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AGRO-CLIMATIC CLASSIFICATIONS OF MAHARASHTRA

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ABSTRACT : This paper deals with delineation of Maharashtra into different agroclimatic zones based on climate, soil and topographic factors of the region. The classifications given by Daji, Maharashtra State Department of Agriculture, Thornthwaite, Murthy and Pandey, Panabokke and Subramaniam *et al*, are used for demarcation of the zones in the State. A similarity in the cropping pattern and agricultural practices are suggested within each of the identified agroclimatic zones in the State.

INTRODUCTION

The soil and climate predominantly influence the distribution of crops, their production and seasons of cropping. Therefore, any classification for identifying agroclimatic zones of a region should be based on these two factors. Such identified agroclimatic zones can be used in planning for transfer of agro technology and improved cropping pattern. In the present paper, an attempt is being made to demarcate Maharashtra into different agroclimatic zones and salient results obtained are presented.

AGROCLIMATIC CLASSIFICATIONS

The classifications given by Daji, Maharashtra State Department of Agriculture, Thornthwaite, Murthy and Pandey, Panabokke and Subramaniam *et al* are applied for Maharashtra to demarcate the State into different zones and discussed in the following.

a) Daji

Daji (1955) summarized the climate of the former Bombay State describing all the principal climatic factors such as rainfall, temperature, humidity, evaporation and also the soil factors. He attempted to classify the zones based on certain ratios such as rainfall/ temperature, rainfall/saturation deficit of air, rainfall/evaporation and Thornthwaite's (1948) indices for precipitation and temperature efficiency. However, the approach does not consider the soil moisture and its effective seasonal variations which is an important factor for plant growth in this tropical region.

b) Department of Agriculture

The Department of Agriculture, Maharashtra (Vaidya and Sahasrabuddhe, 1973; Raman, 1974; Kumbhare, 1978) has divided the State into nine agroclimatic regions based on rainfall and type of soil,

TABLE I : CHARACTERISTIC FEATURES OF DIFFERENT AGRO-CLIMATIC ZONES OF MAHARASHTRA

(Vaidya and Sahasrabudhe, 1973)

Title of the Zone	Rainfall (mm)	Altitude above m.s.l. (m)	Soils	Major Natural Vegetation	Predominant Cropping
i) Very high rainfall zone	More than 2500	Variable	Laterites and lateritics	Moist deciduous forest and the tree savanna (Tectona Lagerstrocmia Terminalia series) with shifting cultivation	Paddy in Plains, Millets in high lands; Fruit farming also carried out
ii) Very high rainfall zone	More than 2000	Variable but mostly less than 300	Non-lateritic loams of brown to red colour formed from trap rock	Moist deciduous open forest with shrub savanna (Tectona Terminalia - Adina - Anogeissus series	- do -
iii) Ghat Zone	More than 3500 with still higher rain at spot places	Between 1000 towards west to 600 towards eastern side	Mostly forest land and *varkas* soils	Deciduous to semi-deciduous forest Memecylon - Syzygium Actinodaphne series)	Hill Millets
iv) Transition-I with red to reddish brown soils	2500 to 1750	Less than 600	Mainly red to brown soils with varying depths and textures	Tree and shurb savanna (Anogeissus - Terminalia, Tectona series	Paddy, Bajra, Jowar and groundnuts
v) Transition-2 with greyish black soils	1750 to 700	Less than 600	Predominantly greyish black soils of varying texture	Shrub and low scattered savanna (Acacia and Anogeissus series)	Kharif crops like bajra, groundnut, cotton, jowar, paddy etc.
vi) Scarcity zone	500 to 750	Less than 600	Medium black soils with varying depths and textures	Low scattered shrubs with discontinuous thorny thickets, (Abizzia Amara and Acacia series)	Millets
vii) Assured rainfall zone with mainly kharif cropping	700 to 90	Less than 500	- do -	Low scattered shrubs and pseudo stoops (Acacia and Anogeissus series)	Jowar, Pulses, cotton and groundnut
viii) Moderate to moderately high rainfall zone	900 to 1250	Less than 600	Brown to dark Calcareous soils formed from trap with varying depths from moderate to deep	Low scattered shrubs savanna with discontinuous thickets (Anogeissus - Terminalia, Tectona series)	Kharif crops of all types and rabi crops on heavier and deeper soils
ix) High rainfall zone with soils formed from mixed rocks	More than 1250	Less than 600	Yellowish brown to red soil of mixed percentage	Deciduous Open forests with thickets	Kharif crops - paddy-

topography, cropping pattern and vegetation (Fig. 1). The agroclimatic zones thus classified represent all climatic, soil and topographic factors. The rainfall range, height above mean sea level and type of soil, natural vegetation and principal crops in each of the nine agroclimatic regions are given in Table 1. The scheme is still inadequate for not taking the distribution of rainfall, water need of the place while classifying the zones.

c) Thornthwaite

Subrahmanyam (1956) and Subrahmanyam *et al* (1965) have classified the climates of India according to the rational scheme of Thornthwaite (1948) which is based on parameters like potential evapotranspiration, water surplus and water deficiey which are again computed by a budgeting procedure evolved by Thornthwaite himself. Due to imbalance in the distribution of rainfall, a region may experience water surplus in one season and deficiency in another season and therefore Thornthwaite proposed a moisture index for accounting the seasonal variation of effective moisture for plant growth. His classification also takes into account an index for thermal efficiency to express plant growth and development. Thornthwaite's thermal index is based on potential evapotranspiration (PE) values derived from temperature and length of day.

Using the information on potential evapotranspiration computed according to Penman's approach and rainfall, the water balances have been computed (Sambasiva Rao, 1983) at 38 locations in the State according to the budgeting procedure given by Thornthwaite and Mather (1957) and identified the climatic types. The moisture and thermal climates are shown in Figs. 2 & 3. The climatic types according to the moisture regime varies from perhumid to arid type. A sizeable portion of Madhya Maharashtra and Marathwada region is under semiarid climate. The humid and perhumid climates occur in the Konkan coast and dry sub-humid climate in Vidarbha region. The map of the thermal regime of climates shows that almost entire State has megathermal (A) type of climate having different degrees (A',-A'6) of thermal efficiency on annual basis. The summer concentrations (the ratio of total PE of three consecutive summer months to the annual PE expressed in percentage) of thermal efficiency are also of the megathermal type. The subtypes extend from A' to A' with A' occupying largest percentage of the area in Madhya Maharashtra and A' the least area in the Konkan.

The validity of any scheme of climatic classification depends on the extent to which it can explain the distribution of natural vegetation in the region (Subrahmanyam, 1958). The main factors which define the natural vegetation are climatic, edaphic and biotic and it is shown by Subrahmanyam (1958) that the thermal efficiency over India is more than adequate to support the most luxuriant type of vegetation in the region.

The indices of humidity and aridity at some stations and the corresponding vegetation types of the State are studied by Subramaniam and Rao (1979). Tropical wet evergreen forests requiring high temperatures and much water are found in Sawantwadi (Ratnagiri district) where per-humid climates prevail. The narrow belts of tropical semi-evergreen, moist deciduous and tropical dry deciduous forest of the State coincides with their varying degrees of humidity at these places. Tropical thorn forest type is found in the semi-arid regions of the State.

The regional application of Thornthwaite's scheme in the present study using PE estimations from Penman's formulation has brought out the following two additional features: (i) the major moisture climates remaining the same a few arid zone

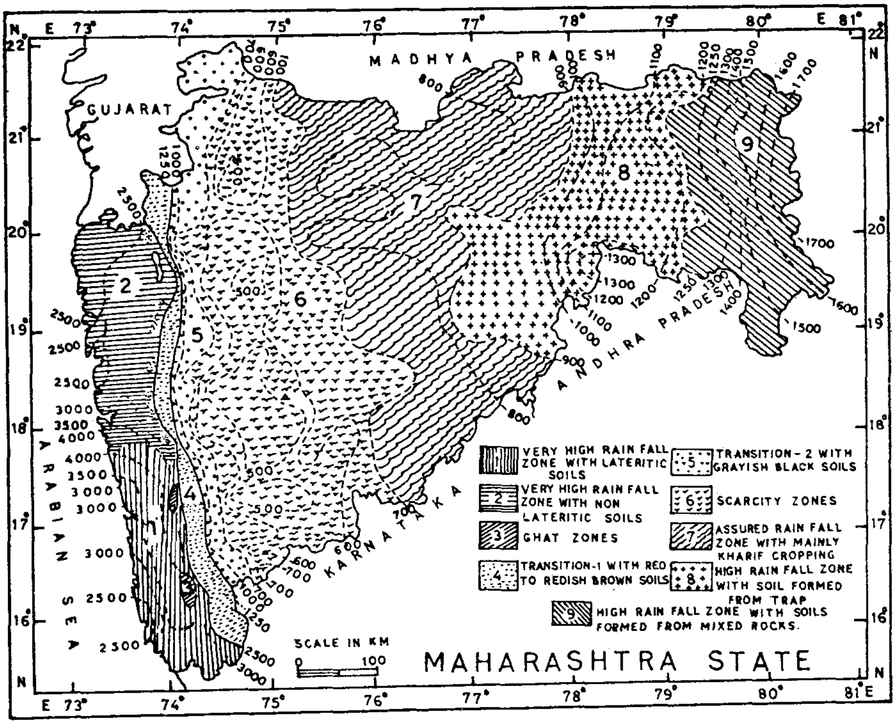

FIG.1. AGRO CLIMATIC ZONES

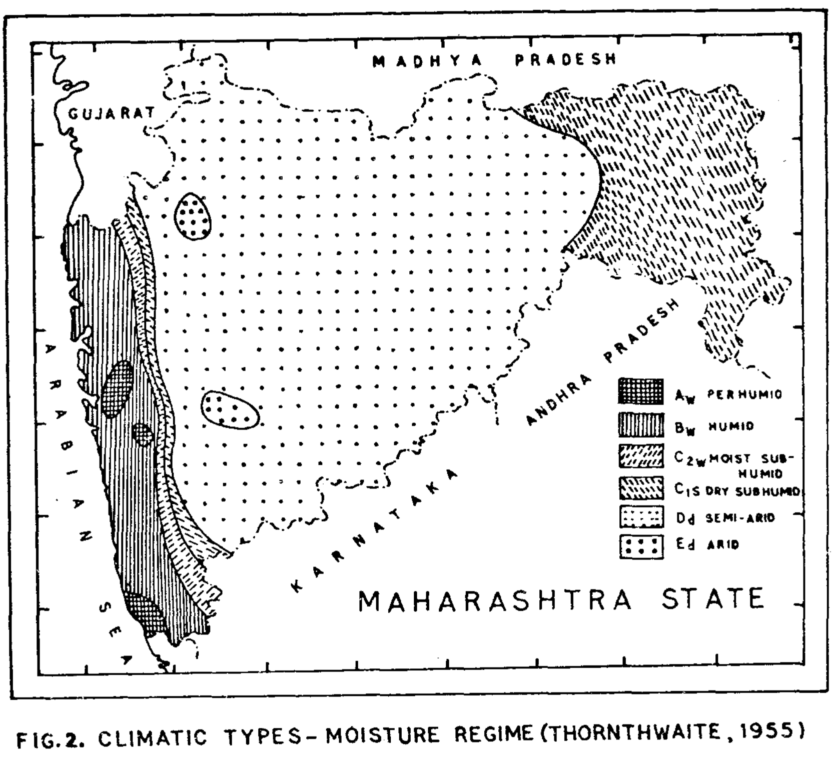

FIG.2. CLIMATIC TYPES- MOISTURE REGIME (THORNTHWAITE, 1955)

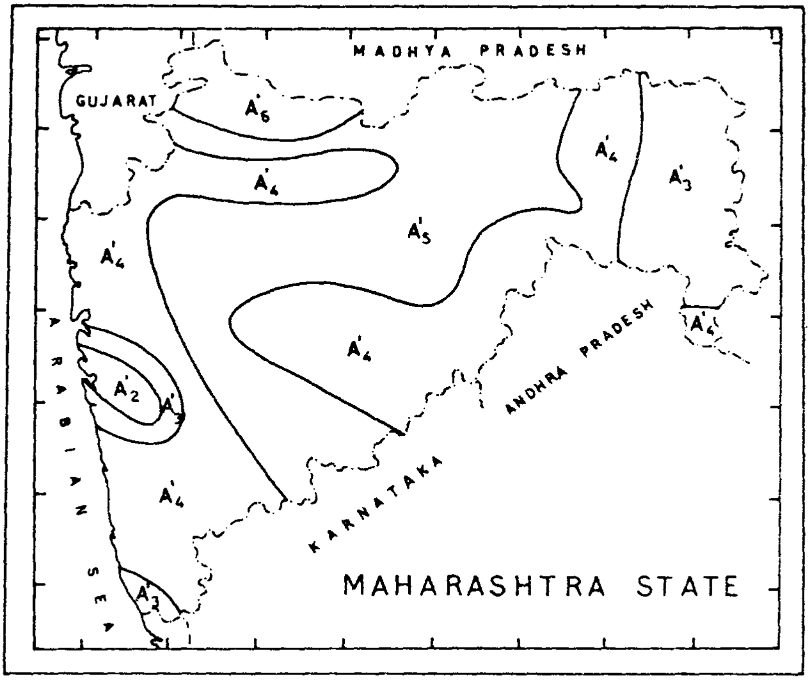

FIG.3. CLIMATIC TYPES - THERMAL REGIME (THORNTHWAITE, 1955)

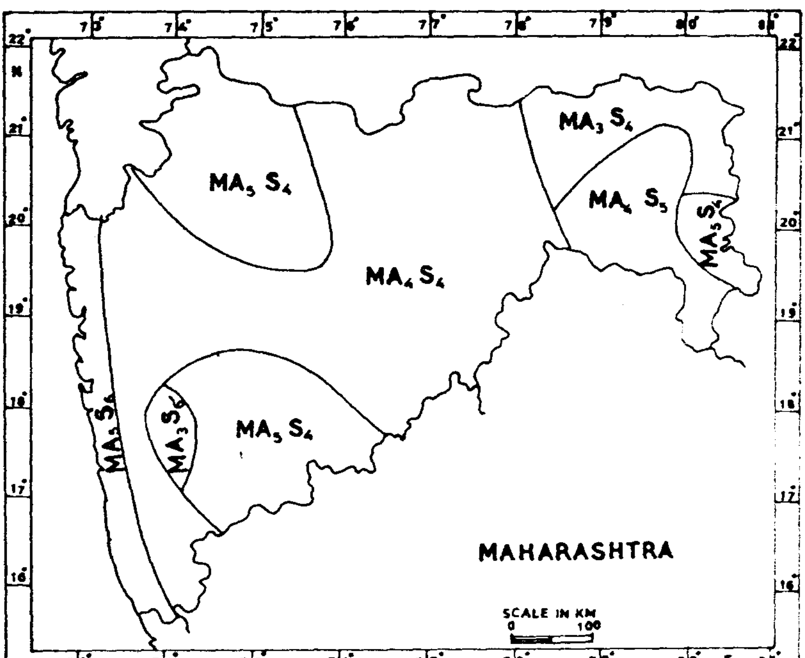

FIG.4. AGRO-ECOLOGICAL ZONES (SUBRAMANIAM)

pockets are identified in the State; and (ii) the main thermal climate viz., the megathermal type being the same, the subtypes of the thermal climates are shifted to higher side which may be due to higher PE estimates obtained from Penman's formulation. However, the Thornthwaite's approach to climatic classification is both objective and rational. It is based on moisture as well as on thermal factors with soil playing a major role in retention and release of moisture to meet continuous atmospheric demand.

d) Murthy and Pandey

Murthy and Pandey (1978) delineated India into eight agro-ecological regions by analysing the individual attributes viz., physiographic, climatic, soil, crop and agricultural regions. Their classification identifies the entire State into a single agro-ecological zone viz., semiarid lava plateau and central highlands. They intended that their classification will be useful for planning certain educational and agricultural research programmes. Since the rainfall varies from 550-2500 mm in the State, their approach which has classified the entire region into a single zone will not be useful for agricultural planning.

e) Panabokke, Subramaniam *et al*

According to Panabokke (1979) an a agro-ecological zone is a major area of land that is broadly homogeneous in respect of its rainfall regime and is made up a grouping of soils that reflect broad similarities in respect of soil profile development. The rainfall regimes are divided according to the annual sequential rainfall patterns that are broadly similar, both in respect of their seasonalities and amounts and that could be grouped into agronomically significant categories. The soil regions were demarcated on a set of overlays at the same scale and these were then superposed on the rainfall regime maps. The resultant agro-ecological zones were identified and demarcated. According to this classification the State can be delineated into four agro-ecological zones.

Since rainfall alone never reflects the moisture status of a region Subramaniam *et al* (1982) suggested the agro-ecological zoning using moisture adequacy index which is the ratio of actual evapotranspiration (AE) to the potential evapotranspiration (PE). The AE and PE values are obtained from the budgeting procedure given by Thornthwaite and Mather (1957). According to the classification, there are six major agro-ecological zones (Fig. 4) in the State. These are MA_3S_4, MA_3S_6, MA_4S_4, MA_4S_5, MA_5S_4 and MA_5S_6.

where MA_3 sufficient moisture adequacy during the main cropping season followed by a well expressed dry season of at least two consecutive dry months

MA_4 Moderate degree of variability of moisture adequacy between years but usually sufficient moisture adequacy within the main cropping seasons followed by a well expressed dry season of at least three consecutive dry months

MA_5 Moderate to high degree of variability of moisture adequacy between years as well as within the main cropping seasons followed by a well expressed dry season of at least three consecutive dry months

and S_4, S_5 and S_6 refers to the soil zones of vertisols, alfisols and ultisols and oxisols.

According to their classification, the

following agronomic groupings could be made

Group A Mainly moisture demanding perennial tree crops (banana, coconut, cashew, arecanut, jack, sapota, pineapple, etc.) $MA_3\ S_4$, $MA_3\ S_6$, $MA_4\ S_1$ (S_1 refers to Entisols)

GROUP B Mainly rainfed dry crops with moderate drought stress (bajra, jowar, ragi, cotton etc.) $MA_4\ S_4$, $MA_4\ S_5$, $MA_4\ S_6$, $MA_5\ S_4$, $MA_5\ S_5$, $MA_5\ S_6$

According to the above modified approach by Subramaniam *et al* (1982) the State falls into six zones whereas original Panabokke classification delineates into four zones. The approach suggested by Subramaniam *et al* (1982) will have greater role as the moisture factor and its distribution is a major ecological factor for plant growth in the tropical environmental conditions.

The above are some of the rational approaches that can be applied for agro-climatic zonation of a region. Regional planning, such as introduction of new crops, transfer of technology, educational developmental programmes, etc. can be taken up on agro-climatic zonal basis. Uniform cropping pattern and agricultural practices can be adopted within a given agro-climatic zone.

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