Coping with Climate Change and Variability:

LESSONS FROM SRI LANKAN COMMUNITIES

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CBA (Community Based Adaptation to Climate Change)

Community Based Adaptation (CBA) is an initiative implemented during the years 2010 -2014 by the Global Environmental Facility/Small Grants Programme (GEF SGP) with financial assistance from Australian AID. CBA was created with the goal of empowering communities in overcoming effects of climate change through improved livelihood resilience along with ensured water and food security, by utilizing modern science and technology.

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Lessons from Sri Lankan Communities

Proceedings of the National Workshop on Community Based Adaptation Colombo, Sri Lanka
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Global Environment Facility/Small Grants Programme Sri Lanka

Summary

Across Sri Lanka, climate change related weather aberrations and resultant extreme weather events are becoming increasingly common. While this affects the country at large, farmers and agricultural workers face the worst impacts of this variability. The increased frequency of flood and drought incidence in the last ten years has caused severe hardship to poor farmers across Sri Lanka.

The Small Grants Programme of the Global Environmental Facility (GEF SGP) in Sri Lanka with the financial assistance from Australian AID implemented a number of Community Based Adaptation (CBA) initiatives during 2010 to 2014 seeking solutions to some of the impacts of climate change. These projects could be considered among the country's first scientifically designed responses to manage risks of climate change-induced changes: to weather patterns and natural resources depletion.

In the design and implementation of these projects, GEF SGP attempted to improve livelihood resilience and ensure water and food security to communities at risk by directly engaging in aspects of science, technology and research. The combination of laying a scientific basis for the interventions, implementation of projects through community based organizations and the engagement of local government actors strengthened the delivery of project targets, and laid the foundation for their eventual sustainability.

This publication is an attempt to capture the lessons and document the important challenges faced during the five years of project implementation, which is important to improve the country's strategic focus on adaptation to climate change.

Main Lessons Learnt During Implementation: There is a lack of awareness about climate change impacts on livelihood among farmers and local government officials especially those engaged in water management and agriculture extension. As such, farmers are not supported to adapt to changed rainfall patterns and seasons with proper advice on crop choice, water saving methods or diversification of livelihoods so that dependence on rainfall is minimized. Year after year, farmers cultivate the same crop combinations, depending on seeds imported by the private sector and on agro-chemical suppliers to provide them with information and advice for managing threats to their crops. This trend has resulted in deep indebtedness among rural households and a lack of disposable income for capital investments needed to a durable change in resilience.

While communities are willing to take action to reduce their vulnerability, they feel that the barriers are too great to overcome by themselves. Communities list poverty (lack of finances to invest in solutions) and lack of technology or awareness of available options and lack of support

from local When designing the activities in each CBA location, a rapid Vulnerability Reduction Assessment (VRA)1 and a trend analysis of weather changes of the previous five years was undertaken at every project site. Activity design therefore responded to the most pressing climate related weather change. However, during the project period, all pilot project sites experienced far greater level of climatic extreme events than anticipated or planned. This placed great stress on the communities and the local organizations that found themselves responding to the urgent humanitarian needs of flood and drought instead of investing in longer term resilience building.

It was also noted that the initially designed project period (18 months) is insufficient to build long term capacity for resilience among the very poor farmers who face the greatest climate change related livelihood risks. Further, while projects addressed one dimension of vulnerability- the physical exposure to climate risks; often communities have other, underlying and entrenched (social, economic) factors that could not be addressed by the planned intervention due to financial and time constraints. In some locations, strong partnerships developed during the implementation of the project, especially with local governments, which had positive results such as communities' ability to overcome marginalization and lack of services. However stronger policy-level initiatives are required to support communities to overcome entrenched inequality and marginalization.

Some of the best practices that emerged from project implementation are;

1) Strong local presence of the civil society organizations entrusted with project implementation. Through this, there was greater investment in local capacity building and retention of that capacity in the villages. The CSOs worked closely with locally established committees to design and deliver the interventions. Their local presence, even after the project was completed meant that the CSO remained accountable to the local people.

2) High level of cooperation from government officials, technical institutes, and extension services such as from the Agriculture Instructors working in the districts meant that the government was on board and engaged to provide solutions and ensure post-project sustainability. While there were many teething issues at the beginning of project design and implementation, all pilot projects were completed with satisfactory levels of local government officials' cooperation.

3) In every location strong and active farmer/community organizations either existed or were initiated through the projects to implement and upkeep the interventions. All meetings and training programmes were conducted with the participation of community members to demonstrate transparency. In many locations farmer organizations were actively engaged in monitoring project progress and supervising any external contractors tasked with civil works during the project.

4) A number of technical best practices can be acknowledged, such as seed and crop selection, agronomic practices such as improving soil quality, crop-livestock integration, land management, water harvesting and improving kitchen gardens were successfully undertaken through the project. These have enhanced the knowledge of marginalized farmers mainly on resilient agriculture and water management.

1 Vulnerability Reduction Assessment (VRA) is a tool formulated by UNDP in 2008 and is part of its monitoring and evaluation framework for climate change adaptation projects at the community level. It is one tool among many to help understand the implications of climate change on the lives and livelihoods of local communities. It facilitates dialogue with local communities and other stakeholders and provides a platform in which an assessment of activities undertaken by projects can be evaluated with input from the community. The VRA tool presents a set of guiding questions to assist in 'identifying the specific climatic events which erode communities' abilities to realize their livelihoods, the specific livelihoods which are most impacted by climate change and their capacity to cope and adapt to its impacts and consequences. It helps development practitioners identify and remove barriers that stand in the way of communities when attempting to cope with climate related risks, as well as identify and strengthen the sustainability of resources that local communities continually use in coping and adapting to climate change impacts'. (Guidebook for Practitioners 2012 UNDP)

Up Scaling of Community Based Adaptation (CBA) Initiatives and Best Practices

Successful adaptive practices that have shown positive results in these pilot projects of the CBA have been up-scaled and integrated in to larger climate adaptation projects. A US$ 8 million proposal for rain-fed and minor irrigated areas in the Mahaweli River Basin which based its modalities on the CBA practices is now funded through the Adaptation Fund and implemented by the Ministry of Environment, in collaboration with the World Food Programme. A second initiative on rural livelihood development to withstand climate related shocks is being implemented by the Ministry of Economic Affairs funded by Special Climate Change Fund (SCCF) of the Global Environment Facility (GEF). A larger initiative on rehabilitation of tanks is approved (2016) to rehabilitate small village irrigation systems funded through the Green Climate Fund (GCF)

Case studies

1) Rehabilitation of Imbulgodayagama Village Reservoir through Community Participation
2) Climate Related Disaster Management in Thoduwawa Lagoon in Barudelpola
3) Minimizing Land Degradation in Serupitiya Village to Facilitate Community Based Adaptation to Climate Change
4) Developing Community-led Strategies and Infrastructure to Ensure Adaptation to Drought Conditions
5) Community Based Adaptation to Floods in the Elapatha DS Division of the Ratnapura District / provincial governments as key barriers.

List of Abbreviations

AFB	Adaptation Fund Board
AUSAID	Australian Aid
CBA	Community Based Adaptation
CBDRM	Community Based Disaster Risk Management
CBO	Community Based Organization
CBRDT	Community Based Disaster Response Teams
CC	Climate Change
CDC	Community Development Centre
CSA	Community Supported Agriculture
CSO	Civil Society Organization
CSR	Cooperate Social Responsibility
DMC	Disaster Management Centre
DRRC	Disaster Risk Reduction Committee
DS	Divisional Secretariat
EDPC	Environmental and Disaster Preparedness Committee
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
FGD	Focus Group Discussions
FIM	First Inter-Monsoon
FO	Farmer Organization
GEF	Global Environment Facility
GMSL	Green Movement of Sri Lanka
GN	Grama Niladhari
I/NGO	International Non-Governmental Organization

KII	Key Informant Interviews
m	Meters
m3	Meters Cubed
MAP	Mekong-Asia and Pacific Regions
MDM	Ministry of Disaster Management
MoERE	Ministry of Environment and Renewable Energy
mm	Millimeters
NEM	North-East Monsoon
NGO	Non-Governmental Organization
NRMC	Natural Resource Management Centre
NTRC	National Steering and Technical Review Committee
PMCA	Participatory Market Chain Approach
RBAP	Regional Bureau for Asia and Pacific
Rs.	Lankan Rupees
SALT	Sloping Agricultural Land Technology
SGP	Small Grants Programme
SIDS	Small Islands Developing States
SIM	Second Inter-Monsoon
SWAMP	Sustainable Agriculture Water Management Project
SWM	South West Monsoon
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNHABITAT	United Nations Human Settlement Programme
UNWFP	United Nations World Food Programme
US$	United States Dollars
USD	United States Dollars
VRA	Vulnerability Risk Assessment / Vulnerability Reduction Assessment

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1. Climate Change: Threats and Opportunities for Sri Lanka

Climatic Hazards and Climate Change in Sri Lanka

Sri Lanka's existing climate is determined by monsoons. Four distinct rainfall seasons are observed as depicted below:

Table 1: Average annual rainfall (1961-1990)[1]

Season	Period	Average Rainfall (mm)	Percentage of Annual Total
First inter-monsoon (FIM)	March – April	268	14
South-West Monsoon (SEM)	May - September	556	30
Second Inter-monsoon (SIM)	October - November	558	30
North-east Monsoon (NEM)	December - February	479	26

Climate change in Sri Lanka is manifest through a slow but steadily rising temperature and erratic and unpredictable rainfall seasons. A number of meteorological studies point to a clear warming trend with both day-time maximum and night time minimum air temperatures showing increased trend at most meteorological stations in the country. The predicted increase ranges from 0.46°C per decade for maximum day time temperature; and around 0.27°C per decade for minimum night time temperature[2]. The number of warm days and warm nights has increased in all districts.

Although total annual rainfall (past 10 years compared to the 30 year average) remains steady,[3] climate-induced changes are already observed in the increased variability of monsoon behavior, pertaining to on-set time, duration, nature of rainfall and seasonal rainfall. Change in the temporal Climate change in Sri Lanka is manifest through a slow but steadily rising temperature and erratic and unpredictable rainfall seasons. A number of meteorological studies point to a clear warming trend with both day-time maximum and night time minimum air temperatures showing increased trend at most meteorological stations in the country. The predicted increase ranges from 0.46°C per decade

1 However this pattern is subject to very wide regional variations.
2 Punyawardena et al, Predicted temperature Change over Sri Lanka by PRECIS RCM for B2 Scenario in combination with ECHAM4 GCM 2010
3 Punyawardena et al. Vulnerability Analysis of Districts 2012

for maximum day time temperature; and around 0.27°C per decade for minimum night time temperature[4]. The number of warm days and warm nights has increased in all districts.

Although total annual rainfall (past 10 years compared to the 30 year average) remains steady,[5] climate-induced changes are already observed in the increased variability of monsoon behavior, pertaining to on-set time, duration, nature of rainfall and seasonal rainfall. Change in the temporal distribution of rainfall across these four seasons is already observable. Data show increased variability in three out of four monsoons, but especially pronounced during the north-east monsoon which supports agriculture in the Dry zone, especially the staple crop, rice. This spatial and intra-annual variability of rainfall has dramatically affected seasonal cropping patterns, irrigation potential and hydropower generation.

Sri Lanka is affected by a number of climatic hazards and extreme events, and these are projected to worsen with climate change. Being an island with a mountainous central-region, Sri Lanka has been historically affected by floods, droughts, landslides, coastal storms and erosion, cyclones and storm surges. Changes in rainfall distribution is clearly manifest in a higher number of intense/heavy rainfall incidents leading to floods and longer periods of consecutive dry days leading to deeper periods of drought during the dry season.

During 2010 - 2015, Sri Lanka suffered from a cycle of hydro-meteorological disasters. Droughts and flood incidents, within a few months of each other, alternated within the same districts, affecting the same vulnerable communities eroding greatly their capacity to cope. Many of these districts are ones that have been affected by conflict and where communities are still in the process of resuming normal lives. The drought of 2012 has been the worst in past 20 years in the Central Highlands, and one of the worst crop years for the country.[6] However by January 2013 floods were affecting 10 districts, many of which were earlier in the clutches of drought. In 2014 drought affected over 1.8 million people in 16 districts including Mannar, Vavuniya, Mulaitivu, Trincomalee, Batticaloa, Puttlam, Kurunegala, Anuradhapura and Polonnaruwa[7]. WFP assessments showed that in April 2014 over 750,000 people were in a situation of food insecurity a condition that was worsened by low rainfall until October 2014. The same districts were subsequently impacted by heavy floods in November-January that same year affecting 1.1 million people.[8]

Vulnerability and Exposure to Climate Change

Sri Lanka's cropping calendar revolves around the four rainfall seasons described above. The dry zone which is where the majority of food crops is cultivated, benefits only from NEM and FIM, and the contribution of rainfall volume by the latter is small. Agricultural seasons are defined based on these rainfall seasons. The Yala season falls within the FIM and SWM rain periods. As the rainfall in the dry zone is low during this period, it is considered as the minor growing season of that zone. The major growing season, Maha, begins with the arrival of SIM rains in mid-September/October and continues up to late January/ February with the NEM rains.

Sri Lanka's hydrological resources consist of a network of river basins with varying degree of water availability. There are 103 distinct river basins which cover 58,550 sq. km. (90%) of the land mass. Out of them, 20 are classified as wet zone rivers (Arumugam, 1969) which originate and flow to the sea through the wet zone comprising less than 25% of the land area. These wet zone rivers carry approximately half the surface water flow, and as such, there is a large variation of surface water availability among wet zone and

4 Punyawardena et al, Predicted temperature Change over Sri Lanka by PRECIS RCM for B2 Scenario in combination with ECHAM4 GCM 2010
5 Punyawardena et al. Vulnerability Analysis of Districts 2012
6 Central Bank of Sri Lanka. Annual Report 2012
7 UNOCHA Drought Update. August 2014/
8 Disaster Management Centre Database 2013

dry zone rivers. The rivers entirely in the dry zone receive rainfall mainly in one monsoon and one inter-monsoon period and usually the demand exceeds the supply of water in that zone.

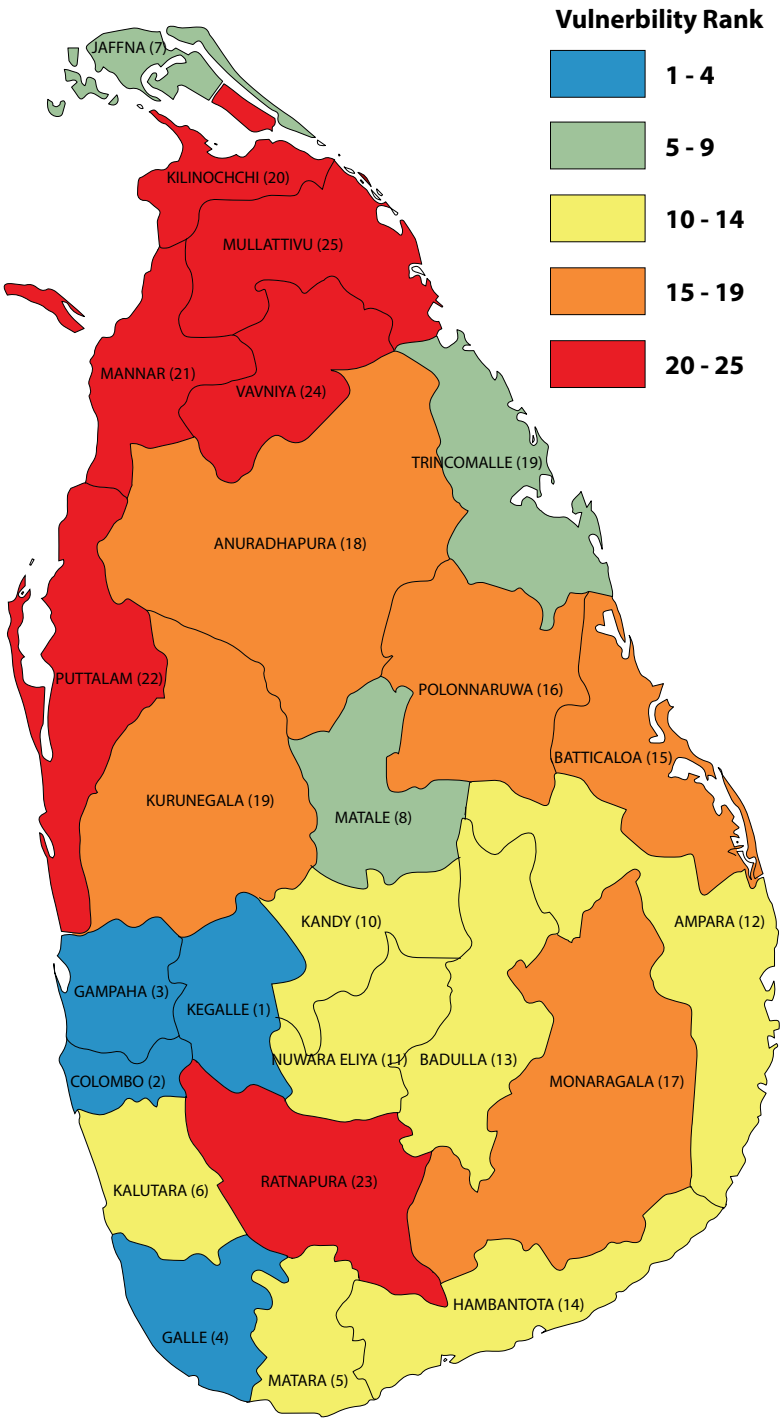
Sri Lanka's agriculture outside the plantation sector is dominated by farmers having small land holdings. As the Figure shows, more than 90% of the farmers have land extents less than 2 ha. Therefore it is evident that a substantial portion of their produce is consumed domestically and output from the farms have a substantial impact of domestic food security.

Rainfall plays on important role in agriculture as any shortages or excess of rainfall gives way to a reduction in yield. Therefore, climate change undoubtedly would trigger serious impacts on the country's food insecurity and vulnerability patterns. This has been highlighted in the recent study of ESCAP (2010) as Sri Lanka is to be one of the hotspots of food insecurity in the Asia-Pacific region.

Expected and predicted climatic changes may lead to an increase in the Maha (NEM) season irrigation water requirement for paddy by 13-23 percent by 2050 compared to 1961- 1990. Reduction of river water flows can increase the risk of saltwater intrusion. High intensity rainfall leads to significant erosion and runoff reducing retention and re-charge. Unusual flash floods damage headworks of irrigation schemes and canal structures hindering a reliable water conveyance and supply. The impacts of temperature increase on water availability include increased rates of evaporation and evapo-transpiration. Thus, during drought periods water availability for irrigation will be affected due to high evaporation rates – this is especially true for the Dry Zone tanks and rivers. These changes in rainfall and temperature, together with other climatic factors, had increased the soil moisture deficit significantly-thus reducing water available for food production, and increasing the irrigation requirement.

A spatial analysis of vulnerability climate change showed that districts with farmers depending on rain-fed agriculture, without adequate infrastructure, with high poverty and chronic diseases were the most vulnerable to climate change impacts. The entire northern, north western and parts of north central provinces are highly vulnerable due to agricultural practices dependent on rain. Ratnapura is the only Wet Zone district that demonstrates high vulnerability due to poverty and flood/landslide exposure. See Map 1.

Map 1: Climate Change Induced Vulnerability at District Level



Source: Punyawardena, B.V.R. and Dissanaike, T. and Mallawatantri, A. (2013). Spatial variation of climate change induced vulnerability in Sri Lanka.; An analysis of the components of vulnerability at district level.

Impacts of Climate Change on Weather Patterns in Sri Lanka

Increasing Temperature

- Average air temperature in Sri Lanka has increased by 0.64°C over the past 40 years and 0.97°C over the last 72 years, which reveals a trend of 0.14°C per decade. However an assessment of a more recent time band has shown a 0.45°C increase over 22 years, suggesting a rate of 0.2°C per decade
- Consecutive dry days are increasing in the Dry and Intermediate Zones (please see agro-ecological zones of Sri Lanka)
- Ambient mean minimum and mean maximum temperatures have increased
- The number of warm days and warm nights has increased, while the number of cold days and cold nights has decreased

Rainfall Variability

- Precipitation patterns have changed but conclusive trends are difficult to establish
- A trend indicating decreased overall rainfall has been observed over the past 30-40 years, but the change is not statistically significant
- There is an increasing trend of one-day heavy rainfall events across the country
- An increase in the frequency of extreme rainfall events is anticipated, leading to more droughts, floods and landslides

Drought and Dry Periods

- Increased frequency of dry periods caused by consecutive dry days and droughts are expected
- The general warming trend is expected to increase the frequency of extreme hot days

Source: Department of Meteorology/ Adapted from the National Adaptation Strategy 2011-2016

2. Planning and Implementation of Pilot CBA Projects

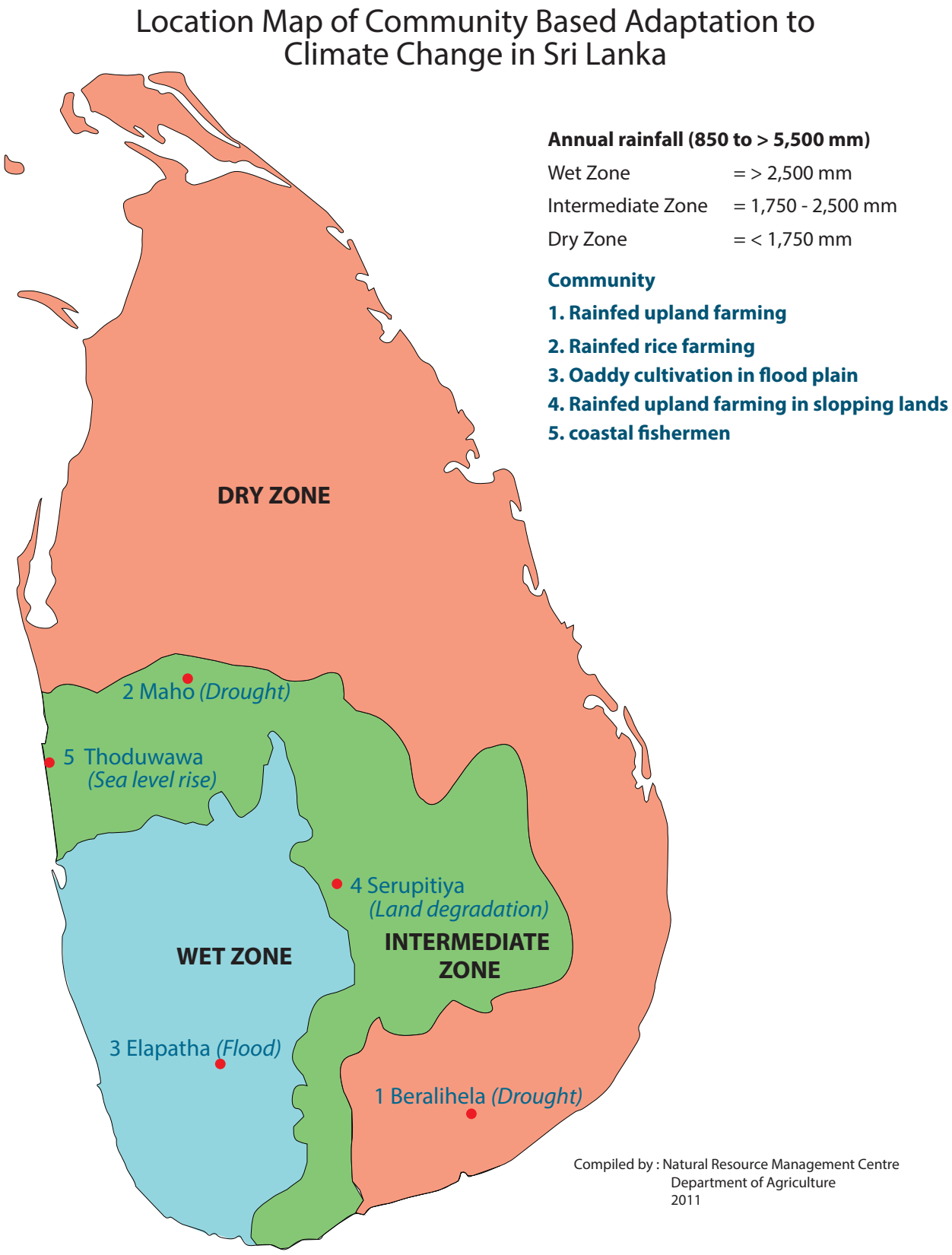
The Community Based Adaptation programme was launched in 2010 to address concerns of vulnerable communities facing climate change risks around the country. The programme was funded by AUSAID and was implemented between 2010 and 2013, five pilot initiatives were funded in the initial phase. With the successful completion of these initiatives further funding enabled extending the grants to three new projects. The guidance for project screening, selection and implementation was given by the National Steering Committee (NSC) and technical guidance was by the Technical Advisory Group (TAG) members of the GEF/SGP.

A four-step strategy was employed to narrow down project areas, and the grant recipient communities.

1. Review of vulnerability based on agro-ecology and recent trends in climate-related disasters

Sri Lanka has three main climatic zones based on rainfall: Wet, Dry and Intermediate zones. Based on rainfall, soil type, land use, and elevation, the country has been delineated in to 46 different agro-ecological zones. Some of these are especially vulnerable to recent changes in climate, especially rainfall variability and late onset of seasonal rains. Through an expert consultation process it was decided that the five pilot projects should represent the more at-risk zones as shown in Map 2.

Map 2: Main Climatic Zones with Project Locations



2. Review of vulnerable population groups within the at-risk zones for better project targeting

Within these agro-ecological zones there are certain groups of communities at greater risk due to climate change and variability caused by their livelihood choice or their socio-economic status. The projects were designed to address the specific vulnerabilities identified among these groups.

3. Calling for proposals from at-risk locations and vulnerable communities

GEF SGP launched a widely advertised call for proposals from the defined climatic zones, mentioning identified vulnerable communities in order to target the pilot interventions better. A concept note template was provided under the themes of drought, floods, land degradation and landslides, and coastal hazards such as sea level rise. Over 60 proposals were received by the deadline from as many civil society organizations, mostly local NGOs.

4. Grant awarding process

A stringent project whetting process was adopted, shortlisting was done by the technical review committee and site visits were conducted to each short-listed location. This involved over 20 site visits to different locations in the country by members of the SGP National Steering Committee and the Technical Advisory Group. Each NGO made a detailed presentation to the National Steering Committee, where the final grantees were chosen.

A two-day workshop was conducted to refine the concept notes and develop full proposals. A number of academics and climate change experts provided guidance to the NGOs to develop their outputs and outcomes to reflect climate change adaptation priorities in the country. This workshop also brought in two or more community members from each location to ensure participation in planning and transparency in financial allocations.

Five pilot projects were awarded in November 2010 and Vulnerability Reduction Assessments (VRAs) were conducted in November through January 2011. In all five locations the primary focus is to increase communities' adaptive capacity through long and short term interventions in improving livelihood resources and environmental conditions linked to their livelihoods such as soil quality, improved tree cover and access to water. The activities met the expectations of the target communities' need for short term results such as improved harvests, better incomes, secured environmental goods and the project's aim of ensuring long-term adaptive capacity of both the eco system and the social fabric. Adverse weather conditions (very heavy rainfall) in January and February prevented timely project execution. However diligent monitoring and commitment of the communities and NGOs ensured that three projects completed their activity schedules by end of 2011. Two projects were behind the others – one had a very long mobilization phase due to its large co-financing requirement which was raised from the government mainly; the other project needed extended time as the work required comprehensive technical assistance for its irrigation component.

3. Proceedings of the National Workshop on Community Based Adaptation

The National Workshop on Community Based Adaptation, was a new initiative formulated to support communities at risk from climate change, with the objectives of providing a platform for CBA participants to share experiences on lessons learned, challenges faced and overcome when implementing the projects in this new area of climate change adaptation. The workshop was graced by many experts from relevant fields. The workshop comprised of six parallel sessions and academics presented five case studies and seven technical papers. The workshop concluded successfully, providing valuable outputs.

3.1 Introduction - Objectives

GEF/SGP has a 15 year history of working with local NGO partners in Sri Lanka on over 370 projects to bring the benefits of sustainable development to communities in remote areas of the island. The new initiative on Community Based Adaptation funded by AUSAID to support communities at risk from climate change was implemented between 2010 and 2013, and extended further with supplementary funding in 2013 to support additional projects.

The objective of the national workshop on CBA was for participants to share experiences, lessons learned, and challenges faced and overcome when implementing the projects in this new area of climate change adaptation. The workshop also aimed at increasing knowledge of the subject and creating greater awareness and understanding, which would eventually promote further study and research. It was an opportunity to present the implementation modality, considerations for designing adaptation projects, to discuss what has worked and what the challenges existed in the context of rural climate change adaptation. It provided a platform to discuss, strategize, and share ideas on best practices on Climate Change Adaptation and building resilience.

3.2. Participants

The chief guests at the workshop were the Hon. Minister of Disaster Management, Mr. Mahinda Amaraweera, the Country Director of the UNDP, Ms. Razina Bilgrami, AUSAID representative Ms. Dulani Sirisena, Dr. B.M.S. Batagoda of the Ministry of Finance, the Secretary to the Ministry of Environment and Renewable Energy (MoERE), Mr. B.M.U.D. Basnayake and Chair of the National Steering Committee GEF/SGP Sri Lanka, Dr. Keerthi Mohotti. The participants were academics, scholars, government officials from Ministries, Department Heads and/or their representatives, Regional representatives from Maldives, Cambodia and New Zealand, representatives of NGOs, CBOs, UN organizations, GEF Small Grant recipients and journalists.

The workshop was inaugurated by Ms. Shireen Samarasuriya, Coordinator, GEF/SGP. Several speeches were made during the Inaugural Session, including a speech by the Hon. Minister of Disaster Management, Mr. Mahinda Amaraweera. The subsequent four sessions had a wide spectrum of presenters from community leaders to University Professors. The final session was an interactive feedback session where the participants voiced their concerns and opinions.

3.3. Plenary session 1: Workshop Opening and Welcome Speeches

The workshop began with an introduction to the objectives of the Symposium on Community Based Adaptation to Climate Change and Variability. Describing the threat of climate change, it was highlighted that adapting to the changing climate is an on-going activity for the survival of rural communities, but rapid changes in weather conditions in the recent past had left these communities further marginalized and vulnerable. This highlighted the need for developing strategies to achieve food and water security; for building the necessary infrastructure as no-regret investments, and for developing resilience of communities to cope. Scientists, practitioners, and communities had to work together to find solutions, increase knowledge, create awareness. Lobbying for funds to finance such initiatives in developing countries is also important. Examples of demonstrations on the ground would serve as practical lessons that would inspire policy makers and decision takers to create the enabling environment necessary to face environmental challenges effectively.

Delivering the keynote address, Dr. B.M.S. Batagoda noted the decline of the agricultural sector in the economy and the government's plans to develop the industrial and service sectors as the engines of growth. Nevertheless, community adaptation to climate change was important because of the dominance of small holders in all sectors of the economy. Accordingly, location specific, small scale, Community Based Adaptation strategies were more important than mitigation in protecting small scale livelihoods and life supporting systems.

Ms. Razina Bilgrami, Country Director of the UNDP and Ms. Dulani Sirisena, Program Officer of AusAID Sri Lanka emphasized the importance of supporting environmental sustainability and disaster resilience, Ms. Bilgrami noted that environment, energy, and disaster management were integral to the Sustainable Development Goals (SDGs) that have succeeded the Millennium Development Goals (MDGs) in the global development agenda. Becoming more knowledgeable about adaptation issues in their own communities would enable participants to contribute to the global efforts when addressing climate change and environmental issues that were critical to achieving sustainable economic development. Presenters contextualized CBA in the national and global adaptation agendas.

Mr. B.M.U.D. Basnayake, MoERE, outlining the national climate change policy of his Ministry, noted that of the eight sectors for which appropriate technologies had been identified, five were in adaptation with the objective of enhancing capacity building of vulnerable communities, especially farmers.

3.4. Session 2 - Climate Adaptation Priorities and Experiences

Dr. Ananda Mallawatantri, Assistant Country Director UNDP, opened the session with a presentation on the nexus between Community Based Adaptation (CBA) and community based disaster risk management (CBDRM). He stated that climate change parameters had an impact on infrastructure, forest and water resources, coastal areas, wild life and eco systems, the economy, agriculture, health, and cultural resources. CBA and CBDRM complemented each other with similar approaches. Sri Lanka has developed the necessary tools, information and best management practices for its efficient implementation of CBA and CBDRM and although there were key areas for improvement in making assessment of risk reduction. While there was no formula applicable to all projects, in mainstreaming CBA and CBDRM, communities would benefit most by multi-stake holder, multi-sector approaches that allowed a range of experience and skills including local knowledge to come together.

Prof. Sarath Kotagama of University of Colombo explained the critical importance of biodiversity in managing climate change risk, and the crucial role of ecological conservation. Biodiversity therefore lays at the heart of all ecological goods and services used for human well-being, and many people have benefitted from the conversion of natural ecosystems to human-dominated ecosystems over the last century. However, the resulting losses in biodiversity and changes in ecosystem services led to declining well-being and even impoverishment for some dependents. Human induced climate change exacerbates the loss of diversity, and for a given ecosystem, functionally diverse communities are more likely to adapt to climate change and variability than impoverished ones. Some species are particularly vulnerable to climate change and would become extinct, eventually leading to species loss. Sri Lanka, though a negligible contributor to global warming, is highly vulnerable to climate change impacts, making adaptation imperative. Both lay people and professionals are involved in making choices that make the best use of biological resources while maintaining the productivity of the ecosystem. When making decisions, the value of all eco system services should be accounted for, not just those bought and sold, and a good information base, experienced and qualified field staff, a well-informed public, and good institutions are prerequisites for effective conservation actions. This calls for harnessing the synergies of the multi-lateral environmental conventions in place, adopting an ecosystems approach and adaptive management, promoting participatory and transparent decision making processes, and using innovative decision making tools boldly.

Mr. M.H.B. Wanasinghe of the Samagi Farmers Organization - Imbulgodayagama, commented on climate risk reduction from the perspective of a community member. As dry zone dwellers, his community had been aware of changes in the weather and environment but the project implement or gave them a clearer understanding of the issues. He elaborated that lack of flexibility and transparency were two problems encountered when working with government agencies. The community had realized that hiring contractors for project work had deprived them of a valuable learning experience. When they undertook the work themselves, they learnt how to minimize cost and maximize output. He lamented that there was no opportunity for them to use the experience gained in rehabilitating a tank even though there are many more in their district which needed rehabilitation. If and when they are rehabilitated the procedure will be to call for tenders and give the work to a contractor at a high cost and not to a farmer group like theirs who would be able to do the work at minimal cost.

In an overview of the SGP MAP/SIDS CBA regional program, Ms. Leanne Harrison, the regional CBA coordinator reiterated SGP's financial and technical support for projects that conserved and restored the environment while enhancing people's wellbeing and livelihoods. The primary stakeholders were poor and vulnerable communities, most at risk because they depended on access to natural resources for their livelihoods and often lived in fragile ecosystems. SGP's engagement with CBA was to reduce vulnerability and increase the adaptive capacity of communities to manage the additional risks of climate change and its variability. To achieve this, the capacity of NGOs and CBOs had to be strengthened to design and implement Community Based Adaptation measures, mainstream adaptation to climate change at community level, document lessons learnt from the projects, and revise the relevant national policies accordingly. The two-year lifespan of CBA projects, the documentation of lessons learnt, and follow-up of policy processes that go beyond the project made information collecting difficult. VRA processes and methodologies were also a challenge to the poor and often less capable communities, while CBA activities were site-specific and context-based.

Sharing her experience in mainstreaming Community Based Adaptation into local planning in Cambodia, Ms. Ngin Navirak the National Coordinator of GEF/SGP Cambodia, mentioned weak capacity and understanding of the concept, insufficient consultation with or participation of local authorities as the key issues encountered during the CBA planning process. CBA needs were not prioritized in development programs as Commune Councils of Cambodia had limited funding; the capacity of the local authority

to mobilize resources to implement projects was limited. Among the lessons learnt from the numerous initiatives were CC integration into CBA defined by communities, collaboration and alignment with technical departments and inclusion of gender issues. Potential impacts were local ownership, a high level of sustainability of CBA projects, leadership of Commune Councils in designing and implementing CBA priorities, better coordination at local level, stronger participation from communities and CSOs and co-financing with Commune funds in implementing climate change priorities.

3.5. Session 3 - Lessons Sharing by Grantee Organizations

Dr. B.V.R. Punyawardena of Natural Resource Management Centre (NRMC), Department of Agriculture, explained the process of project selection, emphasizing the relevance of adaptation rather than mitigation in countering the risks of climate change in Sri Lanka and the need for Community Based Adaptation as climate change impacts were region specific. Three imperatives had emerged from discussions with government, academia and civil society experts to formulate adaptation strategies: to determine the most climatically vulnerable areas to execute the project; to develop a set of activities that could be easily implemented and deliver tangible results, and to align the projects with the government's adaptation priorities and environmental agenda. Five farming systems and livelihoods were identified as the most sensitive to climate change impacts: rain-fed rice farming under minor tanks in the dry zone; rain-fed upland farming in the dry zone; rain-fed upland farming in sloping lands on the eastern slopes of the central highlands; rice cultivation in the flood plains of the wet zone, and coastal fisheries in the coastal zone. A vulnerability review based on agro-ecology and recent trends in climate-related disasters helped to identify the critical pockets at high risk.

Proposals were invited from the most at-risk through the local SGP/GEF network from the climatic zones defined, with a concept note template under four thematic areas: drought (rain-fed upland farming and rain-fed rice cultivation under minor tanks); flood (rice cultivation in flood plains); land degradation (rain-fed upland farming in sloping lands); and sea-level rise (coastal fisheries). Five grantees were selected out of 60 proposals, following review by the National Steering and Technical Review Committees. A two-day work shop helped grantees to fine-tune the concept note and proposed project interventions and Vulnerability Risk Assessments (VRAs) were conducted after the projects were awarded. The primary focus was to increase the resilience and adaptive capacity of the community through a mix of short-term and long-term interventions to enhance livelihood and improve environmental conditions linked to their livelihoods. The projects were:

- Rehabilitation of Imbulgodayagama Tank, Maho/Mahawa, Intermediate Zone: CBA Focal Area - Drought (rice cultivation under minor tanks in the IL3 AER).
- Developing Community-led Strategies and Infrastructure to Ensure Adaptation to Drought Conditions, Lunugamwehera, Thanamalwila, Dry Zone: CBA Focal Area - Drought (rain-fed upland farming in the DL5 AER)
- Minimizing Land Degradation in Serupitiya Village to Facilitate Community Based Adaptation to Climate Change, Serupitya, Walapane, Intermediate Zone: CBA Focal Area - Land Degradation (rain-fed upland farming in sloping lands in IM1c AER)
- Community Based Adaptation to Floods in the Elapatha DS Division of Ratnapura District, Dellabada, Elapatha, Wet Zone: CBA Focal Area - Flood (Rice cultivation on flood plains in WL1a AER)
- Climate Related Disaster Management in Thoduwawa Lagoon in Barudalpola, Badurelpola, Chilaw, Intermediate Zone: CBA Focal Area - Sea Level Rise (Coastal fisheries)

Ms. Tharuka Dissanayake, GEF/SGP Technical Advisory Group member, explained how the VRA tool was used to evaluate the risks of climate change hazards and assess the baseline situation. 4 questions based on the climate related problems were formulated and scores allotted based on consensus at discussions with community members. Creating awareness on climate change issues in the area was the first step in the VRA. She then explained the rating system used in evaluating the responses to determine the trends of climate change from the perspective of an affected community.

The five pilot projects presented their cases next.

The presenter for the project 'Minimizing Land Degradation in Serupitiya Village to Facilitate Community Based Adaptation to Climate Change', Ms. Renuka Badrakanthi stated that the main issue of soil degradation resulting from erosion caused by continuous tilling and clearing of land for farming was addressed by providing land owners with detailed information on managing their sloping lands with conservation measures. Surveying the land parcels and advice on the most suitable crops to cultivate and training in ways of measuring the soil retained by establishing soil conservation measures was given to all beneficiaries. Prospective dairy farmers were given milk cows, training in dairy management, and a milk collecting facility. The cattle owners' society initiated organic farming and a drinking water project. A homestead development program provided families with perennial trees plants. An insurance scheme farmers and a revolving fund through a microfinance scheme were introduced. Family incomes increased and due to the success of the milk cow initiative many families gave up the use of powdered milk for fresh milk available in the village. She stated that the success of the project was due to flexibility, expert advice, institutional coordination, careful selection of target groups, and strong stakeholder participation. As development was sustainable, land conservation measures, crop diversification, establishing a seed bank and expansion of ongoing activities were identified for the next stage.

The presenter for the project 'Community Based Adaptationto Floods in the Elapatha DS Division of Ratnapura District', Mr. Sugath Chandrasena explained that annual flooding of paddy lands triggered by the South West monsoon had disrupted the irrigation infrastructure. Subsistence cultivation of unsuitable paddy varieties, and lack of alternative livelihoods exacerbated the issue. After raising awareness of the issues, flood resistant varieties of paddy and alternative crops were introduced along with training in cultivation techniques. A seed bank was set up and an irrigation canal constructed to drain flood water. The results included increased paddy yields, food security, and effective linkages with agricultural institutions. More time was required to introduce a crop insurance scheme and further improvements to training facilities.

The presenter for the project 'Climate Related Disaster Management in Thoduwawa Lagoon in Barudalpola', Mr. Athula Ranasinghe, identified erosion of the coastal shoreline and salinity of the drinking water wells with the intrusion of sea water as the main issues which had caused property damage and disrupted livelihoods. A drinking water scheme was introduced, and householders were trained to harvest rain water, construct bio-gas units and dry fish. A livestock development program was introduced and a market stall opened. A green belt was created to check salt intrusion and an access road to the main highway constructed for evacuation during emergencies. Inadequate funding had made the drinking water scheme difficult to commission despite the location of a good source of water. In the absence of State support, the scheme was completed with co-financing from the local political leadership and the community, which contributed half the funds required, thus highlighting the importance of developing a strong stakeholder network for this type of project.

The presenter for the project 'Rehabilitation of Imbulgodayagama Tank', Mr. Ajith Samansiri explained that paddy farmers traditionally cultivated both harvesting seasons but climate variability had resulted in water shortage due to drought and excessive silting of the existing reservoir. Consequently, cultivation was limited to half the cultivable acreage during the Maha season alone. De-silting the reservoir, effecting repairs

to minimize waste and maximize capacity, protecting the catchment area, and introducing soil conservation techniques to home gardens adjacent to the reservoir had helped prevent silting, enabling farmers to cultivate both seasons. Success was chiefly due to community participation. The farmer organization was trained to manage a revolving fund for maintenance and repair. Among the issues to be addressed in future were maintaining the reservoir, avoiding political interference in maintaining links with the government and halting the rapid spread of invasive species through inflows from reservoirs at higher elevations.

The presenter for the project 'Developing Community-led Strategies and Infrastructure to Ensure Adaptation to Drought Conditions', Mr. Janaka Withanage observed that the site was located on the border of two districts and was neglected by both administrations because of its remoteness. The main issues were water-related: lack of water for agriculture, a low water table and highly alkaline drinking water. Also, poverty stemming from a livelihood dependent on rain-fed Maha season cultivation of highland crops. Constructing a reservoir and distribution channel, introducing drought resistant crop varieties, promoting inland fishery and establishing home gardens had increased well-water levels, improved banana cultivation, enhanced family income, and improved nutrition levels. The reservoir was a source of water for the wildlife of the Lunugamvehera National Park and provided breeding places for birds and butterflies; when full, it prevented elephants from entering the village. The area had potential as a recreation site for niche visitors and pilgrims to near-by religious site at Kataragama. Project completion has been delayed and co-funding became necessary owing to contingencies that included heavy rain, un-anticipated soil conditions and engineering issues.

Dr. Sarath Nissanka of Faculty of Agriculture, University of Peradeniya Summed up indicators and outcomes based on the quantitative and qualitative evaluations of the four completed projects conducted with the assistance of students of the University of Peradeniya. A baseline survey had been completed through questionnaires and informal discussions, data and information obtained through field observations, frequent monitoring, soil sampling, water quality monitoring visits to all the households and preparation of comprehensive reports. He noted significant improvements in bio-diversity, soil and cop productivity and technical and management know-how and enhanced incomes and livelihood alternatives. Attitudinal changes favoring sustainable agriculture were evident in the shift to organic fertilizer and use of crop residues for compost. Awareness of the benefits of soil conservation was very high, and capacity building programs were rated highly.

3.6. Session 4 - Panel Discussion: Scaling-Up Lessons and Practices

Moderator: Ms. Shireen Samarasuriya

Prof. W. L. Sumathipala, Chairman of the National Science Foundation, noted that although adaptation was less costly than mitigation, funding was severely limited and Sri Lanka was ineligible for some global-level funding initiatives; however, the Special Climate Fund, Short Term Fund, and Long Term Fund were possibilities. Improving the predictive capability of the Meteorological Department and incorporating indigenous knowledge would help reduce the cost of adaptation strategies.

Commenting on project formulation and capacity building of NGOs, Mr. Gamini Gamage Ministry of Environment and Renewable Energy noting Sri Lanka's long experience in climate change adaptation as an agrarian society, argued for the incorporation of indigenous knowledge into adaptation projects as a low cost option and for adaptation policy and strategic plans to be transformed into community based projects through NGOs, which had already excelled in biodiversity work. The NGO network needed to be further activated, with an umbrella organization to facilitate collaboration, information sharing and donor assistance and a pool of experts available to write marketable proposals. He suggested that proposals allow for additional funds to sustain a project after project funds were exhausted and made a case for more

projects covering coastal and marine sites including the fisheries sector and non-environmental sectors such as culture, heritage, and peace.

Discussing technical know-how and research, Prof. Buddhi Marambe of Faculty of Agriculture, University of Peradeniya, outlined ongoing efforts to provide timely and appropriate technical input which had been a key factor in the success of NGO projects. Developing drought resistant and flood resistant varieties was a research priority in the Department of Agriculture and was being done by private agencies as well. It was unfortunate that farming, which had traditionally been an integrated system in Sri Lanka, with agriculture and livestock both coming under the Ministry of Agriculture was now fragmented under various Ministries and Departments. Accurate prediction of climate/weather changes at least a month in advance was another imperative. A University of Peradeniya project expected to predict climate change with 70% probability by the end of 2014, improving on the 40% accuracy of the current prediction models. In another project, The Department of Animal Sciences of the university was studying animal behavior vis-à-vis climate change. The Committee on Climate Change of the Ministry of Environment, of which Prof. Marambe was Chairman, was preparing to implement, through the relevant grass-roots level stakeholders, the climate change policy and strategy at district and village levels.

Commenting on crop diversification and food security, Dr. W. Weerakoon of the Ministry of Agriculture, noted that adaptation to climate change had enabled Sri Lanka to be self-sufficient in the staple food in the past. The threat of more such challenges made it imperative to assure food security in a wide range of crops, expanding the range and improving yields of existing varieties. He cautioned that new strains of pest were likely to emerge that were resistant to known pesticides and that the adverse impact of temperature increase as a key parameter of climate change had already been observed, highlighting the need to achieve self-sufficiency in crops such as maize and gram, for which sufficient gene pools existed in the country. As water was the most precious resource and limiting factor, crop diversification and cultivation of low-water use crops were important in maximizing its use, while agronomic practices also needed to adapt, such as alternating paddy with low-water use crops or switching to shorter term varieties.

Dr. A. Premarathne, the Director General of the Coast Conservation Department, commented on the impact of climate change on coastal resources. The major issues in the coastal zone containing a third of Sri Lanka's population and key economic enterprises were instant flooding, salt water intrusion, coastal erosion and issues related to sea level rise. The impacting of the estuaries of the island's river basins due to sand mining was significant, with the lowering of the river bed resulting in sea water intrusion when the sea level rose, the Mahaoya and Kelani rivers being good examples. These changes, which were the result of both climate change impact and anthropogenic activities, deprived the communities of good drinking water. Coastal erosion had also intensified in the recent past, particularly in the Puttalam district, a hazard mapping exercise was being carried out with UNDP assistance to identify areas most vulnerable to inundation with sea level rise. He proposed an emergency response surveillance system and access roads for evacuation in emergencies; the comprehensive restoration of coastal zone habitats; the establishment of green belts, sand dune gap filling, and enrichment of existing coastal zone habitats such as mangroves and coral reefs, protecting them with no-build zones.

3.7. Session 5 - Adaptation Learning: Applied Research and Project Lessons

Prof. Ranjith Bandara, University of Colombo, observed that studies ranking Sri Lanka as a country with moderate or no water scarcity ignored spatial and temporal variations of water availability occurring internally. Research into water management practices to increase the productivity of water in the Monaragala and Hambantota districts showed that in both districts, drip irrigation techniques had resulted in an impressive and quantifiable improvement in household incomes and change in livelihoods with a corresponding increase in expenditure and higher standard of living with a more commercial outlook.

Noting that deficiencies in technology delivery and confidence building existed in the current phase, he suggested selecting grantees from locations vulnerable to climate change, crops that adapted well to the climate variability in those location, and giving farmers the knowledge and guidance necessary to maintain the system in order to maximize gains from the scheme.

Ms. N.G.N. Rasanji of the Nature Resource Conservation, presented research on the capacity and resources displayed in organic tea cultivation. Tea was a crop that was physiologically responsive to stress conditions, undergoing regular and radical cultivation practices aggravated by weather, crop, and land management factors. The tea holdings studied, had been In-situ Conversion to organic cultivation since 2008, and it was found that the systematic crop, soil, and land management and manipulation practices adopted in the process had significantly improved soil and crop environment and biodiversity. Plants were better adapted and healthier; showed better and earlier recovery from pruning stress, higher yield responses, improved ability to withstand biotic and a-biotic stresses and higher household incomes. Organic tea was found to be more adaptable to climate change than conventional tea and was particularly suitable for small tea holders as it required few resources. Several sustainable soil and environmental quality indicators had been identified for use in climate change impact assessment.

Ms. Indu Weerasoori of UN HABITAT described the role of community participation in effectively building social resilience to climate change in two locations in Kalmunai, where the goal of the project was to establish sustainable disaster resilient and healthy cities and townships in disaster – prone regions by enabling the relevant local authorities to create such settlements in high risk areas. The two high population density locations identified lacked proper drainage and waste water discharge systems. The community helped to prepare community hazard maps and participated in discussions and workshops to identify problems and root causes on the basis of which a Community Based Disaster Management Program was prepared and Community Based Disaster Response Teams (CBRDTs) with specific responsibilities inducted. Action programs were prioritized based on community feedback and contracted out to the CBO of one of the selected locations. The project generated several best practices and created social harmony and community proved to be significant motivators in effective decision making. Regular activation of the CBRDTs helped raise awareness of climate change impacts and develop a resilient community and galvanized CBRDT's at GN division and city level into enhancing community awareness and disaster preparedness, demonstrating that management and technical preparedness alone could not build urban resilience.

Speaking on enabling adaptation finance in developing countries, Mr. Pradeep Kurukulasooriya RBAP UNDP noted that the scale of such finance was outlined in the Copenhagen Accord, with funds currently being deployed mainly for mitigation but half was expected to be available for adaptation by 2020, mainly for infrastructure. Public finance alone was insufficient and most adaptation funds were expected to come from households and private investment which had its own investment agenda. Many countries were already proficient in some aspects of Climate Finance Readiness; the challenge was to identify and organize them to produce an effective system at the national level. Developing countries faced three key challenges to climate finance readiness: climate finance funds were spread unevenly and difficult for smaller countries to access; private funds needed to be catalyzed as public funds were insufficient; finally, climate finance needed to be mainstreamed into planning and development policy. Climate finance was available under the UNFCCC and the Green Climate Fund, What was needed was to enhance the capacity of policy makers to identify the appropriate mix of public and private financial instruments and create the environment necessary to attract investors and multiple stakeholders.

Dr. C. Rodrigo of the Institute of Policy Studies assessed the factors that determined people's willingness to participate in CBA in the agricultural sector. He observed that adaptive capacity was a holistic concept and willingness to participate was determined by cultural, psychological, socio-economic, and institutional

factors. It was also location and sector specific. Household surveys and focus group discussions in GND's affected by flood and drought revealed significant factors such as awareness of CC and Psychological and Cultural factors such as impact, past experience, own risk perception, own coping strategies, awareness of geography and situational characteristics, which are important aspects to be taken into consideration when addressing disaster risk reduction and climate change adaptation issues. Socio economic factors such as educational level and income and Institutional factors such as strong and helpful institutions were also important to be considered.

Ms. Damayanthi Godamulla of the CSO Community Development Center (CDC), Aranayake presenting research on the cultivation of indigenous yams and tubers under improved soil management practices as an adaptive strategy, noted that the upcountry wet zone location had been a traditional yam and tuber cultivated area which had switched to potato cultivation. Land degradation due to soil erosion had impelled the CDC to revive yam and tuber cultivation using soil conservation strategies in home gardens, to improve the livelihood of poor families, especially women. A two-pronged approach was adopted: technological innovations to transform the home garden into a productive unit and a socio-economic initiative to transform the family into a dynamic, happy and prosperous entity. The impact analysis found that the large majority of the beneficiaries confirmed yield increases above 50% and had extended cultivation within their land; confirmed an increase in income after using soil conservation methods and an improvement in soil quality and reported a reduction in soil erosion. By the end of 2010 the home gardens had become productive units with adequate soil moisture to sustain a crop during drought and families were more prosperous and happier, the children better nourished. For this effort, the CDC won the UNDP Equator Prize in 2011. Success was ascribed to the facilitating role of the CDC in acting as an 'external mobilizer' and addressing the needs of the community with practical solutions that simultaneously achieved technical and social transformation. Traditional crops were ideal vis-à-vis climate variation; nevertheless, it was also important for resource-poor people to be convinced of good returns on their investment

Dr. Achini De Silva of Sabaragamuwa University investigated Community Based Adaptation to climate change with specific reference to small scale fishery value chains in the island's southern coast in order to determine the weakest nodes, gain a deeper understanding of sector vulnerability and develop strategies to prepare fishing communities to adjust through capacity building, education and awareness building. In a study undertaken by her, which was based on three small scale fishing communities in Beruwala, Balapitiya and Mawella, she explained that the principle survey instrument was the Participatory Market Chain Approach (PMCA). Focus group discussions, in-depth interviews with unstructured interview schedules were main data collection tools used and the Scored Causal Diagrams were used to mainstream climate impacts as well as adaptation strategies.

The following were the findings of the sample profile: small scale fishermen, starting node of the value chain were varied according to their craft type and gear type. Traditional craft owners were adopted for day time fishing mainly due to catch composition being varied throughout the season as well as on the location, both retailers and wholesalers used to buy fish from the beach auctions or auction centres located in landing sites, mobile retailers were common to all cases while road side retailers and retailers operated in public markets were incorporated into the sample, different types of retailers with long years in business were used to identify market trends and shifting market places and regional wholesalers as well as wholesalers based on main markets were used to identify market operations and trends.

The study identified several implications and adaptation strategies for climate change. Location specific adaptation strategies depends on the community mix (ethnicity, religion and cast issues), resource availability, boats and fishing gear types, fishing technology, markets, fish and fishery product marketing and demand patterns and livelihood options.

Mr. Asoka Ajantha of Practical Action discussed integrated water management as a response to climate variability in Ampara district, where 5720 families had benefitted from the Gal Oya scheme, for paddy farming, livestock development, domestic use and environmental use before irrigation infrastructures collapsed under three decades of civil war. Long dry spells had dried up the water bodies; water storage tanks were abandoned and water scarcity increased. Governance of water resource management was poor. Changing the main system of operations and maintenance was not an option in the circumstances and the need to consider the ideas of the main stakeholders including local authorities, government departments, I/NGOs, CBOs and FOs and the three major ethnic groups in solving even small scale problems added to the difficulties. This indicated a combination of location-specific solutions for water scarcity issues in irrigated areas in the eastern province, precluding dependence on a single source of water. Collecting and storing water at household level and maintaining well- water levels were suggested as measures that would increase water storage capacities, underscoring the need for creating awareness of climate change scenarios.

3.8. Final Session – Feedback

Moderator: Ms. Shireen Samarasuriya

This session was highly interactive. The first question queried the symposium's focus on the human dimension overlooking the eco systems aspect. The respondents pointed out that while project selection was based on climate change hazards vis-à-vis vulnerable communities and the indicators discussed showcased the human aspect, human activity and the environment were inextricably linked and evaluations did include eco-system indicators. The Walapane project was an example where the intervention improved land productivity and prevented movement into natural areas. Land quality had greatly improved and homesteads had made significant contributions towards species diversity and biodiversity conservation. Likewise, bio-diversity enhancement was an important outcome of the Lunugamvehera. Participants referred to the value of the knowledge gained during project implementation, the importance of sharing information, the need to develop and replicate the projects, the need for more funds and a longer time frame to realize project objectives. Concerns were voiced about the bleaching of corals in the coastal zones and the threat to marine biota from hotels channeling their drainage and sewerage lines into the sea. The respondents acknowledged the need to work with the Coast Conservation Department on more coastal zone projects and to scale up the pilot projects, noting that these projects had influenced policy at national level. Projects in the North and East were also being considered for the next cycle of funding. Steps would be taken to increase capacity building and community training with a view to building strong and reliable NGOs and CBOs, The importance of documenting the work done was reiterated and the possibility of entering into competitions was raised.

4. Case Documentation of the Five CBA Pilot Projects

4.1. Rehabilitation of the Imbulgodayagama Village Reservoir through Community Participation

Project No:
SRL/MAP-CBA/2010/04

Grantee:
Sri Lanka Environment Exploration Society

Project Location:
Maho/Mahawa, Kurunegala District, North Western Province, Sri Lanka

SGP Contribution:
US$ 44,171

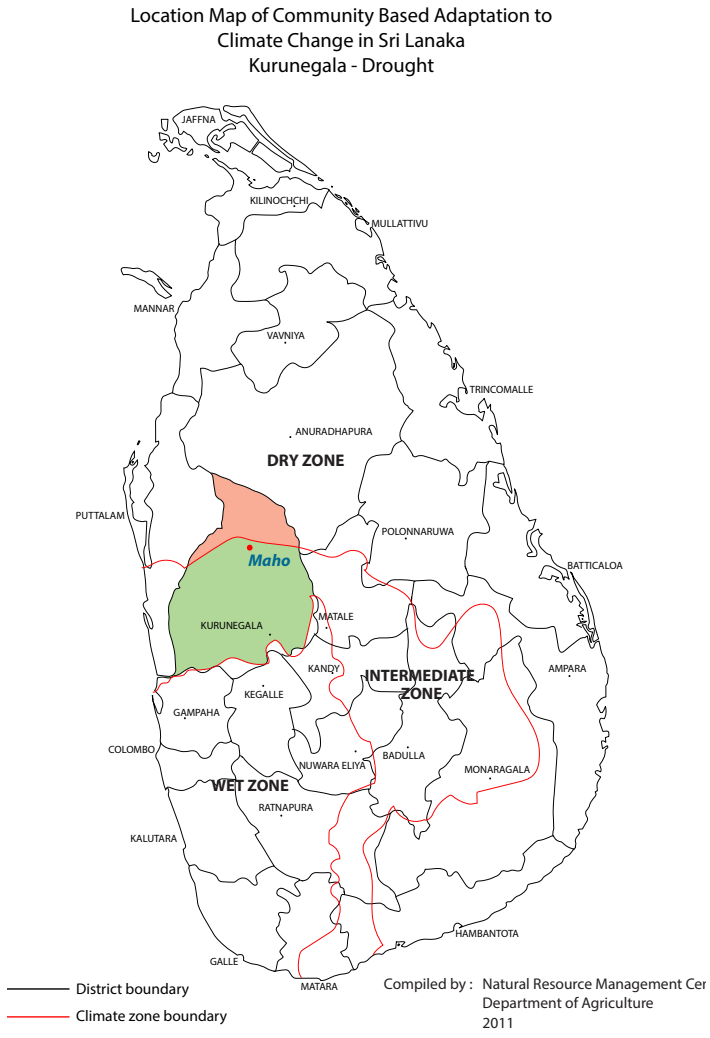
Cash Co-Financing:
US$ 2,025

In-Kind Co-Financing:
US$ 3,600

Project Duration:
24 months

Number of people served:
110 families; 654 people

Focal area:
Community-Based Adaptation



Background

Imbulgodayagama village lies in the dry north western intermediate zone of Sri Lanka. The area is characterized by low rainfall during both major monsoons, receiving much of its precipitation in the second inter-monsoon period (September to October). The village consists mostly of paddy farmers cultivating off the monsoon rains. The main cultivation season, which is generally rain-fed

runs from October to January. The village reservoir, with an area of around 17 acres, captures rainwater from the monsoon storing it for use in case of rain deficiency during late monsoon or for the second cultivation season (April to June). This village reservoir, colloquially referred to as a 'tank', is the lifeline of the villagers and their source of water during the dry season between May and September. Due to water retention in the reservoir, and the maintenance of ground water levels, at least a part of the village will have potable waterin their wells when dry seasons peaks around August.

The Imbulgodayagama village reservoir is of ancient origin, symbolized by the enormous ficus growing near the earth dam (bund) and the shrine underneath dedicated to a local deity. But the village is of more recent settlement. The oldest villager remembers moving to this location around 50 years ago. The village reservoir had become silted due to years of neglect and cultivation in reserved catchment lands. Agrarian development officials estimated that around 60% of the tank capacity has been reduced due to siltation at the time the project was proposed. Around 60 acres of paddy are cultivated in the downstream area, irrigated by the tank. However, almost half these fields were abandoned due to lack of timely irrigation.

The climatic problem at Imbulgodayagama was prolonged dry season, with higher number of consecutive dry days, hampering agriculture. Delay or failure of the second inter-monsoon spelt disaster for this community. When the project was proposed, they had not cultivated a full second season in three years. Even the main season's productivity was low, less than 60 bushels per acre. The income from paddy cultivation had depleted steeply in the past five years, and more importantly, the community's food security was at stake. Unseasonal and intense rains, and localized tornado type of winds were also common in the area, disrupting agricultural activities even more.

Farmers own between 0.5 to 1.5 acres of land in this village. But with growing uncertainty, they have evolved their own coping mechnaism by diversifying livelihood options. Over 40% of households have 'other occupations" such as government jobs, carpentry, masonry and women work in garment factories close by. However all villagers cultivated their fields in the rainy season. Half the villagers have had only primary level education (grade 5) and only 6% had any post-secondary education.

Intervention

The project was proposed to address the main issue of water deficiency during the two cultivation seasons. The main aim was to maximize irrigation potential and efficiency through rehabilitating the village reservoir to overcome drought. The expected outcomes were, to increase cropping intensity and paddy productivity, reduce loss of irrigation water in conveyance, prevent further erosion and siltation of the reservoir, preserve the catchment to ensure better inflow in to the tank, develop food security through home gardens and alternative livelihoods and ensure a sustainable mechanism in place for future maintenance of the reservoir. The four main activities were:

The village reservoir after earthwork and dredging

Transparency

"We never had the experience of handling finances meant for the tank. Whenever the tank was rehabilitated before, it was through contractors. There was much misuse and villagers could only stand aside and watch," Mr. Herath Banda (75), a village elder told us after completion of the project. "This time we knew from the beginning how much money was allocated, what the machine operator was charging us, and we had to ensure that we got value for money. The responsibility transformed us from passive observers of a project to the real 'doers'. Implementing this project strengthened the community immensely, given us new confidence and taught us the value of collaborative effort."

Rehabilitation of Imbulgodayagama village reservoir

Tank rehabilitation was supervised through planning and implementation stages by the Agrarian Department's district technical officer. The finances were handled by the Farmer Organization's committee, which was a new experience for the community. The FO was also directly involved in supervising the work of the machinery employed for dredging and the labour component of the community. Each household's contribution was recorded in a log maintained by FO. The tank was drained fully for dredging, and during this time it was cleaned of all visible aquatic weeds.

Government technical officers supervising the dredging of the reservoir

Increase irrigation efficiency and paddy productivity

Irrigation efficiency was poor due to the damage to the sluice and canals. This resulted in leakage and wastage of water, leaving the tank empty during the May-July season when farmlands need water most. The project supported the Farmer Organization to repair irrigation channels and restore the sluice, including installing a new sluice gate to the dam. Farmers were supported to select high yielding shorter duration (in-field) rice varieties suited for the agro-ecology of this region, and to grow other low water demanding crops in the fields in seasons with low capture in the reservoir.

Paddy fields using the water of the reservoir

Prevent further siltation and protect catchment

The reservoir and its catchment were re-surveyed by the Government Survey Department, on request of the Farmer Organization and the Divisional Secretary (government administrator at sub-district level). The survey demonstrated that much of the catchment is under privately owned perennial cultivation, with some annual vegetable growing adjacent to home gardens. This was the main cause of the continued siltation of the reservoir. The FO demarcated the boundaries of the reservoir and its immediate catchment. Soil protection bunds were installed in all private lands in the catchment, amounting to some 15 acres of land.

Annual crops were banned on reservation lands through the FO decree, and community was allowed to use this land for perennials such as coconut, areca nut, jack fruit, breadfruit, medicinal trees which are important food and income sources for the community. The project funded the planting of some 1500 kumbuk (Terminalia arjuna) trees in these reservation lands. 40 households attended a training workshop on climate resilient soil conservation techniques organized by the Natural Resources Management Centre of the Department of Agriculture.

Develop home gardens and alternate income sources

60 households participated in the home gardening training at the Department of Agriculture, Agri-Technology Park in Gannoruwa. The community was trained in home composting, seed selection, inter-cropping, crop rotation, climate resilient perennials etc. The implementing NGO then evaluated the households that showed good promise in home garden development, and distributed 35 packages of agriculture equipment such as mammoty, hand spade, watering can, hand-fork, hand spray gun, rake and grass slasher. Home garden development was started at the Maha Season, at the end of September. Most successful home garden tree varieties were fruit, spices and annual vegetables during the rainy season.

Summary of Project Impacts:

1. Village reservoir (tank) of 7 hectares has been rehabilitated through several interlinked activities;

- Deepening the tank bed by mechanical dredging supervised by the Farmer Organization and the technical officer of the Department of Agrarian Development
- Tank capacity increased by 1.44 hectare meters enabling the cultivation of 16 Ha of rice in the Yala season, whereas before no cultivation was possible during the lean season. The increased capacity also supports an extra 6 Ha of rice farming in the Maha or major season.
- Strengthening the tank bund or earth dam, removing plants of large trees on the bund, preventing erosion by turfing the sides of the earth dam, a new sluice installed and irrigation canals repaired and aquatic invasive weeds removed from the tank.

Community participation in turfing the earth dam to prevent erosion

2. Home garden development promoted in 60 households

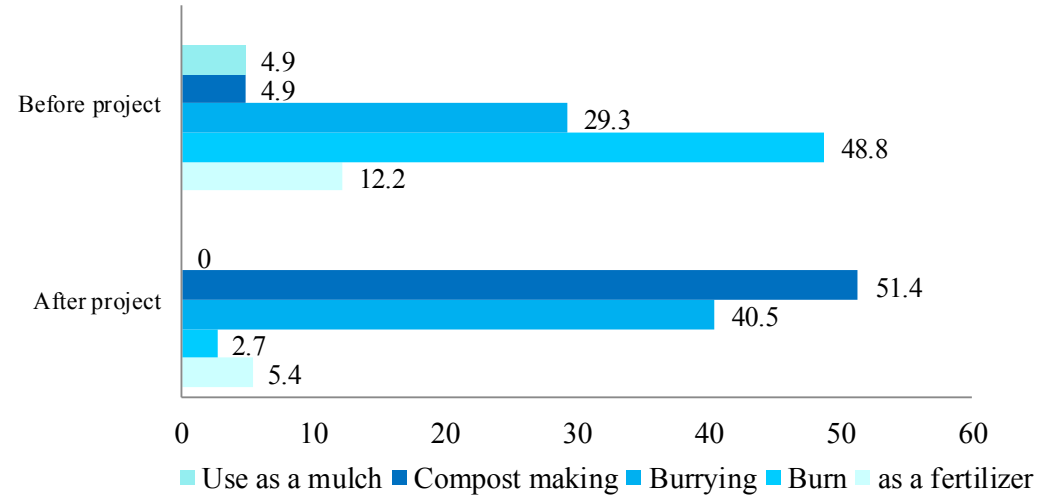
- Organic cultivation promoted through training and inputs
- Perennial fruit crops successfully established in home gardens
- Lake bed soil and aquatic weeds complement organic inputs for home gardens

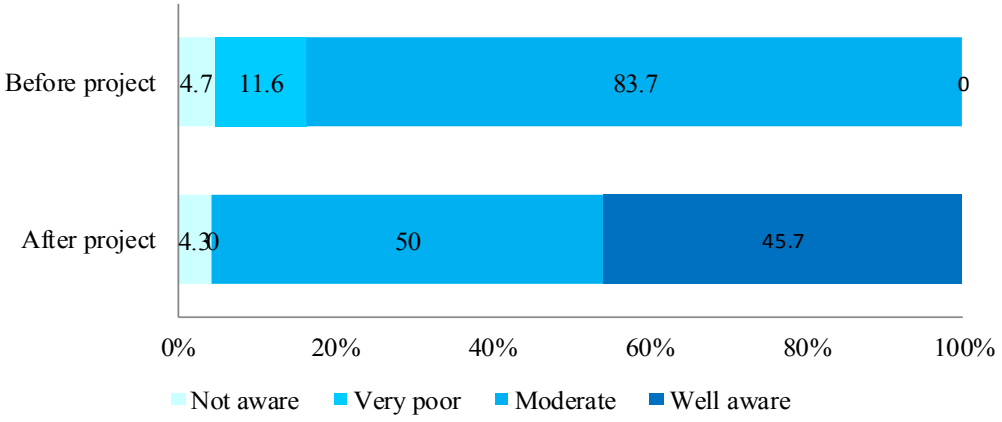
Environmental Benefits

Water for cultivation was the main concern for the village. To meet the challenge of rainfall variability which impacts on irrigation water availability, the project basically invested in improved water collection and storage in the village tank. Improved storage of water, and fairly good monsoon rains enabled farmed to finally cultivate a full second season in April 2013. Land productivity has improved since all paddy fields are put to use. Cropping intensity has improved from around 90% in 2009 to over 150% in 2013.

Increased water storage has improved the ground water table, and part of the village had access to potable drinking water through dug wells during the heightened drought of 2012. The community has diverse access to food crops through home gardens. The project introduced high yielding drought resistant fruit and vegetables that are able to survive through longer dry periods from July-September.

Soil conservation structures such as hedges of vetiver (Vetiveria zianioides) and earth bunds were established in 15 acres of private farm lands alongside the reservoir catchment. 60 villages, around 40 of them women, were trained in integrated home gardening practices at the Gannoruwa Agriculture Park by the Department of Agriculture, Field Extension Services. The impact of these awareness activities and the home gardening training was measured through a post-project survey. The survey showed that during the project period village households had vastly improved their land management and agricultural waste management.





The graphs show change in agricultural waste management techniques (top) and villagers perception on significance of soil erosion (above).

Sustainability

The original project framework was amended with guidance from the GEF SGP's technical team to include an activity that specifically looked at future maintenance of the reservoir. This was deemed important from the first scoping field mission to the site in August 2010. Sustainability initiatives were designed around the village Farmer Organization (FO). Discussions with the community during the Vulnerability Reduction Assessment (VRA) focused on building up the FO, financially and human management capacity.

The reservoir needed seasonal/annual maintenance which included cleaning invasive species, cleaning the canal system, controlling overgrowth on the bund, controlling cultivation on the reservation lands, protect trees planted in the periphery for at least 3 years. A sustainable financing mechanism evolved out of the idea to populate the cleaned reservoir with fingerlings of commercially viable fish types. The FO would earn income through leasing out fishery rights twice a year to local fishermen. The FO also earns an income through member contribution of the value of a bushel of rice every season.

Youth Engagement and Participation

Young people were engaged in project activities such as tree planting along the reservoir catchment. This activity was carried out with the participation of the village secondary school. Youth were also made aware of climate change, its impacts on farming communities such as theirs; and the importance of traditional water harvesting systems such as village reservoirs in capturing, storing rainwater for environmental and human benefit.

Gender Mainstreaming

Women were fully engaged in the design and implementation of project activities. Women were the primary target of the home gardening component. Women also provided time and labour to the work in rehabilitation of the village reservoir, especially the turfing of the bund, clearing the invasive weeds and maintaining the planted trees along the reservoir catchment.

Policy Impact

The project has national level policy impact, as reservoir rehabilitation is prioritized by national and provincial development agenda, at times with large accompanying budgets. The community-centered approach followed and strengthening of FO to maintain the reservoir, are best practices that should inform the development policies on irrigation.

Replication and Up-Scaling

GEF SGP will work with national partners to replicate lessons of this project in another district, Polonnaruwa, through aUSD 7.5 million climate adaptation project funded by the Adaptation Fund Board (AFB) and implemented by the Ministry of Environment (through UNWFP and UNDP). Up-scaled practices include the community-centred methodology for tank rehabilitation, catchment protection, sustainability mechanism and productivity improvement of irrigated fields.

Lessons Learnt

- Traditional water harvesting structures in villages are still effective adaptation measure against climate variability

- Water harvesting alone does not guarantee improved productivity, but has to go hand in hand with efficient use, improved breeds, field management and strong farmer organizations
- For farming communities food security is of primary importance, so livelihood diversification needs to take in to account time spent in agriculture
- Catchment protection and sustainable financing mechanism is vital for the survival of small irrigation systems

Challenges

Implementing the project through adverse climatic conditions proved to be challenging for the local NGO and the community. In January 2011 due to very intense rainfall, the village reservoir spilled for the first time in over a decade. Additional rainfall made it possible for the villagers to cultivate a second season through June, delaying the start of project activity to July 2011. To dredge the reservoir, all remaining water was drained from the basin. Dredging work was accelerated through July and August to ensure that the reservoir would be ready to receive October rain. While work on deepening, sluices and the bund was completed by October 2011, the inter-monsoon failed to bring in sufficient rain to fill the reservoir. The failed monsoon translated in to drought in the entire dry zone of the country throughout 2012. This impacted badly on the community and they abandoned paddy fields for two seasons, it was hard to maintain newly planted trees on the reservoir periphery and the turf on the bund. The drought finally ended with heavy rains in October 2012 causing widespread flooding. The community was finally able to cultivate the mains season, and with stored water cultivate the second season without delay in 2013.

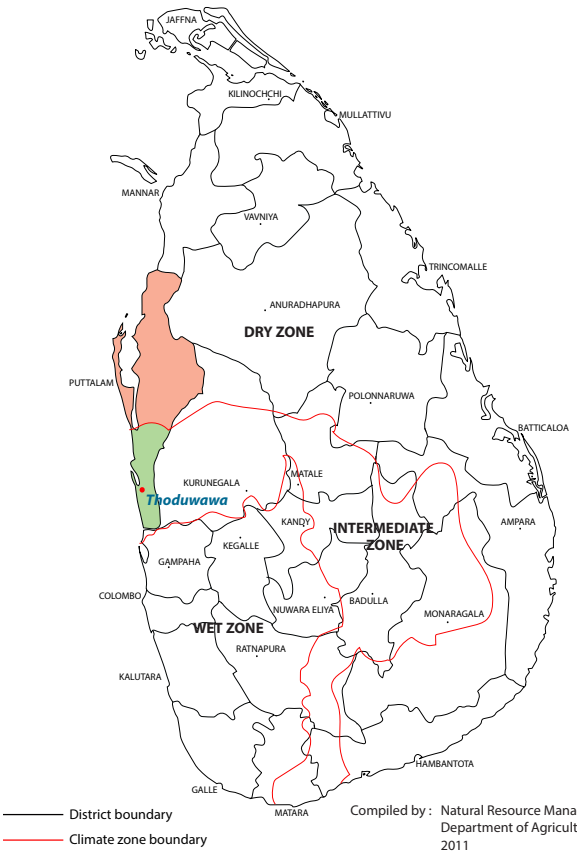
Invasive aquatic weeds proved to be a challenge in this location. Due to heavy weed infestation in neighbouring tanks, and water stagnation for a year in 2012, invasive weeds reclaimed the reservoir after rehabilitation. There is yet no long term solution for this problem. It is impossible to eradicate the weeds fully, and only management is possible.

4.2. Climate Related Disaster Management in Thoduwawa Lagoon in Barudelpola

Project No:
SRL/MAP-CBA/2010/03
Grantee:
Sevanatha Urban Resource Centre
Location:
Nattandiya, Mahawewa Division, Puttlam District, North Western Province, Sri Lanka
SGP Contribution:
US$ 44,419
Cash Co-Financing:
US$ 68,000
In-Kind Co-Financing:
US$ 5000
Project Duration:
24 months
Number of people served:
400 families; 1350 people
Focal area:
Community-Based Adaptation

Coastal erosion in Barudelpola village

Location Map of Community Based Adaptation to Climate Change in Sri Lanaka
Puttlam - Sea level rise



Background

The village of Barudelpola lies along a low-lying strip of land between the sea and lagoon. The villagers have to travel 2 kilometers either way to access a bridge that will connect to the mainland. The coastal village consists almost entirely of fisher families- some 80% of men engage in full time fishery. The men go fishing in day boats from a nearby fish landing site. Some work in multi-day trawlers that belong to richer community members, returning home once a month or so. The women stay

at home, caring for children and elderly. Around 40 households engaged in commercial, low-tech fish drying - basically laying the salted fish out in the sun on a thin plastic mat on their sandy gardens. There is very little agriculture practiced. The community has limited experience in home gardening. Each household plot is small- 0.12 acre or less. Some households were rearing pigs and chicken, however this practice was not integrated with home gardening. Most homes have perennial food trees, especially coconut. 45% of the villagers had only primary education. Only 3% had any kind of post-secondary education. Fishery income was generally good around US$2000-2500 per year. 90% of households owned their own home, a bicycle or a motorbike.

The village is located in an extremely vulnerable coastal area. The coastline in the west and north-west of the country is prone to heavy erosion. During a single monsoon, the sea can claim as much as 5-7 metres of coast, destroying houses, roads, coconut trees and such. Realising the imminent danger, the Coast Conservation Department has begun a project to protect the coastline with a rock embankment; however this embankment has stopped short of the project location.

Containers for collecting water from road tap

The village is also threatened by flood. Upstream drainage water flowing in to the lagoon and its associated waterways can cut the village off from their normal routes to the mainland. Evacuation is complicated when the sand bar connecting the village to the mainland is opened up for flood release. The last major flood was in 2011 after project activities had begun in the village.

The most pressing issue for the villagers was the lack of potable water. Around 50% of the villagers had wells to drink. Salinity had affected all of them save for a few- less than 10 wells were of drinkable quality. Some wells were so saline that it was impossible to even bathe or wash clothes in it. However, the villagers had little choice but to use this water for other domestic purposes. For drinking water, the community adopted a number of coping strategies. There was one common well through which around 10 roadside taps were operated. Women would spend between 2 to 5 hours a day waiting for water at these common taps. The flow was weak, and the well was owned by a private individual who would sometimes divert the water for his own purposes, leaving the village without drinking water. Neighbors who had sweet water wells would share with others. Some people bought their drinking water from vendors in the nearby town.

The Vulnerability Reduction Assessment (VRA) exercise with the community revealed that community livelihoods such as coastal fishery, lagoon fishery and dry fish production are all threatened by unpredictable climate and changed monsoon patterns. The community claimed that increased salinity in their drinking water wells was due to drier weather in the preceding years and the lack of river floods to flush the lagoon. Lagoon fishery has come to a virtual standstill in the village, with fisher folk preferring the more profitable coastal fishery. A thick band of mangrove forest now impeded the access to the lagoon.

Intervention

Sea water intrusion in to the ground water table and the resultant salinization of wells was the priority climate related issue for this community. During the VRA and subsequent discussions with local authorities-

both divisional administration and elected local government- the lack of drinking water was upheld as the most important problem, requiring immediate redress.

The intervention was designed to address drinking water, food security and livelihood development of the coastal women.

1. Design and implementation of a drinking water supply scheme

The initial design and estimate for the water supply scheme was over ambitious. Therefore the grant recipient NGO was requested to carry out a more detailed analysis of possible water sources and cost-effective supply to the village households. Most sources were located too far from the village. Pipelines had to be laid across the lagoon to reach the village through the shortest route. Finally the local authority, the divisional secretary and the Water Supply Board technicians were able to reach a consensus on the source and its capacity around 11 months after project start.

Discussions with officials on the water supply scheme

The water supply project was further plagued with co-financing issues. The estimate for the project was around USD 110,000, when project funds for the water supply component amounted to only USD 25,000. To source the additional financing, the NGO had to approach several parties, i.e. the government through the political influence of a Minister in the area, the local government which is the ultimate owner of the project, the community contributing their share for the infrastructure and the Water Board proving the technical oversight. Through diligent planning and prudent financial controls the project managed to complete the water supply project at less cost than anticipated. Today 261 households are receiving water, and the project is managed by a committee with village and local authority members. The billing and maintenance work is done by the local authority and the collected revenue is used to develop common infrastructure in the Thoduwawa village.

Laying out pipes

2. Livelihood development activities

Project introduced small scale livelihood interventions such as ultra violet fish dryer and chicken coops after consultation with village women on the bet livelihood options for them. These efforts were supported by the Divisional Secretariat and the Grama Niladhari (village administrative officer) who were instrumental in identifying the beneficiaries and linking them with local markets. The project provided livelihood support to 35 women in the village.

Project beneficiary

3. Rainwater harvesting and waste management demonstration

As a solution to the increased salinization of water, the project's technical team suggested rainwater harvesting. However, the community had no previous experience of rainwater harvesting tanks and initially was resistant to the idea. The project supported two demonstrative ferro-cement tanks. There is now a huge demand to install more rainwater harvesting tanks. Similarly, the lack of sanitary disposal of solid waste, including food waste and waste from piggeries (a popular livestock in the area) was a problem in the area. Although not directly connected to climate change adaptation, a solution in the form of small communal biogas units was introduced. The technology is new to the village and has been received well by the community. Its high investment however, is prohibitive to spontaneous and self-funded adoption by other interested villagers.

Rainwater harvesting tank in village household

Partnership in Action

The project's main intervention was entirely supported by a strong partnership model created by the implementing NGO. The key partners were the Divisional Secretariat; the elected Local Government (Pradeshiya Sabha); the community represented through two CBOs; the National Water Supply and Drainage Board for technical support and the non-governmental organisation (NGO) leading the intervention. Implementation and future maintenance of the water supply project is handled jointly by the local authority and community representatives. This ensured transparency in awarding contracts, procurement and distribution of water supply to households

It was this partnership that raised the requisite financing for the project and ensures both quality and technical soundness of the project intervention.

Project Impacts in Summary:

- Developing a strong partnership between local administration, local government, technical services for water supply and community based organizations
- Mobilizing co-financing of around 300% of grant amount to realize the water supply project
- Water supply scheme completed with full local government engagement providing potable fresh water to over 300 families unable to consume saline well water
- Rainwater harvesting systems demonstrated to coastal villagers with no prior experience of the technology
- Livelihood improvement introduced to women - fish dryers and support for livestock (chicken coops)
- Improved land management demonstrated through 20 home gardens including 'container gardens' for houses with limited space
- One functional biogas unit using piggery waste to demonstrate possibilities of energy generation through solid waste management

Environmental Benefits

The project attempted to inculcate good practices for water and land management in a coastal community that previously had no exposure to these practices. This included roof-water harvesting and storage. The stored rainwater helped women to cultivate productive home gardens even in tight spaces and sandy coastal soils. Biogas generated from piggery waste demonstrated how the community could turn an environmental and health problem in to a resource. Composting and bin-gardening were not common before the project. The post-project survey found that many households were now interested in composting, rainwater harvesting and developing home gardens.

The biggest positive impact for this community was to finally have clean, salinity-free drinking water in their homes and in their kitchens.

Sustainability

The water supply scheme is managed by the Local Authority. A committee consisting of the Local Authority officials, representatives of the community and the Water Board meet quarterly to discuss new connections and maintenance issues. The revenue collected from the water supply scheme will be directed towards developing common infrastructure for the village.

Youth Engagement and Participation

The project did not have a particular focus on youth. However, many of the beneficiary families are in the age group of 25-45.

Policy Impact

The biggest policy impact is the cooperation between divisional administration (central government) and local authority (locally elected government) to achieve local needs. Normally these two levels of governance operate separately and with different budget and reporting lines. The involvement of local politicians actually supported project objectives and spurred the institutional collaboration. However this needs to become regularized in order to provide communities the required services.

Replication and Up-Scaling

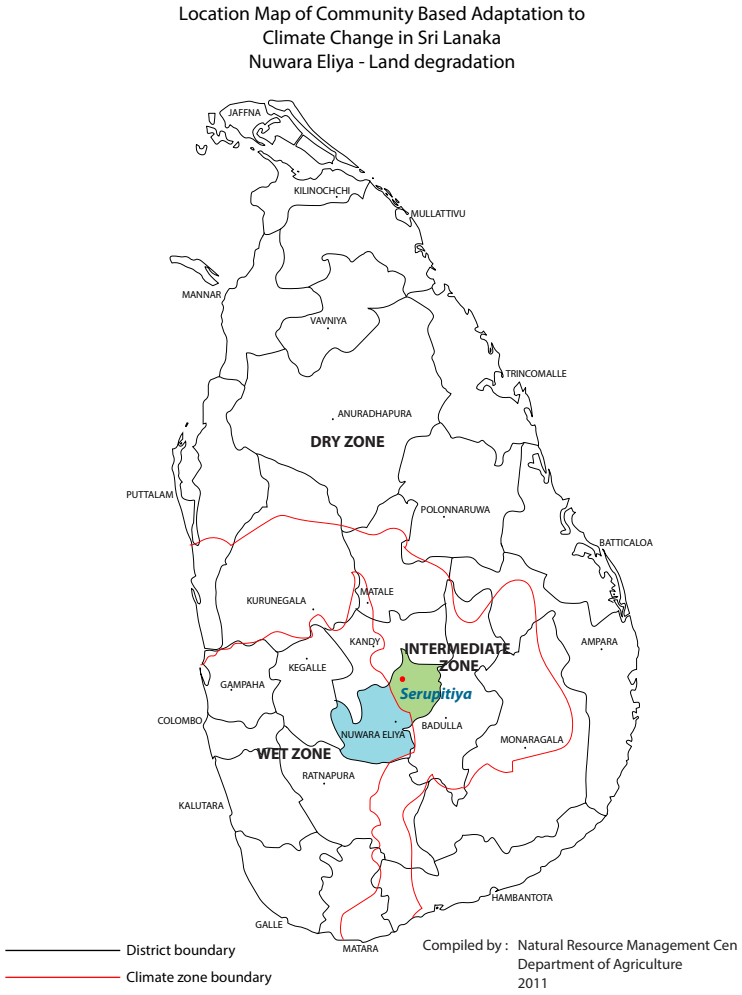
Replicating the partnership approach depends greatly on the ability to mobilise the different actors. A large population in the north western coastal line is in need of similar solutions for salinity intrusion into drinking water wells.

Lessons Learnt

- Project duration needs to be flexible to accommodate needs of developing strong partnerships and attracting co-finance in order to achieve project outcomes
- Technology demonstrations are important in areas without previous exposure
- Women's livelihood activities could be a buffer against climatic impacts
- Community engagement in project decision-making strengthens their own adaptive capacity

4.3. Minimizing Land Degradation in Serupitiya village to Facilitate Community Based Adaptation to Climate Change

Project No:
SRL/MAP-CBA/2010/02
Grantee:
Ekabadda Praja Sanwardana Kantha Maha Sangamaya
Location:
Serupitiya, Walapane Division, Nuwara Eliya District, Central Province, Sri Lanka
SGP Contribution:
US$ 40,504
Cash Co-Financing:
US$ 17,000
In-Kind Co-Financing:
US$ 2,000
Project Duration:
18 months
Number of people served:
200 families; 1100 people
Focal area:
Community-Based Adaptation
Extension Project:
SRL/MAP-CBA/2013/01
SGP Contribution:
US$ 31,363
Project Duration:
16 Months
Cash Co-Financing:
US$ 9,279



Background

Serupitiya lies in the eastern slopes of the central hills in the Nuwara Eliya district and Walapane Division. Its main rainfall season begins in October with heavy inter-monsoon rains and then from November to February, the village receives a fair amount of the north-east monsoon rain. This is the only crop cultivating season for Serupitiya. Dry season sets in May onwards and lasts through August up to mid-September. Strong winds during July and August aggravate dry conditions and dries up streams and other surface water sources commonly used for drinking water and bathing. Although the village lies right above Randenigala, a large hydro-electric reservoir, seasonal drinking water drought is common leading to health and sanitary issues in the village.

As long as they can remember villagers of Serupitiya have battled nature in many forms. Situated on steeply sloping and highly eroding lands with little access to irrigation or drinking water, villagers here live barely on or below the line of poverty. Dismal social conditions are reflected in non-school attendance and early marriage. All target households are vegetable farmers, battling long periods of dry weather, heavy rainfall and intense winds in July/August to eke out a bare living off vegetables. Often vegetable prices plummet during season due to oversupply leaving the farmers bereft of their single annual income source. Crop yields have been declining steadily due to the poor quality of the eroded soils.

Village housing on steep slopes

As there is no irrigation, vegetable farming is solely dependent on rainfall. Increased erratic rainfall patterns are observed by the famers and confirmed by analysis of meteorological data. Increased climate and rainfall variability is evident in longer dry periods, intense and short spells of rain, unseasonal rainfall and late onset of the north-east monsoon.

The surrounding area is declared wildlife sanctuary, limiting the scope for development in the local area. Further, destructive land use and crop cultivation harms the integrity of the protected area around the village. Human-animal conflicts are common, with frequent altercations with elephants and crop damage from monkeys and wild boar.

During the long dry months men migrate out of the village to work in irrigated rice fields downstream, leaving women and children to fend for themselves during the most vulnerable period. Home-based self-employment avenues are very limited in the village, and the lack of water prevents women from undertaking household cottage industry, home gardening or food preparation for sale.

Project Objectives and Key Activities

The main objective of this Community Based Adaptation (CBA) Project supported by SGP was addressing erosive cultivation practices which denude mountain slopes, reduce water yield and increase siltation of downstream reservoirs. The strategy was to institute land protection measures with community participation and introduce more stable year-round income sources to the people. This was done through three main components: 1) Land survey and demarcation for erosion control; 2) Introduction of different perennial crops for stable income; and 3) Introduction of livestock as an alternate income source.

As a prelude to designing and implementing Community Based Adaptation projects, the project used the Vulnerability Reduction Assessment (VRA) tool to gauge the extent of climatic vulnerability and willingness within the community to address the root causes of this vulnerability.

Around 85 households participated in the VRA along with key local officials including the GN (village administrative office), the Agrarian Services Extension officer, the Samurdhi (welfare) officer, other

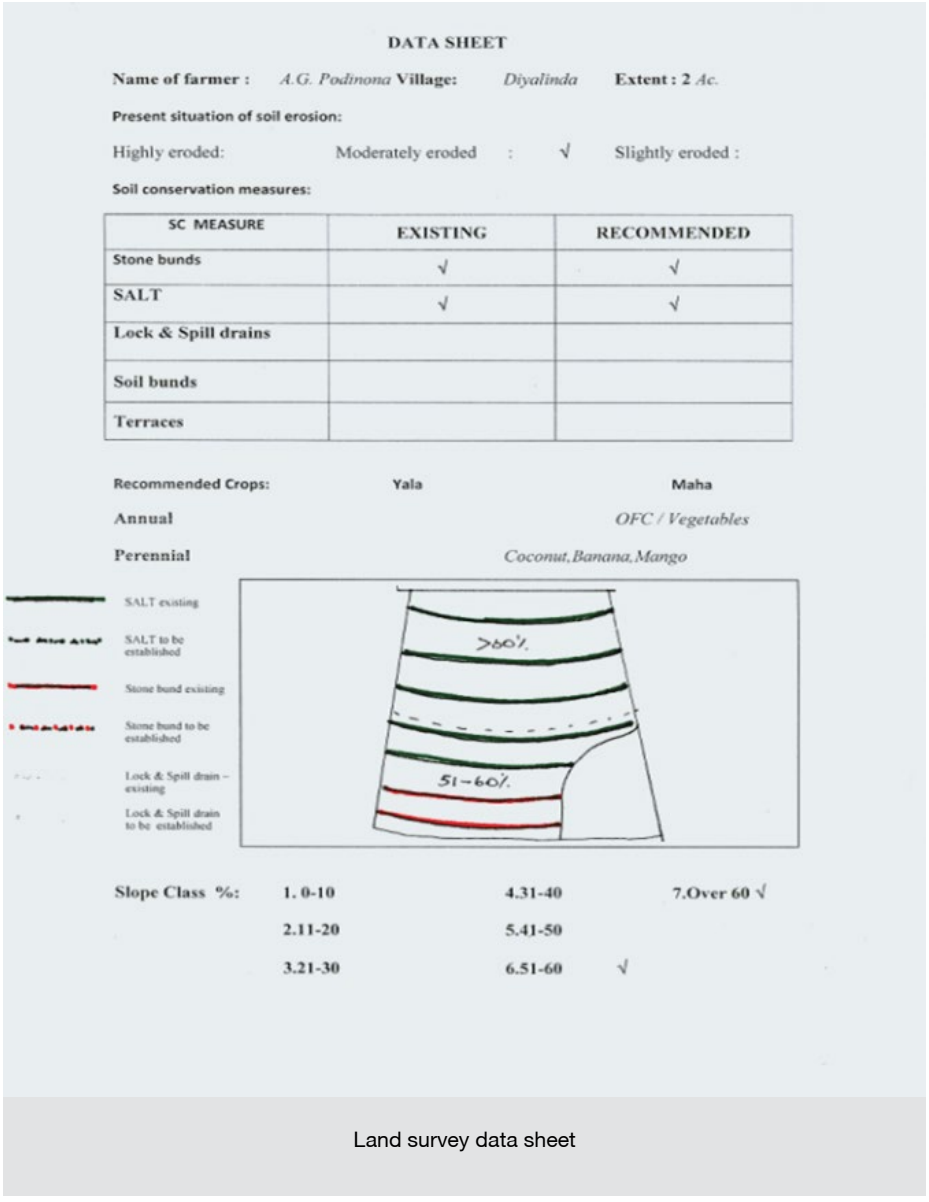
Woman participant in participatory mapping exercise

NGO and voluntary organizations working in this area. The results of the VRA clearly showed that the target population faced substantial risk to their livelihood from current climatic conditions; and that if the situation were to worsen they would be in dire need of alternate income. The exercise also demonstrated the extent of marginalization and distance between this community and its service providers, especially the government administration. Poverty and institutional neglect has prevented this community from adopting and implementing the various adaptation measures that they came up with during the meeting.

1. Land Survey and Soil Protection:

Land parcel survey was the largest scientific undertaking under this project. The survey covered the farm plots of every beneficiary and was conducted by an expert team from the Department of Agriculture, Natural Resources Management Centre. The survey took four weeks to complete due to the difficult terrain and inaccessibility of some plots in the steep sloping hills.

The survey resulted in each plot having its own specific map giving contours, slope category and soil type; a land management plan and crop recommendations. Managing the landscape at household level was made easier through the survey and its results. There were plots where the team recommended only perennial cover due to the steepness of the slope. On most land traces, old soil conservation measures were found. The team recommended that these be rehabilitated and strengthened with additional barriers in between, to cope with the volume of soil loss.



DATA SHEET

Name of farmer : *A.G. Podinona* Village: *Diyalinda* Extent : 2 *Ac.*

Present situation of soil erosion:

Highly eroded: Moderately eroded : √ Slightly eroded :

Soil conservation measures:

SC MEASURE	EXISTING	RECOMMENDED
Stone bunds	√	√
SALT	√	√
Lock & Spill drains		
Soil bunds		
Terraces		

Recommended Crops: Yala Maha

Annual *OFC / Vegetables*

Perennial *Coconut, Banana, Mango*

SALT existing

SALT to be established

Stone bund existing

Stone bund to be established

Lock & Spill drain – existing

Lock & Spill drain to be established

>60%

51–60%

Slope Class %: 1. 0-10 4.31-40 7.Over 60 √

2.11-20 5.41-50

3.21-30 6.51-60 √

Land survey data sheet

Each farmer retained a copy of his land survey data sheet. The project mobilisers worked with farmers to interpret the map and its recommendations. The survey team also marked on each plot the location of live fences, contour drains and stone embankments. The project provided funds for each household to actually put these conservation measures in place. The work took place in the off-season providing farmers with additional income during dry months.

Stone bunds and contour drains to protect sloping lands: results were immediately seen in the next monsoon.

Erecting stone bunds in gardens

Contour drains

2. Introduction of perennial crops:

Perennial crop cover was confined to some fuel-wood and timber species prior to the project. In order to reduce the communities' vulnerability to drastic changes in rainfalls seasons, the technical advisors to the project team introduced a number of high-value perennials with good market demand. This included vanilla, cinnamon, and pepper, among others. Through a complementary government-funded initiative the households received coconut and cashew plants; and due to their popularity the project supported further distribution of these plants.

The successful perennials were ones that withstood the ravage of the long dry period; ones that were resistant to animal attacks and those with a good market potential. Cashew and coconut were by far the most popular. Cinnamon has the market but it has been challenging to establish it during dry periods and protect seedlings from deer attacks. Pepper is another perennial crop with good, but at times fluctuating, market.

3. Introduction of Livestock:

The introduction of livestock for milk became the most popular alternate income source for the people. The project supported the community to organize themselves into a local group for milk farming, which was not a popular livelihood choice in Serupitiya. The group was then supported by government through the local veterinary officers; and by MILCO - the country's largest milk products manufacturer. The project funded the purchase of 15 cows, subsequently their calves have been handed to other members of the group, as per agreement. Today there are 23 milk-producing households, who earn between US$ 3-5/day through livestock. Livestock were insured through the government veterinary insurance scheme.

A beneficiary of the livestock programme

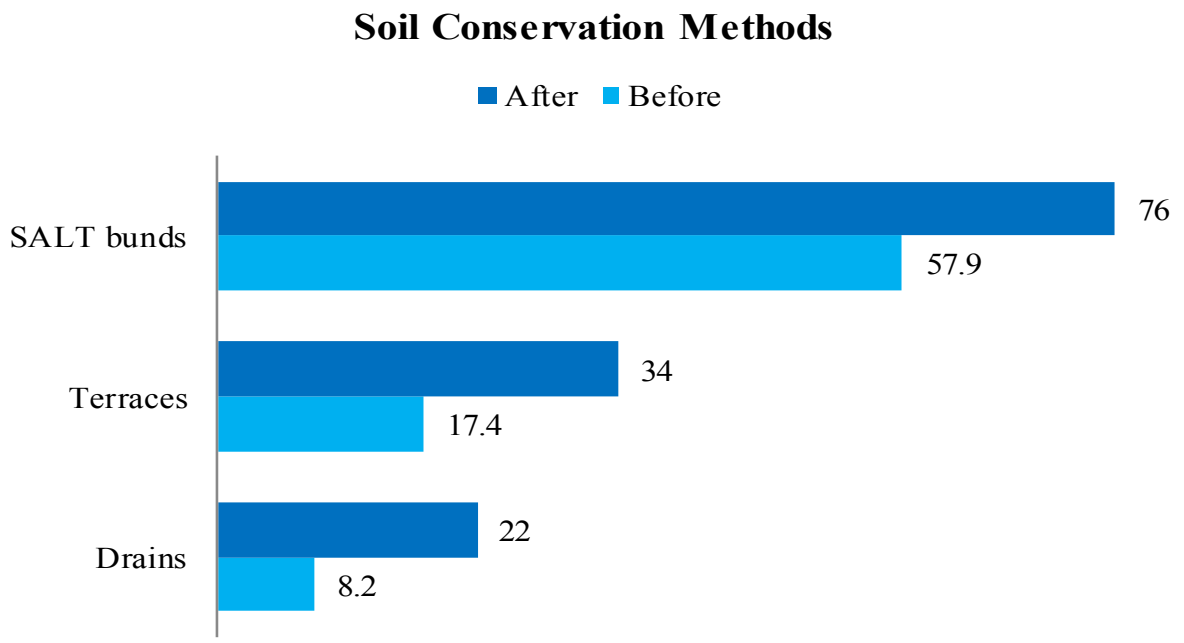
4. Community mobilization and empowerment

When the project baseline was conducted, there were no community based organizations in Serupitiya. Through the project, a great deal of community empowerment was achieved. The villagers were marginalized by their service providers due to issues of access, and many villagers had never visited the government administrative offices in the nearest town- almost an hour away by bus. The project supported villagers to organize themselves in to two community based organizations. One organization supports the key livelihood diversification programme- milk farming. This is a strong society with almost half the project households as members and waiting in line for a calf. The other is a women's organization established by the local NGO to support the habit of saving among women in the village. The majority of women had never owned a savings book all their lives. This platform is used to deliver programme on health, sanitation, kitchen gardens, efficient water use to village women.

Environmental Impact

Climate related issues for the village were identified during the VRA and baseline survey. These included long dry season with high livelihood insecurity and changed rainfall patterns impacting on vegetable farming. The interventions described above were meant to ameliorate some of these impacts; and support the community to sustainably use their natural resources such as soil and water. Continuous monitoring of project results by GEF SGP and technical advisors to the project ensured that climate resiliency of interventions was maximized to the extent possible; and that the community was made aware of current and future changes and adaptation options.

A total of 437 acres of land were rehabilitated with soil conservation measures. Farmers adopted the recommendations of the land survey, and were compensated for the labour spent in establishing the soils conservation structures such as stone hedges, contour drains, live fences etc. Soil conservation impacts were noticeable immediately after the first rains. Some bunds and drains trapped over a foot of top soil. Farmers who had lands outside the project area demanded the same survey and land contour plans.



Improvement in land management before and after the project:

	Live hedges	Drains	Terraces
Number of houses (known length)	28	11	11
Total length (m)	8705	3573	2487
Average slope	45°	35°	36°
Average height of soil (m)	0.553	0.591	0.557
Average width of soil (m)	0.553	0.845	0.770
Conserved volume per meter (m3)	0.153	0.250	0.215
Volume of conserved soil (m3)	**1331.03**	**892.17**	**533.32**

Home gardening was introduced to 200 households and 36 families are already using home garden produce for consumption and sale. A post-project survey of results found that composting habit had increased from 14% of households before the project to over 80% after the project.

Table 1: Effectiveness of the recommended adaptation measures to combat climatic variability

	Observed Climate Impact on Target Community		
Adaptation activity implemented through the project	Increased drought from May-September	Uncertainty of rainfall during main cultivating season	High intensity rainfall causing soil depletion and low yields
Soil conservation measures	moderate impact	no impact	high impact
Perennial crops for extra income	moderate impact	moderate impact	moderate impact
Livestock Farming for extra income	high impact	high impact	no impact

Socio-Economic Impact

A summary of the socio-economic conditions of target households from the baseline survey conducted during the initial phase of project implementation demonstrated that over 60% were beneficiaries of government welfare meant for the poorest families. None had home gardens for household consumption and every household disposed of waste haphazardly. In addition, only 40% of houses were suitable for habitation (i.e., weather-proof) and only 10% have toilets. 98% of households borrowed to cultivate and were in debt. 100% used chemical pesticide/weedicide. None of the target households had erosion control in their fields. All households spent less than Rs. 8000/ US$ 75 on consumables including food. Households with more than 5 species of perennial trees/crops was less than 20%.

In terms of economic impact, 17 families received a free cross-bred cow through project support and 14 families are earning between US $ 60-90/month through milk sales. A milk chilling centre was established with government co-finance to support the Milk Farming Society The Milk Farming Society established through the project has since lobbied and brought in two new projects for community development, including a drinking water project for Siyambalakumbura. 58 families are benefitting from sale of home garden produce and perennial crops such as cashew and coconut. Today, all home gardens have more than 5 perennial crop types ensuring family food and income during periods of climatic uncertainty.

In addition, a fledgling savings and credit society to encourage women's saving habit which was non-existent in the village. Awareness of sanitation, general health and hygiene has been beneficial to women and children in particular. The saving society started with nothing and now has over USD 2000 in the bank.

Youth Engagement and Participation

Young people were the target focus group in this village. Early marriage is a common social phenomenon and 25% of the project target beneficiary families consisted of parents under 25 years of age. Some parents were under 20 years of age. Therefore youth of the village were engaged in the core activities of the project-soil conservation, livelihood diversification and women's social empowerment.

Gender Mainstreaming

Women's participation was high in the initial meetings and vulnerability reduction assessment. The implementing NGO was represented by female officers, and this led to a number of perpheral activities with women's participation. This includes the savings and credit society, nutrition and health awareness, awarness of kitchen management and smoke free kitchen maintenance, children's health etc. Women also participated fully in the core activities of the project including livestock farming, home gardening and soil conservation.

Policy Impact

The Project has local/regional policy implications on the use of livestock as a successful adaptation measure; and on the species of perennial cash crops that are most suited to this agro-climatic region, and harsh terrain. There is also an element policy impact on the approach for land management (survey-planning-implementation-monitoring) that makes it easier for technical extension officers to follow up on recommendations.

Replication and up scaling

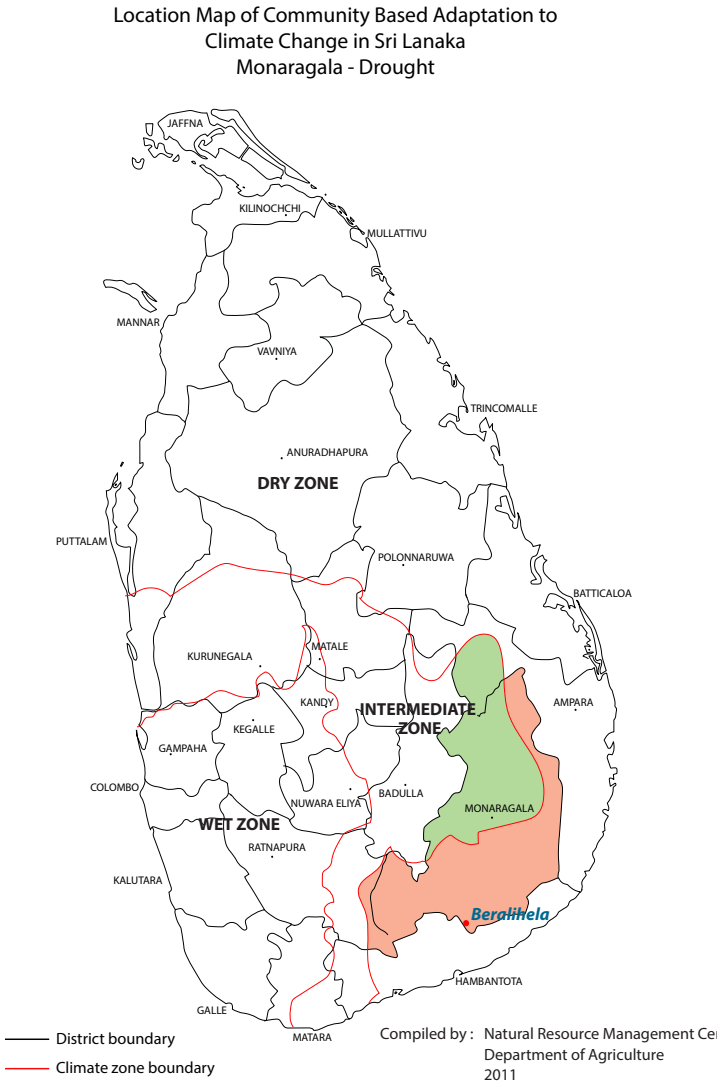
The Divisional Secretariat has followed the project success and recommended the approach for up-scaling through government sponsored rural development programmes. A USD 7.5 million climate adaptation project will up-scale CBA project's proven approach for soil and land conservation in rain-fed farm lands in the entire Walapane Division. The adaptation project is funded by the Adaptation Fund Board (AFB) and implemented by the Ministry of Environment (through UNWFP and UNDP).

Lessons learned

- The importance of technical and scientific information to supplement community knowledge when designing adaptation actions
- Networking with government, semi government and non-government institutions can bring in much needed co-finance to a small-scale project
- Challenging baseline situations can impact on implementation and results. For example, in Serupitya poverty is so endemic that project activities did not make a substantial impact on the socio-economic conditions of the village
- Developing linkages with government service providers can substantially empower a marginalized community

4.4 Developing Community-led Strategies and Infrastructure to Ensure Adaptation to Drought Conditions

Project No:
SRL/MAP-CBA/2010/01
Grantee:
Green Movement of Sri Lanka
Location:
Thanamalwila Division, Monaragala District, Uva Province, Sri Lanka
SGP Contribution:
US$ 40,504
Cash Co-Financing:
US$ 6,400
In-Kind Co-Financing:
US$ 1,500
Project Duration:
24 months
Number of people served:
175 families
Focal area:
Community-Based Adaptation
Extension Project:
SRL/MAP-CBA/2013/03
SGP Contribution:
US$ 17,346
In-Kind Co-Financing:
US$ 1,508



Background

The village of Beralihela lies on the fringes of a protected forest and a large irrigation scheme. Placed within the arid agro-ecological zone, the driest part of the dry zone, it is drought prone even as surrounding areas experience rain. The selected community comprises poor and marginalized farmers who cannot access the irrigation water and engage in rain-fed upland cultivation. The subsistence livelihood can only be practiced once a year during the Maha rains. This too is threatened by frequent variability, low rainfall and delayed monsoons. The community cultivates vegetable and other crops such as ground nut, maize and gingelly, during the rainy season. During the long dry season, they work as labourers in nearby irrigated rice and banana fields. Drinking water was a main problem for the community, but are relieved now with a water supply scheme. The crucial problem they face now is the lack of assured water for cultivation in the main season (Maha) and the dry season (Yala) putting their livelihood under constant threat.

Project Objectives and Key Activities

The main objective of the project was to reconstruct a tank to ensure water security to 44 families in the three villages of Padikapuhela, Pilimahela and Thammennawa, mitigating the impact of drought by ensuring access to a secure source of water throughout the year for drinking and for irrigating Yala season crops. The main activities were therefore connected with constructing the Padikepuhela tank and providing for water to be available to two villages. Creating a water management committee to manage the provision of water through a management plan was also carried out as part of the activities. Establishing drought adaptive agricultural practices such as training in water and soil conservation, introducing perennial fruit plants such as mango, papaya and banana, introducing alternative livelihoods to encourage self employment for women, providing vocational training to school leavers, promoting dairy farming and establishing an optional marketing system to strengthen the socio-economic status of women, particularly widows and initiating a revolving fund were other key activities.

Restoring the Padikepuhela tank

The community volunteering labour

The tank rehabilitation project was initiated at the request of the community; accordingly a participatory approach was employed from the outset. A community based plan was created with an agreed time-frame to complete the project and the necessary maps were generated using community knowledge. Volunteers were recruited according to a community-developed routine, such that four families would provide voluntary labour each day.

However, the work could not be completed as envisaged, as it was necessary to rely heavily on technical expertise, guidance and supervision of engineers of the Irrigation Department, Uva and outside contractors with machinery to carry out the tank construction. Before site clearing could take place, a technical survey report was required which contained the necessary specifications, drawings and estimates

for constructing the tank bund, sluice gate and spill. Having had no prior experience in constructing or rehabilitating a village reservoir, the work was slow in being implemented.

Construction of the tank

The initial tank construction work took over two years and by June 2013, the tank filled up with the rains and the community was able to pump water and harvest a crop that season. Work on the second phase started in September after the water level had subsided. Unlike in the first phase of the project, community involvement in Phase 2 was very high. Maximum community participation, made it possible to cut costs and complete the dam (without the distribution pipelines) with the available funding.

Environmental Impact

An abundance of bird life was observed as the reservoir filled up and even during the prolonged drought (2014) the tank was frequented daily by wild boar, deer, sambhur and elephants. The small pool that remained in the tank bed was their water hole. The elephants would climb the dam and enter the village though not posing a threat to crops so far. This shows the potential of the reservoir to enrich the biodiversity of the area especially for the Lunugamvehera forest reserve that fringes it.

Socio-Economic Impact

The communities explained how the dependence on rain-fed subsistence farming for just 3 months of the year makes the farming families of Padikepuhela of the Thanamalwila DS division 'highly vulnerable' to food insecurity during periods of droughts. Furthermore, drought-affected families put their health and welfare at risk when the coping strategies they have are to cut back on food and reduce health and educational expenses or pawn any valuables they possess. In all probability in these families, most pregnant women, lactating women and children under five did not receive their daily requirements of energy and protein. Data for the Monaragala district in 2012 showed that this age group of children suffer from 'severe acute malnutrition' and that as many as 25.6% were underweight, second only to Kilinochchi in the war-

The completed tank

affected north. Against this backdrop, the ability to irrigate multiple crops of pulses, legumes, vegetables and fruits would fulfil nutritional needs as well as provide for a marketable surplus.

The project area is disadvantaged by its location of being on the border of two districts. Though in close proximity to the Hambantota district, they cannot benefit from the developments taking place there as administratively they belong to the Moneragala district which is over 60 km from there village. This distance factor leaves them feeling marginalized and isolated physically and mentally. In these circumstances, having a reliable source of water is key to becoming independent, maintaining secure livelihoods and higher household incomes.

Although poverty is high in the Monaragala district, multi-dimensional poverty head count is much lower than many other districts, at 4.5% even lower than the national figure of 4.7% showing a marked improvement over the last few years. This could be due to the fact that the women and men have migrated to the Middle East for work. It was evident in Padikepuhela where villagers were proud of the solid brick houses built by Middle East returnees. Villagers were also engaged in micro-enterprises such as making bags and shoes which shows that they ventured into alternative income venues.

The positive factors that would relate to socio-economic impact are that the communities are homogenous with little incidence of disharmony. They originate from five families who settled here in the 1970's taking up the opportunities offered under the Kirindi Oya settlement scheme. Secondly the bond between the Padikepuhela community and the prelate of the temple is a strong one who has confidence that once the reservoir is operational and cultivation under way, the village will be able to prosper. Thirdly, the community has shown initiative in obtaining piped water for some of the houses from another scheme in the face of stout resistance from the Water Board. This experience made them more aware of their own capabilities. Finally, the community is well aware of the potential of their location as a place of historical interest to visitors, where a number of caves that dot the hill behind the village testify to the legend that a very productive agricultural society thrived here that was able to support over 12,000 monks in ancient times.

The project has exposed the communities to interacting with experts and officials, government and non-governmental agencies whom they can access for guidance and input. They include the Forest Department, the Irrigation Department, the Department of Agriculture, the Disaster Management Centre, GEF/SGP and the project NGO Green Movement of Sri Lanka (GMSL).

Gender Mainstreaming

Women would be among the foremost to benefit from the availability of water to cultivate crops throughout the year. Women with very young children, for example Dhammika, a single mother, whose home garden was destroyed by the prevailing drought, is confident that once the village tank is operational, the availability of water will enable her to survive independently. Other potential beneficiaries are those dependent on small businesses for survival. An older woman 'Getamanne aachchi,' is raising two grandsons abandoned by their mother supporting all three by supplying tea and meals at the weekly farmers' market. She would be able to cultivate her home garden with the availability of water. With the high rate of teenage pregnancies known in the area, availability of water would also make a remarkable difference to this group, as all households have land to cultivate to earn an income, as well as ensure food security.

Sustainability

The main components of the tank construction have been successfully completed and villagers of Padikepuhela were able to pump the water for irrigation during a partially successful Yala season in 2013. There has been a prolonged period of drought since then and farmers have been unable to cultivate any

crops since then. The fruit trees – papaw, annona, star apple, cashew, pomegranate and passionfruit show evidence of this with fruits blackened and diseased still on the trees or fallen prematurely. Water availability for crops depends on the rainfall in September. Related to this is the installation of a pipe system to distribute the water to the three hamlets.

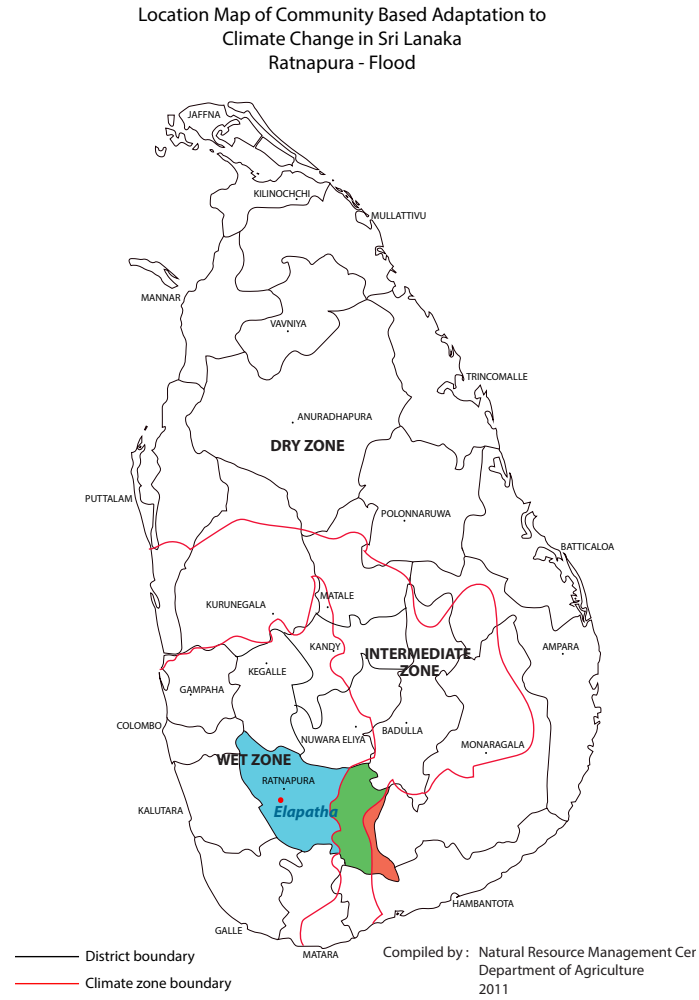
Managing the water resource and sharing it equitably will need to be done efficiently and effectively if benefits are to be sustained. The community led water management committee must have the leadership and management skills to be equal to the task. Such a committee has been formed but since the tank has not been fully operational, the committee has not been active.

Lessons Learnt

- The community members stated that they were prevented from participating in the construction work in the first phase despite their involvement in the planning stages of the project. On one hand, the dense thorny scrub, removing the surface soil, and compacting could only be done with heavy machinery. On the other hand, villagers claimed they felt intimidated and excluded by the Irrigation Department experts, who would not tolerate their participation in construction work, kept them at arms' length and would not share any discussions or knowledge with them. Their contribution was confined to monitoring the work of the two excavators and two large hydraulic trucks and removing the tree roots and debris from the excavated earth before it was compressed into the bund.
- It also became difficult to complete the project within the planned time-frame and budget. Heavy rains in January 2011 postponed commencement of construction work until March. Heavy machinery such as tractors, caterpillars and vibration rollers for construction was not readily available on account of the large number of ongoing development projects being implemented in the Monaragala and Hambantota districts. These delays from the original plan put a strain on the budget.
- In addition, there were changes to the original design of the tank, such as increasing the bund (dam) length from 300m to 420m, raising the height of the bund to 5.1m and expanding the width of bund from 4m to 6m. These were bund and reservoir safety measures necessary to safeguard the communities living downstream they were advised. Further,
- Technical surveys of the area found that there were engineering issues that had not been budgeted for beforehand, for example, removing sandy soil from the tank bed area and replacing it with compacted clay soil to prevent seepage. Additional funding had to be sought to complete the draining and for new activities such as grassing the bund and constructing a rip rap, as well as the livelihood adaptation components of the original project.
- The construction of the tank had raised hopes in the community that the rains would come as expected and the tank would fill. Against this hope, some farmers had invested in growing banana as a crop in lots ranging from 1 – 2 perches to a 1 ha. Growing banana is costly one farmer said, he spent Rs 150,000 on this investment taking a loan to do so. Banana cultivation also requires water and when the drought set in, they had to water their crop using water from the two agro-wells in the village or were not watering them at all, and neither strategy was drought adaptive.

4.5. Community-Based Adaptation to Floods in the Elapatha DS Division of Ratnapura District

Project No:
SRL/MAP-CBA/2010/05
Grantee:
Sabaragamu Janatha Padanama
Location:
Elapatha DS Division, Ratnapura District, Sri Lanka
SGP Contribution:
US$ 42,529
Cash Co-Financing:
US$ 3,000
In-Kind Co-Financing:
US$ 2,200
Project Duration:
11/2010 - 7/2012 (18 months)
Number of people served:
68 families (288 people)
Focal area:
Agriculture and Food Security



Background

Dellaboda village is located in the Ratnapura District in Sri Lanka's "wet zone" where annual rainfall varies between 2500 mm to 5500mm. The village is home to 288 people who, for many centuries, have relied on paddy cultivation and other farming practices for subsistence and income. Over the past decade, climate change impacts and its variability have extremely altered rainfall patterns, which have led to either floods or droughts. A major flood in 2003, with a record rainfall of over 318mm within 24 hours, left the area devastated with approximately 90 lives lost and with the majority of the village rendered homeless, amidst the food shortage due to agricultural crop destruction and potable water scarcity. Since then, the communities have been inundated with up to 5 major floods a year, prohibiting 63% of the area's farmers from producing enough food for the community's consumption and perennial crops for cash income.

Due to these adverse conditions, some farmers have been forced to abandon paddy cultivation and sought other livelihood options such as illegal river sand and gem mining.

Additionally, weeds have thrived in the abandoned paddy fields which have attracted pests such as birds and insects, resulting in more crop losses.

Project Objectives and Key Activities

The project's objective was to strengthen the communities' resilience to the adverse impacts of climate change and its variability by building their capacity to combat floods. The key activities included the renovation of canal systems for effective drainage, especially during heavy rainfall; the introduction of flood-resistant paddy crop varieties, the improvement of home gardens, and establishment of seed banks to overcome the scarcity of seed paddy and other food crops.

Flash floods have caused immense damage to irrigation channels and waterways around Dellaboda and the adjoining hamlet of Modera. Hence, an irrigation channel was constructed to distribute waters to a paddy tract (Muththetu godella) which is damaged during each flood, which also serves as a channel for removing flood waters. The construction was completed according to the specifications of an irrigation engineer, with voluntary labor ('Shrama Dana') continuously provided for 30 days by the community members. The landowners, who sublet their fields to the farmers ('Ande' tenure system), provided free meals and refreshments to the working groups. The villagers' commitment and dedication throughout the project period, along with the materials they contributed, saved funds from the project budget. These savings resulted in the channel being extended by 100m, reaching its neighboring community, the Modera village.

Additionally, whilst being located between the Niri Eli Ganga and Hangamu Ganga streams, whose waters flow into one of the country's main rivers (Kalu Ganga), the streams are heavily silted and are unable to absorb floodwaters during heavy rains. As such, water remains longer in farmers' lands and cause further damage. Therefore, in addition to the construction of water channels to relieve the fields of excess water, flood-resilient species were introduced. These species included short-duration improved varieties and traditional paddy varieties such as Maa Vee which have longer stems and are able to withstand certain level of floodwater for several days.

To protect seeds and plants from floods and droughts, 81 home gardens and plant nurseries were developed. Additionally, the use of organic farming methods such as composting and the use of herbal fertilizers and pesticides were introduced. Appropriate certified paddy seeds were purchased from the Department of Agriculture and seed banks were established to ensure the on-going availability of the seeds.

A participatory approach was used from the concept formulation to the project implementation stages that ensured the communities' concerns were heard and addressed with viable solutions. Building on the communities' knowledge and experiences, project partners such as scientists from the Peradeniya University of Sri Lanka, senior officials from the Rice Research Institute and technical officers from the district's Irrigation Engineers Office provided regular technical support at the community meetings. The scientific data shared with the communities, such as temperatures and humidity in the agro-climatic zones specific to the project area, rice agronomy, agricultural yields, pests and diseases, and integrated pest and soil management have raised the communities awareness and built their capacities on climate change and its effects on their ecosystems, food and water security. As a result of these stakeholder meetings, sensible and sustainable solutions were determined and agreed upon such as the practical irrigation system design.

The Vulnerability Risk Assessment (VRA) tool used in the project is a methodology based on the communities' assessment of current and future climate change risks and their perception on the associated vulnerabilities on their livelihood and welfare. It was conducted at the beginning, the middle and the end of the project. The VRA results showed that the communities' confidence has increased with regard to their abilities to cope with climate change-induced impacts. At the project inception, the villagers, who are traditional farmers from ancient times, were reluctant to seek new knowledge and practices. The project's

strong focus on participatory and inclusive approaches along with its awareness-raising and capacity development initiatives resulted in solidarity, ownership and increased capacities of the community members. In turn, these results led to the communities' empowerment and transformation in adapting to climate change.

Environmental Impact

The positive impacts on environmental conservation can be seen in both the paddy fields and home gardens. Before the project, 180 farmers used heavy chemical fertilizers for paddy cultivation. Now, 89% of the village farmers are following natural farming methods of compost, liquid organic fertilizers, mulch, and use of natural herbicides and pesticides. Only 20 village farmers (11%) depend on chemical fertilizers such as synthetic versions of urea. As a result, the health of farmers has improved and the incidences of deadly fevers such as Leptospirosis and dengue have been reduced. Additionally, a reappearance of fish, dragonflies, and other beneficial insects and birds in the paddies, is now being recorded.

Over 8 hectares of land have been restored with the development of home gardens using organic farming methods. The application of soil conservation and other protection measures, such as live fencing around the home gardens with *Gliricidia sepium*[1], provide fodder and enrich the soil. Furthermore, the home gardens provide organic and nutritious food for the family and reduce the need to purchase vegetables from the market.

Socio-Economic Impact

Upgraded water channels bringing water during extended dry seasons and also help reduce flooding during the rainy season

The construction of the water channel was the biggest investment of the project providing tremendous benefits to the village. Due to the regular availability of water from the channel, the farmers are now able to cultivate paddy rice and other crops such as okra, gourds, long beans and green leafy vegetables in the two harvesting seasons ('Maha and Yala'), thereby, increasing the production yields. With the increased yields and the training on crop quality and price-setting, the farmers are able to negotiate and receive better prices for their harvest. Additionally, the community members have learned that their experience, knowledge and common sense is sometimes more practical than the knowledge of technical officers. For example, when the channel was being designed and constructed, the village elders offered advice to the officers which led to more sustainable and efficient outcomes. For

1 It is considered as the second most important multi-purpose legume tree. Since it is easily propagated and grows quickly, it is widely used for live fencing, fodder, shade and topsoil erosion reduction.

example, officers from the Department of Irrigation designed the canal calculating capacity and water requirements of the communities. However, village elders, who have repeatedly experienced flooding and the associated destruction of crops and land, advised the officers to raise the height of the canal by several inches to increase its capacity during heavy rains as well as the impact of receding waters after the rains. Although this advice was initially neglected by the technical officers, later consideration to follow the elders' guidance resulted in a more even flow of water and better control of the excess water.

The extension of the water channel provided water access water to the Modera village. As such, a decade-long animosity between the two communities, caused by caste segregation and conflicts over water management was ended. The maintenance of the channel is managed by the 'Farmers Society' consisting of members from both villages. Lastly, the relationships of the two communities with the state sector institutions have strengthened such as the Departments of Irrigation, Agriculture, and Agrarian Services, the provincial council, local government authorities and national level programmes. It brought benefits by way of a new road being made along the channel, enabling tractors and other vehicles to reach remote farmers. The road benefited the previously poor and marginalized village of Modera by providing secure access to the town.

The home gardens have resulted in self-sufficiency and food security for the family. The training processes developed the capacities and increased the confidence of women farmers. At present, the production yields from home gardens contribute a substantial portion of household incomes, generating as much as 30% of their monthly income for some families. Their new knowledge on composting, organic farming methods, and soil and environmental conservation, has also generated extensive benefits such as the cost and quantity reduction of purchased inputs. Home garden yields are now monitored by the women who record information on the amount of produce that are sold and those that are consumed by the family. The inventory management enables the women to quantify household savings on food purchases, profit from the sales investment on seeds and inputs for the next season.

Women's home garden: size, health and productivity improved with water management techniques

Through the Credit Scheme, members have been able to obtain distress, medium and long term loans at a maximum of 14% annual interest (much lower than the average commercial annual rates of over 16%, and at times over 20%, in Sri Lanka). Some women members have taken advantage of the credit facilities and opened retail shops in the village. For example, an innovative effort launched by one female member is selling pre-made lunches to laborers with their traditionally grown rice and home grown vegetables.

Policy Impact

The project worked closely with officials from the Departments of Agriculture and Agrarian Service who participate in national level meetings, with one senior officer being the adviser on climate change to several government agencies. Their exposure on the village-led project activities has dramatically raised

their awareness and stimulated different ways of addressing a population's vulnerability, such as using a participatory methodology, using the knowledge and respecting the ideas of the villagers as its inhabitants would know their ecosystems the best. The established affiliations have fostered community–specific climate change adaptation concerns being mainstreamed into local, provincial and national development efforts

Additionally, with these collaborations, non-effective processes have been identified by the government. For example, the government agencies have realized the importance of quick response to the rehabilitation and strengthening of vulnerable infrastructures, such as water channels and anicuts, on which communities rely for their livelihoods. Post-disaster repairs and construction are costly and in many instances, deemed ineffective. Lastly, recognizing that the government does not have the sufficient funding and resources to address the various problems arising from the nationwide climate change issues, the government is now re-evaluating its current process and finance mechanisms to mainstream CBA innovations and channel scarce resources to reach the high-risk communities. For example, the current government procedures of outsourcing services for infrastructure development have to be re-designed and take into account the communities' ideas and contributions. As seen in the water channel construction, communities' ideas, spirit of volunteerism and actions minimized the costs while achieving better results.

Youth Engagement and Participation

The openness and transparency with which the project activities were undertaken attracted young people and subsequently, changing the attitudes of some village youth. Youth were interested in the idea of mobilizing village members for a common good and thus, volunteered their labor for the water channel construction. Young people have expressed that being able to contribute to positive developments in their village has led to better family relations and shedding of anti-social habits. The village elders reported that activities such as elicit liquor brewing and gambling which were spreading in the village were eliminated during the project's implementation period.

Gender Mainstreaming

Women were in the forefront of project activities right from the start. They participated in all decision- making meetings from the planning to the project follow-up stage. In the Farmers Society, women accounted for 62% of the general members and 53% of the executive members.

Women hold leadership roles within the Farmer Organization and are participants in all project activities

The home garden component was embraced by women as an enterprise that would enable them to earn an income, provide nutritional food for the family, guarantee food security, conserve the environment and promote their status in the community. The women take a keen interest in their home gardens and several of them have entered national home garden

competitions with some winning awards. This has been a great source of pride and brought them recognition at the district and national levels.

During VRA exercises, female participation was over 65% which further demonstrated their interest and commitment to seeking solutions to the problems their community faces.

Replication and up scaling

The best practices and lessons learned from this project will be disseminated to inform national processes and practices. Additionally, they will be shared with neighbouring communities through government extensions and NGO interventions for wider adoption.

Lessons Learnt

The following lessons learned were generated throughout the life-cycle of the project. Some of the key lessons that can help others who face the challenges brought on by climate change, specifically floods, and its variability.

- The following conditions exacerbate the vulnerabilities of the poorest subsistence farmers to climate change, compounding their status to be silent victims of climate change: lack of awareness amongst farmers on the climate change-induced impacts on livelihoods, non-availability of agriculture extension facilities in many areas, limited technical advice on crop varieties and choices, and limited ability to affect water management.
- While home gardens are effective buffers against climate change and its variability, its continuous maintenance may be a challenge especially in the increasingly long dry seasons. It is important to find viable solutions that are accepted by the farming communities. While drip irrigation is a good solution, in Sri Lanka, having perennials such as mango and coconut is an adaptation practice that is locally accepted to support the families through the longer dry seasons.
- Many communities have been applying adaptation measures (e.g. application of flood-resistant traditional paddy) for centuries to protect themselves and their ecosystems from climate change impacts, however, a lot of their adaptation strategies are not translated into actions due to lack of organized effort within the community and lack of state interventions. Therefore, providing linkages and synergies are important to ensure that they have access to institutional, financial and government support, as well as mainstreaming CBA innovations for widespread benefits.
- While the funds from the CBA project may be deemed small, it was able to catalyse change beyond the project's framework. The participatory and inclusive approaches used by the project instilled solidarity and teamwork within the communities during the course of the project. In turn, results achieved surpassed what was originally planned in the framework.
- Transparency has to be maintained at all levels to obtain community commitment.
- During VRA exercises, communities identified that a key adaptation barrier was the lack of finance to invest in solutions and a lack of local/provincial government support.
- Once the positive adaptation impacts of project initiatives are shared with government stakeholders and the outcomes are articulated and visible, government can become a strong partner providing encouragement, technical support and co-financing.
- For strategizing adaptation initiatives, comprehensive baseline data has to be in place to develop indicators and to address issues of food security, self-sufficiency and increasing incomes.
- Risk-transfer schemes, acceptable to both farmers and insurance providers, are essential to protect farmers against recurrent floods, other natural calamities and crop damage.

5. Technical Papers

5.1. Cultivation of Traditional Crops Under Improved Soil Management Practices as an Adaptive Strategy

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Introduction

Aranayake division belongs to the hilly part of Kegalle district and falls within the Up-Country Wet Zone agro-ecological region. The area is fed by both monsoons and affected by infrequent landslides. The annual mean rainfall is between 2500 mm and 3000 mm and the mean temperature is around 25oC. These figures may however not be currently accurate due to variations caused by changes in weather patterns experienced during the last few years.

A remote area in Kegalle district Aranayake has a large number of poor families. Many villagers have been traditionally engaged in various trades such as pottery and smith craft. The area had a rich agro biodiversity of indigenous yams and tubers. But the species were mostly lost with time as dietary preference was for potato, which is not a local crop, but introduced by European colonialists over a century ago. All yams and tubers complement the natural complex carbohydrate component needed in the human diet and therefore considered an important food item.

Local cultivation of potato was tried out but never succeeded due to high incidence of disease and the inability to produce seed. As a result, almost all the potato consumed was imported (from other areas of the country). Even the potato that was grown locally had to depend on imported seed, chemical fertilizers and agrochemicals. This raises the issues of food security and environmental pollution.

Therefore revival of traditional yams and tubers was considered not only timely but also essential to ensure food security. It has now become even more relevant due to effects of climate change or rather altered weather patterns which seriously affect the cultivation of other cash and food crops especially vegetables.

The Community Development Centre in 2000 conducted a survey to determine the reasons for poverty among farmer households. The findings could be broadly categorized into two namely technological and socio-economic. The technological problems were poor soil fertility and low water holding capacity as the homesteads were subject to severe erosion. Poor marketability and lack of organized leadership were the observed socio-economic problems.

Revival of traditional yams and tubers

The first step in the revival of traditional yams and tubers was therefore to identify varieties, study their characteristics and conserve in-situ. Technologically, the homesteads of the target farmers were subject to erosion over the years. Thesoils were depleted of nutrients and water holding capacity deteriorated. The effects of weather change became more prominent during the last five years or so and extremes of rainfall and drought periods became critical for crop production. Being underground, yams and tubers could withstand excessive rainfall but not drought periods. Therefore technological problems and their solutions were clear and practical.

Sloping Agricultural Land Technology (SALT) was introduced to the homesteads with live fences of Gliricidiasepium. The Project[1] provided subsidies to establish soil conservation structures (SALT hedge- 1 feet of live fence- Rs 3/=, Lock and Spill Drains- 1 feet – Rs 4/=) as an incentive. Together with the contour drains and stone terraces they were able to minimize soil erosion thus conserving the soil fertility and moisture. The Gliricidia also provided the Nitrogen-rich biomass for the preparation of organic manure and the live fences provided the support for creepers such as pepper.

A study [2] was conducted in 2007 to assess the success of the technological component. A sample of 104 direct beneficiaries from Epalawa, Atthpitiya, Gavilipitiya, Nikkapitiya and Waharakkoda was selected and information was gathered through a questionnaire.

Sixty percent of the respondents said that Sloping Agricultural Land Technology (SALT) method was the most popular method to control soil erosion because it was easy to establish (45%), sticks freely available (42%), Nitrogen fixation is more (40%), can run creepers on the SALT fence (40%). Fifty six percent said that the next best method was lock and spill drains especially on sloping land.

Nearly all respondents (93%) perceived an improvement in the soil quality on their home-gardens as a result of soil conservation measures and 87% increased their incomes from crops grown successfully on their home-gardens. Moreover more than (80%) respondents say that there has been a 50% and above increase in harvest, 90% of the respondents say that soil erosion is less and 82% say that there is an increase in land to cultivate after the introduction of soil conservation practices. The problem of low soil moisture during the drought period was thus addressed adequately and the farmers were able to sustain crops of yam on their home-gardens. Around 60 traditional varieties have been collected from home gardens and conserved thus far and 50 acres of community homesteads have been developed this way.

Social mobilization

Sociological problems were more distressing and ingrained because women were under severe economic stress. Many of the male members were marginally employed with very low and uncertain incomes. Most children were found to be undernourished and majority of families had only a hand-to-mouth existence. Social conditions made it difficult for CDC to address the soil conservation and improvement technologies with these families. Therefore, the NGO employed a slow process of social mobilization was undertaken with grant assistance in 2001.

Experiences of social mobilization in various projects implemented in Sri Lanka were not encouraging as they had failed to sustain the mobilized communities. Studies revealed that failure of social mobilization was more due to poor dedication and the approach of the 'mobilizer' rather than the concept itself. This meant that with proper dedication and correct approach the activity could yield good results.

1 UNDP/GEF assisted Project

2 Jayasinghe, D and Bandara, R (2007) "Small scale environment project and their impact on minimizing land degradation in Sri Lanka: A case study of Community Development Centre" (Abstract of papers) 16th International Forestry and Environment Symposium, Department of Forestry and Environment, University of Sri Jayawardenapura

Two important factors were taken into consideration in the implementation process. Firstly, the 'external mobilizer' namely the CDC had to form and support 'internal moblizers' from among the villagers and secondly, the underlying premise should always be to promote self-help among the target group and get them away from dependency. The actual practice of social mobilization therefore was a challenging task and field workers had to be properly guided and followed up.

The target group (mainly women) formed small groups and established group funds through their own savings. They were made aware of the benefits of developing their homesteads and cultivating traditional yams and tubers along with vegetables to find most of their food requirements from their own garden. Traditional knowledge was available with the elder villagers who came forward to train others.

Impacts of the Project

CDC provided leadership to establish farmer groups. The groups consisted mainly of women. Around 500 poor families were involved in the project cultivating traditional yams on their home-gardens. A total of 50 acres was brought under organic farming and the members produced large quantities of yams and vegetables.

The families obtained nutritious, pesticide free vegetables from their gardens and a balanced diet ensured improved nutrition for children. The groups carried out many community activities such as collective marketing etc, which gave them financial benefits. Husbands and male members of the village joined in the activities helping their spouses to market yams and value added produce such as chips, sweetmeats and flour. Collective marketing of yams, planting material, vegetable was undertaken by men and women. Many beneficiary women became good farmers having developed expertise in the cultivation of yams. They also became trainers and the Project produced 35 women leaders in the villages.

Their main challenge was to develop and sustain a steady market for the produce without which no cultivation will sustain. The services of ITI were obtained to analyze a few varieties for their nutritive value and to improve on the techniques for the production of chips, sweetmeats and the sophisticated French Fries. They are now exploring the possibility of production on a commercial scale to exploit the niche urban market available for products of traditional yams and tubers which are considered rare delicacies for urban households.

Conclusion

Yams and tubers in general are largely unaffected by adverse effects of climate change and can be successfully grown if soil moisture availability during the dry spell is improved. They are also relatively free from pests and diseases except damage by rats and wild boar which is taken care of by the live fences. With a low requirement of external inputs these have become an ideal crop for the highland even under adverse and uncertain conditions caused by climate change. The above ground parts of yams provide a good soil cover thereby improving rain water capture and storage in soil.

Availability of soil moisture during the dry period is critical in combating effects of climate (or weather) change on rain-fed highland farming. This has been satisfactorily overcome by effective soil and moisture conservation practices by adopting standard mechanical and biological methods.

Getting resource-poor families to invest on soil conservation structures (even with subsidies) is the other critical factor as we have seen many projects failing to sustain these changes. Sincere social mobilization approach with the primary aim of promoting "self-help" is essential in getting communities to adapt to ill-effects of weather change.

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5.2 Community based climate change adaptations: lessons learnt from small-scale fisheries of the South coast of Sri Lanka

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Introduction

Small-scale fishery is the backbone of the Sri Lankan fisheries industry, and livelihood for a greater number of fishermen. Sector contributes significantly to the national economy and bolsters local food security (FAO, 1984). Impacts of over exploitation, poor management as well as climate change are already visible in the sector, reducing fish catch, catch size and availability. Such impacts will have implications for the country's economic development, poverty reduction and food security. Further, small-scale fisheries due to its nature, is highly prone to natural disasters and hazards, exacerbated by climate change (Murray et al. 2002).

Principal focus of the study is to identify impacts of climate change on small-scale fisheries in the South coast of Sri Lanka and investigate different community based adaptations. Specific objectives were to identify current and potential impacts of climate change and corresponding adaptation strategies in small-scale fishery value chains, determine the weakest nodes of the small-scale value chain and gain deeper understanding on sector vulnerability and develop adaptation strategies. Such strategies should be aimed at preparing small-scale fishing communities to adjust to climate change impacts, including information and awareness, capacity building, education and technology.

Methodology

Present study based on three case studies based on small-scale fishing communities of Beruwala, Balapitiya and Mawella of Southern coast of Sri Lanka. Lack of pervious research and non-availability of time series data limit the quantitative assessment of the climate change impacts. Participatory Market Chain Approach (PMCA) was the principal survey instrument. Primary data were gathered from randomly selected value chain members and the sample composed of 10 members of the each node. Study sample consisted of 30 retailers, (10 from each location) and 15 wholesalers (5 from each location); and consumers, final node of the value chain and study employed 45 different types of consumers into the sample. Both individual as well as institutional consumers were represented the study sample.

Value chain members were selected based on their experience in the fisheries industry, where members with more than 20 years of experience were selected as contributors to the field survey.

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Further, the rich experience of value chain members were used to develop the time line of the climate impacts on small-scale fishery. Focus group discussions, in-depth interviews with unstructured interview schedules were main data collection tools. Also, scored causal diagrams were used to mainstream climate impacts as well as adaptation strategies.

Results

Small-scale fishermen, the starting node of the value chain were varied according to their craft type and gear type. Craft type of the sample were out-rigger canons (4 from Balapitiya, 2 from Beruwala and 3 from Mawella), log rafts (1 from Balapitiya, 2 from Beruwala and 3 from Mawlla), beach seine (1 each from each location), dugout beach seine crafts (2 from Bapalpitiya, 1 from Beruwala and 3 from Mawella), FRP boats (2 from Balapitiya, 3 from Beruwala and 3 from Mawella). Resource exploitation was primarily done by beach seines, small mesh gill nets, pole and line and youth. Fishermen operating traditional crafts were adapted for day time fishing mainly. Mechanized craft owners engage in night fishing with long hours of operation. Main fishing season of the south coast starts from November to March and in peak season daily operations were possible except for agreed schedules on Madel (large fish net) May to September, South-west monsoon is active and the seas are rough. During this period, termed as off season, fishermen typically operate 2-3 days per month.

Tropical multi-species fish catch composed of sardines, herrings, anchovies and mackerels (Sardinella spp., Harengula spp., Anchoviella spp., Decapterus spp., Rastrelliger spp.), shrimps, lobsters, crabs, oysters, etc. Catch composition varied throughout the season as well as location. Both retailers and wholesalers buy fish from beach auctions or auction centres located in landing sites. Mobile retailers were common to all cases while road side retailers and retailers operated in public markets were incorporated into the sample. Different types of retailers with long years in business were used to identify market trends and shifting market places. Regional wholesalers as well as wholesalers based in the main markets were used to identify market operations and trends.

Identified climate implications and adaptation strategies were;

1. Changes in rainfall pattern and intensity – Fishing seasons are organised to be compatible with rainfall seasons. Therefore, shifting rainfall seasons lead to uncertainty in fishing seasons and unstable livelihoods for small scale fishermen. Further, increased rainfall intensity adversely affects the entire value chain operations. Fishermen change fishing gear types according to the season and species availability as an adaptation to the shifting fishing season. There is very little handling and processing in the small scale fishery value chain. Fish catch is usually marketed and sold during the course of the day. Unexpected heavy rains adversely affected functioning of mobile retailers, small scale retail outlets as well as harvest quality. Especially, small scale fish processing in a traditional way was common in peak harvesting season and popular processing methods of salting, drying and smoking were badly affected from the unusual heavy rains. Poor quality processed fish does not bring better returns to the processors. It also badly affects food security. In general, most of the fisherwomen engage in fish processing as an extra income generation activity and source of food for the off season.
2. Increase in unusual and unpredictable weather conditions – high winds and storms were common in all places in varying degrees. FRP boats were common in all fishing grounds, and generally lead to better harvest. Unfortunately, FRP boats were highly vulnerable to unpredictable high winds and storms, which are becoming increasingly common now. FRP boats are lighter than the traditional wooden crafts and have less stability compared to traditional crafts with outrigger canoes. Features of FRP boats made it less tolerable to high winds and storms

compared to traditional crafts. Traditional beach seines, outrigger canoes, and log rafts are more stable in unfriendly seas. Further, poor knowledge of predicting environmental changes and high dependency on technology and institutional support increases vulnerability levels of fishermen. This situation was common among young fishermen. Results revealed that composition of fishing communities has changed drastically after the Indian Ocean Tsunami in 2004. In the aftermath of the Tsunami, both fishermen and non fishermen received boats. The non fishers used hired labour or fishing crew. Members of the such hired crew composed of less experienced fishermen with poor knowledge on predicting environmental changes. Further, alcoholism and drug addiction showed significant relationship with the performance of the both fulltime and part-time fishermen as well as mismanagement of their income. Study findings highlighted that women and children of fishing families were most affected by environmental and climate changes and impacts were seen significantly affecting family food security.

3. Changes in fish catches - shifting fishing seasons together with several other yet undetermined reasons lead to a change in the volume of fish harvest and species composition (time line shows the changes in species mix such as missing species or change in frequency of appearance and emergence of new species). Long experienced fishermen claimed that many economically important species were disappearing, especially Tuna species (big eye, stripped and albacore) and current fish catch is less economical compared to past.

4. Changes in fishing income - seasonal as well as off season income fluctuation, alternative income opportunities and complexities in household economy were identified in all research locations in varying degrees. Fisher women engage in several off shore activities and local fish processing activities for extra income generation. Timeline shows tenfold increase of fish prices to compensate with low catches. Fresh fish market places high demand for the small scale fish catch and which helps fishermen to survive in current market place.

5. Changes in fish markets and market places - disappearance of traditional market places (beach markets, road side markets) and actors such as mobile retailers were common to all cases. Unusual wet weather conditions, rising temperatures were adversely affected the shelf life of fresh fish and fishery products.

6. Changes in consumer demand - timeline shows the disappearance of demand for traditional species, emergence of new species, shifting demand and special demand fluctuations in festive seasons and increased demand for value added forms with services attached to the fish marketing. Consumer demand on fresh fish (especially additional demand placed on fish harvest from traditional crafts) has risen ever high and consumers were willing to pay extra for the ready to cook or ready to eat forms in its freshest form. Therefore, all crafts including traditional crafts now carry ice on board and chill the fish just after catch ensure quality, freshness as well as shelf life of the harvest.

Conclusion

Community based local adaptations were varied place to place in the three study locations. The three case studies demonstrated different adaptations to location specific issues. Further, location specific adaptation strategies were varied due to the community mix (ethnicity, religion and cast issues), resource availability, boats and fishing gear types, fishing technology, markets, fish and fishery product marketing and demand patterns and livelihood options. Value chains of small scale fishery and its actors were identified several climate change issues and community based adaptations for changes in rainfall pattern, intensity,

unusual weather conditions, changes in fish catch and species mix, changes in income, markets and market places, actors and changes in consumer income.

Study reveals that all endeavours need the support of local communities and sustainable community based adaptations can mitigate the climate change impacts on small scale fishery. Further, community decision makers and planners need to understand the location specific climate change impacts and possible adaption strategies where one size doesn't fit all. Special attention need to be paid to bridge knowledge gaps on climate change, its impact and adaptations measures where women and children can play a great role.

Key words: climate change, small-scale fishery, community based adaptations

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5.3 An assessment of the factors that determine people's willingness to take part in Community Based Adaptations (CBAs) in agriculture sector of Sri Lanka

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Introduction

Climate change is happening, and the impacts are being visible in different forms of natural disasters and catastrophes, which impact lives and livelihoods of communities in rural areas. Climate change is undoubtedly creating impacts to both developing and developed world. However, the developed world with stronger economies and advanced technologies stands advantaged in managing these challenges. Therefore, climate change impacts are more severe in the developed world. Even within developing countries, the impacts are greater for poor and rural communities dependent on agriculture. Ironically, these are the very people who have contributed least to the problem (Shaw, 2006).

Countries have two ways of managing climate change impacts- mitigation and adaptation. Mitigation is to reduce the level of greenhouse gas emissions from industry, energy and agriculture. It required technology, complex financing mechanisms and large infrastructure. Mitigation is not a priority for developing countries like Sri Lanka who have low rates of emissions. Climate change adaptation, which means enabling people to manage the impacts of climate change, can take many forms. An approach that could help vulnerable rural people is community-based adaptation (CBA). Community Based Adaptationis based on the active engagement of the vulnerable community. A CBA programme can be implemented easily, if the implementers are equipped with enough information, technological and financial capacities. However, the sustainability of the programme is largely based on the people's wiliness to take part in the programme. It is common to see that people take part in CBA activities since they for most part provide livelihood opportunities to communities, and even infrastructure and financial benefits. However, these same set of people would easily abandon the CBA programme or neglect interventions once the implementers are out of the arena. Therefore it is utmost important that people's willingness to take part in the CBA programme is evaluated prior to the programme so that sustainability of the initiative is ensured. Willingness to participate in CBA activities is not just a function of socio-economic factors; it also has psychological and institutional dimensions. Many factors come under each of these dimensions. These factors will be further explained in the methodology section. (Action Aid, 2005 and Jenning and Mc Crath, 2009 and Wamsleret al, 2012).

Sri Lanka's climate change policy has identified the agriculture sector as significantly impacted by the climate change. Sri Lanka is still an agriculture based economy, and majority of farmers cultivate paddy. Being the nation's staple food, and the main source of employment for rural poor,

paddy farming is very important to Sri Lanka. However, over the years, climate change impacts have adversely affected this sector. Many farmers are affected by floods and droughts and have lost their harvests. Identifying the importance of helping rural farmers, CBA programmes have being initiated to help farmers fight climate change impacts.

These initiatives were implemented by government institutions, NGO/INGOs and also private sector. Government initiatives are mainly done with the collaboration of the Ministry of Environment and Renewable Energy (MERE), Ministry of Disaster Management (MDM) and Divisional Secretariat (DS) offices. NGO/INGO initiatives are implemented with donor funds from different organizations and countries, however, most initiatives are closely linked with government administrative systems. Private initiatives represent the Cooperate Social Responsibility (CSR) type of activities.

Regardless of the implementer, all CBA activities involve investment of money, time and other physical resources therefore, its sustainability is quite important.

However, over the years many of these CBA programmes failed in the long run. There are many factors for such failure. Financing is a constant challenge, but programmes have derived many mechanisms to deal with money issues such as local financing, and may be putting in voluntary labour. Another major limitation of these programmes is the failure to understand factors that determine people's willingness to take part in CBA initiatives. As mentioned earlier, the wiliness to take part is a major determinant of the sustainability of the programme. Without the willingness to undertake and sustain adaptation related activities, any CBA programme will have limited success. When project funds are depleted, the initiative could collapse due to lack of community participation. Even though CBA programmes are built on the voluntary participation of target community, little attention has been put to identify the factors that determine people's wiliness to take part in CBA initiatives. Therefore this research aims to address the research problem "what factors would determine the people's wiliness to take part in CBA activities in Sri Lankan agriculture sector, with a special emphasis on paddy farmers".

Main objectives of the study

This research is comprised with a one main objective and two sub-objectives. The main objective is to evaluate the factors that determine people's wiliness to take part in Community Based Adaptationstrategies. It has two sub objectives: (1) to identify the factors that could determine people's wiliness to take part in Community Based Adaptationstrategies through literature and expert consultations, and (2) to provide policy recommendations to project implementers on the sustainability of CBA initiatives. The main objective of this research will be identified through an empirical investigation. The first sub-objective is based on literature survey and Key Informant Interviews (KIIs), and will help to identify the factors that could determine the people's willingness to take part in CBA initiatives in the paddy farming sector of Sri Lanka. The second sub-objective is based on the findings of the main objective, after the identification of statistically significant factors that determine the people's wiliness to take part.

Research Methods

Paddy is cultivated in all parts of Sri Lanka. However, the extent of cultivation varies a lot between farmers and in different ecological zones. Sri Lanka is highly ecologically varied and different regions of the country experience impacts of climate change differently. Some regions experience frequent drought and longer dry spells, while in other regions heavy rains and floods can disrupt farming activities. Therefore, staying within the scope of the study and representing all different segments, this research focuses on paddy farmers, living in the major rice producing areas of the country, and was victims of both heavy rains and droughts time to time. Therefore, to address the research problem, three farming communities were selected from Ampara, Puttalam and Pollonnaruwa districts. Each district is comprised of many

GramaNiladharidivisions (GNs or village administrative units). However, from each district, the main paddy producing GN was selected as the sampling area. For each GN, a list of paddy farmers was obtained. Then, by applying the stratified random sampling to account the gender of the head of the household, 50 paddy farming households were selected from each GN division. Therefore the total sample was 150 faming households who are actively engaged in paddy farming.

Data was collected using both qualitative and quantitative methods. An interviewer administered, survey questionnaire was used to collect quantitative information from paddy farming households. In addition, six Focus Group Discussions (FGDs), two per farm locality was carried out to verify the findings of the quantitative analysis. The data was analyzed using a probit regression analysis where the dependent variable is the "farmer's willingness to take part in CBA initiatives".

The main question in the survey is the "willingness of the paddy farmer to take part in the CBA programme". This was captured as "Yes"/"No" answer. The main question represents the dependent variable of the regression model employed. Since the dependent variable is a dichotomous variable the regression model employed takes the form of a "probit model". Rest of the variables explained earlier represented the independent variables. The regression analysis ran with 150 observations. Probit model regressions were corrected for co-linearity and heteroskedastic probit model was ran to correct for heretoskedasticity.

Results

As mentioned, many socio-economic factors, psychological and institutional factors could affect the people's wiliness to take part in the CBA programmes.

According to the findings, farmer's willingness to take part in CBA initiatives are significantly based on the psychological factors such as awareness of climate change and its impacts, past experience of climate change impacts, farmers own risk perceptions, whether farmers have their own coping strategies and awareness of farmers on the geographical characters of the location. The probability of paddy farmer's willingness take part in CBA activities would increase by 16.7% if they were aware of the climate change and its impacts. Awareness of climate change and its impacts will enable farmers to be more interested in fighting against climate change issues, thereby participating in CBA initiatives. The probability of paddy farmer's willingness to take part in CBA initiatives will increase by 14.5% if the farmers have past experience in the climate change events. Just as much as awareness, experiencing adverse effects will push farmers to be more vigilant and interested in fighting against these impacts. Farmers can be risk takers/lovers, risk avoiders or risk neutral. Farmers who are risk lovers would not take CBA seriously and continue with their normal farming routines since they would not perceive climate change and impacts as a risk. However, farmers who are risk averse, would be more cautious about the climate change, thereby would be interested in taking part in CBA initiatives. Therefore, explaining this, the probability of farmers willingness would go high by 9.3% of the farmers is a risk adverse person compared to a risk lover/taker or risk neutral person. The probability of willingness increases by 6.2% if the farmers are already engaged coping mechanisms against climate change impacts such as unseasonal rainfall, flood and drought. A farmer has to be interested in fighting these impacts, in order for him to have coping mechanisms established. Such farmers will be more interested in new initiatives such as CBA. Furthermore, the probability of willingness would increase by 24.1% when farmers are more knowledgeable about hazards pertaining to their geographic location. When farmers are aware of risk profiles, they are more interested in being prepared and managing the risks. These risk profiles are now available for paddy farming areas of the Sri Lanka prepared by the Disaster Management Center (DMC) of Sri Lanka. However factors such as; farmer attitude towards community participation, farmers' perception of the future of paddy farming industry in their locality and the number of coping mechanisms available did not increase the farmer's willingness to take part in CBA activities in any statistical significant way.

Additionally the willingness to take part significantly depended upon socio-economic factors such as educational level and average income of the head of household. Higher education would allow people to be more vigilant and make informed decisions hence they would be more interested in climate change and CBA initiatives. Higher education will also enable farmers to be more connected with the outside world, regularly interact with media and have informed discussions with other fellow farmers. As suggested by the results, the probability of willingness to take part in CBA initiatives would increase by 34.9% when farmers are more educated, especially if they have an education which is at or above Grade 10. Results also suggest that the probability of willingness would increase by 12.3% when a farmer's average monthly household income is increases. Farmers with higher incomes would be more environmentally conscious since he is not battling through poverty. Therefore they also would be more interested in climate change and CBA initiatives. To a certain degree, these two factors are interrelated. A higher education could provide the foundation for a farmer to have a higher earning potential. However, at the end of the day both a higher education and higher income would increase a farmer's willingness to take part in the CBA initiatives. However, other socio-economic factors such as occupational category, whether farmers have a secondary income source, family size, gender of the head of the household , farm land size and number of years at farming did not have any statistically significant relations to the dependent variable: the farmers willingness to take part in CBA initiatives.

Furthermore, institutional factors such as strong local institutions and their helpfulness also significantly influence the farmer's willingness to take part in CBAs. Strength of the institutions would provide political will and institutional capacity in terms of financial, human and physical resources. People would have more trust and believe in such organizations. However, organizations must be supportive of rural communities. Once such support is established, people have more trust and are interested in initiatives such as CBA where local institutions must be actively involved. As suggested by the results, the probability of willingness to take part in CBA initiatives would increase by 11.2% and 4.3% respectively when farmers have strong institutions to help them and at the same time, when these institutions are actually helpful. However, other institutional factors such as number and the types of institutions did not have any significant relationships with the willingness to take part in CBAs. All the findings of the quantitative analysis were confirmed by the findings on the qualitative FGDs.

Conclusions and Policy Recommendations

Farmers' willingness to take part in adaptation initiatives is a significant determinant of their sustainability. The willingness to participate depends on a number of psychological, socio-economic, and institutional factors. Hence proper identification of these factors is very important to the project planning process. It is not practical for a project to identify and satisfy all the factors that are important. However, there should be some attempt to identify if the community composition, structure and condition meet these criteria, as it could be quite crucial in guaranteeing project sustainability. A community consultative process is essential to see whether factors identified by this research are in place. In doing so, CBA initiatives can be successful in terms of high rate of participation and in terms of sustainability.

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5.4 Community-based Adaptation to Climate Change in Kalmunai

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The consequences of climate change are increasingly challenging the daily lives of communities in Sri Lanka. The poor are particularly vulnerable to the effects of climate change, such as floods, droughts and other extreme weather events. Communities must be educated, empowered and prepared to cope with climate change impacts through assisting to build their adaptive capacity and enabling the use of their own knowledge and experience in their decision-making processes.

'Community-based' initiatives do not mean that adaptation should operate solely at the community level. These initiatives should be mainstreamed into existing institutional systems to make appropriate decisions based on best available knowledge and technical information. This will help strengthen institutional policy frameworks and thereby integrate adaptation issues into national development planning and legislative processes. The purpose of this paper is to describe the results of a project being implemented to enhance social mobilization and preparedness initiatives for disaster management within the urban local governance structure in Sri Lanka.

The project "DISASTER RESILIENT CITY DEVELOPMENT STRATEGIES FOR SRI LANKAN CITIES" funded by the Government of Australia (AusAID) is being implemented by UN-Habitat in 4 cities. The project is being implemented in collaboration with University of Moratuwa, Urban Development Authority and the Disaster Management Centre in order to: a) conduct disaster vulnerability mapping and assessments which help identify the disaster-prone regions in the city; b) develop a disaster resilient strategy and action plan for the city; c) build the capacity of local authorities; d) conduct social mobilization and preparedness initiatives for disaster management in local urban communities.

The project has recognized the necessity of strengthening the existing Disaster Preparedness Committee system at GN Divisions and at the city level by coupling the existing system with community level animator teams and enhancing community awareness and disaster preparedness.

Rationale behind social mobilization and preparedness initiative

Disaster management is traditionally concerned with the preparedness for centralized emergency responses from a central government governance structure. Local resources are generally untapped and communities have always been treated as victims of climate change impacts and disasters. Unlocking the potential of the communities through well-structured community based mechanisms will provide local resources for city councils to increase the level of responsiveness to climate change and lower the level of disaster risk.

The community action

This program is based on active involvement of the local government authority, the Divisional Secretariat, Department of Education, civil society organizations and all communities living in the disaster prone areas. It is conducted as a coordinated social mobilization effort with the involvement of four levels of participatory and interactive approaches: 1) City Environmental and Disaster Preparedness Committee headed by the local government/ Municipal Council; 2) Environmental and Disaster Risk Reduction Committee led by the Divisional Secretariat; 3) DRR Committees at GN division level; 4) Lane Committee for every 150-200 households which encompasses the entire urban population living in the identified disaster prone areas. This will help provide a formulated plan of action and structure when facing problems.

The project supports the Local Authority to make the Environmental and Disaster Preparedness Committee (EDPC) a statutory body/standing committee in the council to ensure its sustainability. The EDPC meets at least once a month under the joint leadership of the Mayor and the Divisional Secretary. The committee will plan, manage and guide the environmental and disaster management initiatives and social mobilization activities implemented at city and community levels. The EDPC will guide these initiatives through three channels: the community channel, civil society organizations channel, and the school channel by approving and directing the plans of action adopted by each channel. This paper discusses the community channel and its operational structure.

Social Mobilization Methodology

Three channels of communication were identified and adopted to raise community awareness on DRR and ensure active participation.

First is the Community Channel that is operative at Grama Niladari (GN) divisions through the Divisional Secretariat and headed by the GN officers who constitute the bottom level arm of the official administrative hierarchy as they have direct contact with the people. The disaster preparedness initiatives and social mobilization carried out by the GN division committees and the lane committees will be operative throughout the GN division or at least in all disaster prone areas in the division. The steps taken under this social mobilization process are as follows: a) Set up lane committees for every 150-200 houses within the GN division with a social animator for every 25-50 houses and select a chairman for the committee from among the social animators; b) Establish a community welfare society for every GN division. Presidents and the secretaries of the lane committees will become the members of this committee; c) Formulate training module on community leadership and disaster preparedness;, d) Select 6 trainers to train social animators from the city and conduct training; e) Train the animators through such trainers; f) Social animators to share their knowledge with the households; g) Guide the GN division level committees and empower the GN officers to conduct monthly meetings of the lane committees on regular basis; h) Systematic progress monitoring.

The Divisional Secretary leads the Environmental and Disaster Risk Reduction Committee on the recommendation of the District Disaster Management Committee. This committee meets once in 3 months and reviews the progress of the disaster preparedness and environmental initiatives of the GN division level committees.

The Environmental & DRR Committee will be created in every GN division level. It will meet once in 2 months and make a progress review of environmental, DRR and other community needs with a view to strengthening the disaster preparedness initiatives. The membership of this committee will consist of the presidents of the lane committees (secretary's may represent when presidents are absent) and five other leading citizens of the area appointed by the Divisional Secretary. Under the direction of the GN Division Committee and the guidance of the GN officer, a Lane Committee will be established for every 150-200 households. This committee will meet monthly and review the disaster preprepardenss needs and other

development needs of the community. It is desirable for the GN Officer to examine the minutes of the committee meetings regularly and seek solutions from the relevant authorities and state agencies for issues raised by the community.

The membership of the lane committee will comprise of the representatives selected from every 25 houses located linearly in the adjacent lanes/streets. They will be trained as social animators and work on a voluntary basis. It is important that the objectives and terms of reference (TOR) are clearly and specifically defined for all these committees to avoid probable misunderstandings. The secretary of the committee must maintain a record book showing the progress of the implementation of recommendations. Similarly, every social animator should maintain a record of recommendations and their progress.

The cooperation and coordination between the Local Authority and the Divisional Secretariat is essential, as the LA does not have a direct authority over the GN Officers as they are under the purview of the Divisional secretary.

The training methods used are simple documents while the materials are uncomplicated and easily intelligible to the average person. The training methodology adopted took into account the following considerations: Focusing attention on a common goal and product; Enabling participants to bring their expertise, experience and insights and thereby enhancing the quality of the adopted approach; Mutually sharing knowledge and experience; Tapping diverse views before reaching consensus leading to creative problem solving; Promoting interactive & participatory approaches giving participants opportunities to apply their skills. A video documenting disasters, causes of disasters and what should be done to avoid impact of disasters on life and property is used as the main training material. The management hand book/ trainers guide introduced is only for general reference and can be typically applicable to all situations. Therefore, the training material used can be adapted to suit specific local conditions based on the experience of local populations and information received from them.

Conclusion

It has been proved in many instances that technological and management excellences alone are not adequate and perhaps of no use unless social awareness and community preparedness needs are sufficiently addressed in disaster preparedness initiatives. Sharing responsibility at a community level and ensuring their active involvement is vital. The Lane Committee system is an effective solution to enhance community involvement. The overall aim of the lane committee system is to support the local authorities in developing and strengthening their own structures and approaches for preparedness in conjunction with the other agencies mandated for disaster risk reduction. It will invariably create a strong and low cost human resource base of well-trained voluntary and committed social workers prepared to take the lead and be on alert. Thereby improving the overall effectiveness and efficiency of the disaster preparedness initiatives. Finally, the Local Authority, as the owner and the operator of the system must adopt a council resolution and set up a standing committee on environment and disaster preparedness recognizing the role and the importance of the lane committees in order to implement a sustainable, efficient and effective lane committee system.

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5.5 Climate change adaptation by small-scale farmers dealing with water scarcity in Moneragala and Hambantota Districts in Sri Lanka

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1. Introduction

Countries with strong agricultural roots are especially concerned about impacts of climate change due increased susceptibility. Across the world, small scale farmers struggle with climate change impacts compounding already fragile livelihoods, shortage of land and water scarcity. Situation in Sri Lanka is not exceptional. Even after the introduction of a series irrigated resettlement schemes, small scale farmers in Sri Lanka face water scarcity. This has been recognized as one of the limiting factors in agricultural development in many regions of Sri Lanka. In the past, building new physical systems to harness water resources has been the common policy. However, with the increase in demand by other than agricultural users as well as harmful externalities of irrigation becoming apparent, emphasis is now being placed on the need to improve the performance of existing irrigation systems and maximize the usage of water at the individual frame level.

Globally, efficient and sustainable management of water resources is increasingly becoming a policy objective. There are several factors to be considered in the efficient use of water to improve agricultural productivity and livelihood of the families those who are dealing with water scarcity. One of the key decisions is how much water should be allocated to a particular crop in relation to other crops. This decision needs to be based on their strategy on climate change adaptation, quality and availability of water resources, reliability of water supply, physiological requirements of the crop, and the expected value of the crop output. A frequently followed irrigation strategy is to apply water at a level that gives maximum net income to the grower. Adoption of modern water-saving irrigation technology such as subsurface drip system is often cited as a key to increasing water use efficiency while maintaining current levels of production, particularly at the small scale farmer level. Furthermore, efficient water management in agriculture can help to reduce hunger and poverty in the developing world. It benefits both the rural and urban poor. However, most developing countries lack the capacity to enable their farmers, smallholders and other stakeholders to make use of the technologies available and to realize the benefits of irrigation.

Thus, this study examines how small scale farmers in Moneragala and Hambantota Districts are dealing with water scarcity and adapting to climate change through water management. This system was introduced by the Ministry of Agriculture Development under the Sustainable Agriculture Water Management Project (SAWMP) to enhance climate change adaptation by small scale farmers dealing with water scarcity. The project also invested in drainage management and water harvesting technologies to reduce rural poverty, increase food security and enhance environmental sustainability

in the dry zone of Sri Lanka. The paper consists of four sections including this brief introductory note on the importance and current context of drip irrigation in relation to climate adaptation. The second section provides a comprehensive overview of the available literature on subsurface drip system as a strategy for climate adaptation. The third section presents the data and the method used in the study, while, the fourth section presents results and discussion. The fifth section provides the concluding remarks.

2. Subsurface Drip System as a strategy for climate change adaptation: A Review of Literature

Increasing agricultural productivity and income of the majority of small scale farmers in developing countries who are dealing with water scarcity, most of who cultivate less than one hectare of land, is a relatively untapped opportunity for finding practical solutions to rural poverty (IDE 2002). In fact, opening smallholders' access to affordable small plot irrigation can be a critical first step to wealth creation for the rural poor, and a considerable literature documenting their success has already been developed (Shah et al., 2002; Mehta 2000: Hurdec 2000; Postel et al., 2001; Polak et al., 1998; Shah and Keller 2003). One prominent example of smallholder irrigation technologies is subsurface drip. Drip-irrigation in the developing country context generally refers to the slow application of water through a set of emitters (holes) placed along water delivery lines precisely at the root zone of the plants. Water is supplied to the lines via drums, which can be filled by hand or other means. Drip irrigation is often associated with vegetable production for self-consumption and sale. Drip-irrigation systems can fill an important technology gap for the rural poor by providing a low-cost entry into irrigated agriculture.

Tognettiet al. (2003) determined that drip irrigation positively influenced many of the physiological processes and technological parameters in semi-arid conditions, as compared to low-pressure sprinkler irrigation. Hanson and May (2004) obtained yield increases when drip system were used compared to the sprinkler systems with similar amounts of water applied ; additionally, drips systems reduced percolation below the root zone. Another study analyzed low-energy precision application (LEPA) and trickle irrigation for cotton in Turkey, concluding that both irrigation systems could be used successfully under the arid climatic conditions of this country (Yazaret al., 2002). In contrast to large-scale irrigation systems, which are typically developed in more favorable agricultural areas populated by more well-endowed farmers, drip-systems can be accessed by the poorest and most vulnerable strata of society, particularly women. Most of the literature available on drip-irrigation technology (Sarkar and Hanamashetti 2002; Narayanmoorthy 2004; Naik 2002; Phansalkar 2002; Foltz 2003) has so far been focused mainly on its hardware aspects. However, irrigation technology has made significant advances in recent years. Criteria and procedures have been developed to improve and rationalize practices to apply water, through soil leveling, irrigation system design, discharge regulations, adduction structures, and control equipment. However, in many regions these advances are not yet available at the farm level.

Yadav and Mathur (2008) observed that, with the tested model the water extraction is closely related to soil moisture availability in addition to the root density, which occurs normally from the upper root dense soil profile. Playán and Mateos (2006) reported that in general all irrigation systems can attain approximately the same level of efficiency, when they are well designed and appropriately selected for the specific condition, due to the fact being that irrigation is spite specific. However, differences among irrigation systems appear in many areas as a consequence of design, management and maintenance. Thus, it should be noted that the design, managing, and operation of any irrigation system is crucial to achieve efficient use of the water resources and success in the production of crops and orchards. Water required for crops is supplied by nature in the form of precipitation, but when it becomes scarce or its distribution does not coincide with demand peaks, it is then necessary to supply it artificially, through irrigation. This may be the reason why most of the recent developments in both the policy arena and climate impacts research community point to a growing interest in human adaptation to climatic variability and change. The

Importance of adaptation to climatic changes is affirmed in the Intergovernmental Panel on Climate Change (IPCC) Technical Guidelines for Assessing Impacts and Adaptations and the IPCC's more recent Second Assessment Report. Yet, the nature and processes of human adaptation to climate are poorly understood and rarely investigated directly.

3. Data and Methods

The study used a sample of 1000 small scale farmers all of whom received agricultural water from the Subsurface Drip System introduced by Ministry of Agriculture Development under the Sustainable Agriculture Water Management Project (SAWMP) to enhance the practice of climate change adaptation by small scale farmers dealing with water scarcity in Moneragala and Hambantota districts. A stratified random sampling technique was adopted in selecting this sample. In selecting beneficiaries for the sample, the emphasis was on location, size of the farm, crop cultivated as stratum and sub stratum respectively. In view of the objectives set forth for the study, three data gathering instruments were employed to collect sufficient data needed to assess the objective stated above. These data collection instruments were: (i) a semi-structured questionnaire used to interview households selected for the sample while (ii) focus group discussion and (iii) interactive group sessions held to solicit information from beneficiaries, especially qualitative information that would be useful to supplement the results drawn from descriptive and more inferential statistical analyses. The semi-structured questionnaire used in this study consisted of nine sections: i.e. demographic features of the household, household assets, income generating activities of the household, condition of house (structure, water supply, electricity, sanitary facility and communication facility), and source of income and expenditure pattern of the household, savings/borrowing and social interactions.

In addition, relevant supporting documents and secondary data sources were also explored to supplement as well as to check authenticity of the data gathered. Wherever necessary, observations were made to assess the physical improvements made to the household and businesses. In order to test the significance of changes in expenditure pattern in terms of expenditure categories such as children's education, food consumption, electricity, telephone, LP gas, fuel or firewood as an energy source, medicine, entertainment, clothes, social activities, loan repayment and unidentified other expenditure were tested using paired "t" test. As the same respondents were asked to recall the baseline information through the interview, it was deemed appropriate to use paired "t" test to test the change in expenditure as the same respondent provided the information on, before and after situations. Paired "t" test analysis was extended to investigate any significant difference between average income generated from male managed farms before SAWMP and after SAWMP and female managed farms before SAWMP and after SAWMP situations. The independent "t" test was used to test any significant difference between average annual income generated by male headed farms vs. female headed farms through comparing average annual income generated before SAWMP and with SAWMP assistance.

The descriptive statistical analysis was adopted to carry out a cross tabulation in order to classify the households selected for the study based on demographic characteristics of the household leader and geographical distribution. The geographical distribution of the households was classified into two districts. With a view of understanding the demographic characteristics of the household leader; the age and educational level are grouped in to five scale group classes. The majority of the households are headed by male respondents both in Monaragala and Hambantota districts. The majority of household leaders attended school up to grade 10 in both districts and comparatively lesser number of household leaders are qualified with O/L and above. As far as household leader's age group was concerned the majority of household leaders belonged to age group 31- 40, followed by age group 41 – 50. The data shows evidence that among the age groups of household leaders, the majority of farmers belonged to middle age compared to other age groups.

4. Results and Discussion

It is observed that SAWMP has improved water use efficiency while improving livelihoods. However, despite the rapid adoption rate of drip-technology in the recent past, in developing countries the technology is nascent and poorly understood. The Situation in Sri Lanka is no exception. Despite the positive results shown here, farmers in most areas have been reluctant to adopt this technology even when financial resources are available. Thus there appears to be a gap in the basic understanding of the technology and its uses among most farmers, especially the poorest. One solution to this problem is facilitation through information on improved agriculture and new technology. The other would be the incorporation of user perception into policy and decision making in rural agriculture. In the present study, it was observed that the vast majority of respondents (84%) agreed with the statement that adoption of the drip system helps generate more income than other available livelihood options. Likewise, the majority (67%) explained that their workload has not been increased but instead hours spent on fetching water have significantly declined. The majority (75%) of respondents agreed with the statement that women are more involved than men in vegetable farming under drip irrigation. A summary of user perception is presented in Table 1.

Table 1: Perception on the drip-irrigation technology

Statement	Agree	Neutral	Disagree
Adoption of drip technology helps generate more income than other available livelihood options for women	111(84)	10(8)	10(8)
Credit or subsidy should be provided to new adopters	131(100)	00	00
Women are more involved than their male counterparts in vegetable production under the drip system	98 (75)	27(21)	6(4)
Adoption of the drip-irrigation technology has not increased women's work burden	88(66.7)	27(21)	16(12)
Drip irrigation technology brought changes in the daily vegetable intake	66(33.3)	43(33.3)	00

The overall findings of this study observed that an expansion of this project is imperative. But the study also observed few drawbacks of this project: They are (1) Deficiencies in terms of appropriate design; (2) Process of demonstration, training, awareness and evaluation did not yield the same level of achievement for drip as compared to sprinkler; (3) Difficulties in adapting the new techniques by farmers; (4) Loan repayment by the farmers are not at an acceptable level. It is concluded that there is an urgent need to enhance knowledge amongst all parties and bridging the gap in the efficient application of the new techniques. It is believed that the lack of farmers' confidence in the modern techniques is due to an inherent fear of sophistication, lack of knowledge, and perception of high cost. Thus, the next phase of a project of this nature should be able to address above mentioned drawbacks and results of this study into consideration, look at issue from different angles, and apply a differentiated approach. It should be focused on drip irrigation as an ideal solution for water saving in critical basins with small land sizes and vegetables/horticultural crop patterns. There should be more effort to making drip technique affordable by marketing off-the-shelf kits are easy to install, operate and maintain. Developing and marketing a lower price micro-irrigation product aimed specifically at the poorer farmer can be expected to overcome the problems of state and federal subsidy systems. However, such an approach cannot be 100 per cent reliant upon commercial forces and the approach, therefore, should not be purported as such. Major reliance is placed on local extension service staff and other agencies, and these, in turn, are reliant upon donor funds.

SAWMP does not sell itself. The investment in personnel and marketing is very large and relies on the support of Local Authorities in the area, local NGOs, Multipurpose Cooperative Societies, village level welfare organizations, at least to reach the poorer farmers.

5. Concluding Remarks

In this study it was observed that the introduction of subsurface drip system as a strategy to climate change adaptation for small scale farmers those who are dealing with water scarcity in Moneragala and Hambantota Districts made a difference in a positive way. In order to determine the extent of benefits incurred for the household, qualitative and quantitative data was being used. Since impact measurement is sensitive to the estimation methodology, a Focus Group Discussion and detailed case studies as means of complementary information sources were being used... Results showed that interventions made a significant difference to the beneficiary's household in increasing per capita income, change in consumption pattern as well as household net worth, and as a whole improved the livelihood condition of respondents. The welfare impact on household as a result of the growth of farming income is a major contributory factor for household improvement. It indicates that interventions have definitely benefited the study population beyond income redistribution and income growth towards savings, investment and asset accumulation. However, the research has shown that there are number of issues concerning the marketing approach and its appropriateness to extending micro-irrigation technology to the poor, as described below:

- Currently there is no conclusive evidence of the market for drip technology sustaining itself after the SAWMP facilitator pulls out;
- There are a large number of specific enabling conditions that must be in place before SAWMP can be delivered to the poor as a poverty reduction mechanism;
- It is not adequate simply to deliver the technology to the user. The user must be supported and trained in using it to take the greatest advantage of a whole new farming system.
- The technology offers greater benefits and is more attractive when used to irrigate larger areas usually owned by the better-resourced farmers (still poor, but not the poorest), or occasionally by groups of poorer farmers who have substantial collective financial resources. So customized kits and pressurized systems, more akin to conventional drip technology may see wider adoption using the market approach than small drum and bucket kits, provided the context is right;
- From the Indian and the Zimbabwean experience (and knowledge of similar findings in other African states; Winrock et al., 2000) drum kits are not perceived by farmers to offer sufficient benefits over existing practice to merit farmer investment;
- The emphasis on market forces being the driver and disseminator of technology however is slightly misleading, at least in the initial phases. A facilitator must maintain a presence for at least 5 years to create and sustain an effective marketing chain. The cost of the facilitation is generally not covered by technology sales and therefore represents a need for subsidization.

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5.6 Organic Tea Cultivation as Adaptation Strategy: A Case Study in Rural Small Holder Tea Community in Galle District

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Introduction:

Tea is a perennial crop grown in a wide range of agro ecological conditions which demands quite specific requirements and closer attention. These include special soil conditions, shade management, soil and moisture conservation practices, manure application, other Good Agricultural Practices (GAP's) etc., as recommended by the Tea Research Institute. Field grown tea is also highly physiologically responsive to stress conditions, including cultivation practices such as weekly plucking and cyclic pruning and resultantly affecting its yield, quality and sustenance. The stresses get aggravated by changing weather especially rainfall and air temperature and other crop and land management factors.

Organic agricultural concepts and principles have emerged to ensure ecologically sound, environmentally friendly and socially just systems (www.ifoam-eu.org). Resultantly, specific international markets sought organically certified tea. Sri Lanka pioneered in producing and exporting organic tea in the world with large tea plantations, which later expanded to small holders. The country gains additional price premium in the international markets and benefits to producers, processers and workers of both corporate and small holder sector in the value chain while providing a vast quantum of ecosystem services.

The system sustainability in organic tea cultivation is guaranteed according to organic agriculture principles through ensuring soil, water, areal, crop and animal sustenance as per IFOAM standards, compulsory adoption of non chemical practices, recycling of resources, activation and conservation of biodiversity, strengthening of GAP's and social welfare facilities etc. (Anon., 2011). Sri Lanka has provided an immense amount of lessons learnt from organic tea cultivation in both small holder and large plantations being pioneering organic producers in the world. In addition, scientific validations have been made. Potential harnessing of non chemical methods and practices, opportunities in resource recycling, activation and conservation of areal and soil biodiversity components, improvement of health and welfare of workers and market benefits for organic and biodynamic teas thorough price premium are among them. Awareness, practical limitations in input production and utilization, cost incurred on production, processing and certification have been recognized as barriers to organic tea production in Sri Lanka.

Climate change is a phenomenon which is making impacts in agriculture. In the recent past, most developing countries including Sri Lanka experienced various ill effects of climate change on crop establishment, yield, pests and diseases, economy etc. (Wijeratne, 1996,De Costa, 2008, Mohotti, 2009). Murdiyarso (2000) and Lillian et al., (2010) discussed various biotic and abiotic impacts on agriculture in the western countries. According to Wijeratne (1996) and Mohotti (2009), the climate change effects in the tea industry are significant but the studies are limited. Further, organic farming and small holder and subsistence farming systems have not been studied exclusively except in Africa (Anon., 2011). Hence, the present study was undertaken as a case study to explore the status in small holder tea growers exposed to organic farming for a few years in adaptation potentials against climate change.

Methodology:

As a case study, growth and yield of organically maintained twenty (20) small tea holdings of tea extents below 0.5 ha were compared with that of conventionally grown tea lands in Baddegama area in Galle District (Agro ecological zone: WL4) during the period 2008-2011. 15-20 years old tea cultivars (TRI 2026 and 2027) which are highly responsive to stress conditions have been exposed to organic farming from 2008 onwards.

For data generation, special emphasis was given to weekly green leaf harvest and post prune recovery of the crop in order to study the response of the two systems to most vulnerable physiological stresses in tea under significantly changing climate parameters. Weather data during 1981-2010 were also monitored.

Results and Discussion:

Weather changes in Galle area:

On an analysis of the weather pattern in Galle region of Sri Lanka during the last three decades (separated into 1981-1990, 1991-2000 and 2001-2010 regimes), it was evident that rainfall and maximum air temperatures have been highly erratic compared to 1981-1990 decade over 1991-2000 and 2001-2010 regimes. The total amount of rainfall did not significantly change over the years (Figure 1). However, the number of wet days has decreased compared to the 1981-1990 period (Figure 1, see arrows) and the rainfall appears to be ill-distributed in the latter years. The wet months appeared to be wetter (May and September-October) compared to the 1981-1990 period.

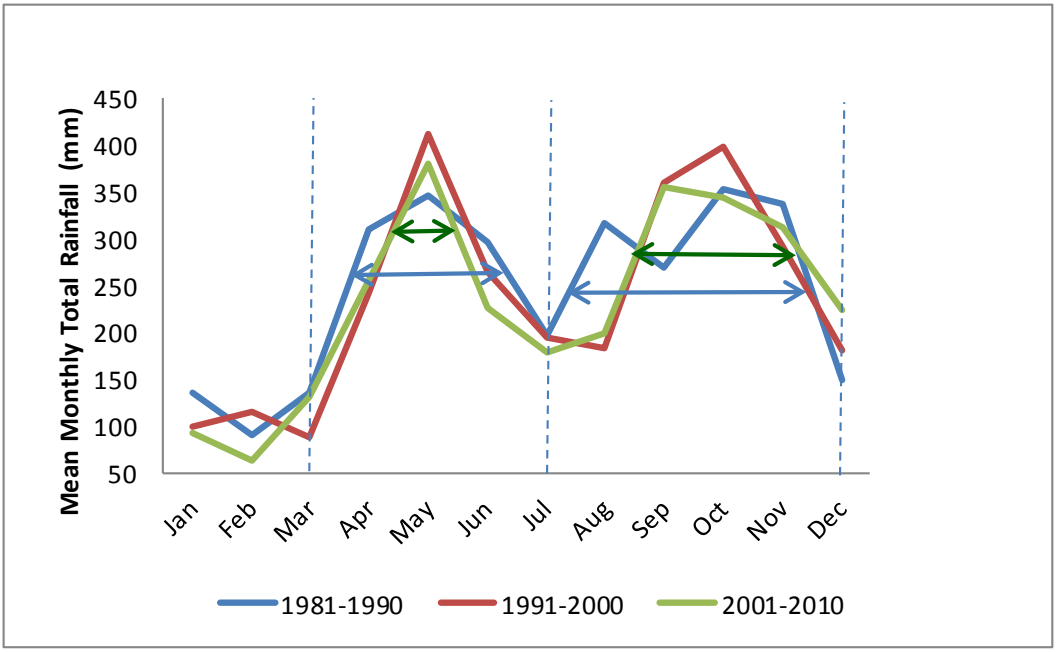
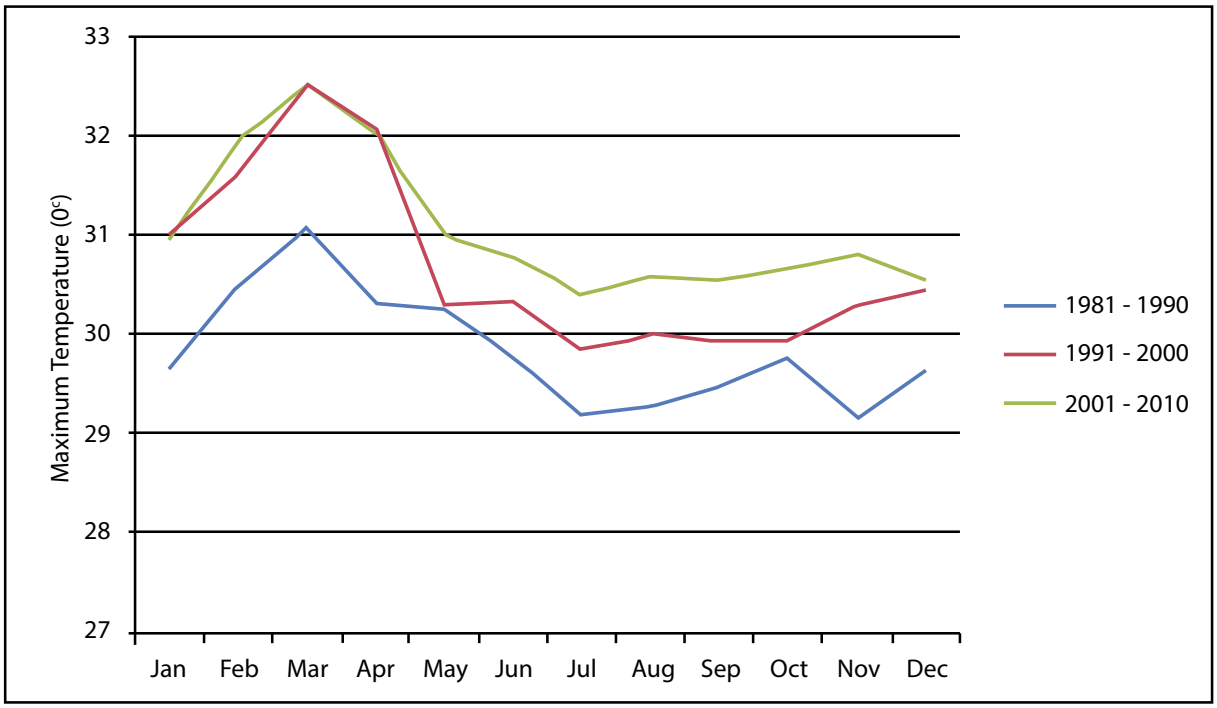


Figure 1 Changes in Rainfall Pattern in Galle Region during 1981-1990, 1991-2000 and 2001-2010 regimes.

In contrast, the monthly mean air temperatures have increased by 1.22 0C for the period 2001-2010, as compared to the period 1981-1990 (Figure 2).

Figure 2 Change of monthly mean air temperatures in Galle Region during 1981-1990, 1991-2000 and 2001-2010 regimes.

Importantly, the increase in monthly air temperature during January to April were more prominent, which was in the range of 1.32 – 1.69 0C (Figure 3), which will have many consequences on the crop.



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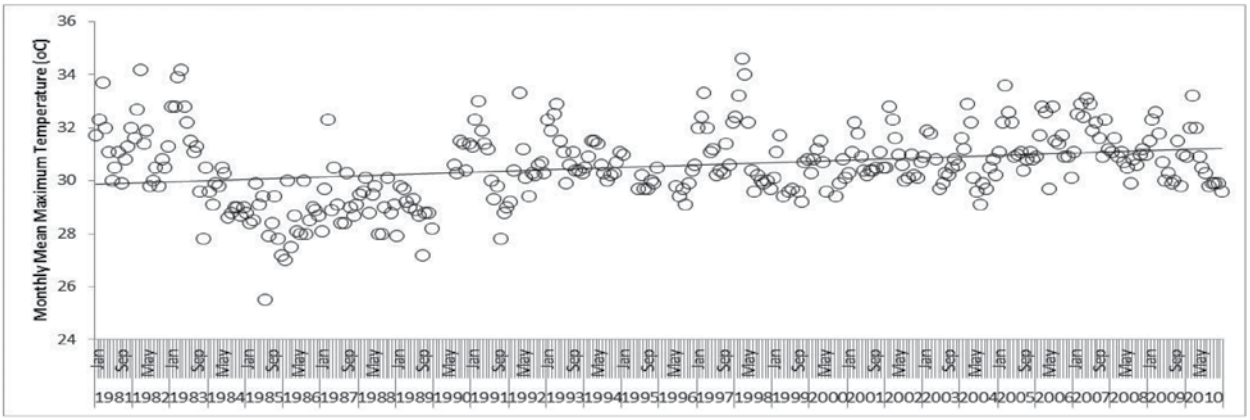

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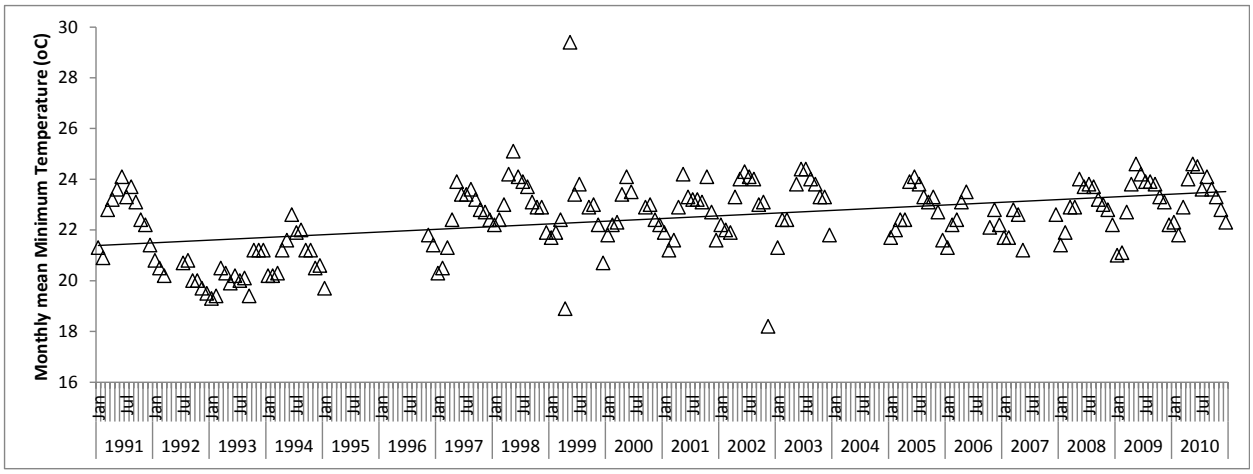

Figure 3 Increasing trend observed in monthly (a) maximum and (b) minimum air temperatures in Galle Region from 1981-2010

Impacts on tea crop:

Such changes in climatic parameters undoubtedly cause negative impacts on crop physiology, sustenance and thereby overall growth and crop yields. These were more prominent especially with the predominantly grown tea cultivars TRI 2026 and 2027, which are highly responsive to stress conditions.

Nevertheless, organically managed tea appeared to adapt better by exhibiting healthier plants, better recovery after pruning and higher yield responses (i.e. higher green leaf per ha basis) compared to that under conventional tea system. Early and satisfactory recovery from pruning stress and higher yields were seen as indications of improved ability to succumb to biotic and abiotic stresses in sustaining growth compensation. Systematic crop, soil and land management and manipulation practices adopted during in - conversion to organic in the year 2008 and organic cultivation from year 2008 onwards were identified as attributes to help withstand biotic and abiotic stresses. Incorporation of organic amendments as alternatives to synthetic fertilizers, improvement of soil organic matter status through composting, green manuring, cover crops etc. and avoidance of synthetic agro pesticides mandatorily imposed and supplemented with time under organic tea cultivation have attributed to improve soil and crop environments. Further, strengthening stands of shade trees and live green belts have given rise to improve micro climatic conditions favorably which resulted sustenance growth under such resource limited conditions and make the tea crop better adapted to such changes in the environment.

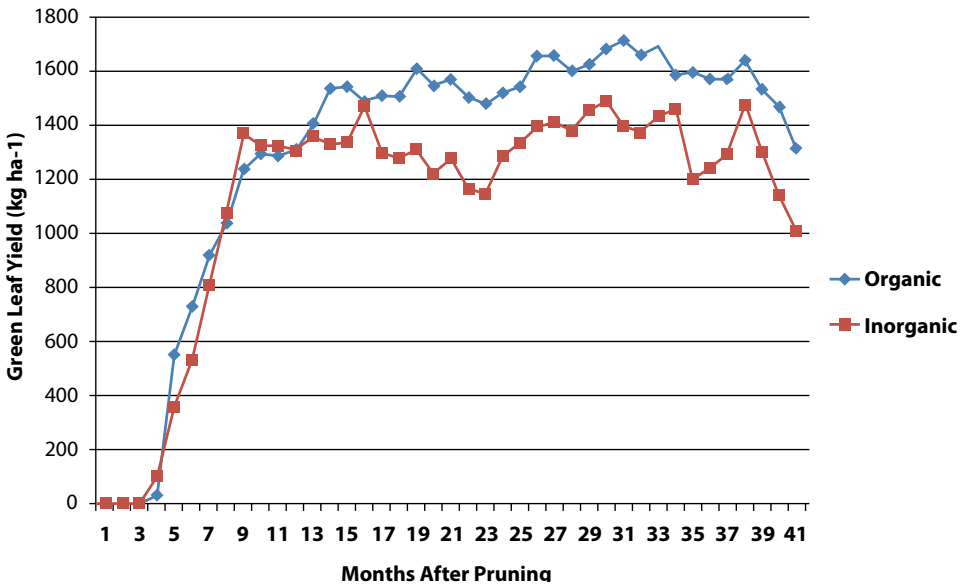

Figure 4 Mean post prune yield response of small holder tea growers (green leaf per ha basis) under organic and conventional practices in Baddegama

Overall, the results of the case study showed higher vulnerability of the conventional systems to climate change. It also showed the capacity and resources in the organic tea cultivation systems as a more sustainable system compared to conventional system, depicting positive responses in sustaining crop yields to climate change impacts and the necessity of amending existing crop, soil and system management practices. Further, our results from organic tea in Sri Lanka added new information on benefits of organic agricultural systems in ameliorating climate change situations reported as reduced greenhouse gasses, sequestering carbon into soil, using less water, reducing soil erosion and nutrient run off and more resilient in adverse weather conditions. However, the evidences based on this community based project studied in the WL4 agro ecological zone should be tested in another few vulnerable locations by exchanging experiences, practices and knowledge.

Earlier research experiences on significant improvements in soil biological, chemical and physical properties, manipulation of crop environment and changes in anatomical, biochemical and physiological attributes, enhanced starch reserves and root architecture, greater dry matter partitioning in tea grown organically in the long term field trials (TRIORCON and BIDORCON trials) will corroborate the lessons learnt in this case study (Mohotti et al., 2001; Mohotti et al., 2008; Mohotti and Mohotti, 2008; Mohotti et al., 2008; Mohotti, 2009).

Climate change mitigation and adaptation measures proposed:

However, we highlight the need to strengthen the system management practices as medium term climate change mitigation and adaptation measures while careful selection of cultivars and lands and avoidance of vulnerable areas as long term measures. Awareness raising at grass root level on climate change and its impacts on crop growth and yields with scientific validations, profit margins and cost benefits of mitigation measures trainings, technical and financial assistance to growers as incentives for adopting specific GAP's. Amongst, harnessing soil and land management for increasing soil organic matter status, increasing green manure banks and amending spacing of low, medium and high shade tree stands, other specific soil erosion control and moisture and nutrient conservation measures to minimize resource wastes etc. would help assist livelihoods while contributing to climate change adaptations in the tea sector.

As impact assessment criteria, we propose to develop sustainable soil and environmental quality indicators in tea such as soil biological and physical parameters, biodiversity components, and root starch levels and architecture, post prune recovery, physiological responses and yield as climate change adaptation indicators. These could be utilized in determining sustainability status of tea under changing climate as well as varying vulnerability levels.

In order for better adaptation mechanisms in organic tea systems to combat the climate change impacts, the sustainable agricultural practices proposed are; soil and land management practices, increase soil organic matter status, increase green manure banks, amend spacing of low, medium and high shade tree stands, soil erosion control and moisture and nutrient conservation measures to minimize resource wastes etc., crop livestock integration, intercropping, vacancy filling with grasses and green manure plants, record keeping and monitoring, energy reduction in the balance value chain: processing, transportation and marketing, price premium through value addition, awareness and training and exchanging experiences, practices and knowledge.

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5.7 Use of suitable crop varieties for climate related hazards

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Climate change is becoming a reality and most of the sectors in the economy will have effects in different magnitudes. Agriculture is one of the most vulnerable sectors since it is mostly relying on climatic factors. With the climate change it is inevitable that the temperatures (both day and night) will increase. Also extreme weather events such as prolong droughts, floods and erratic rainfall distribution will be experienced at a higher frequency than ever before.

Rice is the staple food and any affect on the growth and yield of the rice crop due to climate change impacts will have serious consequence for the livelihood of many farmers in Sri Lanka. Floods in the lower catena of lands with prolong high intensity rains will have serious effects on paddy if they are not tolerant to floods. Floods at the initial stage of crop establishment will either partially or destroy completely the broadcasted paddy crop. Rice research Institute at Batalagoda recently released a variety Bg 455 (DOA, 2014) as a variety tolerant to flood conditions. This can be used to areas where the rice crop is vulnerable for flash floods. Most of the traditional varieties available Sri Lanka were long age (more than 4 months). However the department of Agriculture through its rice breeding stations at Batalagoda, Labuduwa, Bombuwela and Amabalantota have released number of varieties which has short maturity. They can be categorized as ultra-short (21/2 months), shortage age (3 months), and medium age (31/2) months) varieties. These varieties can be used based on the water availability and the season to match in the season to address the effect of climate change. High temperature associate with dry winds can increase the surface evaporation and the salts in the soil can be accumulated in the surface of the soil resulting saline conditions in some of the rice growing areas in the dry zone. The department of agriculture has released number of salinity tolerant varieties which can be accommodated for these paddy field to sustain production.

Food crops other than rice are widely grown in different parts of the country and these crops may have various effects due to the effects of climate change. Crops other than rice include cereals, legumes, condiments, oil crops, fruits and vegetables. Even these crops are not cultivated on lowland, they need adequate soil water regime to obtain maximum yields. Similarly, high temperature conditions will have many negative effects to growth and yield of most of these crops. Apart from these changes of climate increased pest and disease incidence of these crops would further reduce the yield yields.

Field Crop Research and Development Institute (FCRDI) at Maha-Illuppallama with its satellite research stations around the country have developed several short duration crop varieties which can fit to a short season. These crop varieties are either can escape drought by fitting into a short growing season while giving considerable yield or can withstand for periodic moisture stress. Except maize, all the millets are usually requires less water requirement and can fit to any dry spell with little water supply. Legumes are short duration in nature and naturally suits for less water for environment with little effects to the growth and yield. Apart from locally available shortage varieties FCRDI has developed ultra-shortage mungbean variety (MI 6) in year 2004 which requires only 60 days for maturity. This is a good variety which can fit into any short season. Pigeon pea is one of the crops which can grow in water limited environment and can be adopted for climate change without major setback to the yield. Chilli and Onions which falls under the condiments group are vulnerable for moisture stress than all the other crops comes under field crop sector. FCRDI has recently released a short-age red onion variety, "Tinnalveli Red" (DOA, 2010) which is a 60-70 day cultivar giving comparable yield when compared to variety "Jaffna Local" which requires 75- 90 days for maturity. This will be a good candidate under drought or water limited environments. Groundnut and Sesame are the main oil crops grown in Sri Lanka and traditionally they can grow in water limited environments without drastic effect on growth and yield.

Most of the traditional varieties of Cowpea, Millets, and Sorghum have some ability to withstand under extreme weather conditions like frequent droughts within a season. Traditional Kochchi type chilies also perform very well in the all climatic zones of Sri Lanka, especially as a homegarden crop with minimum effect on climate related extremes.

Most of the exotic vegetables are sensitive to high temperature conditions and water stress or excess moisture conditions. Depending on the severity of the event, crops will have complete or partial damage which lead to loss of yield and quality. Horticulture Research & Development Institute (HORDI) has released a heat tolerant tomato variety (Rashmi) and this can be adopted for areas with minor temperature increase. FCRDI, Maha-Illuppallama also has released a heat resistant tomato variety after going through long series of selection process in Kilinochchi district.

There are number of locally grown indigenous vegetables such as Tumba Karavila, Tibbatu etc. which are widely adoptable to both water limited and high temperature environments. These crops can be grown with lesser problems in an event of extreme climate.

Most of the arable fruit crops are sensitive to water shortages and for excess water conditions due to floods. It is very hard to find specific fruit varieties which can withstand without economic loss with extreme climatic events such as drought, floods and high temperature conditions. However, locally available under-utilized fruit crops such as Divul, Veralu, Mora, Madan etc. can withstand under prolong droughts with an average production.

All the responsible research institutes under the Department of Agriculture are now in the process of developing varieties/cultivars for possible climatic hazards such as drought, floods and high temperature situations to meet the challenge of possible climatic hazards due to climate change. Further available germplasm of rice, other field crops and fruits are tested under control environment to select the possible cultivars breeding lines for high temperature and water stress in view of developing varieties for changing climate. Meanwhile, most of the traditional crop varieties and cultivars are capable of performing fairly well under extreme climatic conditions giving reasonable earnings as a means of livelihood until such time that adaptable varieties and cultivars are in place for cultivation.

It is the responsibility of policy makers, researchers, agronomist and finally the farmers to select appropriate varieties with appropriate technologies to minimize the effect of extreme weather events to achieve expected production and productivity from all cultivable crops to meet the growing demand for food in Sri Lanka.

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