

IMPACT OF THE WEATHER ON LANDSLIDES IN SRI LANKA

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A landslide is a kind of earth movement which is due to the instability of slopes. Excessive precipitation due to monsoonal, depressional or cyclonic activity has been identified as the main cause for slope instability which gives rise to Landslides. Main causes for Landslide can be listed as follows (Dhanayake, K., 1986).

causes the most disastrous landslides.

Mining operations by man also modifies the terrain and severely affects the stability of hill slopes.

In this article the Landslide problem is viewed as a natural hazard which is promoted by man-made activities and the weather pattern of Sri Lanka is discussed since this natural disaster is mainly triggered by excessive precipitation. This facilitates to identify the Landslide prone areas and also the season which is favourable for Landslides.

Seasons are identified by the meteorologists by studying the wind pattern, both at the surface and at upper levels, intensity and spatial distribution of rainfall.

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General Weather Pattern in Sri Lanka

Our island Sri Lanka is in the Indian ocean located to the south of the Indian sub continent. The features of the island consist of a mountainous mass somewhat south of the centre, with heights exceeding 2500 meters, surrounded by broad plains. Sri Lanka lies in the tropical belt.

The tropics is defined as a zone between the semi-permeant anticyclonic belts in the Northern and Southern hemispheres. According to this definition and the generalized wind flow, the Island Sri Lanka should

1. Rainfall - Unusually high

Continuous rain results in increasing pore pressure in the debris material and expansion of clays within the joint planes of underlying rocks.

2. Nature of the Rock

Internal properties of earth materials. Failure of weak rocks characterized by multiple fracture systems and feldspar-rich composition.

The geomorphic setting and environment, different topographic relief, steepness and shape of land surface, characteristics of vegetation, climate etc. can be determining factors of slope stability.

3. Man-made Activities - Land use

Destabilization of ancient landslides (which are in equilibrium), by man-made activities such as road construction, drain construction, etc.

Slope stability is reduced by artificially filling the up-slope area or cutting of the down-slope area. This, coupled with heavy rainfall,

be in a region which is under the influence of easterly winds. But we experience two wind regimes namely the Southwesterlies and Northeasterlies throughout the year. The tilt ($23 \frac{1}{2}$) of the earth axis, land/sea distribution and topography govern the wind pattern over our region.

By studying the long term behaviour of meteorological parameters, it is possible to identify four climatic seasons for Sri Lanka.

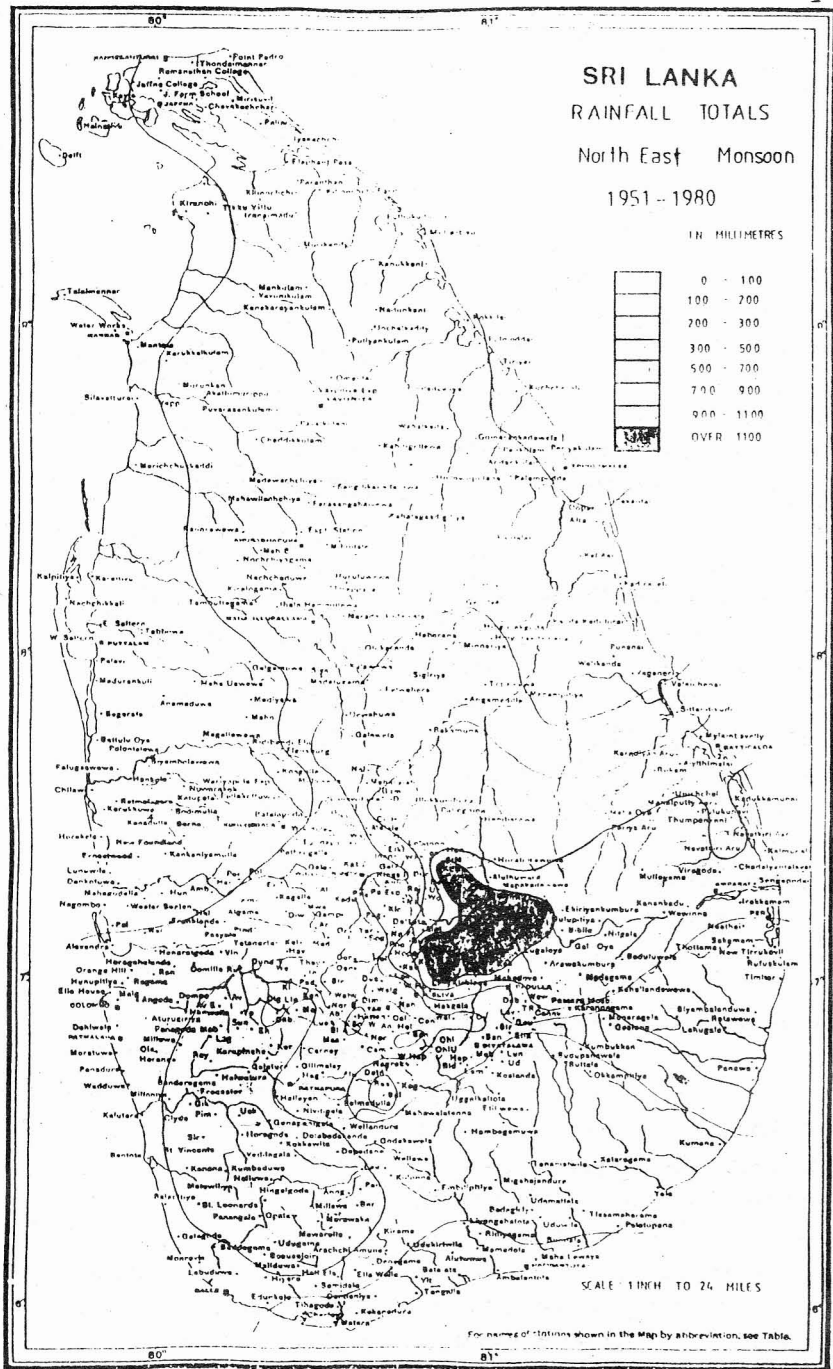
1. Southwest monsoon (May to September)
2. Second Inter-monsoon (October to November)

3. Northeast monsoon (December to February of the following year)
4. First Inter-monsoon (March to April).

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Monsoonal rainfall is very important for Sri Lanka since the nature of the rain specially the intensity and temporal distribution is very much favourable to the crops. The spatial distribution of the northeast monsoon rainfall is shown in the Figure 1.

Climatologically the months from May to September are defined as the southwest monsoon months. But the onset of the southwest monsoon varies from year to year. Onset date is somewhere around mid May. The onset of the southwest monsoon is declared when the wind flow at Colombo (Observatory) becomes southwest to west up to or above 3 km. and when a sharp increase in the 5 day means of rainfall are observed. The monsoon rains are sometimes not easy to distinguish from the inter-monsoon thundershowers. There-



fore Meteorologists find it difficult to fix the date of the onset of the monsoon, uniquely.

Cross equatorial wind flow originates from the Madagascar area bringing moisture to our area during the southwest monsoon periods. Moisture convergence which produces monsoonal rain occurs due to various factors. The spatial distribution of rainfall over Sri Lanka is mainly controlled by its characteristic topography.

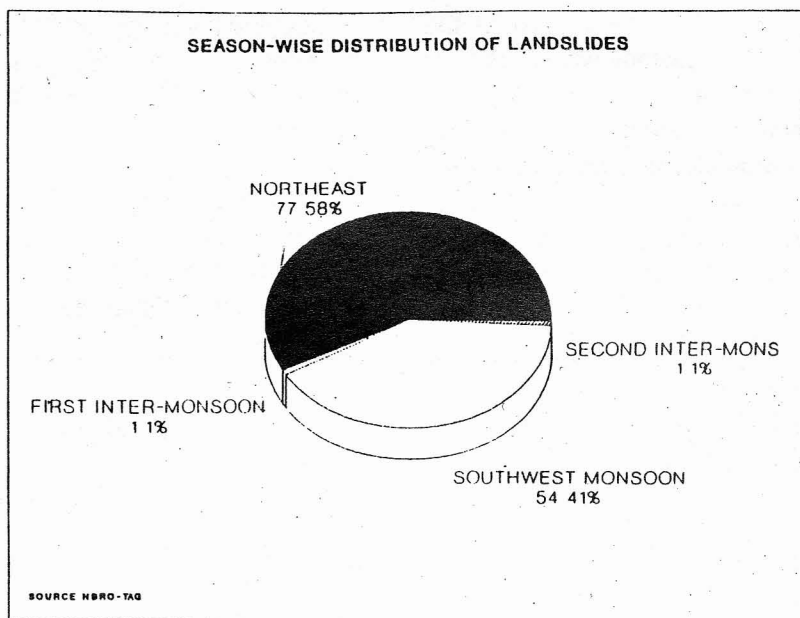
Intermonsoons are the periods between the two monsoons when there is usually no wind. The months, from March to April and from October to November are defined as the First and Second Inter-monsoons respectively. During these inter-monsoon seasons, particularly during the first inter-monsoon, local convection associated with sea/land breeze circulations are dominant. Thunderstorms develop particularly during the afternoon or evening. When there is no synoptic forcing (regional scale influence on the weather pattern) morning peaks of rainfall can be observed. These falls are associated with the Land breeze (Land breeze convection usually occurs off the coast) and shift towards the land due to the influence of the characteristic topography of Sri Lanka. The spatial or temporal distribution of rainfall during the inter-monsoon periods are not so favourable to the crops, though this rainfall contributes largely to the annual total rainfall.

The second inter-monsoon, the months October to November are usually considered as cyclone prone months. During this season most of the depressions that form in the

southeast bay of Bengal further develop into tropical cyclones. Fortunately, the frequency of cyclones having a direct effect on Sri Lanka is low. The last experience was in November 1992.

The change-over of the prevailing wind direction over the island occurs in mid-November and the seasonal wind flow goes on till mid-March. The wind stream over the island is predominantly northeasterly in direction from December to February and as such this period is reckoned as the period of the North-east monsoon in Sri Lanka. During this period the low pressure systems are to the south of the island.

Sri Lanka receives its rain during the North-east monsoon from two air streams, namely, the outflow from the Siberian High and the west Pacific High. The former air stream is cold and dry when it flows into the warm Bay of Bengal but becomes moisture laden after passing over the Bay and reaches the north-eastern coast of the island as a moist air



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stream. The latter air stream also passes over the warm Bay of Bengal before it reaches Sri Lanka and thus it will be moisture laden by the time it reaches the north-east coast of the island.

However, the heavy rainfall during the period of the north-east monsoon is mainly due to:

- i. a series of upper air low pressure systems which form over or near the island or cross the island from east to west, and
- ii. tropical depressions that move across the island or form off the east coast of the island.

(Fernando, T.K., 1985).

Occurrences of Landslides

By referring to the spatial distribution of the seasonal and the annual total rainfall, the central part of Sri Lanka which is mountainous can be identified as a Landslide prone area. This identification takes into account the Geological factors as well. Figure 2 shows the seasonal-wise distribution of landslides. Maximum occurrences of landslides were recorded during the Northeast monsoon period.

Priyasekera, G.D. (1987) documented a landslide which was triggered by excessive precipitation caused by a depression. This was positioned approximately 200 km. off the southeastern coast of Sri Lanka by the 7th of January 1986 and moved across the island in a North-westerly direction and weakened by the 10th of January.

There was almost continuous and widespread rain over Badulla and Nuwara eliya districts during the period from the 6th to the 9th January 1986. Three rain gauge stations in Badulla district had recorded an aggregate of over 1000 mm of rainfall for the 5 day period. The areas of the districts, North of Nuwara Eliya town adjacent and to the west of the Badulla district received the heaviest rainfall.

Nuwara Eliya district areas bordering and to the west of the Badulla district were affected by Landslides. At these locations landslides had taken place during the early part of January (Northeast monsoon period) on the 7th in 1986. There had been continuous rain during the previous two days on the 5th and on the 6th January; very heavy at some places. By using a contour analysis of cumulative rainfall, it was concluded that a threshold figure of 350 to 400 mm of rainfall during two consecutive days could cause Landslides to occur in areas prone to such natural events.

In this case data availability in the vicinity of the area was favoured to study the Impact of the excessive precipitation on Landslides.

The threshold figure of cumulative rainfall is definitely lower than the value obtained in 1986 due to the mismanagement of land use and other man-made activities.

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