

Mapping of agro-ecological zones of Andhra Pradesh through soil-resource data

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ABSTRACT

An attempt was made to delineate agro-ecological zones of Andhra Pradesh using soil-resource information generated on 1:250 000 scale and rainfall data of 700 rain-gauge stations. Length of growing period was computed using both soil-water balance and 0.7 potential evapo-transpiration concept and length of growing period map generated. The length of growing period map was superimposed over soil and physiography layer maps through geographical information system and a 22 agro-ecological zones map was generated. The 7 agro-climatic zones map of the Andhra Pradesh Agricultural University prepared under National Agricultural Research Project was superimposed over 22 agro-ecological zones map for comparison and discussion. The length of growing period varied from as low as 70-90 days in Rayalaseema plateau covering about 6% and as high as 210-240 days in the eastern *ghats* (north) and Delta plains covering about 6 and 2% area of the state respectively. The crop growing season starts earliest in the last week of April in zone 14 of eastern *ghats* (north) and very late beginning in the first week of August in the southeast coastal plain. Soils in general are dominantly gravelly red, black and deltaic alluvial except in the eastern *ghats* (north) where they are brown forest soils with high humus content. The 22 agro-ecological zones when compared with the agro-climatic zones indicated that wide variability with respect to physiography, soils and length of growing period and has 2-4 agro-ecological zones within an each agro-climatic zone. Hence there is a need to reorient research programme based on 22 agro-ecological zones for efficient use and conservation of natural resources and agro-technology transfer.

Key words : agro-ecological zones, agro-climatic zones, soil water balance, potential evapo-transpiration, length of growing period

Efficient crop planning require proper knowledge on the kind of soils and their geographic distribution and agro-climatic conditions existing in the area. Identification of such similar soil-agro-environments for conducting agricultural research, transfer of technology and regional planning is essential for sustainable use of natural resources. This calls for collection, compilation, analysis and interpretation of soils and climatic data. Agro-climatic regional planning approach in the country is gaining importance since 1985. Agro-climatic zone is a land unit in terms of major climates suitable for a range of crops and cultivars (FAO 1983), whereas an agro-ecological zone is a land unit within an agro-climatic zone having distinct kind of soils with specific length of growing period. The agro-ecological zone is a basic unit to disseminate research results and agricultural technology to other similar soil-agro-environments. It helps to determine the suitability of different crops for regional developmental

purposes.

The earliest attempt in agro-climatic classification of Andhra Pradesh was done by Subramanyam and Subramaniam (1962) who divided the state into 4 climatic zones. The Andhra Pradesh Agricultural University has divided the state into 7 agro-climatic zones under National Agricultural Research Project for generation and dissemination of agro-technology. Sehgal *et al.* (1990) had divided the state into 6 agro-ecological regions and 8 subregions. In the present study agro-ecological zoning of Andhra Pradesh has been attempted utilizing the available soil resource mapping and climatic data.

MATERIALS AND METHODS

Long-term weekly rainfall data (1969-93) of 700 provincial rain gauge stations obtained from India. Meteorological Department, Pune were used for the present study. The soil resource information generated on 1:250 000 scale for the state (Reddy *et al.* 1996) was used as base for different interpretations. The available water capacity at 50, 75, 100, 150, 175 and 225 mm/m depth of soil were computed based on soil depth, texture, gravel content and mineralogy of soils.

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The computed available water capacity values were assigned to all the soils studied at 2 740 grid points located at 10-km interval.

Using the available water capacity, weekly rainfall and potential evapo-transpiration data, the soil water balance (Thornthwaite and Mather 1955) was worked out to assess the length of growing period. Length of growing period as defined by Higgins and Kassam (1981) starts when precipitation exceeds 0.5 potential evapo-transpiration and ends with the utilization of assumed quantum of stored soil moisture (100 mm) after precipitation falls below potential evapo-transpiration. Length of growing period obtained by using 0.5 potential evapo-transpiration computation seems to be an overestimation when verified for many locations. Hence for the present study the computation of length of growing period using 0.5 potential evapo-transpiration has been slightly modified. The revised concept constitutes 0.5 for the initial week and 0.7 potential evapo-transpiration for the subsequent weeks including the soil water storage for arriving at length of growing period. The studies conducted in western *ghats* area of Karnataka and Goa used 0.75 potential evapo-transpiration for arriving at dry and wet periods (Bourgeon 1989) which was found to be in agreement with the ground conditions. The length of growing period so arrived at by using 0.7 potential evapo-transpiration has shown a close resemblance to the actual growing period for many locations.

Andhra Pradesh has 8 agro-ecological sub regions based on physiography, soils and overhead climate (Sehgal *et al.* 1990). They are northern Telangana plateau (hot dry semi-arid), southern Telangana plateau (hot dry semi-arid), Rayalaseema plateau (hot arid to semi-arid), south-eastern *ghats* (hot dry semi-arid), north-eastern *ghats* (hot moist semi-arid to subhumid), south-eastern coastal plain (hot moist semi-arid to hot dry subhumid), delta-plain (hot dry semi-arid) and north-eastern coastal plain (hot dry semi-arid).

Using Geographical Information System the 8 agro-ecological subregions (Sehgal *et al.* 1990) map was superimposed on the length of growing period and soils overlay maps and an 22 agro-ecological zones were demarcated. The seven agro-climatic zones map was superimposed over agro-ecological zones map for comparison, discussion and refinement. The salient features of each of the 22 agro-ecological zones under 8 agro-ecological subregions with respect to their geographic distribution, extent, kind of soils and their limitations, beginning and end of the cropping season are briefly discussed.

RESULTS AND DISCUSSION

Northern Telangana plateau

This region receives an annual rainfall of 810–1 135 mm and is divided into three zones with length of growing period ranging from 120–210 days.

Zone 1: It comprises the major parts of Adilabad, southern and south-western parts of Medak, eastern and north-

eastern parts of Warangal and north-western part of Khammam covering about 32.7 lakh ha (11.9%) in the state and receives 810–1 115 mm rainfall. The dominant soils are mixed red and black soils (Paleustalfs, Haplustalfs, Vertic Ustropepts, Haplusterts and Ustorthents). They are shallow to deep, loam to clay, gravelly with medium to high in available water capacity and length of growing period of 120–150 days. The main cropping season is from 2 week of June to 1st week of November.

Zone 2: It comprises the major parts of Nizamabad, Warangal, Khammam, central and western parts of Medak, north and north-eastern parts of Karimnagar and southern part of Adilabad covering about 32.96 lakh ha (12.7%) of the state and receives 810–1 135 mm rainfall. The dominant soils are red gravelly soils (Haplustalfs, Ustropepts, Ustorthents, Paleustalfs and Rhodustalfs). They are moderately deep to deep, clay to loam, gravelly, medium to high in available water capacity with length of growing period of 150–180 days. Cropping season in this zone is from 2nd week of June to 3rd week of November.

Zone 3: It comprises the central parts of Warangal and a small area in south-western part of Adilabad covering about 1.9 lakh ha (0.7%) in the state and receives 980 to 1 085 mm rainfall. The dominant soils are black [Haplusterts, (Vertic) Ustropepts, Ustorthents] deep, shrink-swell, clayey with high available water capacity and length of growing period of 180–210 days. The cropping season in this zone is from 2nd week of June to 3rd week of December.

Southern Telangana plateau

This region receives an annual rainfall of 560–970 mm and is divided into 2 zones with length of growing period ranging from 120–180 days.

Zone 4: It comprises the major parts of Mahbubnagar, Ranga Reddy and Nalgonda districts covering about 26.4 lakh ha (8.9%) of the state and receives 560–850 mm rainfall. The major soils are moderately deep to deep, gravelly loam to gravelly clay, red and black (Paleustalfs, (Vertic) Ustropepts, Haplustalfs, Haplusterts) with medium available water capacity and length of growing period of 120–150 days. The cropping season is from 2nd week of June to 3rd week of November.

Zone 5: It comprises the eastern and north-eastern parts of Nalgonda, central parts of Ranga Reddy and central and south-western parts of Mahbubnagar covering about 11 lakh ha (4%) of the state and receives 690–970 mm rainfall. The dominant soils are mixed red and black (Haplustalfs, Rhodustalfs, Paleustalfs, Haplusterts). They are deep to moderately deep, loam to clay, gravelly with medium to high available water capacity and length of growing period of 150–180 days. The cropping season is from 2nd week of June to 3rd week of November.

Rayalaseema plateau

This region receives an annual rainfall of 436–836 mm

and is divided into 3 zones with length of growing period of 70–150 days.

Zone 6 : It comprises the major parts of Anantapur, south-western part of Kurnool and north-western part of Cuddapah covering about 17.9 lakh ha (6.5%) of the state and receives 436 to 616 mm rainfall. The dominant soils are mixed red and black [Haplargids, Paleargids, (Ustertic) Haplocambids, Paleustalfs, Rhodustalfs, Haplustalfs and (Aridic) Haplusterts] associated at many places with rock lands. They are moderately deep to deep, clay to loam, gravelly with low to medium available water capacity and length of growing period of 70–90 days. The cropping season is from 2nd week of July to 2nd week of November with only 70–90 days of favourable moisture supply with prolonged intermittent drought spells.

Zone 7 : It comprises the major parts of Cuddapah, eastern and central parts of Chittoor covering about 15.3 lakh ha (5.6%) of the state and receives 516–706 mm rainfall. The major soils are red and black [Paleustalfs, Rhodustalfs, Haplustalfs, Ustorthents, (Vertic) Ustropepts and Haplusterts] associated with rock lands. They are moderately deep to deep, loam to clay, gravelly with low to medium available water capacity and length of growing period of 90–120 days. The cropping season is from 2nd week of July to 1st week of November.

Zone 8 : It comprises the major parts of Cuddapah, eastern and central parts of Kurnool, central parts of Chittoor and south-eastern part of Anantapur and receives 655–836 mm rainfall. The major soils are black and red [Haplusterts, (Vertic) Ustropepts, Rhodustalfs, Ustorthents] associated with rock lands and cover about 16.1 lakh ha (5.9%) of the state. They are moderately deep to deep, loam to clay, gravelly with medium available water capacity and length of growing period of 120–150 days. The cropping season is from 3rd week of July to 3rd week of November.

Eastern ghats (South)

This region receives an annual rainfall of 610–1 100 mm and is divided into 3 zones with length of growing period of 120–210 days.

Zone 9 : It comprises the major parts of Prakasam, eastern part of Cuddapah and south-western part of Nellore covering about 14.3 lakh ha (5.2%) of the state and receives 820–990 mm rainfall. The dominant soils are mixed gravelly red and black [Paleustalfs, Haplustalfs, Ustorthents, (Vertic) Ustropepts, Haplusterts] associated with rock lands. They are moderately deep to deep, loam to clay with medium available water capacity and length of growing period of 120–150 days. The cropping season is from 2nd week of July to 3rd week of November.

Zone 10 : It comprises the major parts of Guntur, north-western part of Nellore, north-eastern part of Prakasam, central and southeastern parts of Krishna and south central part of Chittoor covering about 25.9 lakh ha (9.4%) of the state and receives 610–980 mm rainfall. The dominant soils are

red and black [Rhodustalfs, Haplustalfs, (Vertic) Ustropepts, Haplusterts, Ustorthents] associated with rock lands. They are moderately deep to deep, loam to clay with medium to high available water capacity and length of growing period of 150–180 days. The cropping season is from 2nd week of June to 1st week of December.

Zone 11 : It comprises the south-central and north-eastern parts of Chittoor and a small area in the south-eastern part of Krishna covering about 6.4 lakh ha (2.3%) of the state and receives 920–1 100 mm rainfall. The dominant soils are gravelly red (Ustropepts, Haplustalfs, Ustorthents) associated with rock lands. They are moderately deep to deep, loam to clay with medium to high available water capacity and length of growing period of 180–210 days. The cropping season is from 1st week of July to 3rd week of January.

Eastern ghats (North)

This region receives an annual rainfall of 922–1 235 mm and is divided into 3 zones with length of growing period ranging from 150–240 days.

Zone 12 : It comprises the lower altitude agency areas of Visakhapatnam, Vizianagaram, Srikakulam, East Godavari and Khammam covering about 12 lakh ha (4.4%) of the state and receives 920 to 1 150 mm rainfall. The dominant soils are moderately deep to deep, loam to clay, gravelly and non gravelly, red and brown forest soils (Ustropepts, Ustorthents, Haplustalfs, Argiustolls). They have low to medium available water capacity with length of growing period of 150–180 days. The cropping season is from 1st week of June to 1st Week of December.

Zone 13 : It comprises the middle altitude agency areas of Visakhapatnam, Vizianagaram, Srikakulam, East Godavari and Khammam covering about 14.1 lakh ha (5.2%) of the state and receives 940–1 200 mm rainfall. The dominant soils are moderately deep to deep, loam to clay, gravelly and non gravelly, red and brown forest soils (Haplustalfs, Ustropepts, Rhodustalfs, Paleustalfs, Argiustolls) with medium available water capacity and length of growing period of 180–210 days. The cropping season is from 2nd week of June to 2nd week of December.

Zone 14 : It comprises high altitude and tribal areas of Visakhapatnam covering about 4.8 lakh ha (1.7%) and receives 1 040–1 235 mm rainfall. The dominant soils are deep, loam to clay, non gravelly, brown forest soils (Argiustolls, Ustropepts, Paleustalfs, Rhodustalfs), with medium available water capacity and length of growing period of 210–240 days. The cropping season is from 4th week of April to 1st week of December.

South-eastern coastal plain

This region receives an annual rainfall of 765–1 260 mm and is divided into 3 zones with length of growing period ranging from 120–210 days.

Zone 15 : It comprises a small area in the south-central part of Nellore adjoining eastern *ghats* covering about 2.7

lakh ha (1%) of the state and receives 880–1 000 mm rainfall. The dominant soils are deep, clay, gravelly red, lateritic and coastal alluvial (Haplustalfs, Ustropepts, Rhodustalfs) with low to medium available water capacity and length of growing period of 120–150 days. The cropping season is from 1st week of August to 1st week of December. The delay in starting of cropping season is due to less rainfall during south-west monsoon and more in north-east monsoon.

Zone 16 : It comprises the coastal areas of Guntur, Prakasam and Nellore covering about 7.5 lakh ha (2.7%) of the state and receives 765–980 mm rainfall. The dominant soils are deep, loam to clay and sand, gravelly red, lateritic and coastal alluvial [Haplustalfs, (Vertic) Ustropepts and Ustipsamments] with low to medium available water capacity and length of growing period of 150–180 days. The cropping season is from 1st week of July to 2nd week of December.

Zone 17 : It comprises the south-western and south-eastern parts of Nellore, southern part of Prakasam and north-eastern part of Chittoor covering about 3.9 lakh ha (1.4%) of the state and receives 1 050–1 260 mm rainfall. The dominant soils are deep, clay, gravelly red and coastal alluvial [Haplustalfs, (Vertic) Ustropepts with medium to high available water capacity and length of growing period of 180–210 days. The cropping season is from 2nd week of July to 3rd week of January.

Delta plain

This region receives an annual rainfall of 780–1 130 mm and is divided into 3 zones with length of growing period ranging from 150–240 days.

Zone 18 : It comprises the delta areas of Guntur Krishna and West Godavari covering about 5.7 lakh ha (2.1%) of the state and receives 780–980 mm rainfall. The dominant soils are deep, clayey, deltaic alluvium derived (Haplusterts) with high available water capacity and length of growing period of 150–180 days. The cropping season is from 1st week of July to 2nd week of December.

Zone 19 : It comprises the delta plains of East and West Godavari and Guntur covering about 3 lakh ha (1.1%) of the state and receives 925–1 130 mm rainfall. The dominant soils are deep, clayey, deltaic alluvium derived [Haplusterts, (Vertic) Ustropepts, Ustifluvents] with high available water capacity and length of growing period of 180–210 days. The cropping season is from 3rd week of June to 4th week of January.

Zone 20 : It comprises the coastal area of East Godavari covering about 1.4 lakh ha (0.5%) of the state and receives 1 070–1 120 mm rainfall. The dominant soils are deep, clayey deltaic alluvium derived [Haplusterts, (Vertic) Ustropepts] with high available water capacity and length of growing period of 210–240 days. The cropping season is from 3rd week of June to 4th week of January.

North-eastern coastal plain

This region receives an annual rainfall of 970 to more than 1 200 mm and is divided into 2 zones, with length of

growing period ranging from 150–210 days.

Zone 21 : It comprises the central and eastern parts of East Godavari covering about 1.3 lakh ha (0.5%) of the state and receives 970 to 1 100 mm rainfall. The dominant soils are deep, clay and loam, gravelly and non-gravelly red and deltaic alluvium derived (Paleustalfs, Vertic Ustropepts) with medium to high available water capacity and length of growing period of 150–180 days. The cropping season is from 2nd week of June to 3rd week of November.

Zone 22 : It comprises the coastal areas of Visakhapatnam, Vizianagaram and Srikakulam covering about 8.1 lakh ha (3%) of the state and receives 1 100 to more than 1 200 mm rainfall. The dominant soils are deep, loam to clay, red and deltaic alluvium derived [Haplustalfs, Paleustalfs, (Vertic) Ustropepts] with medium to high available water capacity and length of growing period of 180–210 days. The cropping season is from 2nd week of June to 3rd week of December.

The agricultural research and farming technologies being conducted and recommended in the state at present are based on 7 agro-climatic zones as adopted by the university and the Department of Agriculture. It is clear from the discussion that every agro-climatic zone has 2–4 agro-ecological zones with different length of growing periods and soils. The agro-ecological zones map shows 22 agro-soil-environments in the state each having a unique physiography, climate and soils which resulted in different units of length of growing period for crop planning and management needs. It will be appropriate if package of practices generated by the university for different agro-climatic zones be refined according to the kind of soils and length of growing period existing in each of the 22 zones demarcated and the future research programmes be oriented according to the different agro-ecological zones for efficient use and conservation of natural resources for higher productivity.

The agro-ecological zones demarcated can further be refined if the soil resource information is available on 1:50 000 scale where agro-ecological units can be delineated at the district level that will have better homogeneous management units for crop planning and agrotechnology transfer.

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