Exploring socio-economic vulnerability of drought: A case in the North Central Province, Sri Lanka

L. M. A. P. Gunawardhana
Department of Environmental Management
Rajarata University of Sri Lanka,
Mihintale Sri Lanka.
Pradeeplmap85@gmail.com

Introduction

Drought is one of the major natural disasters in Sri Lanka. Acute droughts recur once in every 2-3 years in Sri Lanka especially in the North Central Province (NCP). The Dry zone of Sri Lanka has undergone severe drought conditions creating many socio-economic and environmental problems such as loss of income due to crops failure, increasing poverty, reducing the availability of drinking water, loss of animal husbandry etc. (Disaster Management Centre, 2012). Drought severely damage to the domestic economy of the peasant families of the NCP (Maddumabandara, 1983). Drought means various things to various people, depending on their specific interests. Drought is different from other environmental hazards due to three inherent features namely, drought is a 'creeping' hazard, droughts are not constrained to a particular geological or topographic setting and their impact can extend over very large regions and impacts of droughts vary greatly between the developed and lesser developed countries. Drought is the consequence of a natural reduction in the amount of precipitation over an extended period of time (Sivakumar, 2005). Drought is considered by many to be the most complex but least understood of all natural hazards and it could affect more people than any other hazard (Wadid, 2011). The shortage of the rainfall, the erratic distribution of the rainfall, high evapotranspiration, water erosion, and low water holding capacity of soil are the major causes of drought (Carefree, 2014). Therefore, it is hard to give a universally accepted precise definition for drought.

Although droughts occur frequently and generate many adverse impacts, still there is no sign of resilience. For example some 1,927,069 persons were affected by the drought in September 2017 across 17 (out of 25) Districts in Sri Lanka (Disaster Management Centre, 2017). Despite the fact that, some research studies have been carried out on droughts, still, it remains as a least understood hazard. Therefore, the present study was carried out with the hope of achieving a few objectives i.e. to understand the nature of drought in the NCP, to identify the vulnerability of people and to suggest resilience strategies for drought based on its findings.

Methodology

Both primary and secondary data were used for this study including questionnaire surveys, interviews, and field observations as main primary data collecting methods. Secondary data were obtained from various institutions, books, research articles, etc. All collected data were analyzed using both qualitative and quantitative methods. Rainfall data were collected covering a 60-year period from 1955 to 2014 where nine meteorological stations in the NCP namely, Anuradhapura Mahailluppallama, Puttalam, Mannar, Vavuniya, Trincomalee, Valachchani, Angamedilla and Kurunegala were used.

NCP is the largest province of Sri Lanka covering an area of 10,496.04 KM^2. There are two administrative Districts in the NCP namely, Anuradhapura and Polonnaruwa. There are 29 Divisional Secretariat (DS) Divisions including 22 DSDs in Anuradhapura and 7 in Polonnaruwa. Further, there are 989 Grama Niladari (GN) Divisions in the NCP. Therefore, the researcher selected some DSD for a sample survey. Accordingly, nine meteorological stations were selected and rainfall data of 60 years from 1955 to 2014 were collected from the Department of Meteorology. Then rainfall data were analyzed by using Arc Map 10.1 software, where Geographic Information System (GIS) interpolation techniques were used to find out the distribution of rainfall over the NCP. Rainfall distribution over NCP was divided into three classes and a rainfall distribution map was constructed by DSD level. The researcher could identify three distinct areas in the NCP considering the rainfall distribution and these three areas were named as zone A, B, and C in order to understand the variation. Researcher also selected three DS divisions covering 10 percent out of the total of 29 DSDs in the NCP as areas for sampling considering all three identified zones. These included Rambewa, Thirappane, and Medirigiriya DSDs. A sample of 150 households was selected randomly covering the selected three DSDs.

Results and discussion

As noted above, rainfall of nine meteorological stations covering NCP over a 60-year period from 1955-2014 was analyzed. When analyzing 60 years monthly average rainfall in Anuradhapura meteorological station, the following averages were resulted; January 92 mm, February 56 mm, March 69 mm April 166mm, may 81mm, June 14mm, July 28mm, August 36mm, September 68mm, October 251mm, November 252mm, December 207 mm. when average rainfall was analyzed by the crop seasons, the following results were obtained: North-East Monsoon (November –February) 607mm, First inter-monsoon(March-April) 235mm, South-West Monsoon (May-August) 159mm and second inter-monsoon (September-October) 319 mm. The NCP receives the highest rainfall

during the North-East Monsoon season. Annual average rainfall of Anuradhapura meteorological station was computed as 1,328mm during the past 60 year period from 1955 to 2014. The rainfall distribution during the last 60-years in Anuradhapura is presented in Figure 1.

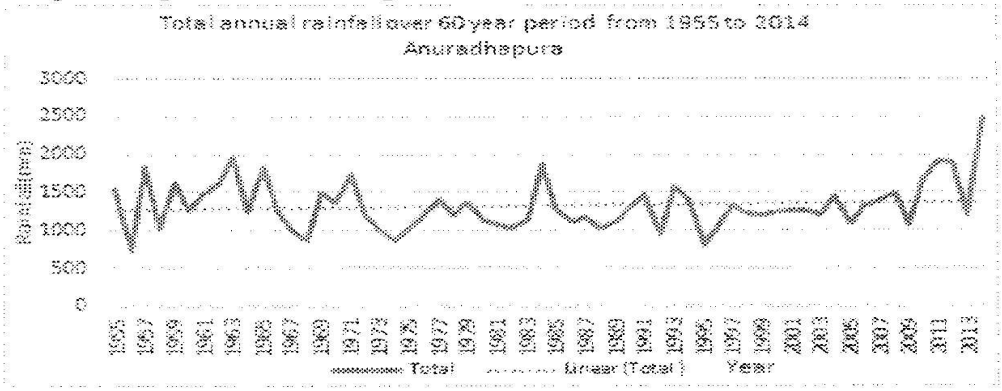

Figure1 Total annual rainfall during 60 year period from 1955 to 2014 in Anuradhapura

Source: Department of Meteorology Sri Lanka 2015

Figure 2 shows the number of droughts occurred over past over past 60 years along with their magnitude. According to Standardized Precipitation Index (SPI), minus values show drought events and positive values show flood events. Above -1.5 values show very severe drought events. For example, Figure 2 shows, years 1956, 1967, 1974, 1984, 1988, 1992, 1996, 2001, 2003, 2009, and 2013 have witnessed severe drought conditions in Anuradhapura. It is noticeable that frequency of occurring droughts has been increasing since the 1970s. According to the perception of people, 48.7 percent believed that droughts occur once in every 2-3 years. Since the majority of the people in NCP are practicing agriculture as the major livelihood, they have a good experience on the frequency of drought occurrence (Table 1). Disasters occur when hazard and vulnerability are combined. The vulnerability is the possibility to being harmed. Hazard is the potential threat. Therefore, it is clear that hazard is generated due to drought and vulnerability generated within the community according to their capacity to respond to drought and achieving resilience. When analyzing the socio-economic vulnerability of the people in NCP their livelihoods, education levels, income and expenditure levels, health condition, access to basic needs etc. are important variables. The survey results show that, the majority of the people are still farmers and 73 percent people are practicing agriculture as the major livelihood activity. Only 28 percent of the households have received a formal education up to grade five while the majority (51%) have studied up to grade 11.

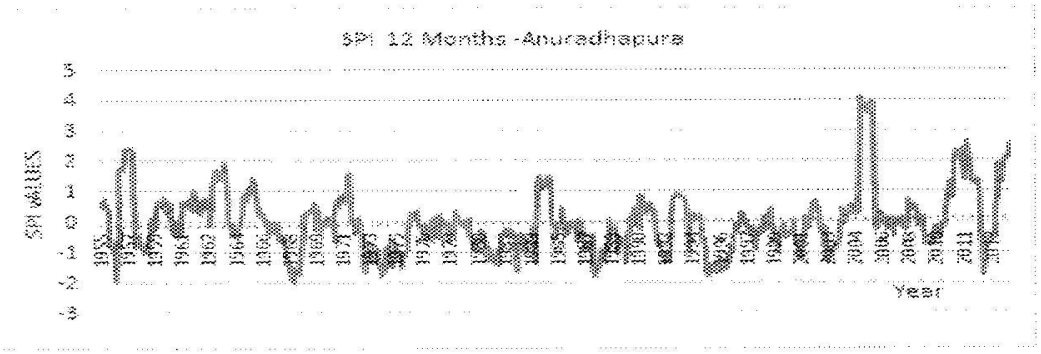

Figure 2 Drought events during the past 60 year period (1955-2014) in Anuradhapura

Table1 Drought occurring frequency according to the perception of people of NCP

	Perception of people on frequency of occurring drought					
DS Division	Every year	Once 2-3 years	once 4-5 years	once 6-7 years	After every 8-10 years	Total
Medirigiriya	13	31	6	0	0	50
Rambewa	20	18	10	2	0	50
Thirappane	13	24	12	0	1	50
Total	46	73	28	2	1	150
Percentage	30.7 %	48.7%	18.7%	1.3%	.7%	100.0

Therefore, low level of education level compels them to be employed in agriculture. The income level of a family is a major factor which enhances vulnerability of drought. The survey reveals that, 8 percent of families have received less than 5000 rupees per month and a large proportion (20%) has received incomes between 5000-10000 rupees per month. Some 46 percent of families received less than 15000 rupees per month. Average family size is 5 in the study area. Therefore, their income is not sufficient even to satisfy their basic needs. The vulnerability of a family is further increased when the family is headed by a female. Some 11 percent of families are found to be headed by females.

Most families practice agriculture based on loans, and when a drought occurs they become helpless due to the failure of crops. It directly affects their family income because as there are no alternative income sources. When their income diminishes, it leads to many problems especially for peasant families. For example, due to Chronic Kidney Disease of unknown etiology (CKDu), NCP farmers are scared to use water for drinking from their usual drinking sources such as wells, tube wells etc. At present, most of the farming families collect water from vendors, or water purification plants spending their meagre incomes. Normally, the cost is ranging from 2- 6 rupees per liter of drinking water. On the

other hand, most farmers hardly buy rice from the market. Due to prolonged drought however, farmers have to buy food items especially rice and vegetables from the market. Food prices are increasing continuously because of reduction of rice production due to drought (See Figure 3).

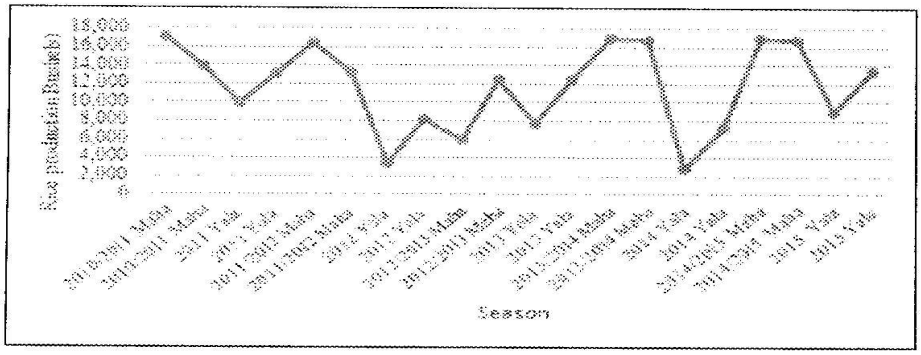

Figure 3 Total rice production in the NCP (Bushels' 000)

Government is following reactive approaches to mitigate drought impacts by distributing drought relief, and drinking water, seeds, etc. Farmers are using both on-farm and off-farm adaptation strategies to cope with acute drought conditions but adaptation strategies have been changed over time. Farmers are making every possible effort to live with the drought, such as practicing *Bethma system,* crops diversification, using underground water for agriculture, and earning from daily paid labor, etc. However, increasing frequency in drought occurrence and prolonged drought conditions exceed their capacity making it hard to achieve a reasonable degree of resilience.

Conclusion

Drought is not a new hazard for Sri Lanka as well as North Central Province. Sri Lanka is famous for agriculture and ancient kings built tanks to store water to be used in drought periods. At present, it is evident that droughts occur once in every 2-3 years but still, there is no sustainable mechanism to face droughts. Farmers in the region are more vulnerable to drought because their capacity to face drought is very limited. It is useful to adopt proactive approaches for achieving some resilience using both structural and non-structural methods. In particular drought management policy is an important component in this process. Potential investment should be introduced considering climate and geography of the region. Insurance system should be introduced for the farming community in the region in order to avoid extreme poverty of the people. Tank cascade systems form the heart of the region, therefore, tank systems *(Wewa)* should be maintained in a proper manner. Off-farm adaptation strategies should be promoted among the farming community. Short-term and long-term solutions

for drought should be developed bringing together all responsible parties including the Government in order to achieve acceptable levels of resilience.

Keywords: *Disaster, drought, hazard, resilience, vulnerability.*

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