

## INPUT PAPER

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### **POLICY SEARCH FOR RESTORATION OF PADDY ECOSYSTEMS IN THE NILWALA DOWNSTREAM AREA AFFECTED DUE TO NILWALA FLOOD PROTECTION SCHEME, SOUTHERN SRI LANKA**

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## **Abstract**

Nilwala River is the major river in the Matara District of southern Sri Lanka, and is 72km in length. Frequent floods and inundation of urban and peri-urban areas resulting in socio-economic impacts are major problems that occur downstream of the basin. In order to address these problems, the Nilwala Flood Protection Scheme was implemented in 1985, by adding flood protection bunds and introducing deeper drainage networks to paddy ecosystems, as well as pumping stations to evacuate the ten-year return floods. In spite of this, the flood protection scheme created new problems for paddy ecosystems due to development of acid sulphate conditions in drying paddy fields after rapid evacuation of flood water from fields. At present, the Irrigation Department has to bear nearly 70 million rupees on fuel alone for flood evacuation from rice fields, creating a conflict situation between the authorities and farmer communities.

The pilot project initiated by ADPC, with financial support of AusAID, helped to study the problems and address the policy issues while mainstreaming climate information applications in order to reduce the vulnerabilities associated with paddy farming. Rallying academia, government institutions, farmer organizations, and local governments under the leadership of the District Secretary to form a management committee has helped in identifying the most effective policy framework. It has also helped with addressing the main issues related to acidity problems through technology interventions and adapting them for farming systems.

Agro ecological studies conducted in the basin by the University revealed that downstream of the basin, ecosystems are often experiencing dry spells within the cropping season. The lack of irrigation provisions to the drying fields results in crop failure due to dryness and associated acidity development. The project established a field research unit for addressing the farmer's needs through participatory approaches, where academics, students and farmers came together to undertake pilot demonstrations. The project findings will be integrated into the relevant post-graduate curriculum on Disaster Management (DM).

## 1. Introduction

The Hyogo framework for action 2005-2015, ([www.unisdr.org/we/in/eng/hyogo](http://www.unisdr.org/we/in/eng/hyogo)) emphasizes the need for systematic integration of disaster reduction measures in policies, plans and programs for sustainable development and poverty reduction, through bilateral, regional, international cooperation including partnerships. Poverty reduction, good governance and disaster reduction are mutually supportive and complementary interventions to achieve aforesaid goals. Therefore, accelerated efforts must be made to build the necessary capacities at the community as well as at sub-national and national levels to manage and reduce the increasing vulnerabilities and risk to natural disasters.

Motivating and involving people in all phases and aspects of disaster risk reduction, as well as relevant activities concerning the respective local communities has been emphasized as a priority and a proactive approach in disaster risk reduction practice. The specific gaps and challenges identified in these areas are Governance, Organizational and Policy Frameworks, Risk Identification, Assessment, Monitoring and Early Warning, Knowledge Management and Education, Reducing Risk Factors and Preparedness through Effective Response, Risk Treatment and Recovery.

Climate change has already made measurable impact on agriculture in a wide range of economies, crops and farming systems. Low-lying rice growing areas in South and Southeast Asia are already experiencing climate change impacts as frequent floods, inundating rice growing areas causing destruction, rising sea levels causing salt water intrusions into fields, droughts causing crop losses and temperature extremes creating unfavorable situations for farming. Since rice is most susceptible to heat stress during the reproductive and ripening stages, extremely high temperatures for even a few hours during a flowering can cause sterility. Therefore, climate change has the ability to create a greater risk to crop productivity, food security, livelihood security etc. throughout Asia in the years to come (<http://www.http://bit.ly/1irgt9k>). This will result in higher demands for farm products, and a greater need for efforts in reducing the related vulnerabilities, especially within the man-made modified ecosystems where land quality degrades over time.

In the present paper, a proactive approach adapted by the Asian Disaster Preparedness Centre (ADPC) along with the University of Ruhuna, and other stakeholder institutions including farmer communities, aims to reveal the results of a pilot study, "Mainstreaming climate information application for enhancement of agro ecosystem services and functions in Nilwala basin in Sothern Sri Lanka". This project has been implemented with the financial assistance from AusAID.

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1. United Nations, *Hyogo Declaration on Disaster Reduction*, 22 January 2005, A/CONF.206/6, available at: <http://www.refworld.org/docid/42b988b24.html> [accessed 25 February 2014]

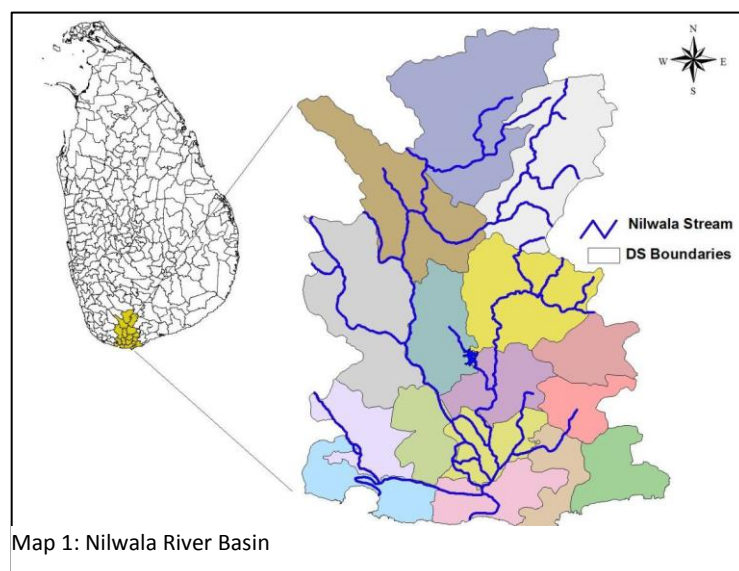
2. <http://www.scribd.com/doc/185978696/Food-Security-in-Asia-No-Time-for-Complacency> [accessed 25 February 2014 ]

## 2. Background to the Project and Problems Associated with the Implementation of the "Nilwala Ganga" Flood Protection Scheme (NGFPS)

Nilwala River is the major river in Matara District of southern Sri Lanka (Map 1). It originates at Panilkanda, near Deniyaya, at an altitude of 1,050 m, and after traversing approximately 70 km it flows to the Indian Ocean at Matara. The area of the river basin is about 1,073 square km. Upstream Nilwala has a steep longitudinal slope, where the riverbed is rocky and the longitudinal slope of the river gradually decreases from 0.4 m/km (GERSA, 1981 cited from Delpachitra, 1996).

The average slope of the bottom of the riverbed approaches nearly zero at last 13 km of the river, where Matara township and urban areas are concentrated. The major hazardous events within the basin could be broadly described as flash floods, droughts, landslides and severe erosion in the upstream side. Preliminary assessment of the sites susceptible to landslides and severe erosions appear to be linked to scrub lands, which are mostly the marginal and abounded tea lands, whereas floods often affect the lower basin area. Its flood plain choked at its outlet to the sea restricts easy evacuation of floodwater to the sea, often resulting in floods and inundation of roadways in Matara town (Panabokke, 1996). Since both upper and lower basin areas are affected by hydro-metrological disaster events, and invariably the events are influenced by global climate change, the events have become more frequent and higher in magnitude. Therefore, it was essential that the government undertake measures to mitigate the growing impacts of such events.

In 1968, The Engineering Consultants Incorporated (ECI) in Denver, USA, with the assistance of the Irrigation Department of Sri Lanka, carried out a study that recommends an option involved with construction of downstream flood control facilities. In 1979, as a result the Government of Sri Lanka, 144 million Sri Lankan Rupess was received in financial assistance from the French Government to implement the flood protection scheme to protect



3960 ha of paddy fields in Kiralakele and Kadawedduwa sectors.

The Nilwala Ganga Flood Protection Scheme (NGFPS), which was implemented in 1985, has created a deeper drainage network to paddy ecosystems, coupled with pumping stations to evacuate the ten-year return floods. It involved the construction of new drainage canals, bunds, control regulators and access roads, as well as the pump house to evacuate the ten-year flood collected from 5000 ha basin within a period of 5.5 days. The NGFPS helped to manage the urban floods, but it has resulted in a major disruption and alteration mentioned above to the earlier hydrological equilibrium. The farmers had learned to live with these disruptions that have caused several complicated situations. Even during the construction phase, numbers of modifications were made to the original plans due to disputes and conflicts occurred with the farmers.

Although the Nilwala project aimed to provide flood protection to paddy cultivation and achieve a high target of paddy yields, it actually created new problems on paddy ecosystems. Among such new problems was the development of acid sulphate conditions in drying paddy fields, which arose after changes in the hydrological regime of the locality from rapid evacuation of floodwater and the intensive drainage. It is clear that NGFPS underestimated this factor, and hence the paddy ecosystem is undergoing severe stress (Weerasinghe et al., 1996, 2000). The major soil problems encountered in relation to this have been identified as acidity, iron and Aluminium toxicity, phosphorous availability, low base status and nutrient deficiencies and possible salinity, which are aggravated due to dry spells. Improvement of water management is found to be the key factor in solving such problems, which will help in rice intensification. Incorporation of Agro technology such as transplanting, fertilizer application and adaption of more susceptible varieties is recommended for safeguarding the paddy ecosystem degraded due to man-made structures (Weerasinghe et al. 1996, 2000, 2002). It has been recommended to maintain a submerged and flowing water regime in the fields to prevent the periodical drying cycles, which are elevated due to the climate change associated phenomena. Engineering measures such as proper management of the gate opening in Nilwala river and lift water from drainage channels for irrigation when electrical conductivity is as low as 2.6 mmhos/cm in order to irrigate drying fields are recommended. The introduction of a polder system of irrigation was also recommended (Weerasinghe et. al 1996).

The brackish water marsh of the mangrove swamps and mud flats are located at lower elevations that are subject to inter-tidal intrusion of saline water. Around the period 4700-3600 years BP, these valleys were submerged by the sea (Panabokke, 1996). The area is subject to micro tidal range within 75-25 cm. During the high tides, fields located in the delta region are subject to salinity intrusion and this situation has been aggravated by construction of man-made structures that have prevented the natural system for flushing such salinity intrusions by floodwater from time to time.

Since paddy fields are concentrated in the delta regions, which are located below 0.3 m mean sea level, often floods, sea water intrusion and associated salinity and inhibited drainage are the major threats incurred on rice based ecosystems of the area. Even though academic research has demonstrated the way forward for the restoration process of the ecosystem to protect it from the degradation due to man-made structures, which are

intensifying due problems associated with climate change, there is a gap between science and practice. Farmers living in the basin are traditional farmers; the cultural and moral bindings associated with paddy farming are very strongly linked to their life patterns. The failure of the old system that was linked to farming practices aligned with periodical flooding and washing regime of the paddy fields is looked at by them as a complete system failure. Therefore, a systematic techno- sociological intervention to link communities with the stakeholder institutions and agencies needs to be worked out.

There are other solutions proposed as alternatives to improve the livelihood of affected farmers in the lower basin area such as animal husbandry, inland fishery so on. But such practices have not been acceptable to traditional farmers due to religious and cultural disagreements. On the other hand, loss of household income, productivity of traditional farm land, difficulties in continuing livelihood practices etc. force the traditional farmers to migrate to other areas looking for other types of employment. That has created new types of social problems within such households and also had direct impact on land value of the farmland. Continuation of such practices lead to other difficulties in motivating the new generation to continue rice farming, and has led to the abandonment of very productive rice farming areas.

### **3. Considerations in Designing the New Project**

After identifying various socio-economic and technical problems associated with the lower Nilwala basin area, the project team felt that the new project should address the associated gaps:

1. Identify a representative pilot project site within the Nilwala lower basin for a technology intervention/demonstration program that can be implemented in consultation with farmers and all other stakeholder institutions. The goal will be to establish a model field research, extension and demonstration center by the University to promote farmer interaction, conduct application research jointly with farmers, knowledge transfer and wide dissemination of good practices.
2. Develop a system for constant on site monitoring by the farmer community for following the different aspects of site condition changes due to variations in water levels in the field that will have negative impacts, as well as to record infield observations of climate variations that will have direct influence to such changes. In the same way, the local office of the meteorological department has an opportunity to interact with the farmer community by providing seasonal forecasts for cropping seasons (at least for three months) so that farmers will be able to take major decisions on crop selection, developing the farming system and taking associated decisions.
3. Form a management and monitoring committee, rally all the stakeholder institutions (Agriculture, Irrigation Department, Regional administration authorities, University, etc.) under the chairmanship of the District Secretary for direct on-site interaction between communities and other stakeholders to facilitate constructive dialogues for



decision making and policy interventions with the aim of mainstreaming the sound farming practices within the lower basin area originating from the project.

The major goal of the pilot project is to build resilient farmer communities through introduction of effective utilization of weather and climate information application and appropriate agriculture and livelihood practices suitable to the paddy ecosystem, affected under the “Nilwala” flood protection scheme and to empower them with necessary knowledge on system changes to withstand weather/climate associated risks.

It will be achieved through:

- Capacity building of the farmer community to maximize the protective functions of ecosystem through training demonstration and awareness building programs and mainstreaming the climate information applications in agriculture and livelihood sustainability;
- Creating a dialogue for onsite decision making by other stakeholders in consultation with farmers; and
- Enhancement of the ecosystem capacities to withstand weather and climate associated disaster risks based on the best practices by using an appropriate package of technological solutions, which is the primary objective of piloting this project.

The integration of the ecosystem-based Disaster Risk Reduction (DRR) and Climate Change Adaption (CCA) measures in the river basin development strategies, plans, regulations and programs are also of vital importance. The project will strengthen the capacity of professionals working in basin development for protecting and restoring the ecosystem to maximize its protective function, through introduction of training and demonstrational programs by the university, and by taking appropriate measures by the university to integrate the good practices in the long and short term academic programs of the university.

#### **4. Project Methodology / Approach**

The project activities commenced in December 2012 (Figure 2), by conducting a kick-off workshop with the participation of all the stakeholders along with the Minister of Agriculture at the University of Ruhuna.

The project activities and outcomes achieved are summarized below.

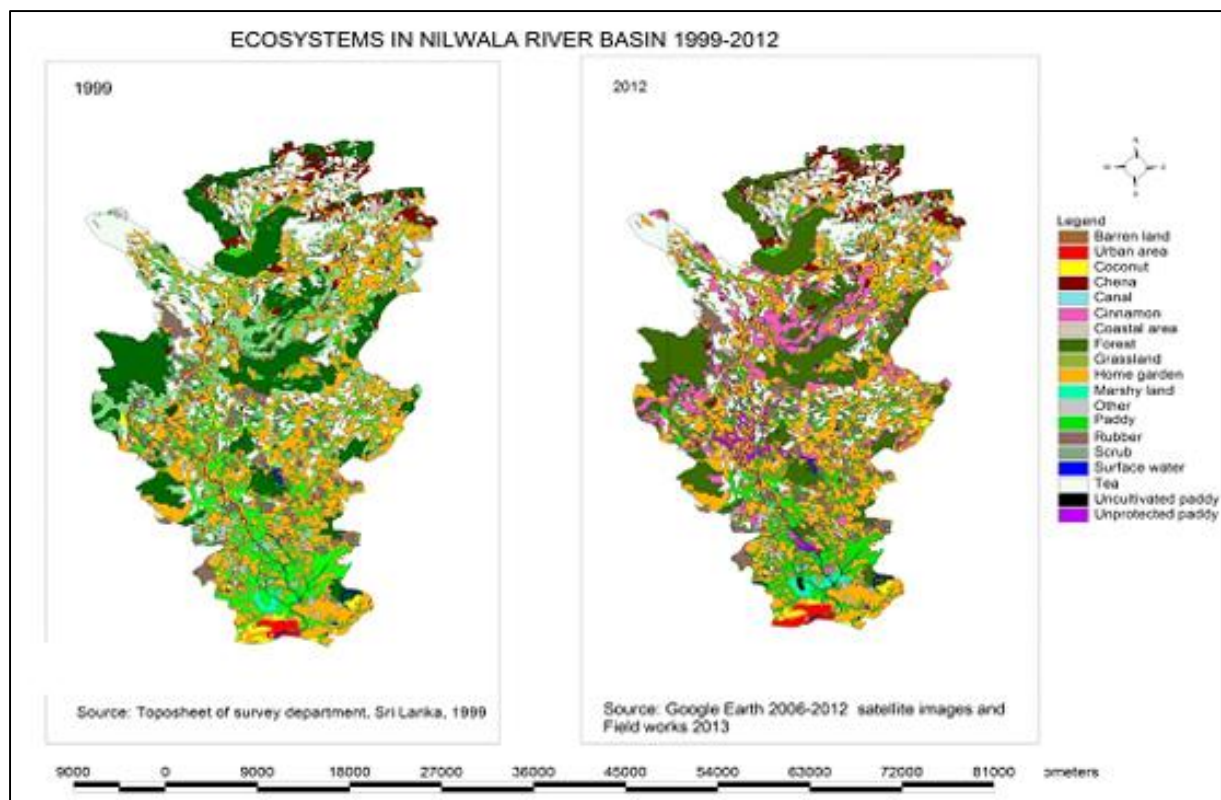


Image 1: Participants of the workshop with the Minister of Agriculture, Secretary Ministry of Agriculture, Vice Chancellor- University of Ruhuna, academics, farmer representatives and ADPC members etc. (left); banner of the first workshop (right)

## **4.1 Identification of Most Vulnerable Ecosystems and Communities due to Multi- hazard Impacts within the Nilwala Basin**

### **4.1.1 GIS and Remote Sensing Approach**

The aerial photographs, available maps, etc. have been used to study the upper and lower Nilwala basin area, identify the characteristics of different associated ecosystems and demarcate them clearly in order to understand recent land use changes and impacts on the different ecosystems due to natural and man-made changes within the basin. The vulnerable ecosystems to landslides, floods, droughts, seawater intrusion, etc. in the upper and lower reaches of the catchments have been identified and mapped. In particular, detailed studies have been carried out in the lower basin area to identify the land use affected due to creation of flood protection embankments under the Nilwala Ganga flood protection scheme (NGFP) by the Government of Sri Lanka in 1985.



Map 2: Land use and land covers change, Nilwala basin

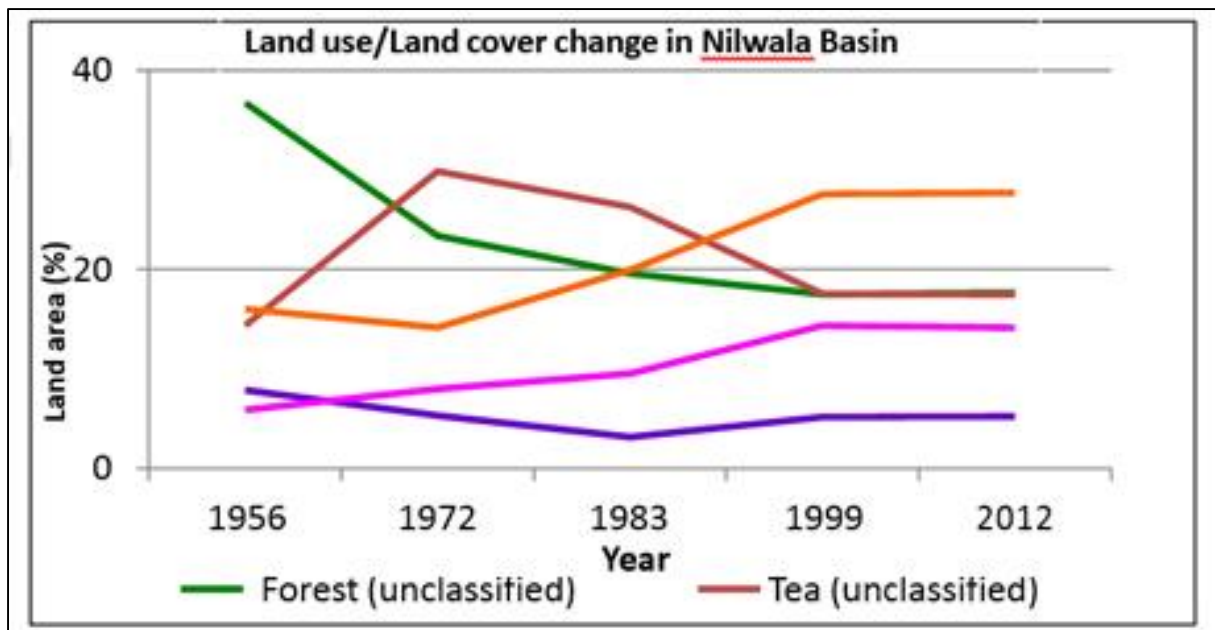


Chart 1: Major land use pattern changes in the Nilwala basin

Initially, the brainstorming session (Image 2A) and a field visit with the stakeholders were conducted to identify and catalogue the different ecosystems and threats incurred on them. Available literature was used to collect historical changes on ecosystems. Topographic sheets published by the Survey Department, Sri Lanka were utilized to identify land use/cover categories during the period 1999-2001. A field survey was conducted from January–March 2013 to demarcate the ecosystems in terms of land use/cover categories. The changes were updated using GIS techniques to reflect the extent of different ecosystems. Field observations were compared with Google Images available on Google Earth, 2012. The images were geometrically corrected and projected to Geographical Information System (GIS) layers. Land use/cover categories were identified through GIS analysis methods. Based on the land use/types that were extracted from the topographic sheets of the Newalla basin, a base map to identify the existing environmental condition was prepared.

After completing the initial ecosystems survey in the basin, the project selected a pilot site in the "Kahaduwa paddy track" to conduct a technology intervention program for ecosystem restoration and lively hood improvement of the farmer communities. A contour and the land use map (Image 2B) of the pilot site was prepared.

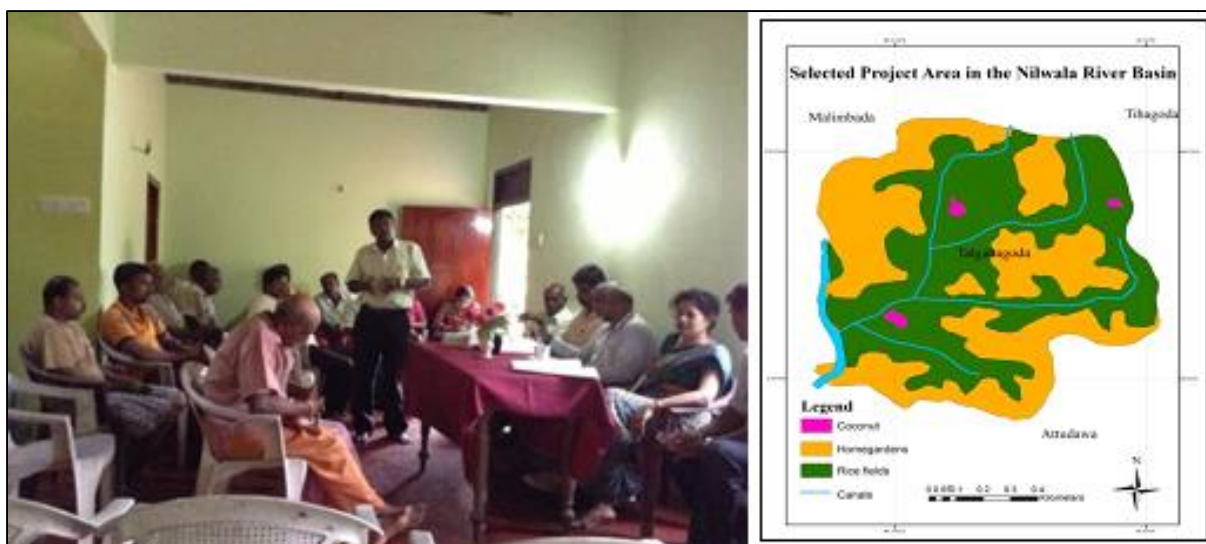


Image 12: (left) Brainstorming session with farmers in pilot project site, (right) Land use map of the project area

Major problems associated with the farmers in the pilot site were identified through a survey and brainstorming session conducted on 10 July 2013.

#### **4.1.2. Agro-Climatological and Hydrological Approach for Identifying Causes of Vulnerability of Communities**

Detailed Climatological, hydrological and soil surveys were carried out in the identified highly vulnerable agro-ecosystem areas in the lower Nilwala river basin to identify severity of the problems. The farming systems, seasonality changes and traditional farming practices, current obstacles in continuing the traditional farming practices etc. have been studied in detail to understand the challenges faced by the farmers due to natural and man-made changes observed in the recent past. A socio-economic and technological restoration plan for the most vulnerable agro-ecosystem to cope with natural hazard scenarios associated with climate variability such as floods, droughts, landslides, erosion, etc. as well as sea water intrusion had been worked out. It was observed that innovative approaches are needed for changing the farming practices, and participatory field research approaches will be necessary to introduce such changes to create awareness of the farmers on the above aspects.

For climate information, application data from Mapalana faculty for the last 30 years (1950-2012) was collected and analyzed with the program, "First (Weerasinghe, Sabatiere, Luc, 1998) to identify the onset of the season. Accumulation probability of 250 mm rains from 1 September at 80% probability was taken as the onset of the season based on the earlier research conducted in Matara district (Weerasinghe et al 1998). Farmer experiences on traditional wisdom associated with the Luna calendar and the forecast information provided by the Meteorology Department was used for decision making for the following three months in Maha season, commencing from September (SON).

For daily observation of the weather information, and to build community awareness on day-to-day weather changes, an on-site rain gauge and Stevenson Screen with a Thermometer and a dry and wet bulb psychrometer was installed at the field center. This helped farmers to understand day-to-day weather events and check them with their traditional experiences.

Final decisions were made at a brainstorming session conducted with all the farmers along with officials of the Irrigation Department, Field Officers of the Agrarian Services Department and University academics, using the forecast information given by the Meteorological department and the Disaster Management Centre. Accordingly, selected farmers of the pilot study program agreed to commence their field activities on the given date (18th Oct. 2013 in case of Maha).

This decision making process was accepted as the policy decision to be placed at the annual "Kanna meeting" (official meeting for decision making on cropping dates, water allocation etc. where all the decision making bodies and farmer organizations of the scheme decide on the cropping calendar).

#### **4.1.3 Sociological Studies**

Sociological studies have been carried out for the most vulnerable communities to understand the type of problems they face, traditional coping mechanisms and current challenges faced due to changes in the pattern and magnitude of the multi hazards from a social and cultural perspective. The sociological research also helped to identify the newly created problems due to the implementation of the Nilwala Flood protection scheme by the government.

#### **4.2 Establishment of the Field Research Center and Piloting Innovative Technological Solutions in Selected Vulnerable Communities**

A research demonstration program was carried out in selected highly vulnerable communities in the lower basin area in the Nilwala river by establishing a field research extension and Demonstration Center (Image 3). The programs are being carried out jointly by ADPC and the University of Ruhuna, in partnership with farmer societies.

The pilot demonstration site was established in consultation with farmer societies in most vulnerable areas for flooding, droughts and seawater intrusion. The area is frequently affected by water shortages or high water levels, salinity, acidity etc.



Image 23: Community and participants at the inauguration of the Field Research Extension and Demonstration Center by the Executive Director of ADPC and Vice Chancellor of University of Ruhuna

The field studies were conducted based on innovative solutions and approaches to reduce the water scarcity salinity and acidity problems. The seasonal weather predictions received by the local Meteorological Department were useful in changing the cropping seasons to



avoid high floods. Certain local level measures were also taken to ensure water supply and floodwater discharge through pumping by developing appropriate low cost pumps. In addition to manual operations for discharging water using traditional ways, several wind and solar powered water pumps will be installed.

### **4.3 Training and Capacity Building (Training of Farmer Community)**

Training for the farmer community was provided by the Ruhuna University through the Pilot Research Program. It was a more hands-on training through on-site activities. The farmers were trained to use the seasonal forecasting information as a decision making tool as well to observe weather parameters and water level fluctuations within the field. They were trained in undertaking different farming practices, ways of coping with acidity, salinity, etc. to suit the prevailing conditions in the field. They were also trained to interact with the Irrigation Department and other government officials and obtained their support when and where necessary. The farmers were happy to engage in innovative technological solutions as they have witnessed the effectiveness of the pilot studies during the present season. Under the next phase, the project plans to have more pilot sites and have more experience sharing sessions between the new set of farmers and farmers already engaged in pilot sites.

### **4.4. Formation of the Monitoring and Management Committee**

The Monitoring and Management Committee (MMC) was formed under the chairmanship of District Secretary (Government Agent) of Matara District to provide strategic guidance for smooth implementation of the project and to ensure long term sustainability beyond the project period by creating ownership by all the project stakeholders (local governments, Disaster Management Center, provincial and district officials from various departments such as agriculture, irrigation, forestry, environment, academia, farming community etc. see Chart 2 Organizational Chart of the project).

The MMC has periodic meetings to convey the findings of the project and to discuss the approach that should be taken to address different challenges. Often it is difficult for academia to provide acceptable solutions to the farmer community, as certain practices are different from the traditional practices and have been passed down through generations. Furthermore, it is necessary to convince Government Officials to undertake certain measures that are being implemented using additional resources. For example, the Irrigation Department is responsible for pumping water using the canal network developed under the Nilwala Flood protection scheme. The canal network has to be dredged time to time for increasing the efficiency, but dredging will lower the water level in certain paddy fields, which may create artificial droughts for the respective areas unless the Irrigation Department is mindful of such facts. In such cases, extra pumping facilities need to be installed in affected areas to ensure water supply. This aspect has been well looked after by the project during the long dry spell during the first part of January, providing canal irrigation provision by researching appropriate pumps for selected farmers (Image 4, Image 5).



Image 34: Installation and testing of hand operated barrel (Archimedean) pump designed by the University. Children enjoy the water pumping and learning about the technology



Image 45: Water pumping to the drying fields by a pump coupled to a two wheel tractor (9 Jan. 2014)

The MMC has created an enabling environment for farmers to discuss problems with government officials and find solutions together. The academia has provided technical inputs that are necessary for finding solutions, working closely with farmer community using their fields as learning and teaching laboratories (Image 6 and 7).



Image 56: Meeting of the Management and Monitoring Committee (MMC), chaired by the District Secretary





Image 67: Management committee along with farmers at the observatory hut in pilot site (left), Media intervention (right)

### ***The Organizational Structure of the Project***

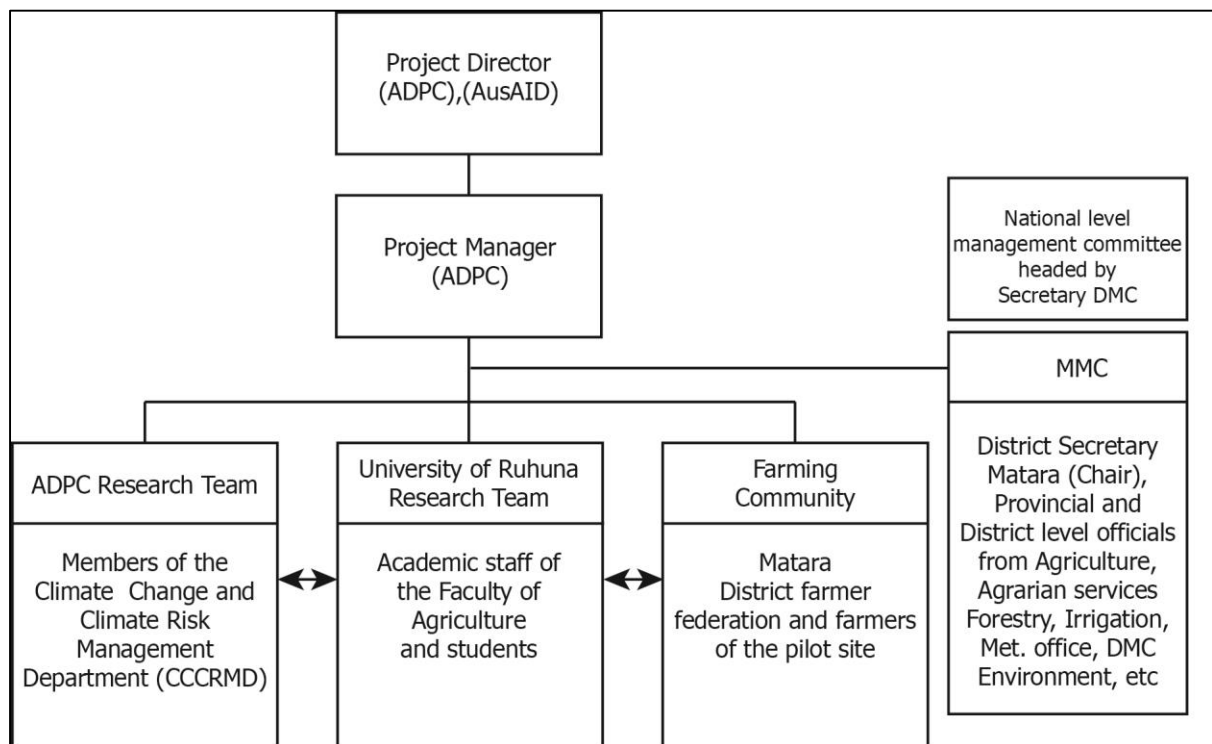


Chart 2: Pproject execution plan

Through a series of workshops and surveys, socio-economical and agronomical data was gathered. More than 40 stakeholder participants from the University, Department of Agriculture, Department of Agrarian Services, Department of Irrigation and Farmer Federations participated in workshops and survey work. Based on the decisions made at the workshops, and recommendations made by the management committee, the following activities are being conducted since December 2012.

1. Building farmer's awareness on the objectives, methodology and the expected outcomes of the project through workshops and brainstorming sessions on existing threats associated with climate change on paddy farmers located in

drying paddy fields, with water scarcity, in semi drying paddy fields, and in low elevated paddy fields with excess water and submerged conditions in the pilot site. The adaptation measures practiced by them are documented.

2. Field research and demonstration program in 'Maha ' (major season) in Sep. 2013 in farmer fields along with the farmers to demonstrate technology interventions as DRR measures to meet with climate change associated risks.

#### 4.5 Technology Intervention Program

Based on past research evidences (Weerasinghe et al 1994; 1996,) and the information gathered at brainstorming sessions with all the stake holders, an appropriate technology intervention for the restoration of the ecosystem health, and to introduce livelihood options are being tested as field trials commencing from Maha 2013 (Sep 2013-Feb 2014).

The objective of the field research program is to address the major problems associated with soil acidity, water scarcity fertilizer practices, weeds, suitable crop varieties, and cropping practices to meet with climate change associated changes in a participatory manner in farmer's fields, along with the undergraduate and the post graduate students.

~~One PhD program and a few M.Phil programs have been incorporated into the field research program. The PhD program is supervised by a Senior Research Officer of the Department of Agriculture. For student thesis work, the Senior Research Officer helps with knowledge dissemination by sharing thesis work to upper levels of the Department of Agriculture directly for policy adaptation and mainstreaming.~~ [SK2]The following field experiments are currently in progress:

##### ***Experiment 1: Impact of mulching, lime application and fertilizer materials on growth, development and yield of rice plants in acidic soils of the Nilwala project***

The design of the experiment is split plot design, with three replicates. There are 16 combinations in the trail with straw mulch and fertilizer combinations. Phenological observations such as plant height, number of tillers per plant, weight and number of filled and unfilled grains in plants, and average yield per square m are measured. Soil data at the initial and end of the seasons such as pH, EC, total N and available phosphorus are also measured. Based on the results of soil analysis and phenological observations, most appropriate technologies will be recommended.



Image 78: Preparation of the field experiment plots and view of the experimental plots in December 2013

As per the results, greener color (leaf color chord LCC) in leaves at tillage could be observed when rice was transplanted with straw mulch. This is an indication of high nitrogen use efficiency when rice straw mulch is used along with other inputs; the weed population was also well controlled with the mulch. Partially burnt rice husk, application of Eppawala rock phosphate as phosphate fertilizer and lime application have also demonstrated promising results.

***Experiment 2: Impact of plant establishment methods on growth development and yield of two rice varieties (traditional variety Kahata wee, new variety At 362)***

The objective of the experiment is to identify a suitable establishment method of rice for rain-fed farming under acidic conditions and to test the performance of the new variety against the traditional varieties. The experiment has a split plot design. Plot size is three by six m.

The parachute method of plant establishment also gave convincing results, especially for boggy paddy fields with submerged water regime. In demonstrational plots, plant vigor was much better and it was a very convenient method for the farmers to practice. After observing the method, farmers have seen the advantage and many farmers are expecting to practice the method in the next season.



Image 89: (left) Nursery preparation for parachute method of transplanting, (center) View of paddy fields parachute method, (right) Broadcasting method

In Image 10, appearance of the transplanted experimental plots that with broadcasted adjacent farmer field during the intense flowering and panical formation stage (12 Jan) is demonstrated. In transplanted fields, tillage was better and plant growth was much ahead compared plant growth in the broadcasted fields. The usual practice adapted by the farmers is to broadcast with very high seeds rate to control the weeds. However, weed population is also high in the farmer fields, which inhibits plants growth and development, resulting poorly developed panicles and low number of tillers.





Image ~~910~~: Appearance of the transplanted paddy fields (left) and broadcasted fields by the farmers (during flowering and grain filling stage)

### ***Experiment 3: Performance evaluation of different rice varieties in Nilwala basin (Observational trial in farmers' fields)***

The objective of the experiment was to identify the most suitable rice varieties for rain-fed farming under acidic soil conditions. Widely used varieties were tested in the farmers' fields. Farmers were given the seed paddy and they established the new varieties in their fields by themselves. Paddy varieties (1) At 362, (2) Ld 368, (3) Bg 369, and (4) Bg 357 are being testing in the current season. Rice variety At 362 is performing well compared to other varieties (Image 11).



Image ~~1011~~: Performance of different varieties at the end of flowering (24 Jan 2014)

The farmers were well convinced with these technologies and measures, and they will be adapted to popularize these practices by farmer training and demonstration methods. The experiments are continuing and final results will be submitted in a scientific conference to take appropriate decisions for policy interventions by the management committee.

## **4.6 Other Training/Capacity Building Initiatives Planned**

The following training packages are being planned under the next phase of the project:

1. A training course module on local level DRR and CCA measures to enhance ecosystem services and functions for governmental officials attached to line agencies/ministries
2. A training course module on Community-Based Disaster Risk Management (CBDRM) methodology for improved agricultural practices to cope with climate change and climate variations for local governmental officials
3. Strengthen the Field Research, Extension and Demonstration Center for knowledge sharing and dissemination of experience, which was established in the lower Nilwala basin under the AusAid funded project on, "Mainstreaming Climate Information Application for Resilience Building of Vulnerable Communities in Nilwala river basin of Sri Lanka"
4. Incorporate research findings into post-graduate courses undertaken by the Agricultural Faculty of the Ruhuna University. Undergraduate students enrolled in the Agriculture Engineering specialty, and postgraduate students in the Green Technology M.Sc program are actively engaged with the field activity programs of the project along with the farmers. The entire surveying and leveling work of the project is given to the undergraduate students as an assignment.
5. ADPC plans to include project experience in Regional Training Courses conducted by the Center annually.

5.

## 5. Research Extension to Mekong Delta (Vietnam)

An analogical pilot project has simultaneously commenced in the Tra Noc province, Cantho, in lower Mekong Delta along with the Cantho University, SIHYMET (Southern Institute of Hydro Meteorology and Environment) in HCM city, IMHEN (Institute of Meteorology, Hydrology and Environment) in Vietnam where a Management and Monitoring Committee was formed under the Chair of the Director, SIHYMET incorporating political and administration leadership of the Tranoc community, in Cantho Province.



Image 1142: Participants of the initial workshop and brainstorming session held in SIHYMET, HoChi Minh city for project commencement in March 2013 (left), Third Meeting of the Local Management Committee held in Tranoc provincial committee conference hall, Cantho

## **6. Lessons Learned from the Implementation of the Project and Larger Contribution to HFA through the Adapted Approach of and activities of the the Project**<sup>[SK3]</sup>

The main lesson learned from the project approach is that high effectiveness can be generated through implementation of the project through a participatory approach. The project team has assembled all the important stakeholders at the problem location and through discussions in the field; everybody felt that win-win solutions could be found through collaboration. Usually farmers demand for dewatering of the respective affected area without understanding the effects on other farmland, which have led to certain conflicts in the past. The Irrigation Department, which is the main authority responsible for dewatering through pumping, faced problems of shortage of funds and other resources in extending assistance to farmers year round. So now both have realized the limitations and agreed to find manual solutions for dewatering during minor flooding situations. The farmers discussed the problems among themselves with the participation of the officials from the Irrigation Department, and helped each other come to the best solutions. The project approach created decision-making and action through dialogue and it has proved to be very effective.

Farmers have traditional farming practices, so new methodologies that are generated through academic research often are not acceptable to farmers due to various social and cultural reasons. Unless they see the effectiveness, which should translate to higher yields or uninterrupted farming during the flood/drought-affected season, farmers are not willing to adopt such practices. Therefore, it is important to have ownership-building for undertaking appropriate solutions that will help in sustaining the practices in future beyond the project period. The community-led farming practices carried out in the field through academic advice was a good initiative that helped in build the confidence of the farmers, develop community ownership and empower them with a new set of sound practices and technical solutions. The new technology solution package proposed by the researchers came as a result of joint collaborative work, as farmers worked hand-in-hand with academia. Traditional farmer communities also gain the respect and rewards for contributions.

The management approach adapted by the project team for mainstreaming the new farming practices directly influenced by the climate/weather predictions by the Meteorological agency and field level observations of climate variations in the micro-catchment area, helped in demonstrating the high effectiveness. The management committee set up the project with government officials, academia and farmer communities, direct assistance to farmers by academia and government officials was not possible in the past due to bureaucratic procedural setbacks. Since this is an outcome of collaborative work, and the end product was acceptable to farmers, they agreed to use seasonal forecasting products in important decision-making practices in the future. The project team is confident that this approach and technology applications can be easily replicated in areas within the lower catchment area with similar problems. Even if similar approaches are adapted, the problems not seen in this pilot study area also can also be resolved as the academia is willing to come up with appropriate solutions. Since they now have direct access to farmer communities, they are able to better understand the problems and provide assistance when and where needed.

Other farmer communities have seen these pilot demonstrations and the effectiveness and there are more requests for assistance. The lesson that can be drawn, is when we do something in the field that is very transparent, it can act as an advocacy method for further replication.

The main contribution to HFA is the field demonstration of DRR applications and introduction of sustainable, cost effective solutions to current problems with the possibility of replication. The HFA has provided an opportunity for the academic and scientific community to think about how scientific approaches can be presented to farmer societies in a simplified and meaningful way. The effectiveness of collaborative work is evident and this can serve as a good practice model for attending to problems in the agricultural sector that are affected due to climate risk, and to come up with sustainable adaptation practices.

## 7. Conclusions

Risk identification, assessment, monitoring and impacts on policy frame work through knowledge management and education in a participatory manner with state agencies, academia, communities, media, the private sector and policy makers is being piloted for DRR adaptation by ADPC in the Nilwala river basin in southern Sri Lanka since December 2012, with the support of AusAid funding. Th

e initial approach of the project was desk evaluation of the existing ecosystems, and application of GIS and remote sensing technologies for further exploration of ecosystems for DRR adaptation. That was followed by a farming systems approach for problem identification, on farm research, research dissemination and policy interventions.

Ecosystems in the Nilwala basin are threatened due to climate change associated hazards such as landslides, flash floods and earth slips upstream, as well as tsunamis, floods, droughts sea water intrusion and salinity downstream. The major disasters occurred in the basin in the recent past are floods and earth slips, which occurred in May 2003, and the Asian tsunami in December 2004.

The total land extent of the basin is 1074 square km, where there are five major land use/covers: Forests (17%), home gardens (27.70%), tea plantations (14.34%), rice fields (13.07%) cinnamon (9.06%) and rubber (5.23%) plantations. Most of the paddy ecosystems of the basin are concentrated in the delta region, which is a little above or below 0.3 m mean sea level and is most vulnerable to climate change associated disasters. An additional threat and conflict situation on paddy ecosystems of the delta region has been yield and land losses after the implementation of the Nilwala Ganga Flood protection Scheme (NGFP) in 1985.

The innovative approach experimented by the ADPC included forming a management and monitoring committee under the leadership of the District Secretary, along with the academic leadership of the Ruhuna University, incorporating all relevant government and state

officials, community leaders farmer organizations and media for decision making implementation and impact at the policy level. This approach appeared to be an efficient mechanism for result orientation within the shortest possible time.

The establishment of the field center for community interactions at the problem sites with academia and decision and policy makers for technology adaption, testing demonstration and extension could be recommended as a good model for active community interaction and to improve student-centered teaching and learning processes.

The experience gathered on the Sri Lankan situation is simultaneously ~~being tested~~ in ~~in~~ tested in lower Mekong delta in a pilot site in Tranoc province along with Cantho University, regional political and administrative leaders, SIHYMET, IMHEN and respective ministries. Field-testing and adaptation is continuing in both Nilwala down stream and Tranoc Province in Mekong Delta, Vietnam. .[SK4][SK5]

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