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SUITABLE GROWING PERIODS IN PENINSULAR MALAYSIA BASED ON AGRICULTURAL RAINFALL INDEX ANALYSIS

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RINGKASAN

Catatan jumlah hujan bulanan bagi 25 tahun dari 300 stesen kajicuaca di Semenanjung Malaysia telah dianalisis untuk mendapatkan *agricultural rainfall index* (ARI) bulanan. ARI yang diperolehi telah dibahagikan kepada 3 kelas: ARI kurang daripada 40 menunjukkan bulan kemarau, ARI lebih daripada 200 menunjukkan bulan yang mengalami hujan berlebihan, dan ARI antara 40 dan 200 pula ialah bulan yang sesuai untuk tumbesaran tanaman. Satu peta Semenanjung Malaysia yang menunjukkan zon-zon tempoh tumbesaran tanaman telah disediakan. Bulan-bulan yang mengalami musim kemarau atau hujan berlebihan juga telah ditunjukkan dalam peta itu.

INTRODUCTION

The availability of water determines the success or failure of a crop. Rainfed crops require timeliness of planting to coincide with the moist months during which water is vital for the vegetative growth, and to coincide with the onset of the dry season during crop maturity and harvesting. Certain crops such as the cereals and sugarcane require low soil moisture content at maturity for proper ripening and yield formation. Many fruit crops do better with seasonal dry periods as the increased range of night to day temperature helps in flowering initiation.

Unseasonal events of extended drought or excessive rains have caused unexpected crop failures in many parts of the world. In Peninsular Malaysia, a notable climatic event that caused tobacco crop failures in the last few years had been flash floods caused by excessive rainfall. Crops such as cocoa have also shown yield depression due to droughts and floods.

This study was carried out to determine the months of the year during which droughts and excessive rains are likely to occur at a probability level of 80 per cent.

METHODS

The Agricultural Rainfall Index

The agricultural rainfall index (ARI) is a useful indicator of the monthly water balance. The ARI is expressed in per cent as the ratio of rainfall at 80% probability to the monthly total potential evapotranspiration. Twenty-five years of monthly rainfall data from 300 rainfall stations were ranked in decreasing order. The lowest five values (or the lowest 20% of values in the frequency distribution) of rainfall were discarded, leaving 20 (or 80%) cases of practical significance. The mid-point between the lowest of the remainder and the highest of the discarded data was approximately the value at 80% probability. This means in four out of five years the rainfall total for that month was expected to be at least that amount (the mid-point value). A serious deficiency of rainfall occurring once in five years is an acceptable risk in an agricultural enterprise.

Rainfall stations with complete records of at least 25 years were analysed for monthly 80% rainfall probability by the above method. The details of this method were described by GHAZALLI and NIEUWOLT (1982). Rainfall records were obtained from

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publications of the Malaysian Meteorological Service Department and the Department of Drainage and Irrigation. A total of 300 stations representing all the states in Peninsular Malaysia were analysed. The distribution of rainfall station by states depends on the number of established plantations present in each state. For example, a large number of rainfall stations are found in the states of Perak, Selangor and Johore; a fair number in Pahang, Kedah, Negeri Sembilan and Malacca; and few are found in Kelantan and Terengganu.

To determine the ARI, the evapotranspiration values for each of these stations were obtained from SCARF (1976). The values were pan evaporation data corrected for grass evaporation.

The ratio of R80 (80% probability rainfall) to E_o (evapotranspiration) was computed for each month for all the stations. Months with ARI between 40% and 200% (rainfall between four tenths of E_o and twice E_o) are considered periods within which shallow-rooted crops will have no water constraints. When rainfall amount in a month is less than the monthly E_o, the deficit in R80 – E_o is made up by soil moisture storage. Studies (ANON., 1978) have shown that when rainfall is down to half of E_o, crops can still be sustained by soil moisture storage. When the rainfall is reduced to four tenths of E_o, drought conditions can be expected. Thus, ARI 40 is a good indicator of drought.

When the rainfall is in excess of soil moisture storage and evaporative demand requirements, surface soil will be saturated. When deep percolation is exceeded by rainfall intensity, which is usually the case, surface flooding will occur. Some crops such as cocoa and tobacco are susceptible to flooding. The effect on cocoa is usually a

Table 1. Seven classes of suitable growing periods and the respective location

Suitable growing period (months)	Location	Feature
12	Johore	Generally, uniform rainfall distribution throughout the year without drought or excessive rainfall.
	The Main Range and most of Selangor	Similar features as Johore. Few rainfall stations in the Main Range.
11	Most of Pahang, interior of Negeri Sembilan, Selangor coastal areas.	Generally, 1 month of dry period OR 1 month of excessive rainfall.
10	Parts of the coastal areas.	2 dry months OR 2 wet months OR 1 dry and 1 wet month.
9	Kelantan, Terengganu, Central Pahang, northwest coast of Selangor, Penang, parts of Kedah and Perlis.	Generally, these areas experience 3 dry months. Kelantan and Terengganu are featured by 1 or 2 wet months along with the proportional number of dry months.
8	Kedah, Kelantan, Terengganu and Negeri Sembilan.	4 dry months OR 3 dry months and 1 wet month.
7	Kelantan, Terengganu, and a small coastal area in Pahang.	Generally, 3 dry months and 2 wet months.
5	Northern tip of Kelantan.	Generally, has 5 months of drought and heavy rains in November and December.

Months during which drought or excessive rainfall occur are easily read off from the map *(e.g.* 1 = Jan., 2 = Feb., *etc)*.

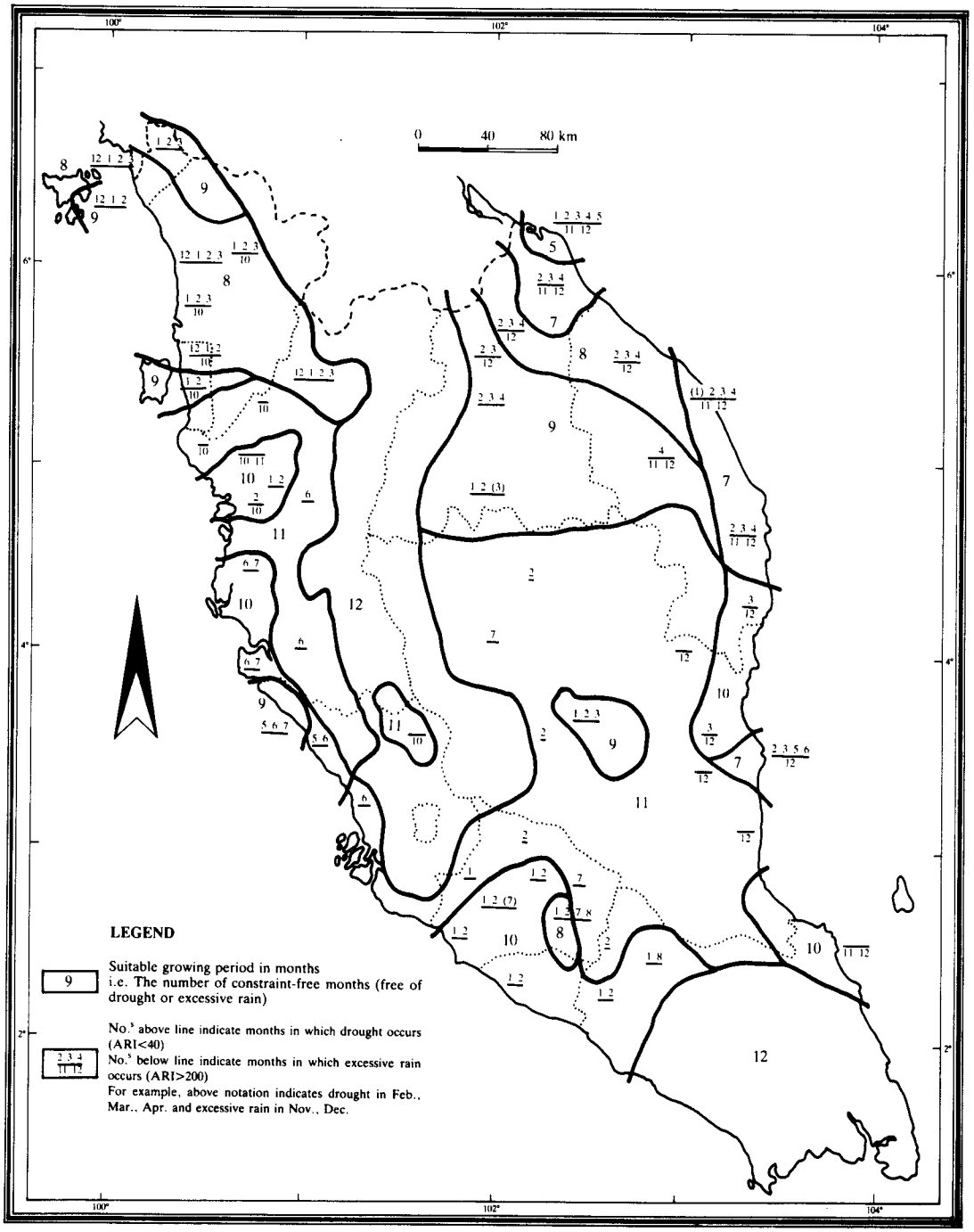

Figure 1. Lengths of suitable crop growing period for Peninsular Malaysia.

reduction in yield, whilst tobacco plants are killed by flood. ARI 200 is an arbitrary limit at which flooding is likely to occur. Thus, it is useful to identify the months with ARI 40 and ARI 200 for agricultural crop planning.

Length of Growing Period Zones

The months during which ARI values are above 40 and below 200 do not have moisture constraints for plant growth. Therefore, they are considered as the 'suitable growing period'. The total annual suitable growing periods in months for all stations were plotted on a 1:1 000 000 scale map of Peninsular Malaysia. Isolines were drawn to indicate the zones of similar length of growing period. The actual months during which seasonal drought or excessive rains occur were also indicated on the map. A reduced scale map is presented in *Figure 1*.

RESULTS

It was intended in this study to present a map which was self-explanatory and could be used directly in the field to time the planting or to decide the selection of crop zones.

In *Figure 1*, seven classes of suitable growing periods were recorded. The seven classes are as shown in *Table 1*.

CONCLUSION

Based on the exclusion of very dry months (ARI less than 40) and very wet months (ARI greater than 200), suitable growing periods were derived on a map for Peninsular Malaysia. The map is self-explanatory such that for any given location, the user can determine the likelihood of occurrence of seasonal dry months or wet conditions. In this way, agricultural planning will be facilitated.

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ABSTRACT

Twenty-five years of monthly rainfall records from 300 stations in Peninsular Malaysia were analysed for their monthly agricultural rainfall index (ARI). The ARI were defined into three classes: ARI less than 40 indicated very dry month, ARI greater than 200 indicated extremely wet month, and ARI between 40 and 200 indicated a suitable period for crop growth. A map of Peninsular Malaysia showing zones of different lengths of growing periods was drawn. In the zones which experienced seasonally dry or wet months, the actual months when these occur were also indicated.

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