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SHORT COMMUNICATION

Characterization of heavy rain and subsequent dry periods during the North-East monsoon in the dry zone of Sri Lanka

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Abstract: The occurrence of heavy rain during the North-East monsoon period in the dry zone has been recognized and documented. However, there is a common belief that periods of heavy rain during the North-East monsoon are frequently associated with subsequent dry weather of a considerable long period. Scientific research evidences are scanty on this issue. Hence, an attempt was made to statistically evaluate the validity of the above statement for the dry zone of Sri Lanka. Non-recording type daily rainfall data were collected from five representative rain gauging stations. The 'Binomial sign test for a single sample' was performed considering heavy rain (a period of at least two consecutive heavy rainy days) as an event, and subsequent dry (a period of at least ten consecutive days with less than 1 mm of rain) or normal (in between the above specifications) rain periods as two possible outcomes. There is less likelihood of the occurrence of a dry period after heavy rain than after normal rainfall. Therefore, the study clearly shows that the belief of dry periods being associated with heavy rain may not be acceptable for the study area.

Key words: Dry periods, heavy rain, North-East monsoon, Sri Lanka, standardized data

INTRODUCTION

The occurrence of dry seasons in between the two rainy seasons is a well recognized character for the dry zone. However, detailed analyses of rainfall and soil moisture balance show another dimension of the dry zone climate, i.e. even during the main rainy season in Maha (late September to February), there are dry periods which are long enough to affect crop growth. Therefore, it is important to study the characteristics of these dry periods in order to apply measures to overcome the adverse effects of such dry conditions.

The North-East monsoon, which extends from December to February is usually associated with heavy spells of rain. However the heavy rain during the North-East monsoon period is actually not due to monsoon winds, but is due to the frequent development of low level atmospheric disturbances, depressions and even cyclones in the Bay of Bengal from November to February. The other important phenomenon that can bring heavy rain during the North-East monsoon period is Easterly waves.[1]

Many farmers are of the opinion that heavy rains during the North-East monsoon period are frequently associated with subsequent dry periods of a considerable duration. The objective of this study was to test statistically whether there is a significant probability of dry periods occurring just after heavy rain during the North-East monsoon period. More specifically, this study has investigated the validity of the above assertion for the eastern and central parts of the dry zone.

METHODOLOGY

The North-East monsoon usually affects the weather over the entire dry zone of Sri Lanka. However, the effect is more pronounced in the eastern and north-central parts of the dry zone. Therefore, eastern and north-central parts of the dry zone of Sri Lanka were selected for the study. The north-central part includes DL1b, DL1c, DL1e, and DL1f agro-ecological regions, and eastern part includes DL1d, DL2a, DL2b and a part of DL4 according to the latest classification of agro-ecological regions.[2]

The North-East monsoon season was defined as the period from 3rd December of one year to 2nd March of the following year. Two selected stations came from

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north-central part of the dry zone namely, Maha-Illuppallama (M.I.) and Minneriya and three other stations came from eastern part of the dry zone namely, Trincomalee, Batticoloa and Amparai tank. Daily rainfall data obtained from non-recording rain gauges were collected from all five stations.

The daily rainfall data for each station was standardized separately and classified into three groups namely, heavy rain, dry and normal rain periods. A heavy rain period was defined here as "a period of at least two consecutive heavy rainy days". When data is standardized, approximately 66% of observations in the distribution lie between –1 and +1 and could be termed as normal data. Observations below –1 and above +1 could be considered as extreme cases. Hence, days having a Z-score equal to or greater than +1 were considered as heavy rainy days. The definition of a dry period for this task was "a period of at least 10 consecutive days, to none of which is credited 1mm of rain or more". The rainfall periods, which could not be categorized either under heavy rain or dry periods were considered as normal rain.

A period of heavy rain was considered here as an event. It can be followed either by a dry period or normal rain, which are the only two possible outcomes. Therefore, data from each station were separately analyzed using a categorical data analysis technique called the 'Binomial sign test for a single sample'. The null hypothesis is that probability of the occurrence of a dry period just after a heavy rain period (P) is equal to the true probability of observing a dry period (p).

RESULTS

True probability of the occurrence of dry period (p) for each and every station was calculated at the beginning of the study (Table 1). The probability of usual occurrence of dry periods is less than 0.5 for all five stations. Therefore, these p values should be used as the basis in the calculation of probabilities of dry spells associated with heavy rain spells.

The 'Binomial sign test for a single sample', which compared the true probability of the occurrence of dry spells (p) and the probability of the occurrence of dry spells just after heavy rain spells (P), produced some interesting results (Table 2).

It was noted that the number of events and number of dry periods were higher in the Maha-Illuppallama and the Minneriya stations. The probable reason for this is that data for about hundred years were taken into consideration for the Maha-Illuppallama and the Minneriya stations while data for only forty years were considered for the other three stations.

Table 1: True probabilities of the occurrence of dry spells

Station	Total dry spells (TDS)	Total normal rain spells (TNS)	p = TDS/(TDS+TNS)
Amparai Tank	94	165	0.356759*
Batticaloa	75	133	0.360577*
Trincomalee	86	136	0.387387*
Maha Illuppallama	231	295	0.439163*
Minneriya	243	355	0.406354*

* Values used in the subsequent analysis

Table 2: Results of the Binomial Sign Test for a single sample

Station	No. of events (n)	No. of dry spells (x)	P=x/n	P (Y<=x)
Amparai Tank	85	17	0.20	0.000428*
Batticaloa	67	12	0.12	0.000602*
Trincomalee	88	27	0.31	0.026551*
Maha Illuppallama	120	39	0.32	0.002956*
Minneriya	177	53	0.30	0.000841*

* Significant at a = 0.05 level

As null hypothesis was rejected for all five stations, one should use values of (P) and (p) of respective stations for further evaluations. It is clear that, P values are always lesser than values of p for all stations and accordingly, the null hypothesis was rejected for all stations because of the lower probability of the occurrence of dry periods after heavy rain. This clearly explains that there is a high tendency for a normal rain spell to occur than a dry period, just after heavy rain in those locations during the North-East monsoon period.

Outcomes of the analysis of data for all five stations provide evidence to refute the general belief. The results obtained for all stations state that the chance of a dry period occurring just after heavy rain is less likely than their usual occurrence. Moreover, results do not support differentiation between North-Central Province and Eastern Province with respect to the occurrence of dry periods followed by heavy rain during the North-East monsoon season.

CONCLUSION

The results strongly state that the belief of farmers about the occurrence of dry periods followed by heavy rain (which are associated with weather systems) during North-East monsoon season in the dry zone of Sri Lanka is a misconception. There is a higher chance of normal rainfall than a dry period after heavy rain during the North-East monsoon season. After heavy rain, farmers may consider a subsequent normal rain spell also as being dry. This could be the reason as to why they tend to believe that there is a higher chance of a dry period occurring after heavy rainfall. There is no difference between North-Central and Eastern regions of Sri Lanka with respect to the occurrence of dry periods within the North-East monsoon season.

Daily rainfall data of five stations were used in the analysis of this study. If more rainfall data can be studied there is a definite possibility of making a more valid and general conclusion for the entire dry zone with respect to the relationship among weather systems, associated heavy rain and dry periods in the North-East monsoon season.

References

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