Recent rainfall trends in ViSCA, Baybay, Leyte, Philippines

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ABSTRACT

Climate is an important factor influencing all ecosystems. Adaptations to local climatic conditions will be found everywhere. ViSCA, Baybay, Leyte is characterized by a moist tropical climate with rainfall that is statistically distributed equally throughout the year. However dry periods occur regularly and more often than would be expected from the average data. They can lead to droughts in certain parts of the environment.

Keywords: Climate, Leyte, Philippines

INTRODUCTION

Climate can be very briefly defined as the sum of all the phenomena usually called weather: sunshine, wind, rain, snow, temperature, air pressure etc. A little more precise definition is given in the Handbook of Climatology: i.e. climate is the sum total of the meteorological phenomena that characterize the average condition of the atmosphere at any one place on the earth's surface. What is called weather is only one phase in the succession of phenomena whose complete cycle, recurring with greater or less uniformity every year, constitutes the climate of any locality (Coronas, 1918).

Almost 80 years later the uniformity mentioned in this definition is still doubtful. Even the question whether climate in this sense exists at all arises when we focus on periods longer than only a few generations of mankind. Changes from year to year can be considerable, however, a general pattern is visible at least for the last 20 years. Moreover, climate has not necessarily always followed this pattern and that climate is not static but a dynamic process like nature itself.

In this article, the focus will be mainly on the rainfall pattern and the possible occurrence of droughts. Other important phemomena of the local climate like typhoons, which also have a considerable influence on nature and require specific adaptations, will be excluded here.

The influence of the climate on nature

Every living organism in nature needs to survive and reproduce within its given environment. Since climate is the major abiotic factor in this environment, every organism has adapt to its conditions otherwise it will not survive. Numerous adaptations of plants to specific climatic condition are well known by now. Many adaptations have been developed in order to save water which is necessary for every life form. The more a certain area is prone to the regular occurrence of drought, the more of these specific adaptations can be found. In areas with high amount of annual rainfall and even when it seems to be distributed more or less equally throughout the year, adaptation to drought can occur. This can be a hint that dry periods can be present every few years and serve as 'bottleneck - periods' in the life of all organisms in the specific area. The more pronounced these dry periods are, the more adaptation will be found.

Most epiphytic plants are usually adapted to drought. Even when they are soaking wet during a daily shower, they will suffer from drought only a few hours later. Other plants that would show adaptations to drought will be found on soils with a limited water capacity, e.g. on the shallow soils of ridges or on well drained soils on limestone. Adaptations to drought will rarely be found in the deep valleys of rivers where evaporation is rather low throughout the day due to little accessibility to wind and limited duration of direct sunlight.

Another important adaptation to drought is the synchronization of flowering in some plant species. Flowering and subsequently, fruiting in these species are likely to happen after a dry spell that lasts for a few days to a few weeks. Among the species which are expected to react to this trigger mechanism are the trees of the dipterocarp family, the most important timber trees in southeast Asia. Many members of this family do not flower every year but only in irregular intervals and always at the same time of the year (Ng, 1981). Reports of local people indicate that seed years in dipterocarps occurred in 1983 and 1987. Iis study, it was observed in 1992 and 1995. All these years showed a pronounced dry period.

Whether the flowering/fruiting was really triggered really by drought or by the change of mostly overcast to bright and sunny days as indicated by Ng (1977) for Malaysian dipterocarps can not be confirmed here. The phenology of dipterocarps is discussed in detail by Ng (1981).

The climate in the Philippines

The Philippines lies near the equatorial belt and is characterized by high temperatures and humidities. Even though the extension of the Philippines especially from east to west is rather small, considerable differences in the local climate can be observed. This is mainly due to the different exposure of the islands to the general winds; i.e. in winter, rains are usually caused by the northeast monsoon winds, in summer and autumn, the major influence of the precipitation comes from tropical depressions with winds coming from eastsoutheast (cyclonic winds). These rains can be very heavy and sometimes can lead to devastating floods like the one in Ormoc in 1991 due to environmental problems such as deforestation.

In the Philippines two main types of climate can generally be distinguished:

The first type is characterized by two pronounced seasons, a dry season up to 6 months in winter and spring, and a wet season in summer and autumn. This type is influenced mainly by the cyclonic winds, the northeastern monsoon is hardly noticeable.

The second type does not show pronounced seasons. The anual rainfall is distributed throughout the year with a pronounced rainy period in autumn and winter.

Apart from these two opposite types, two more intermediate types can be distinguished. Both do not show any pronounced rainy period; the first of these intermediate types shows a short dry season whereas the second does not.

Leyte is divided both geographically and climatically by the cordillera central which runs from the northwest to the southeast of the island. The eastern part has no dry season with a pronounced maximum of rainfall in autumn and though winter, though belonging to the second main climatic type of the Philippines. In the western part where the Visayas State College of Agriculture (ViSCA) is situated, rainfall is more evenly distributed throughout the year without pronounced dry or wet season. It belongs to the second intermediate climatic type of the Philippines.

This subdivision of the climate is made according to the average monthly rainfall over a certain period. This article will show, that despite these average data, the rainfall in western Leyte is not evenly distributed as implied by the Philippine climate presented above.

CLIMATIC DATA OF THE VISCA AGROMET STATION FROM 1976 TO 1995

The average for 20 years

Figure 1 shows the climatic diagram of ViSCA prepared according to Walter. In this diagram, the average temperature is set in relation to the precipitation in order to give an estimate of the potential evaporation. It is a dry period (dotted area) when the line of precipitation drops below the line of temperature,a moist period (striped area) when it is between the line of the temperature and 100 mm, and a wet period (black area) when above 100 mm. It must be noted that above 100 mm for wet periods, the scale for precipitation is changed. Further details on these climatic diagrams are found in Walter (1984).

On the average the chart shows no dry period in ViSCA. Only one month has less than 100 mm of precipitation and all the other months have between 100 mm and 300 mm rainfall. Rainfall is a little less from February/March to May and in September and a little more from June to August and from October to January, but the difference is sufficient to indicate seasons. The average total annual rainfall is 2620 mm and the average temperature is 27.4°C.

Since data on potential evaporation (open pan evaporimeter) are also available, the same diagram was made but temperature was replaced by potential evaporation (Fig. 2). The estimate of evaporation by using temperature at least for this station is not very accurate. The average monthly potential evaporation ranges from 78 mm to 133 mm, its maximum in May and its minimum in December, which lead to a short dry period in May even though the precipitation is only a little below 100 mm. The seasonal changes of the evaporation with a maximum in May when the precipitation is lowest are hardly reflected by the

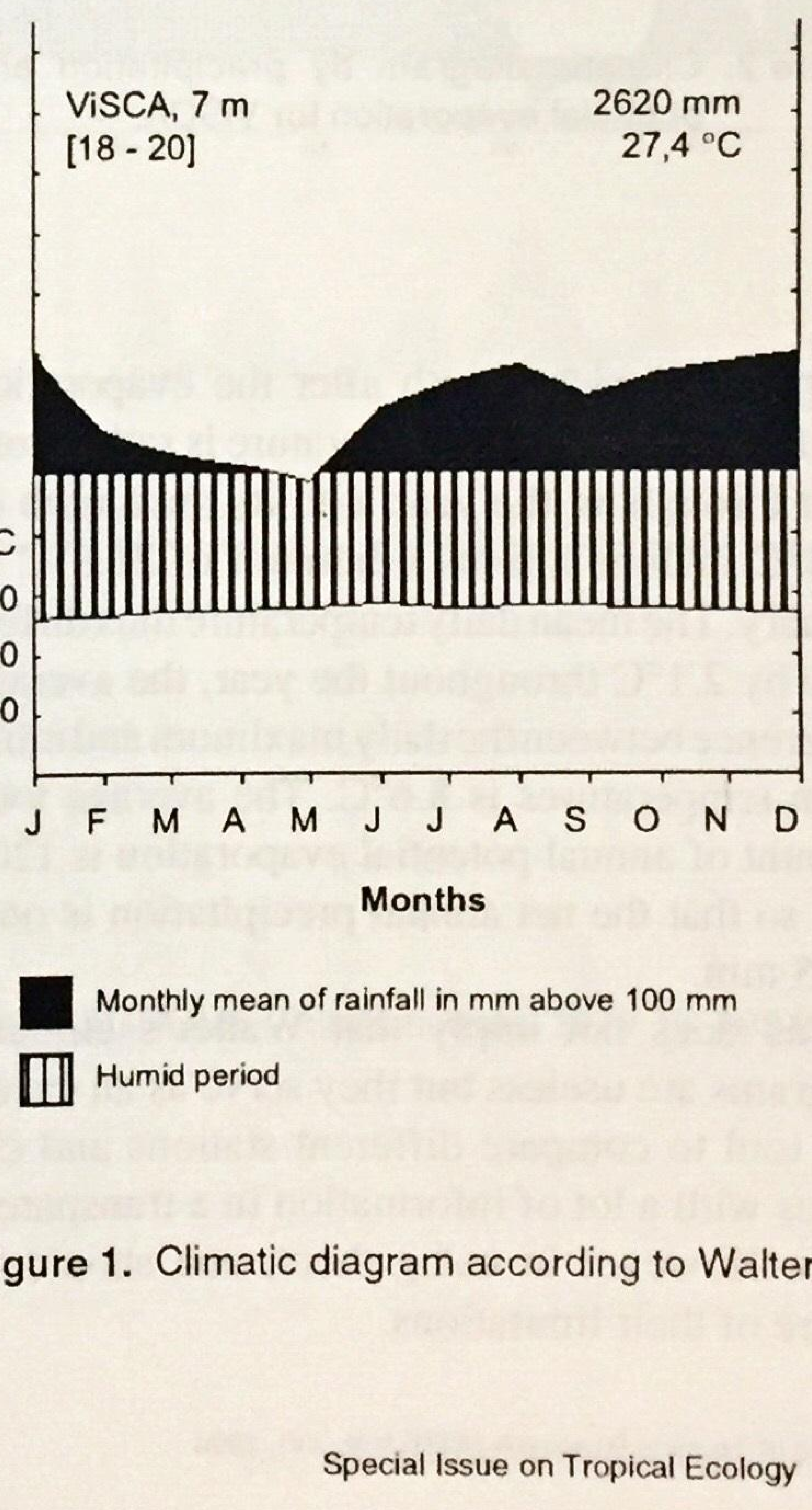

Figure 1. Climatic diagram according to Walter.

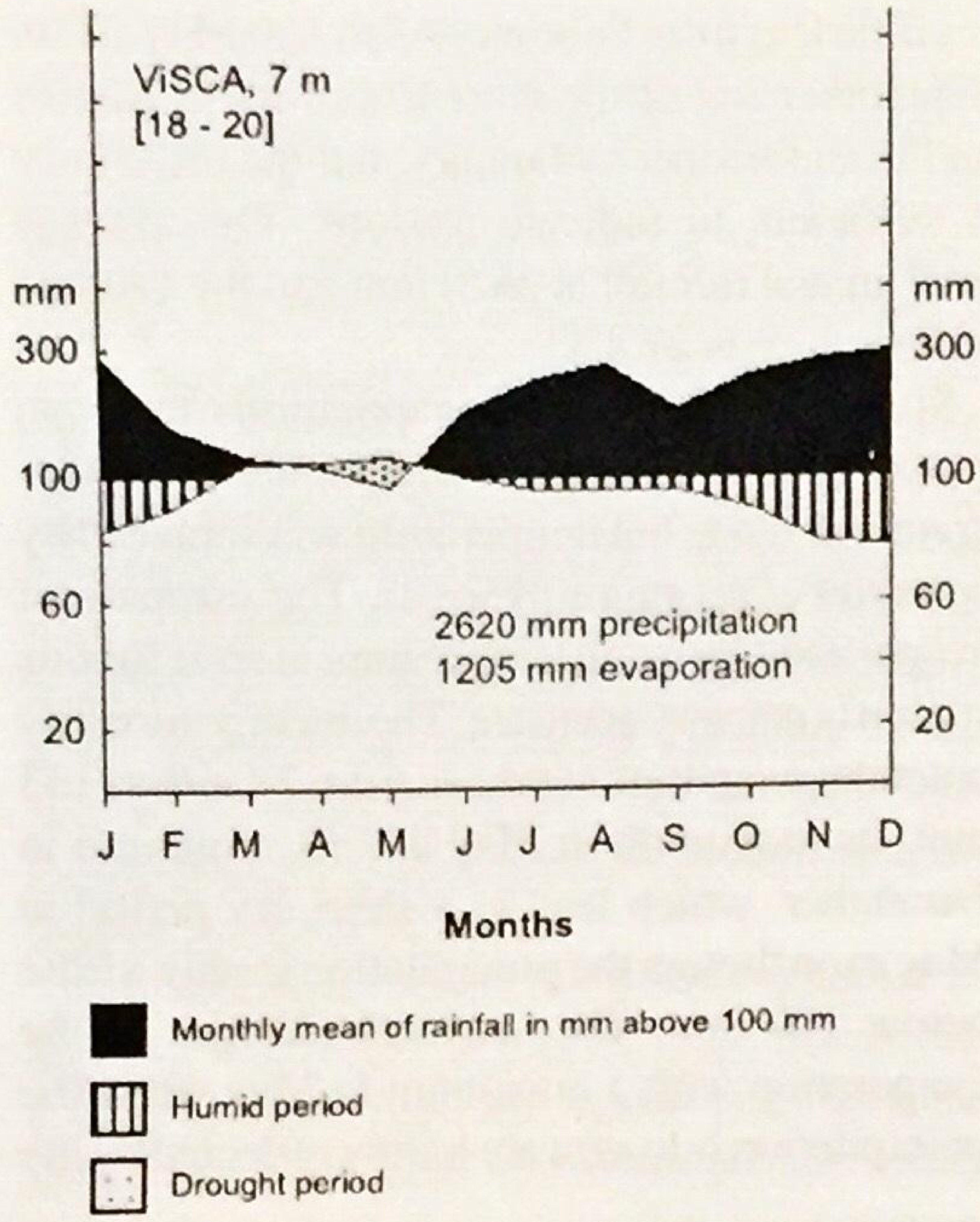

Figure 2. Climatic diagram by precipitation and potential evaporation for ViSCA.

temperature each month after the evaporation reaches its extremes. Temperature is rather constant throughout the year with its maximum of 28.4°C in June and its minimum of 26.3°C in January. The mean daily temperature thus differs only by 2.1°C throughout the year, the average difference between the daily maximum and minimum temperatures is 8.6°C. The average total amount of annual potential evaporation is 1205 mm so that the net annual precipitation is only 1415 mm.

This does not imply that Walter's climatic diagrams are useless but they serve as an excellent tool to compare different stations and climates with a lot of information in a transparent form. However in using them, one should be aware of their limitations.

The monthly climatogram for 18 years

The last paragraph discussed the average climate in ViSCA. However, this is a rather coarse description of the climate because it hides the differences that occur from year to year. Figure 3 shows a climatogram for the average monthly data from 1978 to 1995. The general features, i.e. less rain in the first, more rain in the second part of the year, can still be observed but the differences from year to year can be quite large. For several years, a rather equally distributed rainfall was observed, a pronounced seasonality in other years and severe dry periods in 1983, 1987 and 1992.

Since the climatogram is made according to Walter and the estimate of the potential evaporation seems not very accurate, the same climatogram was prepared with the data for potential evaporation instead of temperature (Fig. 4). Most of the periods with less rain then appeared to be actually dry periods and the dry periods, that appear also in the Walter climatogram are more pronounced and also a little longer. Only a few years do not have any dry periods such that drought a common feature in the 'moist' tropical climate of Visayas State College of Agriculture.

The major droughts in 1983, 1987 and 1992 mentioned above coincide with a phenomen called El Niño or more precisely known as ENSO (El Niño/southern oscillation). This consists of a sympathetic movement involving the Pacific ocean and associated atmosphere in an essentially chaotic manner along the equator. The system oscillates between extremes of the so called "warm events" usually lasting 1 or 2 years and involving movement of warm sea water from the western Pacific along the equator causing impact on the west coast of the American continent, and the "cold events" associated with easterly trade-wind-induced flows of colder water from the eastern Pacific towards the west (Harger, 1994b). While the "cold event" is the normal

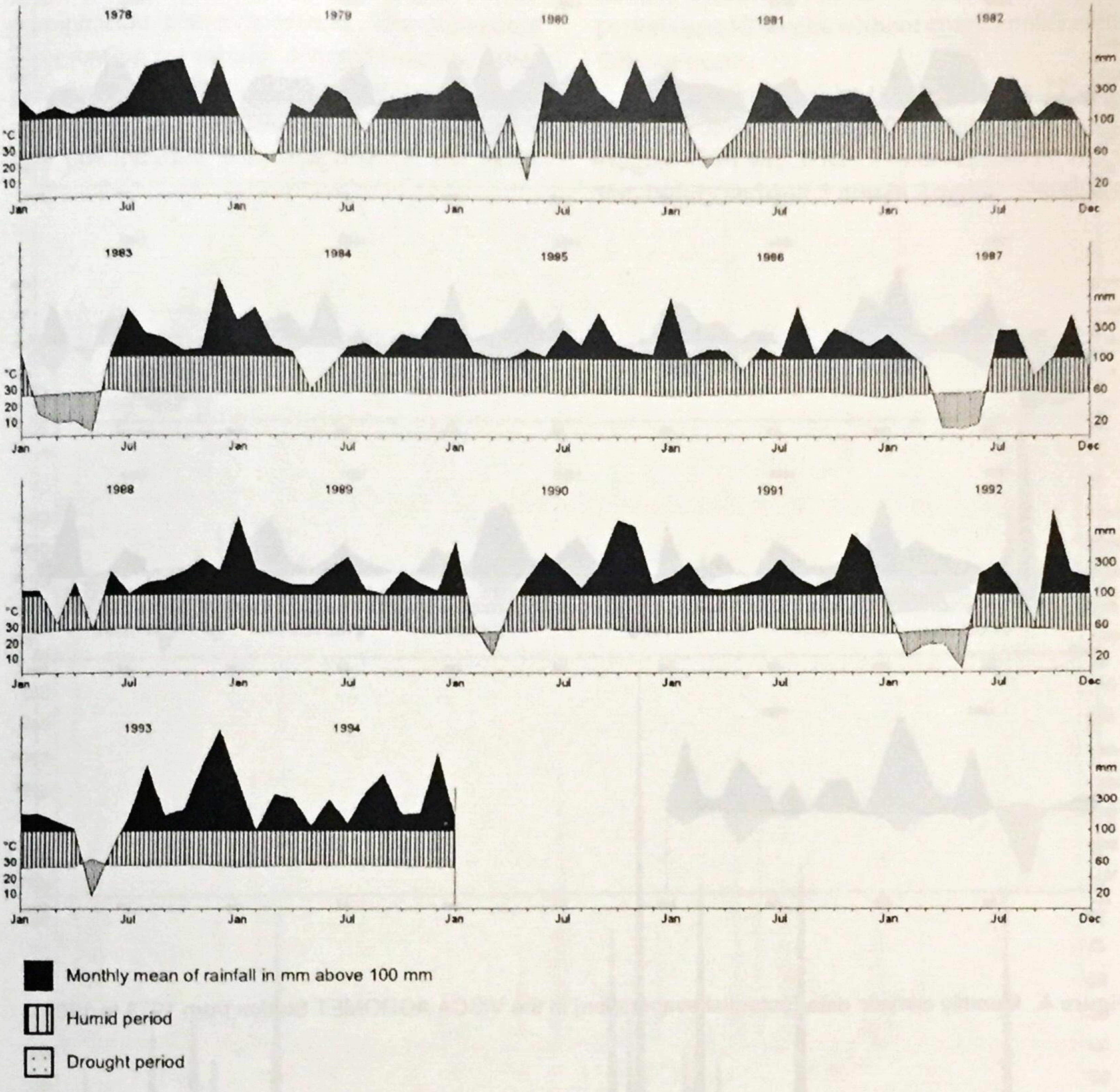

Figure 3. Monthly climatic data (temperature) in the ViSCA AGROMET Station from 1978 to 1994. The climatogram was plotted according to Walter.

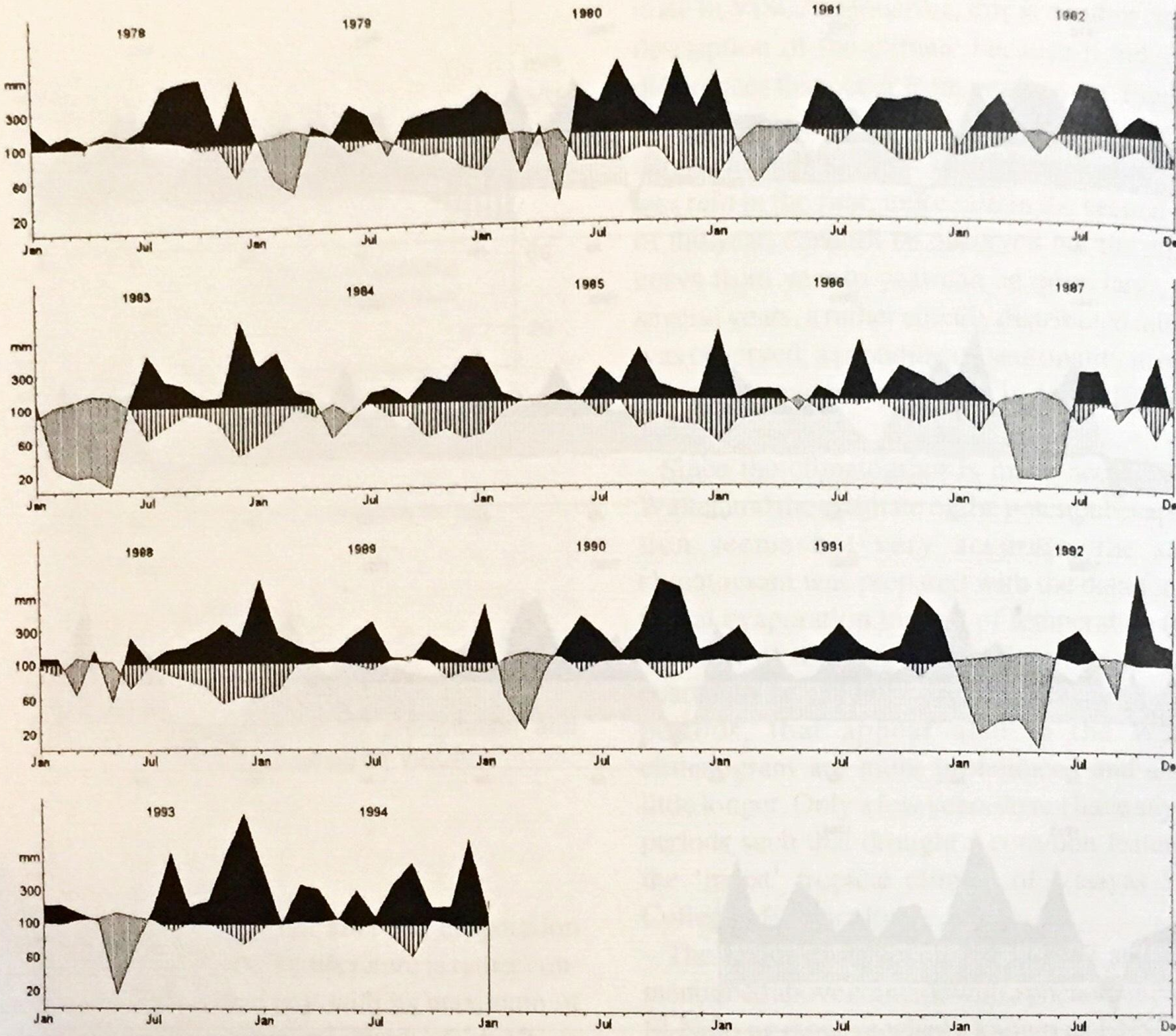

Figure 4. Monthly climatic data (potential evaporation) in the ViSCA AGROMET Station from 1978 to 1994.

situation, the "warm event" is the irregular occurring exception. When a "warm event" locks in, the usually dry west coast of the American continent experiences heavy rains whereas Southeast Asia suffers from drought. The "warm event" occurred in 1982/83, 1986/87 and 1991/92/93 (Harger, 1994a). Since these droughts seem to occur in the second year after a "warm event" locks in, they are somewhat predictable. For more details on the ENSO variation see also Arntz and Fahrbach (1991).

The daily climatogram for 1992 - 1994

The daily climatic data during the last 3 years (Figs. 5-7) were studied. The climatograms show precipitation and evaporation. The signatures representing net rainfall differed from the other diagrams: dotted areas represent higher evaporation than precipitation, striped areas stand for less precipitation than evaporation, the black areas show higher precipitation than evaporation. The insets show the Walter climatogram for the respective year. It was found that even in months with a total rainfall of more than 100 mm, periods up to 2 weeks without considerable rainfall can occur.

An example could be the dry period 27 consecutive days without net rainfall in July and August 1994 which had a total rainfall of 153.9 mm in July and 348.5 mm in August. The major

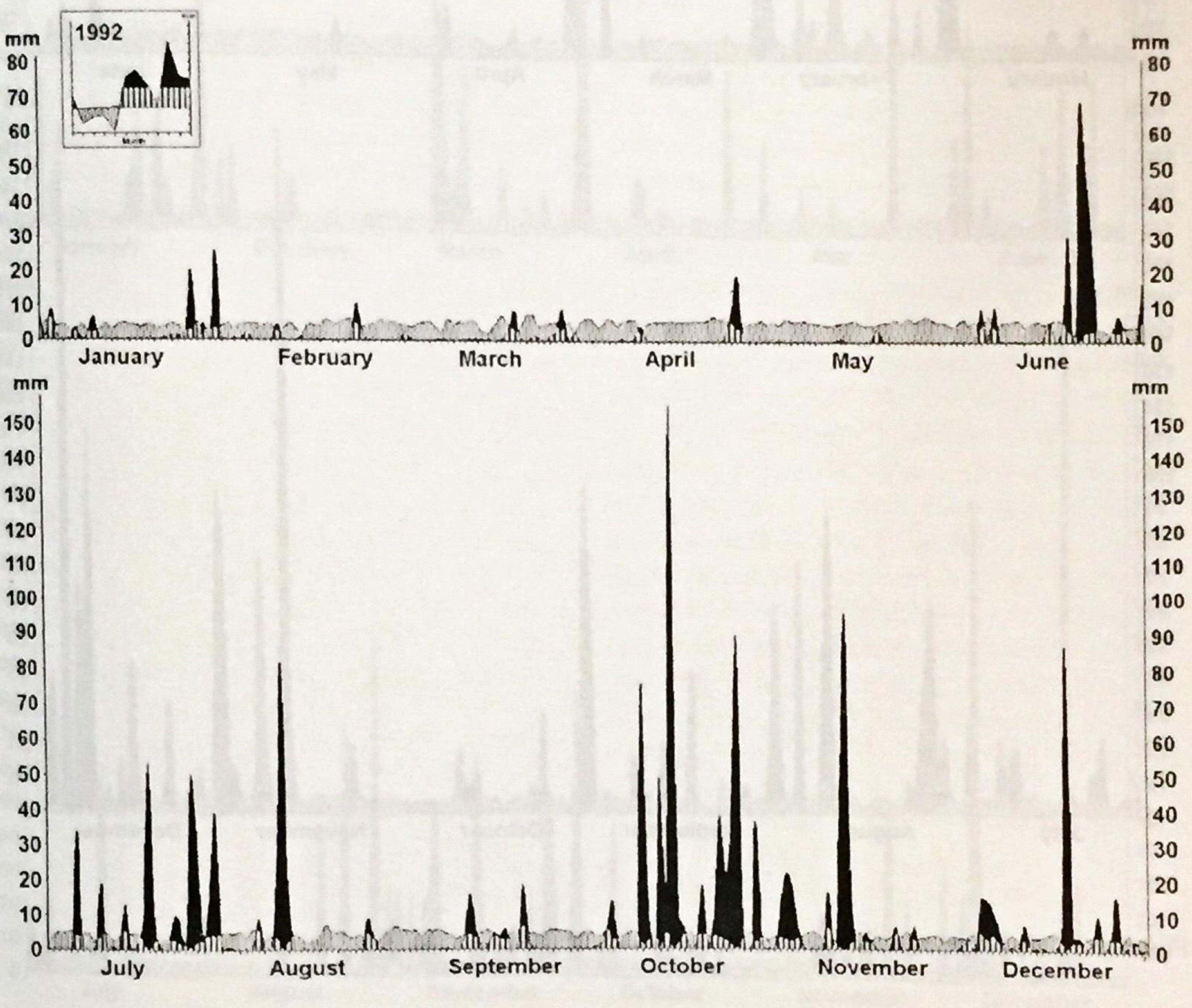

Figure 5. Daily climatic data for 1992.

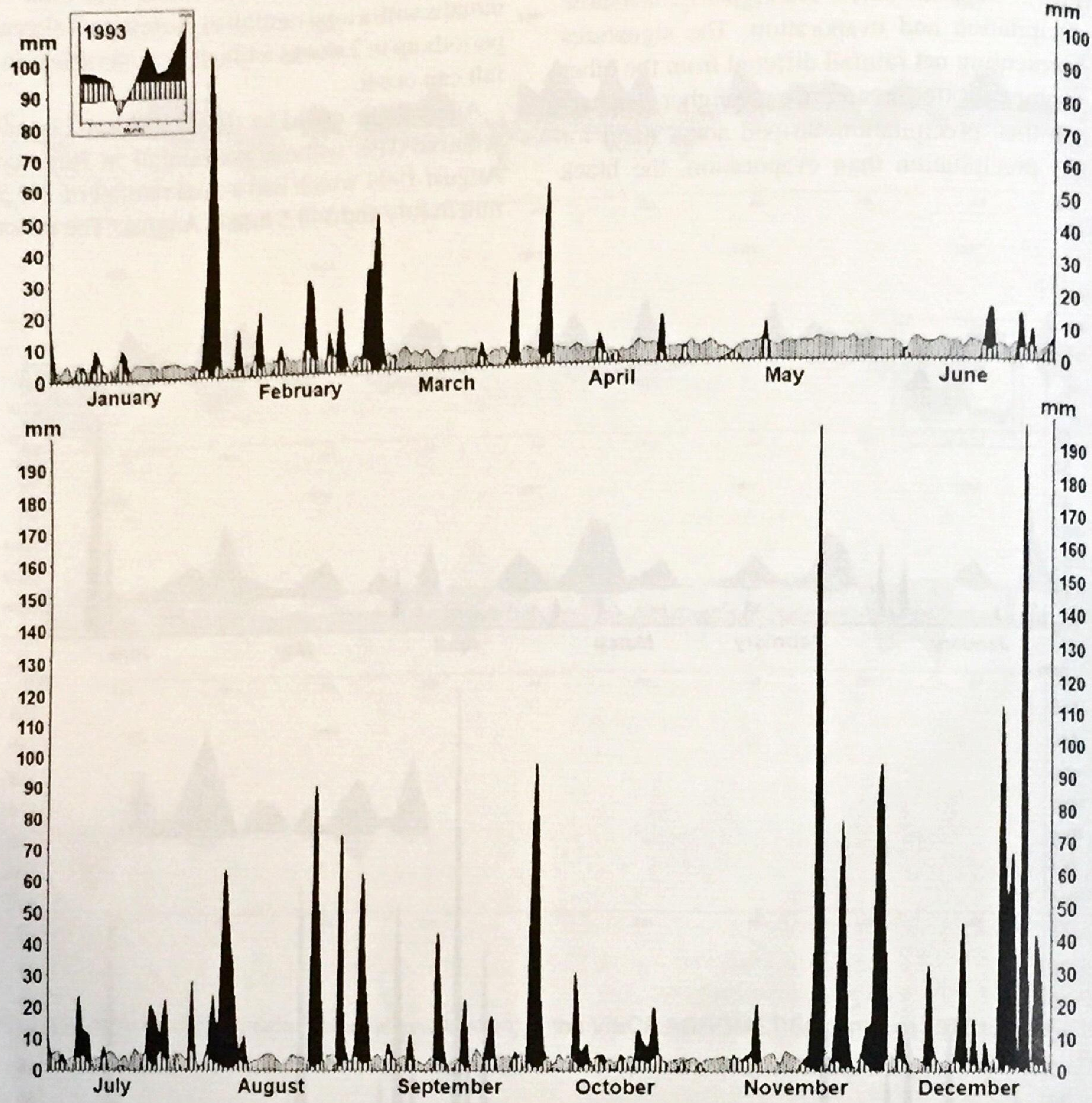

Figure 6. Daily climatic data for 1993.

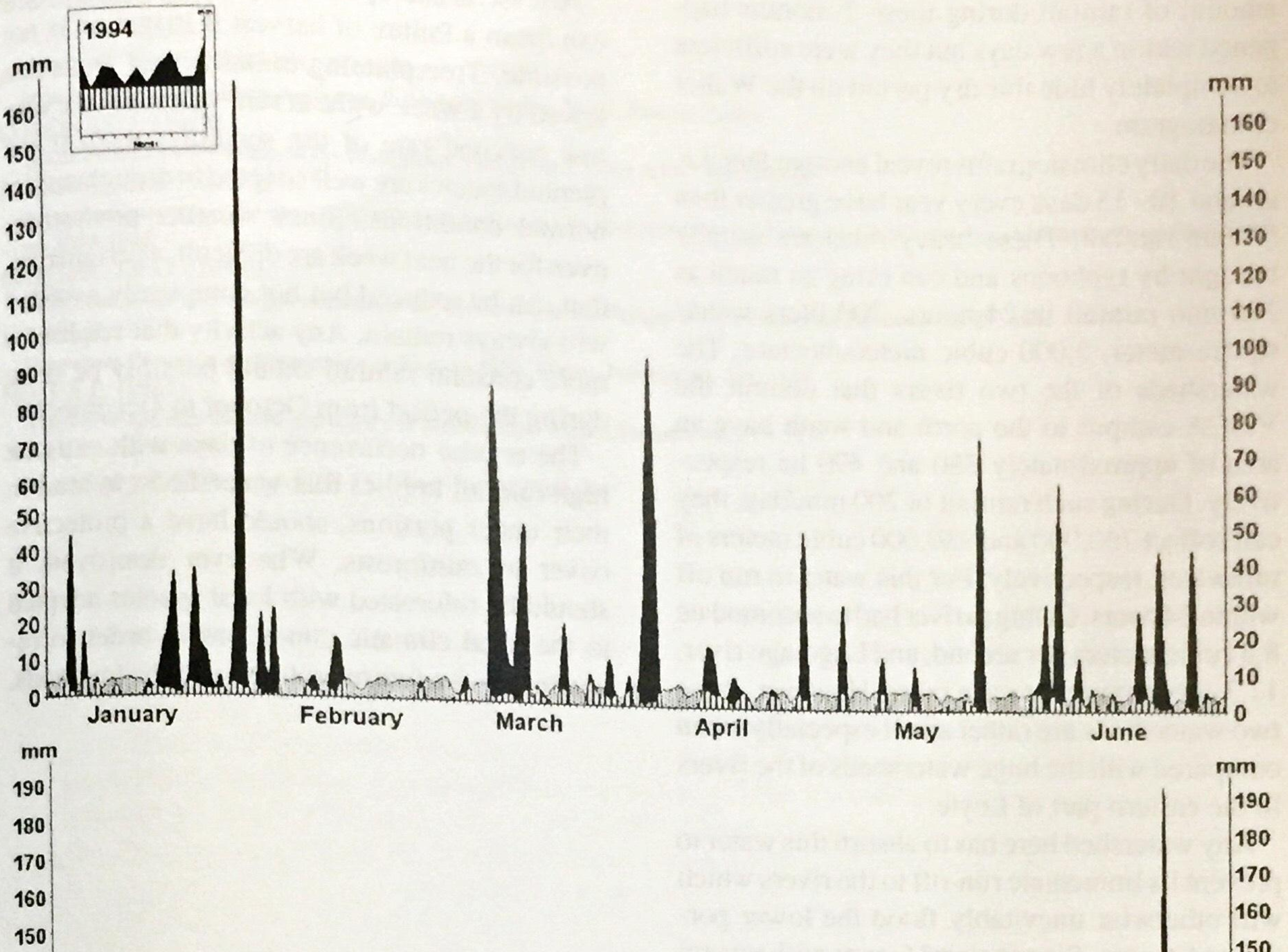

Figure 7. Daily climatic data for 1994.

amount of rainfall during these 2 months happened within a few days but they were sufficient to completely hide this dry period on the Walter climatogram.

The daily climatograms reveal another fact, i.e. around 10 - 15 days every year have greater than 50 mm rainfall. These heavy rains are usually brought by typhoons and can bring as much as 200 mm rainfall in 24 hours, 200 liters water/square-meter, 2,000 cubic meters/hectare. The watersheds of the two rivers that delimit the ViSCA campus to the north and south have an area of approximately 380 and 490 ha respectively. During such rainfall of 200 mm/day, they can collect 760,000 and 980,000 cubic meters of rainwater, respectively. For this water to run off within 24 hours, Calbigaa river had to accomodate 8.8 cubic meters per second, and Lagolago river, 11.3 cubic meters or even more. However, these two watersheds are rather small especially when compared with the huge watersheds of the rivers in the eastern part of Leyte.

Any watershed here has to absorb this water to prevent its immediate run-off to the rivers which will otherwise unevitably flood the lower portions of its area. Since natural forests with several stories already catch a large amount of water within their physical structure, they are best suited to protect the lower parts of the watersheds from destructive floods. Existing tree plantations containing only even-aged trees, thus having less physical structure, do not equally well serve this purpose. Grasslands and bare soil surfaces are the worst.

Conclusions

The fact, that in spite of around 2600 mm of annual precipitation, that - statistically - is distributed equally throughout the year, droughts can be a common feature, is somewhat astonishing. It has important implications on all activities dealing with agriculture and forestry.

At least for susceptible crops 2 weeks of drought can mean a failure of harvest if irrigation is not possible. Tree planting in deforested areas followed by a week without rain will lead to a very low survival rate of the seedlings even if the planted species are well adapted to drought under normal conditions. Since weather predictions even for the next week are difficult, a certain risk, that can be reduced but not completely avoided will always remain. Any activity that requires a more constant rainfall should possibly be done during the period from October to December.

The regular occurrence of days with extreme high rainfall implies that watersheds, at least in their upper portions, should have a protective cover of rainforests. Whenever destroyed, it should be reforested with local species adapted to the local climatic conditions in order to recreate this as a future protection of the lowlands.

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