Trans. Inst. Indian Geographers
Vol. 8, No. 1 January 1986

CLIMATE AND LAND USE OF ANANTAPUR DISTRICT, ANDHRA PRADESH

B. Hema Malini, Waltair

ABSTRACT : Climate largely influences the agricultural land use of any region. Especially the 'Moisture regime' of an area, which can be analysed through water balance techniques, determines the cropping pattern of the area.

Water balance of Anantapur district indicate that most of the region is under arid climate. The very low soil moisture conditions of the region impose severe limitations on the choice of crops. Under such conditions, the region is suitable only to drought tolerant crops like millets, even if supplemental irrigation is provided.

INTRODUCTION

Ecosystem includes all living and non-living components which are in close mutual correlation. Significant changes in climate cause change in vegetation as well as agricultural patterns. Hence, the study of eco-climatic aspects of any region provides an elaborate knowledge of economic development.

The continuous flow of energy, water and the other nutrients across the ecosystem boundaries are considered to be inputs and outputs, which are transported by meteorologic, geologic and biologic factors. Among them, water is the most essential environmental factor, since it largely determines the existence, functioning and quality of ecosystems irrespective of their spatial dimensions. There should always exist a balance between the water availability and water need of a region for the prosperity of any segment of an ecosystem, especially that of plant life.

Thornthwaite (1948) put forwarded the concept of water balance to study hydrological conditions systematically, which was modified later in 1955. Water balance parameters include basic elements such as 'Precipitation' (P), Potential evapotranspiration (PE) and derived parameters like 'Actual evapotranspiration' (AE), 'Water deficiency' (WD) and 'Water surplus' (WS).

The indices of moisture effectivity namely Ia, Ih indicate the dryness or wetness of any region. Where P always equals PE and water is available for use just as needed, there is neither water deficiency nor excess. That means the climate of the region is neither wet or dry. As water deficiency becomes large with respect to water need, the climate becomes progressively drier or more arid. On the other hand, as water surplus (P > PE) increases, the climate becomes wetter or more humid. Knowing water deficiency and water surplus, 'Index of aridity' (i.e. ratio of water deficiency to water need) and 'Index of humidity' (ratio of water surplus to water need) can be calculated. The annual values of humidity and aridity indices help to derive the

'Moisture index' (Im = Ih – Ia), which enables to classify the climate of the region.

'Moisture regime' of climate is determined by moisture index. Positive values of moisture index indicate moist climates namely Perhumid (A), Humid (B) and Moist sub-humid (C_2), whereas negative values indicate dry climates namely, Dry sub-humid (C_1), Semi-arid (D) and Arid (E). Moisture index represents merely how humid or arid a given climate is, but cannot distinguish seasonal variation of effective moisture. To differentiate seasonal variations of humidity and/or aridity, Thornthwaite introduced "s" and "w" to indicate water deficiency in summer and winter, respectively, while the letters 'r' and 'd' are used to indicate little or no water deficiency in moist climates and with little or no water surplus in dry climates, respectively.

'Thermal regime' of Thornthwaite is based on potential evapotranspiration which is an index of Thermal efficiency for vegetation development. Based on annual values of PE which is also called as 'Thermal efficiency' (TE), major thermal provinces were defined. To indicate seasonal variation, he introduced summber concentration of Thermal efficiency (SCTE).

The concepts of water balance are useful in agricultural development of a region. Thornthwaite emphasised the importance of Potential evapotranspiration (PE, i.e., the amount of water that would evaporate and transpire if it were always readily available) and Actual evapotranspiration (AE, i.e., the actual amount of water that is available to meet the demands of both plant community and atmosphere), in ecoclimatic studies. The ratio of AE to PE, which is termed as Index of Moisture adequacy (I_{ma}), provides an objective indication of moisture status of the region in relation to its water need. High percentage values of the index indicate the rich moisture availability and how values signify the poor moisture availability for crop production. Subrahmanyam et al (1963) have observed that an I_{ma} value of not less than 40% is essential for successful crop culture in any region. They have also suggested different categories of I_{ma} values for specific crop culture.

The present paper deals with the water balance conditions and agricultural suitability of Anantapur district.

STUDY AREA

Anantapur district is situated in the westernmost part of Andhra Pradesh between 13°41′ and 15°14′N. latitudes and 76°47′ and 78°26′E. longitudes. It is in the rainshadow zone of Rayalaseema lying east of the Western Ghats. Red soils are predominant in the district covering about 82% of the area, while black soils cover the rest of the district.

METHODS OF STUDY

For the present study, data on rainfall were collected from the records of 17 rainguage stations in Anantapur district over a period of 39 years (1947-1985). Data on temperature during the same period of Anantapur were collected from the records of IMD. Since, temperature data of the other stations were not available, those were obtained by interpolation.

All the water balance parameters are worked out for all the 17 stations using Thornthwaite's (1955) scheme.

Map showing the existing irrigation and land use patterns are traced out from the International maps of vegetation of French Institute of Pondicherry (1962-65). It is correlated with the moisture adequacy indices to understand the climatic control on the distribution of vegetation and land use.

WATER BALANCE

Water balances of Anantapur district are shown in Fig. 1A. Though water balances of all the stations of the district have been worked out, diagrams were given only for a few representative stations. At all the stations, water need (PE) values are high and range between 1590 mm and 1832 mm while water supply (P) values range between 439 mm and 649 mm only. Though P exceeds PE at the stations namely Penukonda and Bukkapatnam for just one month during the southwest monsoon season, the excess has no significance to improve the poor water balance conditions. Hence, the soils throughout the district remain always at or near wilting point under acute dryness.

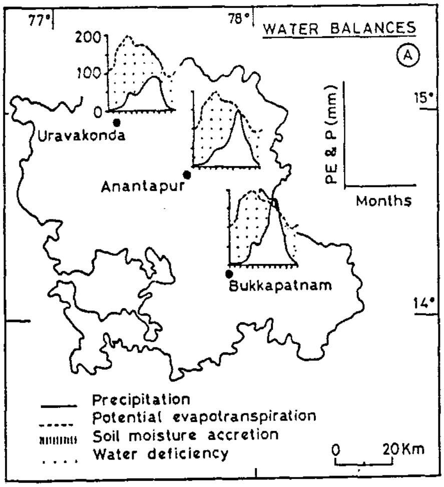

Fig. 1a

CLIMATIC CLASSIFICATION AND VEGETATION TYPES

Based on Thornthwaite's Thermal regime, the entire area comes under Megathermal Climate (A'_4) where Thermal efficiency values are more than 1710 mm. According to the Thermal regime, Megathermal climates support a luxuriant growth of vegetation. Hence thermal potential is enormous in the district.

But, when Carter and Mather's (1966) climatic classification (Moisture regime) is employed, the north and northwestern portion of the district comes under arid (E_1d) climate with I_m values ranging between –66.8 to –74.4, whereas the eastern and southern portions in general are under the influence of Semi-arid (D_3d) type of climate with I_m values between –63.1 and –63.9. The classification reveals that the aridity increases towards north and northwestern parts of the district, while the rest of the area exihibits less tendency towards aridity since it receives a slightly more rainfall than its northern counterpart.

According to the moisture regime concept of Thornthwaite, arid climate supports only thorny type of vegetation (Fig. 1B). Though, it may be recalled, the TE of Anantapur district is favourable for the growth of luxuriant vegetation, the moisture regime of the region, being semiarid, does not support thick vegetal growth. This explains the presence of only thorny bushes in vast stretches of uncultivated land in the district. The map (Fig. 1C) shows the dominance of vegetation types like Phoenix, Hardwikia, Anogeissus, Albizzia amara and Accacia species, indicating the typical nature of the arid climate.

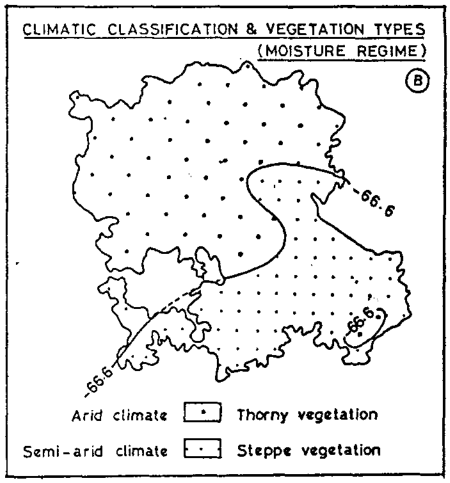

Fig. 1b.

LAND USE

The moisture adequacy indices are above 40% in the extreme southern parts while in the rest of the district, they are below 40% (Fig. 1C). According to the concept of moisture adequacy, when the I_{ma} values are between 60–100% the cultivation of paddy can be recommended even in the absence of supplemental irrigation. It is rather uneconomical to cultivate paddy where I_{ma} values are less than 60%. Millets can be grown successfully in the area having 40–60% of I_{ma}. Areas with 20–40% I_{ma}

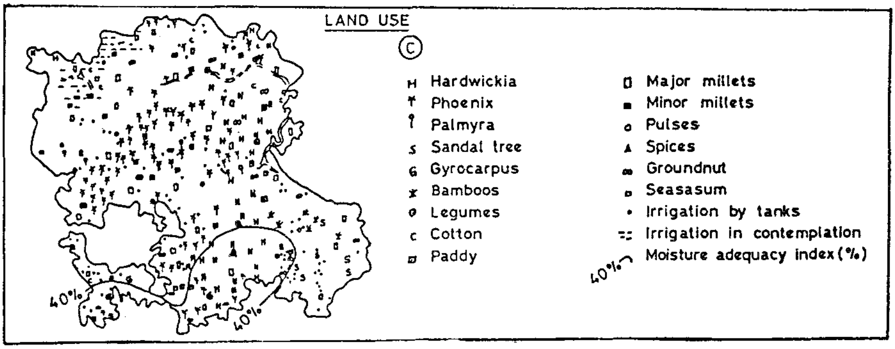

Fig. 1c

values are suitable only for drought resistant crops, whereas the areas with less than 20% of I_{ma} are unsuitable for cultivation. Based on the above concept, Anantapur district, having less than 40% of I_{ma} values is suitable to millets and other drought resistant crops only. The land use map (Fig. 1C) of the district clearly shows the dominance of millets and groundnut crops in the region. However, paddy cultivation is seen in the eastern and the northern parts of the district, where canal irrigation from the tributaries of Chitravathi and Vedavathi rivers is available. The groundwater potential of the district is very poor and highly variable. Moreover, the soils, being light and having low moisture retaining capacities, are unable to recharge the groundwater during rainy season. Spring channels which are an important feature of the irrigation pattern of the district, are found mostly in Anantapur, Kalyandrug, Dharmavaram and Kadiri taluks. But they irrigate only smaller areas. The striking contribution made towards irrigation in the district is by wells. The total wells used for irrigation in the district are 58,483. But their yield is not much due to poor groundwater potential of the region. On the whole, irrigation potential of the region is not sound. Hence, there is little scope to develop the irrigation facilities in the district. Under these circumstances, paddy cultivation is uneconomical there because the water required for the production of a unit of rice is more when compared to the production of other crops.

CONCLUSIONS

Studies on climatic water balance reveal that water deficient conditions prevail throughout the year in Anantapur district, mainly due to inadequate rainfall.

Though the thermal efficiency of the region is favourable for thick vegetal growth, the moisture regime of the district, being semi-arid to arid type, sets severe limitations on vegetation pattern and is favourable only to thorny type of vegetation.

The present land use also reflects the limitations set by the climate and poor irrigation potential of the retion. Under the circumstances, it appears that even in those parts of the district, where supplemental irrigation is available, it is advisable to grow millets and other drought tolerant crops, instead of crops like paddy which require more quantity of water. If, for example, paddy is grown, the quantity of water that goes to atmosphere through evaporation due to high temperatures and wind velocities are more than the quantity of water utilized by the crop, resulting in a wastage of precious water for the production of a unit of rice.

ACKNOWLEDGEMENTS

The author is grateful to the University Grants Commission for the award of Research Associateship.

REFERENCES

Carter, D. B., and Mather, J. R. (1966). *Climatic Classification for Environmental Biology*, Publ. Climat, Lab. of Climat., Vol. 19, No. 4, pp. 305–395.

Subrahmanyam, V. P., Subba Rao, B. and Subramaniam, A. R. (1963). "Moisture Adequacy in Relation to the Distribution of a few crops in India, Proc. Berkeley (California), *Symp. of the Internat. Assn. Sci. Hydrol.* (I. U. G. G.), pp. 462–467.

Thornthwaite, C. W. (1948). "An Approach toward a rational classification of Climate", *Geogr. Rev.*, Vol. 38, pp. 55–94.

Thornthwaite, C. W. and Mather, J. R. (1955). *The Water Balance*' Pub. in Climat., Lab. of Climat. Vol. 8, p. 104.

ADDRESS OF THE AUTHOR

Dr. B. Hema Malini
Research Associate
Department of Geography
Andhra University
Waltair 530 003