

# Policy Compendium of Economics, Extension and Agricultural Systems Research 2020, Volume I



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Edited by  
**Dr. Sanjaya Fernando**

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Department of Agricultural Systems  
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Anuradhapura  
Sri Lanka

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## **Preface**

It is a well-established norm that research outcomes should inform policy. Nevertheless, majority of the researches undertaken by the young and budding researchers do not translate into policy. One argument for this is the low reliability and validity of the research undertaken by the young researchers. However, expert supervision and peer reviews are important tools to increase the scientific credibility of scholarly work. On this backdrop, the Department of Agricultural Systems of the faculty of agriculture wish to contribute to the policy formulation process by utilizing the research outputs produced by the undergraduates of the department by improving their quality through a rigorous supervision and a peer review process. This compendium of policy briefs is the first of the series that the Department will produce. The aim of producing this work is to communicate policy recommendations stemmed from undergraduate research that are relevant for regional and national agricultural development of the country to policy makers and authorities. The policy briefs included in this collection were developed from the researchers conducted by the undergraduate students of the Department of Agricultural Systems of the Faculty of Agriculture, Rajarata University of Sri Lanka under the supervision of senior academics and researchers in the respective field of study. They were also subjected to a rigorous review process aiming to improve their scientific credibility. The policy briefs included in this collection will provide guidance to policy makers in making important decisions related to agriculture. This collection includes eight policy briefs selected out of 15 researches conducted in 2020 and presented at the Annual Research Symposium of the Faculty of Agriculture in the same year. This issue of policy compendium brings policy implications from some of the subject disciplines under the purview of the Department of Agricultural Systems such as economics, knowledge and systems. Accordingly, the eight policy briefs debate currently important policy issues on seed quality, productivity, and sustainability of rice systems, fall armyworm outbreak, adoption of post-harvest technologies, and so forth.

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# Seed Quality and Rice Production



## Introduction

Sri Lanka achieved self-sufficiency in rice production mainly by increasing land extent. There is little room to increase rice production through further expanding land to meet the growing demand as a result of population increase. It is also necessary to release some lands for the cultivation of other crops which are increasing in demand as a result of diversification of food diet. In this context, Sri Lankan rice policy currently focuses on increasing productivity and quality of rice through improved rice varieties, and increased efficiency of input use. Most early studies suggested that the use of quality seed rice is important to increase rice productivity. Quality of seed directly contributes 20% to yield increase and 45% with the management of other inputs. Hence this briefing paper is meant to inform policymakers and donors interested in

## Key messages

- **Building institutional linkages and support**
- **Strengthening the government sector commercial seed production**
- **Strengthening private sector seed production**
- **Strengthening the government sector basic and breeder seeds production**
- **Compulsory labeling**
- **Development Infrastructure**
- **Promoting self-seed production program**
- **Competitive pricing**
- **Establishment of management information system**
- **Formulation a frame work for monitoring and evaluation of the seed production, distribution and marketing**
- **Upgrading value chains for rice seeds**

## Policy background

Until the late 1980s, seed production in Sri Lanka was governed solely by the government. Since 1984, the private sector started to import seeds, and subsequently (in the 1990s) got into seed production. With more private sector collaboration in seed production, the government introduced the National Seed Policy in 1996 to ensure high quality of the seeds. Its main objective was to establish viable seed enterprises for local farmers, and help them access high quality seeds and planting materials. In 2003, the government enacted the Seed Act No 22 of 2003, to regulate the quality of seed and planting materials, and to safeguard farmers as well as the seed handler from malpractices that would harm the seed industry of the country. National Agriculture Policy (2007), The National Agricultural Research Plan, (NARP)-2015, New Development Programs/Project Proposals -2016 and Sri Lanka Overarching Agricultural Policy-2019 play major role in seed sector development in past few decades.

But still unavailability of quality seed rice at the right time has been the main problem in the rice seed industry. Farmers willing to buy quality seeds even at a higher price from distant places away from the farming community. Accordingly, it can be concluded that farmers are quality conscious than price-conscious and willingness to pay and travel long distance for quality rice seeds is high suggesting a higher market potential for quality seeds. This means that conversion to non-quality users into quality seed users' needs easy access to seeds by improving distribution and competitive pricing. A successful strategy to deal with the problem in the seed rice sector must be much more far-reaching than it is at present. Hence this study recommends to following policy recommendation for develop the Sri Lankan rice seed sector.

## Policy recommendations

### ➤ Building institutional linkages and support

Since 1990 production of rice seed has been a multi-stakeholder activity and there should have a strong coordination between public and private sectors including seed farmers and institutional



seed producers by following a multi stakeholder approach. At present, the Department of Agriculture is responsible for producing basic seed required for the private sector to produce commercial seeds for the farmers. Department is also producing registered seeds in limited quantities. After liberalization of the seed industry, National Seed Corporation was established in India to undertake coordinating activities. In Sri Lanka also a National Seed Council has been established according to the Seed Act of No 23 of 2003 comprising government officers, seed producers and seed users. Its functions are to establish guidelines and principles to ensure seed production, to undertake periodic review of the progress of seed production and to advise the relevant authorities regarding the production of quality seeds and supply of seed to farmers. Although the council has been appointed recently, it remains ineffective. No meetings were conducted periodically and decisions were not made available to the stakeholders. Policy reforms are required to make this council effective by providing provisions to meet quarterly, introduce a webpage to make available important decisions,

and make the council responsible to the parliament.

#### ➤ **Strengthening private sector seed production**

In principle the seed replacement rate is about 20 percent of the requirement per season and farmers can use purchased seed at least three seasons. However, the current seed production is around 16% and even purchased seed cannot be used three times optimally due to poor quality. In this context increase in seed production in private sector is timely needed. The seed replacement rate needs to be increased to 25% as in India. The major constraints in increasing seed production are high transaction cost of contract growing, lack of agricultural instructors, selling rice seed by registered seed growers at open market at high prices and selling rice seeds by the government at subsidized prices. These constraints should be solved especially problems faced by small and median seed producers to increase their production because they contribute nearly 50% of the market share.

➤ **Strengthening the government sector commercial seed production**

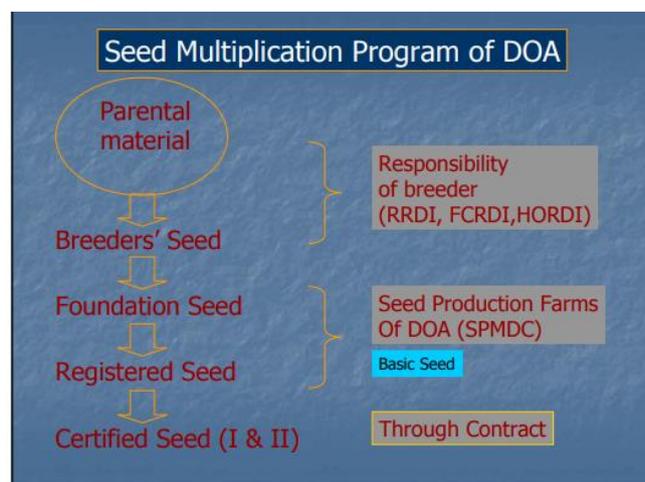
It is not advisable to give full responsibility to produce seed to the private sector because there is tendency to evolve a monopoly due to the nature of the seed production that require high infrastructure cost, and existing a small market. Hence commercial seed production by the department of agriculture should be increased to enhance the market competitiveness like India and Malaysia. At present farmers prefer to purchase department seeds due to superior quality.

➤ **Strengthening the government sector basic and breeder seeds production**

There is a shortage of basic and breeder seeds required by the private sector. Basic and breeder seeds production is a sole responsibility of the department of agriculture. The department is not getting adequate funds to develop breeder and basic seeds and lack of manpower. The present government emphasizes the production-based productivity driven economy. Increasing

allocation for research and development, which has been decreasing over the years, is imperative to achieve this goal.

**Seed Multiplication Program of DOA**



➤ **Compulsory labeling**

Sri Lankan farmers are complained about the quality and use of purchased seeds in third times reduced quality significantly. Since the seed is the most important input to increase productivity compulsory labeling should be imposed by amending the seed Act to promote branded seeds that ensure the quality. In Malaysia recently introduced the QR (Quick Response) system to trace the producer by the users that increase the quality.

### ➤ **Competitive pricing**

Supply of rice seed by the Department of Agriculture should be at competitive price. The current subsidized pricing of the department demotivates the private sector especially small producers and limits the new entrants to the rice seed production. There should be a transparency in pricing and its price should be fixed each season after consultation with the private sector. Competitiveness among competitors should be promoted through non-price factors such as quality, distribution and services such as technology diffusion.

### ➤ **Development of Infrastructure**

It is essential to introduce an intensive package to promote quality seed production at informal sector. The package should include duty free imports of equipment and machineries and provision of credit at the subsidized interest rate. Similarly technical know-how should be provided by the Department of Agriculture through Agricultural instructors. There is inadequacy of the agricultural instructors and vacancies are not filled for long time. Also, there is poor

coordination between central government and provincial councils. Due to this, farmers under minor and rain fed areas lack quality seed and unavailable at the time of required.

### ➤ **Promoting self-seed production program**

Since farmer saved seed is an important portion of the market and hence its development should not be undermined. Hence self-seed production should give due recognition in the seed policy. The role of the farmer saved rice seed needs to be considered in determining the effective demand. In this regard attention should be given to the provision of technical know-how and required infrastructure facilities.

### ➤ **Establishment of management information system**

At present there is no data base on seed requirements, quality parameters, list of producers, prices etc. This situation affects management decision making. The seed sector is more than just production of quality seeds but requires balance between demand and supply. An understanding of the difference between total demand (quantity of seed needs to plant) and effective demand (how much seed is purchased each

season) is absolutely necessary. Seed Act needs to be revised to provide the responsibility to National Seed Council maintaining data base. Council should have a Web page similar to India and Malaysia.

➤ **Framework for monitoring and evaluation of the seed production, distribution and marketing**

At present, monitoring and evaluation is conducted by the National Seed Council of the Department of Agriculture, Monitoring and evaluation division and Technology division of the Ministry of Agriculture but none of them has a framework for it. Hence activities are not taken place as expected in many instances. As explained earlier the role of the National Seed Council is not monitored and evaluated and hence it has become inactive. Similarly, the proposed seed bank is not established yet. In Sri Lanka, policy cycle that includes formation, implementation, monitoring and evaluation is not functioning. Consequently, policies are limited to records in most cases and same policies are recommended many times. This mistake should be corrected. In this context, it is proposed to document a comprehensive seed policy

covering all four elements of the policy cycle in preparation of the seed policy proposed in the “Vistas of the Prosperity and Splendor” which is a main policy document of the present government.,

➤ **Upgrading value chains for rice seeds**

Agricultural value chain approach for the development of rice seed sector is necessary. The existing value chain for the rice seed lack backward and forward linkages and transparent information flow. Hence quality, price and access to seeds have become issues right now. A successful value chain development requires business confidence among value chain players and commitment of each player to play their roles.

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## Credit Facilities and Agricultural Productivity of Rice



### The context

The contribution by the paddy sector to the Gross Domestic Product (GDP) of Sri Lanka in the year 2019 was 0.7%. While paddy cultivation is part of Sri Lankan culture, it occupies a significant position in the Sri Lankan economy in ensuring food security, both at the national and household level. Approximately 1.8 million farm families are engaged in paddy cultivation across the island. Paddy cultivates, on average, 560,000 and 310,000 hectares (ha) in Sri Lanka in two major seasons, namely *Maha* (September to March) and *Yala* (May to end of August). Approximately 2.7 million tons of rice produces annually, which meets about 95 percent of the domestic requirement (Rice Research & Development Institution 2020). The sector greatly supports by the government and private sector

considering its importance. However, it suffers from several drawbacks such as high cost of production, low financial capabilities, poor technology adoption, inefficient use of inputs (water), climate change, and lack of extension services. Generally, paddy production in Sri Lanka is less productive and competitive in the international market.

### Critique of policy options

In line with macroeconomic policy reforms since 1948, domestic agricultural policies were also adjusted. Thus, policies implemented during the first regime (1948-1970) focused mainly on increasing rice production through expanding the area cultivated and improving productivity. The six-year development plan (1951 -1957), the six-year program of investment

(1954-1959), and the ten-year development plan (1959-1968) emphasized the need to enhance the efficiency of the non-plantation sector. Programs during the 1948-1970 period centered around five activities, including subsidies for production inputs, and credit facilities (Henegedara, 2002).

In Sri Lanka, among 2.8 million people who live in rural and estate sectors and among them, almost 50% fall into the poor category. Furthermore, nearly 40% of Sri Lankans who work in the agriculture and allied sectors belong to poor groups. In this context, lack of financial capability is one of the major constraints faced by the farmers (Adhikarinayake, 2005). Nevertheless, the provision of credit has been recognized as an effective tool to increase rice production (Duy 2015). Farmers can access credit from both formal and informal sources (Kelegama and Tilakaratane, 2014). All the same, the majority of the farmers are engaging with credit and access to credit also enables farmers to adopt more capital-intensive methods of production to improve their level of productivity. However,

the effect of agricultural credit on paddy productivity is not adequately investigated, especially in Sri Lanka. Hence, this study empirically evaluated the effect of agricultural credit on paddy productivity in the *Anuradhapura* district of Sri Lanka.

### Key findings

This study employed the Stochastic Frontier Analysis (SFA) to examine the technical efficiency of paddy production in the *Anuradhapura* district. All paddy farmers in the district were considered as the target population of the study. Out of 43 Agrarian Service Centers (ASCs) in the district, four of them were purposively selected based on the land extensiveness of paddy cultivation. The study employed a combination of non-probability sampling techniques to select 60 farmers consisting of both microcredit borrowers (35 farmers) and non-borrowers (25 farmers) from the selected ASCs.

Eleven factors were empirically evaluated, that can be affected to the technical efficiency of paddy cultivation (see Table 1). Credit usage

was considered as one of the factors in the model.

The results revealed that the average technical efficiency of paddy production is 89 percent in the area implying that the resource allocation of farmers is efficient. However, still, there is a scope to increase production by increasing its efficiency. Among the technical inputs, land size, quantity of seed paddy, and cost of agrochemicals show positive significant effects on paddy production. The role of microcredit on technical efficiency, as expressed by farmers' microcredit usage, has a positive and significant impact on technical efficiency. The use of microcredit improves farmers' ability to overcome cash constraints in input purchases and use new technology.

Furthermore, the results showed that the agricultural experience of the farmer, the level of education, and the access to extension services significantly improve the technical efficiency of paddy production in the area. Although credit usage has a significant positive impact on paddy production, the efficiency, the source of credit, whether formal or informal,

do not provide sufficient evidence to show a significant impact on technical efficiency in this study. However, based on the empirical evaluation, 57% of farmers use formal credit sources as their financial source while 40% of farmers use informal credit sources to overcome their financial limitation

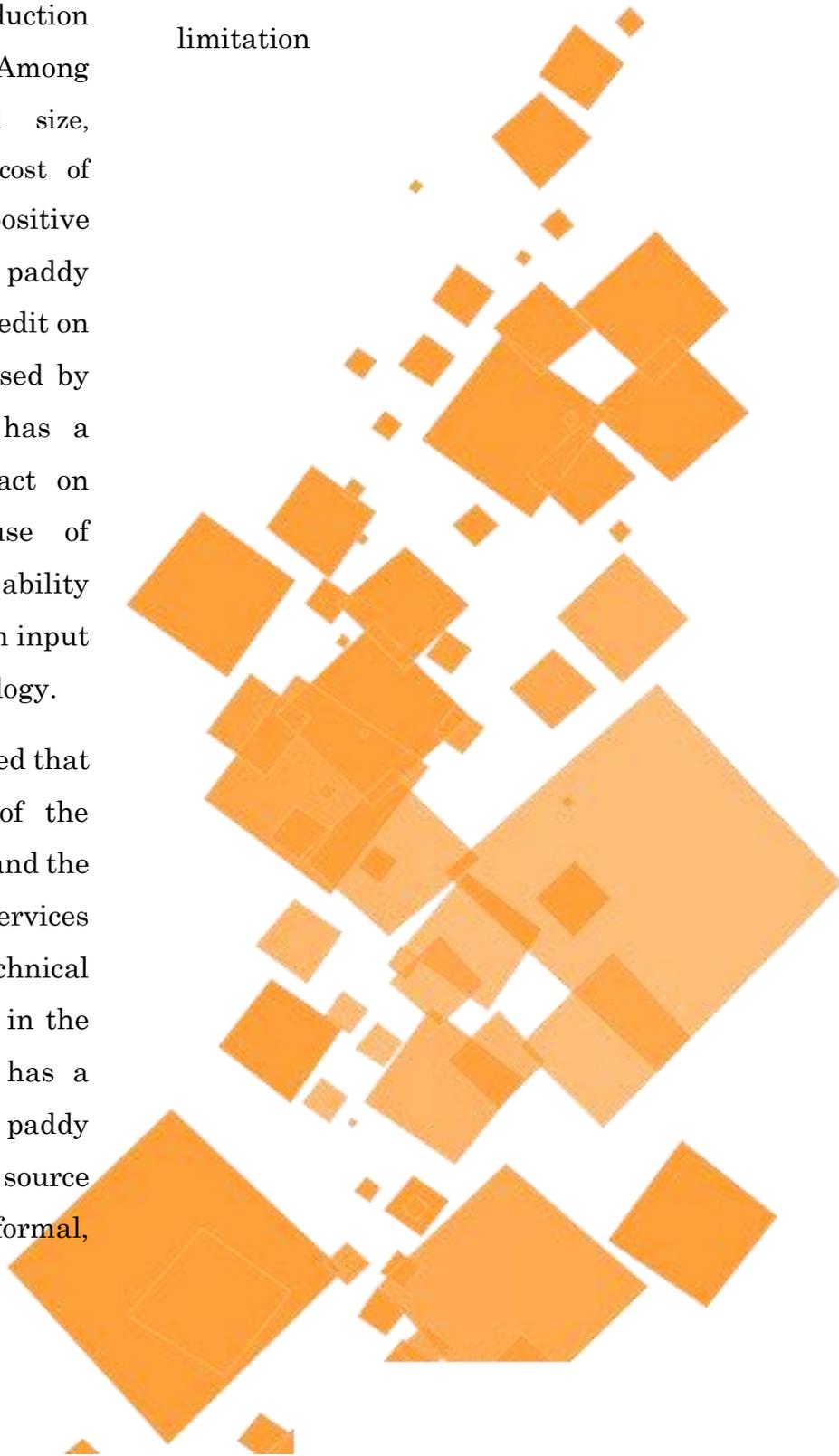


Table 1

Table 1. Factors affecting the technical efficiency of paddy cultivation	
Variable	Effect
Gender	-
Age	-
Farming experience	+
Educational level	+
Household size	+
Membership in FO	+
Extension service	+
Off farm work	-
Credit usage	+
Mortgage practice	-
Loan source	+

	Significant Result
	Non-significant Result
+	Positive Relationship
-	Negative Relationship

### Policy considerations

Credit has been found to increase the efficiency of paddy production, and this may go a long way in farmer's income and thereby reducing poverty. Therefore, existing agricultural policies should be strengthened to enhance farmers' access to credit. In this regard, the rural credit system needs to be improved further to achieve potential production and efficiency levels. When credit is made available, farmers can also obtain the required inputs and technology on time that will increase their productivity. More rural institutions providing microcredit through some innovative credit schemes could be an option to increase the usage. Furthermore, creating an enabling environment that will encourage the setting up of rural banks and microfinance institutions in rural areas, will increase the stock of loanable funds available to farmers.

There is also for educating and training on the use of inputs and technology among smallholder paddy farmers. This can be supported by Agriculture Extension Officers. Farmers could be trained and advised to adopt yield-raising technologies such as improved seed varieties, and fertility-restoring and conservation technologies.

Additionally, the use of various media platforms such as mobile phone applications, radio and television, community-based organizations, and women groups for knowledge sharing on technology adoption and use, may also be beneficial.

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# Potential of Beekeeping as a Livelihood Option



## Introduction

The honeybee is a foremost important species in regulating the ecological balance and biodiversity in nature. In this connection as pollinators, honeybees play a significant role in food production and plant diversity. Rearing honey bees, which is called apiculture has economic benefits. Natural bee honey has a good demand both in local markets and international markets due to its medicinal and nutritional properties. Bee honey, pollen, propolis, bee wax, royal jelly, bee venom, the queen, and the beehives are the major products of apiculture. Rural employment, human nutrition, and income are the benefits to the rural community from apiculture. Annually, Sri Lanka imports around 60 to 80 metric tons of bee honey from countries such as Australia, India, and China to meet the local demand. However, the tropical climate of Sri Lanka provides a potential for apiculture. The favorable temperature and rainfall distribution of the country facilitate the development of the honeybee population and bee honey production. Apiculture provides an environmentally friendly livelihood option.

## Key messages

- Commercialization of apiculture
- Improving awareness
- Provision of inputs and trainings
- Women participation in beekeeping

However, modern agricultural practices such as crop monoculture, use of synthetic fertilizer, and genetically modified crops have threatened the survival of honeybees resulting in reduction of bee honey production. It directly affects the natural honey bee population by losing their habitats and food resources. Decline of honeybee population is directly linked to biodiversity degradation. Therefore, the conservation and propagation of honeybee is timely and important.

At present, Sri Lankan policies on biodiversity conservation have not adequately addressed the conservation of honeybees. But in some counties, Tanzania, enacted, “National Beekeeping Program-2001 to promote utilization of bee resources for poverty eradication and improve biodiversity and environmental conservation. Beekeeping act- 2002 has a lineup to facilitate beekeeping in Tanzania. Similarly in India, the government provides subsidies to apiculture businesses, loans for commercial beekeepers, and insurances. To promote beekeeping as a livelihood option there should be a proper policy framework and support in Sri Lanka, this study analyzed current situation of market for bee honey, including 50 beekeepers selected randomly from *Banadarawela* DS division. To study the farmers' willingness for beekeeping as a supplementary income source, another 50 farmers were surveyed from *Palugaswewa* ASD area. The study was carried out in February and March 2020.

## Method

SWOT analysis revealed that deforestation, over-application of pesticides, pests and diseases, and climate change were the major drivers of rapid decline in the natural honeybee population in Sri Lanka. In this regard, farmers' awareness should be raised on the

complementarity between forests and beekeeping, adverse impacts of pesticide use, proper monitoring of pests and diseases, and strategies for mitigating adverse climate change impacts. Furthermore, there is an expanding market for dry zone bee honey in both local and export markets. The organization of bee honey value chain will be a viable option to ensure proper links between the producers.

<p style="text-align: center;"><b>Strengths</b></p> <ul style="list-style-type: none"> <li>✓ High per-capita land availability – 40% (3.25 ac/per household)</li> <li>✓ Easy to find bee colonies – 90%</li> <li>✓ Availability of bee attractive plants – 64%</li> <li>✓ Availability of pollen and flower nectar for honey bees – 52%</li> <li>✓ Farmers have basic knowledge and experience about beekeeping – 60%</li> </ul>	<p style="text-align: center;"><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>✓ Low access to specific equipment such as beehives, smokers, honey extractors, and Hazmat suit – 84%</li> <li>✓ Farmers require technical guidance – 80%</li> <li>✓ High capital investment – 46%</li> <li>✓ Lack of specific skills for the establishment and maintenance of honeybee colonies – 40%</li> <li>✓ Low interest among women – 10%</li> </ul>
<p style="text-align: center;"><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>✓ High demand in local and global markets</li> <li>✓ High arrival of tourists who seeks natural products like bee honey</li> </ul>	<p style="text-align: center;"><b>Threats</b></p> <p><b>Internal Threats:</b></p> <ul style="list-style-type: none"> <li>✓ Over-application of pesticides – 68%</li> <li>✓ Pest and disease incidence – 58%</li> </ul> <p><b>External Threats:</b></p> <ul style="list-style-type: none"> <li>✓ Impact of climate change – 40%</li> </ul>

### Key Findings:

- In *Anuradhapura*, the most common bee honey marketing channel is beekeeper – processor – the local consumer.
- Value-added products such as garlic in honey (immersed) and cinnamon in honey (immersed) are available high value markets (supermarkets) other than raw honey.
- Beekeeping contributes approximately 22% to the annual income of a beekeeper. Average beekeeper receives an average of Rs. 16,000 annual incomes by maintaining only 2 bee honey colonies.

- Over 90% beekeepers perceived that the environmental conditions such as rainfall, deforestation, current market price, market opportunities, and agro-chemicals affect beekeeping.
- Consumers are conscious about price, quality, taste, packaging, information on package such as expiry date, manufacturer, and volume,
- The processors

## Recommendations and Implications

### ➤ Commercialization of apiculture

The current policy, *Vistas of Prosperity and Splendor* implemented in Sri Lanka recognizes the role of biodiversity for economic development. On this background, beekeeping has a great potential to contribute to the progress of both biodiversity and economy. However, the current beekeeping industry in Sri Lanka is under commercialized. Development of links with other potential industries such as eco-tourism and agri-food industries until they develop up to the commercial level. Bee keeping can be incorporated as a potential livelihood development strategy in formulating the rural development programmers. Also, beekeepers will be benefited from development of quality and certification system.

### ➤ Improving awareness

Raising awareness on alternative and eco-friendly pest management practices is important since they are associated with the size of bee population. Introduction of alternative pest control

methods are important since farmers continued to use pesticides. For example, integrated pest management methods can be identified.

### ➤ Provision of materials, equipment, and trainings

Lack of availability of beehives and equipment are major constraints. Therefore, linking to suppliers of materials and equipment are also vital. Also, authorities need to take action to provide the necessary technical training on the establishment and management of beehives.

### ➤ Women participation in beekeeping

Even though some women have a phobia of bee stings, according to the observations, beekeeping can introduce to women. Such women can engage in other activities related to beekeeping such as bee honey harvesting, processing, and marketing activities. As mentioned in the *National Policy Framework-Vistas of Prosperity and Splendor*, women should be empowered to self-sustained in enterprises. Therefore, apiculture can be used to increase rural women empowerment by providing livelihood options.

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## Factors Affecting the Fall Armyworm infestation in Smallholder Maize Fields in Anuradhapura District



### Introduction

Fall Armyworm (FAW), a destructive pest of maize, has been reported recently in Sri Lanka and has caused serious economic impacts, especially on cultivated maize. Despite various preventive and mitigation strategies adopted and promoted by the government and non-governmental organizations such as FAO, almost 50% of the cultivated maize fields in Sri Lanka were affected by FAW. This has resulted many adverse impacts on farmers' income and food security (potentially increasing food insecurity, malnutrition, and poverty), as well as broader economic, social, health and environmental impacts. Hence this study examined the factors that determine the FAW infestation and strategies adopted to overcome adverse impacts

### Highlights

- 25% of estimated yield loss was due to the outbreak
- The severity of infestation is low when farm families have more labour, chemical and cultural pest control methods are used together, when the crop fields are in the close vicinity, when the crops is established early in the season, and information sources are effective.
- The crop should be promoted among the right socio-economic groups of farmers, ensuring effective information delivery and promoting IPM practices.



## Approach

A total of 100 maize farming households were surveyed in this study from four agrarian service divisions (ASD) selected based on the extent of maize cultivation and reported severity of FAW.

Interviews were conducted during 2018/2019 *maha* season (February and March, 2019) information related to maize plots. The questionnaire addressed the information related to the farmers' socio-demographic factors, contextual factors, farmers' behavioral factors, characteristics of the maize plots, characteristics of the crop, and agronomic practices. Moreover, the questionnaire included some open-ended questions to elicit about likely strategies of the farmers to overcome recurring pest infestations and adverse effects on livelihoods.

## Results

According to the results, one fourth of the crop yield has been lost due the FAW damage. For a small holder farmer, this is a significant loss. The study also identified that the method of pest control, time of crop establishment,

distance to crop field from farmer's residence, number of available family labor and effectiveness of information sources significantly effect on the severity of FAW infestation. In comparison to the zero/no control methods, application of both chemical and cultural methods has decreased the level of infestation severity. Severity of FAW damage found to be significantly low when the crop is established at proper time in the season. When the distance between maize fields and farmers' residence is low, severity of the damage was also significantly low. This is possible due to the frequent monitoring and surveillance when the crop field is more accessible to the farmer. Similarly, availability of more family labor has decreased the severe infestations. Household labour is more reliable and agronomic operations become more regular. Crop establishment at the recommended planting time, increasing seed rate, obtain consumption loans and finding off farm labour works were coming out as important future coping strategies to overcome possible crop damages and adverse livelihood impacts from a recurring FAW infestation.

## Recommendation

Given the extensive yield losses caused by pests, as well as the negative effects of pesticides on natural balance, environmental quality, and human health, there is an urgent need to develop and disseminate effective FAW management methods that are safer, more environmentally friendly, and more sustainable. As a result, it is suggested that Sri Lanka implement Integrated Pest Management as a national policy in agricultural production. Moreover, developments of a national level policy for correct pesticide usage also essential. Conducting education campaigns to train farmers, retailers, distributors and with the adverse effect of pesticide and strengthening the awareness of extension officers/ AIs/ and related parties in FAW diagnosis and management principles. And also, proper monitoring programs efficiently operated at the field level to ensure proper usage of agro-chemicals.

Imposing strict plant quarantine laws at all ports of entry, as well as changing laws to align with current developments, will help to reduce the spread of FAW that are harmful to field crops such as maize. Research focused on minimizing post-harvest losses due to FAW also important.



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# Sustainability of Wetland Rice Ecosystem



## Introduction

Sustainability of wetland agriculture can be defined as the ability to go for regular food production, without causing severe or irreversible damage to the unique wetland characteristics. However, as a result of anthropogenic activities, many wetlands across the world significantly degrade, while causing adverse impacts on their biodiversity. It was evident that the damage to inland wetlands in Sri Lanka is much higher than other wetlands due to human activities including, damming, fishing, agriculture, and forestry. Many studies found that intensive agricultural practices such as improper application of agrochemicals cause significant loss of unique wetland biodiversity.

Until the early 20<sup>th</sup> Century, wetland rice ecosystems were very rich in diversity, including macro-invertebrates, fish, and waterfowl. Rise

of food demand necessitated the expansion of food production and conversion of the majority of the wetlands into conventional farmlands. Subsequently, the bio-diversity of such wetlands has been severely impacted and some agriculture-based wetlands are no longer qualify to be identified as wetland ecosystems.

Rice is the staple food for more than half of the world population and also shapes the culture and economy of the majority of Asian countries. Due to the sediment deposition, naturally fertilized floodplains in river basins have been used for rice farming in many countries around the world.

*Kaduwela* wetland is one of the major urban wetlands in Colombo District which is located in western part of the *Kelani* river basin. It is identified as a seasonal wetland since the inundation is prevailing only in one season. The area

is highly vulnerable to flooding and in *Yala* (May to end of August) season where almost all the fields are flooded due to south west monsoonal rains. Rice farming is one of the main ways that the local community is linking to the wetland. For more than 3 decades people were engaged with rice cultivation and long-term conventional farming practices causing disturbances to this unique ecosystem and in the threat of losing its ecological value and sustainability. Therefore, the main objective of this study was to examine the sustainability of rice farming in *Kaduwela* wetland ecosystem and identifying by looking into factors affecting the adaptability of sustainable agricultural practices by rice farmers in *Kaduwela* wetland. Generating this information will be important in formulating sustainable management plans for the *Kaduwela* wetland agro-ecosystem which has not been a subject of recent research.

### **Approach and Results**

Study collected data from a survey of 100 rice farmers in *Dedigamuwa* area of Kaduwela divisional secretariat which

extends to about 110 acres. The survey was complemented with key informant interviews, and focus group discussions.

The economic, social and environmental sustainability were measured respectively with Economic Efficiency Index (EEI), Social Security Index (SSI) and Environmental Security Index (ESI). Total sustainability was measured by using Total Sustainability Index (TSI). Based on TSI, the rice farms were categorized as sustainable and vulnerable. If the total sustainability index value is equal or greater than 0.5 ( $TSI \geq 0.5$ ) the system is considered as sustainable while lesser than 0.5 ( $TSI < 0.5$ ) the systems considered as vulnerable. A set of 15 recommended sustainable agricultural practices were used to assess farmers' adoptability to sustainable practices. Multiple linear regression was applied to identify the determinants of rice farmers' adaptability to sustainable agricultural practices.

Overall, economic, social, and environmental sustainability of the system remained at a low level of 13%, 8%, and 4% respectively.



According to the results, rice production in the *Kaduwela* wetland ecosystem is unsustainable.

Relationship to farmer adoption	
Variable	Sign
Profitability of rice farming	+
Farmer education level	+
Frequency of receiving extension services	+
Women participation in agricultural activities	+
Farming experiences of the farmer	+
Number of hired laborers per acre showed	-

During the focus group discussion, it was highlighted that the farmers did not receive proper and regular extension services and majority of the farmers were not aware about the importance of the sustainable agricultural practices to conserve the unique characteristics of the wetland ecosystem. Farmers thoroughly informed that even though they were willing to practice organic farming, there was a problem of finding the required number of organic materials to their fields. Hence the study found that, even though there are significant drivers for sustainability in the system, there is less adoption of sustainable agricultural practices by the farmers mainly due to lack of proper and regular extension services, and low availability of organic manure.

### **Conclusion and Recommendations**

According to the study, *Kaduwela* wetland rice ecosystem is vulnerable to degradation due to lesser adoption of sustainable agricultural practices by the rice farmers. Hence, the study suggests the need of government support and intervention of responsible authorities in promoting sustainable agricultural practices for maintaining ecosystem services in *Kaduwela* wetland rice

ecosystems in Sri Lanka. Taking necessary steps to implement land policies effectively to facilitate sustainable land management in the country will be important. And in that sense, institutional capacity should be strengthened to promote the effective implementation of relevant policies and laws. This would facilitate sustainable use of lands and it will discourage destructive activities that lead to land degradation and the pollution of natural ecosystems. Decreasing the cost of production, using resource conservation practices, increasing information availability and accessibility are identified as the major factors that are vital to promote sustainability in this urban wetland-rice ecosystem. Since the majority of the farmers did not have a proper idea about the Sustainable Agricultural Practices it is essential to make farmers more aware. Establishing strong advisory and monitoring services will be much important to bring knowledge and technology to farmers. Providing facilities for farmers to regularly check their soil fertility will be help to control the overuse of chemical fertilizers for rice farming. on the other hand, innovative policies and new farming approaches are needed to

prepare these farmers to face economic, ecological, and social challenges of sustainable rice farming while

conserving the unique characteristics of the ecosystem.



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# Use of Plastic Crates to Reduce Post-Harvest Losses



## Background

Fruits and vegetables make a significant contribution to the food security, nutrition, poverty reduction and to promote economic development. They are highly perishable commodities. Post-harvest loss of perishables account for 30-40% of the total production. It is a significant loss to farmers that affect their income and to consumers who have to pay high prices. Nearly 75% of this loss occurs during transportation due to packaging.

In Sri Lanka, it has been estimated that eleven tons of fruits and vegetables are discarded as garbage from the Manning Market per day by the Colombo municipal. Moreover, approximately

270000 tons of fruits and vegetables are lost during postharvest operations and the value of this loss is approximately Rs. Million 9000.

In Sri Lanka poly-sacks are mainly used for transportation of fresh produce and this practice leads to serious postharvest losses. Even though, the use of rigid containers can reduce the damage during handling and transportation the use of containers of such kind is very minimum among farming communities. Hence, it is important to introduce suitable packages for handling and transportation of fresh fruits and vegetables in Sri Lanka. This study was undertaken to identify the adoption of plastic crates among fruit and vegetable producers in Sri Lanka.

### Existing Policy Related to the Use of Plastic Crates

In September 2011, the Cooperatives and Internal Trade Ministry imposed a rule and made it compulsory to use plastic crates to store and transport vegetables and fruits in order to reduce post-harvest losses. All farmers, distributors, traders, sellers and middlemen were requested to store, transport and display their goods in plastic crates. The Ministry warned that if the new regulations are not followed, action will be taken to fine offenders. Tens of thousands of rural farmers and small traders in almost every region of Sri Lanka protested against a newly introduced government law making it

compulsory to use plastic crates to transport vegetables and fruit. As a result of that a special Gazette was issued in October 2011, saying that the vegetables that should use plastic or wooden crates were tomatoes, beans, bitter gourd, cauliflower, lettuce, sponge gourd, brinjals, yard long beans, cabbage, knolkhol, capsicum, green chillie, winged beans, bush tomato, radish, cucumber, onion leaves, cucumber, carrot, lady's fingers, bell pepper, spinach, beet and spring onions. The fruits were papaya, rambutan, pears, passion fruit, mango, oranges, mangosteen, guava, pomegranate, gaduguda, avocado, grapes and strawberries. However, this law is not in practice.

### Approach and results

This study applied the Theory of Planned Behavior to understand farmers' adoption of plastic crates using both primary and secondary data. A field survey was conducted with a pre-tested structured questionnaire with 74 farmers who have received plastic crates under the subsidy program introduced by National Institute of Post Harvest Management (NIPHM). The survey

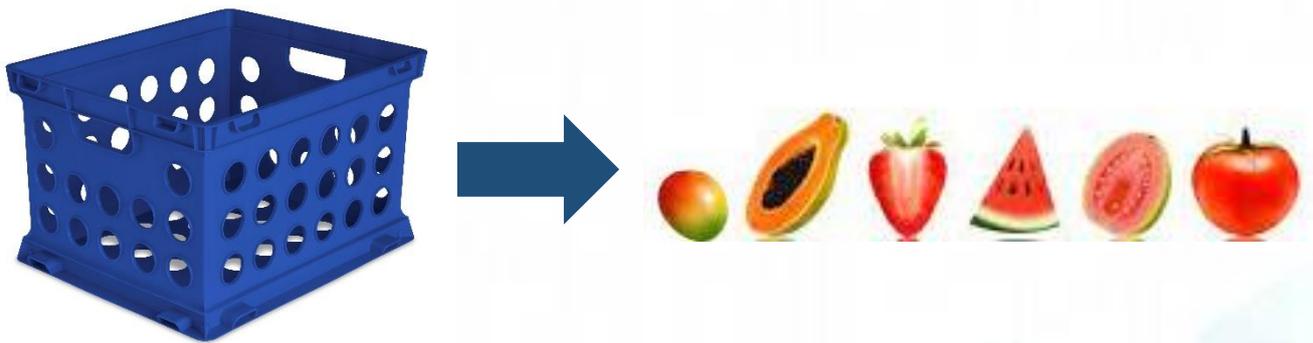
focused on demographic characteristics of adopters, adaptation factors and limitations to adopt plastic crates for fruit and vegetable transportation.

Majority of the farmers (83%) prominently grew papaya which is relatively more perishable compared to other fruits they grew (Guava-29%, Banana-13%, Mango-6%).

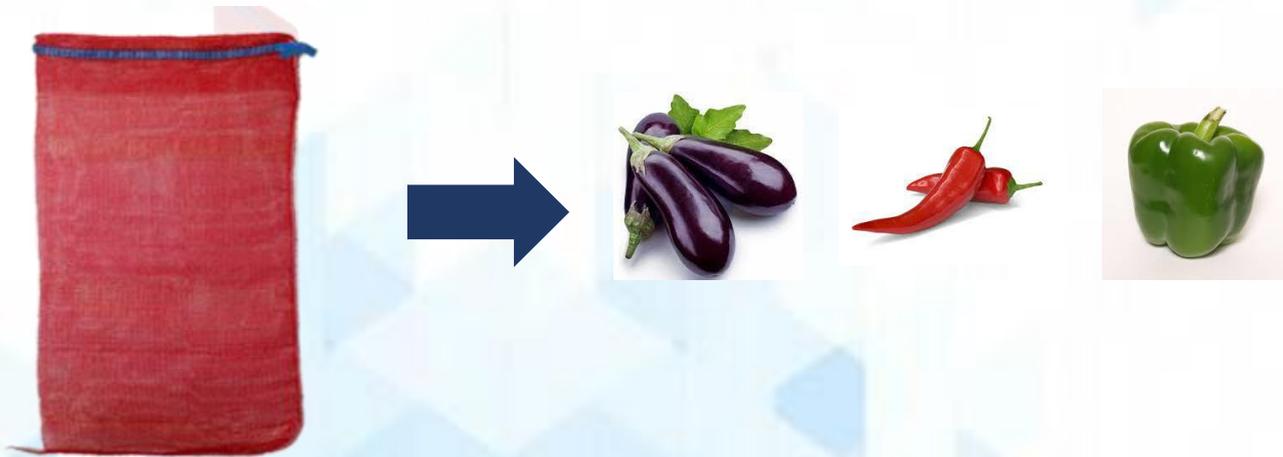


It was interesting to find that the majority of the farmers (82%) used only plastic crates for packing their produce. Another 18% used plastic either crates or poly sacks for packing their produce.

Farmers used plastic crates mainly to pack papaya, guava, mango, tomato and water melon which are more perishable and susceptible to physical damages.



Brinjal, chili, and capsicum were packed mainly in poly sacks.



Compatibility of plastic crates in transportation of perishables, relative advantages of crates over other packaging methods and the influence of

fellow farmers have significantly affected the likelihood of using plastic crates.

Barriers to adopt plastic crates
High price
Low availability
Low accessibility
Additional transport cost
High demand for storage
Lack of proper mechanism to return crates

### Conclusion

Farmers are highly aware that the use of crates can reduce the losses of fruits and vegetables, preserve the quality and create high demand in the market over the products transported in conventional packages like poly sacks. Majority of the farmers packaged their produce in plastic crates for transportation. Adoption can be increased if barriers can be minimized.

### Policy Recommendations

- **Distributing plastic crates at a subsidized price**

Use of plastic crates is important in managing the quality, safety and quantitative losses in fruit and

vegetable supply chains. Although plastic crates are reusable, farmers are concerned about having to purchase them. It would cost ten times higher to purchase one plastic crate than a simple gunny bag. Therefore, if the government can distribute plastic crates at a subsidized price, that would help farmers to use them at the initial stage.

- **Use of durable materials to produce crates**

One constraint raised by farmers was the durability of the plastic crates. Since plastic crates are expensive, to make them economically efficient they should be used at least 100 time or more. Therefore, FAO has recommended

using high density polyethylene or HDPE considering the degradation and price. Therefore, ensuring that crate manufacturers meet with these quality requirements is important.

- **Identification of a suitable crate to meet Sri Lanka's humidity requirements**

The shape and the type of the plastic crates have also been a constrain for adoption. The shape of the crates depends on the purpose of using them. Even though rectangular boxes with sufficient ventilation holes are good for stacking purposes, when it comes to returning the empty crates for reuse, these boxes are inconvenient to transport back to the original centers. Therefore, it is recommended to make arrangements to promote crates may be either nesting crates like the shopping baskets which one finds in supermarkets where empty baskets are inserted into each other or collapsible crates where the walls of the crates are fixed together through hinges or easily removable clips. In either case, it takes lesser space in trucks when returning the empty crates to the original centers for reuse.

Crates with lids would also minimize the threat of lifting fruits and vegetables at the market. Therefore, crates with proper ventilation holes are recommended.

- **Introduce proper mechanism for the ownership of the crates**

If the crates are owned by farmers, it becomes costly and difficult for them to collect the empty crates from the retailers. Therefore, they would add the cost of the crate to the produce and forget about the crates. If the crates are owned by wholesalers, the cost of recollecting them from retailers is less than that of farmers, but they have to supply them at a higher cost to the farmers for repacking of produce. In this background, it is recommended to get a private sector supplier to own the crates and allow them to rent them to farmers and wholesalers. The value of the rent should cover the depreciated cost of the crate, the re-collection and maintenance costs and his profit margins. Like the soft drink manufacturers who re-collect the empty bottles, the private sector

owner of the crates too could re-collect them from the retailers and recycle the same until the crates have exhausted their usable life.

- **Regulatory mechanism to maintain required hygienic condition of plastic crates**

When poorly maintained crates are reused, they can cause several hazards such as microbial contamination that can cause illness in humans; post-harvest diseases caused by bacteria or fungi that spread to new produce and exposure to physical hazards, chemical hazards and insect infestations. The fresh produce packed in crates could be damaged if the crates are broken. Therefore, it is recommended that Consumers Affairs Authority look into these risk factors too.

backward and forward relationship and integrate all the activities. In the dominated conventional marketing system, there is no link between market actors such as farmer and the wholesalers and they are not concerned about the quality of the product. But when production, wholesaling, transportation and retailing are integrated, all the actors are concerned about the quality of the products, therefore transportation using crates becomes possible.

- **Introduce QR (Quick response) system**

Introduction of QR system facilitates the traceability of the product if the product is not in the acceptable quality. Also, when the QR code is applied to products, producers are keen on maintaining the quality of the product therefore will have to adhere to proper handling and packaging techniques to maintain quality and to reduce postharvest losses. By introducing a QR system buyers who are concerned about the quality of the produce can trace the actors throughout the value chain and pay a premium price. This will

- **Introduce Integrated Value Chain System**

Here we propose all the players in the marketing channel to have a

increase the traceability throughout the value chain.

- **Digitalization of Economic centers**

About 65% of vegetables in Sri Lanka are distributed through economic centers. Through a digital marketing system, it can

integrate all the economic centers as in India and plastic crates can be used. In India, the buyers can bid through auctions and purchase and the products are delivered to their door step through an organized transport system.



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# Urban Women and Agriculture



## Introduction

Women, play a critical role in agriculture everywhere in the world. They contribute to the agricultural and rural economies in developing countries their participation in agricultural activities enhances the quality of living. The role of the women changed remarkably in many parts of the world, where economic and social forces are transforming the agricultural sector. Urban women are multi-tasked and involve in household, economic and social activities. However, their participation in urban agricultural production remains low. Amidst rising food demand, urban agriculture gained attention as a food production system to increase country's food supply to ensure food security particularly in the urban households. Thus, women play an important role in ascertaining household food security since in

majority of the cases women voluntarily hold the responsibility of managing household food stocks which will eventually determines household's food availability and consumption.

Urban agriculture is taking in urban dwellings, making it more accessible

## Key messages

- **Most of young urban women are get involved in urban agricultural practices.**
- **Age of women, household size, land extent, training participation and experience in urban agriculture are the significant factors related with participation for urban agricultural practices.**
- **Need specific attention of policymakers to develop gender sensitive policy implications to promote urban agriculture among urban women.**

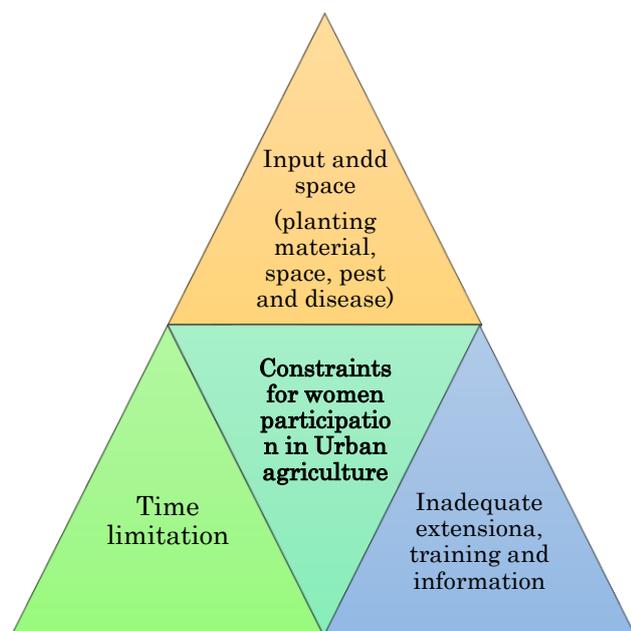
for women as they can involve while performing their other tasks. In their various multiple roles.

In addition, urban women have the potential to actively involved in urban agriculture because it can be carried in backyards, rooftops, and abandoned land around their houses. Also, they can practice simultaneously with other household activities. However, significant participation of urban women in urban agriculture cannot be seen yet. Hence this study aims to understand motivating factors that determine the involvement of urban women in urban agriculture.

### **What determines urban women's participation in urban agriculture?**

Most of the time decision of urban women to participate in urban agricultural activities has been influenced by their perceived expectations. Many of the urban women believed that involving in urban agricultural practices does not disturb their routine household activities and day-to-day life. Women

also perceived that urban agriculture can enhance the family nutrition by giving fresh and nutritious food. Moreover, they expected to practice urban agriculture as an additional income. Women were aware of the use of kitchen wastage as an input in growing fruits and vegetables and it also influenced their participation in urban agriculture. Urban women participated in urban agriculture since it serves an alternative service by providing a scenic landscape, environmental protection, and psychological satisfaction. Some of the key constraints that discouraged urban women practicing in agriculture include time limitation, limited space, incidence of pest and diseases, lack of good planting materials, high cost and inadequate supporting services. The study found that young, educated, unemployed women are mostly engaged in urban agriculture. The number of family members is one of the factors that positively affected the degree of women's participation in urban agriculture.



Women who have less household income are positively related to participation in urban agriculture. This is to compensate for the increasing household consumption expenditure. Furthermore, women who have moderately large lands in their home garden more likely to practice urban agricultural activities.

Also, there was a positive and significant relationship between training participation and women participation in urban agriculture. It implies that those who have trained in urban agriculture are more likely to practice urban agriculture. When urban women accumulate more experience in agriculture, they are motivated to practice improved technologies and practices in urban

agriculture based on observed performances and learning by doing.

### Policy Implications

Results suggest several policy implications to promote the participation of women in urban agriculture. The results highlight the need of providing training, technology, and information. Both government and non-government institutes should recognize the role that urban woman can play in promoting organic agriculture and incentives should be provided to encourage them to participate mechanism to discriminate the quality extension services through training and experience sharing.

The development of urban women groups would be an important policy option to share knowledge, good practices, and new methods of doing urban agriculture. Government policy also should be directed at towards appropriate city planning to accommodate urban agriculture by ensuring better use of limited urban space. Policymakers and non-government organizations need to

take intrinsic actions to promote urban agriculture among urban women while making them aware of the nutritional, social, economic, and environmental benefits of urban agriculture.



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# Home Gardens and Carbon Sequestration



## Introduction

Changing climate has adverse effects on ecosystems in many ways. Reduction of water quality, loss of habitats or loss of many species are some of the common adverse effects of climate change. Long existed dry zone is predominant of home gardens. They can be identified as potential agroforestry units, which can effectively use to overcome the adverse effects of climate change.

Climate-smart home gardens have the potential to effectively sequester atmospheric carbon and contribute to reducing global warming.

Climate-smart agriculture is an integrated approach to managing landscapes, cropland, livestock, forests and fisheries that address the interlinked challenges of food

## Climate Smart Agriculture

Build farmers' resilience to adapt to changes

Sustainably increases agricultural production and farm income

Reduces greenhouse gases, where possible

security and accelerating climate change. Climate-smart home gardening becomes an emerging concept in Sri Lanka and agroforestry consists of units that adopt climate-smart agricultural practices.

Conversion of conventional home gardens into climate-smart home gardens would have a great potential for climate change mitigation and adaptation. These home garden units act to increase the productivity, enhance the resilience to the climate changes and reduce the emission from lowering the ways of emission carbon dioxide and identify ways to absorb carbon out of the atmosphere.

### **Policy Back ground**

When considering the current policies, National Environmental Act No. 47 of 1980 is one of the supportive policies to manage climate change. The national framework legislation in the field of the environment has been implemented by the Central Environmental Authority for the

protection and management of the environment in Sri Lanka. This states no person shall discharge, deposit, or emit waste into the environment which will cause pollution except under the authority of a license issued by the Central Environmental Authority. Sections 23 of the National Environmental Authority of 1980, which is amended in 1988, prohibit the emission of pollutants into the atmosphere. This act encourages the prudent use and conservation of land resources to prevent an imbalance between the needs of the nation and sustainable utilization of such resources.

The National Climate Change Policy of Sri Lanka has been developed to provide guidance and directions for all the stakeholders to address the adverse impacts of climate change efficiently and effectively. When considering the policy statements, it mentions enhancing climate change resilience of natural ecosystems and its diversity to the conservation of water resources and biodiversity. Acknowledging and improving the carbon storage capacity of the forests

in forest management taking into account the other ecosystem services are provided by forests, concerning Responsible with responsible use of natural resources and biological diversity.

The policy recognizes the importance of promoting home gardening and urban agriculture to enhance household nutrition and income and promote women participation in home gardening while mitigating environmental issues.

The potential of home gardens in-tank cascade systems in sequestering Carbon has not been examined. In particular, carbon sequestration potential, and species diversity in the existing home gardens in Sri Lanka has not been studied substantially. The lack of data limits the capacity to plan for low carbon development, the opportunities for smallholders to capitalize on carbon markets, and the ability of low-income countries to contribute to global climate negotiations. Carbon accounting is important when it comes to policy formulation and implementation

towards a low carbon economy. This study focuses on examining how the density and diversity of tree species in Sri Lankan home gardens found intake cascades vary and their potential to sequester Carbon

National Environmental Policy was developed to provide the policy framework for sustainable development and it provides the direction and framework for managing and caring for the environment. Under those environmental strategies are implemented. The environment strategy can be categorized into six groups. Forestry and Wildlife Conservation category mentioned that its focus on promoting agroforestry systems where trees of suitable species will be important components of a mixed, sustainable farming system. Under agriculture, plantations, land development and mining, it mentions to review land tenure systems concerning their impact on land productivity, where necessary, replaces current tenurial systems that would promote good



land management and improved productivity

### Dry zone home garden in tank cascade systems

Home gardens are frequently identified as traditional agroforestry systems with complex structures and multiple functions. Most home gardens in the dry zone are located in minor tank cascade systems. These cascades also have been encroached for settlements and converted to various other agricultural, residential and commercial uses including home gardens.

Enrichment of home gardens located in these catchments would immensely contribute to increasing carbon sequestration. Also, estimating the current carbon sequestration potential of these home gardens will provide baseline data to assess the effects of policy impacts.

In this study, the mean above-ground carbon stock of home gardens was found to be 30.30 Mg C ha<sup>-1</sup>. It ranged from 0.005 to 80.99 Mg C ha<sup>-1</sup> and indicates the varying potential of selected home gardens to

sequester carbon. Mean number of carbon stock in home gardens were vary as 40.17 Mg C ha<sup>-1</sup>, 23.54 Mg C ha<sup>-1</sup>, 28.62 Mg C ha<sup>-1</sup> respectively (< = 0.2 ha small scale (n=13), 0.2 < to < = 0.4 ha medium scale (n=13) and 0.4 < to < 1 ha large scale (n=18) home gardens. This variation in the potential to sequester carbon is attributable to several reasons. They include differences in tree species, management practices used to maintain the tree density of home gardens, and dominant species of the mixed uneven vegetation. This result demonstrates that dry zone home gardens in the village tank cascade system contained a considerably high amount of tree carbon. It may be due to the effect of the environmental factors of the tank ecosystem

### Implications and Recommendations

The Clean Development Mechanism (CDM) provides for Green House Gas (GHG) mitigation projects that contribute towards sustainable development in developing nations and the net emission reductions can be traded to a developed nation to meet its Kyoto obligations. The CDM focus on forest sector. There are

several eligible forest CDM Projects under Bonn Agreement, Introduction of trees in to existing agricultural systems (agroforestry) and Rehabilitation of degraded areas through tree planting or assisted natural regeneration can be identified. The policies, issues and barriers for CDM project development in Sri Lanka are identified with related legislation

According to Hawassa university,2013 countries which negotiating REDD (reducing emissions from deforestation and forest degradation in developing countries) provides incentives to developing countries to carry out forest-based climate change mitigation actions, under UNFCCC. So, quantification of carbon stock is essential for future studies, policy planning related to climate change, and make data available for decision making. Home gardens are small unites rather compare to large forests. They can easily be managed and effectively used for sequestering Carbons.

## Conclusion

This study concludes that home gardens have the potential to store more carbon and optimize tree density with a proper mixture. Climate smart home garden concept found to be more affective in mitigating and adapting practices in related to climate change. National level standard field guide for home garden carbon stock measurement can be recommended. In existing policies, it's not clearly mentioned about home garden agroforestry systems and its potential to carbon stock. National policy should recognize the potential of home gardens in sequestering carbon and support the development of effective and efficient home gardens. Developing proper institutional structure to monitor carbon sequestration respect to low carbon economic frame work is timely needed.

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