Detailed Soil Survey of the Soil Conservation Research Station, Anantapur
District Anantapur : : Andhra Pradesh

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Red and Laterite Soils Region II
BANGALORE

All India Soil and Land Use Survey
(CENTRAL SOIL CONSERVATION BOARD)
INDIAN AGRICULTURAL RESEARCH INSTITUTE,
New Delhi-12
Detailed Soil Survey of the Soil Conservation Research Station, Anantapur
District Anantapur : Andhra Pradesh

by
R. S. Murthy and P. S. Anjanya Reddy

Red and Laterite Soils Region II
Bangalore

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Red Latosolic Soils Region II, Bangalore.
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Map enclosed: Soil and land capability map.
Detailed soil survey of the Soil Conservation Research Station, Anantapur, District Anantapur, State Andhra Pradesh.

I. INTRODUCTION.

A Soil Conservation Research Station at Anantapur has been recently established by the Govt. of Andhra Pradesh for conducting experiments on red soils typical of the Rayalaseema and Telangana tracts and evolving suitable soil and water conservation measures which could be made use of for large areas in the State. This tract is generally dry, with an annual precipitation of about 25 inches. Crop failures are reported when the precipitation is less than 40 percent of the normal rainfall and long dry spells continue during the crop growth. High temperature and low moisture retentivity of the soils are some of the other problems. Any research undertaken on soils under such conditions should be so oriented as to find out suitable management practices which help in the conservation of moisture.

At the request of the Divisional Soil Conservation Officer (Research) Anantapur, a detailed soil survey of the Research Station was taken up during Feb. 1965. A soil and land capability map has been prepared showing the distribution of different soils identified in the area. Recommendations to improve the soil conditions and experiments to be projected upon the various soil units mapped in the farm have been suggested which will help in the planning and execution of the soil conservation work in the State.

II. GENERAL DESCRIPTION OF THE AREA.

1. Location and extent: The Soil Conservation Research Station is situated about 5 miles East of Anantapur town on the Anantapur-Narpala Road. It comprises an area of 277 acres lying near approximately N. latitudes 77°40' and E. longitudes 14°41'. It is bounded on the north by Reddiapalli fields and Anantapur - Narpala road, on the south by private agricultural fields, on the east by Bukkaraya-samudram fields and on the west by private wet lands.

2. Physiography, relief and drainage: The physiography consists of nearly level to gently sloping lands with the slope gradients ranging from 1 to 3 percent. A prominent
dolerite dyke runs along the south and south west boundaries of the farm. The area covered by the survey Nos. 360, 363 and 364 drains to the west of the farm. Survey No. 340 also drains to the lowlying private wet lands. Survey Nos. 345, 365, 349 drain to the north eastern side belonging to private people. The south, south eastern side of the farm drains to the eastern side. In general the drainage is excessively drained on the surface, well drained to moderately well drained internally.

3. Climate: The climate can be described as tropical, semi-arid with a large number of sunny days. The summer is long and hot while the winter is short and mild. The number of rainy days is small and long spells between two showers are common. Geographically this area is situated far from the coastal belt and gets the benefit of neither the south west nor the north-east monsoons except the residual effects. The rainfall in this tract is at times erratic depending upon the depression caused in the Bay of Bengal. Even though the total rainfall may appear adequate, the way it is distributed results in partial or complete failure of crops. The average annual rainfall recorded at Anantapur is 583 mm. The distribution of rainfall with the relevant meteorological data is given in table I.

Table I.
The average monthly rainfall and other meteorological data recorded at Anantapur.

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>6.1</td>
<td>3.3</td>
<td>15.0</td>
<td>53.3</td>
<td>49.8</td>
<td>52.1</td>
<td>84.6</td>
<td>149.9</td>
<td>99.3</td>
<td>58.2</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>ii. Rainfall (in mm)</td>
<td>4.8</td>
<td>6.1</td>
<td>3.3</td>
<td>15.0</td>
<td>53.3</td>
<td>49.8</td>
<td>52.1</td>
<td>84.6</td>
<td>149.9</td>
<td>99.3</td>
<td>58.2</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>ii. Mean wind velocity (km/hr)</td>
<td>10.3</td>
<td>9.3</td>
<td>9.3</td>
<td>10.5</td>
<td>15.0</td>
<td>19.5</td>
<td>19.2</td>
<td>17.7</td>
<td>13.5</td>
<td>7.2</td>
<td>8.0</td>
<td>8.7</td>
<td></td>
</tr>
<tr>
<td>ii. Mean daily max. temp. (°C)</td>
<td>30.2</td>
<td>33.3</td>
<td>36.9</td>
<td>38.5</td>
<td>38.1</td>
<td>34.9</td>
<td>32.7</td>
<td>32.6</td>
<td>32.2</td>
<td>31.4</td>
<td>29.9</td>
<td>28.9</td>
<td></td>
</tr>
<tr>
<td>ii. Mean daily min. temp. (°C)</td>
<td>17.3</td>
<td>18.6</td>
<td>21.6</td>
<td>25.6</td>
<td>25.8</td>
<td>24.8</td>
<td>23.8</td>
<td>23.6</td>
<td>23.0</td>
<td>22.3</td>
<td>19.2</td>
<td>18.2</td>
<td></td>
</tr>
<tr>
<td>v. Highest max. yr. recorded (°C)</td>
<td>35.6</td>
<td>37.2</td>
<td>40.6</td>
<td>42.2</td>
<td>42.2</td>
<td>41.7</td>
<td>36.7</td>
<td>36.7</td>
<td>36.1</td>
<td>35.0</td>
<td>34.6</td>
<td>32.2</td>
<td></td>
</tr>
</tbody>
</table>
The mean daily minimum temperature is 16.8°C in December and the mean daily maximum temperature is 38.1°C. The wind velocity ranges from 7.2 km per hour in October to 19.5 km per hour in June. The monthly evaporation ranges from 126 mm in December to 451 mm in May with a mean annual evaporation of 2892 mm. The normal mean relative humidity at 8 hrs. I.S.T. ranges from 48 percent in March to 76 percent in October. High temperature, low humidity and high wind velocity are the limiting factors for crop production.

4. Geology: The prominent rock exposures observed in the station consist of highly weathered granite gneiss, granite, granodiorite, dolerite dyke and small patches of fine grained sandstone. A prominent dolerite dyke runs east west all along the boundary (survey numbers 353 and 358). This has intruded into hornblende granite rocks which are conspicuously exposed in survey nos. 356, 357 and 358 where approximately the 1150 contour is also running. The weathered granite gneiss is foliated and deeply weathered. granite-gneiss is foliated and deeply weathered. This has given rise to the Vayalpad soils. At places, on gently sloping to undulating topography, minerals of hornblende and epidote form the constituents of granite gneiss rocks. The dolerite dyke gives rise to deep soils which have a kankar horizon as observed in survey nos. 354 and 366.

5. Natural Vegetation: The natural vegetation consists of various kinds of thorny shrubs and few trees. Some portions are covered by stunted vegetation and are open to indiscriminate grazing thus causing erosion. The stony wastes are covered by thin grass. Important among the trees are Euphorbia species, babul, neem, Tamarind, Pongamia...
and Date palms. Alledu (Calotropis gigantea), Thangādu (cassia siamea) and Cactus constitute the shrubs. The leaves of pongamia and Thangādu are used for green manuring.

III. AGRICULTURE AND PRESENT LAND USE.

The area acquired for the Soil Conservation Research Station is under cultivation since long by the local agriculturists. The important food crops grown in the area include jowar, bajra and setaria, pulses like ragam, green gram and horsegram and commercial crops of groundnut, gingleley and castor. Jowar is the staple food grain crop grown either pure or mixed with legumes like green gram and cow pea. The rainfed crops are grown in kharif i.e. June to December. Immediately after the first shower, during May or June, the land is ploughed once or twice by a country plough and followed by blade harrow. The crops are sown by seed drills and never by broadcast. Intercultural operation is done twice or thrice by the blade harrow at 2 weeks interval, one month after sowing. The dry lands are manured only once in five years and the only manure used is farmyard manure.

Yields for some important crops are given below:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Yield (lb/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jowar</td>
<td>400</td>
</tr>
<tr>
<td>Bajra</td>
<td>397</td>
</tr>
<tr>
<td>Setaria</td>
<td>350</td>
</tr>
<tr>
<td>Red gram</td>
<td>250</td>
</tr>
<tr>
<td>Horsegram</td>
<td>200</td>
</tr>
<tr>
<td>Greengram</td>
<td>115</td>
</tr>
<tr>
<td>Groundnut</td>
<td></td>
</tr>
<tr>
<td>(un-shelled)</td>
<td>1120</td>
</tr>
<tr>
<td>Castor</td>
<td>150</td>
</tr>
</tbody>
</table>

Source: Season and crop report of Andhra Pradesh 1960-61.
IV. SOIL SURVEY METHOD.

Detailed traverse was conducted in the Research Station area with the help of the base map 1" = 330 feet supplied by the Divisional Soil Conservation Officer. Soil samples with a post hole auger were examined in a number of places for colour, texture, structure, effervescence with dilute acid, mottlings, concretions etc. Based on the morphological studies of the soils, profiles were examined and described. Soil samples from two profiles and a selected surface sample were analyzed in the laboratory. The profile sites and the surface sampling sites are indicated on the soil map. Variations in texture, soil depth, slope and erosion are delineated on the soil map.

V. DESCRIPTIONS OF THE SOILS IDENTIFIED IN THE FIELD.

During the course of the detailed soil survey of the Soil Conservation Research Station, a number of soil series have been identified, described and mapped and both of them have been correlated with the soil series established during the soil survey of Vayalpād taluk in Chittoor district. Each series differs from the other in certain morphological and other characteristics that ultimately affect its suitability for agriculture and soil management. The various soil series, along with the type, depth of soil, slope and erosion classes have been delineated on the soil and land capability map appended with the report. The areas of the mapping units and the capability classes and sub-classes under which they are classified are given under the respective soil series. The descriptions of the soil series are given below - the analytical data is given in appendix I and soil map legend in appendix II.

Vayalpād series (Vyp).

The Vayalpād series consists of reddish brown to yellowish red soils derived from granite gneiss and coarse-grained granites occurring over extensive areas in Madras under a tropical and semi-arid climate. Moderately deep to deep, excessively to well drained, loamy to sandy loam soils occurring on level to gently sloping lands, they have 4 to 6 inches thick AP horizon underlain by a fairly thick 12 to 20 inches B horizon which gets heavier with depth. The C horizon consists of weathered granite mixed with angular quartz. Geographically associated soils are Vallamanda and Manchurru series.
Valleyped loamy sand - a typical profile, about 100 yards east of the survey stone No.27 in plot No.340 is described below.

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Depth (cm/inch)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>0-10 (0.4)</td>
<td>Yellowish red to reddish brown (5YR 4/6 dry, 5YR 4/4 moist) loamy sand; fine, waxy, granular structure; loose when dry, and friable when moist; pH 7.1; clear smooth boundary; few roots.</td>
</tr>
<tr>
<td>J1</td>
<td>10-26 (4-10)</td>
<td>Dark reddish brown (2.5YR 3/4) sandy clay loam; medium moderately sub-angular blocky structure; hard when dry, firm when moist and sticky and plastic when wet; pH 6.5; gradual smooth boundary.</td>
</tr>
<tr>
<td>32</td>
<td>28-58 (11-23)</td>
<td>Dark red (2.5YR 3/6) clay loam with 45 to 40 percent of 5 to 20 mm size; angular quartz and feldspar; medium moderately sub-angular blocky structure; very hard when dry, firm when moist and sticky when wet; pH 6.4; diffuse wavy boundary.</td>
</tr>
<tr>
<td>C</td>
<td>58+ (23+)</td>
<td>Weathered granitic parent material.</td>
</tr>
</tbody>
</table>

In characteristics: Loamy sand and sandy loam are the important types mapped. Wherever erosion is severe, the depth of the soil decreases and the percentage of gravel increases up to 50 to 60 on the surface as well as within the profile.

Topography: Gently level to gently sloping, with slopes gradients below 3 percent.

Drainage and permeability: Excessively to moderately well drained externally, moderately well drained to well drained internally with moderate permeability.

Vegetation: Natural vegetation consists of cactus, euphorbia species, babul, neem, tamarind, pungamie glabr., cate palms, 'changedu (cassia siamers) and jil jau (cachetropis gigantea).

Use: Mostly cultivated to dry crops like groundnut, castor, jowar, bajra, cotton, red gram, horse gram, green gram etc. In the farm.
The following units are mapped under Vayalpad series.

**Vyp 1s d4**
- 3.00 acres) Vayalpad loamy sand deep on level to nearly level land with slight or no erosion (Class IIIa).

**Vyp 1s d3**
- 9.00 acres) Vayalpad loamy sand moderately deep on level to nearly level land with moderate erosion (Class IIIe).

**Vyp 1s d3**
- 24.10 acres) Vayalpad sandy loam moderately deep on level to nearly level land with moderate erosion (Class IIIe).

**Vyp 1s d3**
- 27.40 acres) Vayalpad sandy loam moderately deep on very gently sloping land with moderate erosion (Class IIIe).

**Vyp 1s d3**
- 118.00 acres) Vayalpad loamy sand moderately deep on very gently sloping land with moderate erosion (Class IIIe).

**Vyp g1 d3**
- 17.20 acres) Vayalpad gravelly sandy loam moderately deep on very gently sloping land with moderate erosion (Class IIIe).

**Vyp g1 d2**
- 27.20 acres) Vayalpad gravelly sandy loam shallow on very gently sloping land with severe erosion (Class IVs).

**Mancheru series** (Mch).

The Mancheru series consists of brown to reddish brown soils derived from granite gneiss influenced by the dolerite dyke occurring in Chittor and Anantapur districts of Andhra Pradesh under tropical semi-arid climate. Moderately deep to deep, moderately well drained, sandy loam to sandy clay loam soils occurring on level to gently sloping lands; they have 5 to 7 inches thick Ap horizon underlain by a thick B horizon of 18-24 inches thickness. The C horizon is mixed with lime concentrations, 20 to 30 percent by volume. Major areas of these soils are under irrigation from tanks. Geographically associated soils are the Vayalpad and Yallamanda series.
Mancora sandy loam — typical profile, about 70 yards east of the survey stone No. 34 in plot No. 268 is described below.

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Depth (cm, inch)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>p 0-11  0-4</td>
<td>Yellowish red to reddish brown. (SYR 5/6 dry, 5/6 4/4 moist) sandy loam; fine-mesh granular structure; loose when dry, and friable when moist; pH 7.3; clear smooth boundary; few roots.</td>
<td></td>
</tr>
<tr>
<td>1-13  3-13</td>
<td>Dark reddish brown (SYR 5/3 dry and moist) sandy clay loam; medium moderate sub-angular blocky structure; very hard when dry, firm when moist and sticky and plastic when wet; pH 7.5; clear smooth boundary; few roots.</td>
<td></td>
</tr>
<tr>
<td>22 -6-6 I</td>
<td>Reddish brown (SYR 4/3) gravelly clay loam with 50-60 percent of 2-5 mm size quartz and felspar; medium, moderate blocky structure; very hard when dry, very firm when moist and sticky and plastic when wet; pH 7.6; gradual smooth boundary.</td>
<td></td>
</tr>
<tr>
<td>Cpe 6-1+ 21+</td>
<td>weathered granite gneiss mixed with lime concretions.</td>
<td></td>
</tr>
</tbody>
</table>

Landscape characteristics: Loamy sand and gravelly sandy loam are the important types mapped. The color of the top soil range is iron brown to reddish brown. In some places massive structure is also noticed in the sub-soil. Quartz and dolomite pieces are spread on the surface at the foot of the ridges. Salinity is associated with these soils.

Topography: Moderately level to gently sloping with slopes gradients below 3 percent.

Drainage and permeability: Excessively to moderately well drained externally moderately well drained to poorly drained internally with moderate permeability.

Vegetation: Same as mentioned under Vayalpady series.
Cultivated to dry crops like groundnut, jowar, setaria, bajra etc. in the farm but mostly cultivated to paddy. 

The following units are mapped under Manchurum series.

Mch 1a d4 Bel (16.50 acres) Manchurum loamy sand deep on very gently sloping land with slight or no erosion. (class IIa).

Mch  d2 (4.20 acres) Manchurum gravelly sandy loam shallow on very gently sloping land with severe erosion. (class IVa)

VI. LAND CAPABILITY GROUPING AND RECOMMENDATIONS FOR BETTER LAND USE:

Capability grouping is a system of interpretation to show the relative suitability of soils for crops, grazing, forestry and wild life. It is a practical grouping based on the needs, limitations and risks of damage to the soils and also their response to management.

The broadest grouping is the land capability class. There are eight classes. All the soils in one class have limitations and management problems of about the same degree but of different kinds as shown by the sub-class. All the land classes except class I may have one or more sub-classes.

In classes I, II and III are soils that are suitable for annual or periodic cultivation of annual or short duration crops. In class IV are soils that should be cultivated only occasionally or only under very careful management. In classes V, VI and VII are soils that normally should not be cultivated for annual or short duration crops but they can be used for raising pasture and range, as forest land or for wild life. In class VIII are soils that have such unfavourable characteristics as to be unsuit for cultivation, grazing or forestry. They are suited only for wild life habitats, recreation, or watershed protection uses.

In the land capability map prepared for the Research Station Farm, Class/III, IV, IIIb, IIIc and IVs have been indicated. "e" indicates erosion hazard (damage due to post erosion and susceptibility to erosion) and "n" root zone limitation, low moisture holding capacity and low fertility.
Class IIIa (5.00 acres)

A very small portion of the Research Station comes under this class - It comprises light textured loamy sand soils of Vayalpad series, deep on nearly level to level land with slight or no erosion. The sub-class "a" indicates that the soils have the limitations of poor nutrient status and low moisture holding capacity particularly in the surface horizon. Sometimes the soils are excessively drained externally. Moisture is the main limiting factor for crop growth. Proper soil management practices including bunding, application of organic manure and fertilizers and conservation of moisture are the only means of increasing the production of crops. The manure that is generally used for dry land crops is the farm yard manure which is not available in adequate quantities and what little is available is utilized for manuring irrigated crops like paddy. The Research Station has on its programme the conduct of studies on the infiltration capacity of soils and the influence of depth of soil on yield. These experiments may be conducted on the above soils.

Class IIIb: (6.50 acres)

Consists of light textured loamy sand soils of Mancheru series, deep, on very gently sloping land with slight or no erosion. The sub-class "a" indicates the susceptibility of the soil to erosion on sloping lands which lie adjacent to the valleys. Bunding on such lands will not only prevent the loss of fertile top soil but helps in the conservation of moisture in the soil for crop use during dry period. The subsoil has appreciable amounts of clay although the top soil is light in texture: Manuring and fertilizer application will further improve the productive capacity of the soils. The area covered by the above mapping unit is also suitable for digging wells and experiments to study the correlation between soil moisture and yields for forecasting crop yields based on the moisture at sowing etc. can be taken up.

Class IIIe: (195.70 acres)

Nearly 70 percent of the land in the Research Station comes under this class. It consists of loamy sand to sandy loam soils of Vayalpad series, moderately deep on nearly level to very gently sloping lands with moderate erosion. Soils are susceptible to erosion.
Heasures to ensure proper soil management to prevent run-off and conserve moisture should be taken. The dry crops generally taken on these soils are row crops which are erosion permitting crops that do not give much ground cover. During the months of heavy rainfall i.e. from June to October the land practically remains bare. The common practice of up and down cultivation on the sloping lands should be discouraged. On the other hand, cultivation with contour bunds of suitable sizes are recommended. The Research Station should take up experiments (i) to evaluate the various mechanical measures of soil conservation which are being recommended to the farmers, (ii) to determine the optimum spacing, section and outlets for the bunds (iii) to select crops suitable for strip cropping, determine seed rate, spacing and width of erosion resisting crops in relation to the main row crop.

Class IVs: (31.40 acres).

It consists of gravelly sandy loam soils of both Vayalpad and Mancheru series, shallow, on very gently sloping lands with severe erosion. The sub-class "e" denotes the root zone limitation. In case such lands are required to be adopted. Pulses like gram and black gram come up well inspite of the soils being shallow. Experiments to study the influence of depth of soil on yield on shallow and deep soils as well give useful information. Such lands can be developed to yield pasture of good quality and studies on grass for various purposes in soil conservation can be undertaken. A part of this land in plot No.342 can be utilized for putting up the Research Station buildings. They will have an easy approach from the main road.

The Dolerite dyke running east-west occupies an area of 21.20 acres and rocky land 4.20 acres. The dykes and rocky areas can be planted to certain ornamental grasses and shrubs in places where there are pockets of soil.

VII. SUMMARY.

Detailed soil survey of the Soil Conservation Research Station, Mantipur comprising 277 acres has been carried out. Soils are classified into two series namely Vayalpad and Mancheru. The soil units mapped under the respective series have been interpreted to the land capability classes and sub-classes. Management recommendations for various classes of land have been specified in the report. A soil and land capability map has been appended to the report.

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VIII. ACKNOWLEDGMENTS.

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1. Chief Soil Survey Officer, All India Soil and Land Use Survey, Indian Agricultural Research Institute, New Delhi, for going through the draft manuscript report and making necessary changes.

2. Sri J.H. Shankara Reddy, Divisional Soil Conservation Officer (Research), Anantapur and his staff for providing the necessary facilities for field work.

3. Laboratory and Cartographic staff.

***

nrs/
Soil map legend.

Series
Vap - Vayalpac
Vch - Manchera

Type
ls - loamy sand
1s - gravelly sandy loam
2s - sandy loam.

Slope
A - 0-1% nearly level to level
B - 1-3% very gently sloping

Erosion
el - slight or no erosion
e2 - moderate erosion
e3 - severe erosion

Depth
D2 - 3-9" shallow
D3 - 9-18" moderately deep
D4 - 18-36" deep

How to read the soil map?

Any soil mapping unit delineated on the map included the soil series (indicated in three letters), the type (texture of the surface soil) and soil depth (indicated by the letter A 2 to 4) in the numerator and slope and soil erosion classes (indicated by capital letters A to E and el to e3 respectively) in the denominator. Soil series describes in detail the morphological characteristics of a typical soil profile in respect of colour, texture, structure, consistency, pH etc. The various units mapped under each soil series are interpreted according to their characteristics into land capability classes and sub-classes which are also indicated within the mapping unit boundary.