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Vulnerability to Climate Change:
Adaptation Strategies and Layers of Resilience

Farmers' Perceptions of Climate Change in Sri Lanka: Qualitative Analysis

Frank Niranjan, MWAP Jayathilake, NPC Uddika, T Dhananjani, Cynthia Bantilan, and Naveen P Singh

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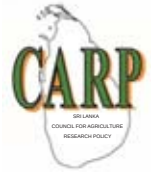

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Dr Frank Niranjan
Country Co-ordinator of the Project, Sri Lanka

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Executive Summary

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is working together with the Sri Lanka Council for Agricultural Research Policy (SLCARP), recognizing the complimentarity of their objectives and the need to facilitate the implementation of the research project on natural resources management, titled ''Vulnerability to Climate Change: Adaptation Strategies and Layers of Resilience'' in 7 Asian countries India, China, Sri Lanka, Bangladesh, Pakistan, Vietnam and Thailand. Farmers in the Asian countries will need to adjust to climate that is changing and accordingly adapt with layers of resilience in their farming practices and investment decisions. Climate change is the most important global environmental challenge facing humanity today.

The overall objectives of the project are to improve understanding of climate variability and its impact on the rural poor in Sri Lanka, identify the best practices and institutional innovations for mitigating the effects of climatic change and develop strategies to address socio-economic problems relating to it. The aim of the project is to identify and prioritize the sectors most at risk and develop gender equitable agricultural adaptation and mitigation strategies as an integral part of agricultural development in these less-favored areas. This includes innovations in agricultural institutions, the role of women, social capital and social networks.

Methods to address the complex challenges and emerging constraints due to climate change in agriculture require a multifaceted approach that encompasses innovations in policy, institutions and new technologies. This study tackles the urgency of identifying adaptation strategies and layers of resilience at the micro and macro levels with critical interventions to reduce vulnerability to water scarcity, drought, desertification, land degradation and future marginalization in the rural areas.

Qualitative analytical methods were used to understand key relationships of social and biophysical inter-linkages with reference to socio-economic, institutional and political drivers of change. Purposive and stratified sampling techniques were employed in selecting the study areas and the households. The main thrust of this study was to assess vulnerability to climate change mainly in the Dry Zone of Sri Lanka. Among the Dry Zone Districts, Hambantota, Puttalam and Anuradhapura Districts were purposively selected. This was the first strata of sampling. The second strata was the purposive selection of Divisional Secretariats in the three Districts – Ambalantota in Hambantota District, Vanathawilluwa in Puttalam District and Horowpothana in Anuradhapura District – based on the rain-fed nature in agricultural operations. The total sample size of 210 was split into marginal (0-1 ha), small (1-2 ha), medium (2-4 ha) and large (> 4 ha) households.

Village-level qualitative data was gathered through Focus Group Discussions (FGD), key informant survey (*Grama Niladhari*) and individual interviews using a semi-structured questionnaire. Information on cropping patterns, input use, markets and infrastructure, occupation, livelihoods, average annual farm income, indicators of weather/climatic variability, impacts, groundwater table, common property resources, land and water management were gathered through a structured questionnaire for 1970 and 2008. The information gathered was supplemented by means of narratives, timelines and transect walks. A total of 16 FGDs and 210 individual interviews were conducted.

Farmers' perceptions of changed climate were elicited through a qualitative questionnaire on the onset of rains, seasonal totals, distribution within seasons, frequency of rain events, frequency and length of dry spells, the size of storms, erosivity of rains, cessation of rains, etc. Although their perceptions on temperature, sunshine hours and wind speed, were also sought, the main focus was on rainfall related parameters.

Results were discussed at the Stakeholder Consultation and Policy Dialogue on Vulnerability to Climate Change: Adaptation Strategies and Layers of Resilience on 5 April 2011, attended by Hon. Mahinda Yapa Abywardena, Sri Lanka's Minister of Agriculture, and other officials. Results reveal that both the maximum and minimum temperatures have increased. Extreme temperatures (number of days reported higher temperature) also increased with increase in temperature. Erratic rainfall pattern was reported. Even though decadal variability has decreased for some climatic seasons, inter-seasonal variability may be high.

The discussions indicated that though a consensus was arrived at during FGDs, there was considerable differences of opinions in the individual interviews. There were instances where there was no shared experience among community members. Unlike in the rural Indian context, there are a limited number of Community Based Organizations (CBOs) in rural Sri Lanka, and little effort is being made by the Government to build up this community cohesion. Long term state intervention either in social or political, welfare delivery system is so atomized where there is no collective activism. A few examples that the society has shown some collective action are at death donation societies and religion societies. In this context, it will be very difficult to have successful community based collective action to help people who face difficulties. People are more dependent and would like the state to come and be the provider of benefits. This would not be a healthy situation in the long run and any strategy would require considerable extra effort at building community cohesion. Further, this situation aggravated the divisiveness of the community based on caste, class, gender, religion, political parties and social capital lines. In such a context, collective action by villagers at an occurence like climatic shock, would be rather minimal. Hence, state interventions are dominated in most of these disaster management activities in Sri Lanka.

1. Introduction to the study area

In Sri Lanka, meteorological data observation was started in 1850, but taking systematic observations was started in 1865 (Premalal 2009). The network climatic data collection stations extend across the country and cover the various agro-climatic zones. Sri Lanka being a predominantly agrarian society has a rich tradition where the lives of people are closely related to the climatic changes throughout the year. As an island in the Indian Ocean located to the south of the southern tip of India, the people benefit from two monsoonal rains and also intermittent rains. The cultivation cycles are in close sync with the climate cycles. The lifestyles and culture are closely associated with farming that is very dependent on irrigation water. The massive network of small man-made tanks that are scattered throughout the "dry zone" of the island stands testimony to ancient knowhow and reconciliation with the natural weather cycles. Thus, the rural communities in the island had sophisticated methods of predicting rain and dealing with the climate to harness its energy to sustain their livelihoods.

This study attempts to make sense of the data collected on climate by the state departments as well as the experiential knowledge of the communities living in the selected areas to assess reality with regard to climate change and its implications. The ADB-ICRISAT-SLCARP study is unique in that it has attempted to study farmers' perceptions on climatic change and adaptation processes as well as interpretation of the hard data collected over several decades on various climate indicators. The basic research questions explored were:

- How do farmers perceive climate change or its variability and respond?
- Which are the individuals or groups that are vulnerable to such changes?
- What kind of adaptive capacities do they have to build resilience when situations get worse?

There is a widespread belief that there is a significant climate change. What is relevant is to find out the farmers' perceptions regarding these changes and assess their vulnerability and identify the adaptation practices. The adaptive capacities were identified. Four villages practicing rain fed farming were selected from three districts from the dry zone for the study:- Mangalapura village in Puttalam District; Galahitiyagama village in Annuradhpura District; Bata-Atha and Mahagalwewa villages in Hambantota District.

Mangalapura is in the *Grama Niladhari*[1] Division of Mangalapura, north of Puttalam District, in the Divisional Secretariat Division of Vanathavilluwa. Mangalapura is located 30 km north of Puttalam, which is the main city of the district. The villagers experience a long dry period from May to October where the maximum temperature is around 37 degree centigrade in March. The onset of the Northeast Monsoons is usually in the 1st week of November. The rains continue till the end of December. The farmers were classified on the basis of the size of their land holding – Marginal (less than 1); Small (1–2 ha); Medium (2–4 ha); and Large (more than 4 ha).

There are instances where the village has developed and grown originally as a state property. Establishment and development of settlements were facilitated by the government in the 1950s. In the 1960s, plots of lands of 10 ha each were allocated to public servants of executive grade for

[1] Grama Niladhari Division is the smallest administrative unit in Sri Lanka. Grama Niladhari is the officer in-charge of that unit.

cultivation purposes. Since then, these officers and the workers who accompanied them started buying other surrounding lands for cultivation. This process led to the gradual development of a village. Beneath the surface soil of the village area, lies a layer of sedimentary limestone. This area has grown to be a major supplier of limestone to the cement industry of the country. Residents of this area have been facing severe shortage of drinking water. The available water has high calcium and magnesium salt content. It was in the 1970s that three large-scale tube wells were constructed by the government to provide drinking water through taps to the villagers.

Galahitiyagama village is in the *Grama Niladhari* Division of Arnolondawa, northeast of Anuradhapura District, in the Divisional Secretariat Division of Horowpothana. Galahitiyagama is 18 km north of Horowpothana, the closest town to the village. The village experiences a dry period from July to October where maximum temperature is around 37 degree centigrade in the month of March. The Northeast monsoons usually set in in the 1st week of November and the rain continues till the end of December. The farmers were classified based on their land holdings – all the farmer had more than 1 ha of land.

Agriculture is the main livelihood of 90% of the villagers and this goes back to the commencement of the village in 1900. Paddy and chena (traditional shifting cultivation) dominate over the other cultivations and water supply to paddy is done through 3 small village tanks. Chena cultivation depends on direct rainfall. The majority (90%) of the villagers use wells for drinking water. Most years, during the dry periods, the village tanks dry off and the villagers do not have sufficient drinking water in the wells, which compels them to walk long distances for water sources. This village does not have electricity. However, nearly 50% of the households have solar power units. One part of the village borders a state forest reservation.

Mahagalwewa village is in the *Grama Niladhari* Division of Mahagalwewa, north of Hambantota District, in the Divisional Secretariat Division of Sooriyawewa. It is located 7 km north of Sooriyawewa, which is the closest town from the village. The village is characterized by a dry period where the maximum temperature is around 38.6 degree centigrade in the month of September. The onset of the Northeast monsoons is usually in the 1st week of November and the rain continues till the end of December. Land holding size varied across the households. Mahagalwewa village was set up in 1959 with the rehabilitation of the village tank, when a few families came and settled in the vicinity.

The village Bata-Atha of the *Grama Niladhari* Division of Bata-Atha South is located in the southern coastal border of Hambantota District, in the Divisional Secretariat Division of Ambalantota. Bata-Atha is located 11 km west of Ambalantota, which is the closest town from the village. The village is characterized by a dry period from July to October where maximum temperature was around 38.6 degree centigrade in the month of September. The onset of the Northeast monsoons is usually in the 1st week of November and the rain continues till the end of December. A three-year period of drought started in 1980 and most of the permanent trees including coconut cultivations were destroyed. The next severe drought was experienced in the year 2000 and the rainfall pattern then experienced was erratic. Here too, the landholding size varied, indicating economic and social inequities. This village was initiated in 1973 with the distribution of lands to fishing communities. Chena cultivation was undertaken as small-scale operations when the village was formed, but presently, chena cultivation and rain-fed agriculture operations are not common. This is mainly due to the gross marginal income earned from fishing being much higher than that from agriculture.

Quite a number of villagers have Government and private-sector jobs. At the beginning (1973), domestic water requirement was supplied by a tube well; pipe water was supplied in 1998. Fisheries industry is the major source of income for the villagers since the establishment of the village; paddy cultivation was started in 1978 on a very limited extent of land with irrigated water provided by a government sponsored project by the Mahaweli Authority. Chena cultivation was practiced till the declaration of the wildlife reserve in the village area in 2006. Home gardening is restricted to a few households who have pipe borne water for cultivation. Livestock can hardly be seen in this village. Detailed socio-economic profile of the above villages, which includes population, number of households, average family size, gross cropped area, literacy rate, percent income below the poverty line, average annual rainfall, soil type, source of irrigation and major crops grown are summarized in Table 1.

1.1 Sampling design

Purposive and stratified sampling techniques were employed in selecting the study areas and the households. The main thrust of this study was to assess vulnerability to climate changes mainly in the Dry Zone of Sri Lanka. Among the Dry Zone Districts, Hambantota, Puttalam and Anuradhapura Districts were purposively selected. This was the first strata of this sampling. The second strata was the selection of Divisional Secretariats in the three districts. Ambalantota Divisional Secretariat Division in Hambantota District, Vanathawilluwa Divisional Secretariat Division in Puttalam District and Horowpothana Divisional Secretariat Division in Anuradhapura District were purposively selected based on the rain-fed nature in agricultural operations.

Overall, vulnerability was calculated for Hambantota, Puttalam and Anuradhapura Districts using Patnaik and Narain method (2005). Based on this assessment Hambantota and Puttalam were considered to be very highly vulnerable while Anuradhapura was less vulnerable in 1977. In 2007, Puttalam was still highly vulnerable, Hambantota was moderately vulnerable and Anuradhapura was less vulnerable.

One *Grama Niladhari* Division from each Divisional Secretarial area was selected. Mahagalwewa Grama Niladahari Division in Sooriyawewa Divisional Secretariat area, Bata-Ata South in Ambalantota Divisional Secretariat area, Mangalapura *Grama Niladhari* Division in Vanathavilluwa and Arnolondawa in Horowpothana Divisional Secretariat Division were selected to capture the variability in the Dry Zone Districts of northern, southern and eastern parts of Sri Lanka. Mangalapura, Galahitiyagama, Mahagalwewa and Bata-Atha were selected as the study villages. The total sample size was 210 (Table 2). Graphical illustration of the study area is depicted in Figure 1a, Figure 1b and Figure 1c. The total sample was separated into marginal (0-1 ha), small (1-2 ha), medium (2-4 ha) and large (> 4 ha) households.

Table 1. Socio-economic profile of the study villages as of 2008.

	Puttalam District	Anuradhapura District	Hambantota District	
Characteristic	Mangalapura	Galahitiyagama	Mahagalwewa	Bata-Atha
Human population	1417	1179	825	1935
Total number of households	394	344	225	484
Average family size	3.6	3.4	3.7	4
Gross cropped area (ha)	1820	168	610	342
Literacy rate*	93.3	90.3	89	89
% Below poverty line	22.3	24.4	32.4	32.4
Average annual rainfall (2001–2008)	1275 mm	_	1234 mm	1234 mm
Soil type	Red yellow Latasol	Reddish brown earth	Reddish brown earth	Reddish brown earth
Sources of irrigation	Tube wells	Tank and wells	Tank and well	Canal and wells
Major crops grown	Cowpea, water melon, green gram, chili, manioc, cashew	Paddy, maize, foxtail millet, chili	Paddy, sesame, finger millet	Sesame, maize, finger millet

Source: Focus Group Discussions in the study villages and key informant questionnaires.

* District data

The rational of the categorization was based on the understanding that each group has different levels of vulnerability and adaptive capacities based on their resources base and factors affecting the same. Details of the study sites, which include agro-ecological regions, district, annual rainfall, area under irrigation, type of terrain, major soil group, land use pattern, availability of agro-meteorological data and its period and the location of representative agro-meteorological station are shown in Table 3.

1.1.1 Sources of data

Primary data in relation to farmers' perceptions were gathered from sampled households through personal interviews.

Table 2. Stratified sampling of villages.

District	Divisional Secretariat	*Grama Niladhari* division	Village	Sample Size
Hambantota	Sooriyawewa	Mahagalwewa	Mahagalwewa	50
	Ambalantota	Bata-Atha South	Bata-Atha South	50
Puttalam	Vanathavilluwa	Mangalapura	Mangalapura	50
Anuradhapura	Horowpothana	Galahitiyagama	Galahitiyagama	60
Total sample size				210

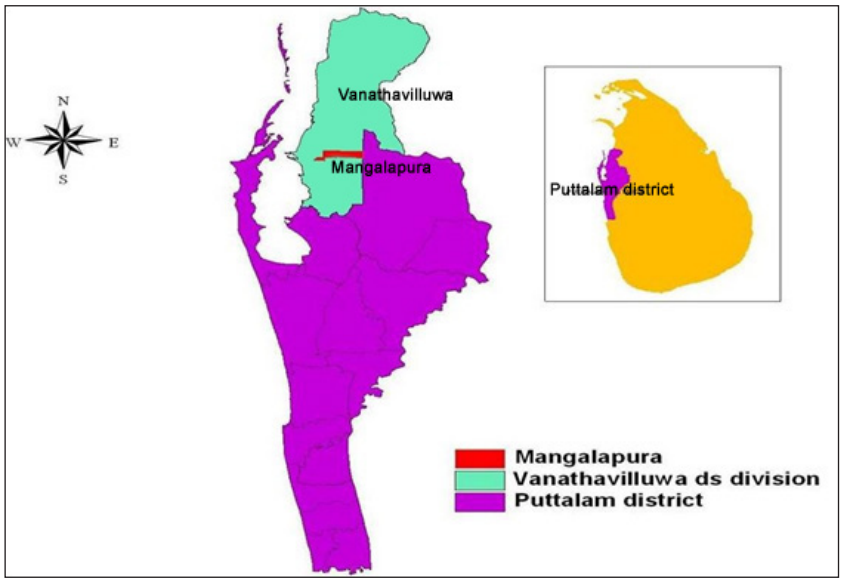

Figure 1a. Study village in Puttalam District.

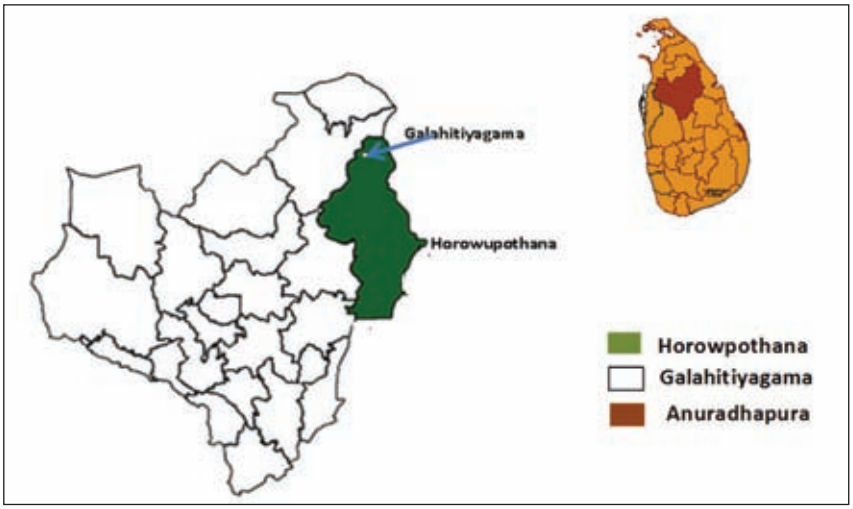

Figure 1b. Study village in Anuradhapura District.

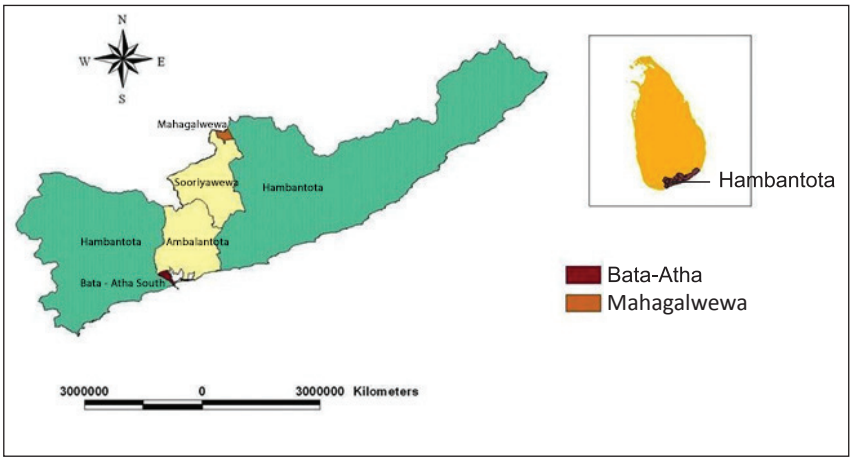

Figure 1c. Study villages in Hambantota District.

Table 3. Details of the study sites.

Agro - ecological regions	District	Annual rainfall (mm)	Area under irrigation (%)	Terrain	Major soil groups	Land use	Data type and availability	Period (years)	Selected Agro - Meteorological station
DL1b	Hambantota	>900	9.6	Undulating	Reddish brown earth and low humic gley	Rainfed upland crops, paddy, scrub, mixed home gardens, forest plantations	Rainfall	1975-2008	Angunakolapelessa
							Temperature -Min. Max.	1975-2008	
							Humidity	1975-2008	
							Panevaporation	1975-2008	
							Sunshine hours	1975-2008	
							Wind speed	1975-2008	
							Soil temperature (5/10 cm)	1975-2008	
DL3	Puttalam	>800	5.5	Flat and slightly undulating	Red yellow latosol and regosol soils	Cashew, coconut, condiments, scrub, natural forest	Rainfall	1975-2008	Eluwankulama
							Temperature -Min. Max.	1975-2008	
							Humidity	1975-2008	
							Panevaporation	1975-2008	
							Sunshine hours	1975-2008	
							Wind speed	1975-2008	
							Soil Temperature (5/10cm)	1975-2008	
DL1b	Anuradhapura	>900		Undulating	Reddish brown earth & low humic gley	Rainfed upland crops, paddy, scrub, mixed home garden, forest plantations	Rainfall	1975-2008	Vavuniya
							Temperature -Min. Max.	1975-2008	
							Humidity	1975-2008	
							Panevaporation	1975-2008	
							Sunshine hours	1975-2008	
							Wind speed	1975-2008	
							Soil temperature (5/10cm)	1975-2008	

1.1.2 Data collection

Village-level qualitative data have been gathered through Focus Group Discussions (FGD), key informant survey (*Grama Niladhari*) and individual interviews (Figure 2) using a semi-structured questionnaire. General information, cropping patterns, inputs use, markets and infrastructure, occupation, livelihoods, average annual farm income, indicators of weather/climatic variability, impacts, groundwater table, common property resources, land and water management have been gathered through a structured questionnaire for 1970 and 2008. The information gathered was supplemented by means of narratives, timelines and transect walks. A total of 16 Focus Group Discussions and 210 individual interviews were conducted (Figure 3).

Figure 2. An individual interview at a farmer's field.

Figure 3. An individual interview at a home of a farmer.

1.1.3 Data analysis

The qualitative information gathered through personal interviews was analyzed after coding responses for each question. Extremely contradictory statements regarding climatic events and its impacts were analyzed using a matrix. Information that was gathered from the Focus Group Discussions were analyzed and discussed in important sections of the report.

2. Perceptions

2.1 Changes in general – Mangalapura village in Puttalam District

A major increase in marginal households (less than 1 ha) was observed in the second and third generations at Mangalapura. The livestock population: cattle, buffaloes, poultry and pig has shown a major decrease except in the case of the goat population. The majority of the farmers have shifted their cultivations from seasonal crops such as vegetable and pulses to perennial crops such as cashew, mango, papaya, banana, citrus and coconuts. Forest cover and common property resources have declined. Further, within the seasonal crops, a shift was observed from traditional food crops to short duration cash crops such as hybrid water melon. Most of the cultivation activities were confined to the *maha* season (October to February) under rain-fed conditions. Wells are used by

a majority of the villagers for household chores and drinking purposes. The majority felt that the use of wells as a source of irrigation has reduced and the use of tube wells as a source of irrigation has increased. The quality of water in the tube wells has declined. During the period 1970–2000, climatic variability has shown few changes, but a significant variability was observed during the period 2000–2008. Agro chemicals and fertilizers are available at the Agrarian Services Centre (ASC) and in the private sector outlets. Output market for agricultural products has been limited to the village-level markets at present, but in those days outputs were sold at the Puttalam market. Presently, a good marketing network has been created for cashew and melon cultivations. Soil fertility has declined and land management practices have reduced in general. Collective actions undertaken to minimize degradation of natural resources are not much prevalent at present.

2.1.1 Variability in Rainfall and its causes – perceptions over the period 1970–2008

Among all the household categories, 100% of the respondents in marginal households, small households and medium households and 95% of the large household category have perceived that the climate has changed during the period 1970–2008. Further, a majority of the respondents in all household categories said weather forecasting ability has changed, the uncertainty has increased. The quantum of rainfall, intensity of rainfall and number of rainy days have decreased according to the perception of all household categories. They have experienced a drought in 1983 as an extreme climatic event. Also, they stated that rainfall outside the rainy season and longer dry spells have increased during the period 2000–2008. These changes affected the cultivation of seasonal crops and the flowering behavior of perennial crops such as cashew.

2.1.2 Changes in temperature and its causes

The majority perceived that the temperature of this village has increased during the period 2000–2008. Destruction of the existing forest cover is considered as the major reason for the rise in temperature; some of the seasonal crops have dried off and harvest and fruit wines such as melons were damaged at times (Table 4).

Climate change has been observed in this area over the last 20–30 years in terms of decline in the quantum and intensity of rainfall and increase in temperature. While weather was forecast by observing animals' behavior earlier, it is not possible at present. This was reflected in agriculture in terms of crop damages due to changes in rainfall. Villagers have observed a decline in cashew production due to flowers being washed off. Destruction of the crop (green gram, cowpea, melon) and germination of seeds even after harvest were observed due to off season rains and increase in temperature.

2.2 Immediate response to climatic shock

The immediate response of the marginal households to a climate shock was diversification of means of livelihood. For the small households, it was the selling of assets. Medium households responded by selling livestock and diversification was the immediate response of the large households. Migration, reduced consumption, obtaining loans and mobilizing and using collective resources too were indicated as immediate responses to climate shocks. Some of the farmers did not have any clear idea regarding the actions taken in the event of such situations (Table 5).

Table 4. Distribution of farmer categories (%) by change in climate characteristics over the period 1970–2008 – Mangalapura.

Climate characteristic	Marginal households			Small households			Medium households			Large households		
	Characteristics have changed		Characteristics have not changed	Characteristics have changed		Characteristics have not changed	Characteristics have changed		Characteristics have not changed	Characteristics have changed		Characteristics have not changed
Climate	100		0	100		0	100		0	95		5
Weather forecasting ability	79		7	50		25	83		17	90		5
	Increase	Decrease	No change	Increase	Decrease	No change	Increase	Decrease	No change	Increase	Decrease	No change
Quantum of rainfall	7	93	0	0	100	0	8	92	0	5	90	0
Intensity of rainfall	0	93	7	0	100	0	0	83	17	0	90	5
Number of rainy days	7	93	0	0	100	0	0	100	0	10	80	0
Temperature	71	7	21	50	0	25	67	0	33	50	5	40

Table 5. Distribution of farmer categories by immediate response to climatic shock over the period 1970–2008.

Farmer category	Migration	Selling of livestock	Diversification of means of livelihood	Improvement of access to water availability through watersheds	Mobilization and use of collected resources that are held collectively	Reduced consumption	Obtain loans	Selling of assets	No response
Marginal households (n=14)	21	0	50	0	7	21	29	29	7
Small households (n=4)	0	50	75	25	25	50	0	100	0
Medium households (n=12)	0	42	33	8	8	17	0	25	17
Large households (n=20)	10	5	70	25	25	10	0	10	25

Dynamics of the FGD regarding climatic changes: The villagers agreed that Mangalapura village was established in 1956. People who arrived from various parts of the Island were identified as the first generation of the village. The distribution of state lands in the *Wagawa* Area by the Government was seen as the most significant and earliest event that occurred in 1971. Different views were expressed by the members of the group in arriving at a conclusion regarding the years. There were different views among the participants regarding the years of occurrence of certain events. Further, the contribution of women was significant in arriving at final decisions on years regarding important events. When making specific objectives, discussions were friendly and cordial and participants were able to reach a consensus. However, the elderly persons of the group seemed to be reluctant to express their ideas while youths remained silent throughout the sessions. As a whole, it was observed that in recalling the years and events of the past, the leading role was played by the *Grama Niladhari* who has been residing in the area for a long time and the participants were in agreement with his ideas. In expressing ideas on weather changes, a young lady teacher expressed her ideas regarding an increase of rain observed during *Yala* season and her ideas opened a path for a discussion. Based on the focus group discussion (FGD) at Mangalapura, climatic shocks such as flood was experienced in 1977 followed by a cyclone in 1978. A drought situation was experienced in 1983 and then unexpected rains were experienced in 2005 (Table 6).

Table 6. Timeline of climatic shocks as observed by the respondents in Mangalapura.

Year	1977	1978	1983	2005
Climatic shock	Flood situation	Cyclone	Drought	Unexpected rainfall

Source: Focus Group Discussion with farmers in Mangalapura, 2010.

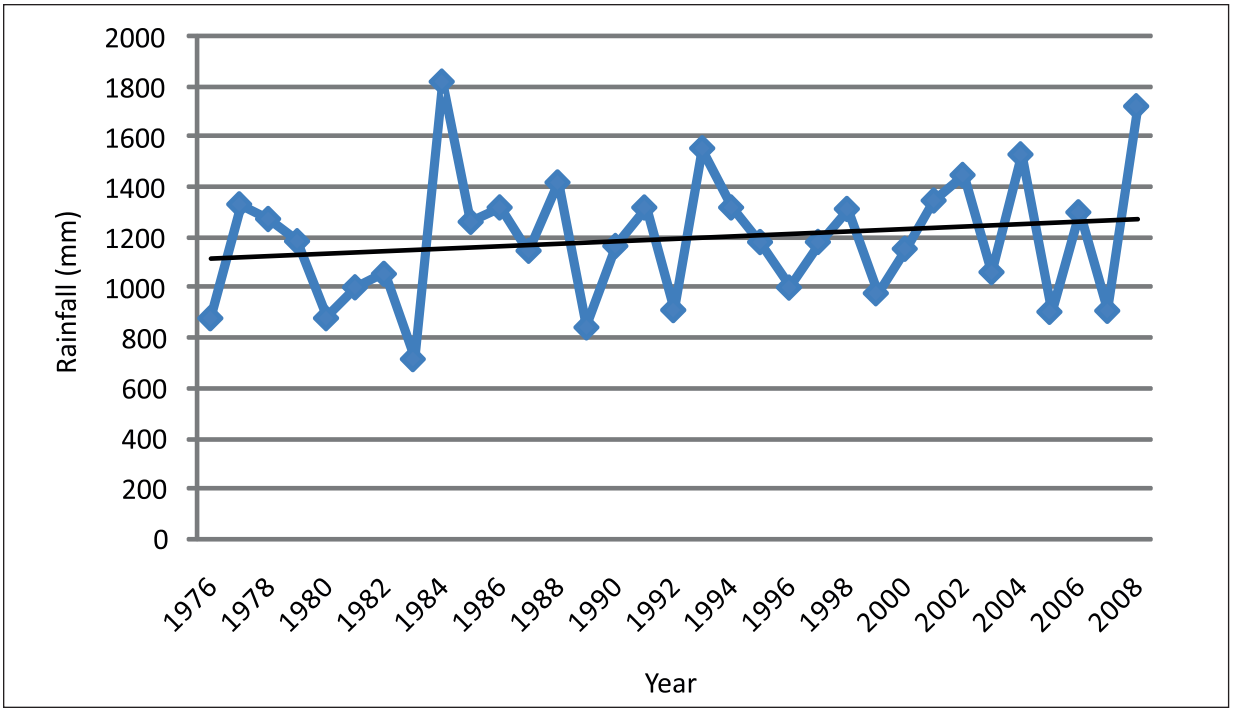

Figure 4. Annual rainfall variability in Eluwankulama.

Source : Department of Meteriology, Sri Lanka

2.3 Changes in general – Galahitiyagama village in Anuradhapura District

Galahitiyagama is a village located in Anaolondawa *Grama Niladhari* division at Horowpothana Divisional Secretariat Division in Anuradhapura District. The total human population of the village was 281 in the year 2008 and the total geographical area is about 450 acres. The primary occupation of the villagers was mainly based on agriculture related activities. Farmer perception of climate change and the related issues are summarized here, showing the percentages of responses regarding the particular issues. The number of marginal households (less than 1 ha) have decreased while other household categories have increased during the period 1970–2008. Livestock population has also increased during the same period. Earlier, the village tank and wells were used as sources of irrigation to cater to the local needs of the villagers. At present, apart from rain-fed agriculture, agro-wells are being widely used by the villagers. According to the villagers, the cultivated area of the village has declined during the period. Farmers perceive that the wild animal population of the peripheral forest has declined except for the peacock population. Most of the farmers were involved in paddy and vegetable cultivations in 1970s; however, the vegetable cultivation has declined over the years. The cultivated area of chili, onion, finger millet, black gram and sesame has also declined while the area under maize has increased. Cultivated area of fruit crops such as mango and papaya has increased during the same period. During 1970s, most of the farmers sold their agricultural produce to the nearby market at Horowpothana, while in 2008 the produce was sold in the village itself.

2.3.1 Variability in rainfall and its causes

The majority of the farmers in Galahitiyagama said that the climate has changed during the period 1970–2008 and that weather forecasting was difficult. A considerable amount of villagers felt that the quantum of rainfall, intensity of rainfall and number of rainy days have declined and these perceptions were generally common to all types of household categories. Longer dry spells and rainfall outside the rainy season have also increased. These general changes have affected the traditional paddy farming and upland crop cultivation. Since the rainy season was short and the rainfall erratic, short-term high yielding crop varieties were adopted by a sizable amount of farmers at Galahitiyagama. Also, use of technology for land preparation was somewhat advanced than that of other villages studied.

Several climatic shocks were observed by the villagers at Galahitiyagama. Among the climatic shocks, a cyclone was experienced in 1963 and several temporary houses and crops were damaged. The period from 1970 to 1977 was unique for a prolonged drought in Galahitiyagama. Again, the drought was severe in 1983. However, negative impacts for trees and crops were relatively less, but formation of hard pan was experienced during the drought period. Hence, large land preparatory tools such as disk harrowers had to be utilized. Another cyclone situation was experienced in the year 2000.

Rainfall variability can be considered as one of the causes attributable to climatic changes during the last 20-30 year period at Galahitiyagama village. These changes reflected sometimes as one month delay of the onset of rains during the Maha season and hardly any rains during the Yala season. Sometimes, rains were delayed by three months and sometimes rains were received at unexpected times. Sometimes, paddy harvests were destroyed due to unexpected rains occurring during the harvesting time. The amount of rainfall has declined in some months; hence, damage went up by 50%. Heavy rains were not experienced. Dry periods (months) had been increased up to 3 months. Temperature has also increased more than during the previous periods. The number of rainy days

has also declined by a half. Unlike in the past, weather forecasting ability has also deteriorated. Successful forecasting is on the decline.

2.3.2 Changes in temperature and its causes

A considerable amount of villagers in all household categories have felt that the temperature has increased due to decline of forest cover over the period 1970–2008. However, increasing temperature had no tangible impact on cultivation operations at Galahitiyagama.

Dynamics of the Focus Group Discussion (FGD) regarding climatic changes: The FGD was held at the Community Hall of Galahitiyagama with the participation of 18 persons (10 females and 8 males). Seven persons out of this group were natives of this village and only 7 have had an education beyond grade five. One female participant did not have any school education. The highest level of education of this group was grade 10 and only one person had been able to reach that level. There were no participation of Government officers in the group discussions.

All the respondents in small, medium and larger household categories in Galahitiyagama village have said that the climate has changed during the period (Table 7). Among them, a majority has said that the quantum of rainfall, intensity of rainfall and number of rainy days have decreased while the temperature has increased. Most of the respondents in all household categories have said that probable weather forecasting ability has declined during the period.

Table 7. Distribution of farmer categories by change of climatic characteristics over the period 1970–2008.

Climatic characteristics	Small households (1-2 ha) (n=17)			Medium households (2-4 ha) (n= 27)			Large households (>4) (16)		
	Characteristics have changed		Characteristics have not changed	Characteristics have changed		Characteristics have not changed	Characteristics have changed		Characteristics have not changed
Climate	100		0	100		0	100		0
Weather forecasting ability	82		6	89		7	88		6
	Increase	Decrease	No change	Increase	Decrease	No change	Increase	Decrease	No change
Quantum of rainfall	6	94	0	7	93	0	0	100	0
Intensity of rainfall	6	82	6	4	96	0	6	88	6
Number of rainy days	6	94	0	11	89	0	0	94	6
Temperature	65	0	24	70	19	11	81	6	13

2.3.3 Immediate response to climatic shock

Most of the farmers in small, medium and large household categories have said that the main shock they have faced was the drought (Table 8). The weather related shocks they have primarily faced were destruction of the cultivated land and harvest, and shortages of water.

Table 8. Distribution of farmer categories according to weather-related shocks they have faced.

		Kind of shock	Weather related shock					
Farmer category	Number of respondents	Drought	Destruction of the cultivated land	Destruction of the harvest	Displacements	Food shortages	Water shortages	Decline of income
Small households (n=17)	94	88	53	35	0	0	29	18
Medium households (n =27)	96	93	78	41	0	15	30	19
Large households (n= 16)	75	75	50	38	6	19	31	13

2.4 Changes in general – Mahagalwewa village in Hambantota District

Mahagalwewa village is in Mahagalwewa *Grama Niladhari* division at Suriyawewa Divisional Secretariat Area in Hambantota District. The primary occupation of the villagers was mainly based on agriculture related activities. Taking the information provided by the villagers into consideration, it appears that the ancient tank of the village had been reconstructed and 92 Buddhist families were settled in the division of Mahagalwewa under an early settlement scheme. The village was established in 1959. *The number of households has increased in Mahagalwewa village during the period 1970–2008. Livestock population, including cattle and buffaloes, has also increased. Most of the villagers had been engaged in agriculture based occupations during the past*, but most of them have given up the farming activities. Farmers were engaged in chena cultivations in the past and most of them have shifted from chena farming to paddy cultivation due to the Government's assistance since 1964. The large extent of forests and the abundance of wild animals that existed during the time of establishment of the village have declined over the years.

2.4.1 Variability in Rainfall and its causes

Most of the villagers felt that the climate has changed over the years (1970-2008). Weather forecasting ability of the villagers has changed during the recent period and most of them said that the weather pattern has changed. Quantum of rainfall, intensity of rainfall and number of rainy days has declined according to most of the villagers. According to them, deforestation had reached a peak by 1970 and eventual decline in rainfall was observed. Hence, cultivation in both seasons has

become extremely difficult after 1975. Farmers felt that the pattern of rain has changed since 1999. Occurrence of rain in an intermittent pattern has been observed since 2003. Consequently, there is an increasing tendency of people to move away from farming.

From the very beginning of the session, one person tried to explain that the root cause of the climatic change that was taking place was the clearing of the tank's catchment area for building houses and settle people. He further stated that those who were engaged in such activities are people of the village itself and since they are related to each other in some way, people are not in a position to protest against them. Therefore, it was highlighted that the Government should intervene to stop deforestation in the catchment area. All the members were unanimous in saying that political influence is strongly felt in almost every activity, throughout. They were of the view that clearing of the jungles caused the decline observed in the rainfall. Furthermore, the teak plantation that replaced the natural forest was viewed as a fruitless effort.

Drawing on memories from their childhood, public officers explained that the pattern of cloud formation and the direction of rainy winds have started to change since 2003. Participants highlighted that lately, the damage caused to crops by stray cattle has been increasing and some remedial measures should be implemented for the same. Women in the group raised their voices considerably regarding this issue. There was a cattle farm owner in the group and it was apparent that the others were trying to drop hints at this farm owner. However, the cattle farm owner remained silent during the session for expressing collective opinion but talked to the research officers who approached him and tried to give explanations to prove his innocence.

2.4.2 Changes in temperature and its causes

Villagers felt that the temperature of the surrounding areas has increased during the period 1970–2008. Most of the villagers believed that this was caused by the deforestation that has taken place in the village. Although they have felt a change in the temperature, there was no significant effect on their livelihoods.

Among all the household categories, 100% of the respondents in marginal households, small households and medium households have perceived that the climate has changed during the period 1970–2008 (Table 9). Among the respondents in the large household category, 95% of the farmers have said that the climate has changed. The majority of respondents in all household categories has said that the weather forecasting ability has changed during the period. The quantum of rainfall, intensity of rainfall and number of rainy days has decreased according to the perception of all household categories. Furthermore, they have said that the temperature has increased.

2.4.3 Immediate response to climatic shock

The immediate response of the marginal households to a climatic shock was diversification of means of livelihood and for the small households, it was to sell their assets (Table 10). Selling of livestock was the immediate response of the medium households and diversification of means of livelihood was the immediate response of the large households. Migrations, reduced consumption, obtain loans and mobilizations and use of collected resources were also said to be immediate responses to climatic shocks by the respondents. Some of the farmers did not have a clear idea regarding the actions taken at such situations.

Table 9. Distribution of farmer categories (%) by change of climatic characteristics over the period 1970–2008.

Climatic characteristics	Marginal households (n=14)			Small households (n=4)			Medium households (n=12)			Large households (n=20)		
	Characteristics have changed		Characteristics have not changed	Characteristics have changed		Characteristics have not changed	Characteristics have changed		Characteristics have not changed	Characteristics have changed		Characteristics have not changed
Climate	100		0	100		0	100		0	95		5
Weather forecasting ability	79		7	50		25	83		17	90		5
	Increase	Decrease	No change	Increase	Decrease	No change	Increase	Decrease	No change	Increase	Decrease	No change
Quantum of rainfall	7	93	0	0	100	0	8	92	0	5	90	0
Intensity of rainfall	0	93	7	0	100	0	0	83	17	0	90	5
Number of rainy days	7	93	0	0	100	0	0	100	0	10	80	0
Temperature	71	7	21	50	0	25	67	0	33	50	5	40

Table 10. Distribution of farmer categories (%) by their immediate response to climate shock over the period 1970–2008.

	Immediate response to the climatic shock								
Farmer category	Migration	Selling of livestock	Diversification of means of livelihood	Improvement of access to water availability through watersheds	Mobilization and use of collected resources that are held collectively	Reduced consumption	Obtain loans	Selling of assets	No response
Marginal households (n=14)	21	0	50	0	7	21	29	29	7
Small households (n=4)	0	50	75	25	25	50	0	100	0
Medium households (n=12)	0	42	33	8	8	17	0	25	17
Large households (n=20)	10	5	70	25	25	10	0	10	25

2.5 Changes in general – Bata-Atha village in Hambantota District

No one was able to mention correctly the time when the village was established. Many were of the view that the village must have been established in the year 1800. During the early period it was called Guru Pokuna; now it is known as Bata-Atha. An elderly farmer shared an interesting story about how the village got its name. According to the story, the merchant brothers, on their way back after taking over the sacred hair relics of Lord Buddha, took a short rest on the seashore near the village and drank some water from the pond, which was brownish (guru) in color. According to a Buddhist monk who had settled in the village around 1885, twelve families had been living near the seashore. Since Bata-Atha village is spread over a large extent of land, villagers, since 1922, have started identifying the major parts of the village as Bata-Atha North and Bata-Atha South. However, it was only in 1977 (during the regime of Late Prime Minister Mrs Sirimavo Bandaranayake) that a separate *Grama Niladhari* division for Bata-Atha South has been established. In 1978, the United National Party led Government took steps to construct houses in the nearby woodlands. Once these houses were handed over to the fisheries community, they sold the new houses to outsiders and chose to stay near the seashore. Thus, the population of the village started to grow.

According to farmer perception on changes over the period 1970–2008, an increase was observed in the number of marginal household (less than 1 ha) and small household (1-2 ha) categories. Medium (2-4 ha) and large (more than 4 ha) categories were not seen in Bata-Atha village. When considering the livestock population of the village, cattle and buffalo populations have shown a major increase while goat population has shown a minor increase. Most of the farmers have shifted from agriculture based income sources to fisheries based earning activities. The cultivated area of seasonal crops such as finger millet, green gram, cowpea and sesame has reduced. The cultivations are mainly carried out in Maha season and most of these crops are cultivated in the home gardens of the villagers only for their household consumption. Perennial crops such as coconut, banana and cashew are also cultivated in their home gardens. Livestock activities are not common. The villagers started tilling the paddy fields in 1978.

Most of the farmers have felt that the consecutive drought, moisture stress and temperature have increased during the period while the volume of rainfall has shown a minor decline. When considering the availability of input, seeds are available within the village and the fertilizers and agro-chemicals are bought from the nearby markets. Most of the agricultural production harvested is consumed by the villagers themselves. Sesame cultivation is still practiced at a considerable level and the production harvested is sold within the village or at nearby markets.

2.5.1 Variability in rainfall and its causes

Most of the farmers in marginal and small household categories have said that the climate and weather forecasting ability have changed over the period. The farmers said that the quantum of rainfall, intensity of rainfall and number of rainy days have declined during both periods, 1970–2000 and 2000–2008. According to farmer opinions, the arrival of monsoons was delayed during the same periods. They have also felt that the rainfall outside the rainy season has increased and longer dry spells were experienced during that period. Normally, they expect intermittent showers from November but they did not have it during the recent past. A woman stated that they are having rains under strange situations and she was of the view that it was due to the tsunami, while another lady stated that earlier, mushrooms were growing during periods of thunder showers from April to September but, in the recent past it has changed since lightning is more frequent.

The farmers said that during the last 20–30 year period, the amount of rainfall and the number of rainy days have declined and especially that the onset of rainfall has been delayed. Rainfall outside the rainy season has increased. According to a farmer, presently, the onset of rainfall has delayed by two months. The small amount of rainfall that occurs during the Yala season has also declined. The temperature in the village area has gone up during the period.

2.5.2 Changes in temperature and its causes

The majority have perceived that the temperature of the area was increasing during the period. Most of the villagers believed that the decline of forest cover is the major cause for the temperature increase. Villagers said that clearing of *Katta Kanduwa,* the nearest peripheral forest cover and Bata-Atha forest areas during 1970s had led to the temperature increases in the surrounding areas (Table 11).

Table 11. Timeline of climatic shocks as observed by the respondents in Bata-Atha.

Year	1940	1969	1980-1983	2000-2002	2004
Climatic shock	Flood situation	Flood situation	Drought	Severe drought	Tsunami

Source: Focus Group Discussion with farmers in Bata-Atha, 2010.

Bata-Atha village is in Bata-Atha South *Grama Niladhari* division at Ambalantota Divisional Secretariat Area, Hambantota District. The primary occupation of the villagers was mainly based on fisheries and agriculture related activities. Farmer perception of the climate change and the related issues are summarized here, showing the percentages of responses regarding the particular issues.

2.5.3 Immediate response to climatic shock

The majority of farmers have said that droughts were the major shocks faced by the farmers of the village (Table 12). The weather related shock that mostly occurred for them destroyed the cultivated land, destroyed the harvest and created water shortages according to a majority of the respondents.

Table 12. Distribution of farmer categories according to weather related shocks they have faced.

		Kind of shock	Weather related shock					
Farmer category	Number of respondents	Drought	Destroyed the cultivated land	Distraction during harvesting	Displacements	Food shortages	Water shortages	Decline of income
Marginal households (n=26)	88	88	50	31	4	8	62	12
Small households (n=24)	92	92	58	33	8	21	46	13

3. Impacts

3.1 Major impacts observed at Mangalapura village

Major impacts of climate variability were identified as water stress, increased damages due to pest and diseases, and infestation of weeds. Apart from these major effects, there were some indirect second order impacts, and those impacts were seen as a result of immediate consequences of what had happened.

Water stress: In 1965, when the Government started digging tube wells in the village, the villagers had sufficient water to cultivate crops. Supply of water by pipes for cultivation was started in 1971. A flood situation due to heavy rains during 1977 led to roads being damaged. In 1978, cashew cultivation was started by the cashew corporation leading to the villagers gradually shifting from seasonal crops to cashew. A drought in 1983 caused severe damage to coconut plantations, apart from severe water shortage throughout the village.

Although cashew and coconut gave them a steady income, they lacked ready cash for their daily expenses. In 2002, when the villagers faced a shortage of water to drink and for cultivation, a drinking water supply scheme was initiated by World Vision International, an international non-government organization in which 120 households in *Wagawa* area in the village had water supply. As in the previous years, change of rainfall pattern and delay in onset of monsoons were experienced in the year 2009. Castor, a new crop to the area, was introduced to the villagers on a very limited scale (Table 13). Severe drinking water shortage was experienced by a majority of the villagers, especially during the monsoon withdrawal periods of August–September and January–February.

Table 13. A recollection of climate events and impacts experienced by the respondents.

Year	1965	1971	1977	1978	1983	2000	2002	2009
Event	Digging of tube well	Supply of pipe borne water for cultivation	Floods	Commencement of cashew cultivation by Cashew Corporation	A drought lead to Water shortage	Melon cultivation becomes popular	Shortage of water for drinking and hardly enough for crop cultivation.	Introduction of Endaru (Jatropha) cultivation Delayed onset of rains and decreased rainfall.
Impact	Enough water for crop production	Enough water for crop production	Roads were damaged	Changed the seasonal crop to cashew	Severe damage to coconut cultivation	Majority of farmers moved to short-term cash crops	Supply of potable water for every house Supply of water for nearly 120 houses under "Wagawa" Programme by World Vision International	Shortage of drinking water and change in weather pattern

Figure 5. Water transportation to houses.

Figure 6. Careful collection of water from a well.

Pests and diseases: Pests and diseases continue to be a major constraint to food and agricultural production, leading to a decline in the expected yields. Rise in temperature and water stress have led to greater incidence of pests and diseases. Drought stress has accelerated powdery mildew, Alterneria and Fusarium wilts, viral diseases and nematodes. Generally, under drought conditions, plants show symptoms of wilting, leaf burn and leaf folding (Zoysa 2010). Fungal wilts and rots caused by *Fusarium* spp. were mainly observed on vegetables and fruit crops. Powdery mildew caused by *Oidium* spp. was also observed in vegetables, fruits and other field crops. Cashew cultivation was mainly affected by pod borer, severely damaging the pod and stem. According to farmers, pests were mainly controlled with the use of pesticides.

Weeds: Weeds compete with plants for available resources such as water and nutrients resulting in low yields. Most of the farmers complained of the rapid spread of weeds, which constrained crop cultivation, and greater cost of production since they had to be either manually or mechanically removed.

3.1.1 Impacts on farmer category

A majority of the respondents in all the farmer categories were firmly of the opinion that climate change had had an impact on them while majority of the marginal households said it had led to a decline in harvest and consequent decline in income, small householders cited insufficient water for plant growth and fall in expected income, and medium householders said insufficient water for plant growth, decline in the harvest and the consequent decline in income were the impacts. The larger households felt a decline in the harvest due to crop failure.

Table 14. Distribution of farmer categories (%) according to weather related shocks faced.

Farmer category	Cultivated crop damaged	Harvest destroyed	Displacement	Food shortage	Water shortage	Exposure to diseases	Death of animals	Sale of assets	Reduction in income
Marginal households (n=14)	71	43	0	21	21	0	0	0	14
Small households (n=4)	100	25	0	50	25	0	0	25	0
Medium households (n=12)	50	42	8	8	25	8	8	0	0
Large households (n=20)	55	30	0	0	15	0	0	0	10

3.1.2 Weather-related impact on livelihood/adaptation

According to the majority of the respondents in all the household categories, weather-related shock had destroyed cultivated crops followed by harvests. Farmers said that the cultivation had been destroyed by the drought. Food and water shortages were the other impacts the farmers faced (Table 14).

3.1.3 Weather related impact on food prices

All household categories have said that the food prices have increased during the period 1977 to 2008. Among those respondents, a majority have perceived that this change was not affected by the changing weather patterns (Table 15).

Table 15. Distribution of farmer categories according to weather related impact on food prices.

Farmer category	Food prices from 1977 to 2008		Weather pattern affected food prices	
	Increased	Not changed	Yes	No
Marginal households (n=14)	26	0	8	16
Small households (n=17)	8	0	4	4
Medium households (n=27)	22	2	8	10
Large households (n=16)	34	2	12	20

3.1.4 Impact on the life of the villagers

A majority of the respondents in all the household categories felt that climate change had impacted their lives. In the category of marginal households, the major impacts were decline of the expected harvest and the consequent decline of the income. Major impacts on small households were insufficient water for plant growth and the decline of the expected income. The majority of the respondents in the medium households category have said that insufficient water for plant growth and reduced harvest and income had major impacts on their lives. For large households, the major impact was reduction of the harvest according to 65% of the respondents (Table 16).

3.1.5 Weather related shocks villagers have faced

According to a majority of the respondents in all household categories, weather related shock was the major threat resulting in destruction of cultivated crops and harvests. Farmers said that the cultivations of the village were destroyed by the drought. Food and water shortages were other impacts the farmers faced (Table 17).

Table 16. Distribution of farmer categories (%) by impact of climate change on life of the villagers over the period 1970-2008.

Farmer category	Impact									
	There is an impact	Delay in commencement of cultivations	Insufficient water for plant growth	Death of plants occurred	Reduction of the harvest	Destroyed the harvest	Reduction of the expected income	Reduction of cultivated land extent	No impact	No idea
Marginal households (n=14)	71	7	29	29	50	36	50	0	29	0
Small households (n=4)	100	0	50	25	25	25	50	0	0	0
Medium households (n=12)	83	0	25	17	25	8	25	8	8	8
Large households (n=20)	85	5	35	55	65	45	45	0	10	5

Table 17. Distribution of farmer categories according to weather related shocks they have faced.

	Weather related shock											
Farmer category	Crops damaged	Harvest Destroyed	Displacements	Food shortage	Water shortage	Exposure to diseases	Death of animals	Sale of animals	Sale of assets	Loss of occupation	Reduction in income	Increase in food prices
Marginal households (n=14)	71	43	0	21	21	0	0	0	0	7	14	0
Small households (n=4)	100	25	0	50	25	0	0	0	25	0	0	0
Medium households (n=12)	50	42	8	8	25	8	8	8	0	0	0	17
Large households (n=20)	55	30	0	0	15	0	0	0	0	0	10	0

3.1.6 Migration due to climatic changes

A majority of the respondents in all household categories have said that migrations of the farmers have taken place during the relevant period. Even though migrations have taken place, these migrations were not related to the climatic changes, according to most of the respondents. The villagers said that the migrants were laborers, farmers or land owners. According to farmers' views, these migrations were in the category of permanent inward migrations. Also, a considerable percentage of farmers in all farmer categories have said that temporary outward migrations have also taken place during the period. These are mostly migrations for occupations to the suburban areas and to the main cities from the village (Table 18).

Table 18. Distribution of respondents among farmer categories (%) by migration due to climatic changes.

	Migration								
	Farmer migration		Due to climatic change		Migrated category			Kind of migration	
Farmer category	Have	Not have	Yes	No	Laborers	Farmers	Land owners	Temporary out migration	Permanent in migration
Marginal households (n=14)	86	14	29	50	36	43	7	57	71
Small households (n=4)	100	0	50	50	50	75	0	50	100
Medium households (n=12)	92	8	17	67	33	25	25	58	83
Large households (n=20)	95	5	25	60	45	60	40	60	85

3.1.7 Village hierarchies changed due to climatic change

About 50% of the respondents in marginal and small categories and more than 50% of the respondents in medium and large categories believe that there is a hierarchy among the villagers (Table 19). Among those, most of the respondents have said that this hierarchy has not changed due to climatic changes.

Table 19. Distribution of farmer categories (%) by change of hierarchies due to climatic changes.

Farmer category	Village hierarchies			
	Village hierarchies		Change due to climatic change	
	Present	Absent	Changed	Not changed
Marginal households (n=14)	50	50	7	10
Small households (n=4)	50	50	25	25
Medium households (n=12)	66	33	8	50
Large households (n=20)	75	25	25	45

3.2 Major impacts observed at Galahitiyagama village

As a result of major events affecting the village Galahitiyagama, several impacts were detected at the village level such as damage to the village tank, forest fires, drying up of the tank and crop damages.

Damage to the village tank: Villagers at Galahitiyagama had experienced a cyclone in 1963 and some of the temporary houses and village tank were damaged. This results in limited water availability for lowland paddy cultivation in the *Yala* season. However, there has been minimum impact on upland crops, which are generally cultivated under rainfed conditions.

Forest fires: Villagers also experienced forest fires during the period 1970–1977, which destroyed not only the peripheral forest cover but also the cultivated upland crops in some areas of the village. These types of unfortunate incidents ultimately have had some negative impacts on food security at the village level. However, Government compensation measures such as loans, subsidies and assistance programs were not usually provided for such incidences. Hence, the entire burden has been faced by the villagers. However, permanent solutions like establishment of fire belts around the boundary of village should be done to avoid future forest fires in these areas.

Drying up of the village tank: A severe drought was again experienced in 1983 at Galahitiyagama, during which the drying up of the village tank led to crop damages. De-siltation of the village tank was an essential activity to increase the capacity, but successive governments have not paid due attention to these essential renovations. As a result, the village tank has been drying up during droughts. The villagers themselves have also not taken any collective initiative to de-silt the tank.

Crop damages: Direct impact was again observed as a result of drying up of the village tank; the lowland paddy cultivation in several cultivation seasons was abandoned. Village food security was abandoned/ threatened as a direct impact of these circumstances. Crop damage was again observed due to a cyclone in the year 2000. Government welfare programs have assisted the affected families in the village; the assistance provided has been a huge burden on the Government expenditure (Table 20).

Figure 7. Village tank at Galahitiyagama, which remains unfilled after the rainfall in the Maha season.

Table 20. Climatic events and impacts faced by the respondents at Galahitiyagama.

Year	1963	1970-1977	1983	2000
Event	Cyclone	Drought	Severe drought	Cyclone
Impact	Damaged the village tank	Forest fires, crop damages	Tanks dried up, crop damages	Damage to cultivations and vegetation

Source: Focus Group Discussion with farmers in Galahitiyagama, 2010.

3.2.1 Weather related impact of livelihood/adaptation

Most of the respondents in all household categories have said that climatic change has unfavorably affected their lives (Table 21). Reduction of expected income due to distraction during harvesting and decline of the harvest were the major impacts on the lives of small households. Reduction of the expected income, destroyed harvest, and reduction of the harvest as a result of insufficiency of water for plant growth were the major impacts on medium and larger households.

Table 21. Distribution of farmer categories (%) according to weather related impact on livelihood/adaptation.

		Weather related shock				
Farmer category	Number of respondents	Cultivate new crops	Find new jobs	Reduction of cultivated lands	Used new methods	Drop the cultivations
Small households (n=17)	59	29	0	6	6	6
Medium households (n=27)	59	19	11	19	4	0
Large households (n=16)	48	4	15	4	11	22

3.2.2 Immediate response to climatic shock

Most of the farmers in the small, larger and medium household categories have said that the main shock they have faced was the drought (Table 22). Weather related shocks they have mostly faced were destruction of the cultivated land and harvest, and shortages of water.

Table 22. Distribution of farmer categories (%) according to weather related shocks they have faced.

		Kind of shock	Weather related shock					
Farmer category	Number of respondents	Drought	Destruction of the cultivated land	Destruction of the harvest	Displacements	Food shortages	Water shortages	Decline of income
Small households (n=17)	94	88	53	35	0	0	29	18
Medium households (n=27)	96	93	78	41	0	15	30	19
Large households (n=16)	75	75	50	38	6	19	31	13

3.2.3 Weather related impacts on food prices

A majority of the respondents in all household categories have said that the food prices have increased during the period (Table 23). However, the majority of respondents have disclosed that food prices have not been affected by weather changes.

Table 23. Distribution of farmer categories (%) according to weather related impact of food price.

	Food prices		Weather pattern affected food prices	
Farmer category	Increased	Not changed	Yes	No
Small households (n=17)	88	6	12	88
Medium households (n=27)	93	0	11	81
Large households (n=16)	100	0	25	75

3.2.4 Impact of climatic change on life of the villagers

A majority of the householders in all farmer categories have said that the weather related shocks have been managed by most of them (Table 24). Factors that determined the capacity to adapt to the climatic changes were ownership of resources of water and financial assets for small and

medium householders. For farmers from larger households, ownership of sources was the major factor that determined the capacity to adapt to climatic change.

Table 24. Distribution of farmer categories (%) by factors determining the capacity of householders to adapt to climatic changes.

	Number of farmers who managed weather related shock		Factors determining the capacity to adapt to climatic changes		
Farmer category	Managed	Not managed	Ownership of sources of water	Financial assets	Water storage capability
Small households (n=17)	76	12	41	18	12
Medium households (n=27)	74	11	33	15	4
Large households (n=16)	75	13	56	0	0

3.2.5 Weather related shocks villagers have faced

Most of the respondents in all household categories have said that the sustainable agricultural practices were effective for them to manage the climatic shocks (Table 25). Moisture conservation of soil and obtaining higher yield were mentioned as the reasons to adopt sustainable agricultural practices.

Table 25. Distribution of farmer categories (%) by reasons to adopt sustainable agricultural practices over the period 1970–2008.

		Methods		Reasons to adopt sustainable agricultural practices			
Farmer category	Number of respondents	Effective	Not effective	Moisture conservation of soil	Drought tolerance of crops	Least damages to soil	Obtaining a higher yield
Small households (n=17)	76	41	35	29	12	0	18
Medium households (n = 27)	67	44	22	11	11	4	11
Large households (n=16)	88	63	25	25	6	19	13

3.2.6 Migration due to climatic changes

According to the majority of respondents in the small household category, diversification of means of livelihoods and improvement of access to water availability through watersheds were the immediate responses to climatic shocks (Table 26). Diversification of means of livelihood, improvement of access to water availability through watersheds, mobilization and use of collected resources, reduced consumptions and selling of assets were the immediate responses shown by the medium households to climatic shocks. Most of the respondents in the larger household category have said that the immediate responses were diversifications of means of livelihood, mobilization and use of collected resources and reduced consumption of food items.

Table 26. Distribution of farmer categories (%) by immediate response to climatic shock over the period 1970–2008.

	Immediate response to the climatic shock						
Farmer category	Migration	Diversification of means of livelihood	Improvement of access to water availability through watersheds	Mobilization and use of collected resources	Reduced consumption	Obtain loans	Selling of assets
Small households (n=17)	6	59	41	18	18	18	12
Medium households (n=27)	0	63	44	33	26	15	26
Large households (n=16)	6	69	31	56	31	13	13

3.2.7 Village hierarchies changed due to climatic change

According to the majority of respondents, government organizations were the major institutions approached by the farmers in all household categories (Table 27). Non-Governmental Organizations (NGOs) were ranked as the next most preferred option by the respondents.

Table 27. Ranking of preference of respondents by institutions approached in the event of a drought.

Scale of preference	Small households (n=17)	Medium households (n=27)	Large households (n=16)
1	Governmental organizations	Governmental organizations	Governmental organizations
2	Non-governmental organizations	Non-governmental organizations	Non-governmental organizations
3	Villagers	Kinship and relatives	Villagers
4	Kinship and relatives	Political affiliations	Kinship and relatives
5	Political affiliations	Villagers	One person
6	One person	One person	Political affiliations
7	Private organizations	Private organizations	Private organizations

3.3 Major impacts observed at Mahagalwewa village

Water stress was the major impact caused by climate shocks in Mahagalwewa village, indirectly impacting the livelihoods of the villagers (Table 28).

Water stress: The villagers stated in unison that they received the rain of Maha season after a delay of 1½ months. Hence, they were compelled to delay their cultivations accordingly. Lower rainfall and its unpredictability was leading to a decline in paddy cultivation. They stated that rain causes damages to their harvest that result in financial losses. In 1970, cultivated crops were affected by a decrease in rainfall and crop damage was observed. Due to the change in rainfall pattern in 1999 and intermittent rain in 2003, crop failures were observed. The minor flood in 2003 had also caused crop damage in the village.

Farmers felt that the pattern of rainfall had changed and the quantity, intensity, and number of rainy days have decreased in the last 20–30 years. The onset of the rainy season had been delayed by about a month and the temperature had increased during the last 30 years.

Table 28. Climate events and their impacts as recollected by the respondents in Mahagalwewa village.

Year	1970	1999	2003	2003
Event	Decline in rainfall	Change in pattern of rainfall	Intermittent rain	Minor flood
Impact	Crop damage	Crop failure	Crop failure	Crop damage

Source: Focus Group Discussion with farmers in Mahagalwewa 2010.

Figure 8. Impacts of water stress.

3.3.1 Weather-related impact on food prices

All household categories were unanimous that the food prices had increased between 1977 and 2008. A majority said this change was not due to the changing weather patterns (Table 29).

Table 29. Distribution of farmer categories (%) according to weather related impact on food prices.

	Food prices from 1977 to 2008		Weather pattern affected food prices	
Farmer category	Increased	Not changed	Yes	No
Marginal household (n=14)	26	0	8	16
Small households (n=17)	8	0	4	4
Medium households (n=27)	22	2	8	10
Large households (n=16)	34	2	12	20

3.3.2 Impact of climatic change on the life of the villagers

The majority of the respondents in all household categories agreed climate change has had an impact on them. In the marginal households, the major impacts were in the form of a fall in expected income and a decline in income (Table 30). Small households experienced insufficient water for plant growth and a decline in expected income. The majority of the respondents in the medium household category said that insufficient water for plant growth, reduction in harvest, and a decline in expected income were the major impacts on their lives. Sixty-five percent of large households said the major impact was a decline in harvest.

3.3.3 Weather-related shocks villagers have faced

According to the majority of respondents in all household categories, the most accrued weather related shock was - destroyed cultivated crops followed by destroyed harvests (Table 31). Farmers said that the cultivations of the village were destroyed by the drought during the period. Food shortages and water shortages were other effects on farmers' livelihoods in unfavorable weather conditions.

Table 30. Distribution of farmer categories (%) by impact of climatic change on life of the villagers over the period 1970–2008.

	Impact									
Farmer category	There was an impact	Delay in commencement of cultivations	Insufficient water for plant growth	Death of plants	Decline in harvest	Harvest destroyed	Decline in expected income	Decline in cultivated area	No impact	No idea
Marginal households (n=14)	71	7	29	29	50	36	50	0	29	0
Small households (n=4)	100	0	50	25	25	25	50	0	0	0
Medium households (n=12)	83	0	25	17	25	8	25	8	8	8
Large households (n=20)	85	5	35	55	65	45	45	0	10	5

Table 31. Distribution of farmer categories (%) according to weather related shocks they have faced.

	Weather related shock											
Farmer category	Destroyed the cultivated crops	Destroyed the harvest	Displacements	Food shortages	Water shortages	Exposure to diseases	Death of animals	Sale of animals	Sale of assets	Loss of occupation	Reduction of income	Increase in food prices
Marginal households (n=14)	71	43	0	21	21	0	0	0	0	7	14	0
Small households (n=4)	100	25	0	50	25	0	0	0	25	0	0	0
Medium households (n=12)	50	42	8	8	25	8	8	8	0	0	0	17
Large households (n=20)	55	30	0	0	15	0	0	0	0	0	10	0

3.3.4 Migration due to climatic changes

Farmer migration was studied in terms of the climate change scenario. Different types of migratory categories and kinds of migration were included in the study (Table 32).

Table 32. Distribution of farmer categories (%) by migration due to climatic changes.

	Migration								
	Farmer migration		Due to climatic change		Migrated category			Kind of migration	
Farmer category	Have	Not have	Yes	No	Laborers	Farmers	Land owners	Temporary out migration	Permanent in migration
Marginal households (n=14)	86	14	29	50	36	43	7	57	71
Small households (n=4)	100	0	50	50	50	75	0	50	100
Medium households (n=12)	92	8	17	67	33	25	25	58	83
Large households (n=20)	95	5	25	60	45	60	40	60	85

3.3.5 Village hierarchies changed due to climatic changes

Status and change of village hierarchies were studied in terms of climate change and details of these are presented in Table 33.

Table 33. Distribution of farmer hierarchial categories (%) by climatic changes.

	Village hierarchies			
	Village hierarchies		Change due to climatic change	
Farmer category	Present	Absent	Changed	Not changed
Marginal households (n=14)	50	50	7	10
Small households (n=4)	50	50	25	25
Medium households (n=12)	66	33	8	50
Large households (n=20)	75	25	25	45

3.4 Major impacts observed at Bata-Atha village

Impacts of the climatic variability in Bata-Atha village were identified as water stress, crop damages, tsunami disaster and the changes in livelihoods of the villagers.

Water stress: During the early stages of colonization, people of the village used water from the stone well situated in the village for drinking, while the lagoon was used for other requirements. During the times of droughts, they had to spend nearly 4-5 hours travelling to fetch water from a nearby village. During the period 1978–1980, water shortages for cultivations occurred due to abandoning of the village tank and the paddy cultivation was almost given up by the villagers. In 1980, the villagers were faced with a drought that continued for two and half years. The Government had provided aid to the villagers during that period. The cultivation of seasonal crops has declined, including their major seasonal crop, sesame. Chena cultivations have drastically declined and some of the seasonal crops were confined to the home garden level.

Crop damages: In the period 2000–2002, the villagers were again exposed to a severe drought and the coconut cultivation in the village was severely damaged. This was by far, the greatest impact of climate change on the lives of the villagers. Some of the farmers were worried continuously about not receiving rains in time and, therefore, they gradually moved away from agriculture towards the fisheries industry. When considering the present situation of the village, the villagers believe that the people occupied in the fisheries industry have achieved more progress than those occupied with agricultural activities.

Tsunami disaster: A tsunami is a series of water waves (called a tsunami wave train) caused by the displacement of a large volume of a body of water, such as an ocean. One of the most powerful earthquakes on the planet hit the Asian continent in December 2004, with its epicenter at Ach, Indonesia. Some of the tsunamis reached as far as 1,600 kilometers (91,000 miles) from the epicenter of the 9.0 magnitude quake, which was located about 160 kilometers (100 miles) off the coast of Indonesia's Sumatra Island at a depth of about 10 kilometers (6.2 miles). The quake struck about 7 am Sunday (midnight GMT Saturday), according to the US Geological Survey's National Earthquake Center. The tsunamis also left thousands injured, thousands missing and hundreds of thousands homeless in Indonesia, India, Sri Lanka and Thailand. It was the fourth-largest earthquake since such measurements began in 1899, according to the National Earthquake Information Center (NEIC), tying with a 1952 quake in Kamchatka, Russia. More than 4,500 people were reported dead in Sri Lanka. Most of them, authorities said, were in the Eastern District of Batticaloa. Thousands were missing and more than a half million displaced. Witnesses in the eastern Sri Lankan port city Trincomalee reported 14 meter (40-foot) waves hitting inland as far as a kilometer (0.6 miles). The agricultural sector has been affected seriously. About 259 km^2 of paddy land had been destroyed in the northern, eastern, southern and western coastal belt of the country. In addition, the extensive salinization of paddy lands had rendered them unsuitable for paddy cultivation. Rubbish had also been deposited on paddy lands. A large number of agricultural vehicles and equipment have been destroyed and canals and drains have been blocked. Underground sources of water have also been salinated.

3.4.1 Tsunami impact

The total number of Divisional Secretary Divisions (DSD) in Hambantota District is 11. Out of this, four Divisional Secretary Divisions were affected by the tsunami of 2004. The affected Divisional Secretary Divisions are Tissamaharamaya, Hambantota, Ambalantota and Tangalle. The total number of *Grama Niladhari* Divisions (GND) in Hambantota District is 576. Out of this, 33 (nearly 5.8%) GND were affected by the tsunami.

Tsunami impact on Bata-Atha village: The *Grama Niladhari* Division of Bata–Atha South and the village Bata–Atha were also directly affected by the tsunami disaster in 2004 since the village faces the Indian Ocean. Originally, livelihoods were focused on agriculture and fishing; presently, the villagers are depending mainly on sea fishing. Fishing boats, associated fishing implements and some houses situated along the coast were damaged, but fortunately, no human deaths were reported from Bata-Atha due to the tsunami. This village is totally a rain-fed agriculture based village presently transformed into one with home garden based marginal agricultural activity, and day to day sea fishing as the major occupation. At present, the villagers of Bata-Atha are finding it very difficult to sustain their day to day livelihoods.

3.4.2 Weather related impacts on food prices

All the respondents have said that the food prices have gone up during the period (Table 34). According to the majority of the farmers, unfavorable weather has adversely affected and consequently increased food prices.

Figure 9. Tsunami impacts to Sri Lanka and to Hambantota District in 2004.

Table 34. Distribution of farmer categories (%) according to weather related impact on food prices.

	Food prices		Impact through weather pattern	
Farmer category	Increase	No change	Yes	No
Marginal households (n=26)	96	0	54	31
Medium households (n=24)	92	0	42	29

3.4.3 Impact of climatic change on life of the villagers

The majority of farmers have said that they have managed the weather shocks during the periods (Table 35). According to them, factors that determined the capacity to adapt to climatic changes were income diversifications, ownership of sources of water and financial wealth. Farmers were unable to manage the weather shocks since they were lacking of at least one of the above mentioned requirements. According to the majority of the respondents, migrations are taking place in the village. Some of the farmers have migrated due to climatic shocks. Both in-migrations and out-migrations have taken place, according to the respondents.

Table 35. Distribution of farmer categories (%) by factors determining the capacity of households to adapt to climatic changes.

	Number of farmers who managed weather shock		Factor determining the capacity to adapt to climatic change			
Farmer category	Managed	Not managed	Ownership of sources of water	Financial wealth	Gender	Depend on other jobs
Marginal households (n=26)	88	12	8	8	15	35
Small households (n=24)	83	13	13	8	4	21

3.4.4 Weather related shocks villagers have faced

Most of the respondents have said that the sustainable agricultural practices adopted by them were effective (Table 36). Drought tolerance ability of crops, low investment and higher yields were the main reasons to adopt sustainable agricultural practices by farmers.

Table 36. Distribution of farmer categories by reasons to adopt sustainable agricultural practices over the period 1970–2008.

		Methods				
Farmer category	Number of respondents	Effective	Not effective	Drought tolerance of crops	Least investment	Achievement of higher yield
Marginal households (n=26)	58	42	19	4	8	4
Small households (n=24)	54	33	21	4	13	8

3.4.5 Migration due to climatic changes

Immediate responses of the marginal householders to climatic shocks were diversification of means of livelihood, reduced consumptions, improvement of access to water availability and buying foods accordingly (Table 37). For small householders, improvement of access to water resources, reduced consumptions, diversification of means of livelihoods were the main responses.

Table 37. Distribution of farmer categories (%) by immediate response to climatic shock over the period 1970–2008.

	Immediate response to the climatic shock							
Farmer category	Migration	Diversification of means of livelihood	Improvement of access to water availability through watersheds	Mobilization and use of collected resources that are held collectively	Reduced consumption	Obtain loans	Selling of assets	Buying foods
Marginal households (n=26)	12	50	31	12	42	4	12	27
Small households (n=24)	13	29	38	4	33	8	13	13

3.4.6 Farmer attitudes changed due to climatic variations

According to the majority of respondents, their attitudes have not changed through climatic changes (Table 38). Some of the farmers have said that their attitudes have changed and among them most of the attitudes have changed for the better to adapt with those changes.

Table 38. Distribution of farmer categories (%) by attitude change due to climatic shock over the period 1970–2008.

Farmer category	Number of farmers who responded		Kind of attitudes	
	Changed	Not changed	Better	Worse
Marginal households (0-1 ha) (n=26)	23	69	19	0
Small households (1-2 ha) (n=24)	29	63	21	0

4. Vulnerability

4.1 Vulnerability issues in Mangalapura village

Vulnerability due to climatic change, impact and adaptation measures vary with the type/ size of the households. Hence, this aspect is discussed in terms of different household categories.

Marginal households (Less than 1 ha): When marginal farmers faced a climatic shock, their immediate responses have been diversification of means of livelihoods, obtaining loans and selling of assets. When they were asked about the future vulnerability and proactive measures, the majority of the respondents had no idea regarding the issue and some of the farmers stated that switching over to less water consuming crops and adopting more efficient irrigation practices could be the better follow up measures. In the event of a drought in the next year, the majority of them believed in cultural faiths and rituals, and some of them said that they would rather limit their agricultural practices.

Small households (1–2 ha): The small households will respond to climatic shocks by diversification of means of livelihood, reduced consumption and selling of livestock. The proactive measures for possible future shocks were identified as switching to less water consuming crops and watershed management systems. If and when they have to face a drought the next year, they said that they would resort to finding new sources of water and ask for subsidies.

Medium households (2–4 ha): Immediate responses of the medium households to climatic shocks were selling of livestock and diversification of means of livelihoods. Their proactive measures for future shocks would be digging deep wells. If and when there is a drought next year they would use short term varieties of crops and put their trust in cultural faiths and rituals.

Large households (More than 4 ha): Immediate response of the large households towards climatic shock would be diversification of their means of livelihoods. This was confirmed by the majority of respondents. They identified crop diversification, watershed systems and soil conservation measures as the proactive measures for probable future shocks. In the event of a drought in the next year they would increase the water supply for their farms by purchasing water from external sources and use short term crop varieties (crop escapers) to minimize the effects of drought.

4.1.1 Future Vulnerability

Farmers in different farmer categories were asked about the proactive measures counterpleaded by them for possible future disasters. Accordingly, marginal householders have said that they would be switching to less water consuming crops, adopting more efficient irrigation practices and diversification of crops. Small households have highlighted switching to less water consuming crops and watershed systems as their proactive measures. Medium householders have said that they hope to have deeper wells in addition to other means. Large householders have mentioned about adopting more efficient irrigation practices, groundwater recharging and adopting methods of soil conservation (Table 39).

Marginal households have said that they would rely on cultural faith and rituals if there is a drought next year. Most of the respondents of the small household category would search for new sources of water and ask for subsidies. Medium and larger categories have different options such as search for new sources of water, limit the agricultural practices, cultural faiths and rituals, use of short term varieties and find other occupations (Table 40).

Table 39. Distribution of farmer categories (%) by proactive measures counterpleaded by them for possible future disasters.

	Proactive measures for possible future shocks								
Farmer category	Switching to less water consuming crops	Watershed systems	Adopting more efficient irrigation practices	Groundwater recharging	Altering dates for agricultural operations	Diversification of crops	Methods of soil conservation	Buying groundwater	Digging deeper wells
Marginal households (n=14)	14	0	14	0	0	7	0	0	0
Small households (n=4)	25	25	0	0	0	0	0	0	0
Medium households (n=12)	8	0	8	8	0	0	0	0	17
Large households (n=20)	10	10	5	10	5	10	10	5	0

Table 40. Distribution of farmer categories (%) by actions to be taken at a drought in the coming year.

	Actions to be taken at a drought next year									
Farmer category	Increase the water supply	Search for new sources of water	Limit the agricultural practices	Establish irrigation schemes	Cultural faiths and rituals	Use short term varieties	Ask for subsidies	Discard the cultivations	Collective actions	Find another occupation
Marginal households (n=14)	0	7	29	14	36	21	7	14	0	14
Small households (n=4)	0	50	25	0	25	0	50	0	25	0
Medium households (n=12)	0	17	17	17	25	25	0	8	0	8
Large households (n=20)	20	10	15	15	25	15	10	0	10	15

4.2 Vulnerability issues in Galahitiyagama village

The degree of vulnerability due to a climatic shock depends on the scale of the householder. Only three categories of households (small, medium and large) were seen in Galahitiyagama, while the marginal households category (less than 1 ha) was not seen. Perceptions of different household categories were recorded based on the Focus Group Discussions at Galahitiyagama in Anuradhapura District.

Small households (1–2 ha): The immediate response of the small households towards any climatic shock was diversification of the means of livelihoods. Diversification has changed their means of earning to labor hiring, carpentry and masonary. They said that their proactive measures for possible future shocks are switching to crops having less water consumption, improving watershed conservation measures and digging deeper wells. If and when there is a drought in the next year, their actions would be to search for new sources of water and to limit agricultural practices.

Medium households (2–4 ha): The immediate response of the medium householders to a climatic shock was diversification of livelihoods such as working as hired labor, carpentry work, etc, and mobilization and use of collected resources. Most of the farmers indicated that proactive measures for future shocks are switching to less water consumption crops and digging of deeper wells. If and when there is a drought in the next year, the actions to be taken could be limiting the agricultural practices and searching for new sources of water.

Large households (more than 4 ha): Immediate responses to a climatic shock were diversification of the means of livelihoods, mobilization and use of collected resources. Switching to less water consuming crops is the proactive measure for possible future shocks. In the event of drought in the next year, most of the farmers indicated that they would search for new sources of water.

4.2.1 Future Vulnerability

The majority of the farmers have mentioned that switching over to less water consuming crops and digging of deeper wells were the protective measures to safeguard farmers from possible future shocks (Table 41). Improvement of the watershed systems and changing the crop variety of cultivated crops were other proactive measures to minimize future vulnerabilities according to farmer responses. Search for new sources of water, limit the agricultural practices, establish an irrigation scheme and obtain aids were the actions to be taken in the event of a probable drought in the next year, according to the majority of farmers (Table 42).

Table 41. Distribution of farmer categories (%) by proactive measures counterpleaded for future shocks.

	Proactive measures for possible future shocks			
Farmer category	Switching to lesser water consuming crops	Watershed systems	Changed cultivated crops	Deep well
Small households (n=17)	24	24	6	24
Medium households (n=27)	15	7	4	26
Large households (n=16)	31	25	19	13

Table 42. Frequency distribution of farmer categories by actions to be taken at a drought in the following year.

Farmer category	Actions to be taken in the event of a drought next year				
	Search for new sources of water	Limit the agricultural practices	Establish the irrigation schemes	Get aid	No ideas
Small households (n=17)	12	12	18	6	12
Medium households (n=27)	11	11	7	4	19
Large households (n=16)	6	6	0	0	19

4.3 Vulnerability issues in Mahagalwewa village

Marginal households (less than 1 ha): Immediate responses of the marginal householders to the climatic shock were use of collected resources, reduced consumption of food items and improvement of access to water availability through watersheds. They said that the improvement of watershed systems is the proactive measure for future vulnerabilities. Most of the farmers had no clear idea regarding the actions to be taken in the event of a drought in the following years, while some of the farmers said that an irrigation system should be provided.

Small households (1–2 ha): Immediate responses of the small households to a climatic shock were diversification of means of livelihoods, obtaining loans and selling of assets. They also stated that the improvement of watershed systems is the proactive measure for future vulnerabilities. Most of the farmers in the small household category also had no clear idea regarding the actions to be taken in the event of a drought in the following years, while some of them also said that an irrigation system should be provided.

Medium households (2–4 ha): Reducing consumption and the use of collected resources were the immediate responses of the medium householders to the climatic shocks. Improvement of the watershed systems was the proactive measure suggested by the medium householders for probable future shocks.

4.3.1 Future Vulnerability

Farmers in different categories were asked about the proactive measures counterpleaded for possible future shocks (Table 43). Accordingly, marginal households have said that they would be switching to less water consuming crops, adopting more efficient irrigation practices and diversification of crops. Small households have listed switching to lesser water consuming crops and watershed systems as their proactive measures. Medium households have included digging deeper wells in addition to the above. Large households have mentioned about adopting more efficient irrigation practices, groundwater recharging and adopting soil conservation methods.

Table 43. Distribution of farmer categories (%) by proactive measures counterpleaded for future shocks.

	Proactive measures for possible future shocks								
Farmer category	Switching to lesser water consuming crops	Watershed systems	Adopting more efficient irrigation practices	Groundwater recharging	Altering dates for agricultural operations	Diversification of crops	Methods of soil conservation	Buying groundwater	Digging deeper wells
Marginal households (n=14)	14	0	14	0	0	7	0	0	0
Small households (n=4)	25	25	0	0	0	0	0	0	0
Medium households (n=12)	8	0	8	8	0	0	0	0	17
Large households (n=20)	10	10	5	10	5	10	10	5	0

Marginal households have said that they would rely on cultural faith and rituals if and when there is a drought next year (Table 44). Most of the respondents of the small household category would search for new sources of water and ask for subsidies. Medium and larger household categories have different options such as search for new sources of water, limit the agricultural practices, rely on cultural faiths and rituals, use short term varieties and find other occupations.

Table 44. Distribution of farmer categories (%) by actions to be taken during a drought in the following year.

Farmer category	Actions to be taken in the event of drought next year										
	Increase the water supply	Search for new sources of water	Limit the agricultural practices	Establish the irrigation schemes	Cultural faiths and rituals	Use short term varieties	Ask for subsidies	Discard the cultivations	Collective actions	Find another occupation
Marginal households (n=14)	0	7	29	14	36	21	7	14	0	14
Small households (n=4)	0	50	25	0	25	0	50	0	25	0
Medium households (n=12)	0	17	17	17	25	25	0	8	0	8
Large households (n=20)	20	10	15	15	25	15	10	0	10	15

4.4 Vulnerability issues in Bata-Atha village

Since vulnerability of the villagers varies with the size of the households, it has been described in terms of household categories. As mentioned earlier, medium and large household categories were not available in Bata-Atha.

Marginal households (less than 1 ha): The immediate response of the marginal householders to a climatic shock was diversification of means of livelihoods to income sources related to the fisheries industry and reduced consumption of food items. Their proactive measures for possible future shocks were indicated as switching to less water consuming crops and practicing new irrigation methods. Most of them had no clear idea of the actions to be taken in the event of a drought in the next year.

Small households (1–2 ha): The immediate responses of the small householders to climatic shock were: improve access to water availability through watersheds, diversify means of livelihoods and reduce the consumption of food items. Possible proactive measures for future shocks were switching over to less water consuming crops, conservation of watersheds, digging of deeper wells and practicing new irrigation methods. They also did not have any clear idea of the actions to be taken in the event of a drought in the next year.

4.4.1 Future Vulnerability

According to the majority of farmers, Government interventions were required by marginal and small householders to minimize the effects of climatic shocks (Table 45).

Table 45. Frequency distribution of farmer categories by interventions required to minimize the effects of climatic shocks.

	Type of intervention required		Intervention required to manage the effects of climatic shocks	
Farmer category	Govt.	Non Govt.	Improving existing water resources	Introduction of improved technology
Marginal households (n=26)	23	12	12	4
Small households (n=24)	29	4	4	8

5. Adaptation

5.1 Adaptation strategies followed in Mangalapura village

The villagers reflected on the impact of climatic changes on their lives. The ability to adapt is influenced by the role of institutions and socio-economic capacity of the villagers across different types of farmers. It is important to note how villagers were reacting to these climatic shocks in terms of their scale of operation. Further, these reactions are technological or non-technological in nature.

5.1.1 Technological

Technological adaptation may be considered either as (i) introduced or (ii) non-introduced influence. Introduced influence can be described as the technology that is introduced by an outside agency to ease the activities of the villages. Non-introduced influences are those that are invented or discovered by the villagers themselves.

Introduced technologies: Introduced technology is defined as any form of technology that farmers adopt having obtained them from outside the knowledge base they have developed from generations of farming experiences. Introduced technologies are again divided into machinery and crop recommendations. Some of the examples given from Mangalapura village for machinery were: tube wells, deep water pumps, drip irrigation system and net houses, while hybrid seeds, fertilizer recommendations and agro-chemicals were considered as crop recommendations. New melon hybrid (sugar baby) was introduced in the year 2000 and with this new crop recommendation, yields and gross margin of the farmers had increased.

There are three tube wells installed in three locations in 1965 in Vanathavilluwa. Among them, only one is working at present. There were three small tube wells installed at Mangalapura during the period 1987–1995, and none of them are functioning at present. Altogether, two wells are found in Mangalapura but none of them are usable at present. The drip irrigation system is being used by larger scale farmers in coconut plantations. Current depths of a tube well and normal well are between 9 m and a maximum of 90 m (30 ft- 300 ft). Water availability in villus[2] is at a minimum level during dry periods. Villagers in Mangalapura do not have sprinklers for cultivation. There were five 4-wheel tractors, nineteen 2-wheel tractors and no threshers recorded at Mangalapura in 2009 by which farming had become less time consuming and hence easier to increase the yield of the crops.

Non-introduced technologies: Some of the technologies that are used by the villagers at Mangalapura were: Perennial crops (fruit crops such as mango, citrus, etc), short term high value crops/ early escapers (hybrid melon sugar baby), Chena cultivation (zero fertilizer and zero agro chemicals used during *Yala* season by the first generation farmers), pitcher irrigation system for plants to overcome water stress situations and changing the time of commencement of cultivations. The above technologies that are used traditionally by farmers through learning by practice may be considered as direct adaptation measures for climatic variability and their impacts. Adaptation of non-introduced technologies varies among the different farmer categories.

First generation farmers: First generation farmers at Mangalapura village have cultivated seasonal crops such as vegetables (chili, okra, pumpkin, brinjal, etc) and pulses (cowpea, green gram, black gram, etc) generally in home gardens. Required instructions have been provided by the Agrarian Service Centre (ASC) at Vanathavilluwa. However, chena cultivation is one of the traditional cultivation practices that were adopted by the first generation farmers at Mangalapura. It required no fertilizer and agro chemicals, hence, it is a derived technology by them. Chena cultivation is mainly done by family labor, hence no cost of labor is involved.

Second generation farmers: The second generation farmers in the village have cultivated seasonal crops in home gardens and chena as their forefathers had done. Most of the cultivations and marketing practices related to seasonal crops are almost similar to the methods of the previous

2. Although there are no large natural lakes in Sri Lanka, there are several flood-plain lakes, commonly referred to as villu, which cover a total area of 12,500 ha. Often they are cut-off former river bends. (http://wordnetweb.princeton.edu/perl/webwns=villus)

generation. However, they were eager to try something different to reduce risk and uncertainty in their cultivations due to climatic variability and also to reduce drudgery of their day to day work. A considerable number of farmers have shifted to perennial crop cultivations such as cashew, coconut and some fruit crops like mangoes and citrus.

Third generation farmers: Third generation farmers are more innovative than their previous generations. They practice chena cultivation, which is a more efficient system for seasonal vegetable crops and pulses. Similar to the previous generations, the shift from seasonal crops to perennial crops has been undertaken but to a slightly higher degree. Third generation farmers are more innovative in terms of moving to short term cash crops such as hybrid melon (eg, sugar baby) from which they were able to earn considerable gross margins for their living. Since the melon crop requires only 90 days before harvesting can start, negative impacts, and risk and uncertainty due to climatic shocks have been minimized.

5.1.2 Changes in the cropping patterns

When comparing the cultivated extent of chili, onion, finger millet, green gram, black gram, groundnut, brinjal and mustard in 1970s and 2008, the areas have decreased in Yala and Maha seasons. The cultivated extent of water melon has increased in both seasons during the period. Most of the seasonal crop cultivations had changed to perennial crop cultivations. The major perennial crop cultivated in Mangalapura village was cashew and the cultivated extent has increased. Coconut and mango cultivations have also increased while banana cultivation has decreased. Drought tolerance ability, higher income through better market demand, attractive prices, better marketing conditions and low usage of inputs were the main reasons to adopt hybrid cashew varieties. Puttalam district is one of the districts of the coconut triangle in Sri Lanka. Hence, coconut cultivation is one of the major income sources among the medium and large scale farmers. Farmers in Mangalapura have also invested in coconut cultivations to take the maximum advantage of the prevailing optimum conditions.

Chena cultivations were popular among the first generation farmers in Mangalapura. At present, chena cultivations are hardly practiced by the second and third generation farmers. Instead, they clear the vegetation prior to the start of the monsoons and then prepare the land using machineries to cultivate hybrid water melons. Water melon cultivations are maintained under rain-fed conditions, but they use higher amount of inputs as fertilizer and pesticides. The traditional chena cultivations that were found in Mangalapura are now being replaced by hybrid watermelon cultivations. This was mainly influenced by the short duration of the crop, better market conditions and the higher returns obtained by the cultivators.

5.1.3 Institutions to aid adaptive capacities

Various institutions have been providing their services to the village communities to support their adaptive efforts. Basically, two forms of institutions were identified as formal and informal depending on their organizational structure. Formal institutions are structured organizations and informal institutions are those systems that were created more out of a sense of belonging, shared beliefs and faith of the people. In this exercise, attention was paid to judge enabling mechanism of all institutions when the community faces any extreme climatic event. Extending the same exercise, perceptions of public officers, adult males and females who are residing in the village were ranked based on the services rendered by these institutions in terms of providing subsidies, information and assistance in emergency situations.

Formal institutions: Among the formal institutions that provide supportive services to the villagers at Mangalapura to strengthen the adaptive capacities, Divisional Secretariat at Vanathavilluwa, village school, *Grama Niladhari* office and office of the *Samurdhi*[3] *Niladhari* ranked high while Agrarian Services Centre (ASC) Rural Development Society, *Samurdhi* Bank and Ayurvedic Hospital ranked at the second level. Other formal institutions listed by the villagers in terms of their degree of supportive services to encourage adaptive capacities of the villagers are highlighted in Table 7. The services of the formal institutions mentioned above in terms of improving the adaptive capacities of the villagers were: 1) Divisional Secretariat in distributing subsidies and assisting in recovering activities. *Grama Niladhari* is the person who coordinates such activities with the Divisional Secretariat office. 2) Agrarian Services Center assists the farmers in obtaining agricultural equipment, seeds, planting materials and information on agricultural activities. 3) *Samurdhi* Bank is a micro financial institution that provides credit facilities to villagers. 4) World Vision International is an International non-governmental organization that assists in micro finance activities, providing agricultural equipment, seeds for cultivation, and giving instructions for their cultivation.

Informal institutions: Informal institutions are systems that were created more from a sense of belonging, shared beliefs and faith of the people. Examples of such informal institutions listed by public officers and adult males and females in Mangalapura village were *Dayaka Sabha* at temples, societies at churches, senior citizens' society and School Development Society. The services of the above mentioned institutions in the village vary to different degrees and these are highlighted in Table 6.

More trust was placed on family members and relatives in an event like a drought or a flood. In addition to these, villagers can rely on the government and non-governmental organizations.

5.1.4 Socio-economic behavior

Socio-economic behavior in the context of adaptive capacity of a group or an individual to cope with extreme climatic events is considered in this context. Different cropping mechanisms were identified by different farmer categories at Mangalapura in an extreme climatic event.

Marginal householders (less than 1 ha): During the Focus Group Discussion, the majority of the marginal household farmers have mentioned about the diversification of means of their livelihoods. It was explained further that usually they earned income from farming activities, which was not sufficient for their day to day living. Hence, they mainly get engaged in non-farm labor hiring activities such as masonry, carpentry and brick-making, to earn additional income for their living. Some of the marginal farmers have obtained loans while others have no alternative other than selling their assets to get money for their day to day living as a coping strategy in an extreme climatic event.

Small householders (1-2 ha): Several coping strategies were undertaken by the small householders in such situations such as selling of their assets for their day to day living, diversification of means of livelihoods, selling of their livestock, either to earn an additional income or to reduce burden from maintaining the livestock and thereby directly reduce the daily consumption.

Medium scale householders (2-4 ha): Among the coping strategies that medium scale householders have adapted were: selling of livestock for their living, diversification of means of livelihoods, selling of assets and reduced consumption.

3. Samurdhi is a Government welfare program to alleviate poverty in Sri Lanka. Janasaviya was the earlier name given by the previous political party.

Large scale householders (more than 4 ha): Large scale householders have selected a number of strategies as coping mechanisms to face adverse climatic events. Among the strategies, diversification of means of livelihoods in terms of crops by shifting from seasonal crop cultivation to perennial crop cultivation in different degrees is the primary one. In such instances, large scale farmers were able to earn a stable income regardless of such calamities. Further, they used the water purchased from an outside source for the purpose of irrigation. Apart from this, they used to utilize previously collected resources in extreme climatic events.

Since the income received from agriculture at present is not sufficient for living, villagers tend to hire their labor outside agriculture. Villagers could not maintain their crop cultivations due to insufficiency of water. When the income from agriculture is not sufficient, family members who are engaged in farming look for financial assistance from other family members who are engaged in non-farming activities.

Collective actions: According to the majority of the respondents in the categories of marginal, medium and large households, the form of assistance they had in the event of a drought was from the Government while small households had assistance from political affiliations, kinship and relations. The majority in all household categories prefer collective action in funerals and marriages. Small and medium householders prefer collective actions in obtaining agricultural information, seeds and obtaining credits. Collective action towards a drought is rather low compared to other situations in all household categories. In an event such as a drought or flood, villagers do not act collectively, but they feel that collective actions in such events are more appropriate. However, collective actions can be seen in Sri Lankan villages only at weddings, funerals, religious activities, societies and in obtaining loans.

5.1.5 Resources

At present, farmers in Mangalapura village are mainly growing perennial crops and short term cash crops to generate higher income. Cultivation of seasonal crops such as cowpea, finger millet, groundnut and other cereals and pulses are mainly at home garden level. Since they do not sell these produce at markets, they store them in their homes for household consumption during the off seasons and vulnerable periods. If the households have a shortage of food, they find help from their relatives or neighbors who may be able to help them in crisis situations. The cashew harvest is stored in households to sell them in off seasons at a higher price. This ensures an income during off seasons or at difficult times and enables them to buy food items during these periods. When the farmers were asked about the criteria that they could use to rank villagers as “rich” or “poor”, they had different views. The criteria used by the male adults of the village were: ownership of land, level of income, occupation (Government jobs/self employment, agriculture and animal husbandry), higher level of education, availability of electricity supply at houses, capability of organized working, availability of infrastructure facilities, availability of modern machinery and equipment and resistance to dry weather (capability of satisfying water requirements at personal level). The criteria used by the female adults to rank the wealth were: occupation of a Government service/permanent job, holding of a larger extent of cultivated or cultivable lands, ownership of business enterprises, possession of personal vehicles, capability of purchasing lands, higher level of education, possession of houses of good standard, not being a laborer and capability of collective working environments (Table 46).

Table 46. Perception on the importance of institutions to aid adaptive capacities in Mangalapura.

Groups	Formal											
	Grama Niladhari Office	School	Divisional Secretariat	Ayurvedic Hospital	Agrarian Services Centre	Office of the Samurdhi Development Officer	Samurdhi Bank	Rural Development Society	Welfare Society (Funeral)	Youth Society	Farmers' Society	World Vision Society
Public officers	H	H	H	M	M	M	L	L	L	L	L	L
Male adults	M	H	H	M	L	H	M	H	M	L	L	M
Female adults	H	H	H	M	H	H	H	H	L	M	H	L

Groups	**Formal**								**Informal**			
	Pradeshiya Sabha	Pubudu Sports Club	Cooperative Society	Police	Agrarian Research Institute	Samurdhi Society	Government Hospital	Agrarian Research Office	School Development Society	Senior Citizens' Society	Dayaka Sabha	Society at Church
Public officers	L	L	L	L	L	L	M	L	H	M	M	L
Male adults	M	M	L	M	L	L	M	L	M	M	M	L
Female adults	M	L	H	L	H	M	M	L	H	H	H	H

Source: Focus Group Discussion with farmers in Mangalapura 2010. H= High; M= Medium; L= Low

Youths have stated that their criteria for measuring the wealth of a particular person was: possession of personal vehicles, receiving higher income from employment, ownership of lands, ownership of houses and their quality, availability of savings and self-sufficiency.

Social/Resource Map

Two groups of villagers selected at random were engaged in mapping the village. This activity was carried out using a map prepared during a previous occasion.

Social Map

This group consisted of four males and two females. The two males were public servants. It should be highlighted that the main contribution was made by the *Grama Niladhari* of Bandaranayakapura with another male representative. Even though the contribution of females was at the minimum level, female representatives have shown more enthusiasm than their male counterparts in the *Wagawa* Programme. Several persons brought an argument that there were two lakes within the village. Several others including the *Grama Niladhari* tried to prove that there were no lakes in the village. A certain disagreement arose on the number of lakes in the village. Finally, with the concurrence of all participants, it was decided that there were two lakes in the village, of which one is still used by the people while the other was in a state of wilderness, and both were included in the map. Further, one person pointed out that there was an ancient village called *Devamittapura*, but this was not accepted by certain participants.

Resource Map

A group was selected at random to prepare the map, entering the resources available in the *Grama Niladhari* Division, Mangalapura. This group consisted of four males including a Public Officer, two youths and four females. At the commencement, the contribution of females was not so enthusiastic and they were of the view that more contribution could be obtained from the *Grama Niladhari*. The contribution of the male party was at a higher level in entering resources on this map while the female members made a contribution at a considerable level in documenting quantitative data. When obtaining information on the extent of service of the agriculture research institute, a

Figure 10. Social map of Mangalapura.

Figure 11. Resource map of Mangalapura.

conclusion was arrived at, followed by a brief discussion. It was stated that there was a reservation of 20 ha (50 acres) at the boundary of *Devamittapura*, but situated outside the *Grama Niladhari* Division, Mangalapura.

5.1.6 Adaptation to and Coping with Climate Change

5.1.6.1 Factors determining the capacity of households to adapt to climatic changes

Ownership of sources of water was considered as the major factor determining the capacity to adapt to climatic change, according to the majority of respondents in the marginal and small households. For medium households, the major factors were ownership of sources of water and the attitudes of the people to determine the capacity of adapting to climatic change. Financial assets, and ownership of sources of water were the major factors for large households according to the majority of the respondents (Table 47).

Table 47. Distribution of farmer categories (%) by factors determining the capacity of households to adapt to climatic changes.

	Factors determining the capacity to adapt to climatic change						
Farmer category	Financial wealth	Ownership of sources of water	Good health	Occupation	Water storage capability	Attitudes	Age
Marginal households (n=14)	0	29	0	7	0	0	0
Small households (n=4)	0	50	0	25	0	0	0
Medium households (n=12)	8	17	0	8	0	17	0
Large households (n=20)	10	10	5	0	5	0	5

5.1.7 Institutional Capacities

5.1.7.1 Institutions' approach in the event of a drought

Government institutions were the main institutions approached by the marginal, medium and larger households in the event of a drought. Most of the farmers in the small household category have said that political affiliations, kinship and relatives were the major institutions approached by them (Table 48).

Table 48. Frequency distribution of farmer categories by institutions approached in the event of a drought .

Scale of preference	Marginal households	Small households (n=17)	Medium households (n=27)	Large households (n=16)
1	Governmental organizations	Governmental organizations	Governmental organizations	Governmental organizations
2	Kinship and relatives	Kinship and relatives	Non-governmental organizations	Kinship and relatives
3	Non-governmental organizations	Villagers	Kinship and relatives	Non-governmental organizations
4	Villagers	Non-governmental organizations	Political affiliations	One person
5	One person	Political affiliations	Villagers	Villagers
6	Political affiliations	School	One person	Private organization
7	Private Organization	One person	Private organization	Political affiliations

5.1.8 Motivational factors for being part of the local groups

According to the majority of respondents of the marginal households, the major motivational factor was assisting in social events of the village such as funerals. Ease of obtaining loans was considered as the major motivational factor by the medium and large households. For small households, ease of obtaining loans, supplement of agricultural inputs and tools, assistance in social events of the village, ease of obtaining subsidies in events like disasters, and assistance in self-employment are also motivational factors to participate in local groups (Table 49).

5.1.9 Collective action that evolved when there was a drought/ flood

When considering the preference for collective action, respondents of all household categories said that the majority prefer the collective action for obtaining agricultural information, obtaining credit, purchasing inputs, storage /sale of outputs, and for funerals /marriages. For droughts, most of them prefer individual actions (Table 50).

Table 49. Distribution of farmer categories (%) by motivational factors for being part of the local groups.

Farmer category	Motivational factor							
	Easy to obtain loans	Easy to obtain subsidies in events like disasters	Supplement of agricultural inputs, tools/ machineries	Assist in selling of agricultural outputs	Giving knowledge and instructions for agricultural operations	Assist in social events of the village	Assist in self employment	Due to the force by family members
Marginal households (n=14)	29	21	7	7	7	36	0	0
Small households (n=4)	25	0	25	0	0	25	0	0
Medium households (n=12)	67	25	25	0	8	42	0	8
Large households (n=20)	35	15	10	0	0	20	10	0

Table 50. Distribution of farmer categories (%) by preference for collective action versus individual action.

Farmer category	Obtaining agricultural information /seeds		Obtaining credit		Purchasing inputs		Storage/sale of produce		Funerals/ marriages		Drought	
	Collective	Individual	Collective	Individual	Collective	Individual	Collective	Individual	Collective	Individual	Collective	Individual
Marginal households (n=14)	29	7	36	7	29	7	21	7	57	0	14	0
Small households (n=4)	50	25	75	25	25	25	25	25	75	0	25	25
Medium households (n=12)	50	0	58	0	25	0	42	0	75	0	17	8
Large households (n=20)	25	0	35	0	25	0	20	0	75	0	30	15

5.1.10 Socio-Economic Capacities

5.1.10.1 Sufficiency of income from agriculture

Most of the farmers believe that their income generated through agricultural activities is not fully sufficient to carry out the planned activities of the year (Table 51). Kinship support is the main method to overcome the deficit from agriculture for the marginal and large households. For small households, borrowing money from local money lenders /cooperatives is the main method to overcome the deficit. Respondents of medium households have said that kinship support and borrowing money from local money lenders/ cooperatives were the main methods to overcome the deficit.

Table 51. Distribution of farmer categories (%) by methods to overcome the deficit from agricultural operations.

	Method to overcome the deficit from agriculture			
Farmer category	Kinship support	Relief assistance or opting for some government scheme	Reducing consumption	Borrowing money from local money lenders/ cooperatives
Marginal households (n=14)	29	7	0	14
Small households (n=4)	25	25	25	75
Medium households (n=12)	50	42	17	50
Large households (n=20)	50	5	0	15

5.1.10.2 Alternate forms of livelihood or agricultural practices

Most of the farmers' felt that the major alternative was to change the cultivations to perennials. The major perennial crop cultivated was cashew and the drought resistant ability of the crop was considered as the main reason to adopt it. The majority of the farmers in the small households category have said that their alternative was changing the occupation and the reasons for adoption was the ability to get a higher income when compared to agricultural activities (Table 52).

Table 52. Distribution of farmer categories (%) by reasons to adopt alternative forms of agriculture.

Farmer category	Reasons to adopt the alternative forms of agriculture							
	Resistance to drought	High income	Easy management	Least damages from pests and animals	Generation of income within a short period	Due to reduced fertility status of soil	High demand	Low cost
Marginal households (n=14)	50	21	7	0	0	7	7	0
Small households (n=4)	50	75	0	0	25	0	50	0
Medium households (n=12)	50	42	8	0	17	0	0	0
Large households (n=20)	75	35	10	10	25	0	0	15

5.1.11 Information and Knowledge Capacities

Most of the farmers have said that the information source they used to find alternative forms of agriculture was neighboring farmers (Table 53). Some of the farmers have also used sources such as agricultural instructors, government institutions and non-government institutions, while some others have used their own experience to find alternative forms of agriculture.

Table 53. Distribution of farmer categories (%) by information sources needed to find the alternative forms of agriculture.

	Information source needed to find the alternative forms of agriculture				
Farmer category	From neighboring farmers	Through agriculture instructors	Government institutions	Non-government institutions	Through own experience
Marginal households (n=14)	43	7	21	0	14
Small households (n=4)	50	25	25	0	0
Medium households (n=12)	67	8	17	17	8
Large households (n=20)	65	5	35	0	20

5.1.12 Technological Capacities

Most of the respondents in all household categories have used hybrids to cope with changing weather conditions. Some of the farmers have used new irrigation methods and new cultivation methods to deal with such difficulties (Table 54 and 55). Farmers have used different means to increase the profitability by adoption of technology. Some farmers in the marginal household category have increased their profitability by increasing the production, improving the soil fertility and by maintaining crops at a minimum level of damages. Large householders have increased that income by user friendly farming practices, increased production, improvement of soil fertility and by low usage of laborers in their cultivations (Table 56).

Table 54. Distribution of farmer categories (%) by technology used to cope with changing weather conditions

Farmer category	Technology used to cope with changing weather conditions									
	New irrigation method	Pump water from an irrigation well	New cultivation methods	Pitcher irrigation	Use of hybrids	New machineries	Constructing tube wells	Planting agro forests	Net houses	Improved fertilizers
Marginal households (n=14)	0	7	0	0	14	0	0	0	7	0
Small households (n=4)	25	25	0	0	25	0	0	25	0	0
Medium households (n=12)	8	0	17	8	33	0	8	0	17	17
Large households (n=20)	5	0	10	20	30	5	0	10	0	5

Table 55. Distribution of farmer categories (%) by constraints involved with adoption of technology.

	Constraint involved with technology adoption								
Farmer category	Water shortages	Harvesting difficulties	High cost involved	Higher occurrence of pest attacks	Higher utilization of chemical fertilizers	Lack of knowledge	Low durability	High labor usage	No constraints
Marginal households (n=14)	0	0	0	0	0	7	0	0	7
Small households (n=4)	25	0	0	0	25	0	0	0	0
Medium households (n=12)	25	0	0	0	0	17	0	0	0
Large households (n=20)	5	5	10	10	5	10	5	10	5

Table 56. Distribution of farmer categories (%) by means of increasing profitability by adoption of technology.

Farmer category	Means of increasing profitability by adoption of technology						
	User friendly farming practices	Increased production	Improvement of soil fertility	Low labor usage	Increase soil moisture	Least damages to crops	Ability to cultivate in drought conditions
Marginal households (n=14)	0	7	7	0	0	7	0
Small households (n=4)	0	25	0	0	0	25	0
Medium households (n=12)	8	17	17	0	0	0	0
Large households (n=20)	15	20	15	10	5	0	10

Successful action taken at previous occasions of droughts

The majority of respondents in all households have said that the successful actions taken during a drought were obtaining subsidies, reporting to cultural faith and rituals and supplementing water through bowsers (Table 57).

Table 57. Distribution of farmer categories (%) by successful actions taken at previous occasions of droughts.

Farmer category	Successful action taken during previous occasions of droughts									
	Subsidies	Soil conservation methods	Searched for new sources of water	Use of short term varieties	Cultural faiths and rituals	Storage of output	Use of efficient irrigation methods	Government aids	Supply of water through bowsers
Marginal households (n=14)	29	0	0	7	21	14	0	7	36
Small households (n=4)	50	25	25	0	25	0	0	0	0
Medium households (n=12)	42	8	8	0	8	8	0	0	17
Large households (n=20)	25	10	10	0	20	0	5	0	15

Most of the respondents have said that the establishment of an irrigations scheme is needed to minimize the effects of climatic shocks. Some of the farmers have said the interventions required were constructing a tube well, improving existing water sources, obtaining subsidies and providing better facilities for drinking water (Table 58).

Table 58. Distribution of farmer categories (%) by interventions required to minimize the effects of climatic shocks.

Farmer category	Intervention required to manage the effects of climatic shocks									
	Construction of a tube well	Improving existing water sources	Establishment of an irrigation scheme	Subsidies	Introduction of crop varieties resistant to drought	Provide facilities for drinking water	Introduction of improved technology	Provide information and instructions	Introduction of a water harvesting method
Marginal households (n=14)	36	21	50	0	14	0	7	0	0
Small households (n=4)	25	25	25	0	25	0	25	0	0
Medium households (n=12)	8	0	33	25	8	25	8	0	0
Large households (n=20)	20	20	45	5	25	5	10	10	5

5.1.13 Adaptation strategies

When considering the adaptation strategies at farm level, it was indicated that the desirable step is to change the seasonal crop cultivations to perennial crop cultivations. Utilizing government support through subsidies was considered as the main adaptation strategy (Table 59). Use of hybrids, short duration varieties and resistant varieties were the adoptation strategies practiced at the technological level. Establishment of better kinship ties was the strategy adopted at the social level. The preferred coping mechanism by marginal and larger householders was diversification of means of their livelihoods. Most of the villagers have taken up different occupations other than engaging in agriculture based activities. Changing the seasonal crop cultivations to perennial crop cultivations is the main coping strategy of marginal, medium and large householders. The main coping strategy of small householders is changing the occupation (Table 60).

Table 59. Adaptation strategies practiced at different levels of intervention.

Intervention level	Adaptation strategy
Farm level	Change the seasonal crop cultivations to perennial crop cultivations
Institution level	Receive subsidies during peak requirements
Technological level	Use of hybrids, short duration varieties, resistant varieties
Social level	Establish better kinship ties

Table 60. Adaptation strategy according to households.

Farmer category	Main coping strategy
Marginal households (0-1 ha)	Change the seasonal crop cultivations to perennial crop cultivations
Small households (1-2 ha)	Change the occupation
Medium households (2-4 ha)	Change the seasonal crop cultivations to perennial crop cultivations
Large households (>4 ha)	Change the seasonal crop cultivations to perennial crop cultivations

5.2 Adaptation strategies followed in Galahitiyagama village in Anuradhapura District

Villagers at Galahitiyagama were also responding to the impact that they have been facing due to climatic changes over a long period of time. These reactions were either technological or non-technological in nature and sometimes changed from the first generation farmers to the second generation farmers. Different adaptation strategies seen at Galahitiyagama have been described in the following section.

5.2.1 Technological

Related technological adaptations have been described in the previous village scenario. Based on these definitions, some of the examples for machinery technology adopted by the farmers at Galahitiyagama were tractors (2-wheel and 4-wheel), tractor mounted big threshers and disk harrowers. These machineries helped farmers to complete their seasonal farming operations within

a very short period of time. Hybrid seeds, new fertilizer recommendations and new agro-chemicals were considered as crop recommendations under the introduced technology category. New hybrid corn named Pacific was introduced as a cash crop in the year 2000, and helped to increase the gross margin of the villagers in general. There were two 4-wheel tractors, eighteen 2-wheel tractors, and implements such as disc harrowers in the village. Use of these machineries and implements helped farmers to complete land preparation as quickly as possible with the onset of rains. Usually, the reddish brown earth in the village gets muddy during the rainy season while crust formation is seen during the dry period. Hence, land preparation activities are difficult during the dry period. The village Galahitiyagama ranked at the top in using technology to increase efficiency in farming in terms of land and labor. Therefore, use of technology helped farmers to reduce drudgery in farming activities. Different degrees of adaptation of technologies were seen from different categories of farmers. Hence, it is important to examine adaptation mechanisms by different farmer categories in terms of technology.

New technology has reached the village – a big thresher "tsunami" has reached the village for threshing paddy. Information on new technology has been received from adjacent villagers and from the media and paddy farming has become profitable. Sometimes, this new technology can be used regardless of the unfortunate climatic conditions. Hence, almost all the villagers have shown their willingness to adopt these new machineries to reduce the drudgery in paddy cultivation and thereby be able to increase the gross margins. The System of Rice Intensification (SRI) method[4] is adopted by most of the paddy farmers in the village. Apart from this method, pitcher irrigation method has been used by villagers in coconut cultivations during dry periods.

First generation farmers: First generation farmers in Galahitiyagama village were cultivating paddy in low lands and seasonal crops in chenas (traditional shifting cultivation system in Sri Lanka). This was a subsistence level of farming from which they were able to meet the household food requirements. Low land paddy cultivation is directly linked to the rainfall since the cultivation of paddy is operated under rain-fed conditions. Although water is supplied through the village tank, the entire cultivation is dependent on rainfall. Hence, paddy cultivation and rain-fed upland cultivation were closely linked and any climatic shock has a direct negative impact on the food security situation at the village level. Chena cultivation was also done under rain-fed condition where selection of crops was based on the knowledge acquired by themselves through their farming experience. Crops selected were mainly food crops rather than cash crops cultivated in *chenas* with virtually no cost of inputs and no labor. Hence, *chena* cultivation could be considered as an adaptation mechanism to climatic change by the traditional villagers at Galahitiyagama.

Second generation farmers: Unlike their predecessors, the second generation farmers at Galahitiyagama have shifted their subsistence level of farming to more income generating cash crop agriculture. This transition had taken place to a lower degree at the village level where all the farmers have not adopted cash crop cultivation at once. Hybrid maize, Pacific was the selected cash crop by the farmers at Galahitiyagama from which they usually earn an income for their living in addition to their subsistence farming with paddy, other food crops and vegetable crops.

4. SRI method had been an appropriate answer to meet the impact of climatic changes. Since zero tillage is practiced, minimum water is required for paddy cultivation and attractive harvests can be obtained by following this method.

Third generation farmers: These farmers have also acted like their earlier generations but the degree of transition to cash crop cultivation was relatively higher than that of previous generations. However, like their previous generations, they too were engaged in subsistence level of paddy farming and other food crop cultivations to meet the demand of household food security. Since hybrid maize is a 120 days variety, farmers were able to cultivate it in their homestead and *chena* and get 4-5 times higher yield than that of traditional varieties. Land preparation using machinery for cultivation starts with the onset of rains. Therefore, the selection of this hybrid maize can be considered as achieving twin objectives of cultivating short duration crops and earning a considerable gross income margin. Hence, cultivating hybrid maize acts as a crop escaper, which is an appropriate adaptation measure to minimize the effect of climatic shocks at Galahitiyagama village in Anuradhapura District.

5.2.2 Changes in the cropping patterns

When comparing the present with the past period, a remarkable change is observed in the pattern and spread of rainfall. The major effect of the change is that the rainfall during the harvesting period has resulted in a decrease in the yield. During the period under reference, a mixed farming system has been used in *chena* cultivation in which several crops were cultivated in one area. However, now it has changed to a mono crop cultivation. At present, corn is popular in the area as a major commercial crop. During the past, a variety called *Kiri Bada Iringu*, an indigenous maize crop, was cultivated while now, a hybrid called Pacific has invaded the place of *Kiri Bada Iringu*. With the introduction of Pacific, it is stated that both the yield and income have increased remarkably. Since more rainfall was received in the past, farmers cultivated the indigenous four-month paddy varieties such as H4, *Hondarawalu*, *Rathhal*, *Muthu Samba, Murungakayan* and *Motta Samba*. However, at present, three-month paddy varieties have become more popular (for example, BG 350, 380, *Hetada Wee, Asuda Wee* and *Goviya Goda*). At present, farmers are giving up traditional cultivation systems. In the past, they used the threshing floor to thresh and fan their harvest using the wind during the *Vesak*[5] season. However, at present, application of modern machinery for threshing is widely seen and it has reduced the additional time taken for threshing. Further, the system called *Pel Rekeema* (watching the cultivation) is now disappearing and can be seen very rarely.

A special feature observed during the study was that most of the farmers were compelled to find other work during February, March and April, which is the off cultivation season. Further, this can be seen up to a certain extent during August and September also. In the past, cattle were widely used for farming but at present, it is not so common; animal husbandry is also at a minimum level.

5. Vesak is the most important religious festival of Buddhists and it is celebrated in the month of May every year.

Table 61. Changes in cropping pattern – now and then.

Activity	Year 1970	Year 2008
Rain during Maha season	• Rain starts in August and continues until October as intermittent rains. • Heavy rainfall was observed from mid-October up to 25 December • Since then, intermittent rains were observed up to the end of January	• From the beginning of September up to beginning of October, intermittent light showers were observed and from the beginning of October up to the end of November, average rainfall was observed. • From December up to beginning of January, heavy rainfall was observed. Since then, irregular showers were observed up to the beginning of February.
Preparation of land	• Preparation of lands for paddy in dry cultivation (Kekulan[6]) commences with the August showers. • Preparation of lands for wet cultivation commences at the beginning of November. • Preparation of lands for chena cultivation commences at the beginning of September.	• Preparation of lands for paddy cultivation commences in mid-October
Harvesting	• From mid-January up to April	• During the months of March and April
Yala season	• Rainfall commences around 15 March and falls intermittently. • Heavy rainfall is observed during the month of April and it remains as intermittent showers up to May.	• Rainfall commences at the beginning of March and it remains as heavy showers for three weeks. Then it turns to a light shower up to the beginning of May.
Crops	• Crops cultivated in Maha season – *Kurakkan, undu, meneri*, green gram, corn, chilies • Sesame is cultivated as a major crop during *Yala* season	• During *Maha* season corn, cowpea, *kurakkan*, green gram, chilies and peanuts are cultivated. However, a decline is observed in cowpea and *undu* cultivation.
Cultivation using agro wells		• During *Yala* season, bushita, onions, okra and corn are cultivated using agro wells.

A comparison was made regarding cropping patterns in a seasonal calendar between 1970 and 2008 with the participation of all members. The information collected in this regard is given in Table 61.

These kinds of changes in rainfall and prolonged drought periods caused a decline in agriculture based earning for livelihoods at Galahitiyagama village. Farmers have changed their lowland paddy

6. Kekulan is a paddy cultivation method in dry conditions. Seeding takes place on the dry lands.

Figure 12. An agro well in Galahitiyagama.

Figure 13. A water harvesting tank in a house at Galahitiyagama.

cultivation by adopting ultra short–term paddy varieties (60 days) although the yield was relatively less. Over the period, there has been a decline in the extent of vegetable cultivation on the highlands and this has been replaced with Pacific, a drought resistant maize hybrid. Therefore, the cropping pattern that prevailed in Galahitiyagama village during the past has been changed and a considerable percentage of this change can be attributed to the climatic changes.

5.2.3 Institutions to aid adaptive capacities

In 1970s, the death donation society was the major organization that supported villagers in emergency situations. On such occasions, the villagers have worked together and they were of the view that the government's intervention was at the minimum level. Relief programs had been implemented in the form of Check Roll. At present, relief programs are being implemented by the World Vision Organization, an international non-governmental organization (INGO) in addition to the Welfare Society in case of an emergency. Further, the *Grama Niladhari* also offers help at every urgent situation. The health sector has been developed under the management of the leaders of societies in the village. It was stated that the delivery of aid received at an emergency was carried out fairly. Further, they said that priority was given to poor people and widows in granting relief aid packages.

During the period of disasters such as droughts, villagers have to work on daily wages. At occasions where the distribution of relief aid was unfair, villagers had become disappointed. Dry rations were provided during times of drought as World Bank Aid based on Check Roll procedure. Villagers have shared their harvest during times of emergency. Relief programs provided by the government have been distributed among the people fairly. As people are provided with relief aid such as Janasaviya during the times of drought, they seem to have more strength to overcome the ill effects of such situations. Further, they have obtained loans by organizing themselves into groups, depending on the extent cultivated. At present, they are in a better situation to face drought more easily since

agro-wells were introduced by the World Vision International. Women of the village are of the view that the living conditions of the villagers have improved.

Ideas of all members were gathered regarding the list of institutions. The major contribution was made by one person (Chairman of the Farmers' Society). Youths also have shown an interest in expressing their ideas. All the members have participated actively in ranking institutions. No difficulties were observed in arriving at conclusions. It was stated that a tremendous service was extended by institutions such as children's society, school, family health center and *Grama Niladhari* office. Further, it was stated that a close and friendly service was rendered by these institutions. Even though two opinions were brought forward on Agrarian Service Centre, the group could arrive at an agreement. However, the enthusiasm shown in expressing ideas on Samurdhi Office was at the minimum level and it was stated that the service of the Samurdhi Office was in no way satisfactory. However when both Venn diagrams were discussed, a disagreement arose on the closeness of the service rendered by the Family Health Officer. Since the visits made by the Family Health Officer to the village were not very satisfactory, they agreed to change the ranking from close to distant.

5.2.4 Socio-economic behavior

The main coping mechanisms of the small householders to climatic shocks were diversification of means of livelihoods and improvement of access in terms of receiving water through watershed conservation. Medium householders have stated that their coping mechanisms were diversification of means of livelihoods, improvement of access to water availability through watershed management, and mobilization and use of collected resources. Major coping mechanisms of large householders were diversification of means of livelihoods and mobilization and use of collected resources. When the institutions approached by all household categories in the event of a drought were considered, the villagers mostly preferred government organizations. Similarly, the next preferred institutions were non-governmental organizations.

Villagers have different views regarding the wealth of the people. Males use the criteria of ownership of larger extents of lands for cultivation, occupation in government service, possession of personal vehicles, higher level of education, ownership of agro-wells, availability of advanced transport facilities, availability of advanced market facilities, availability of advanced health facilities and higher level of engagement in animal husbandry to rank the people as rich or poor (Table 62).

Table 62. Perception on the importance of institutions to aid adaptive capacities in Galahitiyagama.

	Formal								
Groups	*Grama Niladhari* Office	School	Divisional Secretariat	Agrarian Services office	Office of the Samurdhi Development Officer	Samurdhi Bank	Rural Development Society	Family Health Office	Agriculture Development Society
Male adults	H	H	H	H	M	M	H	M	L
Female adults	M	H	M	M	L	L	M	H	M
	Formal							Informal	
	Welfare Society (Funeral)	Childeren's Society	Farmers' Society	World Vision Society	Pradeshiya Sabha	Liyasaviya Women's Society	Police	School Development Society	Dayaka Sabha
Male adults	H	L	H	H	M	M	H	L	M
Female adults	L	M	H	L	M	L	L	M	L

Source: Focus Group Discussions with farmers in Galahitiyagama, 2010.

Females use the criteria of having a permanent employment, ownership of houses of good standard, ownership of personal vehicles, having enough money for their needs, having sufficient food, application of modern methods in cultivation, having positive attitudes and level of education for the above categorization.

Since Galahitityagama is an isolated village in a forest environment, all the villagers get together and take decisions especially in events such as droughts and floods. Collective action was clearly visible during weddings and funerals, and when obtaining seeds and agricultural information. But individual actions were found when obtaining loans, purchasing inputs and product marketing.

5.2.5 Resources

Farmers in Galahitiyagama village are mostly occupied with paddy and maize cultivation under rain-fed conditions. Maize is used as the cash crop while a part of paddy produced is stored for household consumption and the surplus is sold. During the harvesting seasons, they earn their sole income and this money is spent throughout the period until they receive their next harvest. Instead of saving the income generated from the cash crop, most of them have invested that money in purchasing machineries that are used for agricultural operations, motor bikes and other durable items used in the household. Most of the villagers were not very interested in the infrastructure facilities such as improving the conditions of their houses and properties.

Social and Resource maps

Social and Resource Maps were drawn as a collective effort of all members. The Chairman of the farmers' society also participated in this meeting and he volunteered to draw these maps. While the mapping was in progress, a middle-aged person expressed his ideas. However, the contribution of elderly persons was at a lower level. The attention of the female group was also at the minimum level at the commencement of this activity. The major contribution for mapping was made by the male group.

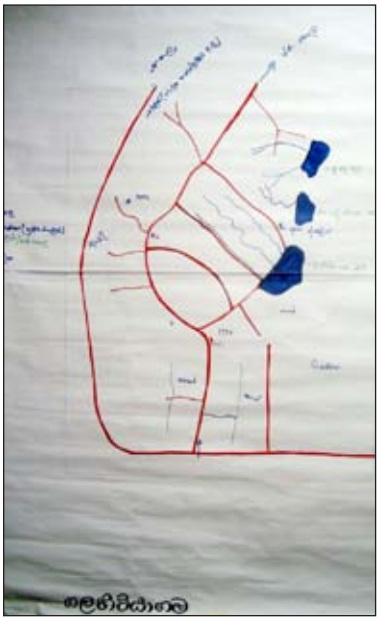

Figure 14. Social map of Galahitiyagama.

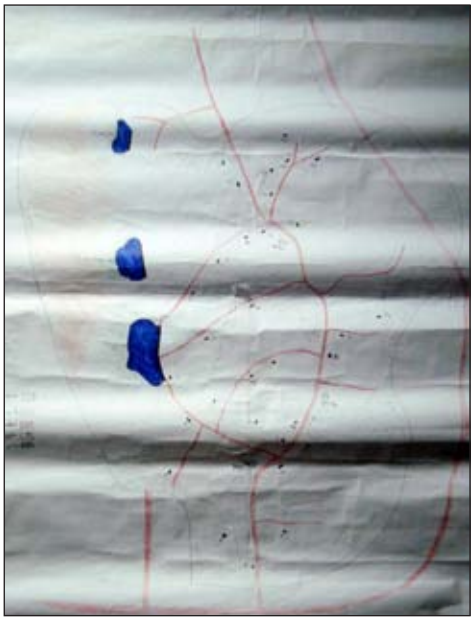

Figure 15. Resource map of Galahitiyagama.

5.2.6 Adaptation to and Coping with Climate Change

5.2.6.1 Factors determining the capacity of householders to adapt to climatic changes

Major motivational factors for farmers to participate in the local groups were convenience to obtain subsidies in the event of disasters, supplement agricultural inputs, tools /machineries, assistance in social events at the village level and importing knowledge and instructions for agricultural operations (Table 63).

Table 63. Distribution of farmer categories (%) by motivational factors for being part of the local groups.

		Participator		Motivational factor				
Farmer category	Number of participants	Male	Female	Easy to obtain loans	Easy to obtain subsidies in events like disasters	Supplement of agricultural inputs, tools/ machineries	Giving knowledge and instructions for agricultural operations	Assist in social events of the village
Small households (n=17)	100	71	6	53	29	29	24	47
Medium households (n=27)	100	78	19	56	30	30	19	52
Large households (n=16)	100	81	19	75	31	38	31	56

5.2.7 Institutional Capacities

5.2.7.1 Collective actions that evolved whenever there was a drought/ flood

The majority of farmers in the small household category preferred collective actions for obtaining agricultural information /seed, obtaining credit, purchasing inputs, storage/ sale of product, in case of funeral/ marriage and during droughts (Table 64). Medium and larger households mostly preferred collective actions in funerals/marriages and during droughts.

Table 64. Frequency distribution of respondents among farmer categories by preference for collective action versus individual action.

Farmer category	Obtaining agricultural information / seeds		Obtaining credit		Purchasing inputs		Storage /sale of produce		Funerals/ marriages		Drought	
	Collective	Individual	Collective	Individual	Collective	Individual	Collective	Individual	Collective	Individual	Collective	Individual
Small households (n=17)	65	35	59	41	71	29	53	47	76	24	59	12
Medium households (n=27)	41	52	48	44	44	44	37	52	85	4	41	19
Large households (n=16)	50	38	38	50	38	56	56	31	81	13	44	6

5.2.8. Socio-Economic Capacities

5.2.8.1 Sufficiency of income from agriculture

The majority of respondents in the small household category have said kinship support from relief assistance for opting for some government schemes and borrowing money from local money lenders/cooperatives and reducing consumptions were their main methods to overcome the deficit from agriculture while larger householders have used kinship support and reduced consumptions (Table 65).

Table 65. Distribution of farmer categories (%) by methods to overcome the deficit from agricultural operations.

Farmer category	Method to overcome the deficit from agriculture			
	Kinship support	Relief assistance or opting for some government scheme	Reducing consumption	Borrowing money from local money lenders/ cooperatives
Small households (n=17)	41	24	6	24
Medium households (n=27)	37	15	19	22
Large households (n=16)	25	6	19	6

5.2.8.2 Alternative forms of livelihood or agricultural practices

The major alternative form of agricultural practices /livelihoods were: use of hybrids and the use of new short term varieties (Table 66). According to the majority of respondents in small, medium and larger household categories, major reasons to adopt the alternative forms of agriculture were: drought resistance ability of the opted crops, high income of the opted agricultural product and generation of income within a shorter period than the time taken by the traditional crops (Table 67).

Table 66. Distribution of farmer categories (%) by alternative forms of agricultural practices/ livelihoods.

Farmer category	Number of respondents who changed livelihoods		Alternative form of agricultural practices/livelihoods	
	Changed	Not changed	Use of hybrids	Use of new short-term varieties
Small households (n=17)	59	24	53	29
Medium households (n=27)	37	15	33	19
Large households (n=16)	81	13	44	63

Table 67. Distribution of farmer categories (%) by reasons to adopt alternative forms of agriculture.

	Reasons to adopt alternative forms of agriculture		
Farmer category	Resistance to drought	High income	Generation of income within a short period
Small households (n=17)	35	53	24
Medium households (n=27)	41	37	30
Large households (n=16)	44	56	38

5.2.9 Information and Knowledge Capacities

Information sources used by all the household categories were neighboring farmers, government institutions, agricultural instructors and non-governmental organizations (NGOs) (Table 68).

Table 68. Distribution of farmer categories (%) by information sources needed to find alternative forms of agriculture.

	Information sources needed to find alternative forms of agriculture			
Farmer category	From neighboring farmers	Through agriculture instructors	Government institutions	Non-governmental institutions
Small households (n=17)	35	6	24	18
Medium households (n=27)	26	15	11	4
Large households (n=16)	38	25	38	0

5.2.10 Technological Capacities

About 50% of the respondents have used technology to cope with changing weather conditions. Mostly, the technologies used by the farmers were: pump water from irrigation well, use of hybrids and new machineries (Table 69). Increased production was the major means of increasing income by all the farmer categories. Minimize the wastage of output, save the money, and low shared labor cost were the other means that farmers used for increasing incomes (Table 70).

Table 69. Distribution of farmer categories (%) by technology used to cope with changing weather conditions.

Farmer category	Number of farmers who used the technology		Technology used		
	Used	Did not use	Pump water from an irrigation well	Use of hybrids	New machineries
Small households (n=17)	53	47	12	12	24
Medium households (n=27)	48	52	22	4	7
Large households (n=16)	44	56	13	13	13

Table 70. Distribution of farmer categories by means of increasing profitability by adoption technology.

Farmer category	Means of increasing profitability by adoption technology			
	Saving money	Increase production	Minimizing output loss	Low labor cost
Small households (n=17)	0	41	6	0
Medium households (n=27)	0	19	11	11
Large households (n=16)	6	25	0	6

5.2.11 Successful action taken during previous occasions of droughts

According to most of the respondents, obtaining subsidies, searching for new sources of water, use of short term varieties and cultural faiths and rituals were the successful courses of actions taken by them during previous droughts (Table 71). According to the majority of respondents in the marginal household category, improvement of access to water availability through watersheds /digging of deeper wells was the most preferred coping mechanism undertaken by them (Table 72). Use of previously collected resources and taking up of non-farm activities were other actions undertaken by marginal households. Diversifications of means of livelihoods was the main coping mechanism of small households followed by obtaining loans, improving access to water availability through watersheds and reducing consumption and expenditure. Medium householders have mostly preferred the use of previously collected resources. Reduction of consumption and expenditure, improvement of access to water availability through watersheds and obtaining loans were other coping mechanisms adopted by farmers.

Table 71. Distribution of farmer categories by successful action taken during previous droughts.

Farmer category	Successful action taken at previous droughts			
	Subsidies	Resorted to new sources of water	Use of short term varieties	Cultural faiths and rituals
Small households (n=17)	18	12	12	18
Medium households (n=27)	0	4	4	15
Large households (n=16)	6	0	6	13

Table 72. Coping mechanisms adopted by farmers ranked according to the scale of preference.

Scale of preference	Marginal households (0-1)	Small households (1-2 ha)	Medium households (2-4 ha)
1	Improvement of access to water availability through watersheds / digging of deeper wells	Diversification of means of livelihoods	Use of previously collected resources
2	Use of previously collected resources	Obtain loans	Reduced consumption and expenditure
3	Resort to non-farm activities	Improvement of access to water availability through watersheds / digging of deeper wells	Improvement of access to water availability through watersheds / digging of deeper wells
4	Reduced consumption expenditure	Reduced consumption expenditure	Obtain loans
5	Selling of assets	Selling of assets	Migration for non-farm activities
6	Diversification of means of livelihoods	Use of previously collected resources	Diversification of means of livelihoods
7	Obtain loans	Migration for non-farm activities	Selling of assets
8	Selling of livestock	Selling of livestock	Selling of livestock

5.2.12 Adaptation strategies

Changing the seasonal crop cultivation to short term cash crop cultivation was the main adaptation strategy at the farm level (Table 73). Mainly, the farmers have adopted cultivating a hybrid maize variety called Pacific as a short term cash crop. At the institutional level, the main adaptation

strategy was providing subsidies during peak requirements. Use of new machineries and hybrid crop varieties were the adaptation strategies at the technological level. At the social level, most of the farmers have established kinship ties to aid in difficult situations.

Table 73. Adaptation strategies practised at different levels of intervention.

Intervention level	Adaptation strategy
Farm level	In choice of crop, time of cultivation and inputs
Institution level	Providing subsidies during peak requirements
Technological level	They did not get any adaptation to the use of technology
Social level	Resorted to help from kinship ties

5.3 Adaptation strategies followed in Mahagalwewa village

5.3.1 Technological adaptation

Introduced technologies: Technologies introduced to the Mahagalwewa village were farm machinery such as 4-wheel tractors, 2-wheel tractors and threshers. Villagers have been introduced to the rainwater harvesting systems to increase the water availability for farming activities. Community water supply system was introduced by the government to provide the needs for drinking water. Hybrid paddy varieties have also been introduced to the farmers as crop recommendations.

Non introduced technologies: Since the agricultural activities of the village are affected by the water stress, farmers have adopted crops that require minimum water such as sesame and finger millet. Perennial crops such as coconut and fruit crops are also cultivated.

First generation farmers: First generation farmers have mostly practiced *chena* cultivations and paddy farming at early stages. Chena cultivation consisted of vegetables and pulse crops and most of the produce was mainly sold at the markets nearby.

Second generation farmers: Second generation farmers have been involved in *chena* cultivation, paddy farming and perennial crop cultivations. More emphasis was given to paddy farming using short- term paddy varieties. Coconut cultivation was popularized since there were optimum conditions in the area for the crop.

Third generation farmers: Third generation farmers are deviating from *chena* cultivations. However, paddy farming is still carried out using short-term paddy varieties. Most of the farmers are engaged in occupations related to inland fisheries industry and agriculture based activities are carried out as a source for domestic food security.

Adoption of new technologies in agriculture was relatively low in Mahagalwewa. In paddy cultivation, short-term varieties were cultivated with relatively less technology. Among the reasons mentioned by the villagers regarding the low use of new technologies/equipment was the difficulty in affording the relatively higher cost associated with the new technology.

Some of the villagers said that the capacity of the existing water tank of the village should be expanded and the water canal of the Meegahajadura should be diverted to the water tank of Mahagalwewa. Even though there will be a decrease in rainfall, the villagers can overcome its impacts if the water tank of the village is reconstructed to improve the capacity of the tank to get the maximum usage of the water collected.

5.3.2 Changes in cropping patterns

In early years, *chena* cultivation was more popular but there is a gradual decline since the farmers have shifted to more income generating activities. Vegetable and pulse cultivations are confined to the home gardens and coconut cultivations were very common. Paddy farming is still practiced at a considerable level since government assistance such as fertilizer subsidy and needed instructions are provided. Sesame and cotton cultivations are still practiced on a small scale. Most of the farmers have given up agriculture based income sources and are occupied in inland fisheries based income sources.

5.3.3 Institutional capacities

Public officers were consulted about the various institutions located within the village and whilst they were naming such institutions, all the other participants too contributed well, by naming at least one institution.

It seemed that there is a significant difference between the results of public officers, male and female village participants. During the discussion that took place later, the females proved to provide correct information. Further, it was observed that the institutions treated males and females in different ways. Females stated that they were not provided with the service required to them by the police station. However, one adult male intervened and reminded them that security was given by the police during the period of terrorist threats. He asked the ladies whether they had forgotten the help given by them when the women fled to jungles to escape from terrorists. The common idea of the people was that the institutions that provided them more services at times such as droughts were Divisional Secretariat and *Grama Niladhari* office. Further, they stated that the police station and the family health officers provided information when there was a need in problematic situations (Table 74).

5.3.4 Socio-economic behavior

Public officers did not classify anyone as rich while the villagers group put seven names to the category of rich. It was observed here that the villagers would prefer to be classified as middle class rather than rich or poor.

Table 74. Perception on the importance of institutions in aiding adaptive capacities in Mahagalwewa.

Groups	Formal							
	Divisional Secretariat	*Samurdhi* Bank	*Janashakthi* Bank	School	*Grama Niladhari*	*Sarvodaya*	Agrarian Research Officer	Members of Parliament
Public officers	M	M	M	H	H	L	H	L
Male adults	H	M	L	H	M	M	M	L
Female adults	H	M	H	H	M	M	M	L
	Formal					Informal		
	Community Based Water Project	Ayurvedic Hospital	*Pradeshiya Sabha*	Police Station	Family Health Officer	Fisheries Society	Farmers Society	*Dayaka Sabha*
Public officers	H	H	L	H	H	L	H	M
Male adults	H	H	L	H	H	M	M	L
Female adults	H	H	L	L	H	M	H	H

Source: Focus Group Discussions with farmers in Mahagalwewa, 2010, H= High; M= Medium; L= Low

Even though the young women seemed to be ranking the names taking the actual wealth into consideration, it was seen that the adult males and females did not classify the names similarly. They were asked about the criteria that they used for ranking. Those criteria were identified as: having savings in the banks, quality and level of the houses, income, not being a debtor, nature of the job, ownership of lands/paddy fields, ownership of land masters (2-wheel tractors) /vehicles and entrepreneurship.

Since this village is situated in the dry zone, it is highly vulnerable to extreme climatic conditions such as droughts. When the participants were asked about how they would face a situation such as a severe drought, they said that there was hardly any mutual relationship between the rich and poor at such an occasion. The people who are regarded as rich (land owners, etc) always extended support to their relatives only. Further, they mentioned that the relief aid provided by the government is fairly distributed among the needy through the *Grama Niladhari*. However, women stated that there were occasions where the aid received from Colombo and suburbs and NGOs were distributed unfairly to favorites of the *Grama Niladhari*.

Collective actions are more successful among the villagers and in some situations individual activities are more prominent. In farming activities such as obtaining agricultural information, obtaining inputs and storing output, farmers are willing to act collectively, and in activities such as obtaining credit, they would rather prefer to act individually. But in social events of the village such as weddings or funerals, they show collective action.

5.3.5 Resources

Farmers in Mahagalwewa village store harvest of cereals and pulses for consumption throughout the period until they receive the next harvest. Such stored produce can be used during any difficult circumstances due to negative impacts of climate or crop failures due to other reasons. Also due to fluctuating prices of these agricultural products, some farmers store their harvest to sell at a higher price during off season. This can ensure higher income to facilitate the cultivation practices at the next season if there is no negative climatic impact. Farmers deposit their income in banks and they also obtain credit from banks and other informal institutions such as money lenders, neighbors and relatives, in difficult situations when they need financial assistance.

Social and Resource Map: Two copies of the village map prepared previously were used for this activity. For this purpose, the villagers acted as two separate groups. Those who were selected for the preparation of the resource map were encouraged to mark useful resources on their map. Other groups were regulated to mark institutions and other places that are socially important. Villagers carried out this activity showing much enthusiasm and cooperation.

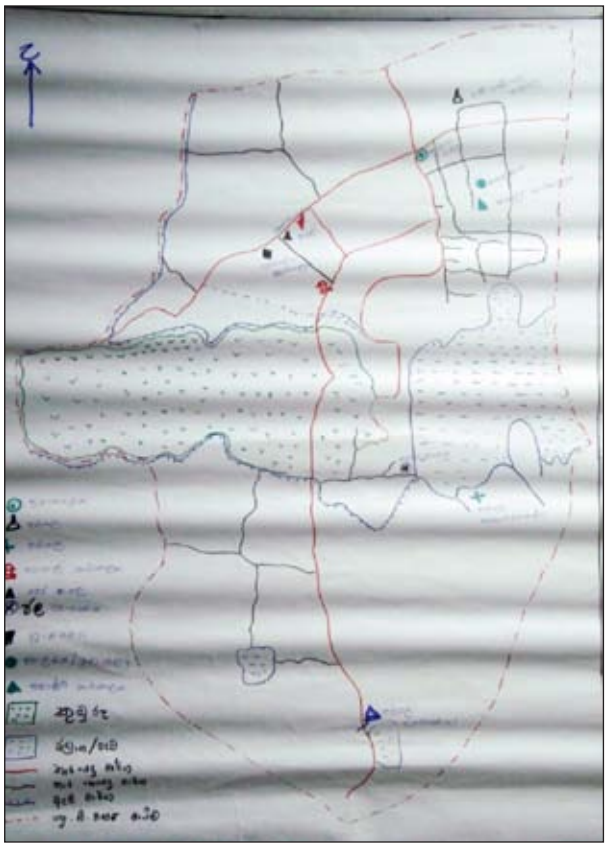

Figure 16. Social map of Mahagalwewa.

Figure 17. Resource map of Mahagalwewa.

5.3.6 Adaptation to and Coping with Climate Change

5.3.6.1 Factors determining the capacity of households to adapt to climatic changes

Ownership of sources of water was considered as the major factor determining the capacity to adapt to climatic change, according to the majority of respondents in marginal and small households (Table 75). For medium households, the major factors were ownership of sources of water and the attitudes of the people to determine the capacity to adapt to the climatic change. Financial assets, ownership of sources of water were the major factors for larger households according to a majority of the respondents.

Table 75. Distribution of farmer categories (%) by factors determining the capacity of households to adapt to climatic changes.

	Factors determining the capacity to adapt to climatic change						
Farmer category	Financial assets	Ownership of sources of water	Good health	Occupation	Water storage capability	Attitudes	Age
Marginal households (n=14)	0	29	0	7	0	0	0
Small households (n=4)	0	50	0	25	0	0	0
Medium households (n=12)	8	17	0	8	0	17	0
Large households (n=20)	10	10	5	0	5	0	5

5.3.7 Institutional Capacities

Government institutions were the main institutions approached by the marginal, medium and larger households in the event of a drought (Table 76). Most of the farmers in the small household category have said that the political affiliations, kinship and relatives are the major institutions approached by them.

Table 76. Frequency distribution of respondents among farmer categories that can be approached in the event of a drought.

Scale of preference	Marginal households (>1)	Small households (n=17)	Medium households (n=27)	Large households (n=16)
1	Governmental organizations	Governmental organizations	Governmental organizations	Governmental organizations
2	Kinship and relatives	Kinship and relatives	Non-governmental organizations	Kinship and relatives
3	Non-governmental organizations	Villagers	Kinship and relatives	Non-governmental organizations
4	Villagers	Non-governmental organizations	Political affiliations	One person
5	One person	Political affiliations	Villagers	Villagers
6	Political affiliations	School	One person	Private organization
7	Private Organization	One person	Private organization	Political affiliations

5.3.8 Motivational factors for being part of the local groups

According to the majority of respondents of the marginal households, the major motivation factor was assist in social events of the village such as funerals (Table 77). Convenience to obtain loans was considered as the major motivational factor by the medium and large households. For small households, easiness to obtain loans, supplement of agricultural inputs and tools and assistance in social events of the village are the major motivational factors. Convenience to obtain subsidies in the event of disasters, and assistance in self-employment are also motivational factors to participate in local groups.

5.3.9 Collective action that evolved when there was a drought/ flood

When considering the preference for collective action, respondents of all household categories said that the majority prefer the collective action for obtaining agricultural information, obtaining credit, purchasing inputs, storage/sale of products, and for funerals/ marriages (Table 78). For droughts, most of them prefer individual action.

Table 77. Distribution of farmer categories (%) by motivational factors for being part of the local groups.

Farmer category	Motivational factor							
	Easy to obtain loans	Easy to obtain subsidies in events like disasters	Supplement of agricultural inputs, tools/ machineries	Assistance in selling of agricultural outputs	Giving knowledge and instructions for agricultural operations	Assistance in social events of the village	Assistance in self-employment	Due to the insistence of family members
Marginal households (n=14)	29	21	7	7	7	36	0	0
Small households (n=4)	25	0	25	0	0	25	0	0
Medium households (n=12)	67	25	25	0	8	42	0	8
Large households (n=20)	35	15	10	0	0	20	10	0

Table 78. Distribution of farmer categories (%) by preference for collective action versus individual action.

Farmer category	Obtaining agricultural information/seeds		Obtaining credit		Purchasing inputs		Storage/Sale of produce		Funerals/marriages		Drought	
	Collective	Individual	Collective	Individual	Collective	Individual	Collective	Individual	Collective	Individual	Collective	Individual
Marginal households (n=14)	29	7	36	7	29	7	21	7	57	0	14	0
Small households (n=4)	50	25	75	25	25	25	25	25	75	0	25	25
Medium households (n=12)	50	0	58	0	25	0	42	0	75	0	17	8
Large households (n=20)	25	0	35	0	25	0	20	0	75	0	30	15

5.3.10 Socio-Economic Capacities

5.3.10.1 Sufficiency of income from agriculture

Kinship support is the main method to overcome the deficit from agriculture for the marginal and large households. For small households, borrowing money from local money lenders/ cooperatives is the main method to overcome the deficit (Table 79). Respondents of medium households have said that kinship support and borrowing money from local money lenders/ cooperatives are the main methods to overcome the deficit.

Table 79. Distribution of farmer categories (%) by methods to overcome the deficit from agricultural operations.

	Method to overcome the deficit from agriculture			
Farmer category	Kinship support	Relief assistance or opting for some government scheme	Reducing consumption	Borrowing money from local money lenders/ cooperatives
Marginal households (n=14)	29	7	0	14
Small households (n=4)	25	25	25	75
Medium households (n=12)	50	42	17	50
Large households (n=20)	50	5	0	15

5.3.10.2 Alternate forms of livelihood or agricultural practices

Most of the farmers' felt that the major alternative form was to change the cultivations to perennials. The major perennial crop cultivated was cashew and the drought resistant ability of the crop was considered as the main reason to adopt it (Table 80). The majority of the farmers in the small households category have said their alternative form was changing the occupation and the reasons for adoption was the higher income when compared to agricultural activities.

5.3.11 Information and Knowledge Capacities

Most of the farmers have said that the information source they used to find alternative forms of agriculture was neighboring farmers (Table 81). Some of the farmers have also used sources such as agricultural instructors, government institutions and non-governmental institutions while some others have used their own experience to find the alternative forms.

Table 80. Distribution of farmer categories (%) by reasons to adopt alternative forms of agriculture.

	Reasons to adopt the alternative forms of agriculture							
Farmer category	Resistant to drought	High income	Easy management	Least damages from pests and animals	Generation of income in a short period	Due to reduced fertility status of soil	High demand	Low cost
Marginal households (n=14)	50	21	7	0	0	7	7	0
Small households (n=4)	50	75	0	0	25	0	50	0
Medium households (n=12)	50	42	8	0	17	0	0	0
Large households (n=20)	75	35	10	10	25	0	0	15

Table 81. Distribution of farmer categories (%) by information sources needed to find alternative forms of agriculture.

	Information source needed to find the alternative forms of agriculture				
Farmer category	From neighboring farmers	Through agriculture instructors	Government institutions	Non-governmental institutions	By own experience
Marginal households (n=14)	43	7	21	0	14
Small households (n=4)	50	25	25	0	0
Medium households (n=12)	67	8	17	17	8
Large households (n=20)	65	5	35	0	20

5.3.12 Technological Capacities

Respondents in all household categories have used hybrids to cope with changing weather conditions. Some of the farmers have used new irrigation methods and new cultivation methods to deal with such difficulties (Table 82). Farmers have used different means to increase the profitability by adaptation technology (Table 83). Some farmers in the marginal household category have increased their income by increasing the production, improving the soil fertility and by maintaining crops at a minimum level of damages (Table 84). Large householders have increased their income by user friendly farming practices, increased production, improvement of soil fertility and by low usage of hired laborers in their cultivations.

Table 82. Distribution of farmer categories (%) by technology used to cope with changing weather conditions.

	Technology used to cope with changing weather conditions									
Farmer category	New irrigation methods	Pump water from an irrigation well	New cultivation methods	Pitcher irrigation	Use of hybrids	New machineries	Constructing tube wells	Planting agro forests	Net houses	Improved fertilizers
Marginal households (n=14)	0	7	0	0	14	0	0	0	7	0
Small households (n=4)	25	25	0	0	25	0	0	25	0	0
Medium households (n=12)	8	0	17	8	33	0	8	0	17	17
Large households (n=20)	5	0	10	20	30	5	0	10	0	5

Table 83. Distribution of farmer categories (%) by constraints involved with adaptation of technology.

	Constraint involved with adoption of technology								
Farmer category	Water shortages	Harvesting difficulties	High cost involved	Higher occurrence of pest attacks	Higher utilization of chemical fertilizers	Shortage of knowledge	Low durability	High labor usage	No constraints
Marginal households (n=14)	0	0	0	0	0	7	0	0	7
Small households (n=4)	25	0	0	0	25	0	0	0	0
Medium households (n=12)	25	0	0	0	0	17	0	0	0
Large households (n=20)	5	5	10	10	5	10	5	10	5

Table 84. Distribution of farmer categories (%) by means of increasing profitability by adoption of technology.

Farmer category	Means of increasing profitability by technology adoption						
	User friendly farming practices	Increased production	Improvement of soil fertility	Low labor usage	Increase soil moisture	Least damages to crops	Ability to cultivate in drought conditions
Marginal households (n=14)	0	7	7	0	0	7	0
Small households (n=4)	0	25	0	0	0	25	0
Medium households (n=12)	8	17	17	0	0	0	0
Large households (n=20)	15	20	15	10	5	0	10

5.3.13 Successful action taken at previous droughts

The majority of respondents in all household categories have said that the successful actions taken at a drought are obtaining subsidies, cultural faith and rituals and supplement of water through bowsers (Table 85). Most of the respondents have said that the establishment of an irrigations scheme is needed to manage the effects of climatic shocks. Some of the farmers have said the interventions required are constructing a tube well, improving existing water sources, obtaining subsidies and providing facilities for drinking water.

Table 85. Distribution of farmer categories (%) by successful actions taken during previous occasions of droughts.

Farmer category	Successful action taken at previous occasions of droughts								
	Subsidies	Soil conservation methods	Searched for new sources of water	Use of short term varieties	Cultural faiths and rituals	Storage of output	Use of efficient irrigation methods	Government aids	Supply of water through bowsers
Marginal households (n=14)	29	0	0	7	21	14	0	7	36
Small households (n=4)	50	25	25	0	25	0	0	0	0
Medium households (n=12)	42	8	8	0	8	8	0	0	17
Large households (n=20)	25	10	10	0	20	0	5	0	15

5.4 Adaptation strategies followed in Bata-Atha village

5.4.1 Technological adaptation

Machinery and equipment such as 4-wheel and 2-wheel tractors have been introduced to Bata-Atha village. Hybrid seeds and fertilizer have been used as crop recommendations for vegetable and paddy cultivations. Since vegetable cultivation is carried out at the home-garden level, these crop recommendations have increased the domestic production. Non introduced technologies have been adopted by the farmers to increase their level of income, through their own experience gained through generations of farming. Hence, adaptation of non introduced technologies varied with successive generations of farmers.

First generation farmers: First generation farmers have practiced chena cultivations. They have cultivated vegetable and pulses in *chenas* and the produce were sold at the nearby markets. Family members were involved in cultivation practices and the cost of production was at a minimum level due to less use of input.

Second generation farmers: Second generation farmers were involved in vegetable cultivation at the home-garden level. *Chena* cultivations were at a minimum. Income generating activities related to fisheries industry has been initiated and some of the farmers have changed their income sources from farming to fishing.

Third generation farmers: Third generation farmers were more ambitious than the second generation farmers to earn more income from the fisheries industry. Agriculture based activities were confined to the small scale home-garden level. Most of the villagers were occupied in the fisheries industry while engaged in farming activities to produce vegetables and pulses for their day to day household consumption. Agriculture based activities are on a very limited scale among this generation of farmers.

According to the villagers, to minimize the impact of climatic changes, the existing irrigation tank should be reconstructed and permanent irrigation schemes should be introduced to the village. Also, improved seed varieties and technologies should be introduced to farmers to minimize possible impacts of unfavorable weather conditions in the future.

Farmers in Bata-Atha village are less innovative in using new technologies for agriculture based activities to face shocks in climatic changes. Use of new crop varieties and hybrids were at a minimum level. As machineries, they use tractors for land preparations. Villagers have not used improved irrigation systems such as drip irrigation and sprinkler irrigation in their cultivation operations.

5.4.2 Changes in the cropping pattern

In 1970s, the villagers practiced *Chena* cultivations only in the *Maha* season. There were coconut cultivations scattered within the village. In the discussion, villagers stated that a significant change is seen in the pattern of rain between the past and the present. Normally, they expect intermittent showers from November but they did not have it during the recent past. Therefore, they expect to refrain from cultivating finger millet (*kurakkan*), and continue cultivating sesame only, which is resistant to dry weather. At present, *chena* cultivations are practiced in the *Maha* season and hardly

any cultivation is carried out in the *Yala* season. Vegetable cultivations such as brinjal, tomato and chili are undertaken in home gardens.

5.4.3 Institutions to aid in adaptive capacities

During the discussion, it was understood that a limited group always enjoys benefits from certain institutions. However, the expression of ideas was somewhat hindered due to the presence of officers from the institutions under discussion. As an example, *Samurdhi* Officers raised some questions when participants decided to rank *Samurdhi* Office under the category of Average service. Further, they stated that they are provided with more services by fisheries society, *Grama Niladhari*, school, health services officer and Divisional Secretariat and close relationships are maintained with these institutions. Further, it seems that the institutions involved in youth affairs were not up to the mark. There were different views on the services provided by the rural hospital at *Ranna*. The women stated that the hospital always lacks necessary medicines and therefore it was a common experience to transfer patients to other hospitals. However, the men were of the view that the services of the hospital were at a satisfactory level, when considering the difficulties of the area. Youths considered the services of the hospital as average. Accordingly, several adult farmers agreed that their previous decision was wrong. It seemed that women were expressing their views frankly (Table 86).

Table 86. Perception on the importance of institutions to aid adaptive capacities in Bata-Atha.

	Formal						
Groups	Samurdhi office	Relief services office	Sweden fisheries activities society	SANASA development society	Youth council	Rural hospital	School
Male adults	M	M	M	M	M	H	H
Female adults	M	M	M	M	L	L	H
Youths	M	L	M	M	L	M	H
	Formal			Informal			
	Health services officer	Divisional Secretariat	Hotel/ school	Farmers society	Youths society	Fisheries society	Dayaka sabha
Male adults	H	H	M	L	L	H	H
Female adults	M	H	M	M	L	M	H
Youths	H	H	L	M	L	M	M

Source : Focus Group Discussions with farmers in Bata-Atha, 2010.

5.4.4 Socio-economic behavior

Preference for collective actions

When considering the preference for collective actions of the villagers in different situations, marginal householders mostly prefer collective action in funerals and marriages, in a drought situation and in obtaining agricultural information/seeds. Small householders prefer collective action in obtaining agricultural information, seeds and in purchasing other inputs.

Based on the social conditions of the village, people prefer to have collective action especially in agricultural activities such as obtaining agricultural information, buying agricultural input, and storage of product output. Also, in activities such as obtaining credits and in social events such as weddings and funerals, collective actions are more prominent.

Coping mechanisms: When considering the coping mechanisms undertaken by different farmer categories, marginal householders have diversified their means of livelihoods as their first option. Other options were minimizing the consumption expenditure, improving access to water availability through watersheds, digging of deeper wells, buying foods and selling of assets. Major coping mechanism of small households was improving access to water availability through watersheds, digging of deeper wells, minimizing the consumption expenditure, diversification of means of livelihoods, selling of assets and buying foods.

Villagers have sold their valuable assets when they did not get sufficient income through agricultural activities. Agricultural activities are very risky in terms of climatic shocks, hence earnings from agriculture are unreliable. The villagers have also diversified their livelihoods, minimized consumption of food items and are digging deeper wells. When diversifying the means of livelihoods, villagers have given up agricultural activities and engaged in income avenues that related to the fisheries industry and various other occupations such as labor hiring, brick making and work for women in garment factories.

Ideas of the villagers on wealth and development: When ideas on development were entertained, the youths provided comprehensive answers. They considered social, economic, health and education sector development as the development of the village as a whole. But, male adults were of the view that development means the improvement in both physical and ethical factors. Female adults stated that development is the ability of the persons to uplift their way of living independently. Adult farmers were of the view that there is no possibility to achieve development under the present situation. They stated that the poor people have to remain at the same helpless situation since wealthy people do not come forward to support the poor. Women stated that the ability to manage the financial wealth is a main factor in the development. They were of the view that loans should be provided to achieve development. Male adults consider persons as wealthy based on ownership of boats, houses with facilities, ability to provide a good education for their children and savings at banks. The youths consider persons as wealthy based on their ability to dress well, be attractive to others and their ability to wear gold jewellery.

Behavior of villagers in a situation of an emergency: Government institutions were mainly approached by all the householder categories in the event of a drought. Other institutions approached for help by marginal householders were political leaders, non-governmental organizations, and relatives. Small householders approached non-governmental institutions,

relatives, villagers and private organizations. Since this is a village severely affected by the tsunami, the views of all the groups were analyzed separately regarding the way that they faced the tsunami. It is significant that the participants were more interested in contributing, when they were given the chance to do the activity as separate small groups. All the participants had similar views about the tsunami. Even though no person died due to this catastrophe, severe damage was caused to the properties. Participants stated that people were transported to other areas by fish merchants and people had to stay for 2-3 days outside the village. Later, necessary assistance was provided by fisheries societies, *Grama Niladhari*, voluntary organizations and *Samurdhi* societies. Youths of the village provided excellent service to the people during that occasion. They assisted in transporting people by getting them into lorries that were brought from nearby areas and also to clean the village. Further, they assisted in the distribution of aid. However, participants of these three groups were of the view that the distribution of aid was not carried out fairly. Female participants stated that especially the vulnerable people of the village were not provided with necessary assistance but some people who were not affected by this catastrophe were given various aid. Women were very emotional in expressing their ideas. Male adults were of the view that around 10% of the aid was distributed out of the way. Youths were not much interested in discussing this matter and they stated that some people were not granted necessary aid.

The views of the participants were called for regarding their attitudes in the event of a drought. In response to this, one woman stated that they would think about it when it occurred. It seems that they have no precautions regarding such urgent situations. Several participants stated that they had enough sources of water even to withstand droughts. They believed that they would be able to manage the situation if arrangements could be made to provide them with pipe borne water. It is obvious that they expect the assistance of the government at such urgent occasions. According to the representations of the adult farmers, they have taken actions such as chanting of *Pirith*[8] and giving *Deva Dana*[9] in the middle of the tank to settle urgent situations. However, they are of the view that it is unfortunate to see that modern society does not believe in such measures. It seems that the adults of the village are very religious. However, they are also of the view that they would not be much affected by drought since the extent of lands utilized for cultivation has now been reduced and more people are provided with pipe borne water. The youth stated that they do not have any plans to face droughts and further, they are not worried about these situations because they would be provided with aid by the government. Further, they were of the view that they did not have to face much difficulty during the periods of droughts since the government has provided a water tank each for every 10 families.

5.4.5 Resources

When considering the present situation of the village, all are of the view that the people occupied in the fisheries industry have achieved much more progress than the persons occupied in agriculture. Further, they stated that a significant change is seen in the strata of assets of people as a result of investing their money with a person called *Danduwam Mudalali*. At present, they have become helpless as a result of losing their money, which was invested to obtain higher interest rates. People who are earning a sufficient income are facing difficulties since they do not pay attention

8. Chanting Pirith is a religious activity of Buddhists, which takes place to bless the people in situations where they expect a relief from tragedies.

9. Deva Dana is a cultural activity in traditional farming to offer a part of their agricultural harvest to the Gods in obtaining more favorable conditions in agricultural activities.

in managing their income. In the meantime, those who are not enthusiastic either in fishing or agriculture, also remain backward. Further, education has also caused such a situation in Bata-Atha village.

Social and Resource Map

Two copies of the map of the *Grama Niladhari* division, Bata-Atha, were used for this activity. After naming two groups as one and two, the villagers were separated into these two groups. The contribution of youths was highly significant in marking the social map. They carried out this activity obtaining particulars from others. As this village is spread over a huge area, the contribution made by persons from different places was very helpful in completing the map.

5.4.6 Adaptation to and coping with climatic change

5.4.6.1 Weather related shocks villagers have faced

Most of the respondents have said that the sustainable agricultural practices adopted by them were effective (Table 87). Drought tolerance ability of crops, low investment and higher yields were the main reasons to adopt sustainable agricultural practices by farmers.

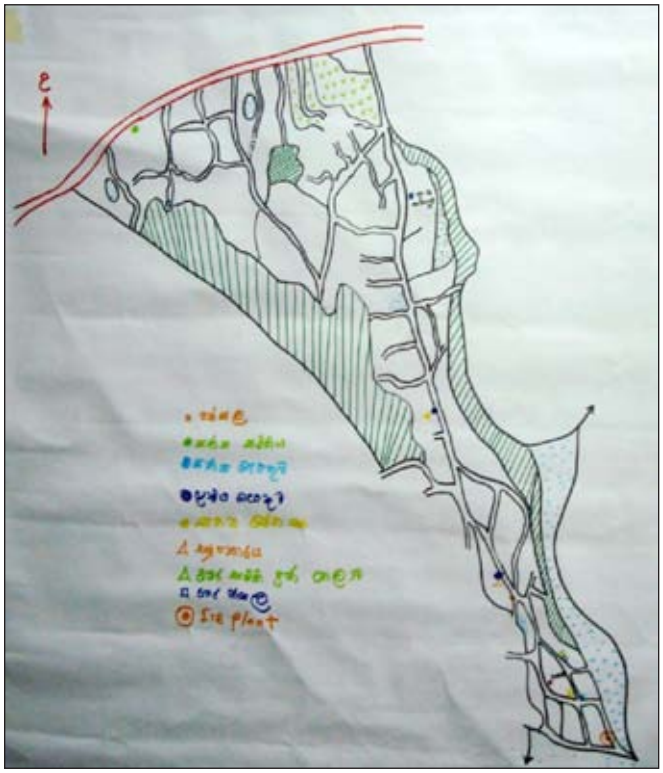

Figure 18. Social map of Bata-Atha.

Figure 19. Resource map of Bata-Atha.

Table 87. Distribution of farmer categories (%) by reasons to adopt sustainable agricultural practices over the period 1970–2008.

Farmer category	Number of respondents	Methods				
		Effective	Not effective	Drought tolerance of crops	Least investment	Achievement of higher yield
Marginal households (n=26)	58	42	19	4	8	4
Small households (n=24)	54	33	21	4	13	8

5.4.6.2 Migration due to climatic changes

Immediate responses of the marginal householders to climatic shocks were diversification of means of livelihood, reduced consumptions, improvement of access to water availability and buying foods, accordingly (Table 88). For small householders, improvement of access to water resources, reduced consumptions, and diversification of means of livelihoods were the main responses.

Table 88. Distribution of farmer categories (%) by immediate response to climatic shock among farmer categories over the period 1970–2008.

Farmer category	Immediate response to the climatic shock							
	Migration	Diversification of means of livelihood	Improvement of access to water availability through watersheds	Mobilization and use of collected resources that are held collectively	Reduced consumption	Obtain loans	Selling of assets	Buying foods
Marginal households (n=26)	12	50	31	12	42	4	12	27
Small households (n=24)	13	29	38	4	33	8	13	13

5.4.6.3 Farmer attitudes changed due to climatic variations

According to the majority of respondents, their attitudes have not changed through climatic changes (Table 89). Some of the farmers have said that their attitudes have changed and among them most of the attitudes have changed for the better to adapt with those changes.

Table 89. Distribution of farmer categories (%) by attitude changed due to climatic shock over the period 1970–2008.

Farmer category	Number of farmers to respond who changed their attitude		Kind of attitudes	
	Changed	Not changed	Better	Worse
Marginal households (n=26)	23	69	19	0
Small households (n=24)	29	63	21	0

5.4.7 Institutional Capacities

Institutes approached in the event of a drought: According to scale of preferences, the most preferred institutions by marginal and small householders were government organizations (Table 90). For marginal householders, political affiliations, non-governmental organizations and kinships were the other institutions approached while non-governmental organizations and kinships were the next of preferred institutions by small householders.

Table 90. Ranking distribution of farmer categories by institutions approached in the event of a drought.

Scale of preference	Marginal householders (n=26)	Small householders (n=24)
1	Governmental organizations	Governmental organizations
2	Political affiliations	Non-governmental organizations
3	Non-governmental organizations	Kinship and relatives
4	Kinship and relatives	Villagers
5	Villagers	Private organization
6	Police station	Political affiliations
7	Private organization	One person

5.4.8 Motivational factors for being part of the local groups

Convenience in obtaining loans and subsidies in the event of disasters, obtaining knowledge and information for agricultural operations and assistance in social events of the village were the major motivational factors for the marginal and small householders to participate in local groups (Table 91).

Table 91. Distribution of farmer categories (%) by motivational factors for being part of the local groups.

		Participator		Motivational factor			
Farmer category	Number of participants	Male	Female	Easy to obtain loans	Convenience to obtain subsidies in events like disasters	Giving knowledge and instructions for agricultural operations	Assistance in social events of the village
Marginal households (n=26)	69	50	19	31	12	15	8
Small households (n=24)	83	54	29	54	8	8	17

5.4.9 Collective actions that evolved when there was a drought/ flood

The majority of farmers in Bata-Atha village preferred collective action in obtaining agricultural information and seeds, obtaining credit, purchasing inputs, storage /sale of products, funerals/ marriages and during droughts (Table 92).

Table 92. Frequency distribution of farmer categories by preference for collective action versus individual action.

Farmer category	Obtaining agricultural information/ seeds		Obtaining credit		Purchasing inputs		Storage/ Sale of produce		Funerals/ marriages		Drought	
	Collective	Individual	Collective	Individual	Collective	Individual	Collective	Individual	Collective	Individual	Collective	Individual
Marginal households (n=26)	65	0	54	0	62	0	62	0	77	0	69	4
Small households (n=24)	67	0	42	4	67	0	63	0	58	0	63	0

5.4.10 Socio-Economic Capacities

5.4.10.1 Sufficiency of income from agriculture

In order to overcome the deficit from agricultural operations, the main method was through kinship support. Apart from that, relief assistance from some government schemes, reducing consumption and borrowing money from local moneylenders/ cooperatives are the other methods of overcoming the deficit from agricultural operations (Table 93).

Table 93. Distribution of farmer categories (%) by methods to overcome the deficit from agricultural operations.

Farmer category	Method to overcome the deficit from agriculture			
	Support from kinship	Relief assistance or opting for some government schemes	Reducing consumption	Borrowing money from local moneylenders/ cooperatives
Marginal households (n=26)	50	31	19	12
Small households (n=24)	38	25	38	29

5.4.10.2 Main income sources of villagers

According to the majority of respondents in marginal and small households, farming was their main income source followed by fishing related activities. Some of the farmers were engaged in the government service and the business sector rather than being engaged in farming or fishing related activities (Table 94).

Table 94. Distribution of farmer categories (%) by methods of main income oriented resource.

Farmer category	Main income sources			
	Farming	Fishing	Govt. works	Business
Marginal households (n=26)	65	27	19	15
Small households (n=24)	42	33	0	8

5.4.10.3 Alternate forms of livelihood or agricultural practices

The majority of the respondents have changed their livelihoods for fishing related jobs from agriculture based activities (Table 95).

Table 95. Distribution of farmer categories (%) by alternative forms of agricultural practices/ livelihoods.

Farmer category	Number of respondents who changed their livelihoods		Alternative form of agricultural practices/ livelihoods		
	Changed	Not changed	Use of new short-term varieties	Move to fishing related jobs	Move to other jobs
Marginal households (n=26)	46	0	8	31	8
Small households (n=24)	42	0	8	21	8

5.4.11 Information and Knowledge Capacities

Majority of farmers have obtained information about alternative forms of agriculture from farmers staying in the neighborhood (Table 96).

Table 96. Distribution of farmer categories (%) by information sources needed to find alternative forms of agriculture.

Farmer category	Information source needed to find the alternative forms of agriculture			
	From neighboring farmers	Through agriculture instructors	Government institutions	Through own experience
Marginal households (n=26)	35	0	4	4
Small households (n=24)	13	13	0	4

5.4.12 Technological Capacities

The majority of farmers have not used technology to cope with changing weather conditions (Table 97).

Table 97. Frequency distribution of farmer categories by technology used to cope with changing weather conditions.

Farmer category	Number of farmers who used the technology		Technology used to cope with changing weather condition	
	Used	Did not use	Use drip irrigation	New machineries
Marginal households (n=26)	15	73	12	8
Small households (n=24)	21	75	13	0

5.4.13 Adaptation strategies

At farm and technological levels farmers have not practiced any adaptation strategies to climatic changes. At intervention level, providing subsidies during peak requirement was the main adaptation strategy while development of kinship ties was the main strategy at social level (Table 98).

Table 98. Adaptation strategies practised at different levels of intervention.

Intervention level	Adaptation strategy
Farm level	They did not get any adaptation to the crop cultivations
Institution level	Providing subsidies during peak requirements
Technological level	They did not resort to any adaptation for the use of technology
Social level	Development of kinship ties

Major coping methodologies of the marginal householders were the diversification of means of livelihoods followed by reduced consumptions and expenditure and digging of deeper wells (Table 19). According to the majority of respondents in the marginal households category, digging of deeper wells, reduced consumption and expenditure, and diversification of means of livelihoods were the major coping methodologies of small households.

6. Conclusions

In the discussions throughout, it was indicated that although at Focus Group Discussions there were some consensus arrived at, there are considerable differences of opinions that are found in the individual interviews. There were some instances where there was no shared experience among community members. Unlike in the rural Indian context, limited Community Based Organizations (CBOs) are found in rural Sri Lanka and little efforts are being undertaken to build up this community cohesion by the government. Long term state intervention either in social or political welfare delivery system is so atomized that there is no collective activism. A few examples where the people have shown some collective action were at death donation societies and religious societies. In this context, it will be very difficult to have successful community based collective action to help people who face difficulties. People are more dependent than in earlier times and would like the State to come and be the provider of benefits. This would not be a healthy situation in the long run and any strategy would require considerable extra effort at building community cohesion. Further, this situation aggravated the divisiveness of the community based on caste, class, gender, religion, political parties and social capital lines, etc. In such a context, collective action by the villagers in the event of a climatic shock would be rather more minimized than expected. Hence, state interventions are dominated in most of these disaster management activities in Sri Lanka.

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Annex-1

List of Participants

SLCARP - ICRISAT Stakeholder Consultation and Policy Dialogue

on

Vulnerability to Climate Change: Adaptation Strategies and Layers of Resilience
held at *"The Sovereign",* Colombo, Sri Lanka, 5 April 2011

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Sri Lanka Council for Agricultural Research Policy

Sri Lanka Council for Agricultural Research Policy (SLCARP) is an umbrella organization of the National Agricultural Research System (NARS) that operates within the Ministry of Agriculture. SLCARP came into existence on 22 December 1987 to create an environment for more productive agricultural research.

With the Secretariat in Colombo, SLCARP serves as an organization in an advisory capacity for coordinating and consolidating research efforts within Sri Lankan NARS, funding research projects/ programs and promoting scientific research linkages in prioritized areas both nationally and internationally. SLCARP has been instrumental in promoting and facilitating research, by improving and enhancing agricultural research through documentation and communicating latest advances in research to the NARS scientists. SLCARP has identified its own perspective, plans and programs for the future in keeping with the aspirations and National goals proclaimed in Mahinda Chinthana to meet the future challenges in enhancing food security and poverty reduction.

Vision

A vibrant and sustainable agricultural research, development and innovation system assuring socio-economic development of Sri Lanka

Mission

To ensure agricultural research, development and innovations are directed towards national development goals through policy formulation, facilitation, coordination, monitoring and evaluation and impact assessment

About ICRISAT

ICRISAT
Science with a human face

International Crops Research Institute for the Semi-Arid Tropics

The **International Crops Research Institute for the Semi-Arid Tropics** (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics have over 2 billion people, of whom 644 million are the poorest of the poor. ICRISAT innovations help the dryland poor move from poverty to prosperity by harnessing markets while managing risks – a strategy called Inclusive Market-Oriented Development (IMOD).

ICRISAT is headquartered in Patancheru, Telangana, India, with two regional hubs and six country offices in sub-Saharan Africa. It is a member of the CGIAR Consortium. CGIAR is a global research partnership for a food secure future.

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