

An assessment on the drought issue in Mannar District, Sri Lanka - 30 Years Statistical Review (1981-2010)

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Abstract: Rainfall is one of the climatic factors influencing a lot in the country's developmental activities as being a natural and freely available resource in all over the world. Sri Lanka is being blessed with the tropical nature where the benefits through the agricultural sectors are higher than the ordinary. On the other hand, drought is one of the identified disasters among the other natural disasters which cause the tremendous decrease in the production performance of the country and livelihood activities of the human being as well. Therefore, the concern on the agricultural activities via the freely available resources especially depending on the rainfall pattern should be focused a lot. With those concerns, present study was conducted by selecting one of the major dry zones (Mannar District) in Sri Lanka. For the documentary supports, statistical records were collected from the Meteorological Department (Colombo and Mannar District) for the period of 1980 to 2010 (30years records). Rainfall data, mean value and its standard deviation were calculated and tabulated for further analysis. At the present study, rainfall pattern was fluctuated with the time period where the lowest rain fall was observed in 1983 and the peak was felt in 1985. Hereafter, the quantity of water was reduced than the optimum. And also, the higher drought condition was experienced in June, July and August of the whole years of the study. The total of 312 months were recorded for the future status and forecasting of the country in which 182 months experienced drought while 130 months were in wet nature in Mannar District. Further, 1982, 1983, 1988, 1989, 1990, 1999 and 2007 were with the extreme drought condition which highly deviated from the mean value and showed the negative nature of the district. Slight Drought, Moderate Drought, Severe drought, Extreme Drought and Far Extreme Drought were with the value of 4.4%, 15.9%, 17%, 22% and 41.2%, respectively. The manmade activities and the present development conditions were the impacts on climatic factors and also need more consideration in management actions for present as well as future needs of harmless environment.

Keywords: Drought, environment, Mannar District, Rainfall, Temporal variation

INTRODUCTION

Drought is one of the serious natural disaster have been recognized a lot in most of the countries as well as in the dry zone of Sri Lanka where the seriousness vary with the country and the location. This condition can be created due to the lack of rainfall and its distribution which ultimately leads to the scarcity of the water in particular places as well. Due to the reduction of rain water, the region's drought condition has been in an increasing trend. There are some supportive observation done by the weather forecasters which shows that the rainfall has been diminished within two decades a lot by the value of 10% and 15% in Kongo and Seerapunchi, respectively[1].

Further, drought can be determined by the amount of water evaporated and amount of water captured from the rain water at the Earth. Creation of deserts is because of the reduced rainfall rather than the increasing temperature of the particular environment. Therefore, Earth's temperature is

dramatically increased and creates more water free environment like drought region and dessert parts in the Third World Countries as well as in some of the developed countries. Additionally, there are many indices have been developed to measure the drought conditions of the particular location of the country. Among those, Meteorological Drought Indices and Spectral Vegetation Indices are common. Temperature Condition Index, Global Vegetation Index, Vegetation Condition Index and Normalized Different Vegetation Index are included into the Spectral Vegetation Indices. Meteorological Drought Indices consist of Percent of Normal, Standardized Precipitation Index, Palmer Drought Severity Index, Negative Deviation, Surface Water Supply Index and Reclamation Drought Index etc.

In Sri Lanka, places such as Anuradhapura, Moneragala, Hambanthota, and Puttalam are under the threat of drought nature. And also, Mannar District falls under the dry zone where the increased temperature and

the reduced rainfall lead to the higher vaporization and the evapo-transpiration losses of water which functionally causes the unavailability of water in most of the periods of this district [2]. Therefore, the economical pattern of the people show the fluctuation and uncertainty of the income level specially to the person who is highly engaged with the agriculture as the main income source to his family. Not only that, natural environment and the health phenomena of the population have also shown negative impacts on it.

Moreover, people dwell in this particular district have lack of awareness on the natural disaster and its causal agents. Therefore, this present study was carried out in order to recognize the facts and impacts by manmade activities, precautions and mitigation with proper suggestions towards the future generations. Additionally, agricultural sector is under the concern in this district where the influence of the climatic condition is quite more. And also, there are some chances to buy water for money and scarcity of the water higher even for domestic as well as the drinking purposes. It was expected to be a mediator in fishing, livestock rearing, agricultural farming, rescued water reservoirs, industries etc which are mainly based on the available water of this region. This study is going to be a vital resource for the estimation of the drought in future of the Mannar District, Sri Lanka.

OBJECTIVE OF THE STUDY

1. This study mainly focus on the below tasks in order to aware the society towards the future decades.
2. To know the drought condition of the Mannar District statically with the 30 years background.
3. To identify the years which were with the higher drought conditions in Mannar District, Sri Lanka over the period of 1980-2010.
4. To find out the reasons and forward the suggestions regarding the drought conditions of the particular district.

MATERIALS AND METHODS

At this current study, data collection was done based on the quantity as well as quality aspects via primary and secondary data. Data on monthly rainfall distribution, temperature and other parameters during the period of 1980 to 2010 were collected from the Meteorological Department of Mannar District and the Head Office of the Colombo District. Not only that, but

other statistical data were also received from the Water Board, Fisheries, Agricultural Department, and Divisional Secretariat Division of the Mannar District, Sri Lanka.

Data collection

Primary data were collected via the direct observation by identifying problems faced by the people due to the drought, leading manmade activities, geological locations of the district etc. Moreover, face to face interview included many supportive statements from the randomly selected employees who work in Department, farmers and leading committee members etc. Books, magazines, records, statistical reports, newspaper, government leaflets, internet etc were used to collect linked documents as the secondary data at the present study during the period of 2011.

Data analysis

Collected data were tabulated in the Microsoft Excel Sheet and the suitable figures and tables were used as the output of the present study in Mannar District, Sri Lanka.

RESULTS AND DISCUSSIONS

This present study was done by recording the rainfall variation for the 30 years period as the expression of the indirect drought conditions of the Mannar District, Sri Lanka.

Distribution of the annual rainfall in Mannar District

The Figure 1 shows the variation of the rainfall data in annual basis. According to that, average annual rainfall pattern was recorded as 903.7mm while the peak value and the least value were 1575.5mm and 150mm, respectively. And also, for the year of 1991 and 1992, rainfall data were not recorded due to the severe internal war crisis in the Northern Province of Sri Lanka.

According to Figure 1, lowest rainfall was recorded in 1983 where the average annual rainfall was nearly 112.8mm. It was clearly seen among the 30 years of the recording, highest drought was felt in that particular year with the negative relationship of rainfall and the drought conditions of the nature. At the last decades, 2007 was recognized as the least rainfall distribution year with the value of 603.5mm per annum. During that period, some other districts have also been experienced with the extreme drought condition.

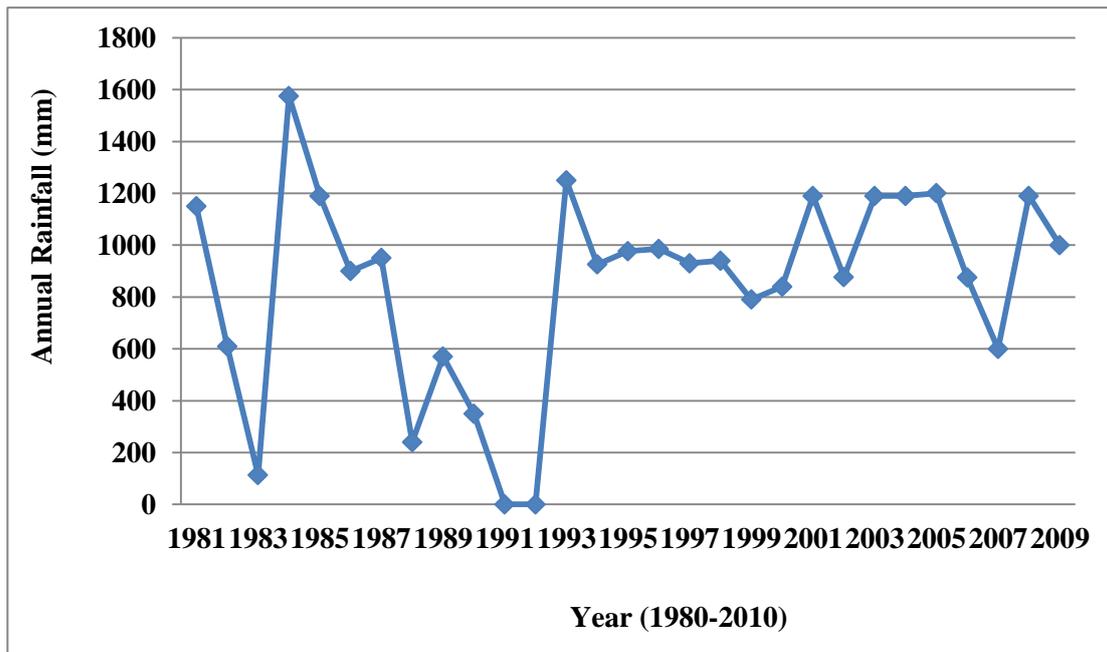


Fig 1: Annual rainfall pattern (1980-2010)

Seasonal pattern of Sri Lanka

Sri Lanka has been blessed with the hottest nature and categorized as one of the tropical countries. There are two main seasons where the agricultural and farming activities are going on. The important season of Maha falls between October to February and the Yala season falls between March to September in Sri Lanka. Even though, this extended period can be fluctuated slightly than the mean of the annum.

Distribution of the annual rainfall during the Maha Season

North -East Monsoonal Rainfall provides the peak performance on its water distribution that mainly starts in the month of October. For the whole period of 30 years, the average monthly rainfall for the October was 152.8mm and the year 1988 showed the lowest rainwater (2.8mm) receiving month for the year of the study period. And also, the month of November received the rainfall which was higher while comparing with the month of October. However, the trend was similar with the peak value of 497.5mm (2005). The latter part of the year (December) received the rainfall as 535.9mm in the year of 1993 where it was the highest fall during the 30 years period of the study. Further, this month showed the fluctuation and showed the variation of reduced rainfall afterwards. Additionally, at the beginning of the year 1990, 279.6mm of rainfall was observed which, was the peak to all the other years in the Mannar District (Figure 2).

According to the Figure 2, there was no any records for the received rainfall during the period of 1991 and 1992 and also the few falls were observed (0.3mm) in the year of 1983 which was with the high deviation and the fluctuation while comparing with the other falls in Mannar District, Sri Lanka.

Distribution of the annual rainfall during the Yala Season

During the Yala Season, people were mainly depended on the irrigation water supply due to the lack of rain water while comparing with the Maha Season. This season falls between March to September and the dry wind across the District is higher. During this period, there was a heavy fluctuation in its falling pattern was observed. Around 292.6mm of rainfall was obtained in 2009 as the represented amount of water for the month of March and showed slightly decrease in its distribution afterwards. However, in 2008 this particular district received 0.5mm of rainfall during March and it was observed as the highest droughtiness year for the month of March. During the month of April (Figure 3), rainfall was quite perfect while comparing with the February and March where the peak was received as 202.5mm in 1995 and the second as well as the third peak value were ensured in 2003 and 2005 as 199.8 and 195.5 mm, respectively. Afterwards, the falling pattern was reduced from the peak falls due to the manmade activities which made this environment into a big consideration. Additionally, after the internal conflicts came to an end, new renovation, innovation techniques have been enrolled for the district development. Higher development occurred at this particular period and it might be the reason for this increased drought in this area.

Mid of the year of May and June showed the greater reduction in the amount of water received for the agricultural activities and much loss was observed to the farmers regarding their livelihood activities in Mannar District. However, month of May was rather perfect while comparing with June. In May, only two years (1991 and 1992) did not receive rainfall whereas

in month of June 7 years among the 30 years period of 1981-2011, people did not receive any rainfall due to the severe drought conditions occurred in this study area. In 2004, 162.6mm of rainfall was obtained in May and 62.7mm was for the month of June (peak for the whole years). And also, the average monthly rainfall for the June was 7.2mm due to the extreme drought as being the mid of the year. In July, the annual rainfall was slightly higher while comparing with the mid period of the year (June). However, there was a decreasing trend was observed during the period of 1991-2010. As the results, Mannar District did not

receive any falls during July for the 11 years and the peak was in 1998 (71.2 mm) while the lowest value was 1.3 mm in 2008. During the period of August, 14 years have no rainfall (0mm) distribution and the highest mean value was in 1988 (78.6mm) of the out of 30 years. September is the month which leads to the greater beginning of the Maha season and the exposure of the wet pattern of the whole country. At this reported value, 138.4 mm of the rainfall was obtained in 2010 which were the fundamental initiation of the high fall afterwards.

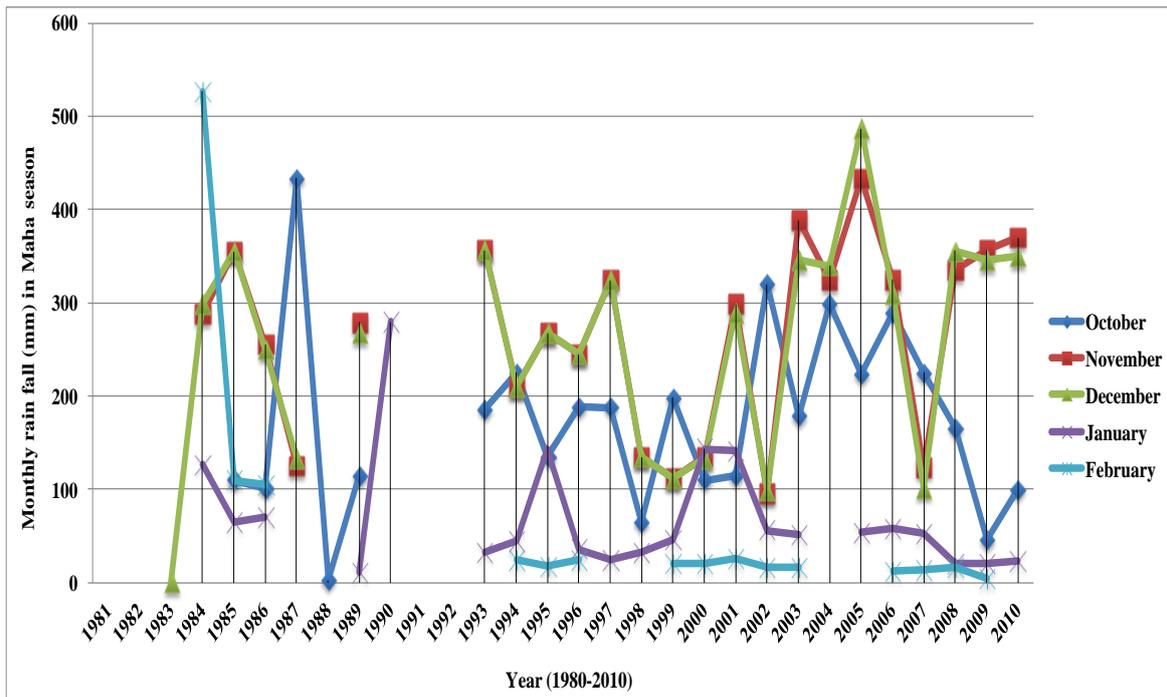


Fig 2: Rainfall distribution during the Maha Season (1980-2010)

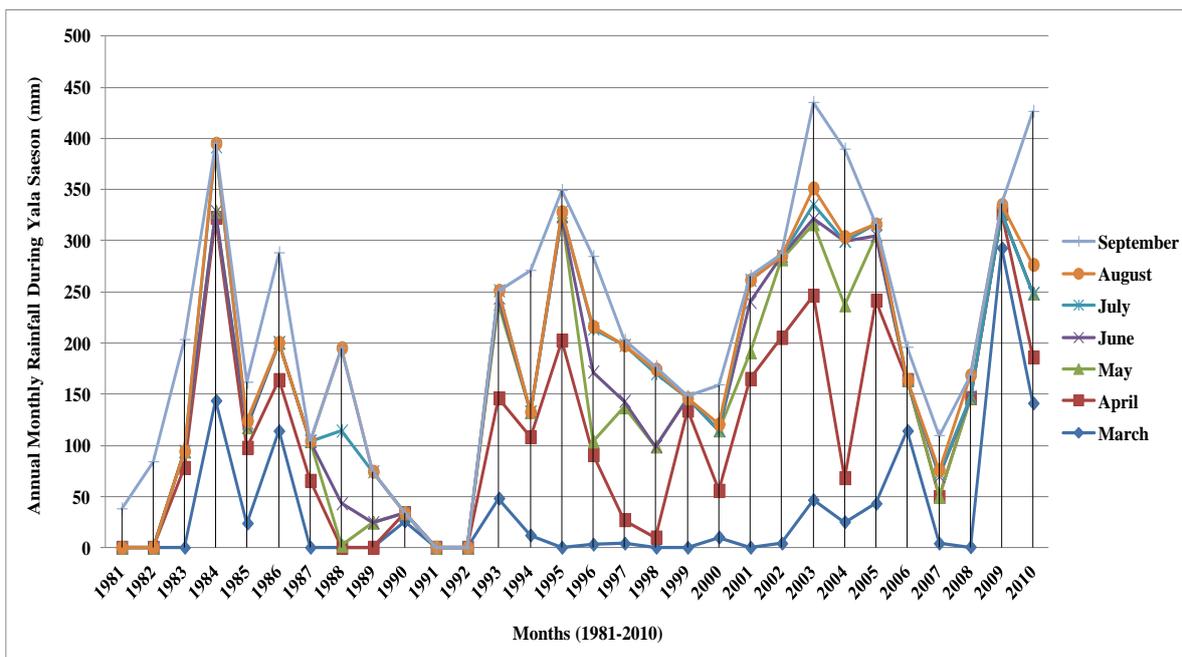


Fig 3: Rainfall distribution during the Yala Season (1980-2010)

Deviation of the rainfall pattern of the year

The above Figure 2 and 3 show the recorded value of the monthly rainfall for the period of 1981-2010 and Figure 1 deliver the meaning for the annual rainfall pattern of the Mannar District, Sri Lanka. Due

to the fluctuation of the rainfall pattern of the country, the mean deviation comparison was done from the standard value per month and the year of the particular district (Figure 4).

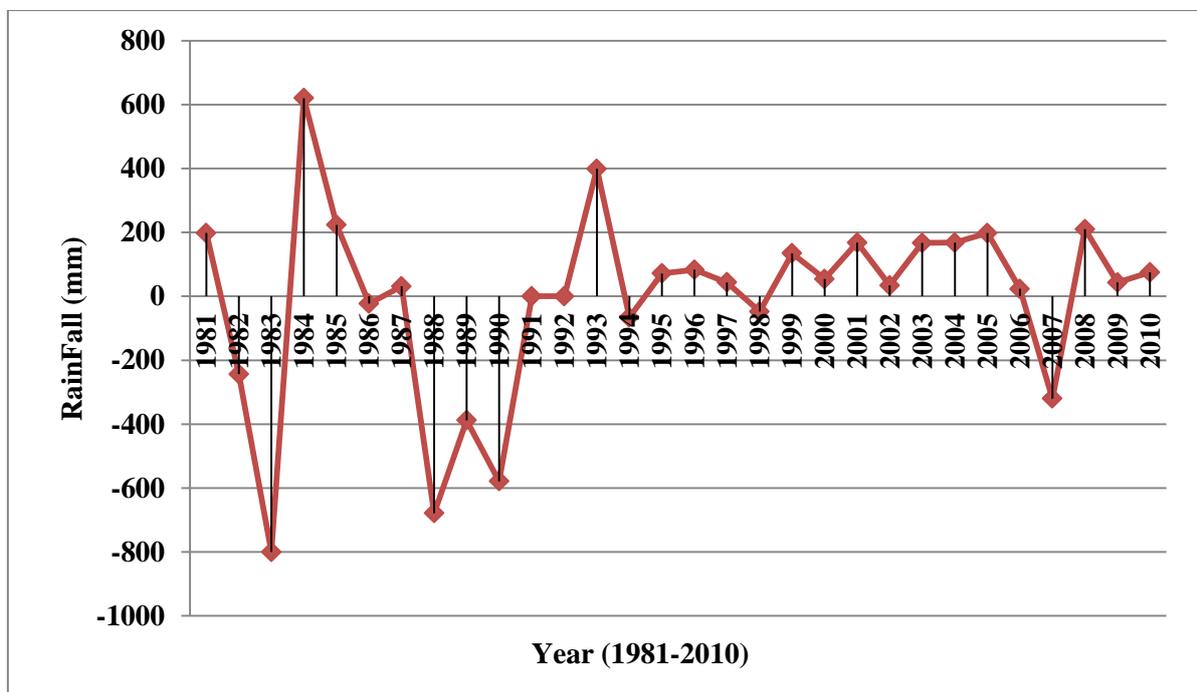


Fig 4: Deviation of the annual rainfall from the standard value

Annual standard deviation was calculated from the mean rainfall of the 30 years annual rainfall (1981-2010) which was recorded at the Meteorological Department, Colombo. The highest positive standard deviation was received in 1984 (628.6 mm) and the negative deviation was received in 1983 (795.9 mm), at the study which passed that the overall drought was highly significant in the year of 1983. It is the symbol of the wetness and the dryness of the Mannar district where the positive mean wetness and the negative mean dryness of the district as well. It was calculated based on the average fall of 908.7 mm of the total annual rainfall and the negative and positive were related to that value, respectively.

Annual drought of the Mannar District

Among the total of 30 years, 7 years were considered as the high drought period of the district which were 1982, 1983, 1988, 1989, 1990, 1999 and 2007. According to the Table 1, categories of the drought were fallen under the Medium Drought as well.

According to the negative deviation pattern, Mannar District has been undergone with four different types of drought conditions (Slight Drought, Moderate Drought, Severe Drought and Extreme Drought) while the far extreme drought was zero conditions. Slight Drought was occurred in 1999 and the Moderate Drought was dominated in 1982, 1989 and 2007 in Mannar District, Sri Lanka. It was obvious that the year of 1983 showed the Extreme Drought of the district.

Table 1: Categories of the drought in annual basis

No	Type of Drought	Rainfall Amount (%)	Number of years	Valid percentage (%)
01	Slight Drought	(76%-89%)	1	14.3%
02	Moderate Drought	(51%-75%)	3	42.9%
03	Severe Drought	(26%-50%)	2	28.6%
04	Extreme Drought	(<25%)	1	14.3%
05	Far Extreme Drought	(0%)	0	0%

Source: Meteorological data, (2010)

Monthly drought conditions of the Mannar District in Maha Season

According to the secondary data which was available at several departments, in October almost 21 years have been experienced with the wetness and only 3 years (1984, 1988 and 2009) were identified with the Extreme Drought conditions in the Mannar District. While comparing with other months, November provide higher wetness to the country where 22 years and 8 years were with wetness and drought, respectively (Table 2).

Further, the average monthly rainfall in December was 167 mm where 13 and 17 years were with drought and wetness, respectively. Among the total, 1983, 1988 and 1990 were under the extreme drought conditions felt years in Mannar District. Additionally, 15 and 13 years were with the wetness of the district in January and February of the Maha Season where the 15 and 17 years were with drought conditions as well for the particular season including different categories of the drought nature.

Table 2: Categories of the drought in Maha Season

Type of Drought	October	November	December	January	February
Slight (76%-89%)	2	0	2	1	0
Moderate (51%-75%)	1	4	3	2	4
Severe (26%-50%)	1	1	3	6	1
Extreme (<25%)	3	0	2	4	5
Far Extreme (0%)	2	3	3	2	7
Wet	21	22	17	15	13

Monthly drought of the Mannar District (Yala Season)

At the beginning of the Yala Season (March), 18 years were recognized with the drought condition where 1983, 1987, 1988, 1989, 1995, 1998, 1999 and 2001 were with Extreme Drought condition. In April, the average monthly rainfall was 88.4mm with 12 drought conditions and 18 wet conditions as well. The extreme drought condition was occurred in 1988 and 1989, in Mannar District, Sri Lanka.

nature was reduced in September due to the onset of Maha Season afterwards where the mean rainfall was 39.5 mm. According to the data collected from the Meteorological Department (Except months without data in 1991 and 1992), the total of 312 months were recorded for the future studies in which 182 months experienced drought while 130 months were in wet nature in Mannar District. As the results, this district can be influenced by the climatic changes a lot in future like other countries.

Mid of the year (May, June and July), wet nature was fluctuated from 15 to 9 and 11 during the study records where the Extreme Drought was observed in June (46.7%). In case of August, again 46.7% of the drought was measured under the category of Extreme Drought with the fall of 7.6 mm. And also, there was no any Normal Drought conditions were experienced at the month of August which was the peak exposure of the drought conditions while comparing with others. This

It was obvious that the nature of drought condition was extremely higher in Yala Season to Maha Season as the rainfall distribution is quite higher. In Maha Season more than 50% of the total months in the records of 1980-2010 were experienced with wet condition while lesser percent of months showed some slight drought conditions. However, these conditions were vice versa in Yala Season where majority of the frame were identified with the dry nature.

Table 3: Categories of the drought in Yala Season

Type of Drought	March	April	May	June	July	August	September
Slight (76%-89%)	1	1	1	0	0	0	1
Moderate (51%-75%)	2	3	3	1	1	3	3
Severe (26%-50%)	3	3	2	1	3	1	1
Extreme (<25%)	5	3	6	5	4	1	5
Far Extreme (0%)	8	2	3	14	11	14	6
Wet	12	18	15	9	11	11	14

This dry period was the crucial period for the economic failure as the country being recognized with the agricultural issue for the future concerns. People were used to adapt different techniques to overcome those issues in Mannar District. In such locations rain water harvesting systems were established. However, those were with the lack of practices to support for the

whole season which was with the reduced rainfall pattern. In some part of the study area, people were displaced during the dry period where the domestic water is available for their increased metabolic activities. Therefore, this study provide awareness in the over view to express the overall drought condition of the Mannar District, Sri Lanka.

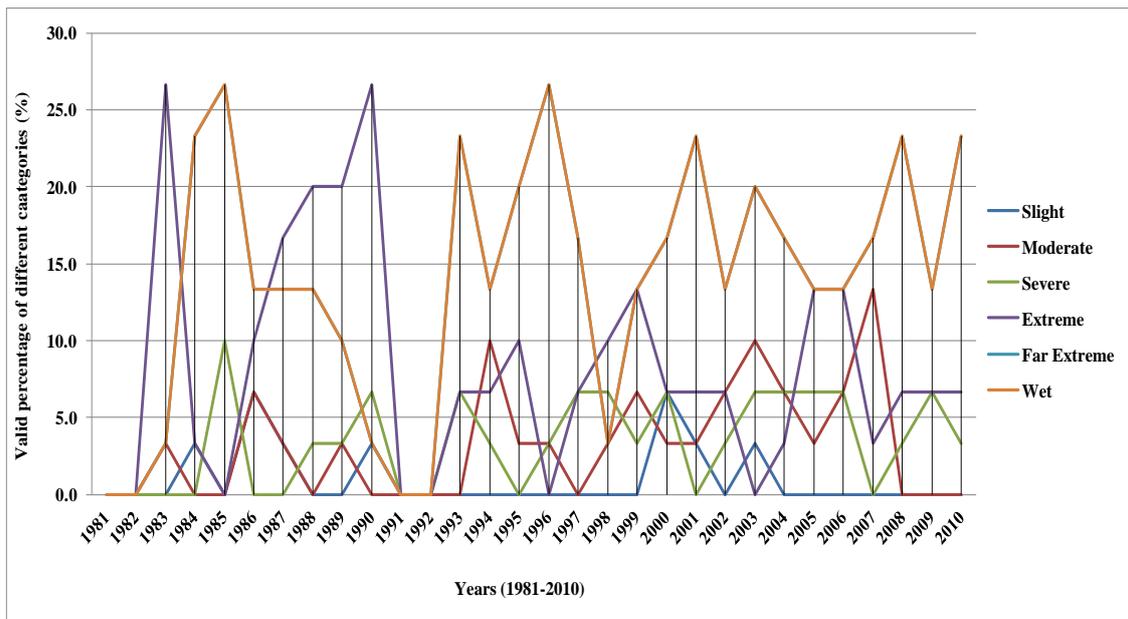


Fig 4: Different categories of the drought conditions in each year (1980-2010)

CONCLUSION

Mannar District is located in Dry zone of the Sri Lanka where the annual rainfall is lower while comparing with other parts of the country. Most of the months during the period of 1981 to 2010 were experienced with the higher temperature especially June, July and August. And also, the least rainfall was obtained in 1983 which was the symbol of the highest drought occurred in the Mannar District. Slight Drought, Moderate Drought, Severe drought, Extreme Drought and Far Extreme Drought were with the value of 4.4%, 15.9%, 17%, 22% and 41.2%, respectively. Further, the extreme drought conditions were equally found with the wet conditions in each mid of the year which was fluctuated with the annual rainfall distribution over the year in Mannar District, Sri Lanka.

Recommendation

- Due to the developmental activities after the conflicts, most of the plant canopies were disrupted which might be the one cause for the fluctuated rainfall. Therefore, people must be encouraged to plant more perennial canopies around them.
- The awareness program should be carried out to promote the cooling atmosphere beyond the unexpected climatic issues.
- People must be exhibited the pattern of rainfall changes over the years and the causal aspects should be discussed in the common meetings and forum.

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