1996, except in bad weathered years, eg, 2011, 2016 floods.
- Extension, education and special technology packages introduced by the DOA, including improved varieties released by the DOA and the quality seed supply by the registered seed producers, have contributed to the TFP growth in the paddy sub sector.

Maize

- Demand for maize seed substantially increased as a result of the poultry industry development, with upsurge of private sector participation.
- Imports continued to meet the domestic requirement as import of maize were under liberal trade regime.
- Introduction of maize hybrid seeds (imported) in 1998 by the Ceylon Agro Industries and the Forward Sale Contract (FSC) program introduced in 1999 by the Rural Development Department of Central Bank, farmers were supported by the purchasing companies with a package including high quality seeds, fertilizer, farming advice and importantly, a buy back guarantee for the crop.

- In 2005 a cess was imposed on maize import, to support the local production. During 2009, import tax on maize was increased and later, importation was restricted since March 2009 to protect local producers.
- Land productivity of Maize has increased from 1000 kg/ha to nearly 4000 kg/ha in the last 18 years registering nearly 8 per cent growth of national average yield. Sri Lankan maize yield is now comparable with the maize yield of countries in the region except Bangladesh, as Bangladesh has achieved an unprecedent growth in maize yield.
- Maize, the second important cereal crop in Sri Lanka in terms of cultivation extent and production by now brought institutional innovation in agriculture that extent cultivation expanded from 23,000 ha in 2005 to 70,000 ha 2017 through contract grower system. Assured market, imported hybrid varieties, organized input supply and extension are key components of this innovation. Maize has a growing derived demand in the feed industry and processed food industry.
- The cultivation has now spread in the entire dry zone districts; Badulla, Ampara, Monaragala, Anuradhapura, Kurunegala
- Labour use in maize cultivation gradually declined as with land preparation and threshing being mechanized over the years, as a result labour productivity has increased.
- Highest TFP growth of nearly 14% was observed as result of the technology package including hybrid seeds, contract farming system, and the forward sales contract.

Chilli

- Chili cultivation in Sri Lanka was encouraged as an import replacement crop in 1970's however, with the fully economic liberalization of chili import in 1994, annual chili demand was mostly met with imports.
- In 2016, the country imported 51,040 tons of chilli amounting to 92 million US Dollars from India.
- Sri Lanka national average yield of chilli is comparable with the regional producers. With the introduction of improved Chili varieties MI 1 & MI, Chili production has significantly increased and 12 % TFP growth p.a. achieved during 2010 to 2015.
- The most recent government intervention program to develop the chilli sector, that chili is one crop considered under the National food production programme 2016 – 2018, with the objectives of reducing dry chilli import and to become self-sufficient in green chili.
- Although the chili hybrid program in Sri Lanka was delayed, the hybrid varieties developed by FCRDI of DOA are superior to many exotic hybrid varieties. The price of imported hybrid seeds is very high, and most of the exotic chili hybrids are highly susceptible to major pests and diseases and show less adaptability under local conditions.
- F 1 seed production program of local hybrids should be given priority in the research agenda of DOA.

Potato

- Sri Lanka's land productivity and labour productivity of potato are very low compared to India and Bangladesh. Labour productivity of Indian potato farming is more than twice the Sri Lankan labour productivity.
- Although the DOA has recommended few varieties Granola, Hillstar, Desiree, Sante, raja, Kondor, Isna, farmer's adoption is mostly the variety Granola.
- In 1997, DOA started the government rapid multiplication program using tissue culture technology and it started to make an impact on the seed potato supply.
- Under this program, 4th to 5th generation seeds are marketed by the DOA farms as certified seeds for commercial cultivation.
- Countries in the region like India and Bangladesh have advanced breeding programs and have released new improved OPV, hybrid varieties using advanced Bio technology for commercial cultivation with the support of private sector and international agencies.
- Seed potato imports were liberalized in 1989 and Seed imported by the private sector entered into the market in large quantities and farmers started to mainly dependent on seed potato imported from Europe for cultivation
- The use of input in the potato farming is declining at a rate of -0.005 p.a. while TFP growth is reporting 1.3% per annum.
- Government policy towards this sector varied significantly over the years due to number of reasons including government fiscal policy and pressure from different groups.
- Tariff and non-tariff measurements are the main policy instruments of the government which determine the potato production in the country. Production decisions, management of the crop and importantly seed production program are affected by the trade policy on edible potato.

Soybean

- Cultivation of soybean is a relatively new to Sri Lanka but has a good potential to promote as a commercial crop in the country.
- Soybean yield shows a clear shift after 2002, as private sector engaged with farmers on contract basis, since soybean has a derived demand in the processed food industry in Sri Lanka and open market sales are risky.
- This assured marketing for farmers produces, the input supply and extension caused to better adoption of good management practices by farmers.
- These technology embodied inputs and the use of good quality seeds for planting are contributory factors for increased TFP with the private sector coming into venturing in soybean production Sri Lankan yields are comparable with India nevertheless the labour productivity is low in spite of tillage and threshing is 100% mechanized.
- The negative TFP growth experiencing before 2002 was changed with the intervention by private sector. Based on TFP index values it shows that TFP growth after 2010 is more or less stagnating.

- The closest reason for this is the cultivation of one variety for 40 years. PB 1 is the mostly grown variety as a promising variety which is the first exotic variety introduced to the country. Although the extension gap has been filled by realizing the potential best farmer yields with contract grower system, research gap and science gap are needed to be filled.

Big Onion

- Big onion (Allium cpa Var. Cepa of family Alliaceae) cultivation was started as a cash crop in the 1980s' in paddy fields during the yala season.
- Big onion is a highly seasonal crop, the main domestic big onion supply from yala season arrive the market from August to October which meets only 25 - 30% of the national demand, the balance was imported to the country.
- Big onion cultivation in the country is primarily determined by the import policy of the government and the trade barriers in exporting countries.
- Until mid-1996, government adopted a trade restrictive policy for the imports of big onion which involved import licensing requirement and high import tariff, but there after Government policy has been inconsistent.
- National average yield of big onion was 9 mt/ha before 1998 and it has increased up to13.8 mt/ha by the year 1999, which is comparable with the productivity of India. However, Labour productivity of big onion in India is much higher.
- A TFP growth of 4.5 p.a. was observed after big onion farming brought under protection after 1998.
- A closer look at TFP growth shows that the TFP growth achievement owing to the adoption of Dambulu Red variety, a selection of Pusa Red variety and the use of true seed for cultivation.

3.2 Findings of Export Promotion fruit crop sector

- Farm survey data has been used from Sample of 100 farmers interviewed from different crop sectors in the study are given as; Pineapple - Gampaha district, Banana - Rathnapura, Hambantota and Monaragala districts, Papaya - Kurunegala and Vavuniya districts, Passionfruit - 40 farmers from Kalutara district.
- Export promotion strategy that has been adopted for fruit crops can benefit from tropical fruit demand in the world and the tariff regime for imports in those countries.
- Out of the main fruit crops focused in this study, pineapple, banana and papaya are exported to main destination market with 0% tariff. Fewer restrictions on sanitary and phytosanitary requirements are the other advantages in the importing destinations.
- Increasing physical productivity alone does not guarantee the exploitation of the increased share of the market.

- In the export market, quality is an important parameter. Size, appearance, taste are some of the important quality parameters that are specific to these fruit crops.
- Recent exploitation of the export market of banana and papaya is due to the new varieties introduced to the country. Cavendish and Red Lady varieties are preferred in the banana and papaya export markets. These two exotic varieties have yields higher than the local varieties. More value-added pineapple exports are picking up the market.

Specific details of each fruit sector are discussed below.

Pineapple:

- Despite being Sri Lanka a small producer with less than 1% of the world production, Sri Lankan pineapple has a high demand in the world market. Mauritius variety grown in Sri Lanka, is one of the tastiest pineapple varieties fetching high price in the world market.
- Export of fresh pineapple was significantly determined by the average exchange rate and the domestic price of pineapple. High price difference between FOB and wholesale price in 2018 shows that new markets in EU and USA are appealing to exporters although finding exportable quality pineapples in sufficient quantities is a problem.
- Fresh pineapple exports have increased up to 2004 by volume and have decreased sharply until 2012. During this period Sri Lankan main export destination has shifted from Maldives to Germany with a high value export.
- Pineapple growers sell their harvest to collectors and collectors are the main contact person for information and technology
- Sri Lankan pineapple yield is very low, although its distinct taste has captured high price in the international market.
- The Sri Lankan yield is stagnating and declining while other countries' yields are increasing. Pineapple yield in Thailand and Philippine is 3 to 5 times higher than Sri Lankan yield where multinational companies grow pineapple as mono crop plantations.
- Econometric Analysis done using farmer survey data to assess the production, has shown that increasing land under cultivation by a unit, gives 98% increase in the production. Increase the use of weedicides and labor has shown positive effect on production but change of any other input has not shown any significant effect.
- The gap between average farm yield and best practice farmers yield is less for pineapple. It is only Mauritius and Kiwi varieties are being cultivated in Sri Lanka and most farmers in main producing areas in Gampaha are cultivating variety Mauritius and are getting an average yield of 11.7 Mt/ha. However there exists higher variability of factor productivity compared to land productivity.
- Farmers have started planting pineapples in high density in double and triple rows 5000- 7500 suckers per ac and the DOA now recommend 10,000 suckers per ac.
- FCRDC of DOA has developed new varieties with leaves having no thorns to ease the management of the crop between plants and allow cultivation with a reduced spacing more practical. However, the availability of such varieties is unknown to many growers.

- The requirement of fruits for freight is the size of the fruit to be between 1-1.25 Kg and no bigger. By having more plants per acre, the size of the fruit gets smaller
- Production efficiency analysis has shown farmers in Gampaha district operate with 53% technical efficiency and there is a 47% of possibility to improve in efficiency with the given inputs and technology.

Banana:

- Banana {Musa spp.) is the most widely cultivated and consumed fruit in Sri Lanka and also the most popular fruit globally. It covers nearly 55% of fruit cultivation area in Sri Lanka.
- Currently, nearly 45,000 ha (20,000 ha in wet zone and 25,000 ha in dry + intermediate zones respectively) of land is under banana cultivation in Sri Lanka. Annual banana production is around 674,000 mt and average yield is 11.5 mt/ha.
- Out of the total production only around 5 percent is exported. Exports grew sharply after cultivation began in Sri Lanka by a giant global partner in world trade, entered into an investment agreement under BOI.
- Expansion of Cavendish cultivation in Sri Lanka is as a result of technology transfer through this foreign direct investment program, a new variety, tissue culture technology for planting material production, new management practices, technology and protocols for quality and standards maintenance, and post-harvest operations were brought.
- Operation of large-scale banana cultivations by multi-national companies is subject to serious challenges from the environmental front.
- The second stage of transferring the new technology happened as a result of the agreement CIC had with Dole Lanka. CIC started Cavendish cultivation in their farms and with contract growers establishing a processing unit for post-harvest preparation. Cavendish suckers are produced in the CIC tissue culture labs.
- This technology is further disseminated through DOA intervention to the farmers in small scale. However, the export market share of Dole is many times higher than the CIC for Cavendish grown in Sri Lanka.
- When banana farming is considered, the variability of land productivity and factor productivity are less among Embul farmers compared to Seeni and Kolikutu farmers. Kolikuttu farmers have the highest variability in yield. Variability in Kolikuttu yield is mainly due to its susceptibility to diseases.

Papaya

- At present the extent of papaya cultivation is 6178 ha (2018). Papaya extent has increased from 3000 ha in 2001 to 8080 ha in 2010 which dropped again after 2010 (Figure 4.82). Kurunegala district is the highest producer in the country by 2018. Cultivation in the wet

zone districts has gone down. Hambanthota, Anuradapura and Gampah, districts cultivated more than 370 ha.

- Contract grower system is also common among papaya export farmers, as that private sector exporters have their contract growers for production.
- There are lots of new entrants to papaya farming and passion fruit farming who are either introduced by specific development programs of the government or NGO's or private sector.
- Papaya has a good demand for local as well as export markets.
- papaya had been exported to Germany, Bangladesh, Bahrain and Maldives in small quantities. The fruit is used as fresh fruit as well as for other processed products. Exporting papaya shows an increasing trend with the introduction of new improved exotic varieties, particularly "Red Lady" which has a veryhigh demand in the international market.
- Papaya exports show a continuous increase after 2013 bringing in some 3.5 million dollars to the country by exporting 5,072 mt of fresh papaya. UAE is the main destination of papaya exports (Figure 4.86 and figure 4.87).
- Land and Labour productivity in Sri Lanka is very much lower to India and only higher than the productivity of Bangladesh.
- Results of the regression analysis of farmer survey data has showed the main socio-economic factors, age and education are somewhat significant. Although majority farmers are above 40 years of age, most of them are new to papaya farming.
- All sample farmers use supplementary irrigation during drought periods. Previous studies have shown that papaya cultivation under micro-irrigation has higher economic viability and adopting micro irrigation technology by papaya farmers can increase productivity and profitability.
- Having the district variable significant it shows that Jaffna farmers have used resources efficiently. Land size is a significant factor. In the sample, 57% of farmers are cultivating less than 1 Ac. In order to increase the efficiency of production at least more than one acre of cultivation is advisable.
- Factor productivity of papaya farming in Vavuniya is more than double the factor productivity of Kurunegala farmers due to yield difference. The high variability of papaya farming in the producing areas shows the information gap among farmers on technical knowledge. Huge extension gap exist among papaya farmers as many of them are new entrants to papaya farming. Accessibility to information and markets is important.

Passionfruit:

- Most farmers interviewed are new entrants to the cultivation
- NGOs have promoted passion fruit cultivation as an additional income support

- Planting density varies around 400 plants per acre, – Harvesting quantity varies around 150 kg/ 200 kg per week, Harvesting begins 6 months after planting and can have the crop for about 4-5 years.
- Farmers had followed the recommendations of the DOA since most cultivation had guided by the support of the extension officer.
- Productivity related factors;
    - Better Management Practices - Management practices like pruning and trellising of vines increase the yield of the crop.
    - Better Varieties – Horana Gold, virus-free passion fruits variety, released by the FCRDC, in 2017, is getting popular presently as some early varieties like Mahaweli, failed due to less yield capacity. Extension agents promote growers to produce and maintain the stock of "Horana Gold" seeds through hand pollination.
    - Financial Assistance – New passion fruit cultivations introduced in some instances has happened as a donor-assisted partnership, outgrowing, and buyback programs. The donor agencies tend to offer microfinance assistance for the passion fruit growers
    - Partnerships and Buy-back Programs – Passion fruit that are cultivated as a partnership program or under buyback programs, stakeholders in those programs supply facilitates like; technical training, extension services and assists with selected inputs such as micro irrigation systems and water pumps to manage water as well as other equipment required for passion fruit cultivation (Pruning tools). In buyback programs, the particular company buys the harvest from the grower. Presently, Cargills Ceylon PLC, and Lanka Canneries (Pvt) Ltd operate as collectors.
    - Output price – farmers tend to use better management practices when the prices are attractive. However, there is high price volatility in the market. Passion fruit cultivation is profitable when the price fluctuates between, Rs. 60.00 and Rs. 120.00.
    - Shift in area of cultivation from the wet zone in 2002 to more in the dry zone in 2018.

- Factor/resource use efficiency gaps existing among farmers provide useful information on the prevailing gaps of farmers' level of technical knowledge (several agronomic practices in crop establishment), socioeconomic status (education, tenure, and nonfarm income) and accessibility to information and markets. The efficiency gaps of factor/resource use among farmers who are cultivating fruit crops are to be concerned.

4 Policy Effects on Agricultural Productivity

4.1 Economy-wide Policies

The present era in the economic history of Sri Lanka began with the liberalization of the Economy in 1977. Although numerous changes were effected over time thereafter in the areas of macroeconomic and trade policies, only the following major policy scenarios, listed in chronological order, were discussed in this study, particularly concerning their effects on the agricultural sector of Sri Lanka.

1977 - Liberalization of the economy
1984 - Second wave of liberalization
1987 - Structural adjustment policy
1988 - Devolution of power to provincial councils
1990 - Nationwide poverty alleviation program –"Jansaviya" program
1977 to 1990s - Export led growth and diversification
1995 - Ratifying WTO Uruguay round on agriculture
2000 onwards - Ratifying regional trade agreements

Liberalization of the economy in 1977

- The major changes effected by this new policy regime were in the macroeconomic and trade sectors and agriculture was not a direct target area. However, the changes in the overall economic policy had significant effects on the performance of the agricultural sector as well as the sector policies that shaped the future path of agricultural development in Sri Lanka.
  - Accelerated Mahaweli River Diversion and Farmer Settlement project was another prominent feature of this period, which had a direct positive impact on agricultural production and rural Employment.
  - Liberalization of the imports of food products had a negative impact on agricultural production and farm income due to depressed farm prices of locally produced food crops.

- However, the overall short-term economic impact of liberalization (from 1977 to 1980) has been reported to be positive. GDP growth doubled from 3 percent to 6 percent between 1977 and 1980.

Devolution of power to provincial councils -1988

- This is another nationwide change that had far-reaching implications on the agricultural sector, by the devolution of some centralized administrative powers of the central government among nine newly formed provincial councils.

- Agricultural administration and the agricultural extension service fell among the devolved functions. This proved to be a definitive policy change that affected agricultural production and productivity in the country.

- Although the Ministry of Agriculture, responsible for overall planning for the agricultural sector of the country and providing some directions to the provinces remained at the center, the main responsible department under the ministry, the Department of Agriculture (DOA), was partially devolved.

Outcome of the Devolution of Functions of the DOA

Prior to Devolution: A monolithic agricultural development program conducted and administered by the DOA

- The DOA consisted of 6 technical divisions namely:
  Research Division (RD),
  Extension division (ED),
  Education and Training division (E&TD),
  Seeds and Planting Material division (SPMD),
  Seed Certification and Plant Protection division (SC&PPD) and Agricultural Economics and Planning division (AE&PD).

- The RD developed new crop varieties and new agricultural technologies and passed them to the training staff of the E&TD as well as the extension workers in the ED through the regular in-service training program conducted by the E&TD as well as through the Regional Technical Working Group (RTWG) meetings held seasonally. - technological flow from the researchers to the extension officers,
- A reverse flow of information from the extension officers on technical problems encountered in the field, to the research community.

After Devolution:

- ED, E&TD and AE& PD divisions were devolved to the provinces while RD, SPMD and SC&PPD were retained in the DOA of the central government. (AE&PD was later reverted to the central DOA).
- As a result, abovementioned two-way information flow and the research-extension rapport completely broke down.
- Although the RTWGs were replaced by Provincial Technical Working Group meetings, the intended results were not realized because the research personnel and the extension personnel belonged to two different administrations, central government and provincial governments respectively, with different agendas,

When the DOA had all the functions under one umbrella driving countrywide or region-wide agricultural programs were technically and administratively feasible to a great extent.

- Breeding new improved rice varieties, producing high quality seeds of those varieties, popularizing them and realizing a near hundred percent adoption and doubling county's rice production within 15 years (from 1968 to 1983) is a concrete example vouching for this.

Due to the divergence of interests and priorities between the center and the provinces, such achievements have now become all but impossible. This is a problem that the political system has apparently failed to overcome.

1990 -Nationwide poverty alleviation program

- "Janasaviya" (People's Power) poverty alleviation program was launched in 1990.
- The Grama Niladhari (GN) division, was to monitor this program and expansion of the GN carder by about 5000 additional carders was required. The government was to immediately absorb about 2000 village-level agricultural extension workers (Krushikarma Vyapthi Sevakas) or the KVSs, of the DOA and a little higher a number of Cultivation Officers (CO) employed by the Department of Agrarian Services (DAS) into the GN carder.

- As a result entire village-level agriculture extension program was disrupted and it was a significant blow to the agricultural development efforts of the country.

1977 to 1990s - Export led growth and diversification program

- Diversification within agriculture first stated in late1970s with the drive of the Ministry of Agriculture that encouraged farmers producing traditional crops to switch into non-traditional crops such as cut flowers. This program also established specialized "export crop villages"

- However, the DOA, in spite of being the main agricultural research and extension arm of the government did not apparently put a concerted effort in the areas of crop diversification and agricultural export promotion.

- The Department of Minor Export Crops (presently the Department of Export Agriculture) from its beginning has made a significant contribution of promoting quality spices for both local and export markets but Sri Lanka has not been a big player in the world spice market, except for cinnamon.

- The Export Development Board (EDB) of Sri Lanka, on the other hand is actively engaged in finding new markets for Sri Lankan agricultural products and providing information and advice to the current and prospective exporters of agricultural products.

- Despite the efforts, crop diversification, neither for export nor for domestic market, have held foot among Sri Lankan small farmers. Some medium scale farmers and large corporate organizations have adopted the concept of diversification aiming at foreign markets producing cut flower and foliage, some exotic fruits such as Cantaloupe and vegetables such as Gherkin are good examples. The extent and spread of such enterprises are not adequate to help Sri Lanka to achieve the coveted goal of export led growth. May be the recent advent of large irrigated farms producing local fruits like mango and a possible expansion of pineapple and newly introduced dragon fruit would be able to drive the country in this direction.

2000 onwards -Ratifying regional trade agreements

Starting from 2000 Sri Lanka has ratified two bilateral trade agreements and three multilateral trade agreements, mainly but not exclusively, within South Asia. The bilateral agreements are Indo-Sri Lanka Free Trade Agreement (ISFTA) of 2000 and Pakistan-Sri Lanka Free Trade Agreement

(PSFTA) of 2006 while the multilateral agreements are the agreement on Global System of Tariff Preference (GSTP) of 1988, Asia Pacific Trade Agreement (APTA) of 2005 (previously Bangkok Agreement of 1975) and South Asia Free Trade Agreement (SAFTA) of 2006. Further, Sri Lanka is in the process of negotiating a China-Sri Lanka Free Trade Agreement and a SAARC Agreement on Trade in Services (Ministry of Foreign Affairs, 2016).

Sri Lankan agriculture doesn't seem to have derived the aforesaid kind of benefits out of these agreements to a satisfactory degree.

4.2Agriculture Sector Policies

A review of Agriculture sector policies found in most instances government policies are not well formulated with a set of objectives, instruments, and implementation strategies.

However, all governments have given priority to developing irrigation infrastructure for dry zone. The priority received for research and development, quality seed production and quality seed import, extension, technology transfer, mechanization, efficient fertilizer use, and other supportive services for risk management, credit facilities etc was mostly in line with the broad policy framework of the government but subsequent political regimes have adopted broadly a different approach to implementing various sector policies and programs.
Although, the Irrigation and fertiliser policy aimed to achieve the agriculture growth through factor accumulation but bringing new technology and innovations to farm are more vital in increasing land productivity through increasing total factor productivity.

Agriculture sector policy reviews in the domestic food crop sector has focused on the following order:

Research & Science Policy,
Extension policy,
Policies related to agriculture inputs mainly water and fertiliser
Seed policy
Policies favoring mechanization
Development of rural road infrastructure and
Policies on credit, finance and insurance are reviewed.

i)Science and Agricultural Research Policy

- Agricultural research has initiated in Sri Lanka in 1822 at the Royal Botanic Garden at Peradeniya and Since then the DOA's research service has grown into a network of 18 research institutes and centers spread around the country.

- The private sector does not venture into agricultural research, the products of which are quite often of public good or common property nature.
- DOA had been the driving force behind the food crops sector research in Sri Lanka with the annual budgetary allocations directly from the Treasury.
- The Council for Agricultural Research Policy was set up in 1987 with a view to regulate, fund and monitor research activities in the entire agricultural sector of Sri Lanka.
- SLCARP has under its purview the allocation of funds, monitoring and evaluation of research programs of 13 research institutes. To perform all the above SLCARP has limited staff which seems thoroughly inadequate.
- The total funding allocated by National Agriculture Research Program (NARP) for research on food crops in Sri Lanka is thoroughly inadequate for the task at hand.

Direct disbursement of research funds, with or without the prior approval from SLCARP, from the treasury was the major modality of providing funds to the research institutes of the DOA right throughout in the past.

- The World Bank policy document "Reviving Sri Lanka's Agricultural Research and Extension System; Towards More Innovation and Market Orientation" by the World Bank, Colombo (2007) observes that agricultural research in Sri Lanka has grown very slowly-slower than the growth of agriculture itself.
- They attribute the slow growth to the organization of agricultural research, may be the policies behind rather than to the very low public investment in it.
    1. Research (and extension) in Sri Lanka is supply driven and Top- Down in its approach to the farmers.
    2. It does not respond to the research demands of the users of technology and does not secure the participation of the private sector in designing research projects and programs.

    (Bottom-up research planning existed in the DOA in the form of an Regional Technical Working Group (RTWG) system, but this system disappeared after the disintegration of the DOA extension system.)

- The World Bank report proposes four wide-ranging changes to Sri Lanka's Agricultural Research Policy and Related Institutional Setup.

(i) Recognizing the ineffectiveness and inadequacy of SLCARP as the country's apex agricultural research policy organization it is proposed that SLCARP be elevated to a new apex body- the

National Agricultural Innovation Council (NAIC), which is to be chaired by the President of the country, following the model of the Council of Scientific and Industrial Research in India.

(ii) The national agricultural policy is proposed to be formed as 8 to 10 Mission Oriented (or Mission Mode) programs focusing primarily on economic accomplishments such as "the development of dairy industry to reduce dairy imports to less than 40 percent of domestic consumption". The implementation of the national innovation program will be assigned to a consortium representing the major stakeholders around the topic, involving the private sector, universities, farmer organizations, research and extension, and other government agencies.

(iii) It is proposed to form "Provincial Agricultural Innovation Councils" (PIACs) in each province with direct links to the NAIC. They are to focus on 'strategic development initiatives at the provincial level'. This proposition is made following the success observed in district-based "Agricultural Technology Management Agencies" (ATMAs) of India. But in the provinces in Sri Lanka, unlike the 'districts' in India, do not have enough trained manpower, particularly in agricultural research. Thus, the success of ATMAs in India may not be replicated in PAICs in Sri Lanka.

(iv)The concept of private sector participation. The NAIC, most certainly based in Colombo, may be able to secure some private sector participation and the participants would be a couple of large corporations, several firms involved in seed and planting material imports, and some medium and small-scale agri-business entrepreneurs, focus on Market Oriented Innovations.

Agriculture Extension Policy

- Agricultural extension service is the vehicle that carries agricultural technology developed in the research institutes all the way to its final users, mainly the small farmers
- The first formal institution of agricultural education in Sri Lanka was set up in 1916, the School of Agriculture under the DOA at Peradeniya, which offered a two-year diploma for those who were recruited as Agricultural Instructors for extension work of DOA and a one-year certificate course for teachers and Village Headmen.
- The DOA appointed a Deputy Director of Agricultural Extension along with the establishment of an exclusive Division of Agricultural Extension (DAE) in 1964. District Agricultural Offices, headed by District Agricultural Extension Officers (DAEOs) were established in each of the 22 administrative districts of the country. The district offices at the time had 6 to 17 Agricultural Instructors (AIs) and 20 to Krushikarma Vyapthi Sevekas (KVSs) depending on the size and the farmer population of the respective districts. This development is the beginning of an exclusive division dedicated to agricultural extension service in the DOA.
- The extension service at this time was centered on individual and group meetings conducted by the KVSs at farming villages, under the supervision of AIs.

- Training and Visiting (T&V) system was adopted as the basic method of extension at farm level.
- In order to fulfill the field requirement, KVSs cadre was expanded to over 2000.
- Downfall of the Extension service started with the two political events and their implications on agricultural extension in Sri Lanka was already discussed.

1) In 1987 'devolution of power' of the central government of Sri Lanka to newly established "Provincial Councils" in the nine provinces of the country, Agricultural extension was devolved to be administered by the Provincial Councils while keeping the Agricultural research identified as a non-devolved function and therefore held with the Central government. (already discussed under section 4.1)
Extension functions in the "Inter-Provincial Areas" were retained with the Central government and managed by the newly formed "Extension and Training Center" (ETC) under the DOA. In addition, the "Mahaweli Authority of Sri Lanka" (MASL) which was solely responsible for extension in the productive settlements under the Mahaweli River Diversion Scheme.
As a result, personal-contact based agricultural extension system of Sri Lanka was broken-down. The segregation of the extension system from the research system demolished the research-extension link operating through RTWG mechanism.

2. The second major blow to the agricultural extension service of Sri Lanka was, as pointed out earlier, the transfer of the entire KVS carder engaged in field level extension to Janasaviya program, an activity totally outside agriculture. That was the end of agricultural extension based on individual contact modality in Sri Lanka.

- Later a new Ministry namely the "Ministry of Agrarian Services and Development" (MAS) established and the Department of Agrarian Services was renamed as the "Department of Agrarian Services and Development" (DASD) mainly to provide subsidies and other services to the farmers, with a new permanent carder of 9600 village level agents, designated as "Agricultural Research and Development Assistants" (ARDAs). They are supposed to devote three days per week to agricultural extension activities even they were not given any post-recruitment education or in-service training in agriculture.
- After these changes effected in agriculture in general and in agricultural extension in particular, some new trends could be observed emerging in DOA extension programs through spread of Information and Communication Technology (ICT). As a result, DOA established the "National Agricultural Information and Communication Center" (NAICC) headed by a director, in 2007. New extension initiatives have been set up under the Center and the designing and popularization of Agricultural Extension Apps for speedy dissemination of extension information is a prominent one.
- However, technology dissemination task at the grass root level, is still not satisfactorily

Completed. Popular criticisms on it, are the agricultural extension services in Sri Lanka is supply driven and limitedly focused on farmers' needs and aspirations and also the public extension service in Sri Lanka is crop wise institutionalized or compartmentalized.

- Within this setup, a new institutional arrangement for an extension system that suits integrated small farming systems including fruits and vegetables stands out as a policy priority in Sri Lankan agriculture.
- WB document proposes group extension based on organized "Producer Groups" of farmers as an extension modality with great potential in Sri Lanka.

Irrigation Policy

Through irrigation development it is expected to expand the cultivable area, to increase cropping intensity (both maha and yala cultivation) and to increase the quality of land. Construction of large reservoirs received attention of all governments.

The public investment program allocated about 13 % of its investment for irrigation infrastructure development during pre-Mahaweli period while it rose to more than 30% during Mahaweli construction.

Of the total irrigated area, about 400,000 ha are under major schemes which are considered more than 80 ha of command area. Of that 3/4 th of the area is administered by the Irrigation Department and ¼ th is by the Mahaweli Authority. About 200,000 hectares of irrigated land under minor schemes (below 80 ha) is administered by the Department of Agrarian Services and it is estimated that minor schemes may number over 15,000, of which only half are operational

Currently there is no policy on water allocation from major water courses or water bodies for various purposes. The government through the Cabinet of Ministers decide on water allocation for various purposes on a situation-by-situation basis or when an issue arises with respect to water allocation. The situation is really critical during the years with less rainfall.

In major and minor schemes alike, farmers use pump water mostly for irrigating other food crops (OFCs). Besides lifting groundwater, farmers use pumps for lifting water from rivers, canals or tanks (dead storage in particular) to irrigate their crops.

Since 1989, the government has been making major efforts to promote lined dug-wells in both major and minor irrigation schemes in the dry zone through extending a subsidy to farmers.

iv) Fertilizer Policy in Sri Lanka

- As a result of the green revolution, in 1957, high yielding paddy varieties were introduced to Sri Lankan Paddy farmers. These varieties were responsive to chemical fertilizer and a need

arose to promote chemical fertilizers use for high yielding varieties by Sri Lankan paddy farmers.

- Fertilizer policy was introduced in 1962 with the aim to provide subsidies for fertilizer, guaranteed price for the output (paddy), improve the availability of fertilizer and awareness of fertilizer use among farmers through extension.
- In 1964, government entered into fertilizer trade establishing Ceylon Fertilizer Corporation.
- By 1975, the subsidy policy was extended to other food crops in an effort to increase the fertilizer use efficiency in paddy sector.
- After liberalization of the economy in 1977 private sector entered into fertilizer trade 7 suppliers handled 40% of the trade volume.
- Fertilizer subsidy policy was handled by the treasury up until 1978 and thereafter National Fertilizer Secretariat (NFS) was given the authority to administer the subsidy scheme.
- Fertilizer subsidy was implemented either as at a fixed subsidy rate or as at a fixed price rate and the farmers to pay the balance according to imported price.
- A decision was taken to abolish the subsidy scheme since 1st January 1990 and in 1994, the fertilizer subsidy scheme was reintroduced considering the soaring Urea prices. A fixed price rate was given for urea, SA, MOP and TSP.
- In 1996, the subsidy on SA was abolished and since 1997, the subsidy was offered only for urea. From 1998 to 2003, a 50kg bag of urea was given at.350 LKR.
- With the new fertiliser subsidy2005, farmers were given the three main fertilisers at 350 Rs per 50 kg which is the lowest price recorded for all three fertilisers after withdrawal of the subsidy in 1990.
- In 2016, fertiliser subsidy scheme was revised with the provision of a cash grant in place of the provision of fertiliser. The government converted the fertiliser subsidy to an allowance of Rs. 25,000 per hectare up to a maximum of two hectares per paddy farmer per annum in place of the provision of a 50 kg bag of fertiliser at Rs. 350. Further, the government extended the fertiliser subsidy for tea, coconut and rubber as well in 2016 under which a cash grant of Rs. 15,000, Rs. 9,000 and Rs. 5,000, respectively was provided per hectare per annum. Other field crops (potato, onion, chili, soy bean and maize) received 10,000 LKR/Ha/Year. Cash grants were executed through state banks. Those were People's bank, Bank of Ceylon, National Savings Bank and Regional Development Bank.
- In 2018 a decision was taken by the Cabinet of Ministers, to revert the cash grant into fertilizer provision and approved amount of fertiliser was provided to farmers at a concessionary price of Rs. 500 per 50 kg bag for paddy and Rs. 1,500 per 50 kg bag in respect of other crops.
- In 2020, cabinet released approval for issuing fertilizer free of charge for paddy farmers who possess minimum of 2 ha of lands. Urea and super phosphate were approved under this scheme until the banned on chemical fertilizer import in May 2021. However the policy was reverted back in November 2021 after many controversies.

v) National Seed Policy

- The first formal arrangement of the seed sector was reported with the establishment of the Department of Agriculture (DOA) in 1912, as DOA was assigned the responsibility of producing seeds and planting materials of major food crops.
- By the 1950s, hybrid seeds for the paddy sector were introduced.
- In the 1960s, in response to the green revolution polices, research and development in high-yielding varieties was encouraged by the Sri Lankan government.
- By 1972, nearly 71 percent of the farmers were adopting high yielding varieties.
- After 1977, agricultural policy continued to evolve broadly in the direction of gradual government withdrawal from the production of seeds and was directed towards opening up the other field crops sector to trickle down the development of the seed technology in the rest of the world through imports. Promotion of private sector and farmers in seed production, facilitation of safe import of quality materials, removal of impediments in quarantine procedures, are some of the important policy directive changes towards this direction.
- Seed import liberalization (1984), privatization of government seed farms (1993), enacting the Seed Act as a regulation policy are the major changes brought with the liberalization of the seed sector. Currently, the formal seed sector comprises both the government and the private sector seed production and imports.
- In 30th July 2003, Seed Act No 22 of 2003 was enacted. It was "AN ACT TO REGULATE THE QUALITY OF SEED AND PLANTING MATERIALS; AND TO PROVIDE FOR MATTERS CONNECTED THEREWITH OR INCIDENTAL THERETO". The Director General of Agriculture is the in-charge of general administration of this act and discharges the functions assigned to him by this act.
- The National Seed Council was established under this act. It comprises of Secretary to the Ministry, Director General of Agriculture, Director of the Seed Certification Department of Agriculture, the Executive Director of the Sri Lanka Council for Agricultural Research Policy (SLCARP), Director-General of the Sri Lanka Standards Institution (SLSI) and four of other members are appointed by the minister to represent seed producers, users and importers (private sector).
- Under the Seed Act No 22 of 2003, Director- Seed certification is given the authority of responsibilities including "exercise the exclusive right to certify seed and planting materials grown in Sri Lanka; and more.
- All the seed handlers are required to register under the Director-in-Charge of the Seed Certification and Plant Protection Centre (SCPPC) of the Department of Agriculture (DOA).
- Successive Governments focused on the policy of Produce and supply high quality seeds and planting materials of commercial varieties in a competitive environment with the participation of state and private sector as indicated in National Agriculture Policy documents of (NAP) 2007 and the Government policy documents of 2010 and afterwards with the following important strategies identified.

- Introduce a "domestic seeds policy" to produce quality seeds at international standard
- A standards certificate to be made compulsory to import seeds
- Promote private sector to produce quality planting material on a large scale
- Establish a seeds bank under the Ministry of Agriculture to ensure seed safety

vi) Policies on Farm Machinery and Mechanization

- Mechanization in Sri Lanka started as far back as late 1940's with the introduction of the Massey Ferguson 4-wheel tractor and Tractor use became popular in land preparation in irrigated rice farming began with the formation of state-run tractor pool for hire.

- Use of two-wheel tractor began in late 1960's with the introduction of Sri Lankan designed British land master in 1960' which later manufactured by Japan, China and India. It was affordable to individual farmers to own it. After 1970's other field crop sector also started using tractor power in land preparation.

- The next introduction of machinery in paddy farming was the threshing machine either propelled by tractor or as a separate machine. In 1970's The Farm Mechanization and Research Centre (FMRC) introduced a 2-wheel tractor operated thresher designed by FMRC. Today, four-wheel tractors, threshers, combine threshers and combine harvester are used for threshing.
- When mechanization in OFC sector is concerned, machinery power is used for land preparation for entire fields except there are topographical limitations for adoption. Several types of machineries have been accustomed to suit the operation related to weeding, seeding, harvesting, threshing etc with some success.
- Government policy also emphasizes to support development and manufacture of agricultural machinery, and the promotion of agricultural mechanization through public and private sector participation. The 2012-2015 National Agricultural Policy provides clear directions for implementing a comprehensive package providing credit and tax concessions for machinery, equipment and extension services for farmers engaged in such activities in agriculture.
- Adoption of irrigation equipment is also important in mechanization of agriculture. The Government promoted the rapid adoption of water pumps and the development of groundwater wells for agriculture; provision of subsidies and credit facilities for purchasing micro-irrigation equipment; and government policies on tax, tariffs and extension support.
- In 2000, the Government of Sri Lanka initiated a subsidy program to encourage the Installation of micro-irrigation (MI) with agro-wells.
- In 2006, the government introduced a reduction of 50% of the tax payable on the profit for 5 years for companies importing drip irrigation equipment (through amendments to the Inland Revenue Act No. 10 of 2006).

- Providing tariff concessions for agricultural machinery and the open economic policies adopted by successive governments encouraged the private sector to import water pumps from China and other countries.
- Yet, the relatively high cost of pump and irrigation technology packages, alongside the lack of capital or access to loans for investment, are major constraints to the adoption of these packages for many smallholder farmers.
- Today, Sri Lanka has a largely mechanized agriculture sector next to Bangladesh in South Asia. Machinery use in land preparation and harvesting is common in most food crop Farming as Labour use in agriculture has come down.
- There is a large scope opened to mechanization in several management practices including seeding, weeding, lift irrigation due to scarcity of labour, and banning of agro chemicals for weeding.
- Therefore, policies should be directed to add value through the forward linkages of modernization of agriculture through mechanization. Policy mechanisms, such as targeted subsidies, concessional loan schemes, etc., may be needed.

vii) Policies on Road infrastructure

- A proper road network is crucial for connecting input and output markets.

- Ancient Sri Lanka had a road network connecting the religious places and ports from the capital cities of the ruling kings. Historically, Sri Lanka's Road network development was initiated during the colonial period mainly to transport commercial plantation crop products to the ports and to facilitate the other activities such as administration and defense of the country. A railroad network was developed during this period and a canal system was developed during the period of Dutch as a means of transportation.

- Prior to the introduction of motor vehicles in 1940, roads were constructed to move the animal drawn carts. Thereafter, road transport became the most widely used transport mechanism.

- The road network of Sri Lanka was maintained and developed by the Public Works Department in 1950s (RDA, 2020). In 1959, Sri Lanka had 19, 104 km long road network out of which 12, 000 km was access roads

- A new Department of Highways was formed in 1969. The new department was solely established for the development and maintenance of class A, B, C, D and E roads. There were approximately 28,000 km road network in 1969.

In 1971, most of the functions of the Highways Department were transferred by forming two organizations namely; the Territorial Civil Engineering Organisation (TCEO) and the State Development and Construction Corporation (SD & CC).

Additionally, to the road development and maintenance, the TCEO had the responsibility to improve and maintain the irrigation works including village tanks, irrigation canals and to assist local authorities to improve local roads and bridges. The State Development and Construction Corporation (SD & CC) was formed to construct the bridges and other civil engineering work.

In 1978, the functions of TCEO were transferred back to the Department of Highways. Road Development Authority was formed under the Ministry of Highways in 1983. It is formed by the RDA Act No 73 of 1981.

- Thoroughfares (Amendment) Act, No. 9 of 1988 and Thoroughfares (Amendment) Act, No. 81 of 1988 were came into effect to amend the Thoroughfares Ordinance.

- In 1989, with the 13th constitutional amendment; provincial councils were formed. Under that, C, D and E roads and the bridges came under the authority of corresponding provincial councils. Approximately 17,000 km of roads were in C, D and E classes.

1991 onwards

Sri Lanka's road network consists of National Highways (A & B class roads and expressways), provincial roads (C & D class roads), unclassified local authority roads and other roads, including those maintained by state sector agencies (CBSL, 2017). Highways and Expressways are maintained and developed by the RDA.

It illustrates that total road network has increased from 25, 738 km in 1990 to 31,144 km by 2018[5].

"Maga Neguma" programme initiated in 2004 which supported the rural road development has significantly contributed to this provincial road network expansion. Nearly 60 percent of the roads in Sri Lanka come under 'C' (40 percent) and 'D' (20 percent) categories. A considerable improvement in class 'C' roads is observed since 2009 which is soon after the end of civil war of the country. Record keeping on class 'E' roads has been excluded since 2006.

Since 2009 to date, development of road transportation was considered a key priority compared to the other means of transportation such as rail, air and sea transportation. The National Thoroughfares Act No 40 of 2008 came into effect to provide " planning, design, construction, development , maintenance and administration of an integrated public road network in Sri Lanka; to provide legal framework necessary to facilitate private sector investment and participation in

road construction, development and maintenance; to assist the provincial councils and local authorities in the development in the development and maintenance of roads; to promote and facilitate community based organizations engaging in the construction, maintenance and management of roads and public roads; and to provide matters connected therewith or incidental thereto" (National Thoroughfares Act, 2008).

In 2009, the re-opening of A9 road significantly facilitated goods and passenger transportation to Jaffna. Measures were continued to rehabilitate national roads in the Northern and Eastern provinces. The estimated cost was 123 billion LKR. Rehabilitation of 1,174 km of roads was planned under the Trincomalee Integrated Infrastructure Project (TIIP) under which Northern Spring and Eastern Revival programmes are driven (CBSL, 2009). Road density per square kilometer in Sri Lanka was 1.6 km which is a comparatively high figure compared to the other countries in the region. RDA spent 78,186 million LKR in 2009 which is nearly 47 percent increase or roads and bridges.

Major road development projects continued were Southern Expressway Project, Colombo-Katunayake Expressway Project, Colombo Outer Circular Highway Project and Colombo – Kandy alternate highway project. Four flyovers were completed and four more were planned. The longest bridge in the country connecting Trincomalee and Kinniya was opened during 2009.

2011: The government's objective on linking the regions was continued through Northern and Eastern road development projects and 'Maga Neguma'. The Southern expressway was opened for traffic which is an important milestone of the transport sector in Sri Lanka

2015: Road development was given top priority to facilitate the economic activities and regional connectivity.

2017-2018: Regardless of the tight fiscal conditions in 2017 and 2018, the road development projects were continued giving priority. The total length of the expressway network by 2018 was 170 km and it is expected to achieve 350 km by 2021. Currently, it is expanded to Hambantota and Katunayake -Kadawatha- Kerawalapitiya. The road network is expected to expand to Kandy and Ratnapura (RDA,2020).

Currently, Ministry of Highways and Road Development is the apex body of road network of Sri Lanka. Road Development Authority is responsible for the maintenance and development of national highway network. It includes class A and B roads and expressways. Provincial and local governments maintain C and D roads. As table 2.4 and figure 2.18 shows, C class road network has expanded considerably and mainly in agricultural provinces.

The current road density of Sri Lanka of 1.7 km of roads per square kilometer is very high when compared to its regional peers. Sri Lanka's road network is dense and well laid out to provide accessibility to the country's entire population across the provinces. However, with the steady growth of vehicular traffic since 1978, the capacity of the road transport system still has become inadequate which resulting the reduced efficiency in mobility especially in city areas. However, the RDA has been working on a sustainable programme to rehabilitate and improve the National Road Network to reach the required level of service.

Road network of Sri Lanka is mainly divided into three categories as National Roads, Provincial Roads and roads governed by Local Authorities. The RDA takes over roads that belong to the Provincial Councils / Local Authorities time to time considering the network connectivity and enlist them into the National Road Network. The National Road Network consists of 12,224.7km of Trunk (A class) and Main (B class) roads, 312.6 km of Expressways and about 4,254 bridges as at end of 2021

Agriculture Credit and Finance Policies

Need for credit and financial facilities for agriculture was evident with the informal financial markets operated before the formal financial market came into operate.

Institutional arrangements for agricultural credit were began since 1947. It commenced with three loan schemes namely; the short term cultivation loans disbursed by the Department of Food Production, the medium term loans disbursed by the Co-operative Agricultural Production and Sales (CAPS) societies for purchasing machineries and the long term credits provided for CAPS societies to purchase vehicles and to construct storage facilities (Sanderatne, 2002). These schemes were continuously expanded by increasing the coverage of the societies and the money allocated. For example, the amount disbursed from 1947 to 1953 increased from 4.36 million LKR to 15.86 million LKR.

new scheme was introduced in 1963 which is named Expanded Credit Scheme. It considered share of capital in the cooperative, area cultivated and loan repayment in granting loans for the burrowers. The scheme has disbursed 34.6 Million LKR by 1964.

The New Agricultural Credit Scheme was introduced in 1967 replacing the previous scheme. Under this scheme, cooperatives had to obtain funds from the government and to lend those to farmers.

Central Bank of Sri Lanka is involved in financing cooperatives and small-scale agriculture through the establishment of the People's Bank in 1963. Thereafter, in 1974 Bank of Ceylon also joined the new agricultural credit scheme and Hatton National Bank joined with a limited scope

Agricultural and Industrial Credit Corporation Ordinance of 1943 was amended in 1970 by the Agricultural and Industrial Credit Corporation (Amendment) Act (No. 5 of 1970). This act regulates

and authorized to lend money to undertake cultivation or processing related agriculture investments.

Comprehensive Rural Credit Scheme was introduced in 1973 to provide credits through the rural banks operated by the cooperative societies.

Comprehensive Rural Credit Scheme initiated in 1973 existed up to 1986.
Loan recovery was a major issue in implementing the credit schemes for agriculture over the years.
International Fund for Agriculture Development (IFAD) had funded the National Agribusiness Development Programme (NADeP) completed in 2017 and another 5 refinance loan components under Smallholder Agri-business Partnership Programmes (SAPP) in 2018

Agriculture Insurance Policies

In 1956, the Sri Lankan government recognized agricultural insurance as a mechanism to increase agricultural productivity and to offer relief and protection to the socially and economically beleaguered segment of the population. the country sought the assistance of the FAO in the preparation of the operational framework of an agro-insurance scheme. The first experimental crop insurance scheme (CIS) in Sri Lanka was introduced in 1958 for rice cultivation. This scheme covered about 28,000 acres of paddy in selected areas of six districts and was administered by the Department of Agrarian Services.

Crop Insurance Act No. 13 of 1961

This Crop Insurance Act passed by the Parliament provided the necessary legal framework for the operation of a regular CIS, which commenced from 1961/62 maha season. This Act provided the necessary legislative authority for the operation of a crop insurance scheme, which could be considered as the second phase of development
The Crop Insurance Act No. 13 of 1961 became operative and the area under insurance gradually increased to around 200,000 acres. This operated until 1973,

The third phase of development of agricultural insurance began with the repeal of the Crop Insurance Act No. 13 of 1960 and the enactment of the Agricultural Insurance Law No. 27 of 1973, which took effect in April 1974. The agricultural insurance scheme was subjected to various experimental changes in administration. making provisions for a more comprehensive and compulsory scheme.

The objectives of Act No. 27 are as follows:
i. To operate a comprehensive agricultural insurance scheme for the benefit of paddy crop farmers;

ii. To undertake research studies necessary for the promotion and development of agricultural insurance.
This scheme was to be implemented in 3 stages as follows:
i. Insurance of the paddy crop in the country;
ii. Insurance of livestock and selected subsidiary food crops;
iii. Insurance of non-traditional food crops.

Public investment programme and its share in Agriculture

5.Conclusions-Regional Comparisons.

Most of these crops cultivated in the region are not native to this region, but countries have adopted new technology for better utilizing the genetic potential of these crops. Bringing in technology through research and development partnering with international agencies, and bringing capital for development through private sector participation and multinational investments are striking features of their success in achieving growth in their food crop sectors in their countries. The size of the Indian and Bangladesh economies and the stage of the development of their economies are considerable factors in this comparison.

Sri Lanka has somewhat drifted away from global research and development programs since mid 80's. Several reasons can be attributed to this including the political instability after 1983, the gradual distancing from working collaboratively with International NGO and other international agencies , flow of technology and technology products at a lower price from international markets after opening the economy and for others.

International development assistance also took a different dimension that multinational companies became part of development assistance. Bangladesh and India are working with these organizations.

The emerging private seed sector in Bangladesh includes both multinational companies and domestic seed businesses. The leading seed companies in Bangladesh are Monsanto (Bangladesh) Limited, Syngenta (Bangladesh) Limited, BRAC, Pioneer, Advanta, National Agri Care, CP seed, Alfa Seed International, Rashel Seed, Lal Teer Seed Limited, ACI Seed, Auto Equipment Ltd., Kushtia Seed Store, Siddiquis Seeds, Supreme Seed Company Ltd., Alpha Agro Limited, Getco

Agro Vision Ltd., United Seed Store, Agri Concern, etc. Most of the world‟s seed multinationals get cultivars into Bangladesh through locally owned collaborating companies.

Apart from that, internal factors such as less funds allocated for research and development, less human resource training opportunities given, adopting more inward looking perspective are attributable factors of low innovations in Sri Lanka.

Most public expenditure was allocated to irrigation investments and as transfers in terms of subsidies particularly the fertilizer subsidy. Rural infrastructure development reduced largely the transaction cost of input supply and farmer's accessibility to agrochemicals, seeds, and other inputs was vastly improved.

About the institutional factors that research and technology adoption to improve agricultural productivity, two important changes can be highlighted.

1. The orientation of DOA as a professional organization was gradually converted to a more administrative setup. During this period other apex bodies like CARP, and NASTEC were set up for research administration.

2. Agriculture Extension became under provincial administration, with less technical more administrative setup, and coupling poverty alleviation intervention implementations with the extension system.

Rising wage rates in the agriculture sector in response to rising wage rates in the non-agricultural sector made increasing returns for mechanization. The private sector captured this market and played a significant role. Nevertheless, Sri Lanka had not been quite successful in benefiting from the multiplier effects of backward linkages of mechanization through establishing machinery plants, assembling units, and some innovations.

6. Recommendations

Policy Recommendations

1. Increased budgetary allocation for research and development in the sectoral budget for a comprehensive food crop sector development medium-term plan
Allocate additional funding to the DOA budget as block grants to research and development programs in the medium plans

Responsible Agencies - Ministry of Agriculture, Ministry of Finance, Ministry of Plan Implementation, DOA, SLCARP

Guiding principles:

i) Adhering to neighboring country standards

2. Reposition of DOA, the largest national food crop research and development institute in Sri Lanka accountable to the national development objectives, as a scientifically- orientated, autonomous institute. (DOA strength in terms of institutional capacity and the human resource base is vital to leading the research program in the food crop sector.)

3. Agenda for Training

- Human resource development program to be jointly designed emphasizing training to be coupled with DOA research and development program and technology transfer.
- Introduce mission- mode research and development program to the DOA research program with a component of post graduate training at postgraduate training institute (eg. PGIA) in Sri Lanka or possibly with international collaborations.
  (USDA- land grant universities model in the US and the ICAR – State agricultural universities model in India provide guiding principles)
- Allocate of additional funding to the DOA budget as a block grant to implement the mission-mode R&D program that includes studentships
- Redesign National Science Foundation's research programs and scholarships to cater to research agenda of the DOA
- Regional research institutes of DOA can collaboratively design focused research programs with universities, and international agencies (eg RRDI – Wayamba University) by sharing existing field and laboratory facilities at the DOA and the universities for research activities.
- Enter MOUs with universities oversees for technology transfer and training
- Promoting sandwich programs with overseas universities
- Entering into joint research programs with international agencies

- Strengthen the coordination activities in the Ministry with the international agencies, IRRI, CYMMIT, ICRISAT, EU, UN agencies such as Commission on Science and Technology for Development of the UNCTAD
- Designate institutes for international collaborations

Responsible Agencies - Ministry of Agriculture, Ministry of Finance, DOA, Department of External resources, National Science foundation, SLCARP, Ministry of Higher Education

2. Mainstreaming new/up to date technology to increase land productivity, labour productivity and sustainability

- Exploitation of heterosis / hybrid vigor of F 1 in cross-pollinated plants which is globally common.
- Biotechnology Research
- Tissue culture and micro-propagation, Marker-assisted breeding, Advanced genetic engineering and transgenic crops

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- Frontier technologies such as Artificial intelligence (AI), Internet of Things (IoT), Big Data, 5G, Drones, Nanotechnology, Solar photovoltaic (Solar PV) for low-cost automated small machinery development, plant disease management, early warning of pest outbreaks, developing a low-cost diagnostic toolkit for extension workers, market intelligence, risk assessment

Responsible agencies – DOA, SLCARP, NSF, Universities

5. Legislations, protocols, and guidelines for technology innovations

- Plant Varietal Protection (PVP) Act been in preparation needs to address
  - ➢ the legal provisions to safeguard the rights of local farmers and their traditional knowledge.
  - ➢ Farmers' rights to receive benefits arising out of farmers' protected plant genetic resources if such resources are used by the breeders to develop new varieties
- Some of the aspects failed to be addressed in the Seed Act and Plant Protection Act
  - o Seed Act – breeder rights are acknowledged but no implementation strategy for a rewarding system
  - o Plant Protection Act of 1999 – does not exclude GE products import but contradicts with general quarantine procedure for importing plants and plant products states that Genetically Modified Organisms (GMOs) and Living Modified Organisms (LMOs)

➢ the possible private-public funding arrangement for research and development with intellectual property rights IPR

- Finalize the National Biosafety Framework which includes the National Biosafety Policy and the National Biosafety Act that has been developed in conformity with the country's

commitments to the Cartagena Protocol signed and ratified by Sri Lanka in order to undertake biotechnology research for commercial cultivation

- Active participation in agreements with international partners for genetic materials exchange within the provision of the ge International Treaty on Plant Genetic Resources for Food and Agriculture of FAO
- Strong institutional framework for implementation of seed act, plant protection actor/and plant varietal protection act- Seed Certification and Plant Protection Center can follow the model of Sri Lanka Standards Institute

Responsible Agencies - Ministry of Agriculture, Ministry of Science and Technology, Ministry of Environment

6. Enabling environment for value chain innovations to technology transfer, extension and up-scaling of technology

- Recognize the private sector/corporate sector as the development partner
- Financial support for purchasing new technology – credit, subsidies
- Free Access to information
- Establish a mechanism to implement pilot/project basis out scaling/ upscaling of innovations nationally that are currently being implemented by DOA Institutes, Ministry of Agriculture as development programs
- Formalize the Central Bank-implemented Forward Sales Contract program
- Accommodate market demand signals of the value chain to be incorporated in the research and development programs
- Enter into bilateral agreements with trading partners
- Establish contract enforcement and dispute settlement institution
- The need for an institute like AgEnt/ADA to be established by the government
- Design public sector training programs for extension agents in the value chain including retailers, collectors
- Lessen the trade regulatory and administrative bottlenecks for technology import
- Establish a functioning approval mechanism in effect for bio technology related imports
- Maintain stability and consistency of trade and market operation policies
- Facilitate the functioning of value chain through rural infrastructure development
- Targeted interventions - Dry chilli production program to be organized in to a value chain from F1 seed supplier to 250g ,500 g dry chilli packet in super markets –Lessons from maize program implemented in Sri Lanka

Responsible Agencies – Ministry of Agriculture, Ministry of Finance, Ministry of Trade and Commerce

7. Data and information as necessary prerequisites for productivity improvement

- Amalgamating existing information systems with different algorithms to cater the needs of different users
  - Digitized paddy land registry http://www.aginfo.lk which contains Metadata of farmers
  - croplook.net web-based crop production-related AI-level data collection system covering the entire country
- HARTI food information system
- Expand the current data and information collection programs ex. Cost of cultivation
- Developing a geo-referenced information system with a real-time data-feeding system using farmer farmer-motivated web-based application (APP) and developing algorithms to translate information to users
- The Agriculture Instructor's office at ADCs to be modernized as the interphase for the exchange of information and training AIs on information technology and incorporate IT in the curriculum of agriculture schools

Responsible Agencies – DOA, HARTI, ICTA

8. Institutional support and other interventions for land productivity, labour productivity improvement and sustainability

- Imposition of environmental tax on weedicides
- designing a comprehensive risk management programme which is integrated in a broader programmes for development and climate risk management and considering weather derivative contracts and catastrophic risk in it
- Development of an Index based insurance for farmers which is integrated in a comprehensive risk management programme
- To strengthen the activities of the international relations division in the ministry of agriculture for international negotiation and bilateral agreements
- A high level technical person is to head the international relations division in the ministry of agriculture to represent the country and to coordinate the relevant research agencies such as HARTI, SEPC of the DOA that undertake studies on international relations.
- A separate division at HARTI to carry out research studies on international relations and agriculture
- To focus NARP competitive research funding program of SLCARP only on collaborative research programs partnering many institutes.
- SLCARP to establish investment prioritization criteria based on impact of public expenditure on food crop sector output growth.

Responsible Agencies – Ministry of Agriculture, Ministry of Finance, Ministry of Environment

7.Reference:

*Research Report of the" **Policy Research on Agricultural Productivity**" – undertaken for the Agriculture Sector Modernization Project by the Marga Institute, Centre for Development Studies, 941/1, Jayanthi Mawatha, Kotte Road, Ethul Kotte, Sri Lanka*

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