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Impact of drought condition on the ecosystem of the Mannar District, Sri Lanka- A Case Study

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Abstract

Country's developmental process is mainly based on the developmental activity of the personal well being where the satisfaction level of the livelihood activity creates the nations' developments. Sri Lanka has faced so many natural disasters by water, wind, fire etc. As being the sub tropical and tropical country, most of the territorial places are undergone with the drought condition which causes the imbalance nature of the living standard of the population. In Sri Lanka, most of the places in Northern and Eastern Provinces come under the dry zone sector. Among those, Mannar District is the identified location which has the remarkable deviation in its meteorological data. In this view, this study was focused on the drought conditions and its impacts on reservoirs, economical, living standard, social and biological conditions of the eco-system in Mannar District. Statistical reports were gathered from the Meteorological Department and from the Agricultural Department where the interview was carried out among the randomly selected population regarding the issues on the basis of their livelihood activities were analyzed carefully. The results revealed that the people suffer for the portable water during the Yala Season and the May to July were the identified months with higher disaster and the displacement of the people due to severe drought. According to the statistical data collected during the period between 2005 and 2009, land used for the cultivation and the farming was reduced a lot in the selected 5 Divisional Secretariat Division and the pattern varied with its yield. The Musali and Manthai-West DS Divisions were highly affected while comparing with the Naanaddan DS Division of the Mannar District. It was obvious that the 80% of the land was not utilized in the Yala Season due to the lack of water. The yield was below 10,000 Metric Ton except Naanaddan DS Division and also the land use pattern was below 2000 Hectare in most of the months. Although, the rainwater harvesting system such as rooftop harvesting tanks, small pond and tanks available in the study area, this should be promoted and rehabilitated for the future use and able to solve the water demand to some extent.

Keywords: Economic impacts, Drought, Disaster, livelihood, Rain water harvesting, Season.

Introduction

Drought, flooding and pollution (air, land and water) have been denoted as the identified major issues in Sri Lanka where the drought is the dominant issue in most of the dry zone of the country. It mainly occurs due to the lack of rain water in an unexpected way and the demand of the water for the several activities within a particular period of time and the place. According to the several definition given by many of the researchers, drought condition can be classified based on its severity in the environment as Meteorological Drought, Hydrological Drought, Agricultural Drought, Socio-economic Drought and Famine Drought, etc[1,2].

According to the current situation, deficiency of the rainfall causes the alteration in the land resources and the degradation of the pasturing lands for the cattle and buffalo. Therefore, people could not tolerate the maintenance charges and other stuffs where famine for the food and the seeds for the next cultivation also are in the critical conditions. While the condition prolongs, loss of soil fertility, displacement of the population occurs which ultimately leads to the physical and mental disorder of the total community and in a particular place as well. Not only that, ecosystem, agriculture, health care, economical status, society's well being also is in the consideration of the country. For an instance, in 1972, coastal area of the Peru experienced with the severe drought conditions which leads the country to have a heavy failure in the fishing where the fluctuation of the temperature killed the fish population in a huge amount. Therefore, fish production diminished from 13 million tons to 2 million tons[3]. Similarly in Sri Lanka, drought directly caused the famine and 370,000 families were affected in Hambantota District[4].

Further, Manmade activities, geological location and the climatic conditions are the key factors determine the range of drought conditions of the country. With those backgrounds, Mannar District was elected to this current study where the annual temperature and the rainfall were comparatively lower while comparing with other parts of the Sri Lanka. Particularly, annual and monthly average rainfall of the Sri Lanka is 2397 mm and 200 mm whereas; the annual and monthly average

rainfall of the Mannar District was 960 mm and 74-134 mm, respectively. Moreover, annual temperature of the country and the Mannar District is 26˚C- 29˚C and 28˚C- 33˚C.

Therefore, this study was aimed to find out the various types of impacts and the problems associated with the drought conditions in Mannar District, Sri Lanka.

Objectives of the study: i. To identify the locations which have been undergone with higher economical impact due to the drought condition in Mannar District, Sri Lanka. ii. To study the impacts related with reservoirs, livelihood, biological and social aspects in Mannar District, Sri Lanka.

Methodology

Present study was conducted with the support of primary and secondary data where the direct and face to interview were carried out among the randomly selected population and from the department staffs. Relevant statistical data was collected from the departments of Irrigation, Fisheries, Agriculture and Divisional Secretariat Division of the Mannar District, Sri Lanka. People were randomly selected from the district and were interviewed regarding the current issue of the drought conditions of the last three decades (1980 to 2010) of the study location. Statistical records (2009) for the total cultivable land and the yield were compared in 5 different GN Divisions of the Mannar District and were tabulated for the clear description of the economical status of the district.

Results and Discussion

Manmade activities and its links to the drought conditions in Mannar District: Other than the location and geographical nature, it has been identified that the contribution of the manmade activities influences a lot on the drought nature of the Mannar District, Sri Lanka. Increased continuous pasturing and the deforestation are two main factors determine the increased dry conditions of the district. Not only that, lack of care, maintenance and attention on the irrigation system and the emission of green house gases also creates the favorable conditions for the drought conditions. Further, there are some places with the high pasturing lands for cattle and buffalo which are totally used by all the farmers for their livestock feeding system. Therefore, it creates bare lands without plant population finally; the fertility of the land is degraded and increases the atmospheric temperature. This common activity has been practiced in Mullikulam GN Division which comes under the Musali Divisional Secretariat Division where the loaded pasturing is done to rescue the product of Yala Season from the livestock.

Furthermore, it was the evident with the observation of the World Meteorological Organization that over 70% of the natural disasters are partially or totally related to the weather and climate in combination with economic, social, and political factors of the nations. And also, the developmental activities (resettlements and rehabilitation) soon after the war, created the district to destroy the plant cover and canopy for the proper infrastructure and the establishment in Mannar District. It is still happening nearby the Madhu Region of the Mannar District, Sri Lanka. With the background, moisture deficiency of the Mannar District during the period of 1980-2010 also was studied on the basis of five different categories as below.

Impacts on the reservoirs and natural water bodies: Reduction on the level of water quantity and the complete dryness were the common symptoms of the diminished rainfall of the nature. It was obvious that the complete reduction of the water column in all the minor ponds located in the Mannar District, Sri Lanka. Not only that, but some medium and the large scale ponds' water column also becoming lower than the expected. Especially, Malwathu Oya, supplies more water to the majority of the ponds including "Kattukaraikulam and Puthukkamam" where the conditions were also forwarded to the threat for the adequate supply of water for cultivation.

Due to those issues, cultivation land for the Agriculture in the Mannar District has been also reduced by 10-20% at the present conditions. The northeast monsoon, which supplies water for the main rain-fed agriculture (*Maha* season) across the key paddy producing areas (Kurunagala, Ampara, Polonnaruwa, Anuradhapura District) in the country was delayed and brought the lowest reported precipitation (less than 40 percent) during the last three years period leading to prolonged drought across many parts of the country[5]. Sri Lanka's provision of drinking water and agriculture practices depend heavily on major reservoirs and minor tanks that store rain-water and provide water for drinking and crop irrigation during the dry season with the support of the well established storage channel in most of the North-Central Province of the Sri Lanka. Although, the study area consisted a fewer number of storage tanks to cover more areas of the cultivable land as well. Colonies in the most drought-affected areas are dependent on open dug-wells for domestic water consumptions and for home garden production. At the present study, both major and minor tanks and dug-wells have been dried out and water levels are dangerously low in many major reservoirs which led the people to move away from those identified locations in Mannar District, Sri Lanka.

Impacts on the economic conditions of the district: It includes agriculture, industries, rearing livestock, fishing and the production of electricity. Among those agriculture is the vast section which has the very big role in most of the living standard of the community. Majority of the population (67%) cultivate paddy in 37,160 hectare land while the total availability of land is 2,002,006 hectare. Water is one of the requirements for the seed germination, seedling establishment, flowering, seed formation and for the photosynthetic accumulation. When the restriction occurs in one of the developmental stages of the plant growth, it would ultimately causes the reduction in the assimilation process of the plant.

Commonly, October to December is the period receiving more than 40% of the total annual rainfall in Mannar District. During this Maha Season, people harvest the rain water for the cultivation of crops in Yala Season where the destruction of the Yala cultivation is in major concern. In Sri Lanka, Northern and the Eastern Provinces include the most of the dry zone where January to February is the peak harvesting months in the year. According to the statistical count held on 1984/1985, a total of 177,718 hectare land was undergone to the Maha Season. As the result, 4.08% and 3.05% of the cultivable land was destroyed by the climatic conditions in Maha Season and Yala Season, respectively. Department of Agriculture (2009) supported that the 24,000 hectare of land experienced drought in 1973 and 1974 and completely destroyed. In 2007, climatic changes caused the impacts on 8 districts in the country where the level of production was decreased and rate of import was increased with the increasing price of the rice for local people. During that period, land was dropped without cultivation and also the land which was used for the cultivation also showed the reduced yield in its performance records.

Cultivation on Maha Season: The Figure 1 shows the hectare of land used for the paddy cultivation in 5 different DS Divisions named as Mannar, Naanaddan, Musali, Manthai-West and Madhu where the trend shows the reduction of the cultivable land in such DS Divisions of the Mannar District. As shown in Figure-1, the cultivation on Maha Season in Musali DS Division has been reduced a lot in 2008 and 2009 where the complete dropping of the cultivation occurred. Further, in Manthai-West and Madhu DS Divisions, the cultivable land has fallen rapidly during the period of 2005-2009, in Mannar District, Sri Lanka.

Data which were recorded in the Disaster Management Centre (DMC) indicated that the floods, high wind, drought, landslides and lightening are the major recurrent disasters caused the dramatic impact in Sri Lanka. With the successful implementation of the disaster risk reduction programmes in the country for 9 years, the Ministry of Disaster Management has succeeded in reducing the loss of lives due to natural disasters (Source: NDMCC). However, the property damages and economic loss due to recurrent and frequent natural disasters continue to rise.

Figure-2 shows the production performance of those particular DS Divisions of the Mannar District where the production was higher in Naanaddan DS Divisions while comparing with other DS Divisions. It was obvious that the scarcity of the rain water and distribution were different in place to place even in Maha Season of the country. The allocation of land for the cultivation in Naanaddan DS Division was higher therefore; the yield also was higher in that particular area of the Mannar District, Sri Lanka. Additionally, enhancing irrigated agriculture to be commercially viable and maximizing water use is recognized as critical for development of Sri Lanka's agricultural sector in the *Mahinda Chintana* (Sector Vulnerable Profile-Water, 2010). In rain fed agricultural systems, erratic rainfall can have comprehensive and devastating impacts on affected livelihoods and local economies. The most immediate impact of erratic rainfall on rural livelihoods is on crop production. Droughts and floods undermine farm yields and the national harvest, reducing household and national food availability, and agricultural income derived from crop sales.

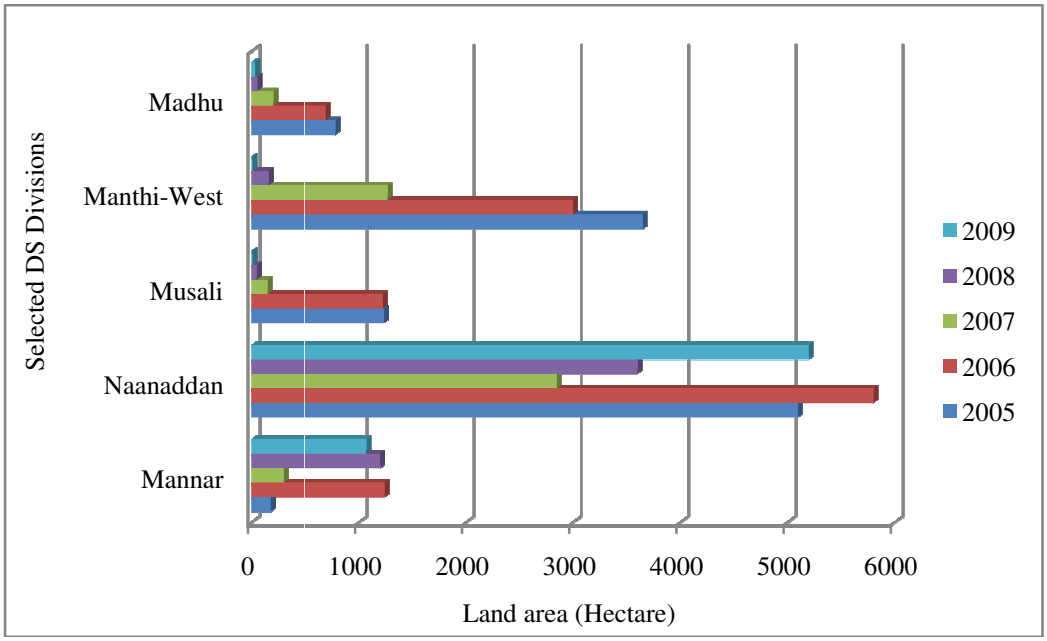

Figure-1
Total area of land used for cultivation in Maha Season

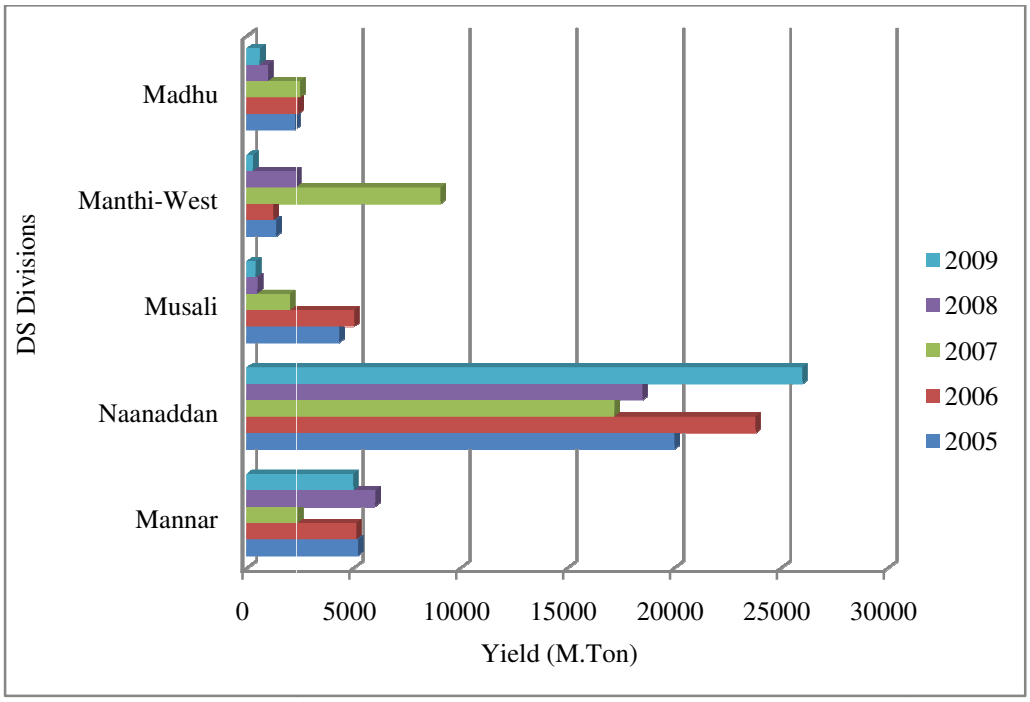

Figure-2
Total Yield for the cultivation in *Maha* Season (Metric Ton)

Cultivation on *Yala* Season: Figure-3 shows the land used for the cultivation in *Yala* Season where Naanaddan DS Division plays a significant role in the performance of the district as the representative of whole.

According to the Figure-3, during the period of 2006-2009 very less hectare of land (3-10 Hectare) was utilized for the cultivation. And also, there was a lack of involvement in the Madhu DS Division for the paddy cultivation. It was mainly occurred due to the lack of awareness on the rainwater harvesting system as the utilization of rain water which was received in the *Maha* Season in an excess amount.

Current records for the statistical (2009) supports in Mannar District showed the uncertainty of the yield in all over the *Yala* season which was higher comparatively *Maha* Season[6]. In 2009, the cultivation was at 10 hectare of land where the yield was in zero amounts. It was clearly seen that the scarcity of water was the issue in 4 DS Divisions except Naanaddan DS Division of the Mannar District. Further, this evidence shows that the influence of water is higher on *Yala* Season than the *Maha* Season of the district.

Figure-2 shows the production performance of those particular DS Divisions of the Mannar District where the production was higher in Naanaddan DS Divisions while comparing with other DS Divisions. It was obvious that the scarcity of the rain water and distribution were different in place to place even in Maha Season of the country. The allocation of land for the cultivation in Naanaddan DS Division was higher therefore; the yield also was higher in that particular area of the Mannar District, Sri Lanka. Additionally, enhancing irrigated agriculture to be commercially viable and maximizing water use is recognized as critical for development of Sri Lanka's agricultural sector in the *Mahinda Chintana* (Sector Vulnerable Profile-Water, 2010). In rain fed agricultural systems, erratic rainfall can have comprehensive and devastating impacts on affected livelihoods and local economies. The most immediate impact of erratic rainfall on rural livelihoods is on crop production. Droughts and floods undermine farm yields and the national harvest, reducing household and national food availability, and agricultural income derived from crop sales.

On the other hand, farming includes livestock rearing from which milk, meat, egg, skin etc can be produced. Those are the base for many of the byproduct and its distribution all over the world. The wastage including cow dung and other feed odds are also used for the compost making which have the ability to function as the natural organic bodies and join the environment into the environmental friendly ecosystems.

However, scarcity of the water occurs during the drought season which causes the availability of water and feed for the livestock rearing. Therefore, disease outbreak is the critical issue in the Mannar District due to the lack of available drinking water in most of the days. Although the proper vaccination and management practices exist, death of the animal is the common issue in dry season.

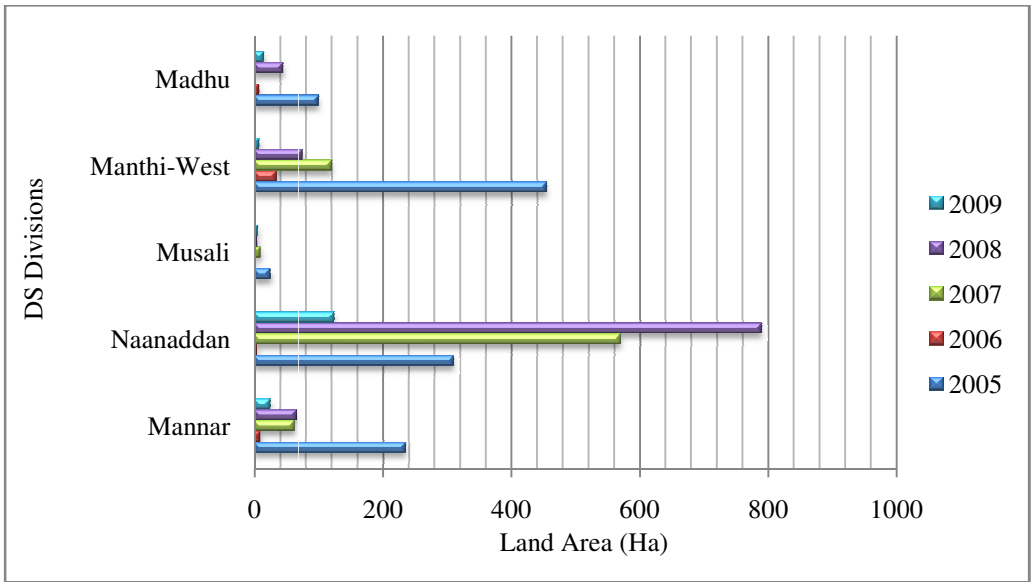

Figure-3
Total area of land used for cultivation in *Yala* Season

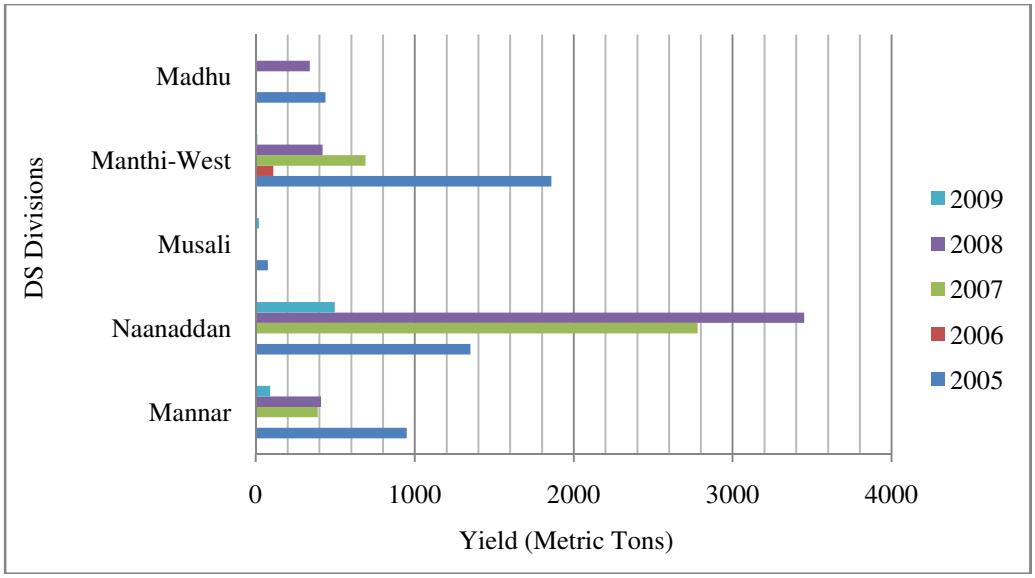

Figure-4
Total Yield for the cultivation in *Yala* Season (Metric Ton)

The second most important issue is fishing where the high temperature causes the interference with the Plankton growth and development and also the death of fishes happened within the water bodies. In the fisheries sector, about 80% of the production (224,000 Metric Ton) of fish has been from coastal resources. Nowadays, most of the coastal resources in Sri Lanka are being exploited at the maximum sustainable level or sometimes even exceeding it. Improvement in inland and aquaculture fish supplies is possible mainly through increased production and supply of fingerlings to the inland reservoirs. There is very little information available on specific allocation of water for uses such as inland fisheries[7]. Therefore, the accumulation of the organic matter from the death aquatic plants causes the odor to the surrounding in some cases as well. And also, there are some activities going on such as weaving mats, crafting etc which also depends more on water.

Sri Lanka's economy faces many challenges due to the natural hazards where the Agriculture in Sri Lanka is highly susceptible to variations in temperature, rainfall, soil moisture deficits and increases in the intensity and frequency of extreme events. Delayed monsoon rains and an increase in the frequency of droughts and floods generally affect the extent of paddy sown and harvested and yields obtained.

Impacts on the livelihood performance of the district: Livelihood conditions of the people are mainly based on the portable drinking water, unavailability of the drinking water, famine for food, lack of food etc. During the dry season, people move to the places where the water is available at the required amount. However, the manmade activities led to the water pollution at higher amount. Therefore, more than 80% of the total people rely mostly on tube well and also, in dry season reduced level of water causes the mixing of chemical which has been used a lot for the agriculture as the chemical fertilizer. In Mannar District; Musali, Manthai-West and Madhu DS Divisions have been identified a lot as the places of scare water. In Musali DS Division; Mullikulam, Marichukatty, Palakuli, Karadikkuli, Kondachchi, 4th Miles Stone, Veppangkulam, AhathyMurippu, Elluppitti etc, were the identified locations. Paaliyaaru, Kalliydy, Thevanpiiti, Vellangkulam, Pallamadu and Vettayan Murippu were the places where severe water scarcity was identified in Manthai-West DS Division of Mannar District. Although, the problems rose in Madhu Region, purification often carried out to reduce the conditions of the polluted water. According to the statistics, April and May were the peak drought months in the year of 2011. And also, the lack of water creates the food scarcity due to the poor satisfaction of the Agricultural benefits of the district.

Impacts on the biological conditions of the district: It is the overall concern of the human, plants as well as the animal regarding its death, disease outbreak, malnutrition, reduced metabolism, etc. Complete destruction of some plants causes the reduced density of the plant canopy in the nature. Therefore, the direct warming impacts cause the human and animal for the stress in the atmosphere. Continuous increased temperature led to the higher death in the animal and plants which ultimately influence the reduction in the healthy plant and animal population in the district. During the dry season, the outbreak of disease is higher. Flies, bugs, and other causal agents are disseminated in the environment where the Malaria, Cholera, Mumps, Vomiting etc were the dominated diseases in the Mannar District, Sri Lanka. Further, the morphological features of the people also differ from one location to another in this district.

Impacts on the social background of the district: There were some major issues on behalf of the social concerns where famine, poverty, displacement, increased price for goods and services, loans and reduced income of the family were in top. According to the records, people who were from Musali and Madhu DS Divisions often displaced to the Thadshana Marutha Madhu region during the dry seasons. At that condition, government officers and the staff face the difficulties to fulfill the needs of the society. Here the people dwell below the poverty line and their mentality also affected while comparing with others. And also, lack of commodity and the production and increased price of the commodity caused the unbalances among the population who are below the poverty line.

Conclusion

Present study revealed that the people who dwell in the particular places of 5 different DS Division have been affected a lot due to the dry season in Mannar District, Sri Lanka. It was obvious in April, May, June and July where the high temperature lead to the scarcity of water which ultimately reduced the production level of the district. The total land area which was used for the cultivation was reduced with the year where the Musali and Manthai-west DS Divisions were impacted a lot while the Naanaddan DS Division was with the peak performance. It was clearly seen that the population move from one place to another due to the lack of portable water for their domestic purposes. The efficient utilization of water, rehabilitation and management of damaged tanks and ponds will be an added advantage to this area. Awareness on climate change and its adaptation strategies will support the people to withstand against drought in Mannar District

Recommendations: i. Protect the plant canopy (A forestation, improved pasture lands). ii. Concentration on aquatic resources (Renovation techniques, Formation of new reservoirs, rainwater harvesting technology). iii. Planting the crops which are drought tolerant. iv. Formulate the rules and regulations to improve the living standard of the community especially in dry season (Improved economic level, approved living categories, subsidies and commodities). v. Creating awareness among the population.

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