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USE OF RAINFALL PATTERNS FOR EFFICIENT OPERATION OF AGRONOMIC PRACTICES IN RUBBER PLANTATIONS: THE CASE OF MONERAGALA DISTRICT

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INTRODUCTION

Rubber is a crop which has its all operations connected with the rainfall pattern. Hence, for timely and efficient operation of agronomic practices from planting through felling, one needs a thorough understanding of the prevailing rainfall pattern of the area. There have been several reports on the rainfall pattern in traditional rubber growing areas in the Wet zone of Sri Lanka. Yet, such reports are limited for the non-traditional rubber growing areas except for the study reported by Wijesuriya *et al.* (2005), hindering efficient decision making processes connected to rubber cultivation. The present article is an update of that report in 2005, giving more emphasis on recent findings based on GIS approach.

Agro-ecological zones in the Moneragala district

As depicted in Fig. 1, Moneragala district has intermediate and dry climatic conditions scattered in the entire area of the Moneragala district. According to the agro-ecological classification of Sri Lanka, the Southern and Eastern boundaries of the Moneragala district comprise of DL2a, DL2b and DL5 while the Northern boundary belongs to agro-ecological zone, DL2a (Fig. 1). The areas adjoining to Badulla district fall into the zone, IM2b and a very small area belongs to IU2. It is evident from Fig. 1 that the interior locations of the district belong to IL1c and IL2. Table 1 lists the rainfall characteristics in the Moneragala district together with explanations on the abbreviations for agro-ecological zones used in this article.

Table 1. *Rainfall characteristics in Agro-ecological regions of the Moneragala district*

Agro-ecological zone			**75% expected rainfall (mm)**
Intermediate zone	Low country	IL 1c	> 1300
		IL 2	> 1600
	Mid country	IM 2b	> 1600
	Up country	IU 2	> 2100
Dry zone	Low country	DL 1 a	> 1100
		DL 1b	> 900
		DL 2a	> 1300
		DL 5	> 650

Source: Natural Resources Management Centre, Department of Agriculture, 2003

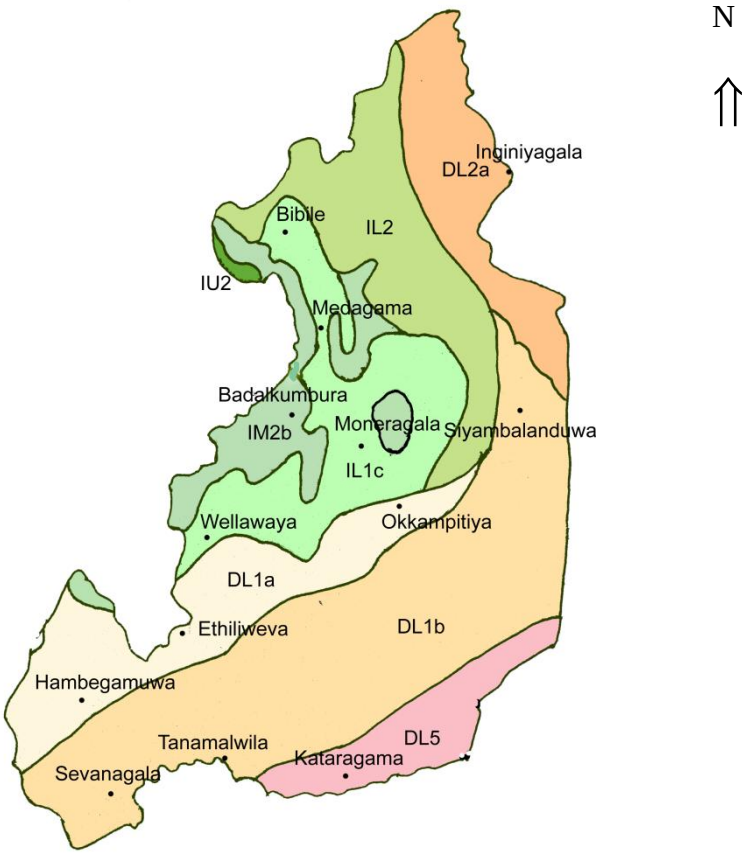


Fig. 1. *Agro-ecological regions in the Moneragala district (Source: Natural Resources Management Centre, Department of Agriculture, 2003)*

Rainfall pattern in the Moneragala district

Moneragala is the second largest district in Sri Lanka next to Anuradhapura district with an extent of 5660 km^2 (565930 ha). From this extent, nearly 70% belongs to the dry zone while the rest belongs to the intermediate zone.

The annual average rainfall in the Moneragala district ranges from 1250 mm to 2622 mm. The figures derived from daily rainfall records collected from a rainfall station in the vicinity of Moneragala town are depicted in Fig. 2. This rainfall station represents the agro-ecological zone, IL1c. The mean annual and the 75% expected rainfall figures in this station are 1632 mm and 1560 mm, respectively. The annual rainfall varied from 1054 mm to 2258 mm during 1983 to 2007.

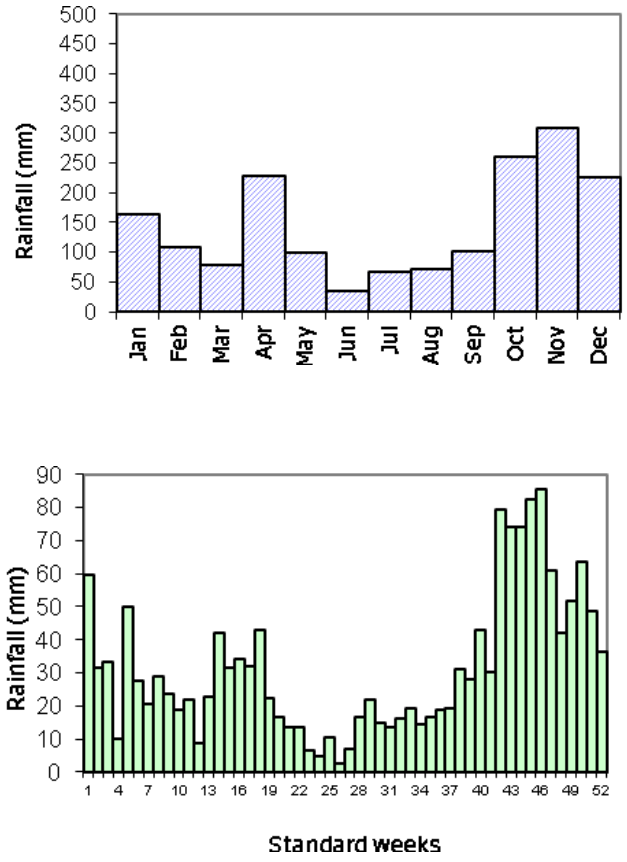


Fig. 2. *Weekly and monthly distribution of rainfall in Moneragala (IL1c)*

A slight departure is observed in the rainfall pattern observed in Bibile area although enclosed in the IL1c region (Fig. 3). Relatively higher amount of rainfall is experienced in this area when compared to the other IL1c areas. It is worth mentioning here that this station is located close to IL2 region. Further, it should be noted that a similar pattern of rainfall exists in Nannapurawa (IM2b) and in Padiyatalawa (IL2) which belong to Ampara district adjoining the Moneragala district (Fig. 4). Rainfall distributions observed in several other stations are depicted in Fig. 5, 6 and 7, respectively for DL1a, DL1b and DL5 agro-ecological regions. Fig. 5 depicts the rainfall distribution in Ethiliweva, Hambegamuwa and Okkampitiya areas which belong to the DL1a region. Rainfall distribution in Tanamalwila in the DL1b region and Kataragama in the DL5 region are depicted in Fig. 6 and Fig. 7, respectively. One can identify similar features of rainfall distributions in these dry zone areas of the Moneragala district.

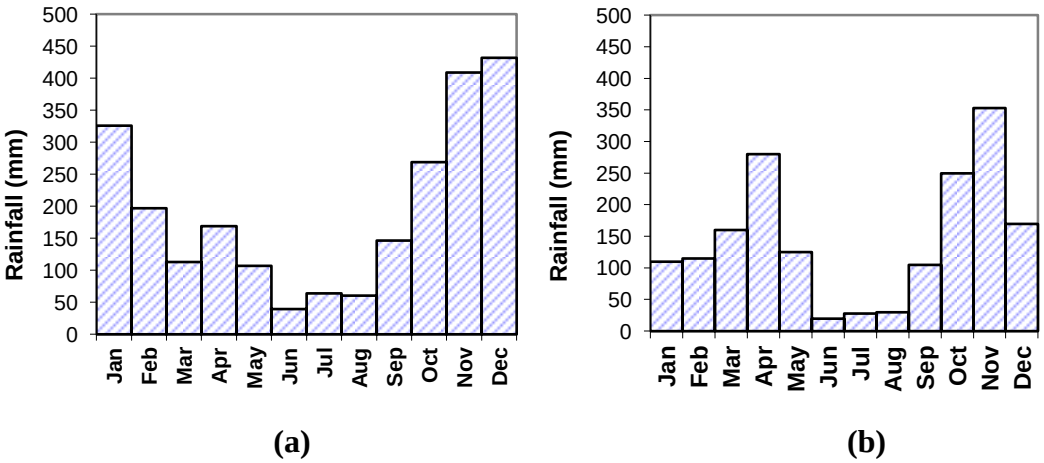


Fig. 3. Distribution of monthly rainfall in (a) Bibile and (b) Wellawaya (IL1c)

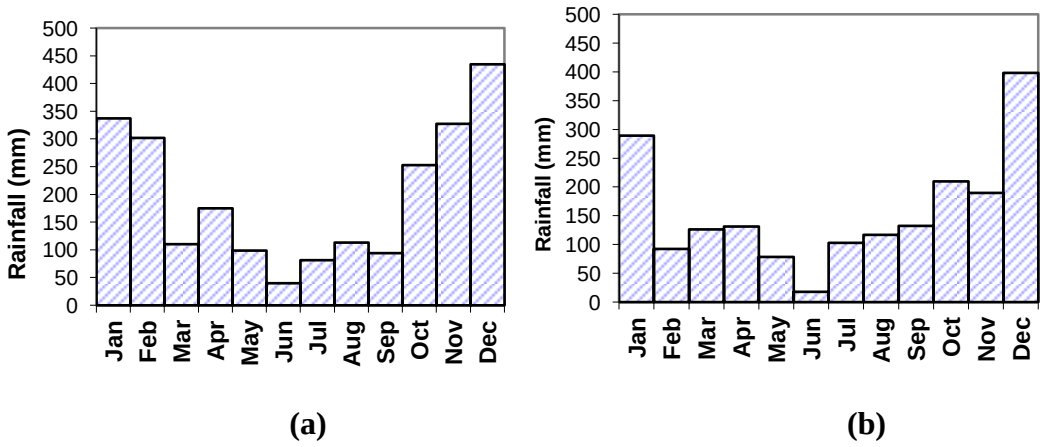


Fig. 4. Distribution of monthly rainfall in (a) Nannapurawa (IM2b) and (b) Padiyatalawa (IL2)

A recent study conducted in the Moneragala district produced several map outputs through GIS support. The maps describing the spatial variation of annual rainfall in the Moneragala district are depicted in Fig. 8 a&b. Areas receiving an annual rainfall of more than 1650 mm (the minimum requirement for rubber cultivation) are depicted in Fig. 8b. This map clearly illustrates that only 1/3rd of the extent in the Moneragala district receives a total annual rainfall less than 1650 mm. The remaining portions of the district are suitable with respect to the adequacy of rainfall for rubber cultivation.

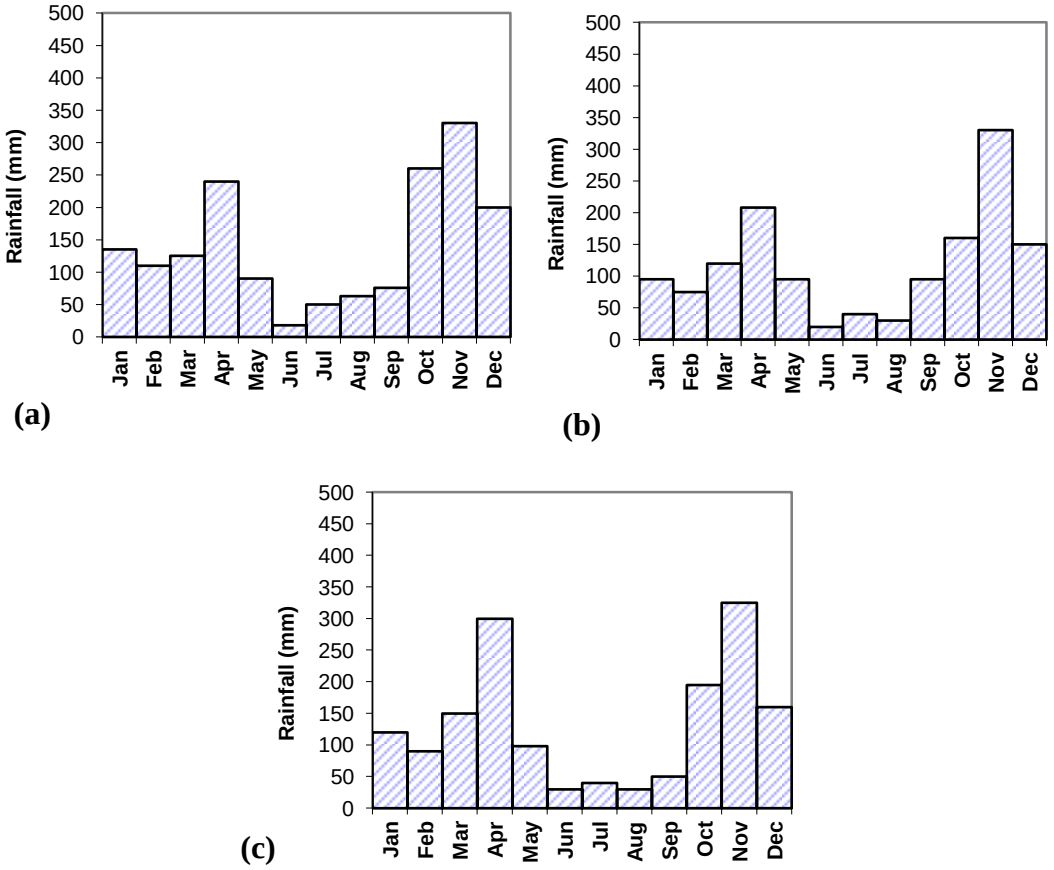


Fig. 5. Distribution of monthly rainfall in (a) Okkampitiya, (b) Ethiliwewa and (c) Hambegamuwa (DL1a)

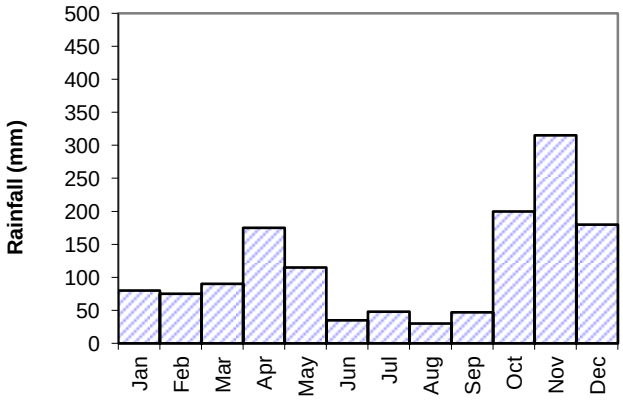


Fig. 6. Distribution of monthly rainfall in Tanamalwila (DL1b*)*

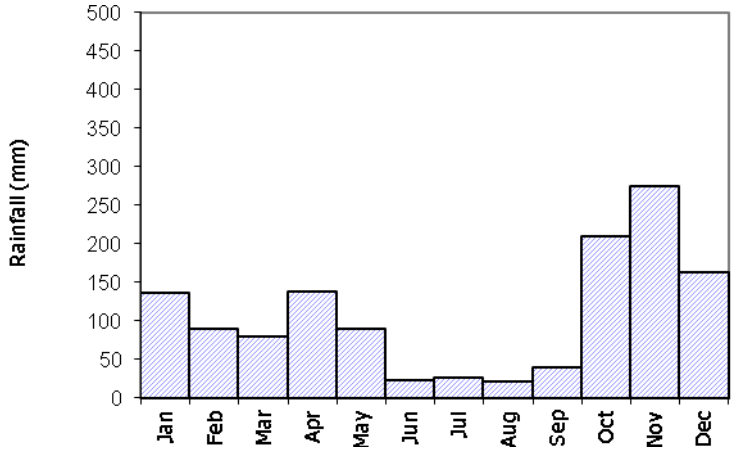
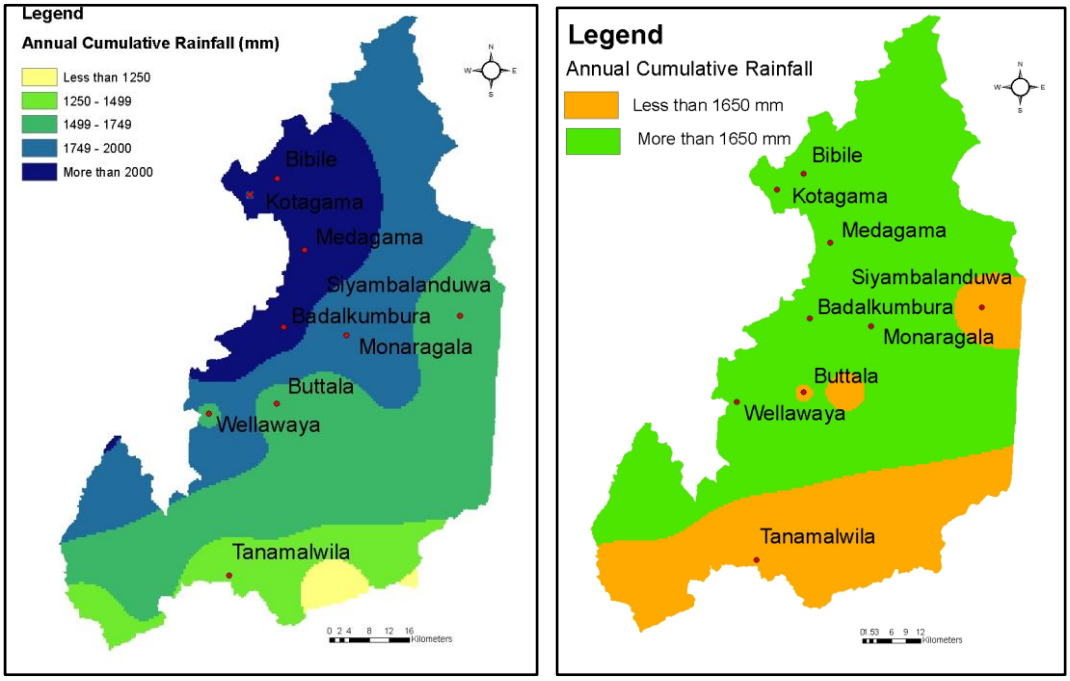


Fig. 7. Distribution of monthly rainfall in Kataragama (DL5)



(a) **(b)**

Fig. 8. Spatial distribution of annual rainfall in the Moneragala district

Influence of South-West and North-East monsoon seasons

The details of onset, cease and duration of South-West and North-East Monsoon seasons in the areas belonging to IL1c area are given in Table 2. These calculations are based on daily rainfall data collected over the period, 1983 to 2007. Please note that the onset and cease dates of rainfall seasons are based on criteria mentioned by Wijesuriya & Herath (2001). Wind direction is not taken into account in deciding the onset and cease dates of rainfall seasons.

Table 2. *Details of first and second rain spells in IL1c areas of the Moneragala district*

Incidence	First rain spell (Includes South-West monsoon)	Second rain spell (Includes North-East monsoon)
Rains begin before this date at a 75% certainty	08th April	24th October
Rains cease before this date at a 75% certainty	11th July	26th January
Mean date of start of rain spell	4th April	12th October
Mean date of cease of rain spell	25th June	17th January

Accordingly, in 3 out of 4 years (75% probability) the 1st rain spell begins before 8th April and ends before 11th June. The second rain spell starts before 24th October and cease before 17th January. The 1st rain spell extends for a period of 82 days while the 2nd rain spell extends for 97 days.

Table 3 reveals the information in some dry zone areas (DL1a and DL1b) of the Moneragala district regarding the onset of rainfall in the two rainy seasons. Based on this information, although Hambegamuwa belongs to DL1b, the 2nd monsoon season extends for a period of 95 days as in IL1c areas.

Table 3. *Details of first and second rain spells in DL1a and DL1b areas of the Moneragala district*

Rainfall recording station	Mean annual rainfall (mm)	First rain spell		No. of days	Second rain spell		No. of days
		Start	End		Start	End	
Hambegamuwa ($DL\ 1_a$)	1621	March 14	May 13	57	Oct. 03	Jan. 10	95
Ethiliweva ($DL\ 1_a$)	1438	March 08	May 01	51	Oct. 10	Dec. 25	72
Tanamalwila ($DL\ 1_b$)	1335	March 18	May 06	46	Oct. 02	Dec. 30	75

Is the rainfall adequate for rubber cultivation in the Moneragala district?

Rubber needs an annual rainfall between 1650 mm to 3000 mm for successful establishment, growth and optimum production of latex. Further, a reasonable distribution of this rainfall throughout the year is considered an important requirement. Hence, a cumulative rainfall of 500 mm in 6 consecutive months is also considered an important indicator of adequacy of rainfall for successful rubber cultivation. The above-mentioned requirement is very critical especially during the immature phase of rubber. Hence, it can be assumed that the dry season prevailed in the Moneragla district during May to September period can adversely affect on the growth of immature rubber. There is a tendency of receiving a rainfall of 1300 mm to 1600 mm in areas belonging to the agro-ecological region of IL1c with a 75% probability. In IL2 and IM2b areas this amount exceeds 1600 mm. However, during the midyear dry period which is common to all areas in the Moneragala district rubber plantations need special care and attention on moisture conservation measures.

The GIS output in Fig. 9 depicts the spatial distribution of cumulative rainfall during the period, March to August. According to this study, it was revealed that during the 6-months periods; July to December, August to January, September to February, October to March and in November to April, all areas of the Moneragala district receive a cumulative rainfall above 500 mm. Yet, several 6-months periods recorded cumulative rainfall values less than 500 mm in several locations of the Moneragala district. As depicted in Fig. 9, several places in Madulla, Siyambalanduwa, Wellavaya and Tanamalwila divisional secretariats, the whole of Kataragama divisional secretariat receive a cumulative rainfall less than 500mm during March to August.

A clear demarcation of suitable areas for rubber cultivation is given in Fig. 8(b). Areas which receive a rainfall of 1650 mm or above can be used for rubber cultivation with appropriate moisture conservation measures as recommended by the rubber research Institute of Sri Lanka. It is indeed a timely action to educate rubber farmers in the Moneragala district about this matter. Moisture conservation measures to overcome moisture stress should be given priority in farmer education programmes in this district.

Long dry spells is another limiting factor for growth and productivity of rubber plants. Fig. 10 depicts the probability of incidence of dry spells of varying lengths (5, 10, 15 and 20 days) in Moneragala (IL1c) and Okkampitiya (DL1a). It was revealed that in DL1a areas there is a high tendency for the occurrence of dry spells than IL1c areas (Fig. 10). There is a chance of about 70% to occur a 20 day dry period in DL1a areas compared to a 20% chance in IL1c areas. This information (Fig. 9) is very vital for moisture conservation to combat adverse environmental impacts on rubber cultivation.

Information on excess and deficit of rainfall also provides a practical guide for planning moisture conservation practices. The distribution of evaporation recorded using the Class A pan and rainfall in Moneragala (IL1c) is depicted in Fig. 11. It illustrates the moisture deficit during the mid year period, where evaporation

exceeds the rainfall. This also demands proper attention on adhering to recommended practices in rubber plantations to avoid adverse impacts of moisture stress.

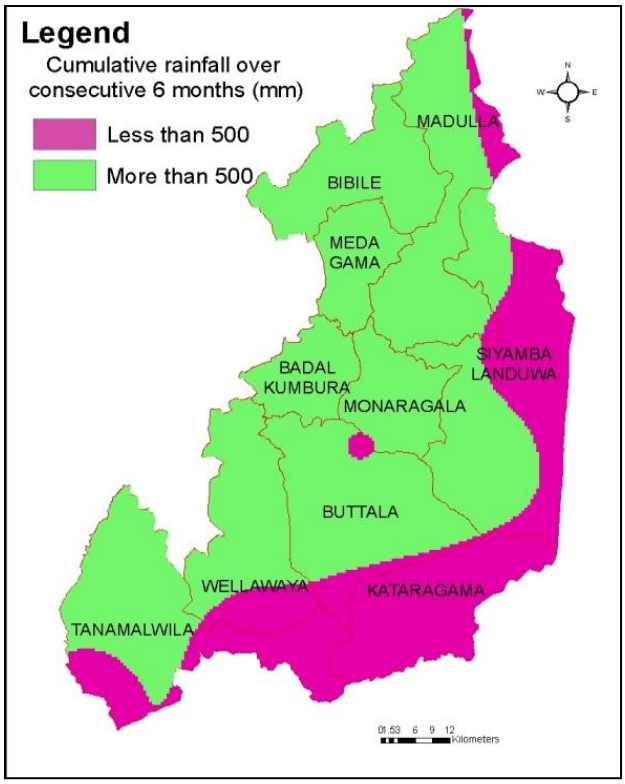


Fig. 9. Spatial distribution of cumulative rainfall from March to August in Moneragala district

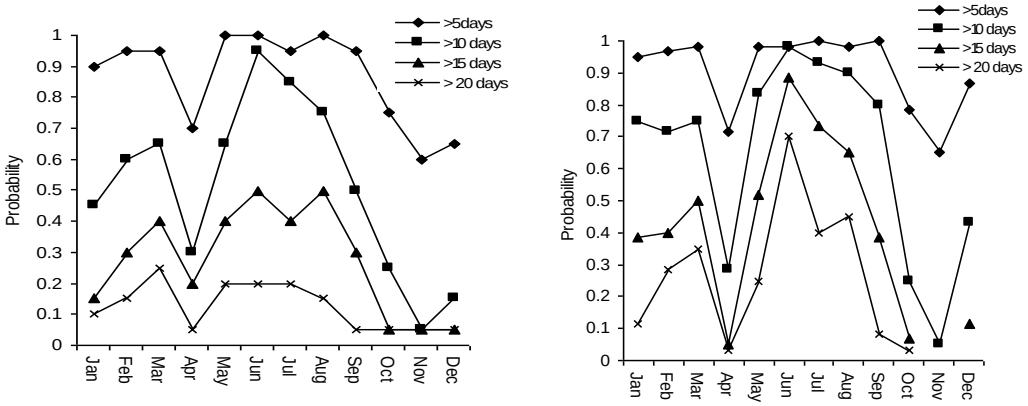


Fig. 10. Probability of incidence of dry spells of varying lengths (5, 10, 15 and 20 days) in Moneragala (IL1c) and Okkampitiya (DL1a)

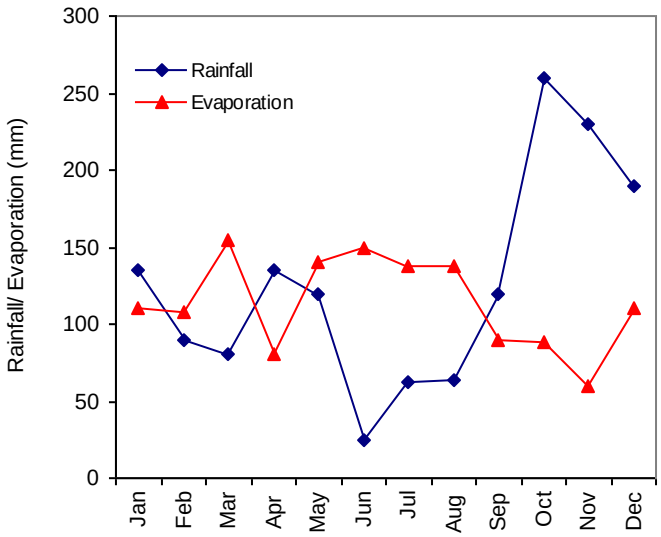


Fig. 11. Distribution of mean monthly values of evaporation and rainfall in Moneragala (IL1c)

The basic activities in rubber plantations and their relevant operational times are highlighted in Fig. 12. This crop calendar clearly indicates its connection with the rainfall pattern. Adhering to this calendar together with appropriate recommendations assures successful rubber cultivation in the Moneragala district.

	January	February	March	April	May	June	July	August	September	October	November	December
Cleaning							▨	▨				
Burning*								▨	▨			
Holing									▨			
Planting										▨	▨	
Fertilization			▨							▨		▨

* Not required for replanting of rubber

Fig. 12. Crop calendar for rubber in Moneragala district

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