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Soil Survey of the Amaravathy Reservoir Project Ayacut Area, Coimbatore District.

by

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ntroduction : A scheme for " Post irrigation soil survey " in the Amaravathy Reservoir Project ayacut area was ordered by the Government of Madras in early 1959. Results of some preliminary soil studies conducted during the first year of the scheme are reported and discussed in this paper.

General Description of the Area : *Location and Extent :* The ayacut area is 21,500 acres distributed equally between the taluks of Udumalpet and Dharapuram in Coimbatore District. The main canal runs on the contour and the irrigated areas lie between the canal and the river. The irrigated area consists of 3,000 acres of sugarcane, 1,000 acres of paddy and 17,500 acres of dry crops such as cholam and cumbu.

Physiography : The topography is slightly undulating and rolling with a general fall in level towards the river. Several drainage rivulets cut the ayacut area and flow in the valleys to the river. These streams rise in floods during the rainy months.

Geology and Climate : The parent material of the soils of the ayacut area has been derived from the gneisses of the archean age. In Udumalpet taluk the geneiss is mostly feldspatic while in Dharapuram taluk it is hornblendic in character. The parent material in Dharapuram taluk is calcareous in general. The area has an average annual rainfall of about 20", the rains falling mostly in North East monsoon season.

Agricultural history and statistics : Cholam is the most important crop in the area followed by ragi and groundnut. Paddy and sugarcane are the most important wetland crops. The average per acre yield of paddy is about 2,500 lbs and that of sugarcane is about 25 tons.

Drainage : The drainage in the ayacut area in general is only moderate. The valleys in between the spurs are not efficiently drained. Most of the wells in this area have the water table at present risen up to the ground level. Before the introduction of irrigation the water table was several feet below.

Methods of soil survey: A base map of the Amaravathy ayacut area prepared to scale 1″ = 1 mile, showing the important roads, villages, streams, canals etc. was used for the field work. The proformas prescribed by the I. A. R. I. in the standard methods of soil survey was used for the collection of agro-economic data for the villages in the ayacut area. The entire ayacut area consists essentially of a series of sub-water sheds; each sub-water shed was taken as a unit for soil examination. The areas were traversed on foot and soil profiles up to parent rock were examined according to topography, drainage conditions etc. for each unit or a series of two or more units if they are too small. The soil horizons were examined for texture, structure, consistence, reaction etc. following the methods described in the standard methods of soil survey. Soil samples from each horizon were also collected for detailed analysis in the laboratory.

Morphological examination of soil profiles: Forty seven soil profiles were examined representing the high and low level areas. Some of the typical high and low level soil profiles in the two taluks are described in tables appended.

Conclusions from the field studies: From the description of the profiles and the hydrological and topographical features the following important points emerge.

(a) The soils have developed on material derived from the underlying gneissic rock. While in the upper aspects of the slope the soils have been formed on the residium, in the lower aspects the soils formed on the residium are underlain by deposits of alluvium either originated in the upper slopes and brought down by eroding water or formed elsewhere and deposited during floods in the rivulets that occupy the valleys.

(b) The red earths (latosol) occupying the top and slopes of the undulations are formed under conditions where there is a net downward movement of water. These red earths may be divided into two soil classes (1) the Udumalpet class and (2) the Dharapuram class. In the former, granitic or feldspatic or feldspatic gneiss and in the latter hornblendic gneiss are the parent rocks.

(c) The amount and depth of occurrence of kankar (Calcium carbonate) differentiates the two classes. In the Udumalpet class (Profiles 1, 45, 5, 16 and 19) nodular calcium carbonate is not generally met with in the surface and subsoils. However due to limited rainfall (20″) causing concentration and deposition from the

percolating waters, the deep layers containing mostly the fragments of disintegrating rock at the bottom have nodular Calcium carbonate also. In the Dharapuram class kankar is met with even in the surface and subsoils indicating the calcareous nature of the residium from which they are formed (Profiles 25, 28, 32).

(d) The calcium taken up in solution and carried in subsoil flow from the higher regions is precipitated as Calcium carbonate in the profiles of the valleys. This precipitation is brought about by the elevated soil pH caused by the impeded drainage conditions obtainable in the valleys. The saline, alkaline and other hydromorphic soils that occupy the valleys are only variants or phases of the red earth above formed under the influence of drainage.

(e) Thus, climate and parent material remaining unchanged in any given sub-water shed in the ayacut area, soil formation is influenced mainly by topography. Under the influence of the undulating landscape, a catenary sequence of soils ranging from typical red earths (latosol) to their halomorphic and hydromorphic varients are recognisable in a traverse from the top of the spur to to the bottom of the adjacent valley.

Laboratory examination of the soil samples: All the samples were analysed for soil texture by international pipette mothod and textural class was determined by the triangular method developed by Prescott, Taylor and Marshall (1934). The results indicate that the entire ayacut area soils at all the depths are generally of a light texture (sandy to sandy loam) thus confirming the field observations.

The composition and concentration of total soluble salts were determined for all the soil samples using a soil water ratio of 1 : 5. The average values obtained for the typical profiles in the elevated and low level areas in the two taluks are presented in table I.

It may be seen that (Vide table I) the higher level areas particularly in Udumalpet taluk are only moderately drained as is indicated by the figures for total soluble salts (0·27% and 0·13%). This concentration is not excessive considering the salts resistence crops like cholam, cotton, ragi, tobacco etc. that are to be raised in such areas. The quality of irrigation water both from wells and canals in the area have also been found to be of good to moderate quality and may be used to irrigate plants with good salt tolerance (Govinda Iyer and Subramaniam 1960). The data for the low lying areas reflect a different picture altogether. Although the total

concentration of soluble salts is not so excessive there are toxic amounts of carbonate ions indicating that the base exchange complex is abnormally saturated with sodium and the soil has all the associated physical and chemical abnormalities. However a good proportion of the total cations consists of bivalent Ca plus Mg. This is a very valuable asset from the point of view of reclamation of such areas. On mere dilution of the soil solution such as may occur during irrigation and on improvement of external and internal drainage, most of the absorbed sodium will be replaced by Ca and Mg. The soil will then be converted into a normal one. This is because dilution increases the replacing power of bivalent cations much more rapidly than that of sodium (Kelly 1951 & 1948).

Irrigation Suitability of the Soil: An irrigation soil survey has the object of arriving at an estimate of the suitability of the soils for irrigation. Since irrigation efficiency is dependent upon the soil characters such as depth, drainage, tilth, salinity etc. this type of survey has to pay special attention to these soil factors in addition to usual purpose for which soil surveys are undertaken such as genetic, fertility, land use etc. Considerable changes in these soil characters may take place as soon as the soil is subjected to irrigation for agriculture and a proper appraisal of such changes should be made before determining the probable response to irrigation on these soils. It is therefore apparent that the "compilation" of the soil called "irrigable value soil map" is the main object of irrigation soil survey.

To arrive at this, soil profile studies in the field are classified into four grades as follows (Dewam 1953):

1. An 8' depth of soil free from undesirable layers such as hard pan, dense clay or coarse sand etc.

2. At least 4' of soil of grade (1) resting on solid containing interfering layers or semi-permeable hard pan or clay, very open sand etc.

3. At least 4' of soil of grade (1) resting on solid rock or other impermeable formation, or 30" of soil of grade (1) resting on semi-permeable or gravelly layers.

4. Shallow soils which do not conform to the above grading such as less than 4' of soil on impermeable rock or less than 30" of soil on semi impenetrable or markedly interfering layers. This may be called the permeability profile. Similarly, the soil is classified according to the average salt content of the profile.

Grade I : Includes profile showing an average salt content of less than 0·15%.

Grade II : Average salt content of 0·15 — 0·35%.

Grade III : Average salt content from 0·35 to 0·55%.

Grade IV: Average salt content of over 0·55%.

These two factors are combined to deduce the final irrigable values thus:—

Profile	*Salt*	*Irrigability*
I	I	I
II	I	II
I	II	
II	II	III
III	I	
I	III	
Others.....		IV

Based on the above criteria tentative average irrigable values for the soil classes and their variants in the Amaravathy ayacut area, may be assigned as shown in Table I.

Conclusions : It will be observed from the above that in general the soils of the Amaravathi ayacut area are only III rate in point of its suitability for irrigation. This is based of course on the information gathered so far. Such a low rathing has been caused chiefly bythe improper soil depth and or drainage of the soils of the area.

According to the cropping programme for the ayacut area, most of the higher level areas lying adjacent to the canal are to be grown to dry crops requiring only light irrigation. But in actual practice paddy is being cultivated in many such areas. There is also extensive seepage from the cannal and laterals because of the general light textured nature of the soils in the arca. This has further aggravated the drainage problem in the valleys. It was noticed that in some valleys tobacco was growing well before, but does not come up so well now and has given place to paddy which crop also has only stunted growth due to the high water table. In order to avoid this difficulty the canal should be lined at least in portions where there is too much seepage, and a strict adherance to

the cropping programme should be insisted upon. A general improvement in the existing drainage system and its maintenance in good repair are also of paramount importance for the permanence of irrigated agriculture in the tract.

Summary: Results of prelimanary soil studies in the irrigation soil survey of the Amaravathi ayacut area are reported and discussed. The soils have been divided into two soil classes Udumalpet and Dharapuram. Tentative irrigability values have been assigned to the soil classes and their halomorphic phases. A general improvement in the drainge system is recommended for maximum response to irrigation in the tract.

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REFERENCES

Dewan, M. L. A. 1953 Pre-irrigation Soil Survey. *J. Soil and Water Cons. in India* 2 *(1)*: 4—11.

Govinda Iyer, T. A. and T. L. Subramanian 1960 Quality of irrigation waters Amaravathy ayacut area—*Madras agric. J.* 4 : 265—74.

Kelly, W. P. 1941 *Cation exchange in soils.* Reinhold Pub. Corp. New York.

—— 1951 *Alkali soils.* Reinhold Pub. Cosp. New York.

Raychaudhri, S. P. 1958 *Standard methods of Soil Survey.* Indian Agri. Res. Inst., New Delhi.

TABLE I.

Tentative average irrigable values for the soils of Amaravathy ayacut.

Taluk	Location	pH	M. E./100 grams of soil							Total and grade	Soil profile & grade	Average irrigable value
			Co_3	HCo_3	Cl	So_4	Ca	Mg	Na			
UDUMALPET TALUK	High Level	8·0	...	0·34	0·31	1·77	0·66	0·54	1·28	0·27 II	Generally 30" of soil free from undesirable layers such as hard pan etc., resting on gravelly layers. Permeable. Grade III	III
	Low Level	8·7	0·45	0·57	0·35	1·82	0·87	0·47	1·30	0·29 II	Generally less than 30" of soil resting on unpermeable layer or temporary high water table. Grade III	III
DHARAPURAM TALUK	High Level	8·6	0·28	0·58	0·62	0·95	0·64	0·62	1·10	0·13 I	Generally 30" or less of soil mixed with kankar nodules and rock fragments but free from undesirable layers such as hard pan etc., resting on gravelly layers permeable. Grade IV	III
	Low Level	8·6	0·40	0·56	0·33	0·87	0·52	0·25	1·39	0·18 II	Generally less than 30" of soil resting on impermeable layers or temporary high water table. Reclaimable. Grade III	III

UDUMALPET — MODERATELY DRAINED.

VEDAPATTI – PIT. No. 16

0"
Brown sandy, slightly aggregated, friable—
DIFFUSE CHANGE TO
8"
Dark brown sandy loose and with small pieces of ferruginous gravel
IRREGULAR CHANGE TO
20"
Dark brown gravelly sandy clay loam, structureless with fragments of decomposing feldspar and quartz in dark brown clay matrix overlying saft decomposing parent rock.
28"

MADATHUKULAM 0 PIT. No. 5

0"
Light brown sand slightly aggregated, friable consistence, few roots and neutral in reaction.
FAIRLY WELL DEFINED CHANGE TO
6"
Brown sandy hortizon with yellowish brown streaks and rounded ferruginous gravel.
GRADUAL CHANGE TO
20"
A brown sandy layer with more ferruginous gravel, fragments of quartz and feldspar than above overlying partly weathered parent rock.
30"

ELAYAMUTHUR – PIT. No. 19

0"
Red with tinge of grey at the surface due to organic matter, sandy with few ferruginous gravel and few roots and loose consistence.
ABRUPT CHANGE TO
18"
Reddish yellow to reddish-white sand, structureless with quartz, feldspar and few banker nodules overlying slightly slightly weathered soft rock.
37"

THUNGAVI – PIT. No. 19

0"
Brown sand, single grained, loose consisence, neutral in reaction and with few roots –
ABRUPT CHANGE TO
4"
Reddish brown clayloam, structureless moerately firm, with whitish streaks of Calcium carbonate.
ABRUPT CHANGE TO
18"
Light red sand with small pieces of gravel, streaks of Calcium carbonate and dark iron staiming.
ABRUPT CHANGE TO
22"
Dark brown gravelly sand with streaks of Carbonate and pieces of quartz etc., overlying soft decomposing rocks.
65"

AMARAVATHI NAGAR – PIT. No. 1

0"
Brownish blacksand slightly aggregated, loose consistence and with few roots.
ABRUPT CHANGE TO
4"
Brownish white sandyloam aggregated loose consistence, neutral in reaction and with few roots.
ABRUPT CHANGE TO
18"
Brown sand structureless and mixed with fragments of quartz feldspar and ferrugenous gravel
DIFFUSE CHANGE TO
30"
Whitish brown gravelly sand, structureless with kanker nodules and with more fragments of quartz and feldspar than above overlying less decomposed material and slightly fragmented solid rock

UDUMALPET — IMPERFECTLY DRAINED.

NILAMBUR — PIT. No. 10

- 0″ Greysand, loose, slightly moist, alkaline in reaction
  GRADUAL CHANGE TO
- 6″ Brown sandy, wet with highly dispersed clay, kankar nodules and ferrugenous gravel lying over an alkaline sub water table at 24″
- 24″

KUMARALINGAM WEST - PIT. No. 7

- 0″ Grey sandy loam, moderately aggregated, friable, neutral in reaction with greyish white patches due to salt on surface
  ABRUPT CHANGE TO
- 6″ Yellowish grey sandy loam, blocky slightly firm, alkaline in reaction, slowly permeable and with mottlings in the form of rusty streaks on a grey background.
  CLEAR CHANGE TO
- 12″ Grey sandy loam, blocky, highly dispersed clay, alkaline reaction with more rusty streaks, fragments of quartz and kankar nodules overlying on alkaline subwater table
- 24″

ELAYAMUTHUR – PIT. No. 43

- 0″ Light grey sandy loam slightly aggregated friable with lime concretions.
  IRREGULARLY CHANGE TO
- 3″ Gray brown sandy, moist with dark brown strains of iron and kanker nodules, alkaline in reaction.
  IRREGULARLY CHANGED TO
- 9″ Grey brown sandy loam, wet, sticky consistency, firm on drying, blocky structure, with lime concretions and lying above the water table. Wateralkaline to phenalphthalein.
- 32″

THUNGAVI — PIT. No. 20

- 0″ Light red sandy, clay highly dispersed, alkaline, small pieces of nodular calcium carbonate, slow infillration rate.
  IRREGULARLY CHANGE TO
- 12″ Red to brown heavier soils, blocky, highly dispersed clay, hard on drying with more kankar. nodules than above and also with dark brown rusty streaks overlying the water table at 36″, the subsoil water alkaline, water permeability slove.
- 36″

JOTHAMPATTY — PIT. No. 17

- 0″ Brown sand, highly dispersed, clay, low infiltation rates.
  GRADUAL CHANGE TO
- 6″ Brown sandy, loam blocky, firm with alkaline white streaks of kankar.
  GRADUAL CHANGE TO
- 24″ Dark brown sandy zone, sticky, firm on drying with dark brown nothings in the form of rusty streaks on a grey background dark brown iron gravel and grey to white kankar nodules.
  GRADUAL CHANGE TO
- 32″ Dark brown sandy loam sticky and hard on drying with mottling, concretions and nodules more than above on an alkaline water table at 37″
- 37″

DHARAPURAM — MODERATELY DRAINED AREAS

CHINNAKKAMPALAYAM — PIT. No. 30

0″ — Red brown sandy loam, slightly aggregated, loose and with few streaks of lime.

ABRUPT CHANGE TO

4″ — Red brown loam with kankar nodulep and few pieces of disintegrated rock fragments.

IRREGULARLY CHANGE TO

8″ — Red clay, blocky, firm with broken pieces of quarts pebbles, feldspar and kankar nodules cemented in a clay matrix and overlying the less weathered parent rock.

14″

CHETTIPALAYAM — PIT. No. 32

0″ — Graybrown sandy loam, aggregated, friable, with streaks of Calcium carbonate and moderately permeable,

ABRUPT CHANGE TO

6″ — Brownish black loam with kankar nodules.

IRREGULARLY CHANGE TO

12″ — Brownish black-clay to clay loam with plarty of kankar nodules and fragments of disintegrating rock overlying soft less weathered greissie rock.

26″

DHARAPURAM — IMPERFECTLY DRAINED AREAS ON THE FLOOR OF THE VALLEYS.

KUMARAPALAYAM – PIT. No. 26

- 0″ — Red, sandy, single grain loose and alkaline in reaction and with kankar.

  ABRUPT CHANGE TO
- 6″ — Reddish brown, sandy blocky, firm and abundant kankar.
- 13″

KARATOLU — PIT. No. 22

- 0″ — Red brown, moderately moist, sandy, loose, slightly alkaline, low infiltration rate due to highly dispersed clay and with kankar nodules

  ABRUPT CHANGE TO
- 4″ — Red brown sandy, moist, sticky, hard on drying, highty disbersed clay, alkaline in reaction, slow permeability and with kankar nodules overlying the water table at 14″
- 14″

CHINNAKKAMPAYAM – PIT. No. 28

- 0″ — Reddish brown, sandy single grain, loose, alkaline with streaks of calcium carbonate and few roots

  ABRUPT CHANGE TO
- 5″ — Reddish brown loam to to clay loam, blocky, sticky and hard on drying with abundant calcium carborate nodules overlying the water table at 17″. Water alkaline to phenalphthalien
- 17″

CHETTIPALAYAM PIT. No. 31

- 0″ — Brownish black loam, aggregate, friable with streaks of calcium carbonato and plenty of roots alkaline in reaction
- 6″ — Black, loam to clay loam, hard, blocky with plenty of calcium carbonate nodules, alkaline in reaction and low permeability.
- 18″

NATTUKAPALAYAM – PIT. No. 34

- 0″ — Grey brown sand, structureless loose with streaks of calcium corbonate.

  ABRUPT CHANGE TO
- 4″ — Brown gravelly and dispersed clay with few nodules of kankar and low permeability.

  GRADUAL CHANGE TO
- 11″ — Red to red brown gravelly sand with plenty of fragments of parent rock and kankar nodules overlying less weathered and soft parent gneissic rock.
- 42″