Effect of rainfall on cropping pattern of farmers in Hambantota District

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Abstract

The effect of rainfall on cropping pattern among farmers in the Hambantota district was studied by analyzing the spatial and temporal variation of rainfall, with respect to rainfall magnitude, risk and onset. The rainfall data over 42 years (1960-2002) in six rain gauge stations and pan evaporation data at Angunakolapelessa meteorological station in Hambantota district were used for the analysis.

Yearly and monthly magnitudes of rainfall were expressed by mean annual rainfall, annual dependable rainfall and monthly mean rainfall respectively. Hargreaves Moisture Availability Index at 75% probability dependable rainfall level was used to find the wet weeks in each station through out the year. Hargreaves Moisture Availability Index at 60% probability dependable rainfall level was used for rainfall onset identification. Farmer survey was conducted to find out the existing cropping pattern of farmers. The amount of rainfall, which accumulated on the date of crop commencement, was assessed using forward accumulation method.

The results revealed that mean annual rainfall decreased with time in the Hambantota district. Less than 20% wet weeks were recorded in all stations. It revealed that high risk was involved in rainfed crop cultivation in Hambantota district. Rainfall onset for Yala and Maha seasons varied from 12th to 14th week and from 38th to 42nd week respectively. The farmers were able to minimize the irrigation needs of crops when crop cultivation commenced with the onset of rain at the given magnitude of 60% probability. The farmer survey revealed that crop commencement week in Maha season varied between 39th and 41st week and farmers rarely cultivated during Yala season. According to the forward accumulation method at 75% probability level the amount of water accumulated at crop commencement time was 75mm. The results indicated that the crop commencement week based on the farmer survey coincided with calculated rainfall onset during Maha season.

Keywords: *Rainfall, risk, cropping pattern, crop commencement week, Moisture Availability Index, forward accumulation*

Introduction

Hambantota district situated in southern part of the dry zone of Sri Lanka belongs to DL5 agro-ecological zone. According to Zubair (2002), the average annual rainfall in Hambantota district is 1016 mm. Moreover rainfall pattern in Hambantota district has changed with time (Punnyawardane, 2001). As a result, existing cropping calendar in the area has also been changed. These changes in rainfall create water shortage periods during cropping seasons, affecting crop yields. Therefore, it is of prime importance to adjust the existing cropping calendar to suite the present rainfall pattern. To achieve this, a rainfall analysis was carried out in the Hambantota district using available data for the period 1960 to 2002.

Materials and Methods

The rainfall data over 42 years (1960-2002) in different rain gauge stations, namely *Angunakolapelessa, Ambalantota, Bataatha, Hambantota, Liyangahatota and Mamadala* and Pan

evaporation data at *Angunakolapelessa* meteorological station in Hambantota district were used for the analysis.

'FIRST' computer program (Weerasinghe *et al*, 1990), Ms-Excel and SPSS computer program were used for the analysis. GIS Arc View package was used for mapping purposes. Further, the existing cropping calendar was identified by conducting a farmer survey.

Risk and onset of rainfall

Hargreaves Moisture Availability Index (MAI) was used to find the wet weeks in each station throughout the year. If MAI value in a given week was lower than 0.34 (MAI<0.34), that week was classified as a dry week, and when MAI value was equal or greater than 0.34 (MAI>=0.34), that week was considered as a wet week as adopted by Krishnan (1980) for India.

$$MAI = PD/PE$$

where,

MAI = Moisture Availability Index
PD = 75% probability dependable rainfall
PE = Potential Evapotranspiration

A farmer survey was conducted to find out the existing cropping calendar. Thirty farmers were interviewed using a pre-tested questionnaire.

Identification of optimum cropping calendar

Hargreaves MAI was used to identify the onset of rain for both *Yala* and *Maha* seasons, considering 75% probability level for calculations. The commencement of wet weeks soon after dry period, was considered as onset time of the respective season. However, when rainfall at 75% probability level was used to calculate dependable rainfall in MAI, rainfall onset could not be identified for *Yala* season in all stations and for *Maha* season in some stations. Therefore, probability level was reduced gradually and suitable probability level with high risk for rainfall onset was identified.

Hargreaves MAI at 60% probability dependable rainfall level was used for rainfall onset identification. These rainfall onset weeks were identified as the crop commencement week of the respective station. The amount of rainfall, which accumulated on the date of crop commencement, was identified using Forward accumulation method.

Results and Discussion

Mean annual rainfall in Hambantota district

Figure 1 shows the average annual rainfall distribution during 1960 to 2002 in selected stations of Hambantota district, three year moving average curve, five year moving average curve and linear trend line. Based on above results the mean annual rainfall decreased with time in Hambantota district. Decreasing rates were 2.3, 4.8, 10.6, 8.9, 7.7 and 3.1 mm/year for *Angunakolapelessa, Ambalantota, Bataatha, Hambantota, Liyangahatota* and *Mamadala* stations respectively.

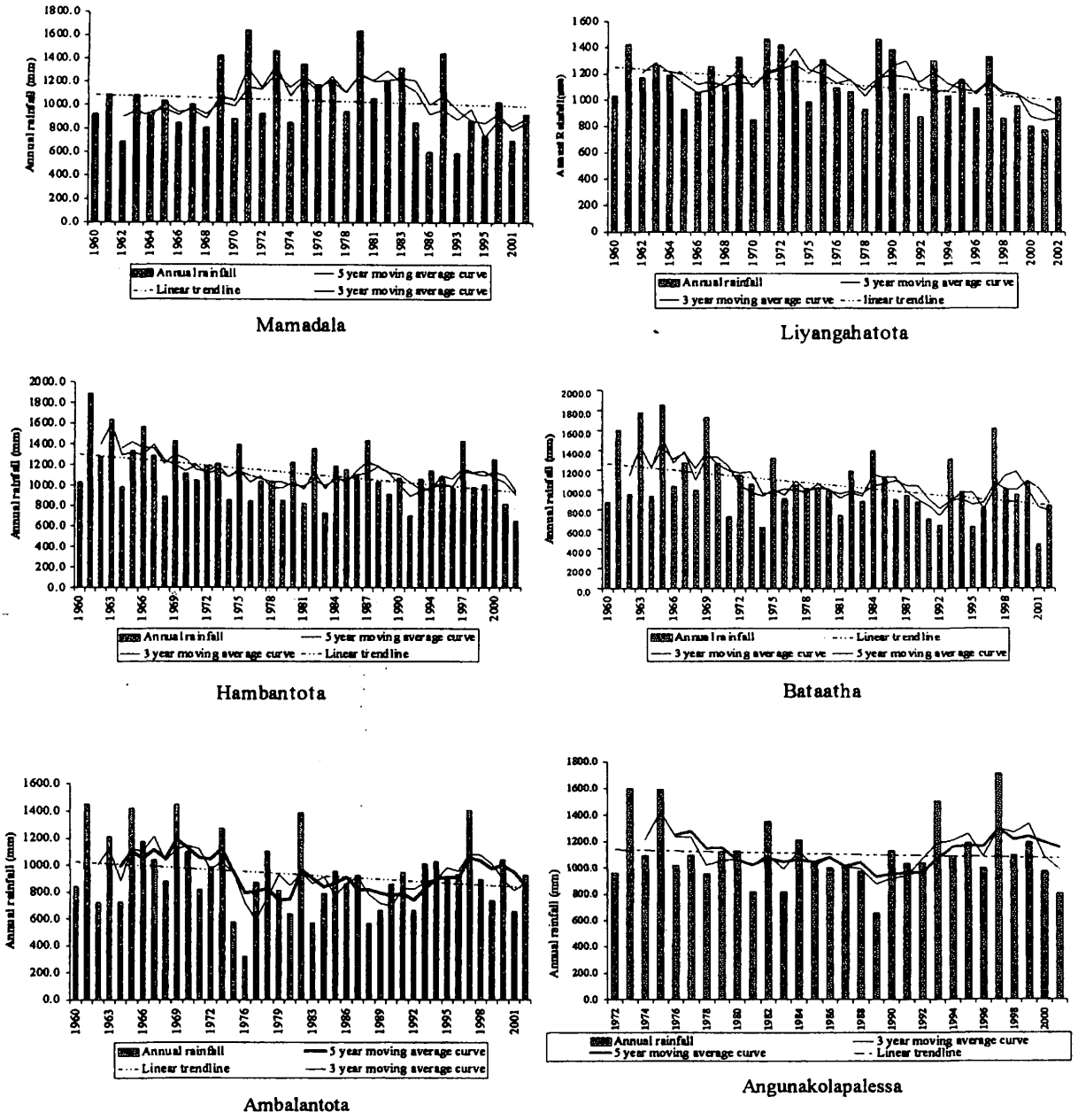

Fig. 1: Rainfall pattern in selected stations in Hambantota district

Wet weeks per year

Table 1 indicates the number of wet weeks per year in different stations in Hambantota district.

All stations recorded less than 20% wet weeks. Results revealed that there was a high risk involved in rainfed crop cultivation in Hambantota district. Existing dryness of the area both in *Yala* and *Maha* seasons are well illustrated by Hargreaves MAI. It appeared that risks associated with dry spells were much higher in the coastal region of *Ambalantota*, which declined towards, *Mamadala* and *Liyangahatota.* (Fig. 2)

Table 1. Number of wet weeks per year and percentage of wet weeks per year in each station based on Hargreaves MAI more than 0.34

Station	Hargreaves MAI method	
	No. of wet weeks	% of wet weeks
Angunakolapelessa	04	7.7
Ambalantota	00	0.0
Bataatha	03	5.8
Hambantota	10	19.2
Liyangahatota	04	7.7
Mamadala	02	3.8

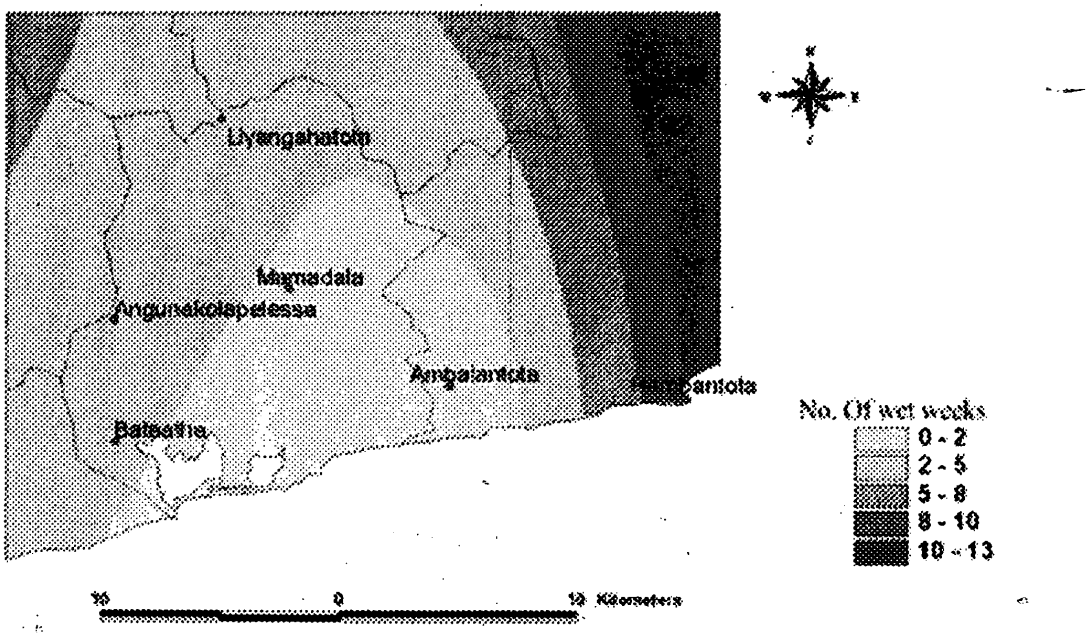

Fig. 2: Regionalization of Hambantota district based on number of wet weeks

Onset of rainfall

Based on the Hargreaves MAI at 60% probability dependable rainfall, onset of rainfall for *Yala* and *Maha* seasons varied from 12th to 14th week and from 38th to 42nd week respectively (Table 2).

It is the experience of the farmers, who lived closer to *Liyangahatota* station, to cultivate their fields in both in *Yala* and *Maha* seasons, using the local natural water resources. Rest of the farmers do not cultivate their fields in *Yala* season owing to lack of water. Farmer survey revealed that crop commencement week in *Maha* season varied between 39th and 41st week and farmers rarely cultivated during the *Yala* season.

Table 2. Rainfall onset weeks for *Yala* and *Maha* seasons based on Hargreaves MAI method and actual crop commencement dates adopted by the farmers.

Station	Hargreaves MAI (at 60% level dependable rainfall)		Crop commencement weeks based on field survey data	
	Yala	*Maha*	*Yala*	*Maha*
Angunakolapelessa	13	39	-	39
Ambalantota	-	43	-	41
Bataatha	-	38	-	39
Hambantota	14	38	-	39
Liyangahatota	12	39	11	39
Mamadala	15	42	11	40

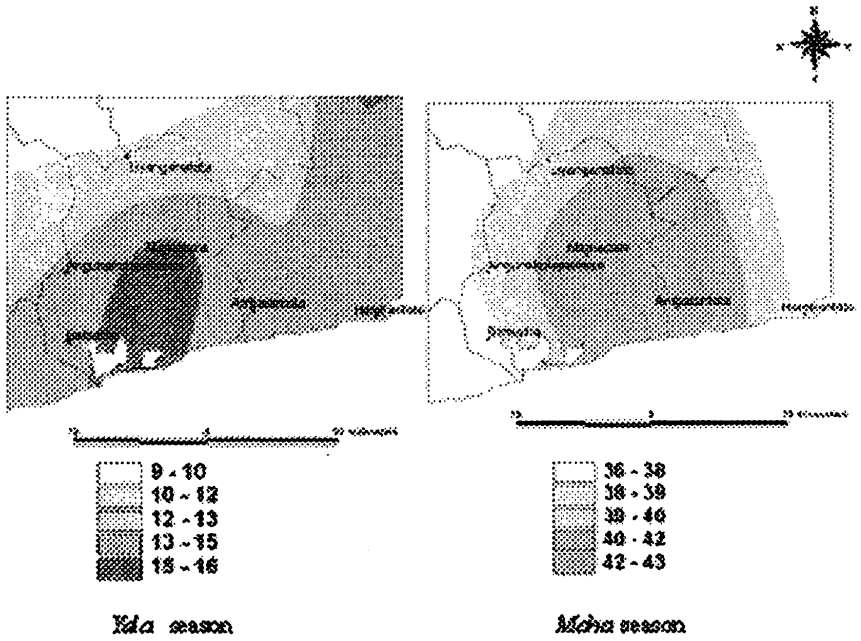

Fig. 3: Crop commencement maps for *Yala* and *Maha* seasons (based on Hargreaves MAI method at 60% probability level)

Rainfall onset of the area in respect to both *Yala* and *Maha* seasons indicated that rainfall onset was much delayed in coastal regions compared to central parts of the district. (Fig. 3)

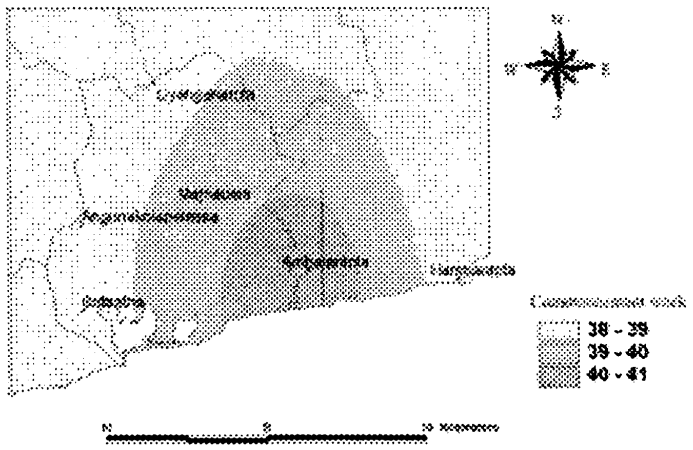

Fig. 4: Map of crop commencement for *Maha* season (based on time adopted by the farmers)

Crop commencement date of the area adopted by the farmers in respect to *Maha* season appeared to be delayed in coastal regions compared to central parts of the district. This coincided with the rainfall onset weeks for *Maha* season based on Hargreaves MAI method (at 60% probability level dependable rainfall). These results revealed that existing cropping calendar almost correlated with developed cropping calendar using Hargreaves MAI at 60%probability level of dependable rainfall for the *Maha* season. The farmers were able to minimize the irrigation needs if they commence cultivation with the onset of rains (Calculated using Hargreaves MAI at 60% probability level).

According to the forward accumulation method at 75% probability level, the amount of water accumulated at crop commencement time was 75mm.

Conclusions

Rainfall received in Hambantota district was not sufficient for rainfed crop cultivation in both *Yala* and *Maha* seasons. The dryness of the district increased towards the central coastal area of the district. The onset of rainfall for *Yala* and *Maha* seasons varied from 12th to 14th week and from 38th to 42nd week respectively. Crop commencement week in *Maha* season varied between 39th and 41st week and farmers rarely cultivated during *Yala* season. Existing crop commencement time correlated with the simulated rainfall onset, using Hargreaves MAI method. Based on forward accumulation of rainfall at 75% probability level, 75mm rainfall was accumulated in the area at the time of crop establishment.

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