



Food and Agriculture
Organization of the
United Nations

HEALTHY SOIL MATTERS



Rehabilitation of degraded agricultural lands in the central highlands of Sri Lanka

The Food and Agriculture Organization of the United Nations
Colombo, 2021

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Abbreviations and Acronyms

AI	- Agricultural Instructors	JEDB	- Janatha Estate Development Board
ARDO	- Agriculture Research and Development Officers	LUPPD	- Land Use Policy Planning Department
COVID19	- Corona Virus Disease 2019	MoE	- Ministry of Environment
CSR	- Corporate Social Responsibility	MOP	- Muriate of Potash
DAPH	- Department of Animal Production and Health	MT	- Metric Tons
DEA	- Department of Export Agriculture	NPK	- Nitrogen Phosphorus Potassium
DoA	- Department of Agriculture	NPPD	- National Physical Planning Department
DoAD	- Department of Agrarian Development	PDoA	- Provincial Department of Agriculture
DPA	- Department of Provincial Agriculture	PES	- Payment for Ecosystem Services
DS	- Divisional Secretary	PLUP	- Participatory Land Use Plans
DSD	- Divisional Secretariat Division	PPP	- Public Private Partnership
FAO	- Food and Agriculture Organization of the United Nations	PRA	- Participatory Rural Assessments
FFS	- Farmer Field Schools	RDALP	- Rehabilitation of Agricultural Lands Project
GAP	- Good Agriculture Practice	SALT	- Sloping Agricultural Land Technology
GEF	- Global Environment Facility	SLM	- Sustainable Land Management
GND	- Grama Niladhari Division	SriCAT	- Sri Lanka Overview of Conservation Approaches and Technologies
GoSL	- Government of Sri Lanka	SSERP	- Site-Specific Fertilizer Recommendation Project
ha	- hectares	TEV	- Total Economic Value
ICT	- Information and Communication Technology	TRI	- Tea Research Institute of Sri Lanka
IFM	- Innovative Financing Mechanisms	TSHDA	- Tea Small Holdings Development Authority
IPM	- Integrated Pest Management	TSP	- Triple Super Phosphate
IPN	- Integrated Plant Nutrition	UDA	- Urban Development Authority
IUCN	- International Union for Conservation of Nature (IUCN)	WOCAT	- World Overview of Conservation Approaches and Technologies

Executive Summary

The GEF funded Rehabilitation of Degraded Agricultural Lands Project (RDALP) is a 5 year project that was initiated in 2016, and executed by the FAO in partnership with the Government of Sri Lanka, several large private organizations as well as national and international NGOs.

The focus of the project was to promote suitable practices to rehabilitate the degraded agricultural lands in the central highlands of the country, specifically those in the Kandy, Badulla and Nuwara Eliya districts where as much as 50% of agricultural lands are in a degraded state. It also supported the identification of policy and institutional level gaps towards SLM and develop possible recommendations while developing the guidelines for innovative financing mechanism to address the financial issues in this sector and develop a few demonstration models on this regard.

A holistic approach, involving several regional Government bodies, private sector stakeholders, NGOs and the FAO collaborated in the selected landscapes and developed the PLUPs for those areas with land related issues. This increased the intersectoral collaboration and efficiency of implementing SLM in selected fields.

Well planned capacity building programs were held for field level officers and farmers to provide support for them to understand the importance of maintaining the quality of the soil to ensure a high yield of their chosen cultivation year after year. Instead of the conventional top-down extension methods, farmer field schools were successfully conducted where farmers not only learnt about SLM, but they also gained knowledge of other management practices which are useful to improve total productivity, value addition and marketing as well. They were also able to network among one another and enrich each other's knowledge by sharing their own experiences.

This approach was further strengthened by the introduction of the use of group messaging applications such as Whatsapp, which has created a vibrant set of farmers who collaborate with one another, while also reaching out to agriculture extension officers when a higher level of technical advice is required. This approach is also used as a tool for motivating farmers and field level officers as a monitoring and follow up tool to agriculture extension programs.

In the field level implementation, the project supported the development of SLM models in selected landscapes, and in different farming systems such as home gardens, low and high input vegetables, small holder marginal tea cultivations, integrated crop and livestock management etc.

The project also practically demonstrated how the GAP certification and technology enhancement through private public partnerships and the market-based approach can be used to promote SLM while increasing the productivity and profitability of the farmers. These practices also provide realistic tools for reducing the need for chemical fertilizer and other agrochemicals while providing improved environmental and economic benefits.

Public private partnerships for GAP certification and technology enhancement, economic home gardening and crop-livestock integrated farming systems laid the groundwork for private sector participation and innovative financing on SLM.

INTRODUCTION

RDALP deviated from the conventional conservation-oriented approach in SLM and adopted a productivity improvement approach, giving consideration to long term sustainability. The Rehabilitation of Degraded Agricultural Lands Project (RDALP) is a 5 year project initiated in 2016, with funding from the Global Environment Facility (GEF). It was built on existing institutional and regulatory frameworks in the country as well on a series of field programs and activities that are currently underway. The Food and Agriculture Organization of the United Nations (FAO) in partnership with the Government of Sri Lanka is rehabilitating degraded agricultural land in the Central Highlands, where 50% of agricultural lands are in a degraded condition.

RDALP deviated from the conventional conservation-oriented approach in SLM and adopted a productivity improvement approach, giving consideration to long term sustainability.

Past experiences of similar sustainable land management (SLM) projects that adopted conservation-oriented approaches have proven that they are not sustainable. Therefore, to ensure the long-term sustainability of the project, RDALP focussed on

- the overall productivity improvement of farmlands by adopting SLM technologies and approaches
- ensuring higher yield, higher income or lower cost of production and
- value addition and marketing or other economic benefits to the farmers.

The project also focused on a broader geographical area, a village or micro watershed in implementing these approaches. The land use plans were prepared for these areas while inter sectoral collaborations and community participation were promoted in the planning and implementation phases. This approach has also contributed to ensuring success and sustainability. It avoided duplication of work and bureaucratic bottlenecks.

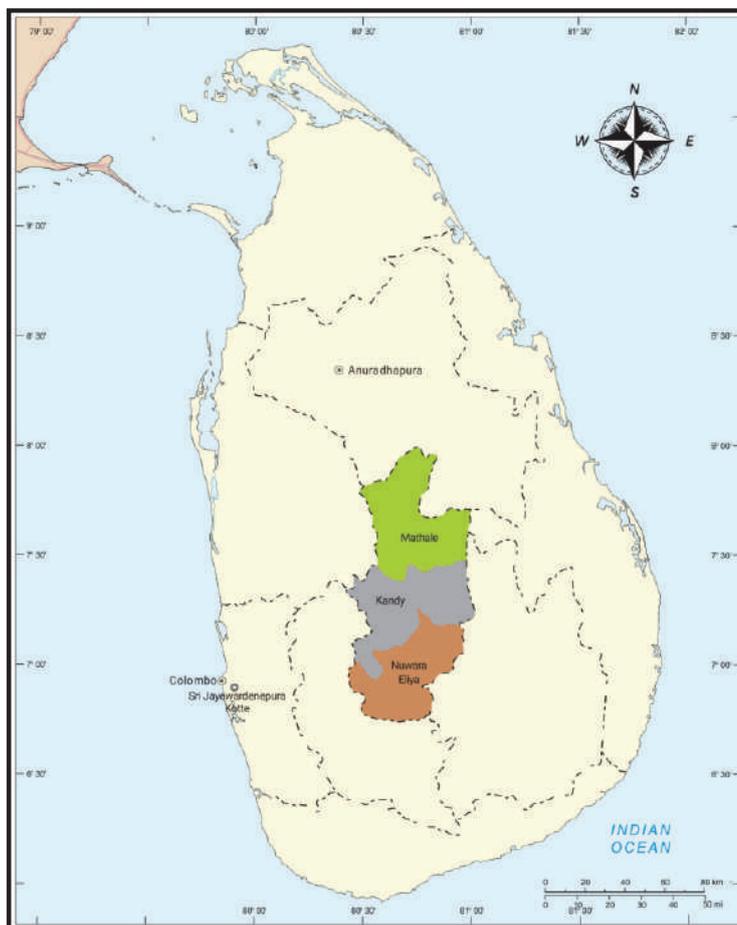


Naranhinna mini watershed being developed under the RDALP

With funding of USD 1.3 million from the GEF, the project covers an area of approximately 50 000 ha and is being implemented in the Kandy, Badulla and Nuwara Eliya districts which have the highest levels of land degradation. The integrated efforts of the Ministries of Environment, Agriculture, Lands and all other government and non-governmental institutions along with the FAO is focussed on the following four project components:

- Strengthening institutional, policy and regulatory frameworks for SLM
- Implementing identified SLM land restoration technologies and approaches
- Developing and implementing innovative funding systems to promote SLM
- Encouraging knowledge management, awareness raising, and dissemination of best practices on SLM

This booklet aims to detail the tools and techniques used in the design and implementation of this project along with the challenges that arose and the mitigation methods used to ensure a successful and long-lasting outcome.



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Map of Project Area. Redesigned based on UN Geospatial Maps.

Project Environment Objective:

To reverse and arrest degradation of agricultural lands in the Kandy, Badulla and Nuwara Eliya districts in the Central Highlands of Sri Lanka.

Project Development Objective:

To increase the availability of ecosystem goods and services and enhance food security in the Central Highlands of Sri Lanka through the promotion of Sustainable Land Management (SLM).

SUSTAINABLE LAND MANAGEMENT APPROACHES

SLM is defined as the use of land resources, including soil, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions. (WOCAT)

SLM Technology is defined as a physical practice in the field that controls land degradation and/or enhances land productivity. Each technology consists of one or several measures, such as agronomic, vegetative, structural, and management measures.

An SLM approach defines the ways and means used to implement one or several SLM technologies. It includes technical and material support, involvement and roles of different stakeholders, etc. An Approach can refer to a project/program or to activities initiated by land users themselves.

The selection of appropriate SLM practices and approaches is an important step in ensuring the effectiveness of land management and restoration. RDALP successfully introduced several new SLM approaches over the course of this project. This chapter elaborates on these.

2.1 PARTICIPATORY LAND USE PLANNING

Sapugasulpotha micro watershed covers several small villages in the Bandarawela Divisional Secretariat Division (DSD) of the Badulla District. In 2018, the RDALP project introduced SLM programs for this area. The project covered home gardens, tea smallholdings and vegetable farmlands for rehabilitation, introducing SLM technologies and approaches to farmers.

Considering the severely degraded condition of the lands, the Divisional Agriculture Committee headed by the Divisional Secretary (DS) selected and approved this micro watershed for rehabilitation.

Preparation of Participatory Land Use Plans (PLUP) is the first step of the project implementation. The project uses a participatory approach in land use planning considering the more practical and effective nature of the approach. The Land Use Policy Planning Department (LUPPD) along with the communities and other stakeholders prepared a land use plan for the Sapugasulpotha micro watershed using this approach.

RDALP with the LUPPD have prepared LUPs for 96 micro watersheds in the project implementation areas. Of these, the Sapugasulpotha micro watershed has been successfully used by the RDALP and other stakeholders for SLM and other agricultural and non-agricultural land use purposes.

When preparing a land use plan, all characteristics and parameters such as physical, human, environment and geographical elements are considered in order to demarcate a geographical area.

In Sri Lanka, the responsibility for spatial planning has been divided among several government institutions such as the National Physical Planning Department (NPPD), the Urban Development Authority (UDA) and LUPPD. However, the levels and scales of planning may vary depending on their objectives and mandates.

Land use planning is crucial in SLM, and LUPs can be used to minimize land degradation by implementing their recommendations with the participation of various stakeholders. It is important to note that the natural boundaries of a mini/micro watershed area are what is considered in this approach. The use of administrative boundaries does not provide a wholistic approach to LUP in this context.



A micro watershed in the Uva Paranagama DSD, during rehabilitation

A micro watershed area could consist of residential areas, home gardens, farmlands, tea smallholdings, forest reserves, water streams, small tanks, ponds, water springs and other features. The PLUP is a holistic plan to sustainably use all these land resources. Many criteria that measure the land degradation level were considered in this planning process. All stakeholders in land resource management along with the community, actively participated in the preparation of PLUPs.

The PLUPs were discussed in detail, debated, and passed at the Divisional and District Agriculture Committees, which are the highest committees that take legally binding decisions in agriculture. The LUPPD took the responsibility of PLUP preparation and it also gives legitimacy to the LUPs prepared under this new participatory approach.

Planning Process

1. The planning process begins with a discussion between all stakeholders, that is chaired by the DS. It is held in the village, with the objective of obtaining the consent of all stakeholders for a practical and precise PLUP which gives them the ownership of the final output and obtain the necessary contributions for the implementation of the devised plan.
2. Using participatory rural appraisals (PRA), questionnaires and field observations, the LUPPD officers generated the present land use pattern of the area and carried out the assessment of land management and land degradation. They also collected other important details of agriculture sector and socio-economic data in the area. Finally, the proposed land use plan (land restoration plan) for the area was prepared with detailed activities and responsibilities. Based on this, the following maps were developed
 - a. Present land use map
 - b. Land parcel map
 - c. Land degradation level map
 - d. Land management level map
 - e. Contour map and
 - f. Proposed land use plans.

Each of these maps were prepared at a scale of 1:5000.

3. The degradation levels (high, moderate or low) and management levels (well-managed, moderately managed or poorly managed) of the individual farmer's agricultural lands were determined by the field officers. These degradation/management levels were validated by visual analysis of the land and vegetation by experienced and well-trained field officers.
4. Finally, the LUPPD prepared a LUP for the area with an activity plan. This proposed PLUP is discussed at district level and converted into a practical action plan. The DS takes the responsibility of implementing this action plan with the help of all stakeholders.



Participatory land use planning in progress

Challenges faced and mitigation measures used

The natural boundaries of a micro watershed may be covered by different administrative boundaries and create implementation issues. To resolve these issues, the planning scope was widened to cover the relevant administrative boundaries.

The lesson learnt here is that land resource planning should be done for a large geographical area considering natural boundaries as well as administrative boundaries. As a demonstration model, PLUP was prepared for the Doluwa DSD amalgamating the GN Divisions plans. Preparing and updating the divisional land used plan is a mandatory and routing task of LUPD and based on this experience, PLUP guidelines was developed to improve the land use planning process by giving more ownerships to the stakeholders and promoting the intersectoral collaboration for wide implementation.

“ The LUP prepared for Sapugasulpotha area has many advantages. Now that there is a detailed land use plan for each land plot of the village, and it is helpful to implement SLM programs of the RDALP as well as other government programs. When a new project or program related to agriculture is launched in the Bandarawela DSD, Sapugasulpotha gets priority, because of the availability of all details with which to select suitable beneficiaries. For example, many of this project’s beneficiaries have already received polytunnels from another government program for vegetable cultivation. ”

Mangalika Karunaarachchi
Agriculture Research and Development Officer

The farmers engaged with RDALP in tea and vegetable cultivation and home gardening in Sapugasulpotha now reap benefits. They get an income, and their home gardens provide fruits and vegetables for family consumption.

2.2 FARMER FIELD SCHOOLS (FFS)

Proven success in disseminating SLM among farmers

FFS is a group-based learning process introduced by the FAO. The first FFS were designed and managed by the FAO in Indonesia in 1989. FFS have been used in pest control in rice cultivation in Sri Lanka in the 1980s. However, this approach was abandoned later and the RDALP attempted to revive the model in SLM promotion and this has shown impressive results.

FFS is a totally practical farmer training approach conducted in the field. The agriculture extension officers and other experts act as facilitators to the farmers to share their experience, understand wrong practices they adopt and learn scientific agriculture practices. In this approach, the facilitators always value the traditional knowledge and experience of the farmers. Facilitators avoid lecturing and always attempt to respond to any queries that come from the farmers. In 2019, the RDALP project together with the Department of Provincial Agriculture (DPA) – Uva Province, organized FFS to disseminate SLM among potatoes farmers in the Badulla and Nuwara Eliya districts.

One of the villages piloted for FFS for seed potato is Wapassawela. This village is a farming village that mainly produces vegetables. Soil erosion, overuse of inorganic fertilizer and the resultant soil and water pollution are among the main land degradation issues in the area in relation to the potato cultivation. According to studies, the use of inorganic fertilizer is two times higher than the recommended amount in the Badulla district.

Ten farmers were engaged in the first FFS organized for seed potato cultivation. Following the success of this initial FFS, the project conducted a further 12 FFS interventions in the Badulla and Nuwara Eliya districts for seed potato cultivation. A total of 235 farmers participated in these FFS. Quarter acre land plots from each farmer were used as model farms that apply SLM in potato cultivation. Accordingly, under this program 37.5 acres of land were cultivated successfully and achieved impressive results.

What farmers learn at FFS

- Identification of issues in the cultivation by deep analysis of the agro-ecosystem in the farm.
- Get an understanding of experimental and group-based learning procedures
- Improve the farmer capacity for localized decision making



Agro ecosystem analysis

As a result, farmers adopted

1. Soil conservation and SLM practices
2. Integrated Pest Management (IPM) practices
3. Integrated Plant Nutrition (IPN) practices
4. Good cultural practices
5. Value addition and marketing

Results

Potatoes is a crop where chemical fertilizers and agrochemicals are extensively used, leading to soil and water pollution.

With the practical knowledge gained at the FFS, Mr. D.K. Mahakumbura, a farmer in Perahettiya has reduced chemical fertilizer usage from 200kg to 85kg (by 57.5%). In conventional methods, farmers use 200kg of mixed inorganic fertilizer at two rounds for a 0.25acre land plot (800kg/acre). The recommended fertilizer application for potatoes by the Department of Agriculture (DoA) is 22kg of Urea (in two rounds), 27kg of TSP (once before planting) and 25kg of MOP (in two rounds). Accordingly, his total fertilizer usage was reduced to 85kg. This reduced the cost of production and increased profitability for the farmer. In addition, the farmers began to use the recommended amount of organic fertilizer which improves micronutrients and biodiversity in the soil. They started to use straight fertilizers instead of mixed fertilizers.



D. K. Mahakumbura harvesting fresh potatoes from his field

The fertilizer requirement and pH levels of the soil were identified by testing the soil. Farmers had traditionally added calcium carbonate (lime) to the soil as routing fertilizer. At times, farmers added lime to the soil which already had a basic value of more than pH 6, while at other times, they do not use the required amount of lime to correct the low pH value of the soil. They often believed that lime acts as a pesticide. The farmers were educated on soil pH levels and its importance for the proper absorption of nutrients, as well as the rationale behind adding calcium carbonate. They adopted the soil-test based approach to fertilizer application and IPM practices, including the use of recommended amounts of organic fertilizer while minimizing the use of agrochemicals.

FFS motivated farmers to implement soil conservation technologies in their farms.

Farmers learned how to identify pests and plant diseases through ecosystem evaluations. They were of the habit of spraying pesticides every week; but with the knowledge of pest and plant diseases they gained at FFS, this practice was stopped. This has further reduced their cost of production.

FFS became one of the most successful farmer extension approaches in the seed potato production sector. With the achievements of FFS in seed potato farming, there was a demand from other stakeholders to replicate the approach in the other sectors that the project is engaged in. Accordingly, FFS was introduced to disseminate SLM in home gardening with the partnership of the Department of Agrarian Development (DAD) and 61 FFS were conducted for 1084 farmers. It was also extended to the Good Agriculture Practice (GAP) approach in vegetable cultivation with the partnership of the PDoA, Uva and Central Provinces and 9 FFS were conducted with the participation of 173 farmers. FFS was also introduced to the tea small holdings sector with the partnership of the Tea Small Holdings Development Authority (TSHDA).

The RDALP has conducted;

- FFS for 13 farmer groups in seed potatoes cultivation with the participation of 260 farmers
- FFS for 64 farmer groups in home gardening with the participation of 1317 farmers
- FFS for 12 farmer groups in GAP programme with the participation of 245 farmers
- FFS for 31 farmer groups in small holder tea cultivation with the participation of 276 farmers
- The total FFS carried out was 102 groups with 2098 farmers



Farmers attending an FFS on soil conservation in a seed potato cultivation plot

“The programme started with 10 farmers and their farmlands were used as demonstration models. With the success of the approach, farmers tend to replicate the same and new FFS have been organized for them. Now they produce high quality seed potatoes and vegetables that fetch a higher income and profit.”

Anusha Priyangani,
Agriculture Instructor of the Department of Agriculture

Mr. Gunapala enjoys increased harvests and better profits using improved SLM practices

Maligathenna is a small village surrounded by large tea estates in the central highlands of Sri Lanka. It is 30km from Badulla, the capital of the Uva Province. Blessed with a mild climate and fertile soil, the village, in its long history, has mainly been farmland, supplying upcountry vegetables such as potatoes, beans, cabbages, tomatoes and capsicum to the country.

K. M. Gunapala (60) is considered a top farmer who has worked to ensure an uninterrupted supply of vegetables for over 43 years. Vegetable cultivation is inherent in Gunapala as his father and grandfather were also vegetable farmers. "I started farming when I was 17 years old. Since then, it has been my livelihood. I have produced hundreds of tons of vegetables over the years. I have three children. I educated them, built the house we live in and improved our living standards through farming," Gunapala said.

However, vegetable farming is a challenging and risky venture due to market volatility and the adverse impacts of climate change. Gunapala said that in recent years his yield and income were low because the cost of disease control and soil erosion made vegetable farming less profitable.

He joined the FFS on potato cultivation organized by the RDALP of the FAO in January 2020. "At the FFS, we gained new knowledge in vegetable farming. We learnt scientific farming methods and understood that some of our traditional practices are correct while some are wrong. We learnt that the cause for low yield is the poor quality of soil in our lands because of severe degradation. We received fertilizer recommendations based on soil testing and instructions on rehabilitating the land. The officers instructed us on how to improve the soil quality. As a result, our cost of production declined with yield increasing significantly. My potato harvest increased from an average 1:6 to 1:14," Gunapala said.



K. M. Gunapala in his bountiful home garden

“Before joining the FFS, I thought of the quantity of the harvest and added fertilizer and agrochemicals blindly. I had no sense of its impact on the consumer and the environment. I had no choice. I was compelled to do so because I spend money and labour in starting a cultivation and can't bear the loss of a failed crop. Now I consider the quality of the harvest as well. We now produce vegetables with less fertilizer and agrochemicals,” he said.

He added that with the practical knowledge gained at the FFS he reduced chemical fertilizer usage from 200kg to 85kg or 57.5%. It reduced the cost of production and increased profitability. In addition, the use of organic fertilizer improved the micronutrients and biodiversity in the soil. Farmers began using unmixed fertilizer instead of blended fertilizer.

Anusha Priyangani, Agriculture Instructor of the DoA, who organized FFS in the area and befriended farmers in this land rehabilitation programme, said that SLM practices introduced by the FAO have boosted vegetable cultivation in the area.

Madushanka produces high quality seed potato after obtaining FFS training and knowledge

Madushanka Rathnayake (29) a farmer from Mandaram Nuwara in the Nuwara Eliya district successfully used the knowledge he received at the RDALP organized FFS to sustainably manage his land. He now reaps the benefits of SLM and has become a key seed potato producer in the area.

“My first potato cultivation with the RDALP initiative was very successful and I produced high quality seed potatoes. Other farmers in this area used them for cultivation and with the success of their cultivation now there is a high demand for locally produced seed potatoes. Now I cultivate potatoes and vegetables in over two acres of land” he said.

Farmers prefer locally produced seed potatoes because they are resilient to pests and diseases. After the FFS training, they cultivate seed potatoes with the SLM technologies introduced by the PDoA. The Agriculture Instructor of the DoA supports them to continue their seed potato cultivation and to also apply SLM in their vegetable cultivations. Madushanka now trains other farmers on SLM and GAP in their own cultivations of potatoes and vegetables. In the meantime, he has received assistance to construct a warehouse to store seed potatoes and expects to produce GAP certified vegetables in the area too. Potato cultivation in the central highlands leads to severe soil degradation in two ways; by soil erosion as a result of loosening soil frequently and the soil and water pollution that occurs due to the extensive use of chemical fertilizer and agrochemicals.

The RDALP provided 30MT of high-quality seed potatoes to 150 farmers in Badulla and Nuwara Eliya and now the farmers produce high quality local potato seeds that are more resilient to the climate, pests and diseases at a lower cost. This program was further strengthened by the SAPP program and provided 64MT of seed potato for 350 farmers and developed the certified seed potato production process.



Madushanka's seed potato harvest

2.3 EMPOWERING FARMERS WITH ICT

Information and Communication Technology (ICT), particularly the mobile phone, is an important tool that has been successfully used in the development of agriculture. The technology is already applied to connect farmers with markets, provide information on the weather, advisory services and early warning systems.

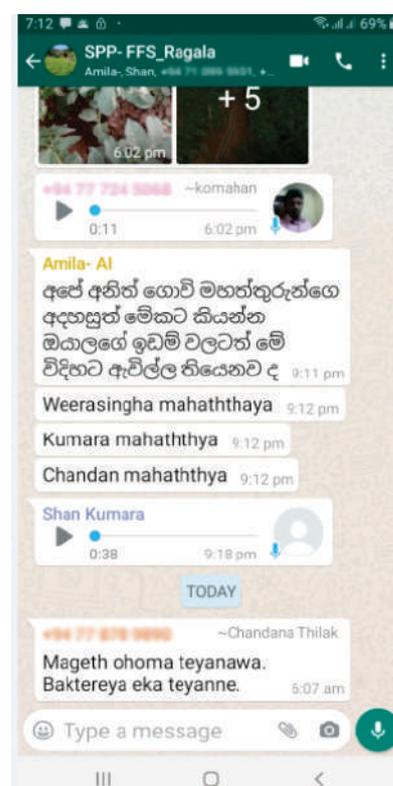
The RDALP project has used mobile telephones and social media to continue the knowledge and experience sharing processes initiated by FFS through digitally connected farmer organizations. In this process, RDALP organized farmers and agriculture extension officers into instant messaging groups. WhatsApp was the specific freeware application that was introduced at this time.

This is an attempt to modernize FFS using ICT and ensure it remains a sustainable process upon which to build ICT based farmer organizations. RDALP has been conducting FFS for about 20 farmers in four sectors

- seed potato production,
- vegetable cultivation under the GAP program,
- home gardening and
- tea small holdings.

In parallel to the FFS, most of these farmers joined an instant messaging group to continue to share information related to their crops and get advice or solutions on the issues they face. For instance, one farmer uploads a photo of his crop affected by an unknown pest or disease with description. Other farmers who have the same issue or have experience on the pest or disease add their comments, the name of the disease (if known) solutions and pesticides to be used. If the diagnosis of the farmers is wrong or needs more technical details and remedies, the extension officers will add their comments and recommendations.

The farmers also upload information about their successes, such as an increased harvest because of following a technology learnt at the FFS. This prompted them to motivate other farmers to adopt those successful technologies. They inquire about the availability of seeds, inputs or market information and farmers in the group who know the answers provide assistance.



An active Whatsapp group in Ragala

There is another category of a instant messaging groups called Experts Club, consisting of the officers who are involved in the FFS groups. There are four Experts Clubs, one for each type of FFS. In addition to field officers, senior officers of technical institutions and researchers have also joined the Experts Clubs. If the extension officer cannot solve or explain an issue faced by farmers under discussion in a farmer's messaging group, he forwards the issue to the Experts Club and obtains solutions from an specialist in the field, to share it to the group.

These instant messaging groups are now being used to strengthen the agriculture extension service. Under the present extension service of the DoA, an agriculture instructor has to cover a large geographical area. The capacity of the DoA is not sufficient to closely address and solve the issues faced by the farmers in many of the crops that they cultivate. By using this technology, the farmers can upload posts to their groups with photos related to the issues they face and obtain the necessary advice from the extension officers or other experts in the field.

Following the introduction of the ICT based farmer organizations concept in FFS, it has been replicated by many officers. In addition to the main benefit of creating a sense of unity and mutual support within the farmers, this technology solution has addressed the existing limitations of human resources of the department.

“ We have a group of 47 farmers involved in the FFS for vegetable cultivation. We started a WhatsApp group with 10 farmers, and they are actively sharing their farming information and knowledge. Today, the number of farmers joining the messaging group continues to increase and we use this technology to carry out agriculture extension services more efficiently. ”

Amitha Kekulandara,
Agriculture Instructor, Nilandahinna, Nuwara Eliya

RDALP has formed 98 instant messaging groups to date with over 1321 farmers and around 122 officers therein. These mobile solutions have many advantages in addition to that of sharing knowledge and experience. They have motivated farmers and officers, and have created competition and solidarity among their peers in other areas.

Based on the initial experience, video teleconferencing software (E.g., Zoom) based digital farmer schools were initiated to share new knowledge on SLM. The Digital Farmer School on tea was very successful and provided training to more than 400 farmers on SLM and other management practices. During the COVID pandemic, this was a very useful tool. As a result of the tea digital farmer school, soil test-based dolomite application, nutrient management practices and land productivity improvement technologies were successfully adopted. A digital farmer school for rainwater harvesting was also organized and the project managed to construct 150 rainwater ponds within three weeks amidst COVID restrictions.



Putting ICT to good use

“ Farmers who have never before used a mobile phone have bought one and begun to use it at home. They have become more tech savvy and have learned how to use it from their children. Around 50 - 60% of the farmers who joined FFS now have smartphones.

This approach has reduced the digital divide between parents and children of the farmer communities. The COVID19 pandemic required online education and now, many children have smartphones or other digital devices They support their parents to obtain and make use of smartphones.

Children who had distanced themselves from farming activities have become interested in what the parents do and begun supporting them. They make creative posts and videos for their parents and upload these to the instant messaging groups, YouTube and other social media. This approach has also improved technology use by government officers. ”

Upul Jayaweera,
RDALP Field Coordinator, Uva and Central Provinces

In addition to this mobile solution, the project supports the Ministry of Environment (MoE) to build the National Land Information Sharing Platform. The RDALP has already developed Sri Lanka Overview of Conservation Approaches and Technologies (SriCAT) www.sricat.net.

The website has been designed in the same format of the WOCAT. Many countries follow this WOCAT format in their national land information sharing and reporting platforms. This gives uniformity in global land information and convenience in sharing experience. UNCCD officially recognizes WOCAT as the primary recommended Global SLM Database for best practices.

SriCAT has been designed in the Sinhala, Tamil and English languages and is now ready to share land information of the stakeholder agencies and the private sector. The SriCAT Facebook page is also used to share information, experience and knowledge with the farmers, officers, and other interested parties.

2.4 GOOD AGRICULTURE PRACTICES (GAP) CERTIFICATION

A market-based approach in SLM

Immense importance is attached in assuring food quality and safety of the nation. According to the FAO, Good Agricultural Practices (GAP) are a set of principles, regulations and technical recommendations applicable to production, processing and food transport, ensuring safety and quality of produce in the supply chain, capturing new market advantages by modifying supply chain governance, improving natural resources use, worker health and working conditions and creating new market opportunities for farmers and exporters in developing countries.

The project attempted to use this customer requirement and new market opportunity to encourage farmers to adopt SLM which is an integral part of GAP certification. However, during discussions with the agri-business division of the DoA, it was revealed that the marketing arrangement, which is the essential part of farmer motivation, was still poor. Subsequent discussions with the private sector resulted in Cargills Ceylon PLC coming forth with a sound proposal which includes not only the marketing arrangement but also a technology package and company investment for agriculture modernization of farmer fields to improve the yield by 20% while reducing the cost by 20%. It included many solutions for soil and water management, pest and disease management, reducing the labour cost as well as value addition.

This technology package was first launched by the Cargills in the Anuradhapura and Monaragala districts for vegetable farmers. This technical package and GAP certification process addresses most of the SLM aspects; resulting in this program enjoying a high degree of relevance to the objectives of SLM. Farmers primarily consider the extent of the land cultivated to increase production and income. There is less focus on productivity improvement. Therefore, farmers tend to encroach upon the environmentally sensitive lands in the central highlands for cultivation.



Drip irrigation, plastic mulch and insect proofing nets in practice

This unsustainable farming practice also leads to social issues. Farm products coming out of these lands are highly contaminated with harmful agro-chemical residues and consumers purchase unhealthy fruits and vegetables. The contaminated vegetables and fruits are a major reason for the rise in non-communicable disease in Sri Lanka.

The GAP program attempts to address these issues through both the supply and demand aspects. Consumer demand for safer products is on the rise and a market is being developed rapidly for safer products, especially among middle- and high-

income consumers. Today, supermarkets and vegetable exporters are mindful about consumer needs and Cargills has special stalls for GAP certified foods called "GAP Corner" in its outlets.

The project introduced SLM best practices and environment-friendly agricultural practices through the joint initiative with Cargills. It introduced proper land preparation, plastic mulch with drip irrigation systems, fertilizer application through drip irrigation, insect proof nets around the land etc. Each technology has given the following results;

I. Plastic mulch 3 – 4 seasons and will give the following results;

- Reduce soil erosion due to minimal disturbance to the soil and by covering the land for a longer time period
- Control the growth of weeds
- Reduce water evaporation and keep the soil moist for a longer time
- Control the evaporation of fertilizer and instead, allow the fertilizer to be absorbed into the plants
- Reduce certain pests due to the reflection of sunlight to the underside of the leaves
- The labour required to manage the crops is drastically reduced, thereby reducing costs.



The use of plastic mulch

II. Drip irrigation

- Water usage efficiency increased by 3 folds. This has increased the number of seasons being cultivated from 1 to 3
- Fertigation through drip irrigation over shorter intervals reduced the usage of fertilizer by 70 -90%
- Provide the ability for off season cultivation with the advantage of higher prices
- Reduces the labour requirement for fertilizer application.



The workings of fertigation through drip irrigation

III. Insect proof nets

- Drastically reduce pest attacks
- Reduce damages to crops caused by wild pigs and other such animals
- As a result, production has increased by nearly 20% while the cost has reduced by 15 - 20%, thus allowing a profit increase of 30% - 40%



Insect proof nets of a minimum height of 6ft

“ *Considering the extent of land degradation in the central highlands, the Government alone cannot be expected to stop the process and promote SLM. Land is not a public good and land degradation is a result of using it for economic activities that generate profits. The issue is created due to the unsustainable use of lands.*

Thus, it is important to shift land users towards sustainable use of this asset; to reverse the process of further degradation. The investments needed for this is large and cannot be afforded by most small farmers. However, when initial external support is provided, they will be empowered to improve their income and will begin to expand on their own. In all of this project’s initiatives, it was attempted to promote market-based approaches and the GAP program was one of the best success stories herein.”

National Project Manager of RDALP

These technology packages make the adoption of GAP and its certification easy.

This program supported the complete development of selected land areas of individual farmers using the PPP model. This provides a role model for the modernization of farmer technologies for the implementation of GAP. At the same time, capacity building programs conducted by the DoA and PDoA through FFS improved the farmers' skills and knowledge on GAP practices.

The RDALP had three objectives in supporting this project;

1. Promote a market-based approach for SLM
2. Encourage PPP in SLM and
3. Encourage private sector investment and innovative financing in SLM.

Implementation

The GAP certification ensures that farm products meet the required quality standards while being environmentally friendly, socially acceptable and economically profitable for the farmers. Agriculture extension officers of the DoA worked closely with the farmers to that GAP principles are applied in each stage of production.

Initially, 80 farmers were selected and the DoA extension officers trained them on SLM best practices and GAP principles. Under the program, the farmers are trained on soil conservation technologies, fertilizer application based on the results of soil testing, conservation of water sources and catchment areas and the RDALP provides financial or material assistance to the farmers to implement these.



GAP certified produce ready for the market

“ SLM cannot be implemented merely by mobilizing farmers or by implementing strict regulations. The RDALP has proved that the application of SLM best practices can increase land productivity, harvest and farmer income. They can also fetch higher prices for market-based, environmentally friendly products. ”

National Project Manager of RDALP

“Ethical products” is another brand name that refers to products that do not damage public property during the production process. Therefore, farm products that are produced using excessive chemical fertilizer while polluting soil and water cannot be considered ethical products. GAP certified products carry the tag “safe, fresh and socially responsible agro products” and it certifies that they are sourced from sustainably managed farmlands.

Farmers were selected considering marketing, coordination and capacity development aspects. Accordingly, farmlands belong to progressive farmers around the existing vegetable collecting centres of Cargills in Haguranketha, Nuwara Eliya, Bandarawela and Boralanta were selected.

The RDALP coordinated the GAP program introduction to the vegetable cultivation lands in the central highlands. The project also supported the program by supplying insect proof nets and plastic tanks for water storage for drip irrigation.

Cargills conducts the greater part in modernizing farming by introducing micro irrigation systems and the use of liquid fertilizer. The cost of production is reduced significantly by plastic mulches as it reduces the cost for land preparation and weed control. Part of the cost of modernization is borne by the farmers.

Capacity building of farmers was done by Cargills and the DoA. Value addition and marketing was carried out by Cargills. Farmer training on GSP through FFS is done by the GAP division of the DoA, PDoA Uva and Central provinces along with Cargills.

The LKR 42.6 million investment on the GAP program was funded jointly by Cargills (LKR 13.6 million), RDALP of the FAO (LKR 10.8 million) and LKR 18.2 million contributed by farmers.

Outcomes

- Empowered 80 farmers by providing the required technology and training
- 26 farmers have already obtained GAP certification
- All 80 farmers have a stable and a higher price and market for their vegetable and fruits
- Use of chemical fertilizer reduced by 80% due to the use of plastic mulch and fertigation through drip irrigation at shortened intervals

- Water usage reduced by 60% due to drip irrigation and plastic mulch
- Yield increased by 10 -20%
- Due to low water requirement, off season cultivation was introduced providing an opportunity for farmers to fetch a higher price for off-season vegetables
- Due to the full coverage of soil, soil erosion and water evaporation were minimized
- Labour cost reduced by 60% enabling farmers to manage the cultivation with the help of their families
- Supply value-added, safer products to consumers
- The potential to export vegetables was increased
- A viable solution to climate change mitigation
- The program was further expanded by Cargills Bank with green loan facilities and Government subsidies. Furthermore, the SAPP project also implemented this methodology for 500 farmers in collaboration with the Keells Supermarket chain.
- Other institutions and projects to receive the solution as a sound model for expansion

Chandrika and Nishanthi no longer spend their entire day in the farm

Chandrika Kumari (49) and Nishanthi Nishanka (44) are two women beneficiaries of the RDALP who were traditional farmers who cultivated vegetables once a year during the monsoon season. Farming was not lucrative to them, nor was it to the other farmers here. Extreme weather conditions such as drought, market volatility (especially over production that drops prices below the cost of production), degraded lands, low productivity and high cost of production affect their crop, yield, income and lives.

In 2019 these women joined the RDALP as beneficiaries. They began a joint agricultural venture with the support of the DoA and Cargills (Ceylon) PLC. After joining the training and awareness programs organized by the project, they cleared half an acre of land to begin the first modern model farm in the area.

“Agriculture Instructors Praneeth and Prasanna of the DoA and Provincial DoA (Central) motivated us to implement this venture, assuring us of a higher yield and income. We invested money for land preparation and Cargills PLC provided a state-of-the-art drip irrigation system along with a soft loan of LKR 175 000.00 over a long repayment period, to cover other costs. We formed a farmer organization that initially consisted of 12 farmers and worked collectively, supporting each other.” they said.

“The drip irrigation system resolved the issue of water shortages; the main challenge we faced. Now we cultivate three - four cropping seasons per year and apply fertilizer through the drip irrigation system. This has reduced fertilizer usage significantly. The RDALP provided insect proof net to cover the whole farm to lessen pests and diseases. We use plastic mulch and this has cut labour costs. We can cultivate three - four cropping seasons in the same beds without land preparation. There is no need for weeding and we do not labour all throughout the day on farming. We have time to do our routine household chores - cooking, washing and attending to our children's education needs. Therefore, we see farming as an interesting and decent job now,” Chandrika said.

They have now cultivated long beans on their farm and are profiting from the seasonal short supply of vegetables, expecting a much higher price during the New Year festival season. Although most of the traditional farmers have ceased farming during this drought period, all GAP certified farmers here continue farming in their modernized farms.



Bountiful harvest of longbeans

2.5 DAIRY-CROP INTEGRATED APPROACH IN SLM

Dairy farming in the central highlands of Sri Lanka is predominantly a smallholder, mixed crop–livestock operation. Animals are mostly fed on natural grasses available in common lands and cows are reared in open areas. Cowsheds for the animals are not a consideration. Proper farm waste disposal systems are another missing aspect.

The livestock and crop farming integrated model is a profitable option for small scale dairy farmers as it enables the use of the farm waste of both systems as organic fertilizer.

Although cattle manure and effluent are good organic fertilizers for crop cultivation, many farmers do not use them properly, and dispose of them in a way that is detrimental to the environment. This results in the pollution of water bodies.



Before intervention; Kallora's haphazard 'dairy' in the foreground with his home garden in the sloping land in the background

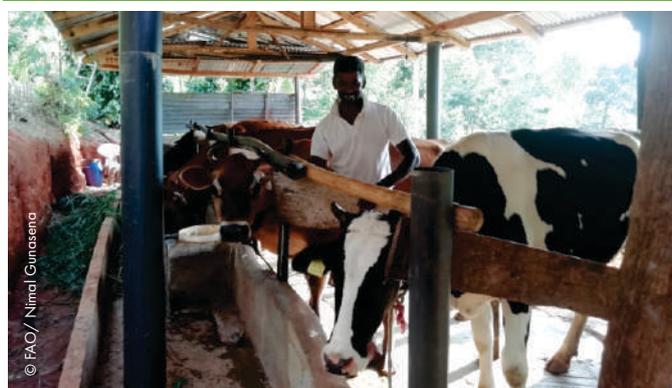
The number of smallholder dairy farmers in the country is estimated to be approximately 400 000. Unsustainable farming practices at such a large scale creates major environmental, social and economic impacts. Furthermore, dairy farming has become less profitable over time and is no longer the main source of income for most of these smallholders.

According to studies,¹ a minimum of 15 litres of daily milk production is needed to earn a reasonable income from dairy farming at the smallholder level. Therefore, at least three cows with proper shelter and feeding are required to make dairy farming an attractive and lucrative venture.

The livestock and crop farming integrated model is a profitable option for small scale dairy farmers as it enables the use of the farm waste of both systems as organic fertilizer. It also ensures sustainable management of soil and water resources and long-term sustainability of farming.

In 2018, the RDALP with the support of the DAPH and other relevant government agencies and Fonterra Brands Lanka a private company in the dairy sector, launched a new program to promote SLM among dairy smallholders in the central highlands.

This new approach is based on integrating dairy farming and crop cultivation and is targeted to increase the income of the farmers by implementing SLM practices in dairy farming and crop cultivation.



After intervention; Livestock as an integral part of SLM, now properly housed with ample food, water and shelter at all times

¹Sri Lanka : Opportunities for Dairy Sector Growth, Accessible at <https://www.fao.org/3/i0588e/i0588e08.htm>

The Approach

Doluwa DSD in Kandy is a land area that is severely degraded. What is mainly a barren land today was once where the first tea plantations were launched by the British in 1867. It has been subject to erosion and other forms of land degradation over time. Also, this is an environmentally sensitive area as it is part of the catchment of the Mahaweli River.

The lands have been degrading continuously due to farming and off farm activities. The government is now attempting to arrest the trend and rehabilitate the lands.

K.M. Shantha Kallora (43) and his wife Anula Kumari (37) are farmers. They have successfully cultivated around two acres of their land under the RDALP dairy crop integrated model. Kallora carries out tea and vegetable cultivation along with dairy farming and with the overall increase of his income and yield from his farming activities, he now feels that farming is a good, high income and sustainable occupation; especially when compared to the daily wage he used to receive as a casual labourer in the construction industry.

Kallora's land is on sloping terrain and suffers regular soil erosion. The main crop is tea with pepper as an intercrop as well as a measure of shade management in the tea plantation. He also cultivates vegetables and fruits.

Due to poor management of his land and crop, his income from farming was unsatisfactory. He had four cows reared under the semi-intensive cattle rearing method. Every morning he milks the cows and tethers them, allowing them to graze. He has to go to this site 3 – 4 times a day to change the tethering of cattle and provide fresh water for them. This process consumes 5 – 6 hours of Kallora's time each day. As a result, he is compelled to spend most of his time on dairy farming despite the low income generated from it.



Cow dung, soon to be used as organic fertilizer

Since his earnings from dairy farming is low, he worked as a casual labour on a construction site to make a living. In his absence, Kallora's wife had to look after the cattle. But due to her commitments at home, the animals often had insufficient water and food. Furthermore, Kallora did not utilize the cow dung and other farm waste for his vegetable and tea cultivations. Instead, these farm wastes were dumped in open areas and on rainy days, this resulted in polluting the water sources of the Nilambe reservoir which provides

drinking water to a large part of the Kandy town. This is the common scenario for many small-scale dairy farmers in the area. He also had to face issues such as long droughts in most parts of the year, fluctuation of rainfall and changes in the monsoon rain pattern due to the adverse impacts of climate change; all of which affect his cultivations.



Home gardening

The RDALP supported Kallora to modernize his dairy farm and introduced an integrated approach to develop his farming activities, tea and vegetable cultivation and dairy farming. Kallora's land is now being used as a model farm to train dairy farmers on SLM and on the integration of dairy farming with crop cultivation.

“ We were educated on the degraded state of soil in our lands and trained to improve soil quality implementing SLM and good agricultural practices by the FAO and government officials. Farmers were funded through the project to implement soil conservation technologies in our lands. Most of the farmers used the opportunity to develop their lands using conservation methods based on scientific farm planning prepared by technical officers,” he says.



Kallora's fertile tea land after the intervention

I started to feed my cattle in the shade and provided sufficient grass, cattle feed and water. It saved my time enabling me to dedicate myself to the cultivation. Since all the work is within my home garden, now my wife can support me. Milk production has increased by 10 litres per day (a 30% increase). I reduced unnecessary shade in my tea plantation and protected the soil by applying the conservation methods introduced by the officials. All cow dung and farm waste are collected in a small shed and used as compost fertilizer for the crops. All effluent goes through a filtering process and are used in the tea plantation as fertilizer. I pruned the neglected tea and pepper cultivations and improved management according to the instructions given by the project officers.

Now my dairy farm has been properly organized thanks to the best practices introduced by the RDALP and other agencies. The cows have proper shelter and supply of food and water and as a result they are healthy. ”

Shantha Kallora, farmer

Implementation

The RDALP introduced 12 demonstration sites to promote the crop livestock integrated model in Kandy and Badulla districts. The demonstration sites:

- Demonstrates the crop livestock integrated management system for sustainable land management
- Showcases the proper waste management mechanism for the dairy sector and thereby reduce water pollution
- Demonstrates the private public partnership for sustainable land management and economically viable production system.

The following public and private agencies partnered in the implementation of this model;

Partner Agency	Role
Department of Animal Production and Health (DAPH)	The mandatory government institution that provides technical leadership to the livestock industry and its stakeholders
Department of Agriculture (DoA)	Provides technical know-how on crop production, soil conservation and compost production
Department of Export Agriculture (DEA)	Provides technical know-how on spice production
Tea Small Holdings Development Authority (TSHDA)	Provides technical know-how on tea cultivation
Fonterra: A leading dairy product company that collects milk from dairy farmers in the project area.	Field coordination and dairy products marketing

Outcome

As a result of adopting SLM approaches demonstrated, the farmers achieved the following;

- An increase of milk production by 10 - 20% a day
- Certain farmers were able to expand their farms
- A 10 - 15% increase of income for most farmers
- Reduced wastage of cow dung and effluent. These were in turn used as inputs for cultivation or sold to other farmers
- Environment pollution on dairy farming was drastically reduced
- A cleaner environment in the household was created, ending pollution through farm waste.

2.6 SUSTAINABLE LAND MANAGEMENT IN TEA SMALL HOLDINGS

Tea cultivation was carried out in Sri Lanka since 1824. Over the centuries, land management in this sector has declined due to various reasons. The tea small holding sector has gradually surpassed the large plantation sector. With the expansion of tea small holdings in the central highlands, it too contributed to land degradation.

According to studies, tea small holdings are responsible for a significant amount of land degradation in the central highlands and a majority of these lands have already degraded. As a result, productivity and farmer income have declined as well. Considering the scale of the land area covered and the gravity of the land degradation, the RDALP project joined hands with the Tea Small holdings Development Authority (TSHDA), the government agency that supports the development of the sector, to introduce SLM in the tea smallholding sector.

With the experience of previous initiatives that introduced SLM to small scale farmers it was clear that awareness programs and lessons on land degradation issues along with its impacts to the farmers or introducing conservation methods and providing material and cash grants alone cannot persuade farmers to adopt SLM.

The RDALP approach focused on total productivity increase in tea small holdings and increase the yield as well as farmer income. This approach is considered a sustainable and market-based approach because they get a higher yield and an increased income from it. Under this approach, farmers are educated on the existing condition of their lands, reasons for low yield, how to improve productivity by implementing appropriate SLM and other management practices.



An FFS in progress in a tea plantation

The main issues identified in the tea small holdings were;

- The highly eroded lands due to the absence of conservation methods
- Low tea plant density
- Aged tea cultivation
- Low pH levels of the soil resulting in lowered fertilizer efficiency
- Poor shade management
- Poor management practices (plucking, pruning etc.)



The Lock and Spill drain used in soil conservation in the tea fields

RDALP introduced physical conservation technologies such as lock and spill drain systems, leader drain systems, Sloping Agriculture Land Technology (SALT), terraces, stone bunds etc. and provided cash grants to the farmers for soil conservation in their lands. Green manure crops were introduced to increase soil fertility, soil cover, reduce the use of weedicide and reduce soil erosion.

Most tea small holdings did not have an optimum tea plant cover and it was as low as 50% in some lands. Hence the farmer income was low and the cost was high for weeding. This also led to poor attention on the plantation.

RDALP

provided tea plants for infilling in rehabilitated and conserved lands.

As a result of low shade, in the dry season, tea yield declines and some plants had even died. Gliricidia was planted for low shade and Grevillea for high shade in the tea cultivation lands. The project also promoted intercropping with tea bushes. Fruits such as orange, pomegranate, pepper and areca nut were introduced as intercrops that provide extra income and also low shade.



Marginal tea land being improved



Infilling the existing gaps in the field with new tea plants

It also improves the soil cover of the land and promotes efficient nutrient circulation, improving a microclimate that favours tea cultivation. Simply put, a tea-based agro forest was created.

Also, the project promoted tea sector modernization with mechanization for planting hole preparation, tea pruning, and plucking. It also will reduce the labour requirement; thus saving the time for farmers which will allow them to attend to more crucial management practices. Also, the project promoted the use of safety kits for tea farmers to improve their hygiene, safety and social status and to attract the youth to the sector.



Proper methods of tea pruning

All these factors contribute to increase the total productivity of sustainably managed tea small holdings and thereby increase the yield as well as the farmers' income.



Burying tea pruning litter

The RDALP also supported the TSHDA to establish SLM training facilities for tea cultivation in the TSHDA training centre in Sooriyagoda, Kandy and the Tea Research Institute extension centre – Uva province in Passara, Badulla.

582 tea cultivation farmers were trained to implement SLM.

Pushpa Ranjaneer goes from low income and loans to an improved lifestyle and money in the bank

Women play a big role in the tea industry: In tea plantations, tea plucking and weeding are female dominant and this is common for the large plantation sector as well as the tea small holding sector. However, women's responsibility in the tea small holdings is much greater. In addition to plucking and weeding, they bear all responsibilities of maintaining small tea plots. This is evident in Pambadeniya in the Doluwa DSD in Kandy where a majority of tea small holdings are operated solely by women.

In Pambadeniya, the role of productivity improvement and SLM in the tea small holding sector is spearheaded by the Women Home Garden Society, which operates under the purview of the area Agrarian Services Centre. The women were trained on SLM practices suitable for tea cultivation through the RDALP project.

Although tea is the second largest export commodity of Sri Lanka, less and less farmers are willing to invest in the crop due to the steady decline in yield in the past few decades. An average decline of 350 – 400kg per acre has been recorded, while in some lands, it is as low as 150kg per acre. But according to the Tea Research Institute of Sri Lanka (TRI), the yield of a well-managed tea plantation could easily be enhanced to 1,000kg per acre.

Pushpa Ranjaneer of Pambadeniya is a farmer and an active member of the Women Home Garden Society. Pushpa began cultivating tea in a two-acre plot of land in 2004. However, the lack of knowledge in tea small holding and the unexpected onset of drought that lasted for longer periods affected her tea plantation which was in a state of neglect. It was in this backdrop that Pushpa joined the RDALP in 2018.

Her land was severely degraded due to soil erosion. The land did not have optimal tea plant density. Shade management and other important aspects of maintaining a healthy environment for tea had been neglected. The quality of the soil on Pushpa's land had declined because she had not applied any soil conservation methods and because of the indiscriminate application of chemical fertilizers without due consideration to the pH level of the soil and its organic matter content. The micronutrients and microorganisms in the soil had declined sharply. All this had contributed to the low yield, and therefore low income.



Ranjini in her high yielding tea plantation today, where she uses specially designed equipment including selective plucking shears

The RDALP and the Tea Small Holdings Development Authority (TSHDA), the government agency responsible for the development of tea small holdings sector, helped Pushpa and other farmers to improve their tea cultivations. A series of training and awareness programs were conducted to educate farmers on SLM and maintaining a successful tea plantation. A range of SLM technologies were introduced including organic fertilizer application, shade management, intercropping and soil conservation.

“I applied the SLM practices to my tea cultivation as recommended through the training programs. The project provided cash grants for soil conservation and fruit plants for intercropping. Tea plants were provided by the TSHDA for infilling. I used compost to improve soil quality. All these measures contributed to a high yield, income and the plants are more resilient to droughts now.” said Pushpa.

Pushpa who now engages in organic tea production said that the organic green tea leaves she harvests are able to fetch a price of LKR 110 per kilogram compared to LKR 80 per kilogram through conventional tea production. Successful tea small holding provides a stable monthly income for women and little variation take place only at extreme weather events. This has been addressed through the provision of fruit crops for intercropping which assures an income all year round. Intercropping cash crops, especially pepper and fruits not only provide an additional income but also serve as shade trees for smallholder tea plantations.

“Increased income from tea plantation enabled most of the women to come out of debt. Now they have repaid their loans and they are saving money” according to Iroshini Seneviratne, the Agriculture Research and Development Officer of the division who guides the women in this program.

Pushpa has also started a vegetable cultivation in a one-acre plot of land and maintains a vanilla cultivation in her home garden. In addition to leading the smallholder tea cultivation in Pabadeniya, the Women Home Garden Society also leads the home garden program with vanilla as an economical crop.

Empowering women in sustainable agricultural ventures such as tea can uplift the economic condition of the whole family. Better economic conditions mean better access to nutrition, and other services such as health and education for the family.

2.7 SUSTAINABLE LAND MANAGEMENT IN HOME GARDENS

Home-gardening in Sri Lanka is a major food production system that operates with the objective of achieving self-sufficiency in food. It is a sustainable food production method and is considered to be the oldest and main land use activity. According to studies in 1995 home-gardens accounted for 13.1% of the total land area of the country.²

Home-gardens still play a pivotal role in food production and with government incentives and promotional programs, the concept is on a growth trajectory. With the COVID19 pandemic, fears of food insecurity and movement restrictions were rife and home gardening became very popular.

Considering the extent of land cover in home-gardens, its contribution to food security, income generation as well as poor attention to land management, the RDALP introduced SLM practices in home gardens jointly with the Department of Agrarian Development.

Following the implementation of the program, the level of productivity in these lands has increased; and land degradation has reduced. Under the project, soil conservation methods have been introduced. New technologies, high value crops such as vanilla and compost production have begun. The project also encourages the farmers to expand their home-gardens to economic home-gardens to earn additional income.

The Department of Agrarian Development successfully conducted SLM promotion programs in the Bandarawela division under the RDALP.

²Tropical Agriculturist, Vol. 160, 2012



A flourishing home garden today

“ There are 24 GNDs in the Bandarawela division which are covered by the field officers of the Agriculture Research and Development Offices (ARDO). They provide agriculture extension services to the farmers. With the SLM promotion program of the RDALP, 29 farmer groups were requested to implement the SLM in their home gardens. ARDOs organised FFS for home gardening with the technical support of the AI of the area. The FFS was mainly focused on SLM and GAP principles. ”

Sanjima Wijekoon,
Agrarian Development Divisional Officer, Bandarawela

In addition, various group activities related to home gardening such as sharing plants, seeds and experiences began. The RDALP approach towards home gardening programs was carried out by the government. Women lead the programme and there is a significant interest from children for home gardening as well.

29 instant messaging groups for various clusters of farmers were set up and now these are used for experience and knowledge sharing, The relationship between ARDOs and the farmers have been improved. An improvement is seen in the attitudes and working patterns of the officers. Instant messaging groups enable the officers to closely engage with the farmers. This attitude change and new relations ensure the long-term sustainability of the SLM initiatives.

| Sriyani reaps the benefits of SLM from her home garden in Pabadeniya, Kandy

Sriyani Gunasekara developed her home-garden according to the instructions she received at the training and awareness programs organized by the RDALP. She owns a 15 perch property, where she grows vegetables and other crops for family consumption. She also maintains a small vanilla cultivation within this land.

“Home gardening provides fruits and vegetables for the family. This is beneficial in reducing household expenditure. I did not know anything about vanilla cultivation; but after joining the project, now I know it well. Though we still have not received any income from the vanilla crop, we expect a good return in the future” she says.

Sriyani has applied SLM technologies, especially soil conservation methods in her garden. She uses all degradable solid waste for compost production. Materials such as dry leaves, saw dust and straw are used as mulch in her garden. Sriyani and other vanilla farmers in Pabadeniya are struggling to protect their crops from the adverse effects of droughts. Water scarcity is a serious issue that they have to face. However, Sriyani says that the plants in her home-garden are more resilient to the drought now due to the SLM technologies they use.

2.8 SOIL TEST BASED FERTILIZER APPLICATION

Soil and water pollution caused by the excessive use of inorganic fertilizer has been identified as one of the main causes of land degradation in the central highlands. Farmers use excessive amounts of inorganic fertilizer to obtain a higher yield from their degraded lands. The RDALP introduced a new approach to address this issue through fertility management of the farmlands.

RDALP implemented a soil test-based, site-specific fertilizer recommendation programme in the Badulla district. This approach is an extension of the Site-Specific Fertilizer Recommendation Project (SSERP) jointly implemented by the FAO and the DoA and ended successfully in 2018. That project introduced portable soil test kits that can be easily used at farmlands to analyse nutrient content in the soil and recommend appropriate quantities of fertilizer. The project used the knowledge and experience of the SSERP to find solutions to stop soil and water pollution in the central highlands.

Portable soil test kits are used to minimize time taken to issue fertilizer recommendations. It became very popular among farmers. At the time of reporting, soil testing had already been completed for around 90% of the farmlands in the selected project implementing micro watershed areas of the district. This was an important initiative in introducing scientific agriculture for traditional farmers.

The project is implemented in four micro watersheds in the Badulla district and they are; Sapugasulpotha in the Bandarawella DSD, Dambugasagala in the Welimada DSD, Sapugolla in the Haliela DSD and Galenbindichcha Dova in the Uva Paranagama DSD. The soil in all the lands in these micro watersheds were tested and beneficiary farmers get soil recommendations and/or instructions to improve soil quality in their lands by the field officers. The pH value of the soil, as well as the phosphorus and potassium concentration are tested and all farmlands, home gardens, paddy fields, vegetable cultivation lands and tea lands were covered.

“Vegetable cultivating paddy lands are the most polluted lands in the area. These lands are used for vegetable cultivation in three cropping seasons a year and the excessive use of inorganic fertilizer leads to soil pollution. Phosphorus and potassium concentration is also high in these lands.”

Anusha Priyangani,
Agriculture Officer for Bogahakumura division

Soil test kits have been provided by the project for the Agriculture Instructors (AI) of the micro watershed areas. The responsibility of soil testing has been given to the AIs through the Provincial Director of Agriculture. RDALP also supports the farmers to rehabilitate their polluted farmlands by changing the chemical composition of the soil. The Provincial Director of Agriculture issued a report to each farmer on soil composition of their land, recommended fertilizer and other instructions to improve the soil.

Welimada is one of the main vegetable cultivation areas of the country and the lands here are subjected to severe soil erosion. As the soil fertility is low, the farmers use inorganic fertilizer excessively. According to studies,³ the use of inorganic fertilizer in vegetable cultivation in this area is two times higher than the recommended amount and it is three times higher than in Nuwara Eliya.

Incentives such as fertilizer subsidies have been given by the government to ensure that food security has been encouraged before encouraging farmers to use more inorganic fertilizer. Today, the government is introducing various programs to reduce inorganic fertilizer usage. The project encourages farmers to adopt SLM and GAP to reduce soil erosion, improve the quality of the soil and reduce chemical fertilizer use and ultimately manage their lands with the objective of long-term sustainability.

The RDALP has donated 100 soil test kits to the MoA to scale up soil test-based fertilizer application in the central highlands.

³Sri Lanka : Opportunities for Dairy Sector Growth, Accessible at <https://www.fao.org/3/i0588e/i0588e08.htm>



Soil samples being tested with mobile soil test kits

2.9 INTERSECTORAL COLLABORATION IN SLM

The most important aspect in the RDALP approach to SLM was inter-sectoral collaboration. This process is made possible by all relevant government agencies, and they collectively work with the community to carry out each task. The repetition of work and bureaucratic bottlenecks were eliminated, and decisions were taken based on practical situations. In the Dambugasagala participatory land use planning process, approximately 25 officers of 15 government agencies that are responsible for land resources management participated.

2.9.1 A Successful case – The conservation of the Dambugasagala mini watershed – Welimada

This process also enabled the stakeholders to pool their resources to implement the plan. For instance, in the Dambugasagala planning process all stakeholders agreed to conserve and develop the 4.2 hectares of degraded government land as a forest reserve. The DS resolved issues in demarcation of the forest reserve; a fence was constructed around the forest which was funded by the Uva Provincial Land Commissioner's Department; the RDALP financed survey charges for demarcation; the Forest Department supplied plants, the DS monitored planting and the village youth organization, school children and community organisations were involved in planting and maintaining the forest.

The Kalubululanda tank was restored to improve groundwater levels in the micro watershed area. This tank was originally constructed by a British planter and had been an important component in the agro ecosystem in Dambugasagala for at least 70 - 80 years of known history, according to the elderly people in the area. However, the tank had been dilapidated due to siltation, encroachment and other unsustainable land use practices in the surrounding farmlands.



Demarcation and conservation of degraded forest in Dambugasagala mini watershed; before and after intervention

Under the RDALP initiative, it was decided to reserve and conserve the tank catchment area and rehabilitate the tank. The project invested LKR 1.1 million to renovate the tank. The project interventions include

- the restoration of the tank bed by removing silt,
- construction of tank bund and spill gate,
- introducing SLM best practices including soil conservation technologies to the farmers,
- financially supporting them to implement these new technologies,
- training and awareness on SLM and value of ecosystem.

The project will benefit around 1300 farmer families.

The tank is not used for direct irrigation purposes and its main objective is recharging and enhancing ground water in the catchment area. This Percolation Tank model has been used in ancient Sri Lanka. British planters too had constructed several small tanks in the central highlands for the same purpose. Most of the lands in the Dambugasagala micro watershed are covered in vegetable cultivations while the other dominant land use/cover categories include mixed crops and tea lands. During the planning process, open scrub lands were identified which were then restored to improve the forest cover.

According to the degradation level, most of the lands were in high or medium degraded levels. A plan was prepared to convert this poorly or moderately managed lands to well managed lands using SLM best practices. The final target was to rehabilitate these high and medium degraded lands to well managed lands. The RDALP has prepared participatory land use plans for 64 micro watersheds in Kandy, Badulla and Nuwara Eliya districts in the central highlands.

2.9.2 A holistic approach for SLM –The Pabadeniya Sustainable Agriculture Village, Doluwa

During the latter half of 2017, we were introduced to the FAO project on rehabilitating degraded agricultural lands by Mr. Dayananda, the then Divisional Secretary of the Doluwa DSD. At the start, the Maligamale micro watershed area, which covers the Panvilathanna and Pabadeniya areas were selected for this project. The Kandy office of the Department of Land Use Policy Planning coordinated the involvement of all relevant organizations and the community to formulate a land use plan.

A number of good practices and strategies were introduced to improve the land productivity in the area through Sustainable Land Management (SLM). Soil conservation, the promotion of sustainable home gardening, improving productivity of the tea cultivation lands, introduction of vanilla cultivation to home garden as an economic crop, dairy farming and the conservation of an entire agriculture ecosystem were among the activities that were piloted in this DSD.

Many organizations came together and worked with one common goal; which was to promote the economic and social growth of the villagers. This, along with the enthusiasm of the villagers themselves helped in making this venture entirely successful. The concept of Farmer Field Schools (the school with no walls) was introduced to this community in the 2nd half of 2020, and this caused a monumental shift in the way that farming is done by these farmers. This process was able to disseminate agricultural knowledge through practical activities while giving priority to the existing knowledge of farmers. It became very popular among the villagers who were involved in agriculture. Three FFS groups were focused on home gardening while one was related to tea cultivation.

The use of the smart phone based social messaging platform “WhatsApp” aided in rapidly spreading this knowledge within the community, which was now banded together in WhatsApp groups. In addition, these groups tended to share experiences and seek advice while creating a healthy level of competition between the farmers. As field officers, these WhatsApp groups were immensely helpful to us too, as they helped us to get the idea of the progress that the farmers were making and quickly address the situations where improvements were required.



Ms. Iroshani Seneviratne in discussion with a group of villagers

As part of the home gardening FFS, land preparation and home garden planning, the importance of soil conservation, soil fertility management, compost production, nursery management and the development of planting materials as well as pest and disease management were learnt through practical programs. Today, every household that took part in this FFS has a well-planned home garden and produces several types of organic fertilizer. Each household also maintains a plant nursery shed that allows for a continuous supply of new plants for cultivation.



A plant nursery in every home garden

The community wanted to pass on the knowledge gained in home gardening to their main economic crop - tea. For this, an FFS dedicated to tea cultivation was established. However, due to COVID restrictions, the gathering of people to participate in the FFS became difficult. As a result, the project introduced the concept



A Giant Mexican Sunflower (වල් සුරියකන්න) green manure crop fence

of digital farm schools with the collaboration of the Tea Small Holding Authority, and it became even more popular among the tea small holding farmers than we expected. Training sessions on pruning, managing plant nutrition and facing the prevailing fertilizer issue were conducted which resulted in more than 100 farmers gaining new knowledge. Furthermore, using this new knowledge, as many as 76 farmers began making compost, compost tea and vermish. 28 farmers correctly pruned their tea lands, and implement the relevant technologies such as burial of pruning litters, soil test-based dolomite application, infilling, introducing intercropping with pepper, areca nut, vanilla etc.

Wild sunflower and gliricidia were planted along the fences as green manure crops for in-situ compost production. Most of these technologies were not practiced by these farmers before.

95 samples of soil have been tested over this short span of time, based on which assistance was given for the use of dolomite treatment.

The sense of respect and prestige that the farming profession deserves was reinstated. The farmers were, of course, required to carry out their farming work in a more systematic way. The importance of the safety of the farmers was instilled, with emphasis on wearing the appropriate protective gear when in the field.

As a result of these interventions, the District Agent for Kandy has declared the village of Pambadeniya as a model village for sustainable agriculture.

Ms. Iroshani Seneviratne
APRC, Pambadeniya and Pannilathanna Area



Correct application of fertilizer

STUDIES

The RDALP carried out four studies related to SLM in Sri Lanka.

1. Study on SLM policies - Component 1 of the project is to strengthen institutional, policy and regulatory frameworks for SLM in Sri Lanka.
2. Study on Ecosystem Valuation – Component 3
3. Study on Innovative Financing for SLM
4. Study on soil test-based fertilizer application. This study is of timely importance in the ongoing debate on the application of inorganic fertilizer.

This section provides the abstracts of these four reports.

1. Sustainable Land Management Policy and Regulatory Framework

According to the report published by the RDALP project, it has been revealed that the majority of features of SLM in Sri Lanka are already covered under existing regulatory frameworks. The issues present that aggravate land degradation are related entirely to the non-adherence as well as the weaknesses in implementing such framework. The following are the key points of this report;

- As per the power vested on the ministers of the respective disciplinary areas, amendments have been done to SLM and SLM related laws and policies in Sri Lanka at regular intervals, whenever, new issues are to be addressed. Therefore, SLM and SLM related policies are adequate and up to date.
- The report stresses that the availability of comprehensive policies and regulations does not necessarily mean that land degradation issues can be controlled fully by these regulatory mechanisms alone. The report points out various implementation issues and policy gaps.
- Inadequate legal provisions and the required regulations (e.g. not issuing the required gazette notifications), contradiction between regulations, unavailability of responsible institutions, overlapping mandates of institutions, inadequate institutional capacities are the main reasons for such drawbacks in translating policies in to action.

The report has identified the main SLM related issues seen in Sri Lanka and the reasons behind those issues; and has presented policy recommendations for the issues;

- Non-adherence to prevailing land use and environmental protection related laws, policies and regulations by individuals, institutions and businesses is the most serious issue.
- Lack of knowledge and awareness of existing policies and regulations among the public are the reasons behind the issues. To this end, the report suggests strengthening the implementation aspects of existing policies and regulations. It also suggests introducing adequate policies and regulatory measures to ensure the compatibility of other laws and policies with land use planning.
- Rapid fragmentation of agricultural, plantation, uncultivated and neglected arable lands has been identified as another key SLM related issue.
- Over application of fertilizer and chemical inputs in agricultural lands is another major issue. Harmful and illegal activities leading to water and soil pollution by industries and individuals, poor and/or inadequate soil conservation related land use practices in small scale plantations, unlawful and unauthorized natural resource exploitation, including acquirements, encroachments, illegal water abstractions and use by individuals and organizations are the other major SLM related issues recognized by the report.

The report has presented comprehensive policy recommendation to address these issues.

There is emphasis on an effective coordination mechanism for an effective implementation of SLM policies. The subject of SLM spreads over a wide array of activities, which cut-across many government departments, authorities and institutions/organizations. Therefore, the actions to be taken at the regional/provincial, district/local level by the respective stakeholder agencies need to be coordinated and monitored at the national level.

Sustainable Management of Soil fertility

The report states that soil fertility has decreased in recent decades due to indiscriminate exploitation of land resources and is a reason for the country now facing the challenge of increasing food production.

The government increased the dependency on chemical fertilizers and did not reward the farmers who used organic fertilizers. There is a need to revisit the fertilizer subsidy program and it should be re-oriented in such a way that farmers are encouraged to use both inorganic and organic fertilizers at appropriate ratios, while maintaining the productivity at an optimum level without losing yield. The eligibility criteria for a subsidy, preferably in cash, should be based on their outputs, the report said.

Financing Sustainable Land Management

The report identified SLM as a public good since the market economic system fails to finance the SLM. Given this status, SLM must be publicly financed. An establishment of an SLM fund, clearly identifying the mechanism to acquire funds and priority investments, is recommended by the report.

The team of experts consist of Prof. Nimal Gunawadana, Senior Professor of the Faculty Agriculture, University of Peradeniya, Kapila Munasinghe, Former Additional Director of the Natura Resources Management Center (NRMCM) and Dr. Sunil Thrikawala, Senior Lecturer, Open University of Sri Lanka.

2. Valuation of Ecosystem Services

The study 'Ecosystem Services Assessment in Selected Agricultural Lands in Kandy, Badulla and Nuwara Eliya Districts of Sri Lanka' carried out by the International Union for Conservation of Nature (IUCN), Sri Lanka on behalf of the RDALP project and under the guidance of the Land Resources Division of the MoE was a pioneering attempt to value the services provided by agro-ecosystems in the micro catchment areas in the central highlands of Sri Lanka.

The economic value of the ecosystem services provided by 1 acre of general cropland in the central highlands is estimated at LKR 79 000 per year. This can be significantly increased by adopting SLM best practices to reach as much as LKR 225 000 per annum.

The study was carried out in selected farmlands of three districts in the central highlands, Kandy, Badulla and Nuwara Eliya, where the project is implemented. By calculating the total economic value including ecosystem benefits of agricultural lands and mini catchment areas, the project attempted to introduce new financing mechanisms for SLM based on this new approach.

The ecosystem services concept came about as a means to communicate society's dependence on ecological systems for their own wellbeing. Biodiversity and ecosystem services are often considered public goods. Therefore, the cost of destroying or damaging ecosystems are passed on from the user to society.

This ecosystem valuation process attempts to give monetary, biophysical or other value to an ecosystem and ecosystem services provided by them. This study attempted to give monetary value to the ecosystem of a farmland and a mini-catchment area where the farmlands are located and point out how these values increase in well managed farmlands that use SLM best practices.

According to this study, the total economic value, including ecosystem benefits, of one acre of general cropland in the central highlands of Sri Lanka is estimated as high as LKR 79 000 per year, and it can be increased significantly by adopting SLM best practices. The total economic value, including ecosystem benefits by one acre of a well-managed home garden that use SLM best practices was calculated at LKR 225 000 per annum.

One of the responsibilities of the RDALP was to introduce innovative financial mechanisms for SLM in Sri Lanka. The central highlands of Sri Lanka has faced a higher level of soil degradation, and the lack of financing is one of the main barriers to promoting SLM best practices among farmers. Through this valuation exercise, the RDALP attempts to educate farmers on such services and stress the importance of adopting SLM best practices.

The study also assessed perceptions of the farmers on ecosystem services/disservices of agricultural lands. Therefore, the findings of the study will help to educate the farmers on the total benefits they receive individually and as a society and encourage them to develop innovative financing mechanisms for SLM.

The report points out previous studies that focused on environment cost of poorly managed agricultural lands. Some studies have calculated the costs to the farmer by poorly managed lands.

A study by Samarakoon and Abeygunawardena (1995) considering soil erosion, valued the cost of the impacts of soil erosion to potato cultivation in the Nuwara Eliya District. It was found that 9 - 15 tons of soil per hectare was lost depending on the season and based on this, the NPK and organic matter lost was calculated. The study estimated the replacement cost ranges from LKR 2305 - 3443 per hectare.

Similarly, Premachandra and Kotagama (1995) assessed the onsite impacts of soil erosion in tea lands in the Kandy District, and found that the cost of erosion is LKR 1.56 million/year.

Dharmasena and Bhat (2011) assessed the nutrient losses from soil erosion and estimated the replacement cost for one hectare of old seedling tea fields at LKR 18 011 per year, and for vegetative propagation fields as LKR 8270 per year. However, this RDALP-IUCN study attempted to focus on an environmental benefit-based approach. Some of the important ecosystem services that are considered in this study include, sequestering carbon, pollination and seed dispersal, aesthetic value, soil retention, water purification, water flow regulation, timber, fuel wood etc.

The study has estimated the total economic value (TEV) from a general agricultural land at around LKR 79 000 per year per acre. This include approximately LKR 25 000 worth of water quality and purification benefits, about LKR 6000 worth of air quality benefits, LKR 10 000 worth of climate regulation benefits and about LKR 17 000 worth of soil fertility benefits per year.

The TEV of one-acre home garden was calculated as LKR 225 000 with ecological benefits; around LKR 4000 worth of pollination benefits and about LKR 177 000 worth of carbon sequestration benefits per year.

According to the study report, the main reason for not adopting SLM practices in the project areas is a lack of awareness among the farmers. Agricultural lands produce a disservice of water pollution due to current practices, and eco-certification could potentially address this issue.

However, unlike these farmlands, paddy lands have a higher educational value as they utilize the SLM practices relevant to this crop. Further understanding into the transfer of knowledge in paddy cultivation may aid in the adoption of SLM in other lands, the report points out.

Finally, while tea and paddy lands have a higher aesthetic value, home gardens have more biodiversity and there may be potential for agro-tourism based financing mechanisms to be implemented.

In order to conduct a full ecosystem service assessment, temporal and spatial variations must be taken into consideration, the report says.

The comparative study of well-managed lands and the poorly managed lands highlight the ecosystem services that can be generated with good agricultural practices. A generalized valuation highlights that these ecosystem services have significant value for both society as well as for farmers and landowners. Therefore, encouraging farmers to adopt SLM practices on their farmlands can generate both private and public values, the report concludes.

3. Innovative Financing Mechanisms for SLM

Payments for ecosystem services have been identified as one of the best Innovative Financing Mechanisms (IFM) by a study conducted by the RDALP. The International Union for Conservation of Nature (IUCN) Sri Lanka conducted the study on behalf of the RDALP. The following are extracts from this report.

Financing mechanisms are innovative as they provide new resources for a particular development objective. In the field of agriculture, IFMs can generate new resources or increase the transfer of existing resources to promote agricultural practices that are sustainable and that will conserve and enhance the delivery of agricultural ecosystem services.

According to FAO estimates, the global food and feed production needs to increase by 60% by the year 2050 to meet global demand. Every country must increase their food production accordingly. It is crucial to ensure food security in all countries.

Agricultural production in Sri Lanka is the backbone of the economy and it mainly consists of small-scale farmers. Approximately 80% of the country's population lives in rural areas, and almost half of the rural poor are small scale farmers. To increase food production and improve their income and living standards, new investments are needed to increase agriculture productivity. The application of SLM in agricultural lands is crucial for increasing agriculture productivity. There is a dire need of new investments for SLM in Sri Lanka.

One of the underlying reasons for the insufficient investment on SLM is that the Government of Sri Lanka (GoSL) and the farming community have not accounted adequately for the real cost of land degradation and the benefits of SLM to individuals as well as the economy. In effect, the costs of not implementing SLM is borne by the society and the common benefits of adopting SLM are not fully valued directly by farmers or landholders.

Therefore, there is a critical need to understand the on-farm and off-farm effects of land degradation and evaluate the ecosystem services generated by well-managed agricultural lands, so that such information can be used in developing appropriate financing mechanisms to promote SLM. Furthermore, as investments in SLM generate greater social benefits compared to short-term individual gains, there is a rationale to encourage and provide incentives to smallholder farmers to utilize sustainable practices on their farmlands.

Developing IFMs can provide further assistance (financially or in kind) to farmers to help them overcome certain transaction costs, while also facilitating financial institutions to overcome uncertainties and risk related to the agriculture sector. It is expected that by operationalising IFMs individually or collectively, farmers can be encouraged to conduct SLM practices on their lands by building on private sector investments and/or government funds.

Payment for Ecosystem Services

The report points out that Payment for Ecosystem Services (PES) is a good approach that gives positive incentives to change the behaviour of land users to better manage ecosystems.

In a PES scheme, the beneficiary or user of an ecosystem service pays the provider (monetarily or in-kind) to ensure the provision of that service through better management.

The report stated that there is potential for the development of PES schemes in Sri Lanka. It highlighted a case study, the Ganthuna Mini Hydropower Project was identified as a model, with potential for similar schemes in the Kandy, Badulla and Nuwara Eliya Districts being observed.

The Ganthuna Mini Hydropower Project is located in the upper catchment of the Gurugoda Oya basin, which is a principal sub river basin of the Kelani river. In this IFM scheme, the hydropower operator provides financial inputs to upstream farmers and communities to better manage their lands and restore the catchment areas. In return, the hydropower operator benefits from the ecosystem services - a steady flow of good water quality.

Reallocation of Public Budgets

The report suggests the reallocation of public budgets as an IFM. The study mainly focused on the fertilizer subsidy provided by the government for inorganic fertilizer used in paddy cultivation. The report also points to various previous studies on this fertilizer subsidy scheme to highlight its positive and negative impacts to the economy and ecosystem. This financial subsidy for yield enhancing inputs is neither cost effective nor sustainable.

The reallocation of public budget is considered under the broad umbrella of IFMs. However, developing such an IFM and implementing it in Sri Lanka would be complex due to the various institutions involved as well as the existing structural hurdles, the report stated.

Sustainability Standards

A sustainability standard is a set of rules or principles that define good environmental and social practices for producers, traders, retailers, manufacturers or service providers to follow. They can be applied for farm products. Such standards are already in place. For example, the Fair-trade Certification and Good Agricultural Practices (GAP) certification in Sri Lanka recognize farmers who ensure quality and safety of agricultural commodities. The RDALP supports the GAP program of the Department of Agriculture and Sarubima - the agriculture modernization project of Cargills PLC to introduce SLM to vegetable farmers in the central highlands.

In this approach, the RDALP has already proved GAP as an effective IFM. The voluntary certification promotes agribusiness by increasing market linkages, increasing the profits of farmers and encouraging farmers to adopt sustainable practices. This can be done in formal ways such as certification, branding and labelling or via informal ways with mutual trust between the farmer and purchaser of the products.

Agro -Ecotourism

Considering the aesthetic value of farmlands and the damages that unsustainably maintained lands add to the ecosystems and environment, there is potential of combining tourism with SLM. Tourism mainly depends on aesthetic values of the ecosystems which is the main tourist attraction in the central highlands of Sri Lanka.

The report highlights eco-tourism options such as spice gardens, tea plucking and organic farming as potential areas for the development of financing mechanisms. In addition, partnering with hotels pursuing sustainability will provide opportunities for direct market linkages, where the farmer has an incentive to pursue SLM practices and the hotel can advertise a farm to table concept, the report said.

Corporate Social Responsibility (CSR)

CSR helps companies live up to their responsibilities as global citizens and local neighbours. A coherent CSR strategy, based on integrity, sound values and a long-term approach, offers clear business benefits to companies and a positive contribution to the well-being of society and the planet as a whole. CSR includes business process re-engineering as well as the funding of charitable activities which could be directed towards the promotion of SLM practices in agriculture.

Risk Schemes

The report recognizes Disaster Risk Insurance schemes (against a premium) which cover the costs incurred by the insured entity from extreme weather and natural disasters such as drought and floods, as an IFM. If the risk occurs, the insurer refunds a percentage of the costs incurred.

Insurance schemes are widely used to increase household and enterprise resilience to external shocks by reducing future expenditure. Environmental risk insurance schemes cover environmental liabilities such as financial risk associated with environmental pollution and contamination in exchange of a premium. In addition, to prevent future expenditure to realize and reduce business risks, they provide contingent resources for immediate remedial action in the event of an environmental disaster.

Green Lending

Lending facilities by banks or other lending schemes with conditional criteria for environment protection and SLM have been proposed as IFM in the report. These criteria can include an identified sub-sector such as climate change adaptation or reference to certain best practices such as certification of sustainable agricultural/forest management practices.

4. Policy recommendations for the promotion of soil test based fertilizer application

The application of chemical fertilizers on site-specific basis is beneficial in terms of farmer's economy, environmental sustainability and most importantly to relieve the heavy burden to the Sri Lankan economy for importing chemical fertilizer, a study has revealed.

The study "Present Status and Future Directions on Adoption of Soil Test Based Fertilizer Recommendations in Food Crops" was conducted by the RDALP project together with other stakeholders.

The study report states that since Sri Lanka is an import-dependent market for chemical fertilizer, any technique or procedure, which encourage the thrift use of chemical fertilizer, without adversely affecting to the productivity of crops, needs to be encouraged to ensure the economic prosperity of the country through more efficient fertilizer use. However, to achieve maximum benefits from site specific nutrient management, four principles (right product, rate, time and place) of nutrient management need to be followed.

The study was carried out in Welimada, Nuwara Eliya and Hangeranketha DSDs of the Central and Uva Provinces of Sri Lanka.

The study aims to address the issues of general fertilizer recommendations for food crops in Sri Lanka. DoA has introduced and carried out a soil test-based fertilizer recommendation programme. This study attempted to identify the present status of the above soil test-based fertilizer recommendation programs and to suggest future directions towards addressing the constraints.

For this purpose, four field activities, namely

- i. online meetings with project stakeholders,
- ii. key informant meetings
- iii. field surveys
- iv. focus group discussions with stakeholders from the government and private sector were conducted.

A structured questionnaire-based field survey with farmers was conducted in the focus areas in 2020. Further, the issues related to soil fertility decline in agricultural lands, leading to land degradation and restoration of soil fertility in degraded agricultural lands were also considered in this study.

The study report pointed out that out of 14 land degradation processes dominantly taking place in the country, 9 (nutrient depletion, loss of organic matter, eutrophication, soil acidification, soil salinization, soil alkalization, soil pollution, soil compaction and soil crusting) are directly related to the soil fertility management, soil testing and soil test-based fertilizer recommendation.

Although, many farmers in Sri Lanka follow the fertilizer recommendations issued by the DoA, there are instances of deviations, especially in intensive vegetable and potato cultivating regions of the Central and Uva provinces. Therefore, there is an urgent need of formulating fertilizer recommendations acceptable to all farming communities of the country since the fertilizer recommendation is the key to the soil test-based fertilizer recommendation, the report says.

The report gives important recommendations related to enhancing the adoption of soil test-based fertilizer use for food crops in three sectors: research, development and policy.

Research Sector

The research sector includes activities such as soil testing and making site specific fertilizer recommendations, development and testing of new soil and plant testing methodologies. It also covers conducting fundamental and basic research related to fertilizer use in food crops, coordinating adaptive research related to fertilizer use in farming villages. Formulation of soil test-based fertilizer recommendations for food crops and periodic revision of the recommendations have also been considered with the agronomic and economic changes. Recommendations given to this sector by this study are listed below.

- Separate criteria to be used in formulating fertilizer recommendations for high input and low input categories of crops.
- Regular revision of fertilizer recommendation to address the changing needs of nutrients in different crops.
- Need of micronutrient requirement to be investigated.
- Research to develop alternative methods for recommending nitrogen requirement.
- Research on new generations of fertilizer
- Research for inclusion of organic manure to recommendations
- Site specific fertilizer recommendations based on soil fertility map information.
- Research to include fertigation technology.

Development sector

The development sector includes activities such as plot level and yaya based testing of fertilizer related research recommendations and sending the feedback to the research sector. It also covers training field staff on soil sampling techniques, soil sampling in farm fields, interpretation of soil test-based recommendation results to farmers and providing necessary facilities to ensure smooth implementation of the soil test-based fertilizer recommendation program in the field and following recommendations have been given.

- Comprehensive training for village level extension staff regarding soil sampling techniques.
- Facility to purchase appropriate fertilizer mixture from the market by producing the soil test report to fertilizer dealer.
- Provision of weighing scales to farmers
- Need of minimizing the time taken to issue soil test reports for farmers.
- Bridge the gaps in technology transfer to farmers regarding site specific fertilizer use
- Inclusion of soil test-based fertilizer recommendation technology for GAP certification programme

Policy sector

The policy sector includes activities such as periodic revision of the Regulation of Fertilizer Act, No. 68 of 1988, formulation of regulations under the above Act, smooth implementation of the provision available in the said Act and periodic inclusion of relevant sections to the National Agriculture Sector policy. The proposed recommendations are;

- Implementation of provisions available in the Regulation of Fertilizer Act (No. 69 of 1988)
- Site specific fertilizer recommendation program to strengthen the national fertilizer subsidy scheme
- Manufacturing or importing soil test kits with only necessary chemicals to reduce the unit cost

Glossary

- Fertigation - A method of fertilization application in which fertilizer is incorporated within the irrigation water by a drip system
- GND - Grama Niladhari Division. This is the smallest administrative unit in Sri Lanka
- Percolation Tank model - An artificially created surface water body, submerging in its reservoir a highly permeable land, so that surface runoff is made to percolate and recharge the ground water storage. Percolation tanks are mostly earthen dams with masonry structure only for spillway.
- pH value - Potential of Hydrogen; this is a scale used to specify the acidity or basicity of an aqueous solution.
- SALT - Sloping Agricultural Land Technology. This is a technique introduced to sustain fertility and reduce erosion of the soil in cultivated, sloped lands.
- Uva Province - One of the 9 largest administrative areas that Sri Lanka is divided into. The Uva province is on the southeastern part of the central hills of the country.

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