Farmers' Responses to Drought: Dry Zone of Sri Lanka: (Case Study in *Medirigiriya*)

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Abstract: *Some years the erratic weather (dry) has affected a higher percentage of the agriculture farming community in Northern, Eastern, Uva and North Central provinces in Sri Lanka. Droughts can severely impact on human, natural environment, animal, agriculture and water resources. In the case of paddy production in Sri Lanka, if Maha rainfall is lower than the mean values, it effects on the paddy production not only in Maha but also in the preceding of Yala cultivation seasons. In Sri Lanka drought is frequently occurring in the Dry Zone areas with lack of rain water in particular cultivation seasons and years. The 2013/2014 drought has seriously damaged the agricultural production (specially the paddy production) in both Yala and Maha cultivation seasons. Over one million people in Sri Lanka have been severely affected by the drought in 2013/2014 for many districts in the Island. The Medirigiriya Divisional Secretariat (DS) of Polonnaruwa district has been one of the worst affected districts. Water levels of the many tanks have been declined. Paddy farmers have been faced economic hardships situation due to this drought. The main objective of this study was to examine the impacts of drought on paddy farmers. To study the adaptations practices of paddy farmers for drought, and how they are going to face for the same incidences in the future is also studied. This paper examined the perceptions of drought among paddy farmers in two villages using in-depth interviews with paddy farmers and focus group discussions with relevant officers. The field visit has been conducted in the month of October 2014. This drought has impacted to the agriculture, water resources, drinking water and food, environment, and household income. This study also examined how subsidies are distributed to victims, adaptations practices of the farmers, and future suggestions to mitigate the drought.*

Keywords: *Climate, Drought, Farmers, Agriculture, Dry Zone, Perception*

1. Introduction

Drought is one of the most disturbing climate extreme events to livelihoods of the agricultural farmers particularly in the Dry Zone areas in Sri Lanka. Drought occurs when the dry weather (dry spells) is lasting of the considerable period of time. The reduction of water or moisture availability is the main cause of drought. Some years the erratic dry weather has affected a higher percentage of the paddy farmers in Northern, Eastern, Uva and North Central province in Sri Lanka. Most agriculture-based livelihoods in the Dry and Intermediate Zones have been affected time to time by the drought. A prolonged period of extremely hot and dry weather leads to lower the water levels in rivers, lakes, tanks and give the poor yield of the food crops. The drought results are encountered as changes in habitats, shortage of water, increase heat waves and stress to various ecosystems. Other impacts are identified as crop failure, the death of livestock, energy and water shortage, dry soil and high evaporation. Meteorological drought is the reduction of rainfall and hydrological drought is the reduction of water resources. Agricultural drought is the impact of drought on human activities influenced by various factors; like presences of the irrigation system, moisture retention capacity of the soil, the timing of the rainfall and adaptive behavior of the farmers. The impact of drought creates negative consequences to various sectors of the economy, environment and society in a country. Economically decrease the GNP and increase the food insecurity due to drought. Environmental impact due to drought leads to weakening the terrestrial carbon sink, triggers ecosystem, create forest fires, disturbances for bio diversity and alter the climate system. In addition to that drought can decrease farmers' net agricultural production and income, create a high cost of irrigation, decrease the hydroelectric power generation and increase the food and water price. Decreasing the agricultural income can lead to low investment for the following year or cultivation seasons (Perera, 2006). Sociological impacts are also more serious to the nations in a country. It makes public health issues with low water supply, reduces income, increases anxiety associated with economic issues, public insecurity issues and various environmental issue i.e. forest fire, and drying water sources. However, drought makes a very perceptible impact on the population that is largely dependent upon agriculture and related occupations for their livelihoods. As crops are adversely affected, agricultural income shrinks and causes loss of employment in the agriculture sector (Department of Agriculture, India, 2009). With the impacts of climate change the severity of droughts will be increased in Sri Lanka (Rekha, 2011). Adaptation measure such as rainwater harvesting, de-silting of minor tanks and the rehabilitation of tanks in the Dry zone would be imperative as a precautionary action against anticipated climate change (Plan Sri Lanka, 2012). According to the social dimension of the drought, when the drought duration has increased the occurring of the sociological drought is becoming worst. Agricultural and hydrological droughts are more hazardous to create the socio economic drought condition. Drought can be severely impacted on human, natural environment, animal and water resources.

For paddy cultivation the crop year in Sri Lanka is divided in to two main seasons. The *Maha* or the wet season is from September to March and the *Yala* or the dry season is from April to August (Sirinanda, 1983). When the *Maha* rainfall is lower than the mean value, it increases the effects on the production in the preceding *Yala* cultivation seasons. *Yala* is considered as the minor cultivation season dependent on the shorter rainy season and *Maha* is major cultivation season in the rainy period. In Sri Lanka drought is frequently occurring in the Dry zone area with lack of rain water in particular cultivation seasons and years, with drying water sources. Sri Lanka's irrigation system was designed to collect water during the rainy season, so it could be distributed during the dry season for agricultural activities. However, at present, while reservoirs overflow in the rainy season, and they dry-up immediately in the dry season specially *Yala* cultivation season in the Dry zone. The 2013/2014 drought seriously damaged agricultural production (specially the paddy) in both *Yala* and *Maha* cultivation seasons. Over one million people in Sri Lanka have severely been affected by the drought in 2013/2014. Districts of *Polonnaruwa*, *Anuradhapura*, *Moneragala*, *Ampara*, *Hambantota*, *Puttalam*, *Trincomalee*, *Mannar*, *Vavuniya*, *Mullaitivu* and *Kilinochchi* have been impacted. The Government has allocated 1.9 billion rupees to provide relief to the people affected by the 10-month long drought in the Dry zone (http://www.dmc.gov.lk). The *Medirigiriya* Divisional Secretariat (DS) of *Polonnaruwa* district has been the worst affected with decreasing the water

levels of inland water storage (tanks) such as *Meegas-wewa*, *Wadiga-wewa* and *Ambagas-wewa* and *Nikahena* (http://www.sundayobserver.lk/2014/08/24/new40.asp).*Polonn aruwa* district has affected the lives of over 200,000 people (Disaster Management Centre, *Polonnaruwa)*. *Medirigiriya*, paddy farmers have faced economic hardships situation due to this drought. The main objective of this study was to examine the impacts of drought on paddy farmers due to 2013/2014 drought. This paper examined the perceptions of drought among paddy farmers in two villages of the *Wadigawewa Grama Niladhari(GN)* of *Medirigiriya* Divisional Secretariat (DS) division in the Dry Zone, using in-depth interviews and focus group discussions. To observe the farmers adaptations for drought, and how they are going to face for the similar incidences in the future is also studied. The field visit has been conducted in the month of October 2014 in the study area. Farmers' response to drought and future strategies to mitigate the drought is also examined. Variations of the monthly rainfall (mm) of *Polonnaruwa*: from 2012 to end of 2014 (particularly reference to the current drought), total rainfall of the *Maha* and *Yala* cultivation season in the drought period and rainfall variation of the *Maha* and *Yala* cultivation season are also analyzed to identify the weather condition in the study area.

2. Methodology

To study the impacts of drought (2013/2014) the *Nikahena* and *Wadigawewa* villages are selected from *Wadigawewa* GN divisions from *Medirigiriya* DS division in *Polonnwruwa* district from the Dry Zone of Sri Lanka. These two villages have been affected by this drought throughout the year affecting the cultivation seasons.

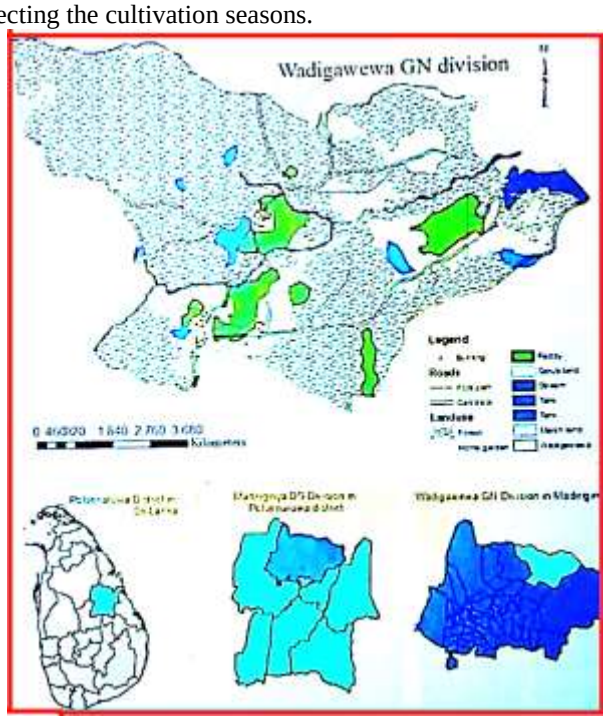


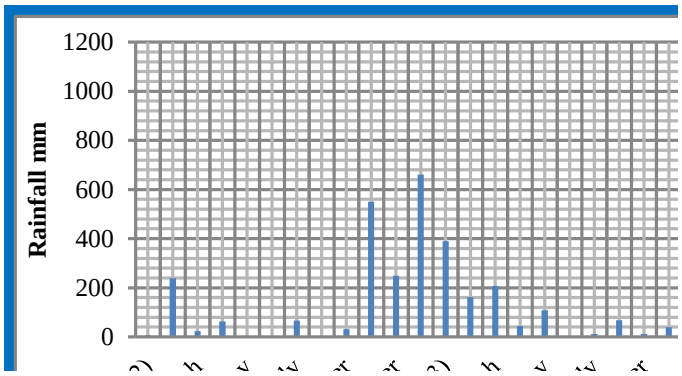
Figure 1: The study area (*Wadigawewa* GN Division)

40 paddy families have been selected for the survey, using random sample method. Divisional Disaster Management Coordinator (DDMC) and *Grama Niladhari* (village officer) and other relevant agricultural officers in the village level have supported to conduct this survey. The study tried to realize the impact of drought, farmers' perception regarding drought, existing adaption methods, and their suggestions to overcome this issue. This study was conducted in October 2014. The study area belongs to the Dry Zone and annual rainfall is about 1250 mm and annual average temperature is about 30°C. More rainfall receives from the Northeast monsoon due to its location. The study area topography is mostly flat and plain having with paddy fields, *chena* lands, scrubs, and tanks. This village society is basically agro-base and mainly depends on both *Maha* season rainfall and irrigated water *(Yala)* for their paddy cultivation. Primary as well as secondary data and information have been used for this study. Quantitative as well as qualitative data are used to analyze the data. A questionnaire survey, observations and focus group interviews have been conducted to obtain the primary information regarding the drought incident. It is basically focused to obtain information on the current situation, the impact of drought, drought supports, public and farmers' perception, adaptation and mitigation strategies and future suggestions. Some secondary information is received from newspapers, internet sources, and from various reports.

3. Results and Discussion

3.1 Variation of the rainfall

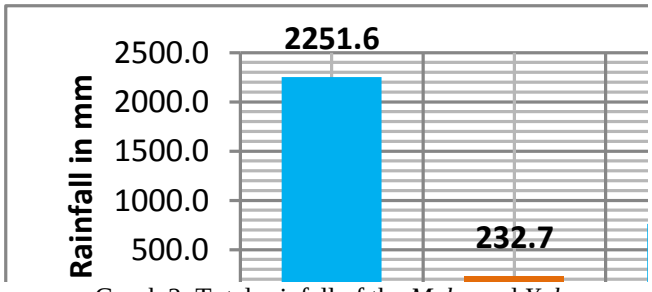
The Northeast monsoon rainfall, which supplies water for paddy cultivation received below an average rainfall for consecutive months from September 2013 to March 2014 leading to consecutive dry spells until October 2014 across the study area. The graph 1 clearly shows that three years (2012-2014) of monthly rainfall is fluctuating and some months show very dry condition (zero mm) in *Polonnaruwa*. Except a few months (October, December of 2012), January 2013, and towards to the end of 2014 (October, November and December) each other months received the rain below 271 mm. From 2013 February to September to 2014 had continuously very less rainfall (about 18 months) and therefore the dry spells are predominated in the study area.



Graph 1: Variations of the monthly rainfall (mm) of *Polonnaruwa*: from 2012 to end of 2014

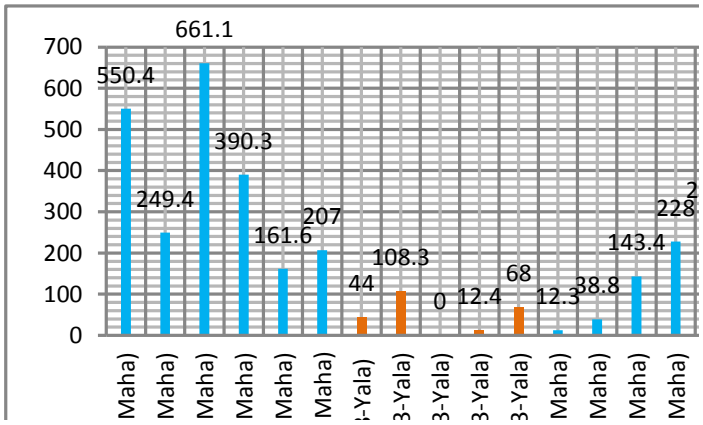
Shortage of water has been drastically impacted to the agricultural farmers in the district. Normally the month of June gives the most hazardous weather condition to this district because the single drop of water is not fallen to the land during the three years period.

There is no guarantee that heavy rain will fall in the same month in consecutive years. In December 2012 the rainfall was 661.1 mm but in December in 2013, it was 228 mm. In October 2012 the rainfall was 550.4 but in October 2013, it was 38.8 mm. In December 2013 the rain was 228 but in 2014 same month it was 1129.6 mm. Sometimes apart from main rainfall season the atmosphere creates the storm and low pressure weather conditions in the Indian Ocean which can create more rainfall during the cyclone activating months.



Graph 2: Total rainfall of the *Maha* and *Yala* cultivation seasons

Graph 2 clearly shows that rainfall differences of the *Maha* and *Yala* cultivation season and also the continuous declining of rainfall since the 2013 *Yala* to following year *Yala* cultivation in 2014. Less amount of the rainfall has been the main cause creating the current drought condition in the study area. Graph 3 shows the both cultivation seasons differences of the amount of rainfall received during the drought period. The total rainfall received only about 480 mm in the *Yala* season during the drought period from 2013 to 2014. But *Maha* cultivation season rainfall is better during *Maha* season in 2012 and received total rain is about 2251 mm. But again in 2013 the *Maha* season rainfall is not received in the satisfactory level as 2012 and it has been affecting seriously to the following *Yala* season total rainfall in 2014.

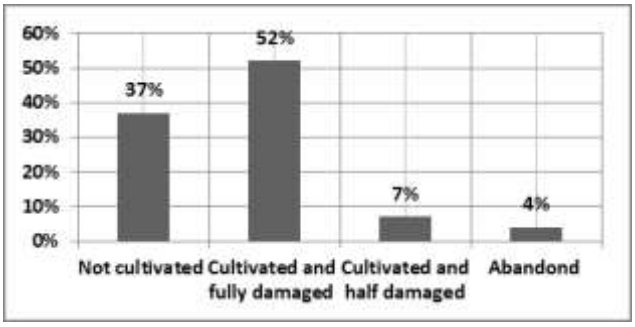


Graph 3: Rainfall (mm) variation of the *Maha* and *Yala* cultivation seasons

3.2 Impacts on agriculture:

Three main agricultural systems have been identified in the study area as; paddy cultivation, *chena* cultivation (a plot of shifting cultivation), and home gardens. Chena crops need less soil moisture than the regularly irrigated rice crops and as such they survive amidst erratic and insufficient rainfall to give the farmer some return from the land cultivated (Tennakoon, 1986). Paddy is the major cultivation crop in the study villages. Most of the farmers accepted (80%) that normally they receive enough water for their paddy cultivation in *Maha* season. Based on rainfall pattern, the farmers of the study area are basically engaged in agricultural activities (73%). Most of the farmers are engaging the paddy cultivation. 15% of the respondents are engaged in civil and government security services. Another 12% are labors engaged in some other activities. Security sector people are also engaged in agricultural activities as livelihood practices. They also cultivate wheat, *kurakkan (millet: eleusine coracana), cowpea (vigna unguiculata), greengram and* vegetables as *chena* cultivation crops. The farmers maintain the home garden and mainly grow fruits like mangoes, banana, vegetables, coconut and etc. Most of the household have planted crops for day to day consumption but due to the dry condition most of the home gardens also perished in the study area. Almost all the tanks (*wewa*) are dried-up in the study area: namely; *Wadiga-wewa, Pathok-wewa, Hene-wewa, Kaduru-wewa, Nikahena-wewa, Meegas-wewa,* and *Kurundugas-wewa.* During the field visit it has been observed that the farmers were digging the *Nelum* (lotus: *Nymphaea nouchali*) yams in the tank bed in *Wadiga-wewa*, due to dried-up the tanks. Farmers used to eat these yams for their dietary food. Due to the drought condition most of the water distributing channels has also been dried-up.

The farmers said (85%) that normally the *Yala* cultivation season is having water shortage for their paddy cultivation. But stored water from the rainy season is the source for *Yala* season paddy cultivation. But the paddy cultivation has been dramatically affected by 2013/2014 drought due to a shortage of rainfall. Only 7% of the paddy lands are cultivated due to drought in this year. 52% cultivated paddy lands are fully damaged. Graph 4 shows the paddy damaged percentage. The home gardens also destroyed by 2014 drought. One lady farmer Ms. *Piyaseeli* (52 years old) said that *"my two acres vegetable cultivation is completely lost due to drought in 2014"*. The situation is same for the vegetable cultivation everywhere in this village. Mr. *Wijayabandara* (36 years old) one of the farmers said that we cultivated paddy and maize but it is completely withered due to the drought. The farmers' general opinion is that the dependence on rice could be reduced if other crops (less susceptible to droughts) are being practiced. Less water dependent agriculture and cultivation of alternative crops and cropping of drought resistant varieties could be encouraged (Rekha and Mohapatra, 2009) to the Dry zone farmers.



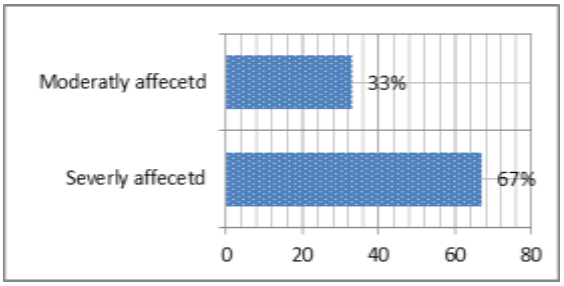
Graph 4: Damaged for the paddy cultivation

Vegetables, coconut and fruits cultivation in home gardens have been affected because of high temperature and evaporation condition and insufficient water in the study site. About 45% of the home gardens are destroyed in the study area. The drought has damaged the livestock and inland fisheries too. The farmers of this village are doing the cattle and buffalo ranging in a small scale. Some families are selling cow milk and practice the buffalo ranging engaging various labor activities. But due to the prevailing drought condition their incomes have been decreased from these activities. As a results diary production and income from this occupation have been reduced. The cattle were suffering from lack of fodder, water and grasses. Therefore farmers are used to feeding cattle with *Punnakku* (cattle food) which cost high expenditure for the farmers. Farmers are supposed to bring grasses from remote areas but they have to pay high vehicle charges for this choice. Some live stocks die due to a shortage of water. Farmer *Mr. Sirisena* told us, that "*my son had seven bulls and died all due to drought". Ms. Srimali* told that *"my calf died in the cow's womb due to dehydration".* The ecosystem of the tanks totally collapsed that directly or indirectly affects the livelihood of the village farmers in various ways. Due to the shortage of water in

the tanks, inland fishing also died. Therefore, the diet of the farmers is also affected due to the failure of the inland fishing.

3.3 Impact on household income, drinking water and food:

Due to the drought farmers were badly affected in terms of their seasonal and annual household income. According to the survey, about 67% of the peoples' income was severely affected and the rest of the 33% was moderately affected.



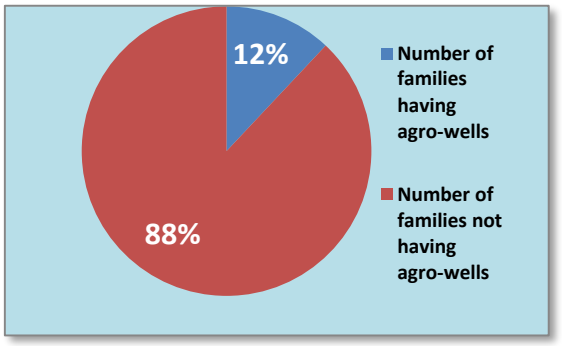
Graph 5: Impact on household income

Those who were employed but not in agriculture were substantially lower the impacts than directly engaged agricultural farmers. Farmers in affected areas have built up substantial levels of debts, have insufficient access to water for irrigation, have limited quality seed supply and are exposed to a continued decline in agricultural income. As a consequence, food insecurity has increased dramatically in the study area.

Drought made vast impacts to the food security too. Household food consumption failed and most of the households consume in-adequate diets of the low calories. Their food preparation and habits were also changed due to drought condition and they faced several difficulties to prepare their food. They used to limit their main meals times of the day. Most of the families reduced their daily number of food meals. Some families have adjusted with previous food stocks. During the field visit we were able to notice that the people were waking in the middle of the tank and some are collecting firewood and lotus roots for their daily food.

3.4 Impacts on water resources and environment

There was a number of water sources are in this study area. There are village tanks, wells, agro wells, tube wells, and water channels. The main water sources of village tanks are normally flourished by the seasonal rainfall. The water is received mainly from the tanks for paddy cultivation and for day to day household activities. 100% of the respondents said that the tanks are totally dried up due to 2014 drought. Due to the good distribution of village tanks in the study area, there are a few agro wells are built in this area and all of them water level are also decreased as the impact of drought. Villagers have been walking a long distance for getting water. *Ambagaha Oya* has only a little water for their other necessities. The 10 household wells are dried up completely and 08 wells are dried up almost half.

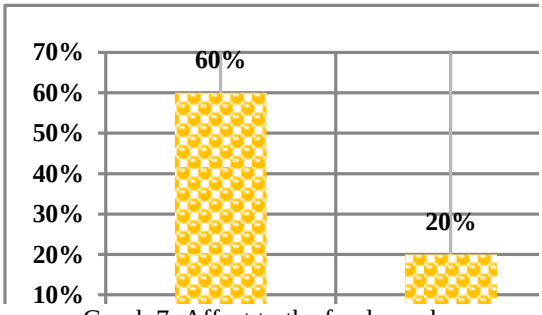


Graph 6: Availability of Agro-wells in the study area

The drought has increased the drinking water problems also in this community. During the drought period, 87% of the respondents said that they did not have drinking water and 13% said that they had water but the water is having the *Kivul* (hard or salty) and therefore it was difficult to drink. Later they were given the drinking water from the government during the drought period. People face very difficult situation regarding water needs such as washing and bathing. Due to the water shortage the villagers have limited their bathing frequency and washing clothes.

Figure 2: Totally dried up water tanks (*Wadigawewa*)

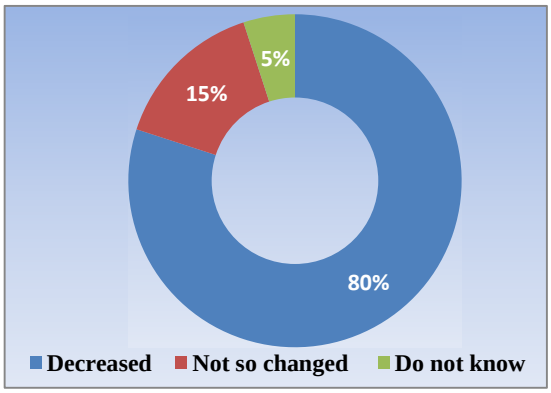
They have faced the sanitary problems and they traveled such a long distance to find the water for their day today requirements. The few tube wells exist in the study area but the underground water level also decreased due to dry condition and therefore to collect (pumping) water from the tube wells are also taken a long time.



Graph 7: Affect to the food supply

Plants, animals, and soils and many others are also affected by drought conditions in this area. According to the observation soil is very dry and soil may become bare and infertile. According to the framers perception, except the drought incidents, time to time they are having some other natural disasters too. Strong winds, floods, high temperature events are also occurring in this area. The rainfall pattern has also been

changing some years (than the normal pattern) and therefore the variability of rainfall has been increased. 100% of the respondents said that the drought condition has been increased



Graph 8: Water level of the ground water

The level of the ground water has been decreased during the drought period; farmers' views of the ground water are stated in graph 8. Farmers were also asked about the wetness of the area. They said it is decreased (60%), not changed (20%) and do not know (20%). Some farmers said that due to the water shortage many elephants are also coming to their paddy lands and to their home gardens either to search food or water.

3.5 Subsidies for drought victims:

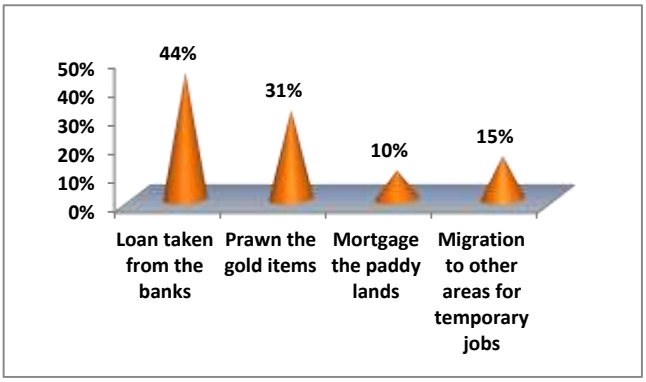
Government and non-governmental organization have taken several steps to supports to the victims of the drought. The government has distributed dry ration and drinking water. About 20-25 liters (containers) has been given to each family and 10 liter chambers are also given. Various organizations have distributed different things like dry rations, water bottles and etc. Some of the organizations are identified as *Sinha* society, Buddhist societies, *Rajarata* development bank, World vision, *Hemas* institute, Nestle, *Derana*, *Hiru*, and *Sirarsa* television network, *Damro*, and etc. In additions to those organizations some small groups also distributed some needy things like cloths, medicines for needy people, and books for school children. According to the concept of "food for work" and "money for work" programs, the people do some community work and given them some money as labor cost. For repairing the water canal and for some small common work 500 rupees is given to a person. This method is already used in some Asian countries like India.

Figure 3: Distribution of the dry ration to the drought victims

If the drought has been occurring always it will increase the poor condition of the people. Poverty is badly influencing to increase the low income and decrease the development of the country. Since Sri Lanka basically depends on agricultural activities and frequent dry spells can decrease the productivity of agricultural crops, and decreased the income and then decrees the investment so therefore it is badly affected to the living condition of the farmers. If the condition is being continued the adaptation capacity will be also decreased. The Government and Non-Governmental organizations have given various subsidies for the drought victims. The national media units, temples, churches, mosques, and various banks are among them. Milk packets, water bottles, small water tanks are also given to the people. Rice and other dry rations have been also distributed. In additions to that some mobile medical service also conducted in this area. Some farmers said that varies rich people individually given some cash to buy necessary items for the affected people. Small community organizations also help to the people in this area,

3.6 Adaptations practices in the study area:

When water is not available in the study area (especially *Yala* cultivation season) the DS secretary office and *Govijanaseva* officers encourage the *Bethma* system through farmer organizations. *Bethma* system means that under which a small extent of land near the tank is cultivated jointly by all the farmers in the village (Madduma Bandara, 1983). Normally the yield is shared among the paddy farmers proportional to paddy land. According to the field survey and discussion with various stakeholders when the water is not enough for the paddy cultivation, the *Kanna* meeting is called for farmers with *Grama Niladhari (GN)* and a representative from the divisional secretary. The *Kanna* (cultivation season) meeting in a village is held usually in late September. This is to decide the cultivation strategy that is to be adapted during *Maha* cultivation season from October to January. The dates for different agricultural activities such as land preparation, and sowing, paddy verity are determined in this meeting. Farmers who have irrigated paddy land should participate in this meeting. Farmers in this area are willing to practice the Chena cultivation specially in the *Yala* cultivation season due to less water availability. This trend is increasing recent years. The main reason is for this trend is the less water consume for the Chena crops. Most of the families are used to get loans from banks. In addition to that various other methods are being practiced in the study area as an adaptation to drought (Graph 9).



Graph 9: Adaptation practice in the study area

In addition to the above adaptation practices, the farmers are used to selling their cattle, tractors, agricultural equipment and

etc. Although the farmers are well aware of building the agro wells in their lands but they do not have enough money to build the agro wells. Still They are also having some indigenous and region specific cultural and sociological practices to avoid the drought condition such as arms giving to mothers, *Bethma* practice, a celebration of the pots ceremony, the offering of the milk rice to the temples and specific gods. While doing the paddy cultivation the farmers of this village are practicing the Chena cultivation due to frequent drought occurs in this area. This implies the farmers of this area having the community experience to adapt to the existing weather extremes and they used to have their own strategies to minimize the incident.

3.7 Suggestions from the farmers and some officials to minimize the risk of drought: *The* ***suggestions are based on the questioner and interviews, 2014:***

The following suggestions could be introduced short term as well as long term basis.

a. Construction of agro wells should be encouraged.
b. Raw seed should be distributed on time to the paddy farmers. Drought resistant paddy seeds should be distributed among the farmers on time.
c. When people become the victims due to drought drinking water and dry food should be distributed immediately.
d. Rehabilitation of the tanks, irrigation canals and other related structures (Sluices, bund, spilling way and etc) should be repaired soon
e. Various types of rain water harvesting tanks i.e. roof rainwater harvesting should be constructed for an individual house.
f. When drought occurs need to introduce proper methods to distribute animal fodders for livestock.
g. Storage building facilities should be established to store paddy and other field crops.
h. Compensation and subsidies for drought should be given to the victims as soon as possible.
i. Increase the number of tube wells in the study area.
j. Appropriate early warning messages should be given before the drought incident.
k. Rehabilitation of the *Wadigawewa* and *Nikawewa* tanks in the study area strongly recommended.
l. Less water consumes crops should be introduced.
m. Alternative job opportunities and self-employment opportunity should be encouraged.
n. Systematic cultivation practices could be introduced with paddy cultivation.
o. Systematic farming insurances methods could be introduced to the farmers and stranded price range also need to introduce for at least rice and main field crops.
p. Common use wells should be constructed for drinking water supply and the community drinking water supply projects should be introduced.
q. Forest clearing should be banned but community forestry could be introduced with minimum damaged to the forests.
r. Encourage common community work (village level) through the farmer organization. i.e. cleaning the tanks bunds and etc. De-siltation of the tanks should be done very quickly.
s. Drought resistance paddy seed and seeds of the other field crops should be distributed before the cultivation period (or real time).
t. Crop diversification needs to be strengthening with supports of Agriculture Department and other relevant institution.

4. Conclusion

The study area had severely hit by 2013/2014 drought after 10 years circle from 2004. 2004 also this area had a hazardous drought condition. 2014 drought had given the vast impact on agriculture, water resources, food security, and household income in the study area. It is necessary to increase the emphasis on drought policy and preparedness. Need to improve drought monitoring tools and early warning system to the community level. Development of regional drought preparedness and responses network is strongly recommended. Risk and impact assessment process need to be formalized. The adaptation methods would have been encouraged and the severity could be minimized if the various actions have taken before the incident occurred. There is no proper self-employment opportunity is introduced into this area. The infrastructure also not developed into the good condition in this area. The farmers in this area are not having proper drinking water facilities especially during the drought period. The government should introduce at least roof rain water harvesting system for each house. *Yan Oya-Ella* project is going to introduce drinking water project to this area. The *Wadiga-wewa* and *Nikahena-wewa* will be benefited from this project. The farmers of this village are requesting to de-silt their tanks and increase the water storage capacity of the tanks. They also need to have the water tap line for their houses. These farmers also have the hope to receive the early warning for droughts, in advanced. Appropriate adaptation methods, preparedness practices, should be introduced with proper monitoring systems. When serious drought conditions occur, an immediate relief coordinating network specifically targeting the vulnerable households is recommended to prevent a further collapse in the community.

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