MINISTRY OF IRRIGATION
MINISTRY OF AGRICULTURE

# NATIONAL GUIDELINES FOR CLIMATE SMART AGRICULTURAL TECHNOLOGIES AND PRACTICES

## FOR THE DRY AND INTERMEDIATE ZONES OF SRI LANKA

**SUMMARY**

Ministry of Irrigation & Ministry of Agriculture

**2021**

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CRIWMP

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குளங்கள் கிராமங்களின் மறுமலர்ச்சி

NRMC

GREEN CLIMATE FUND

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# FOREWORD

The extreme climate aberrations, such as long spells of drought and high intensities of rainfall, result in higher temperature occurrences and floods in Sri Lanka. The resultant negative impacts on Sri Lanka's Dry and Intermediate zone cultivations, and thereby on the respective communities, prompted the Ministry of Agriculture to seek expert views on switching to agriculture practices that can withstand drastic climate uncertainties. Developing guidelines to help the respective stakeholders in Sri Lanka's Dry and Intermediate zones in the implementation of these Climate Smart Agriculture practices, thus became a vital need.

The Ministry of Agriculture highly appreciates the assistance provided by the United Nations Development Programme, Sri Lanka, through the Green Climate Fund (GCF) to develop the *National Guidelines for Climate Smart Agricultural Technologies and Practices for Sri Lanka's Dry and Intermediate Zones*.

The Expert Group and the Technical Advisory Committee appointed for this task worked with the respective regional government staff, farmer organisations and other members in the communities, to produce this set of guidelines and the training manual.

The publication, on all aspects of CSA technologies and practices, and its *Training Manual for the Agricultural Extension Staff* to be used in awareness programmes for the farming communities, are the outcomes of the collective effort of these teams' hard work. This summary has been produced in order to make the National Guidelines more comprehensible and workable at field levels.

I am hopeful that the planned training programmes and activities would help enhance not only the total ecosystems of Sri Lanka's Dry and Intermediate zones, but also the livelihoods of farming communities and working environments of other respective service providers in these areas.

Prof. Udith K. Jayasinghe
Secretary
Ministry of Agriculture

# FOREWORD

Man adapting to an agricultural way of life is a significant milestone in the evolution of human civilization. Overtime, they identified the different climate and weather patterns and adapted their agricultural practices-accordingly. They were adapting to the climate conditions and became successful through a coping meshanism. However, the modern human civilization had to face the challenges of climate changes that affected their entire life patterns. It becomes obvious that this mechanism was not adequate to adjust to the extreme weather conditions that resulted from climate changes.

The intensity and frequent incidence of the climate change which had .. taken a long time to recover was another challenge. It is extremely difficult to control and challenge the geographical factors that affect the climate change. Under these circumstances there is no other alternative except adjusting for the climate changes. Hence, it becomes essential to use climate smart recovery practices. Even though the Climate Resilient Agriculture that was introduced to the agricultural sector enbanced the production and the resilience capacities, the issue of greenhouse gas emission has not been addressed.

The win-win mitigation methods also helped to increase the production capacity and greenhouse emissions, but, doesn't seem have paid attention to adaptation. In this background, there emerge the timely need for a Climate Smart Agriculture that could address simultaneously the need for the enhancement of production and resilient capacities minimizing the greenhouse gas emissions as well. This is not really strange concept as is a methodology aligning the conventional wisdom and the experience the man had accumulated until today in a more appropriate manner. It is not an individual or a negotiating process or a product. This is an approach to identify the resilience systems that existed traditionally within the community to

empower and plan by aligning with the modern socio-economic systems. Climate Smart Agriculture is a more practical solution for the ch?llenges faced by agriculture sector due to climate change.

The national climate smart agriculture guidelines and the training aid has been designed by the Natural Resources Management Centre of the Ministry of Agriculture and Department of Agriculture. This has been designed through a consultative process involving stakeholders at national and local levels. This guideline has been developed under the supervision of a specially established scientific and advisory committee, with a view to understand in identifying the climate changes in our country and how they impact the agriculture sector, and how the agriculture sector should be planned accordingly. This process also provides a correct direction for the planning process in agricultur sector.

In addition, the training aid developed along with the National guidelines has been recommended by the Ministry of Agriculture for the use of relevant projects. This has also been recommended to use as a planning tool for the regional agricultural institutions as well. The Climate Smart Agriculture National Guideline and the Training Manual will be a nationally important approach and a tool.

Anura Dissanayake
Secretary
Ministry of Irrigation

# MESSAGE FROM THE DIRECTOR GENERAL OF AGRICULTURE

Sri Lanka, as a climate-sensitive country in Asia, has given high priority to identifying possible climate-related disasters, in order to develop plans to mitigate the negative effects on agriculture, ecosystems, and social and economic wellbeing of Sri Lankans.

In this regard, the Ministry of Agriculture has identified three sensitive river-valley basins in the Intermediate and Dry zones – namely, Malwathu Oya, Mi Oya and Yan Oya – as target areas for detailed studies, due mainly because of their high dependency on climatic factors for farming and hence, the social life. This is to remodel the infrastructure of these settings, considering the views and suggestions of the experts, government employees, service providers and farming communities.

The team of experts entrusted to develop guidelines for Climate Smart Agriculture, in consultation with a 26-member Technical Advisory Committee, has undertaken extensive studies to view the inherent features of these river-valley basins and the farming systems that evolved over centuries. Based on these observations, the team has set out national guidelines with recommendations for implementation, and a Training Manual for the Extension Agriculturists to follow in the training of farmers, school leavers, village communities and other partners involved in developing Climate Smart Agriculture systems in these areas. This Summary of CSA Guidelines is expected to serve the field level stakeholders, better understand and work with the CSA interventions.

I take this opportunity to extend my sincere appreciation to the United Nation Development Programme in Sri Lanka and the Green Climate Fund (GCF/UNDP/CRIWMP), for the financial and technical support extended to initiate this humanitarian programme in Sri Lanka.

Dr W M W Weerakoon
Director General
Department of Agriculture

# MESSAGE FROM UNDP

2020 is a momentous milestone, as we enter what is called the 'Decade of Action'. Sri Lanka is making considerable strides to achieve the Sustainable Development Goals (SDGs) by 2030. Nevertheless, challenges posed by the effects of climate change toughens this endeavour, particularly on the goals related to sustainable agriculture and food security, due to the long-term and gradual changes occurring in global climate. According to global climate risk indices, Sri Lanka is highly vulnerable to climate change induced extreme weather events and climate variability.

Given that agriculture is one of the most significant sectors in Sri Lanka, with nearly 1.6 million smallholder farmers reliant on it for their livelihoods, the national need is to mainstream climate change adaptation in the development process. In this context, the introduction of the concept of Climate Smart Agriculture (CSA) is regarded as an approach to transform the country's agricultural systems, to effectively support farmers in their livelihoods and to ensure food security, while reducing the greenhouse gas emissions.

I am confident the guidelines developed will support the relevant authorities in making informed decisions on working towards being climate smart in agricultural interventions, and to strengthen the resilience of the farmers in Dry and Intermediate zones to climate variability and extreme events.

I thank the Government of Sri Lanka for collaborating with the UNDP on this through the Climate Resilient Integrated Water Management Project funded by the Green Climate Fund. With over 50 years of experience in serving as a key development partner, UNDP is pleased to be a part of building the resilience of smallholder farmers.

Robert Juhkam
Resident Representative
United Nations Development Programme, Sri Lanka

# MESSAGE FROM THE PROJECT DIRECTOR

The Climate Resilient Integrated Water Management Project (CRIWMP), locally known as "Wevu Gam Pubuduwa", was launched in 2017, covering seven districts in the Dry zone of Sri Lanka. The project aims to strengthen the resilience of vulnerable smallholder farmers, particularly women, who are facing increased risks of rising temperatures, erratic rainfall patterns and other extreme events related to climate change.

Amongst numerous activities which improve the resilience of climatic vulnerable farmers, measures to enhance the agriculture-based livelihoods of smallholder farmers have taken a very significant place. Therefore, in order to provide holistic and persuasive solutions to smallholder farmers in the Dry and Intermediate zones, the Climate Smart Agriculture (CSA) concept and approach was adopted. The CSA approach was highly recognised for its strength in improving climate resilience, productivity, and food security, while reducing the emission of greenhouse gases.

The Ministry of Agriculture has recognised the need for a common framework for implementing CSA in Sri Lanka. As the Project Director of CRIWMP, I was privileged to offer the project support to develop these national guidelines for streamlining CSA in Sri Lanka. I am confident that these Guidelines, Training Manual and this Summary would be of immense use for national and provincial level agricultural agencies, as well as for existing and future agriculture development projects in Sri Lanka. I take this opportunity to extend my sincere appreciation to all the government agencies that contributed to develop these important guidelines, which will be adopted in the Dry and Intermediate zones of Sri Lanka from year 2020 onwards.

Eng. Chandana Edirisooriya
Project Director
Climate Resilient Integrated Water Management Project

# ACKNOWLEDGEMENTS

The ***National Guidelines for Climate Smart Agricultural Technologies and Practices for the Dry and Intermediate Zones of Sri Lanka*** and ***Training Manual on Climate Smart Agriculture*** are the outcome of an extensive study undertaken by a team of experts nominated by the Ministry of Agriculture under the United Nations Development Programme in Sri Lanka. The study was financially sponsored by the Green Climate Fund (GCF/UNDP/CRIWMP). The summary of CSA Guidelines is aimed at making the guidelines more comprehensible for field levels.

The key objective of this project is to train the farming communities and the relevant service providers in the implementation of the recommended Climate Smart Agriculture interventions. The interventions are meant to upgrade livelihoods of the farming communities and maximise the work efficiency of relevant service providers in the relevant areas.

With the confidence gained through the initial stage of the project, I am positive that the planned activities would help fulfil the desired goal of achieving Sri Lanka's climate smart agriculture.

I am thankful to the Provincial Agricultural Directors and staff members working in the three river basins for their valuable contribution to this study. I also greatly appreciate not only the expertise provided by the Expert Group, but also its members' challenging work aimed at collecting the insights on existing agriculture systems in the project areas. I am also grateful to the members of the National Technical Advisory Committee for their valuable input, and support provided to complete these working documents successfully. My gratitude also goes to the officials of respective government institutions and civil society Organisations for the information shared and the positive suggestions made to meet the expected targets of the project. I am, to conclude, extremely grateful to the GCF/UNDP/CRIWMP staff for the technical and financial support extended to complete this task.

Shantha Siri Emitiyagoda
National Consultant, Climate Smart Agriculture
Climate Resilient Integrated Water Management Project

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**Dr B V R Punyawardena** - Climate and Climate Change

# ACRONYMS

**AWS**
Automated Weather Station

**CC**
Climate Change

**CSA**
Climate Smart Agriculture

**CF**
Conservation Farming

**CRIWMP**
Climate Resilient Integrated Water Management Project

**DOFC**
Department of Forest Conservation

**EG**
Expert Group

**DAD**
Department of Agrarian Development

**DoM**
Department of Meteorology

**DoA**
Department of Agriculture

**DoI**
Department of Irrigation

**DS**
Divisional Secretary

**FAO**
Food and Agriculture Organization

**FIM**
First Inter Monsoon

**GCF**
Green Climate Fund

**GHG**
Greenhouse Gas

**MASL**
Mahaweli Authority of Sri Lanka

**NTAC**
National Technical Advisory Committee

**NEM**
North East Monsoon

**NRMC**
Natural Resources Management Centre

**OFC**
Other Field Crops

**SIM**
Second Inter Monsoon

**SWM**
South West Monsoon

# 1

# National Guidelines for Climate Smart Agricultural Technologies and Practices for the Dry and Intermediate Zones of Sri Lanka

Agriculture in the Dry and Intermediate zones of Sri Lanka became the most affected by the recent extreme climate aberrations due to the sector's heavy dependence on climatic factors. Long spells of droughts and high-intensity rainfall causing higher atmospheric temperatures and floods became quite common in the country. The severe drought during the period of 2015 - 2018, compelled the farmers in the Dry and Intermediate zones of the island – particularly in the river basins of Malwathu Oya, Mi Oya, and Yan Oya– to abandon four consecutive seasonal cultivations, thereby making them rely on the state-sponsored relief services. Thus, arose the need for the respective agriculture authorities to turn to Climate Smart Agriculture (CSA) options and then to work on the required guidelines to follow while practising CSA applications. The development of National Guidelines for Climate Smart Agriculture interventions therefore became a timely need.

The National Consultant for the United Nations Development Programme in Sri Lanka, through the Green Climate Fund, in collaboration with the Natural Resources Management Centre (NRMC) of the Department of Agriculture and the Expert Group (EG), compiled the National Guidelines. Detailed studies relating to the National Guidelines were carried out by them in the basins of Malwathu Oya, Mi Oya, and Yan Oya that had been previously chosen mainly due to the high dependency of the respective river basin communities on the climatic factors for agriculture. The study consisted of several components such as field visits to the three river basins and extensive fact-finding missions. Previous exposure of EG

members to replicable CSA practices in other countries also became useful in the preparation of the National Guidelines.

A National Technical Advisory Committee (NTAC) appointed by the Ministry of Agriculture, with the inclusion of officials representing the most relevant national and provincial agencies, also played a crucial role in the compilation of the National Guidelines. (Please note: NTAC members are listed in this document). The NTAC also recommended that these guidelines could be used as a *National Techno-Guide* related to CSA.

The outcome of these endeavours are published as the National Guidelines for CSA Technologies and Practices, and the Training Manual on CSA.

**National Guidelines contain the following chapters:**

I. Introduction: Key challenges faced by Sri Lanka's agriculture sector with special reference to Malwathu Oya, Mi Oya, and Yan Oya river basins

II. Existing practices in agricultural production systems and recommendations for the future

III. Climate Smart Agriculture (CSA) applications in other countries

IV. CSA adoption in the Dry and Intermediate zones of Sri Lanka with special focus on the basins of Malwathu Oya, Mi Oya and Yan Oya: Enablers and challenges

V. Recommended technologies and practices on Climate Smart Agriculture interventions

During the consultation process the Provincial Directors of Agriculture in the four respective provinces – namely Eastern, Northern, North Central and North Western – developed a plan for pilot testing of CSA practices. This was implemented during the Yala Season of 2019 in the respective provinces. The findings of the pilot scale testing of these CSA practices were used for readjustment and endorsement of CSA Technologies and Practices presented in this document.

On the usage of the Training Manual, a few programmes of Training of Trainers (TOT) were conducted in five districts – namely Anuradhapura, Kurunegala, Puttalam, Trincomalee and Vavunia – to train the extension officers and other relevant officers on the proposed CSA practices.

Results of the aforementioned processes are published by the Ministry of Mahaweli, Agriculture, Irrigation and Rural Development.

# 1.1

## KEY CHALLENGES FACED BY SRI LANKA'S AGRICULTURE SECTOR WITH SPECIAL REFERENCE TO MALWATHU OYA, MI OYA AND YAN OYA RIVER BASINS

Sri Lanka enjoys a tropical monsoonal climate. It experiences a wide range of topographic features with three distinguishable elevation zones within the island: the central highlands, the plains, and the coastal belt. Despite its small size, Sri Lankan land mass exemplifies a variety of climatic conditions, depending on the geographical setting and elevation. Out of the four rainfall seasons, two consecutive rainy seasons define the major cultivation seasons of Sri Lanka, namely Yala and Maha seasons.

Sri Lanka's climate has traditionally been divided into three climatic zones based largely on the annual rainfall – Wet zone, Dry zone and the Intermediate zone. There are about 103 distinct major river basins in Sri Lanka. Out of these 103 river basins, Malwathu Oya, Mi Oya and Yan Oya are mainly spread across Sri Lanka's Dry zone, where annual average rainfall is less than 1,750 mm with a distinct dry period from May to September. Malwathu Oya, at 164 km in length, is ranked the second longest river in the island. Mi Oya originates from the hilly regions of Dambulla, located on the boundaries of Matale, Kurunegala and Puttalam districts, has a river course of 109 km. Yan Oya originates from the hilly areas in the Matale district and is 142 km long. The catchment area of Yan Oya is about 1,598 $km^2$ spreading mainly across the North Eastern part of Sri Lanka.

Agriculture has been the mainstay of the Sri Lankan economy for centuries. Both rain-fed and irrigated agriculture form the backbone of rural livelihoods. Rice is the main crop in the domestic sector, and its cultivation is the most important economic activity for the majority of people living in the country's rural areas, including the project area. Furthermore, it is the single most important crop occupying an approximate total area of 0.885 million ha (Department of Census & Statistics 2015). At present there are 885,000 ha asweddumized rice lands in the Island (Dept of Censu & Statistics 2015). Majority of this land extent is located in the Dry and

Intermediate zones of the country.

Sri Lanka's agriculture sector faces several challenges. The key challenges are identified as: persistent poverty, high production costs borne by the farmers, non-existence of market-oriented production, threat from wild animals and stray cattle, increased incidences of pests and diseases, shrinking of arable land, changing and variable climate, unplanned development interventions, inadequate use of machinery, land tenure problems, slow advancement and inadequate adoption of technology, and diverse and marketing issues such as low prices. The list of challenges continues with the lack of storage facilities for agricultural producers, lack of quality seeds, increasing negative impacts on the environment caused by the indiscriminate use of agrochemicals, the increasing demand for safe and quality food, low efficiency of irrigation water use, damage to irrigation infrastructure, rapid degradation of natural resources base, salinity build-up, over-exploitation of groundwater and lowering of groundwater tables, lack of reliable seasonal climate forecasts, absence of farmer-friendly insurance schemes, sand mining in cultivable areas, and the lack of coherent national agricultural policies addressing the challenges in Sri Lanka's agriculture sector.

In summary, Sri Lanka's agriculture sector is mostly affected by Climate Change. This is evident from the rising atmospheric temperatures and erratic rainfalls in the country. Climate Change and its effects intensify the adverse impacts of many other challenges faced by the agriculture sector. Therefore, Climate Change adaptation is identified as the key strategy to sustain agriculture in the Dry and Intermediate zones of Sri Lanka. Rain-fed and minor irrigated agriculture sub-sectors are highly vulnerable to Climate Change impacts and hence, the implementation of adaptation activities is a priority for those sub-sectors.

# 1.2

## EXISTING PRACTICES IN AGRICULTURAL PRODUCTION SYSTEMS AND RECOMMENDATIONS FOR FUTURE

The three major soil types found in the three respective river basins, namely Malwathu Oya, Mi Oya and Yan Oya are: Reddish Brown Earth, Low Humic Gley, Non Calcic Brown and Alluvial soils. Different agricultural production systems are practised in the country such as Rice/Rice, Rice/OFC Vegetables, Rice/OFC Vegetables supported by agro-wells, farming systems supported by agro-wells and Bethma system, maize production, rice cultivation in submergence zones, upland agriculture production systems, traditional chena cultivation and improved upland cultivation with agro-wells and the system of home gardens.

Third Season cultivation in rice fields, cultivation of short duration crops after Maha season in the uplands, cultivation of semi-perennial or seasonal crops under agro-wells, toxin-free or organic agriculture, ecological farming that includes climate-smart home gardens, agroforestry, Conservation Farming, and high-tech agricultural systems are among the recommended agricultural production systems. In addition to these, other interventions such as high-tech agricultural systems, cultivation in polytunnels, shade houses and rain shelters, use of micro-irrigation with or without fertigation, hydroponics, aeroponics and vertical farming systems with or without automation are listed as recommended CSA interventions. The identification of promising agricultural practices in ensuring high agricultural productivity under changing and variable climates, and such practices being capable of adjusting well in the prevailing agro-ecological environments in the three respective river basins are of utmost importance.

Climate-smart farming systems are identified as most promising agricultural production systems for the future. Climate-smart farming systems are characterised by their potential for increasing agricultural productivity and climate resilience, and reducing

greenhouse gas emissions. The need to increase the cropping intensity in order to increase the productivity of minor irrigated farming systems, which are most affected by Climate Change, should be highlighted. The use of marginal paddy lands for the cultivation of other field crops (OFC), adoption of improved water management practices, and appropriate farm mechanisation are some of the key measures identified for establishing climate-smart minor irrigated farming systems. Minimising encroachments and other various unfavorable practices linked with land usage in the eco-systems under minor irrigation, and adopting innovative approaches for increasing community participation for the sustainability of agricultural eco-systems under these farming structures are also of similar importance.

# 1.3

## CLIMATE SMART AGRICULTURE (CSA) APPLICATIONS IN OTHER COUNTRIES

There are several CSA applications the EG members have become familiar with during their previous overseas visits and through websites. Among the regional exposures are: Indian experiences on the delivery of technology through mobile apps, adoption of pro-active farming practices based on weather parameters provided through Automated Weather Stations, increased income for farmers through solar-powered agriculture, traditional water harvesting systems, root zone irrigation techniques and the Climate Smart Village Approach. Focusing on the CSA practices applied beyond regional level crop diversification, soil and water conservation in the Latin American region, the use of ecologically engineered seeds in Cambodia, bee-siness of agriculture in Kenya, mapping out soil health in Ethiopia, improving the livestock productivity in Zambia, rainwater harvesting (Half Moon technique) in Niger, and risk transfer mechanisms in agriculture through efficient agricultural insurance markets in Niger should be noted as replicable CSA interventions for Sri Lanka.

# 1.4

## ENABLERS AND CHALLENGES FOR CSA ADOPTION IN THE DRY AND INTERMEDIATE ZONES WITH SPECIAL FOCUS ON THE BASINS OF MALWATHU OYA, MI OYA AND YAN OYA

Policies and Acts related to soil, land, water and agriculture that would in some way or the other be positively linked with CSA adoption are considered as enablers, and are listed below:

1. Forest Ordinance No. 16 of 1907
2. Land Development Ordinance No. 19 of 1935
3. Irrigation Ordinance No. 32 of 1946
4. The Soil Conservation Act No. 25 of 1951 and Amended Act No. 24 of 1996
5. The Paddy Land Act No. 1 in 1958
6. The Agrarian Services Act No. 58 in 1979 and amended as Agrarian Development Act No. 40 in 2000
7. Mahaweli Authority Act No. 23 of 1979
8. The National Environment Act No. 47 of 1980 and amended in 1988, 2000
9. Disaster Management Act No.13 of 2005
10. The National Forestry Policy - 1995
11. The National Environmental Policy, 2003
12. The National Watershed Management Policy - 2004
13. The National Wetland Policy - 2005
14. The Action Plan for Haritha Lanka Programme, 2009
15. The National Climate Change Adaptation Strategy (NCCAS), 2011 - 2016
16. The National Climate Change Policy (NCCP), 2012
17. National Policy on Protection and Conservation of Water Sources, their Catchments and Reservations in Sri Lanka - 2014
18. Readiness Plan for Implementation of Intended National Determined Contributions (NDCs) - 2016
19. The National Adaptation Plan for Climate Change Impact in Sri Lanka 2016 - 2025

Furthermore, as institutional enablers, the agencies such as the Ministry of Agriculture, Provincial Ministries of Agriculture, Department of Agriculture together with its institutions and centres, Provincial Departments of Agriculture, Department of Agrarian Development, Agrarian and Agricultural Insurance Board, Department of Irrigation, Department of Forest Conservation, Department of Meteorology, District and Divisional Secretariats, Civil Security Department (CSD), Samurdhi Development Department, and Samurdhi Development Bank play significant roles in the adoption of CSA by respective farming communities.

Among the informal enablers are: Farmer organisations, local governments, organised markets, private sector companies, financial

institutions/banks, private vendors, temples and other religious organisations, farmer groups, media and informal credit suppliers.

CSA related Climate Change adaptation projects that are funded by international donors are noteworthy. Some of the key projects are: 1. Projects under the Small Grants Programme of the Global Environmental Facility (GEF/SGP) of the UNDP that are implemented in different parts of the country; 2. Australian AID-funded community-based adaptation projects, implemented in selected areas of the island, with CSA as a major component; 3. Climate Change adaptation project titled Addressing Climate Change Impacts on Marginalized Agricultural Communities Living in the Mahaweli River Basin of Sri Lanka, funded by the Adaptation Fund of UNFCCC and implemented through the UNDP/Sri Lanka, targeting the Walapane Divisional Secretariat Division in Nuwara Eliya District, and Medirigiriya and Lankapura Divisional Secretariat Divisions in Polonnaruwa District; 4. An Adaptation Project funded by the Special Climate Change Fund (SCCF) of the UNFCCC with the objective of improving rural livelihoods in three districts of Sri Lanka, namely -- Kurunegala, Puttlam and Ratnapura; 5. World Bank-funded Climate Resilience Improvement Project, (CRIP) which was commenced in 2014 and implemented in collaboration with the Ministry of Irrigation and Water Resources Management in Uva Province; 6. World Bank-funded Climate Smart Irrigated Agriculture Project (CSIAP), being implemented since 2018 covering seven districts of the Dry and Intermediate zones.

In order to plan and carry out CSA interventions successfully, it is crucial to pay attention to the challenges faced by the farming communities. Key challenges are: Land ownership issues, land fragmentation, lack of field level coordination, social and religious barriers, farmers' off-farm activities, youth moving out of agriculture, Climate Change itself, women leaving for Middle Eastern countries as migrant workers and regular change in political interests.

# 2

# Recommended Technologies and Practices on Climate Smart Agriculture Interventions

Climate Smart Agriculture technologies and practices suggested by the NTAC for adoption in the three river basins of Malwathu Oya, Mi Oya and Yan Oya are listed below. These practices are also applicable to other areas in Sri Lanka's Dry and Intermediate zones. Categorised into 15 Thrust Areas, they are classified under six thematic areas.

**Please note: A few Technologies and Practices are listed under more than one thematic area. This repetition is due to the role played by those Technologies/Practices under each thematic area.**

**Thematic area 1:**
**Tank Cascade Management**

Thrust Area:
1. Tank Cascade Management

**Thematic area 2:**
**Soil and Water Management**

Thrust Areas:
2. Soil and Land Management
3. Nutrient Management
4. Water Management

**Thematic area 3:**
**Agronomy: Research and Development**

Thrust Areas:
5. Crop Management

6. Conservation and management of genetic resources

**Thematic area 4:**
**Climate Information and Forecasting: Research and Development**

Thrust Area:
7. Climate Information

**Thematic area 5:**
**Institutional and Social Development**

Thrust Areas:
8. Management Integration
9. Agrarian Services
10. Agriculture Marketing and Value Chain Development
11. Social Development Measures
12. Risk Transferring Mechanism

**Thematic area 6:**
**Energy and Mitigations**

Thrust Areas:
13. Energy Management
14. Mechanisation
15. Post-harvest Operations

The FAO definition on CSA[1], has three specific objectives: 1. Mitigation of GHG emissions from agriculture 2. Adaptation of agricultural practices to Climate Change, and 3. Sustainable maintenance or increase of agricultural productivity. Therefore, the CSA practices proposed in the National Guidelines should have the ability to provide at least one or more benefits out of the three FAO listed objectives, to Sri Lanka's agriculture system, especially to the three river basin areas.

[1]The most commonly used definition is provided by the Food and Agricultural Organization of the United Nations (FAO), which defines CSA as "agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals". In this definition, the principal goal of CSA is identified as food security and development (FAO 2013a; Lipper et al. 2014); while productivity, adaptation, and mitigation are identified as the three interlinked pillars necessary for achieving this goal. https://csa.guide/csa/what-is-climate-smart-agriculture

# 2.1 TANK CASCADE MANAGEMENT

| Technologies and Practices | Benefits |
|---|---|
| **1. Tank cascade management:**<br><br>Instead of individual tank-focused rehabilitation activities, it is recommended to consider a cascade approach, where tanks in forest areas (e.g. Kulu Weva, Olagam Weva), village tanks, anicuts making up one eco-system are included for rehabilitation. | Ensures sustainable rehabilitation of the entire cascade system. |
| **2. Boundary demarcation on village tanks:**<br><br>This prevents unauthorised cultivations in the tank catchment area, by which the smooth runoff flow to the tank from the catchment area is ensured. We recommend identification of land ownership and establishing a proper management approach before boundary demarcation. | Enhanced water productivity. |
| **3. Establishing Gass Gommana and Wev Thavulla:**<br><br>Having suitable perennial trees in the "Gass Gommana" and "Wev Thavulla" will help enhance water availability in tanks. It will also ensure a smooth runoff flow to tanks with a minimum amount of sediment. | Facilitates proper management of the tank.<br>Enhances water quality, quantity and productivity. |
| **4. Renovation of tank bunds and developing of access roads:**<br><br>This would guarantee maximum water storage of the tank, while ensuring the easy access to the tank for regular maintenance. Future climatic scenarios and extreme weather events should be taken into consideration while designing the tank bund and other headworks. | **An adaptation intervention.**<br>Ensures food security through water and social security. |

| Technologies and Practices | Benefits |
|---|---|
| **5. Establishing and conservation of Kattakaduwa with suitable tree species:**<br><br>This intervention is important to arrest seepage of salt from the tank minimising the downstream salinisation of soils. | Improves the soil, land and water quality and productivity. |
| **6. Improved catchment yield to the tanks with reforestation and afforestation:**<br><br>Depleted catchment cover of almost all village tank cascades of the Dry and Intermediate zones, is the main reason for low cropping intensity in these regions of the country. A zero-catchment encroachment approach for village expansion is not realistic. Therefore, strategies are needed for proper conservation and maintenance of private lands in the catchment areas.<br>Hence, a tree planting programme with community participation, coupled with the adoption of appropriate soil and water conservation measures, should be in place in homesteads situated in village tank catchments. Its purpose is improving the inflow to those village tanks during both rainy and dry seasons. | **An adaptation intervention.**<br>Ensures food security and social security. |
| **7. Establishing/strengthening of tank cascade Operations and Maintenance (O & M) systems:**<br><br>For effective Operation and Maintenance of a tank cascade system coming under a respective tank, it is advisable to get the respective Farmer *(continued overleaf)* | **An adaptation intervention.**<br>Improves food security of the river basin, by ensuring water security in the given area. |

# 2.1 TANK CASCADE MANAGEMENT (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **7. Establishing/strengthening of tank cascade Operations and Maintenance (O & M) systems (cont'd):**<br><br>Organisation involved in the decision-making process.<br>Awareness programmes for other users of the tank eco-system (fishermen, firewood collectors, free-grazing livestock keepers) need to be conducted regularly in order to ensure the sustainability of the tank cascade system. | **An adaptation intervention.**<br>Improves food security of the river basin, by ensuring water security in the given area. |
| **8. Implementation of soil conservation measures in the upstream:**<br><br>Soil and water conservation measures should be promoted in the in-catchment areas to avoid siltation of tanks while increasing the catchment yield. | Improves the land and water quality, and productivity. |
| **9. Systematic de-silting of village tanks:**<br><br>A scientific and systematic de-silting technique for the village tanks can improve the tank storage and thereby the overall system performance, if other required rehabilitation activities on structures like bund, spill, sluice and canal network are also undertaken simultaneously. It should also be supported with institutional capacity building of the farming community under each tank. | Improves the land and water quality, and productivity. |

| Technologies and Practices | Benefits |
|---|---|
| **10. Establishment of wind breaks with timber trees:**<br><br>A tree belt established around the tank circumference had been an essential element of a village tank during ancient times. The purpose of this tree belt was to reduce the evaporation losses from the tank surface, by slowing down wind velocity over the tanks. However, in most of the tank cascades, this tree belt has by now disappeared due to unethical anthropogenic interventions. Re-establishment of this essential tank component would reduce water losses from the tanks during the dry season (conservation at the source), while adding an aesthetic value to the tank environment. | Improves the land and water quality, and productivity. |

## 2.2 SOIL AND LAND MANAGEMENT

| Technologies and Practices | Benefits |
|---|---|
| **1. Land preparation with incipient rain or before rains as appropriate:**<br><br>This helps utilise the rainfall for land preparation saving water in the tanks for future operations. | Uses available soil moisture for land preparation and dry sowing. |

# 2.2 SOIL AND LAND MANAGEMENT (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **2. Land levelling with laser technology:**<br><br>Proper levelling is essential in increasing the uniformity of surface irrigation. The use of a laser leveller will lead to a uniform surface of the land for evenly distributed water in the land. But this should be done where the land consolidation is possible. | **An adaptation intervention.**<br>Laser levelling increases the land and water productivity. |
| **3. Contour soil bunds in uplands:**<br><br>Contour bunds would reduce the kinetic energy of runoff, thereby reducing the surface soil loss (soil conservation). | Improves land productivity; reduces sedimentation of downstream water resources. |
| **4. Mulching with crop residues and trash:**<br><br>Mulching will increase the water retention of the surface soil layer for longer periods after irrigation. This is caused by the reduction of evaporation from the land surface, while enhancing the soil fertility in the long run. | Enhances land and water productivity. |
| **5. Boundary demarcation of village tanks:**<br><br>This would prevent the unauthorised cultivations in tank catchments, allowing smooth runoff flow to the tank from the command area above. It would also facilitate the proper management of the tank. | Enhances water productivity. |

| Technologies and Practices | Benefits |
|---|---|
| **6. Provide adequate drainage (Kunu Ela):**<br><br>Drainage is crucial in minimising the salinity build-up. It would also facilitate surface drainage from cultivated areas while avoiding the stagnation of water that would otherwise build up soil salinity. | Improves land and water productivity in a sustainable manner. |

## 2.3 NUTRIENT MANAGEMENT

| Technologies and Practices | Benefits |
|---|---|
| **1. Integrated Plant Nutrition System (IPNS):**<br><br>This technique, known as IPNS, supplies essential nutrients by using organic and inorganic supplements (including slow release fertiliser) to meet the crop nutrition requirement. | Increases productivity, reduces the farmers' production costs, and facilitates the **mitigation benefit**. |
| **2. Site specific fertiliser recommendation:**<br><br>Soil and leaf analyses are done using portable testing kits and leaf colour charts. It avoids the dumping of excessive fertiliser to the soil, which can reduce GHG emissions. | Increases productivity, reduces the overuse of fertiliser and facilitates the **mitigation benefit**. |

# 2.3 NUTRIENT MANAGEMENT (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **3. Recycling of straw and stubble:**<br><br>Burning of straw and stubble increases the release of carbon dioxide to the atmosphere. Hence, straw and stubble should be used as a soil ameliorant; and mulch would improve the physical and chemical fertility of soil, while reducing GHG emissions. | Increases the productivity, reduces the overuse of fertiliser and enhances the **mitigation benefit**. |
| **4. Production and use of compost with available crop residues:**<br><br>This step increases the soil organic content while improving the soil's physio-chemical status. | Increases land and water productivity and has the **mitigation benefit**. |
| **5. Foliar application of nutrients as and when required:**<br><br>The practice prevents the excessive fertiliser application to the soil, while increasing the production of the cultivated crop, especially under drought conditions when the root system is undergoing physiological malfunctioning. | Increases the land productivity with **mitigation benefit**. |
| **6. Non-conventional fertiliser sources:**<br><br>This advice refers to bio-fertiliser sources, bio agents such as nitrogen fixing bacteria, phosphate solubilising bacteria and Azolla. | Increases land and water productivity and has a **mitigation benefit**. |

# 2.4 WATER MANAGEMENT

| Technologies and Practices | Benefits |
|---|---|
| **1. Application of rainwater harvesting techniques:**<br><br>This tool is mainly for the rain-fed upland farming system. The traditional rainwater harvesting pond system – Pathaha – is recommended for wide use in the Dry and Intermediate zones. It would direct all the rainwater into a single collection pond made of stone or soil bunds and ditches, preventing the loss of rainwater; also, it would obstruct the rainwater from leaving the respective farm field. In order to minimise the percolation loss of the collected water, the plan is to layer the surface of the collecting tank with a polythene sheet of appropriate thickness or plaster with a non-Montmorillonite clay layer. | **An adaptation Intervention.**<br>If systems are coupled with solar-powered water pumps for irrigation, the same intervention can have a **mitigation focus against Climate Change**. Ensures increased land productivity and food security. |
| **2. Improved pitcher irrigation:**<br><br>This method is to be used instead of the conventional pitcher irrigation technique. Four sand columns are to be built in a pit of 2' X 2'. It should be filled with compost and topsoil enabling fruit crops to be irrigated with lesser amounts of water without allowing root zone concentration in a single side of the pit. This tool is for a rain-fed orchard system. | **An adaptation intervention.**<br>Ensures increased land productivity without soil moisture stress for the orchards. It is an ideal technique to be adopted in Dry and Intermediate zones.<br>If coupled with solar-powered lift irrigation facilities, it also qualifies for **mitigation focus** of the CSA approach. |
| **3. Roof rainwater harvesting:**<br><br>Rainwater falling on a roof-catchment is directed to a PVC tank of large capacity to be used for bucket irrigation of home gardens, food crops and tree saplings during the dry period. This tool is for roof rainwater for home gardening. | **An adaptation intervention.**<br>Ensures home gardening productivity and household food security. |

# 2.4 WATER MANAGEMENT (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **4. Agro-wells and tube wells with appropriate well density:**<br><br>Agro-wells can play a vital role in providing supplementary irrigation water during unexpected dry spells. However, they should be dug with appropriate density for a given area unit, in order to ensure environmental sustainability and the continuous supply of water as per the natural recharge rate of the geographical settings of the location. | **The tool is useful for rain-fed upland farming.** Ensures household and national food security; this approach would substantially **contribute to greenhouse mitigation in climate change.** |
| **5. Appropriate micro-irrigation techniques supported by solar-powered pumps:**<br><br>Agriculture is the mainstay of the economy of Sri Lanka's Dry and Intermediate zones. They are often subject to dry weather conditions. Supplementary irrigation for rain-fed upland crop cultivation is essential, especially during the Yala season. Fortunately, these two regions are blessed with abundant sunlight during most parts of the year, except from October to the mid-January period. Hence, the generation of renewable energy through solar power is strongly proposed. The basic cost involved is considerably high; but sustainability is assured in the long run, provided that the right technology is used. | Ensures farming productivity and household food security.<br>Used during drought or unexpected long, dry spells, especially in rain-fed upland cultivation, to ensure food security.<br><br>Increases the land productivity while ensuring food security. Moreover, due to its use of gravity for irrigation support, it may qualify as the **greenhouse mitigation aspect of CSA** as well. |

| Technologies and Practices | Benefits |
|---|---|
| **6. Bucket drip-kits with grow bags:**<br><br>As a counteracting measure against the impact of frequent dry spells on the performance of high value crops, they can be raised in specially made polythene grow-bags of appropriate dimensions. Their management is relatively convenient as it is a controlled environment. The performance of growing systems of this type can be further improved by the provision of a simple bucket drip irrigation technique. A water storage tank in an elevated place ensures at least one bar water pressure along the water distribution network. | **T**May act as **a mitigation tool** where inorganic fertiliser use is minimised.<br>Ensures food security through water security. |
| **7. Use of traditional varieties and farming practices when and where applicable:**<br><br>Weather lore appears to be somewhat obsolete in Climate Change-related weather aberrations, and related forecasts currently. Such is the case with many traditional crop varieties and practices regarding the vulnerable cropping systems. However, some of these practices (e.g. about land productivity) have turned out to be reliable although they have existed for generations. | **Low cost adaptation intervention.**<br>May act as **a mitigation tool** where inorganic fertiliser use is minimised. |

# 2.4 WATER MANAGEMENT (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **8. Adjusting of irrigation intervals and quantity by taking the prevailing rain spells into account:**<br><br>This technique can save large quantities of irrigation water available in tanks/reservoirs if dry spells occur in the immediate future. This had been practised even in ancient times in irrigation schemes (Please refer to Kondawatuwana Inscription in Gal Oya during the reign of King Dappula IV (AD 934). | Ensures food security through water security. |
| **9. Restoration of irrigation infrastructure including spills and sluice gates:**<br><br>Most of the irrigation infrastructures located in the Dry and Intermediate zones, especially in the case of minor tanks, have not been subject to systematic and appropriate restoration processes, except for some ad-hoc attempts. Hence, it is suggested that all minor tanks along witt their respective irrigation canal networks must be repaired, thereby reducing their conveyance loss and increasing water productivity. Wherever appropriate, tank bunds along with spills should be raised to increase the command area. | **An adaptation intervention.**<br>Ensures food security through water security. |

| Technologies and Practices | Benefits |
|---|---|
| **10. Strict adherence to cultivation meeting decisions:**<br><br>The decisions of Kanna meetings are always aimed at increasing both land and water productivity of a given tank. Measures should be introduced to have strict action against those who violate Kanna meeting decisions. Such action can enhance collective performances. | **An adaptation intervention.**<br>Ensures food and water security. |
| **11. Improved water inflow to the tanks with reforestation and afforestation measures:**<br><br>Addressing the low cropping intensity, the reason for which is the depleted catchment cover of almost all village cascades, we propose to have workable strategies for conservation and maintenance of land in the catchment areas. One such step would be tree planting activities with community participation, which can be coupled with the adoption of appropriate soil and water conservation measures. This would improve water inflow to those village tanks during both rainy and dry seasons. | Ensures food security through both water and social security. |
| **12. Recharing of groundwater through percolations pits:**<br><br>Groundwater recharing assisted by percolation pits is recommended to achieve adequate groundwater levels in dry weather conditions. It also supports the perennial vegetations and dry weather inflow of streams. This would lead to the improved recharging rate of dug and agro-wells of the respecrtive area, facilitating increased sub-surface water storage for community use. | Ensures food security through both water and social security. |

# 2.5 CROP MANAGEMENT

| Technologies and Practices | Benefits |
|---|---|
| **1. Crop diversification:**<br><br>Using soil drainage classification, the well-draining areas can be brought under Other Field Crop (OFC) cultivation, thereby maximising the water efficiency. | Increases the land and water productivity. |
| **2. Crop rotation:**<br><br>It is proposed that farmers should be encouraged to change the crop group i.e. shift to nitrogen fixing types such as legumes. This method would improve the soil health, which would eventually enhance land productivity. | Reduces the cost of production, enhances land productivity while **supporting adaptation**. |
| **3. Systematic home gardening:**<br><br>Systematic home gardening is a well-recommended step that maximises the utilisation of land, water and other resources. | **Supports adaptation**, reduces production costs, improves land productivity.<br>Ensures safe food supply, thus enriching overall livelihoods. |
| **4. Cultivation of fruit types such as papaya and guava:**<br><br>Papaya, cashew, pomegranate, citrus, pineapple (under shade) and guava are well adapted to Dry zone conditions, hence, better yields and farmer incomes can be ensured. | Enhances livelihoods and increases land productivity. |
| **5. Grafted fruit plants cultivation:**<br><br>Grafted fruit plants are early bearers and would result in good yields in relatively short periods. | **An adaptation intervention.**<br>Adds **a mitigation benefit** as well. Improves land and water productivity and enriches livelihoods. |

# 2.5 CROP MANAGEMENT (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **6. Traditional yam cultivation:**<br><br>Yams are well adapted to grow in environments with water shortage and would also provide ample yields to support livelihoods. | **Includes a mitigation benefit.**<br>Improves the land and water productivity. |
| **7. Bee keeping:**<br><br>Bee keeping is a much-recommended occupation for farmers and their families assuring satisfactory supplementary incomes to farmer families. | **Has a mitigation benefit.**<br>Improves the land and water productivity. |
| **8. Sandwich cropping systems using short-age legume types (third season cultivation):**<br><br>Cultivation of early maturing crops such as green gram or cowpea soon after the main rice harvest, thereby making use of the residual moisture, should be considered. This system would supplement farmer incomes while increasing the cropping intensity. | Reduces crop losses; improves land and water productivity. |
| **9. Cultivation of climate smart crops:**<br><br>Early maturing and drought/heat/salinity tolerant and climate-smart crop types are proposed to be cultivated in the three river basins that are being studied. | Ensures an eco-friendly crop production process. |

# 2.5 CROP MANAGEMENT (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **10. Biotic stress management:**<br><br>We recommend Integrated Pest and Weed Management (IPM) as an effective CSA intervention, due to its ability to control damage caused by pests, weeds and other pathogens in an economical and environmentally sustainable manner. | Reduces crop losses; improves land and water productivity, with an added mitigation benefit. |
| **11. Parachute method of crop establishment:**<br><br>Transplanting of paddy seedlings using Seedling Broadcasting Method, instead of the traditional direct sowing and machine transplanting, have been regarded as a very effective transplanting method. | An adaptation intervention with an added mitigation benefit.<br>Improves land and water productivity. |
| **12. Crop protection from wild animals:**<br><br>Solar-powered electric fences and live fences with species like bougainvillea, citrus, agave sisilana, and palmyrah and/or beekeeping have been identified as effective measures to prevent or minimise damage by wild animals. If the other protection measures are not effective, the use of air rifles can be an alternative. | An adaptation intervention.<br>Improves land productivity. |
| **13. Self-seed production:**<br><br>This step ensures the ready availability of region-specific seeds and other planting material at the beginning of the season. | An adaptation intervention.<br>Improves land productivity. |

| Technologies and Practices | Benefits |
|---|---|
| **14. Pot culture of crops:**<br><br>Pot culture is considered a climate resilient cultivation practice aimed at saving water and sustaining production, especially under adverse weather conditions. | Improves land productivity. |
| **15. Cultivation under controlled environments such as net houses and rain shelters:**<br><br>Cultivation using net houses and rain shelters is also considered one of the climate resilient cultivation practices that save water and other inputs, sustaining and improving production, especially under erratic weather conditions. | Improves land productivity and includes a mitigation benefit. |
| **16. Shared cultivation (Bethma Method)**<br><br>When the water supply is not adequate to irrigate the entire command area of a minor tank system, only a part of the command area is cultivated. Then, a smaller portion of the command areas adjacent to the tank bund is shared among the farming community. Land allocation for farmers is in proportion to the extent of land owned by them. This system is popularly known as the Bethma system.<br>This unique land sharing system had been in practice since ancient times as a counter mechanism for natural climatic variability, which can be appropriately applied under unpredictable climates as well. | Improves land productivity and an adaptation strategy. |

# 2.5 CROP MANAGEMENT (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **17. Intercropping with leguminous crops that have a nitrogen fixing ability:**<br><br>This measure would provide the supplementary requirement of nitrogen, which would reduce the inorganic nitrogen requirement. | Improves land productivity. |
| **18. Bund cultivation with vegetable crops in paddy fields:**<br><br>This practice would increase the unit land productivity, thereby enhancing community livelihoods. | An adaptation and mitigation intervention. |
| **19. Application of appropriately chosen deep ploughing:**<br><br>Deep ploughing increases the physical, chemical and biological fertility of the soil, thereby increasing its productivity in the upland area. | An adaptation and mitigation Intervention. |
| **20. Food forest system for abandoned uplands:**<br><br>The food forest system is a new holistic approach, which is similar to the Kandyan Forest Garden, where seven layers of trees and crops are planted. (More details in - Agroforestry www.thewire.inagriculture: *Indian farmers are creating "Food forest" to minimise the impacts of Climate Change.*) | An intervention with both adaptation and mitigation effects.<br><br>Improves productivity. |

| Technologies and Practices | Benefits |
|---|---|
| **21. Application of Biochar:**<br><br>Biochar is the solid, carbon-rich material obtained through a process of chemically decomposing organic materials at elevated temperatures in the absence of oxygen.<br>Partheenium and water hyacinth are recommended. However, certain tests need to be carried out to screen heavy metals in these plants before being applied to the soil. (Spot Plant Tissue Analysis) | Improves productivity. |
| **22. Silage making:**<br><br>Promoting silage making among the farming communities is a recommended intervention.<br>Silage is a type of fodder made from green foliage crops, which has been preserved by acidification, achieved through fermentation.<br>This silage can be used for animal feed during the dry season. | Improves productivity. |

# 2.6 CONSERVATION AND MANAGEMENT OF GENETIC RESOURCES

| Technologies and Practices | Benefits |
|---|---|
| **1. Use of genetically diverse crop varieties:**<br>We recommend the use of multi-resistant varieties to counter biotic and abiotic stresses. This process can ensure the resilience of the farming system against Climate Change impacts. | **An adaptation intervention.**<br>Ensures food security through improved land productivity and minimises input cost. |
| **2. Conservation of wild relatives of crops:**<br>This initiative would lead to the conservation of existing genetic resources. It would ensure high resistance of the crops against biotic and abiotic stresses such as Climate Change, and pests and diseases. The wild species could be used in future breeding programmes. It should be noted that most of such genetic resources are nearing extinction or on the verge of extinction due to Climate Change. Hence, their conservation via in-situ or ex-situ is an investment for the future. | **A future focused adaptation intervention.**<br>Ensures food security through improved land productivity; minimises input cost.<br><br>Ensures global food security under unpredictable climates. This would support future research on CSA. |
| **3. Introduce drought resistant herbs of ayurvedic value**<br>The introduction of herbs such as Katuwelbatu (Wild Eggplant -Solanum virginianum) Thippili (Long pepper - Piper longum) at commercial level with proper Forward Contract Agreements is suggested. | **A future focused adaptation intervention.**<br>Increases land productivity. |

# 2.7 CLIMATE INFORMATION

| Technologies and Practices | Benefits |
|---|---|
| **1. Strict adherence to seasonal climate forecasting and Agro-Met Advisory service:**<br><br>The Department of Agriculture and Department of Meteorology regularly issue notifications basing on the Agro-Met Advisory Service and Seasonal Climate Forecast (SCF) specifically focusing on the farming communities. Although this combined effort is made by all these sectors, this service is yet to be fully made use of by the target groups. Some farmers are not aware of these services and some still prefer to depend on their traditional knowledge of the climate. The importance of following these government issued notifications should be conveyed/driven to the farmers. | Improves land productivity and an adaptation strategy.<br>Improves the irrigation water use efficiency, improves productivity and production levels, while reducing the climate risks in varying climates. |
| **2. Appropriate training to FOs on Climate Change adaptations:**<br><br>Arriving at right decisions on the potential extent of cultivation using the Agro-Met Advisory Service and Seasonal Climate Forecast (SCF) is of prime importance to the farming communities. FO members should be adequately trained to use the SCF and accordingly use available storage of the village tank cascade system. Along with the FOs, other parties like field-level extension and agrarian officers should also be familiarised on these adaptations. An appropriately drawn up media campaign would serve useful in this venture. | Improves water productivity and facilitates the optimum use of other inputs. |
| **3. Improved capacity development within Department of Meteorology:**<br><br>Human resources and infrastructure facilities should be enhanced at the DoM focusing on a state-of-the-art climate information dissemination system at the DoM. The importance of finer spatial resolution and reasonable lead time, which is made more appropriate for the farming communities, is underscored. | Improves the efficiency and effectiveness of the regularly issued notifications, making them result-oriented. |

# 2.7 CLIMATE INFORMATION (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **4. Surveillance system for pest and diseases emergence:**<br><br>Climate Change may induce the emergence of new and existing pest and disease types to uncontrollably dangerous levels. Therefore, a surveillance system should be established to alert farmers during such situations. | Improves land productivity and an adaptation strategy. |

# 2.8 MANAGEMENT INTEGRATION

| Technologies and Practices | Benefits |
|---|---|
| **1. Integrated farming of crop and livestock:**<br><br>It is a well-established fact that animals are less sensitive to weather aberrations than annually planted crops. Therefore, the integration of livestock and poultry into annual cropping systems is seen as a suitable way of increasing the resilience of farming systems against Climate Change. This method also has some other additional benefits such as the availability of organic manure and animals for farm needs. This is not a new concept for the Dry zone farmers in Sri Lanka. Dairy cattle has been an integral component of farming households in the Dry zone. Moreover, this system turns economically beneficial during total crop failures due to droughts, floods, or pest and disease outbreaks in their seasonal cultivations. | An adaptation intervention.<br>Ensures food security while contributing to a GHG reduction in a minor or lesser extent. |

| Technologies and Practices | Benefits |
|---|---|
| **2. Upgraded technology in the livestock sector:**<br><br>Intensive farming systems for integrated agriculture are proposed as another CSA intervention. Also, energy sources such as bio gas and solar power should be introduced and widely utilised. Farming communities should be guided towards innovative methodologies in livestock breeding, improvements to rearing, management practices and value addition to farming systems. | Ensures food security while contributing to GHG reduction. |
| **3. Crop insurance as an essential factor:**<br><br>Risk-transfer mechanisms such as crop insurance are globally accepted adaptation strategies addressing Climate Change. However, it is up to the insurance firms to design more customer-specific schemes – such as a weather index-based insurance scheme for the Dry zone – as opposed to blanket schemes set for the entire country. In highly vulnerable regions, the farmers' premiums should be subsidised by the government to ensure the sustainability of the scheme.<br><br>The following criteria should be considered:<br><br>A. Incorporate a wider range of crops, including vegetables and OFC as crops to be insured.<br><br>B. Make the insurance providers' attendance in cultivation meetings crucial.<br><br>C. Provide insurance only for the agreed crops and extents.<br><br>D. As previously mentioned, consider weather index-based insurance schemes as applicable. | An adaptation strategy. |

# 2.8 MANAGEMENT INTEGRATION (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **4. Conversion of Chena lands to perennial gardens as appropriate:**<br><br>The traditional Chena or shifting cultivation, which used to be rain-fed, was found to be a good adaptation strategy before the farming communities faced Climate Change impacts. But in the present contexts, Chena cultivation – being only a rain-fed system – does not provide rejuvenation solutions because no shifting of land takes place. For annual crops grown in a Chena, moisture stress is a common feature with the impacts of global warming. Hence, in order to improve land productivity, these cropping systems should be transformed to a more resilient series of perennial crops, e.g. to orchards with supplementary micro-irrigation facilities. | Enriches farming community livelihoods/the country image, and thereby a higher possibility of FOREX earnings.<br><br>Ensures food security, while contributing to GHG reduction. |
| **5. Agro-Eco tourism:**<br><br>Sri Lanka's agricultural region can harness the potential for Agro-Eco tourism. In order to meet such requirements, appropriate infrastructure facilities and capacity building should be provisioned.<br><br>Ideally, farmer federations should be set up and they, as opposed to individual farmers, should be linked with the relevant members in the corporate sectors such as the hospitality industry. Farmers would then feel more confident, more empowered with a sense of entrepreneurship that would give them additional incomes. Developing country-friendly arrangements such as Fairtrade can be attractive in these approaches. Also, Chena systems could be potential tourist attractions. Nevertheless, the national government's crucial role in such steps is emphasised herein. | **An adaptation intervention.**<br><br>Ensures food security.<br><br>This approach enables farmers to have more control over their lives and decide how to invest in their future.<br><br>The country would be more recognised in arrangements such as Fairtrade, thereby qualifying to earn more in global markets. |

# 2.9 AGRARIAN SERVICES

| Technologies and Practices | Benefits |
|---|---|
| **1. Adherence to Seasonal Climate Forecasting (SCF) and Agro-Met Advisory Service:**<br><br>As mentioned in a previous section (under Climate Information in 5.5) the Agro-Met Advisory Service and SCF notifications should properly reach the farming communities. Media advisories containing both current (Agro-Met Advisory Service and SCF notifications) and appropriately picked traditional knowledge are encouraged. Provincial media outlets (radio, in particular) working in respective areas in the Dry zone may be good partners to work with. | Improves irrigation water use efficiency, increases land productivity and production levels. |
| **2. Appropriate outreach and training to farmers and Farmer Organisations (FO) to help them determine the potential extent of cultivation, depending on SCF and available water storage of village tanks:**<br><br>In addition to the above-mentioned media campaigns, display boards – erected in appropriate locations of the river basins – with relevant and timely messages in local languages, which target field-level extension officers, agrarian officers and all farmers are proposed. | Improves efficiency of irrigation water use and overall productivity. |

# 2.9 AGRARIAN SERVICES (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **3. Due recognition to agriculture extension officials at Kanna meetings – (Minor Irrigation):**<br><br>In many situations, official recommendations (agrarian and agriculture) are not adhered to and not implemented fully or partially, resulting in total or partial crop failures.<br>We recommend compulsory adherence to those notifications. Attendance at Kanna meetings by agriculture officers, assigned to the project areas, is seen as one definite way of overcoming above-mentioned issues. | **An adaptation intervention.**<br>Improves productivity. |
| **4. In-kind support in times of disaster:**<br><br>Frequent flash floods coming from the runoff of torrential rains, is a common occurrence in the areas being studied. These rains can damage freshly sown rice crops, requiring re-sowing and re-fertilising. In such situations, provision of in-kind support is highly recommended. Examples of such support are seed paddy of same or different varieties; parachute trays to assist in broadcasting of seedlings in the same or lesser age groups. Assistance of this nature helps the affected farmers recover rapidly from the shocks caused by weather aberrations. | Helps in the adaptation of CSA practices.<br>Improves productivity. |
| **5. Quick rehabilitation of irrigation infrastructure of disaster hit tanks:**<br><br>This irrigation intervention should be accomplished in parallel with Component 1 of the CRIWMP. | Helps achieve high percentages of adopted CSA practices. |

| Technologies and Practices | Benefits |
|---|---|
| **6. Strengthening of existing Farmer Organisations (FO) while setting up new FOs:**<br><br>The crucial role played by FOs in the successful introduction and implementation of CSA interventions is reiterated herein. In addition, where applicable, new organisations should be formed, in consultation with the Department of Agrarian Service. | Helps achieve a high success rate of CSA practice adoptions. |
| **7. Awareness of CSA activities among all river-basin communities:**<br><br>For the successful execution of CSA interventions, all river basin communities should be made aware of the project activities and get them appropriately involved. A comprehensive communication strategy that includes climate programmes for schools, climate group meetings, media programmes and media campaigns, should be devised. These community awareness programmes should target people of all age groups. | Helps increase the adoption rate of CSA practices. |
| **8. In-depth awareness of land use laws among the people:**<br><br>Most land users are unaware of the laws pertaining to land use. Hence, extremely comprehensive awareness programmes involving all village communities are recommended. *(continued overleaf)* | Helps increase the adoption rate of CSA practices. Increases productivity. |

# 2.9 AGRARIAN SERVICES (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **8. In-depth awareness of land use laws among the people (cont'd):**<br><br>Informative sessions would enable them not only to take respective action against those who violate land laws, but also educate them on refraining from going against the law. Areas of special interest should be the use of water bodies, land reservation, agro-forestry, reserve forests and farmlands. | Helps increase the adoption rate of CSA practices. Increases productivity. |
| **9. Online networking for all agricultural inputs, outputs and other resources:**<br><br>All information pertaining to agricultural inputs, outputs and other related matters should be at the farmers' fingertips. These should be made easily accessible online, so that all stakeholders can make prompt and well-informed decisions on their relevant agricultural requirements. For purchase and marketing of both agricultural inputs and outputs, the private sector companies are a definite partner of the farmers. Hence, the relevant corporates should be a sure link in the network. To facilitate this network, we recommend the setting up of village-level cyber centres, and providing free Internet access to the farmers. | Helps improve overall productivity, avoid gluts and the short supply of agricultural produce, thereby helping desired marketing while improving profitability. |

# 2.10 AGRICULTURE MARKETING AND VALUE CHAIN DEVELOPMENT

| Technologies and Practices | Benefits |
|---|---|
| **1. Farmers organised into commodity groups and linked with the relevant members of the private sector:**<br><br>Productivity improvement is one of the three objectives/pillars of CSA. Solving the issues in agricultural marketing plays a significant role in adopting CSA practices. To make marketing more effective, it is recommended that smallholder farmers be organised into commodity groups, and those groups be linked with the relevant members of the private sector for marketing of fresh produce. | Enhances the adoption of CSA interventions by farmers, whose produce gets a guaranteed market. |
| **2. Promote Village Fairs (Pola) in town areas of the respective three river basins:**<br><br>The village market is an appropriate intervention (location and concept-wise) for CSA villages in the three river basins. Farmers would sell their produce in the open market, which is held at a specific time, on a specific day of the week, in a conveniently accessible location. The other advantage of this Village Fair is the value addition opportunities given to farmers' produce, by groups of enterprising villagers. Examples of these value-added items are dried fruits and vegetables, packed products such as rice, green gram, cow pea, kurakkan (finger millet or African millet) flour, livestock products, and prepared foods made with local ingredients like pickles and curd. Those products have a significant demand in the urban set up; hence, this arrangement benefits several parties. *(continued overleaf)* | Helps the adoption of CSA interventions by farmers through assured markets. |

# 2.10 AGRICULTURE MARKETING AND VALUE CHAIN DEVELOPMENT (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **2. Promote Village Fairs (Pola) in town areas of the respective river basins (cont'd):**<br><br>Some intervention is required, often to facilitate space for the farmers at these weekly fairs, which reduces their food miles. | Helps the adoption of CSA interventions by farmers through assured markets. |
| **3. Value chain management through processing and value addition:**<br><br>It is proposed to introduce methodologies to bring farmers' agricultural produce to more usable and easy forms viz. food, feed, fibre, and fuel aimed at conservation. This set of techno-economic activities which is seen as agro processing, can improve many components of their livelihoods. Value addition in general, is the process of changing or transforming a product from its original state to a more valuable state. Methodology used in value addition is called processing; both value addition and processing are hence, interconnected. | The profitability of farming increases; farmers gradually become small entrepreneurs, and would also get motivated to improve their productivity, which is an essential component of the CSA. |
| **4. Forward Contract Agreements (FCA):**<br><br>All steps, from land selection to final delivery of the entire agricultural production cycle, should be included in the FCA. Enacted in 1896, this legal tool, if run smoothly, brings the farmer, buyer and the facilitator to a win-win situation. | Helps improve the marketing component, which leads to farmers' enthusiasm to improve productivity. |

| Technologies and Practices | Benefits |
|---|---|
| **5. Quality assurance procedures such as GAP and GMP:**<br><br>Food safety is a major concern for the present-day consumer. Good Agriculture Practices (GAP) promoted by the DoA, will make sure the produced crops are safe. Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Participatory Guarantee Systems (PGS) and organic quality assurance procedures should be promoted among farmers as CSA practices. | Contributes to mitigation effect.<br>These practices improve the profitability and productivity of agricultural operation, which is essential in CSA interventions. |
| **6. Introduce value addition and value chain development for varieties such as tamarind (Tamarindus indica), woodapple (Limonia acidissima), orange and mango:**<br><br>These are commonly found fruits in the Dry and Intermediate zones. Value addition industries using these varieties should be encouraged. | Enhances people's entrepreneurial skills; thereby improving productivity and profitability. This is essential in CSA interventions. |
| **7. Entrepreneurship fostered from within:**<br><br>Selected entrepreneurs from the village should be provided training with the required assistance so that successful entrepreneurs, who would use locally produced raw materials/ingredients would emerge from the river basin areas. | Enhances entrepreneurial skills, thereby improving productivity and profitability. |

# 2.10 AGRICULTURE MARKETING AND VALUE CHAIN DEVELOPMENT (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **8. Processing technologies and the concept of regional branding:**<br><br>Latest technologies to apply for value addition and processing should be introduced and promoted. Regional branding of products (e.g. "Mi Oya Tamarind Paste") should be encouraged. | Enhances entrepreneurial skills, thereby improving productivity and profitability. |
| **9. Warehouse receipt system:**<br><br>These are new community-based storage systems promoted by regional development banks in Sri Lanka, where farmers can safely store their agricultural produce. Farmers can use the receipt obtained for the produce as a Document of Guarantee for a credit facility with a bank. Once the price goes up after some time, they can sell the produce at a higher price. | Facilitates higher incomes for produce. Enhances profitability. |

# 2.11 SOCIAL DEVELOPMENT MEASURES

| Technologies and Practices | Benefits |
|---|---|
| **1. Strengthened extension services:**<br><br>Availability of a well-integrated and efficient extension approach is crucial for the promotion of CSA practices among farmers. There are several government, non-government and private sector agencies involved in agriculture extension, delivering their services in an un-coordinated manner. *(continued overleaf)* | **An adaptation intervention.**<br>Improves productivity. |

| Technologies and Practices | Benefits |
|---|---|
| **1. Strengthened extension services (cont'd):**<br><br>However, in the three river basin areas, the provincial agriculture extension system is the existing institutional and official system for the implementation of agriculture extension. | **An adaptation intervention.**<br>Improves productivity. |
| **2. Improved agriculture extension activities:**<br><br>Improvement and strengthening of the present extension delivery system should immediately happen in consultation with all stakeholders involved in delivering CSA practices to the end users. | **An adaptation intervention.**<br>Improves productivity. |
| **3. Effective use of ICT:**<br><br>Use of Information Communication Technology (ICT) for the extension delivery, which makes the extension service more effective and efficient, is highly recommended. Most of the farmers and/or their family members use smartphones. Therefore, using ICT such as mobile apps, extension strategies for related activities can be delivered without extra expense or effort. Reviewing of the existing apps and developing of new apps for planning, implementation and marketing should also be a definite focus. | Enhances adaptation.<br>Improves overall productivity. |

# 2.11 SOCIAL DEVELOPMENT MEASURES (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **4. Farmers organised into commodity groups:**<br><br>Marketing of produce is a serious issue that farmers currently face. Formation of commodity groups/societies would improve their bargaining power and in meeting their marketing challenges. Once established, these societies would federate from village to divisional levels. They can be guided to focus on the productivity, marketing and appropriate improvements to processing of their commodities. These farmer societies should be strengthened through diverse skills enhancement programmes on subjects such as leadership, accounting, bookkeeping and technology issues. Required support should be given to have them officially recognised, so they can deal directly with banks and other institutions. | **An adaptation intervention**<br>Improves overall productivity. |
| **5. Crop clinics:**<br><br>Crop Clinics are the agricultural version of health clinics for humans. Crop clinics are considered an important mechanism in the service delivery to farmers. It is recommended that these clinics are arranged for farmer groups, so they can deliver product or area-specific advisory services, coupled with other related services such as agricultural inputs. | Facilitates better adoption of CSA interventions. |
| **6. Village mobilisers:**<br><br>Implementation of field-level activities through a village-level mobiliser is a recommended practice, used in most agriculture development programmes. This involves a minimal cost and has a participatory approach. A young farming community member can be selected for this purpose and employed after a brief hands-on training period. | Contributes to better delivery of CSA practices and better adoption. |

| Technologies and Practices | Benefits |
|---|---|
| **7. Support from mass media, digital and other traditional communication tools, as appropriate:**<br><br>In situations where large numbers of farmers are to be reached, with a limited number of extension officers at service, media (all types) becomes the ultimate delivery tool.<br>Currently, there are many choices available: smartphone apps that are specifically developed for farmers, SMS alerts, provincial radio stations for a wider audience, social media and other ICT tools; and locally – display boards, appropriate print media (posters, banners, leaflets), and the use of public address systems. | Contributes to better delivery of CSA practices and better adoption. |
| **8. Capacity development of relevant officers:**<br><br>Capacity development of officers makes a better delivery system. UNDP sees capacity development as the 'process through which individuals, organisations and societies obtain, strengthen and maintain the capabilities to set and achieve their own development objectives over time.'<br>As opposed to frequently provided inappropriate and non-technical training activities organised by numerous agencies, the field officers working in these respective river basins should receive a well-coordinated and agriculture-specific technical exposure programme. In parallel, their leadership and management skills should be honed. We also recommend that these officers' mobility and other resources needed for an efficient extension delivery be improved. | **An adaptation intervention.**<br>Improves better delivery of CSA practices to farmers and helps towards better adoption. This would also improve the accountability of the extension workers. |

# 2.11 SOCIAL DEVELOPMENT MEASURES (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **9. Removal of agriculture advisory services from non-technical agencies:**<br><br>This action had been suggested often in the past by many respective sectors. When non-technical agencies provide technical advice to field officers in general, it upsets the respective government's technical delivery flow, thereby creating confusion and inefficiency in the entire process. | This is an accepted CSA strategy used in many countries. |
| **10. Climate-smart Farmer Field Schools:**<br><br>The Farmer Field School (FFS) is an approach based on people-centered, experiential learning, and it is highly recommended in a Sri Lankan context. The group may consist of 20-25 farmers from the village who meet weekly throughout growing seasons at a test-field of climate-resilient technology. They would share views, concerns, experiences such as the use of in-situ moisture conservation, establishment of community seed banks and other practices, soil conservation, reforestation, and agro-forestry as steps to increase crop production. | Facilitates better adoption of CSA technologies. |

| Technologies and Practices | Benefits |
|---|---|
| **11. Farmer to Farmer Extension (F2FE):**<br><br>This system has been in practice in many countries to promote Climate Smart Agriculture interventions due to its proven success. Farmer to Farmer Extension (F2FE) empowers the farmer as a change agent and helps improve adaptation. An inclination to learn from or follow their fellow-farmers rather than the extension officers has been a common observation. | Improves productivity and better adoption of CSA technologies.<br>These programmess contribute to overall CSA, i.e. they help improve productivity, build resilience and reduce GHG emissions. |
| **12. System of revolving funds:**<br><br>The farmer groups should be assisted with a Revolving Funds Scheme, to which the member farmers contribute a certain amount of cash. These revolving funds can be utilised for the procurement of inputs needed for agriculture production. Later, the funds used by each farmer member should be recovered from the income through the sale of produce. | Improves overall productivity. |

# 2.12 RISK TRANSFERRING MECHANISM

| Technologies and Practices | Benefits |
|---|---|
| **1. Climate-smart village concept with wider stakeholder participation:**<br><br>Climate-smart village approach concentrates all recommended practices in one village for the entire farmer community, which is widely used to apply and promote CSA practices.<br>The accepted strategy to promote CSA in many countries is followed here as well. | **An adaptation intervention.**<br>Globally accepted CSA strategies are promoted widely. |
| **2. Encourage the use of notifications assisted by Seasonal Climate Forecast (SCF) and Agro-Met Advisory:**<br><br>Agriculture Department issues regular notifications from the Agro-Met Advisory Service supported with the Seasonal Climate Forecast (SCF) issued by the Meteorology Department of Sri Lanka. This service is not widely made use of by the farmers. This is either due to unawareness of the services and/or due to their heavy dependence and loyalty to traditional knowledge. Farmers should be educated on the importance of SCF and the Agro-Met Advisory Service through a media campaign after establishing a user-friendly and state-of-the-art SCF and Agro-Met Advisory Service for determination of suitable crop varieties, and the extent of land, depending on SCF and available storage. | **An adaptation intervention.**<br>Farmers' adherence to seasonal climate forecast in their farming activities results in increased productivity overall. |

| Technologies and Practices | Benefits |
|---|---|
| **3. System to recognise and appreciate farmer performances and a proper M&E methodology:**<br><br>The introduction of an official Monitoring & Evaluation (M&E) system for the farming communities on CSA, is highly recommended. The farmers, who adopt CSA practices at above average level, should be recognised for their exemplary work and publicly appreciated in some manner. The same conferring is suggested for the field officers, who set an example through high performance with CSA interventions. Private sector companies, financial institutions involved in different phases of CSA practices, and broadcast media promoting agriculture can be potential sponsors for such events. Later, the identified best practices along with their respective achievers could be featured in relevant media as models for other farming communities, and their work documented for future reference. | Knowledge on CSA practices would be widespread and better accepted. Improves productivity. |
| **4. Mechanism to regulate the extent and production:**<br><br>The agriculture sector in Sri Lanka often faces situations of gluts and shortages of many crop varieties. This often creates huge marketing issues that require strategic addressing. Out of the two most workable options, the regulation of seed issue in coordination with the private sector is seen as one. The other option is allowing all crop extents and productions to be decided on, at the cultivation meetings under the close supervision of an identified village-level government official, who would work in collaboration with Farmer Organisations and societies. | Helps increase the adoption rate of CSA interventions. |

# 2.12 RISK TRANSFERRING MECHANISM (cont'd)

| Technologies and Practices | Benefits |
|---|---|
| **5. Inclusion of CSA in curricular of agriculture education:**<br><br>It is strongly proposed that CSA should be included in all the curricular of agriculture schools and agriculture universities. | Helps students understand CSA and would also improve its efficiency. |
| **6. Reinforcement of acts and ordinances related to agriculture, water, land, and environment:**<br><br>Reinforcement of all existing acts and ordinances pertaining to the country's agriculture sector is essential. | Policy-level Intervention. |
| **7. Cottage Industries such as artisanal handicraft using sedges, clay and wood:**<br><br>Off-farm incomes invariably bring supplementary benefits to farming communities. Therefore, cottage industries using locally available raw materials such as pan (Cyperaceae family), clay and wood should be promoted among the farmers and their families along with assistance in the marketing of these products. | Off-farm incomes facilitate the adoption of recommended CSA practices. |

# 2.13 ENERGY MANAGEMENT AND MITIGATION

| Technologies and Practices | Benefits |
|---|---|
| **1. Solar power as an energy source:**<br><br>As previously mentioned, solar power can be extremely effective when used in several phases of the entire agricultural value chain. For example, solar power is ideal for lift irrigation, drying of agricultural produce, and as the energy source for domestic power in households that are off the national-grid supply. | **A mitigation intervention.**<br><br>Contributes to productivity enhancement. Due to reduced running costs, this helps increase productivity. |
| **2. Wind for energy supply:**<br><br>Even though the potential of wind energy in the interior locations of Sri Lanka's agricultural regions such as the Dry and Intermediate zones, is relatively low, mini wind turbines would still be a potential candidate to establish small lift irrigation systems. | This is again a **mitigation aspect** of the proposed CSA interventions. |
| **3. Bio energy:**<br><br>Bio gas using crop residues and animal waste generating from integrated farming systems could be used as an energy source for drying and other forms of energy uses in the river basin households. Even though these communities have a significant knowledge and experience on the use of this natural energy source, its introduction as a cost-effective and an efficient technology has to come along with a subsidy. Left-over material from bio gas plants can be directly used as organic manure. | **A mitigation intervention** towards the achievement of CSA. |

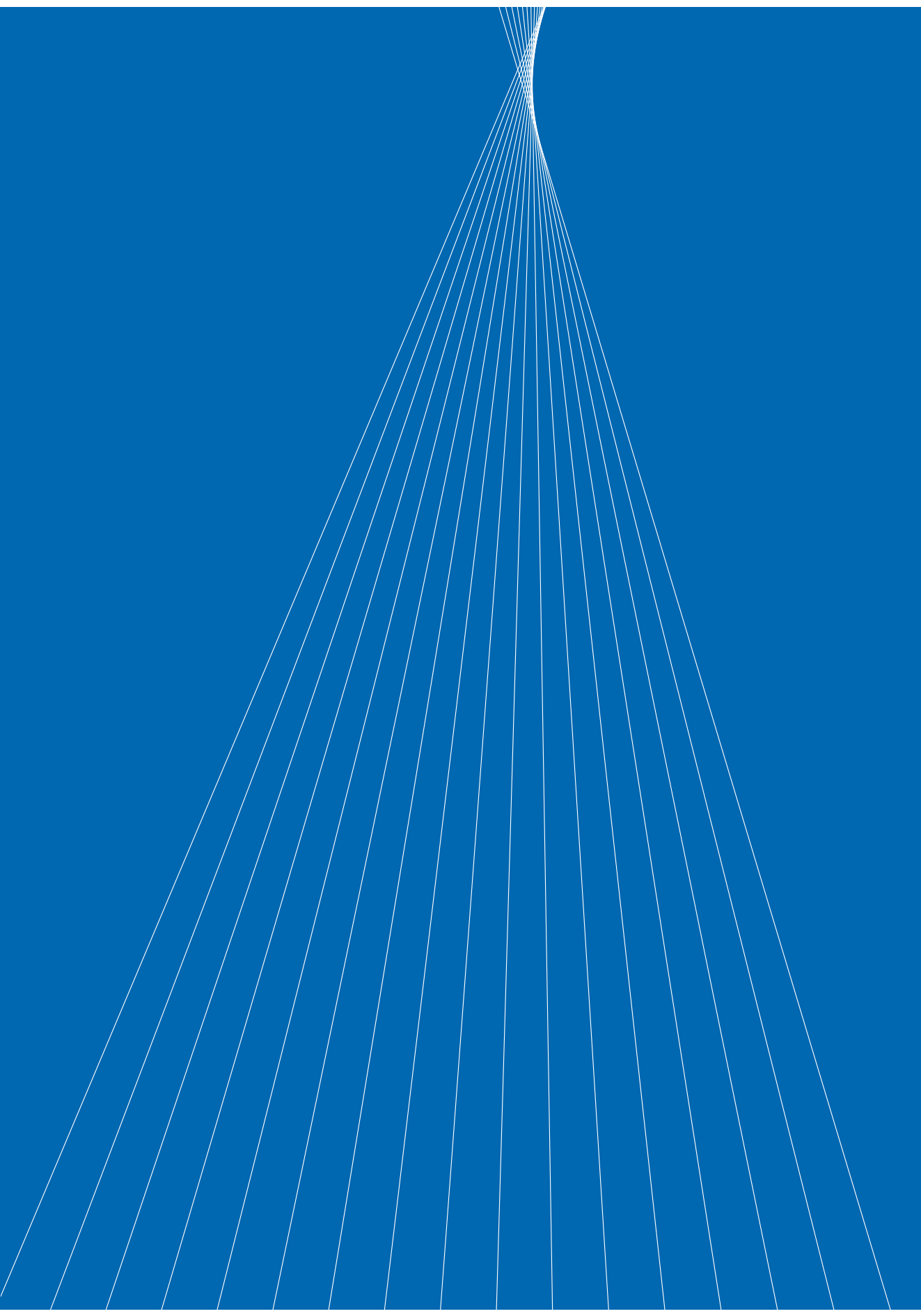
# 2.14 MECHANISATION

| Technologies and Practices | Benefits |
|---|---|
| **1. Introduction of appropriate mechanisation:**<br><br>Mechanisation brings in timeliness and precision to agricultural operations, greater field coverage over a short period, cost-effectiveness, efficiency in the use of resources and applied inputs. Mechanisation has an added advantage of attracting the younger generation to agriculture. However, care should be taken to introduce the appropriate machinery to the respective river basins. | Helps improve the productivity and profitability of agricultural operations and attracts the younger generation into a career in farming. |
| **2. CBOs and the private sector to establish machine hiring centres:**<br><br>One of the serious constraints faced by the farmers is the non-availability of appropriate machinery for use at the right time at an affordable fee/rental. It is proposed that CBOs and the private sector venture together to set up specific machinery hiring centers in the villages, for agricultural machinery. The most needed machinery and instruments are four-wheel tractors, two-wheel tractors, motorised transplanters, rotary tillers, zero till drillers, drum seeders, multi-crop planters, power weeders, and combine harvesters. | This would help farmers to engage in agriculture in a timely manner; and would also improve productivity. |

| Technologies and Practices | Benefits |
|---|---|
| **3. Rewards to deep plowing as appropriate:**<br><br>Deep plowing (up to 10 inches), when and where necessary, is required for productivity improvement of annual crops. Farmers tend to use only rotavators, which would break the soil only up to 4 inches, which is not enough for the root zone development of most annual crops. However, there are certain limitations for deep plowing. If it is carried out once in every season, there can be a salinity build-up on the soil. Deep plowing can also increase water losses if the hardpan layer underneath is damaged. | This will improve the productivity of the crops and a deep root zone means higher adaptability to drought, which minimises the use of added fertiliser, hence, mitigation is also done. |
| **4. Use of farm machinery by land and plot consolidation:**<br><br>Most of the rice fields in the project areas have been fragmented through successive generations. Farmers are unable to use machinery in small plots due to the presence of several bunds and these plots are low in productivity. Research has shown that consolidation of small plots can bring a 10% increase of land extent. The project is advised to help the farmers practise plot consolidation. It would facilitate the use of heavy machinery leading to improved efficiency, without affecting the land extent and the ownership. | Helps improve the productivity and reduces the amount of water use due to efficient water management. |

# 2.15 POST-HARVEST OPERATIONS

| Technologies and Practices | Benefits |
|---|---|
| **1. Post-harvest processing through farmer federations:**<br><br>In the absence of the private sector in value addition ventures, the farmer federations should be encouraged towards post-harvest processing. It is suggested that the processing facilities are arranged with farmer groups/farmer federations, making sure adequate quantities of the primary produce are constantly available in the processing factory for continuous operations. | Improves sustainability of agriculture and improves productivity.<br>Helps improve overall productivity, avoid gluts and the short supply of agriculture produce, thereby helping the desired marketing objectives while improving profitability. |
| **2. Reduction of post-harvest losses with the help of appropriate tools such as collapsible crates:**<br><br>Use of crates reduces losses in fresh produce during transport. Previously, the transport space required for empty crates after delivery of produce had been a significant barrier. Collapsible crates have ideally addressed that issue, and hence are highly recommended. | **An adaptation intervention.**<br>Reduced post-harvest losses will improve productivity; also has a mitigation effect. |
| **3. Collection centres with cold storage facilities at regional and community level:**<br><br>Collection centres at regional level with or without cold storage facility – in collaboration with the private sector – are a good way of ensuring the market for agricultural produce. However, for areas where perishable produce is harvested, cold storage facilities are an investment in order to store the surplus in good condition. Depending on the crops grown in the areas, collection centres with or without cold storage facilities should be established and state support should be compulsory for this intervention. | **Involves a Mitigation effect** due to the use of lower quantities of chemicals.<br>The profitability of farming increases; farmers gradually become small entrepreneurs, and would consequently get motivated to improve their productivity, which is an essential component of the CSA. |



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