BULL. BOT. SURV. INDIA
Vol. 4, Nos. 1-4 : pp. 67-69, 1962

# MAPPING OF VEGETATION AND ENVIRONMENTAL CONDITIONS

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## ABSTRACT

There are various methods of vegetation mapping which depend upon the scale of the work and the facts to be shown. Professor H. GAUSSEN's method has proved as successful in Tropical India as in temperate and mediterranean regions. It aims at representing the vegetation types at medium and small scales.

(1) The basic principle is the use of colours of an ecological value. Among the factors of the environment, only those which play a part in the water equilibrium of the vegetation will be shown and the combination of their colours will become representative of the ecology.

High temperature and long dry period will increase the evaporation. Rainfall and relative humidity will be favourable to the plant growth. Then a conventional, but natural choice of blue and violet shades for humidity, and on the other hand, red or yellow shades for heat and drought will provide all the coloration possibilities.

Six classes are defined for Temperature, Rainfall and Xerothermic index (length and intensity of the dry season). Each class has its conventional shade. In any place the climate is easily summarised into an ecological formula[1] which will include for more precision the light factor, the vegetative period and the soil factor.

Soil factor is taken into account :

—either by its effect on the water balance. The colour is shaded accordingly, for instance, the mangrove, the vegetation of saline soils ;

—or by its limiting effect on the floristic composition of the vegetation types. For example, the lateritic caps. These features are shown by the superimposition of a symbol.

(2) Another originality of the method is the representation of "Series of Vegetation". Various physiognomic stages of degradation of the same series are shown by means of lines, stripplings etc. But the same colour, representative of the general ecology of one series is used for all its serial stages.

Floristic relevés are made in the field. Their comparison brings out the relationship between the successive stages of the series and leads to the most developed type possible under the present ecological conditions. This maximum stage, the least disturbed by biotic factors, is the "plesioclimax". It is the maximum vegetation to be expected under present conditions if human interference is excluded. Its characteristic and dominant species are used to name the series.

The plesioclimax helps to appreciate the ecological potentiality of the place and therefore will be of some guidance for the introduction of new species.

Since similar colours are used for similar climates in the world, the colours show homo-bioclimates under which grow similar vegetation types even if their floristic composition is different.

Several examples are taken from vegetation maps of Tunisia, Algeria, and South India.

There are several methods of vegetation mapping depending upon the scale of the work and the facts to be shown. In the present work, an account is given of Professor H. GAUSSEN's method of representing the vegetation types as well as the environmental conditions on medium and small scale maps.

(1°)—The first aspect of the environmental factors that may be developed here is that of the *ombrothermic diagrams*. The method of the ombrothermic diagrams expresses in a clear way the bioclimatic conditions.

The principle underlying these diagrams is that a month is considered as dry when its precipitation expressed in millimetres is less than twice its mean temperature expressed in degree centigrade.

The diagram is drawn in the following manner:

On a graph are shown a curve of mean monthly temperature, called the *thermic curve*, and a curve of the monthly precipitation, called the *ombric curve*.

The scale used for ombric curve (in mm.) is double of that used for the thermic curve. The curve of precipitation is presented in continuous line, that of temperature in broken. Drought occurs when the ombric curve passes under the thermic curve. The area included between the

[1] See Dr. MEHER-HOMJI's paper on "The bioclimates of India in relation to the vegetational criteria".

crossing points of the two curves gives an idea of the importance of the dry period.

A transect passing from the West coast to East coast of South India, through the 10th and 11th parallels, reveals several types of ombrothermic diagrams.

The following stations may be considered along the transect:

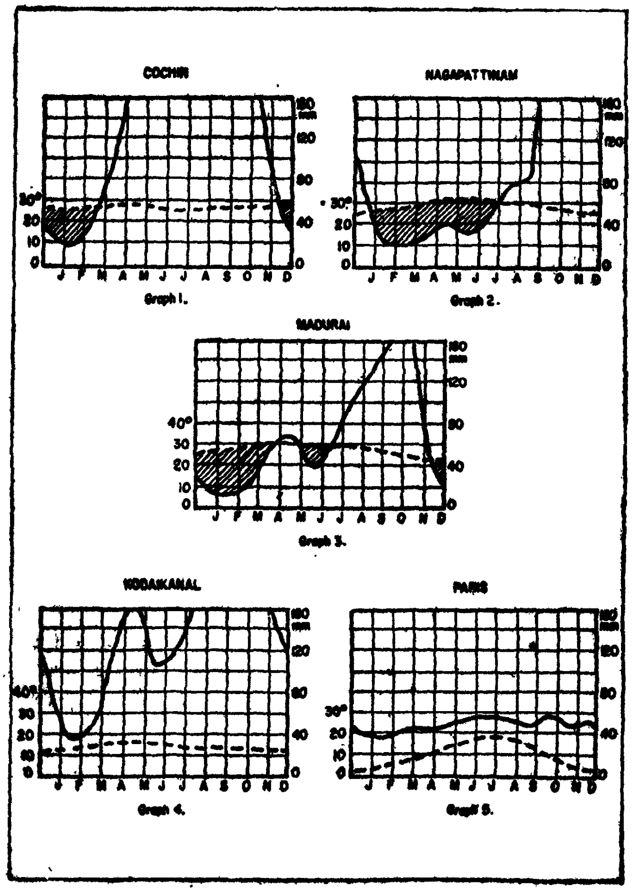
—Cochin on the West coast.

—Kodaikanal on the Palni range at an altitude of 2,328 m.

—Madurai in the plains on the leeward side of the Western Ghâts.

—Nagapattinam on the East coast.

The ombrothermic diagram of Cochin (Graph 1) reveals a typical tropical climate with summer rains during the South-West monsoon. On the other hand, Nagapattinam on the East coast shows a different pattern (Graph 2). Being affected both by the advancing and retreating South-West monsoons, its ombrothermic diagram shows a rainy period during August to January; the drought occurs during the spring and early summer. The regime of rainfall may be called "tropical dissymetric".



Madurai which is situated further inland shows a short wet period interrupting the dry season in May. The regime is termed bixeric (See Graph 3).

Kodaikanal which is a hill-station on the Western Ghâts, presents an ombrothermic diagram (Graph. 4) that is typical of the *tropical mountain climate.* There is no dry period as the precipitation curve remains above the temperature curve. The mean temperature of the coldest months December, January is 12.4°C and this is why some phytogeographers have considered Kodaikanal as having temperate climate. Here we would like to point out that this is not the case, firstly because the light conditions and photoperiods are different for a true temperate climate and a tropical mountain climate like that of Kodaikanal. Whereas in the former the seasonal variation in the hours of day-length is very pronounced, this variation does not exist for the mountain climates of tropics situated at a latitude of 10 to 15°. The second feature of contrast between the two types of climates is the seasonal variation of temperature under the temperate clime. The ombrothermic diagram of Paris, a characterist temperate type of station, in Graph. 5 shows that the mean temperature of the coldest month January is 2.5°C and that of the hottest month July is 18°; thus, the difference comes to 15.5°C. Under tropical mountain conditions as exemplified by Kodaikanal, such an annual range of temperature is slight, only 4.4°C, but the variations in the night and day temperature are striking.

CHAMPION (1936) has classed the vegetation of Kodaikanal as of wet temperate type. Here we would like to draw attention to the fact that the forest-type of this region which is known by the name of "Shola" has very little in common with the summer-green deciduous and the coniferous-forests of the temperate countries. Besides, in the Sholas, the tropical stock is predominating floristically. Therefore, the exact term for this vegetation would be a "tropical montane forest".

Similarly, the grassland-vegetation of the higher altitudes of the Western Ghâts that is generally described as "alpine" is not at all so. These grasslands are of a biotic origin and there is not the least of resemblance with either the climate, the vegetation or the flora of the Alpine zones which are characterised by very low temperatures, important snowfalls and marked seasonal variation in photoperiod.

Again, the middle zone of vegetation of the Palni range, between the plains bearing a scrub and the "Shola" above 1500 m, is classed as sub-tropical. In our opinion, this vegetation is clearly of tropical type, climatically, floristically and physiognomically.

Therefore, the method of ombrothermic diagrams permits us to delineate the different bioclimatic zones with their characteristic plant-formations.

(2°)—The second aspect of the environmental factors is expressed by the ecological formulae.

Among the ecological factors only those which play a part in the water balance of vegetation are considered. Each ecological factor is represented by a colour; accordingly, a combination of several colours represents the ecology of a particular place.

High temperature and long dry period increase the evaporation. On the other hand, rainfall and relative humidity favour the growth of plants. Therefore, a conventional, but natural choice of blue or violet shades for humidity and red or yellow shades for heat and drought provides the possibilities of colouring.

Six classes are defined for the temperature, rainfall and xerothermic index which is a measure of length and intensity of dry period.[1]

The factor of temperature has been designated by the letter *t* and has been divided into six classes as shown below; each class is given a conventional colour.

| | | |
|---|---|---|
| $t_1$ : | $M$[2] $< +10°C$ | Dark grey dots |
| $t_2$ : | $\begin{bmatrix} M > +10° \\ m < -5° \end{bmatrix}$ | Light grey |
| $t_3$ : | $-5° < m < +10°$ | White |
| $t_4$ : | $10° < m < 20°$ | Gold yellow |
| $t_5$ : | $\begin{bmatrix} m > 20° \\ \text{yearly average} < 30° \end{bmatrix}$ | Orange brown |
| $t_6$ : | yearly average $>$ 30° | Orange red brown |

The divisions proposed for rainfall (S) are:

| | | |
|---|---|---|
| $S_1$ : | Precipitation (P) $>$ 2000 mm | Dark violet |
| $S_2$ : | 2000 $>$ P $>$ 1500 mm | Blue violet |
| $S_3$ : | 1500 $>$ P $>$ 1000 mm | Light blue |
| $S_4$ : | 1000 $>$ P $>$ 500 mm | White |
| $S_5$ : | 500 $>$ P $>$ 100 mm | Sulphur yellow |
| $S_6$ : | P $<$ 100 mm | Orange yellow |

The factor of xerothermic index (x) is also divided into six classes:

| | |
|---|---|
| $x_1$ : | 0- 40 physiologically dry days in the year |
| $x_2$ : | 40-100 ,, ,, ,, ,, ,, ,, |
| $x_3$ : | 100-160 ,, ,, ,, ,, ,, ,, |
| $x_4$ : | 160-230 ,, ,, ,, ,, ,, ,, |
| $x_5$ : | 230-280 ,, ,, ,, ,, ,, ,, |
| $x_6$ : | 280-365 ,, ,, ,, ,, ,, ,, |

This factor is represented by triangles of varying dimensions and densities.

Besides the above three principal factors, others like the length of vegetative period, light factor and soil factor are also considered. Therefore, the climate of a place may be expressed by means of an ecological formula.[3]

Soil factor is expressed in two ways:

— either by its effect on the water balance. To represent the vegetation of physiologically dry habitats like the saline soils, an additional orange tint is superimposed on the colour given by the climate to show the special edaphically dry condition.

— or by its limiting effect on the floristic composition of the vegetation type; for example, the lateritic caps. Such features are represented by means of symbols.

(3°)—Another originality of the method is the representation of "Series of vegetation". Various physiognomic stages arising out of degradation of one and the same series of vegetation are shown by different symbols such as gridding, hachures, stippling etc. However, the colour used for all the serial stages is the one that is representative of the general ecology of the series.

Floristic relevés are made in the field. A comparison of the these relevés brings out the relationship between the successive stages of the series and shows the most developed type possible under the present ecological conditions. This maximum stage, the least disturbed by biotic factors, is the "plésioclimax". It is the maximum vegetation to be expected under present conditions if human interference is excluded. The characteristic and the dominant species of this maximum vegetation type are used to name the series.

The concept of plésioclimax enables one to appreciate the ecological potentiality of a place and therefore it can provide useful information for the introduction of new species.

Since similar colours are used to represent similar climates throughout the world, the colours point out homo-bioclimates under which grow similar vegetation types, even though floristically they may be different.

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[1] Cf.: LEGRIS, P. and VIART, M. (1959). Study of xerothermic index in India, Burma, Pakistan and Ceylon. *Trav. Sect. Sci. and Tech. Inst. Fr. Pondichéry t. I., fasc. 4*, pp. 181-96.

[2] M = Mean temperature of the hottest month of the year.
m = Mean temperature of the coldest month of the year.

[3] Cf.: MEHER-HOMJI, V. M. (1962). Bioclimates of India in relation to their vegetational criteria. Symposium on "Taxonomy and Floristics of Indian Plants". Summer School in Botany. Kodaikanal.