https://doi.org/10.29321/MAJ.10.A03220

Madras agric. J. 64 (8) : 497—505, Aug., 1977

Soils of Kovilpatti Taluk, Their Use and Applications for Dryland Agriculture and Planning

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A soil map of Kovilpatti taluk was prepared to show the extent of occurrence and distribution of the six soil series identified in the taluk. The nature and magnitude of problems associated with these soil series were discussed and measures to achieve success in dryland agriculture through consumptive use of moisture, erosion control measures, improving nutrient status, etc., were suggested.

Kovilpatti is one the ten taluks of the Tirunelveli district in which the Integrated Dryland Agriculture Project is in operation. In order to provide basic information for planning and execution of project, a detailed working Knowledge of the soils of the taluk is necessary. Hence a reconnaissance soil survey of the taluk was conducted during 1971-72. This inventory of the soil resources of the taluk, besides providing basic information will also help in locating problem areas, so as to suggest remedial measures and for exploiting the potentialities for intensive agriculture.

MATERIALS AND METHODS

A reconnaissance soil survey was carried out adopting 'Standard Soil Survey' techniques (Anon., 1970). Sixty profile pits were examined, covering the entire taluk based on heterogenity. Representative samples from the established soil series were studied in detail in the laboratory for various physico-chemical characteristics (A.O.A.C., 1950; Piper, 1950).

RESULTS AND DISCUSSION

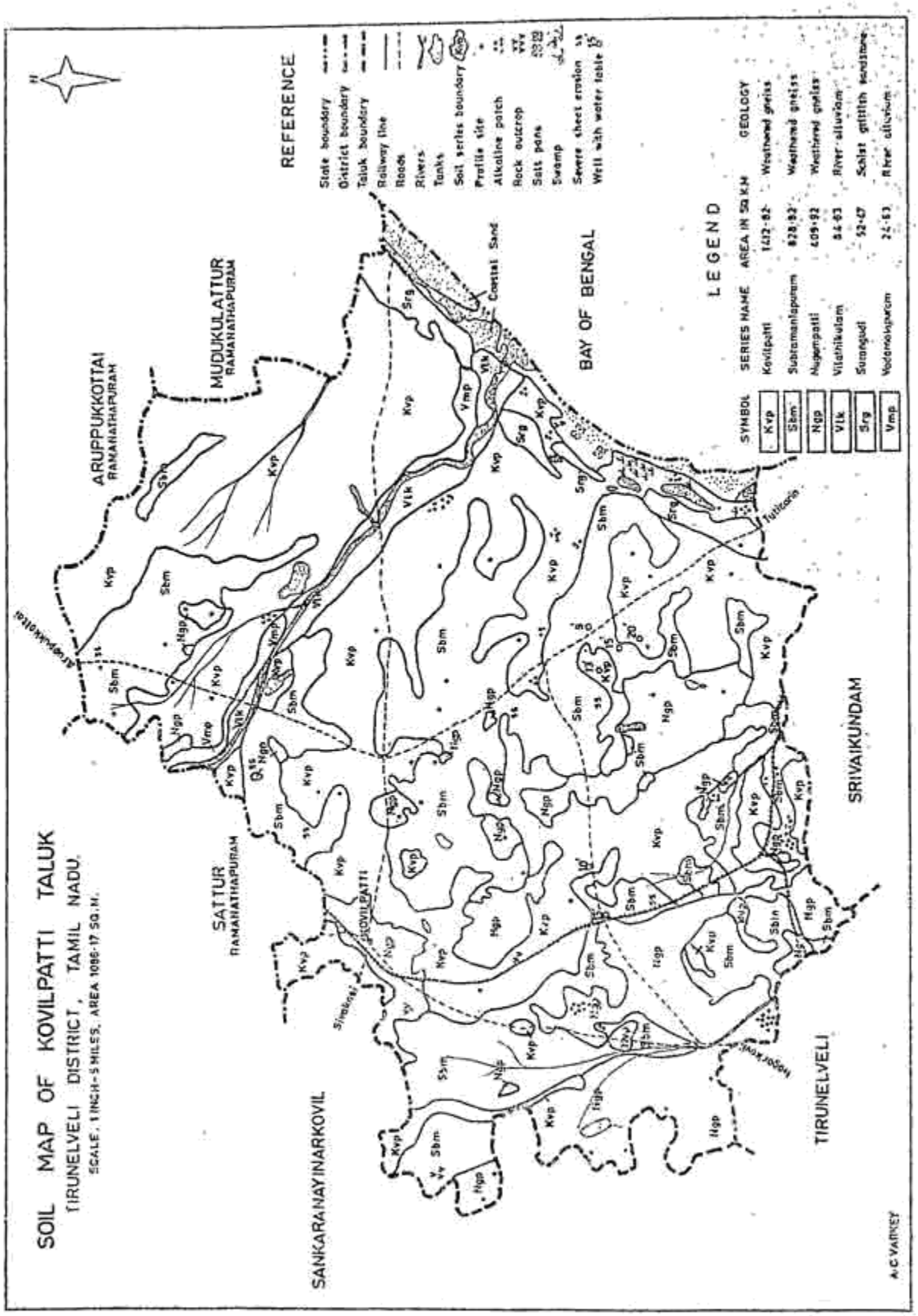
Six new soil series were established and a soil map of 1:63,360 was prepared (Fig. 1).

Description of the area

a) **Physiography, relief and drainage:** Kovilpatti taluk lies between 8° 45' and 9° 20' North latitude and 77° 40' and 78° 25' East longitude situated in the Northern side of the Tirunelveli district. The taluk is a vast stretch of plains, with intermittent elevated plains in patches, occupied by red soils. The main drain line is Vaipar which empties its contents into the Gulf of Mannar. The rainfall is poor (620 mm) and the weather is hot and oppressive.

b) **Geology:** It is mainly of Archaean gneisses and schists with

1-6 : Soil Survey and Land Use Organisation, Coimbatore.


SOIL MAP OF KOVILPATTI TALUK
TIRUNELVELI DISTRICT, TAMIL NADU.
SCALE: 1 INCH = 5 MILES. AREA 1086·17 SQ. M.
REFERENCE
State boundary
District boundary
Taluk boundary
Railway line
Roads
Rivers
Tanks
Soil series boundary
Profile site
Alkaline patch
Rock outcrop
Salt pans
Swamp
Severe sheet erosion
Well with water table
LEGEND
SYMBOL
SERIES NAME
AREA IN SQ KM
GEOLOGY
Kvp
Kovilpatti
1412-82
Weathered gneiss
Sbm
Subramaniapuram
828·82
Weathered gneiss
Ngp
Nagampatti
409·82
Weathered gneiss
Vlk
Vilathikulam
84·63
River alluvium
Srg
Sumaguli
52·67
Schist gritish sandstone
Vmp
Vodamalapuram
24·63
River alluvium
BAY OF BENGAL
Coastal Sand
ARUPPUKKOTTAI
RAMANATHAPURAM
MUDUKULATTUR
RAMANATHAPURAM
SATTUR
RAMANATHAPURAM
KOVILPATTI
SANKARANAYINARKOVIL
SRIVAIKUNDAM
TIRUNELVELI
Tuticorin
A.C. VARKEY

crystalline limestones, fluviatile and marine alluvia and the aeolian deposits of Teris and sand dunes, occurring towards the coast.

Description of the soils

Six soil series were recognised, described and mapped. General information about these six soil series are given in Table I.

I. Kovilpatti series (Kvp)

Horizon	Depth in cm	Macromorphology
Ap	0-19	Very dark greyish brown (10 YR 3/2)M; dark greyish brown (10 YR 4/2)D; clay loam; wet, coarse crumbs breaking in to finer crumbs; slightly sticky and slightly plastic, friable moist, slightly hard dry, small, $CaCO_3$ concretions, 7-10%, violent effervescence; moderately rapid permeability; pH 7.5; clear, smooth boundary.

TABLE I. General information about the soil series

Name of the soil series	Brief description	Extent in Sq. km.	Percentage to the total area	Parent material	Ground water table (in meters)	Crops grown
Kovilpatti	Black, very deep, heavy, calcareous with cracks and gilgai microrelief, gypsum, occur in the subsoil	1334.8	48.00	Weathered gneiss	3 to 13	Cotton, cumbu, chillies
Subramaniapuram	Black, very deep, heavy calcarious, non-gypsiferous with vertic characteristics	828.82	29.45	,,	6 to 13	Cotton, cumbu, chillies, gingelly
Vilathikulam	Dark yellowish brown, very deep, calcarious medium textured	84.51	3.01	Alluvium	3 to 5	Cholam, cumbu, cotton, groundnut, avuri
Vadamalapuram	Greyish brown, very deep, calcarious, medium textured	24.6	0.88	——	——	Cumbu, cotton, chillies, ragi
Nagampatty	Red, deep to very deep, non-calcareous, coarse textured	400.92	14.58	Weathered gneiss	——	Groundnut, cumbu, chillies, samai
Sivagudi	Red, deep to very deep, non-calcareous, coarse textured	52.47	1.87	Aeolion deposits	5 to 10	Groundnut, ragi, cholam, avuri

A_1V	19-37	Very dark grayish brown (10 YR 3/2)M and D; clay; medium, Moderate, subangular blocky; indistinct, intersecting slicken sides; violent effervescence; moderately; rapid permeability; PH 7.4; few, fine roots; diffuse boundary.
A_2V	37-87	Very dark brown (10 YR 2/2) M and D; clay, strong, medium, angular blocky, prominent, intersecting slickenside; very sticky and very plastic; very firm moist, very hard dry; violent effervescence; slow permeability pH 7.4; few, fine roots; diffuse boundary.
A_3V	87-107	Very dark grayish brown (10 YR 3/2) M and D; few, fine, faint, dark grayish brown (10 YR 4/2) mottles due to CaSO4 crystals) clay-loam; weak, coarse, subangular blocky indistinct, intersecting slickensides; stickly and plastic, friable moist; small $CaCO_3$ concretions, 20-25%; violent effervescence, moderately rapid permeability, pH 7.4; abrupt, smooth boundary.
C Ca +Cs	107-123	$CaCO_3$ concretions, more than, 50% mixed with prominent gypsum crystals.

II. Subramaniapuram series (Sbm)

Horizon	Depth (in cm)	Macromorphology
Ap	0-15	Dark greyish brown (10 YR 4/2) M; Dark gray (10 YR 4/1) D; clay; weak, medium crumbs; sticky and plastic, very friable moist; very few emall, irregular, iron and $CaCO_3$ concretions; violent effervescence; few, fine, roots; moderately rapid permeability, pH 7.6, clear smooth boundary;
$A_{12}V$	15-75	Dark gray (10 YR 4/1)M and D silty clay; moderate, coarse, angular blocky; slicky and plastic, moist firm; very hard dry; prominent slicken sides; very few, small, $CaCO_3$ and iron concretions; cracks 4 cm wide; moderate permeability; pH 7.5; diffuse boundary.
$A_{13}V$	75-111	Dark gray (10 YR 4/1) M and D; silty clay strong, coarse, angular blocky; very sticky and plastic; moist firm, dry very hard; prominent slickensides; very few irregular $CaCO_3$ and spherical iron concretions; violent efferve-

scence; pH 7.3; moderately slow permeability.

C Ca 111-142 Weathered gneiss with $CaCO_3$

III. Nagampatty series (Ngp)

Horizon	Depth (in cm)	Macromorphology
Ap	0-17	Yellowish red (5 YR 4/6) M and (5 YR 5/6) D; loamy sand; single grained; very rapid permeability; pH 7.0; clear, smooth boundary
B_{21}	17-50	Dark and (2.5 YZ 3/6) M; red (2.5 YR 5/8) D; gravelly clay loam; massive, slightly sticky; moist firm, dry hard; 1-2% iron concretions; 3-5% quartz gravel; moderate permeability; pH 6.5; clear smooth boundary.
B_{22}	50-120	Dark red (10 YR 3/6) M and D; gravelly clay massive; sticky, moist friable, very hard dry, thin clay films, small, 5-8% iron concretions; abundant, small quartz fragments, moderately slow permeability; pH 6.3; abrupt smooth boundary.
C	120+	Weathered gneiss.

IV. Surangudi series (Srg)

Ap	0-11	Dark reddish brown (2.5YR $\frac{3}{4}$) M, (2.5 YR 3.5/4) D; loamy sand; weak, fine crumbs; moist very friable, soft dry; rapid permeability; pH 7.0; plentiful fine roots; gradual, smooth boundary
B_1	11-23	Dark reddish brown (2.5 YR 3/4 M, (2.5 YR 3/6) D; sandy loam; moderate, fine to medium Subangular blocky; slightly sticky, friable moist, slightly hard dry; many, fine roots; rapid permeability, pH 4.7; gradual, smooth boundary.
B_2	23–165	Dark reddish brown (2.5 YR$\frac{3}{4}$) M, sandy clay loam; massive, sticky and plastic; friable moist, very hard dry; moderately rapid permeabiiity; pH 4.8.

V. Vilathikulam series (Vlk.)

Ap	0-17	Dark yellowish brown (10 YR 3.5/4) M; yellowish brown (10 YR 5/4 D; loamy sand; weak, medium subangular blocky breaking into crumbs; very friable moist, soft dry; rapid permeability; pH 7.4; many, fine roots; smooth boundary.
	17-71	Dark brown (10 YR 4/3) M; sandy clay loam; strong, coarse, subangular blocky; slightly stic-

ky and plastic, very firm moist, very hard dry, moderately rapid permeability; pH. 7.4;fine roots; gradual smooth boundary.

71-107 Dark brown (10 YR 4/3) M; sandy clay loam; strong, coarse, subangular blocky; sticky and slightly plastic, moist very firm, very hard dry; 2-3 sized, 3-5% $CaCO_3$ concretions, strong effervescence; moderately rapid permeability; pH 8.2; gradual, smooth boundary.

107-160 Dark brown (10 YR 4/3) M rubbed; fine sandy clay; moderate, medium, subangular blocky; sticky and slightly plastic; moist very tirm, hard dry; 5-10% $CaCO_3$ concretions; violent effervescence; moderately slow permeability; pH 9.0.

VI. Vadamalapuram series (Vmp)

Ap 0-14 Darkgrayish brown (10 YR 4/2) M, brown (10 YR 5/3) 4; sandyloam: weak, medium, subangular blocky, slightly sticky, very friable moist; very few, small, $CaCO_3$ concretions; effervescence localised; fine roots; rapid permeability; pH 8.1, abrupt smooth boundary

B_{21} 14-50 Dark greyish brown (10 YR 4/2) M; clay; moderate, medium, subangular blocky; sticky and plastic; friable moist, hard dry; few $CaCO_3$ concretions; violent effervescence; few roots; moderately rapid permeability pH 7.8; clear, smooth boundary.

B_{22} 50-71 Dark greyish brown (10 4/1) M; clay; moderate, medium, subangular blocky, very sticky and plastic, friable moist, few small $CaCO_3$ concretions; violent effervescence; very few, fine roots; moderate permeability pH 7.6; diffuse boundary.

B_{23} Ca 71-163 Greyish brown (10 YR 5/2) M rubbed; clay loam; weak, medium subangular blocky, slicky and plastic, very friable moist; small, irregular, 45-50% $CaCO_3$ concretions; violent effervescence; moderately rapid permeabilitp; pH 8.2; diffuse boundary.

The physico-chemical properties are presented in Table II. Soils of Kovilpatti and Subramaniapuram series are neutral in reaction, deficient in organic matter, rich in clay and silt and

TABLE II. Analytical data of soil series

Series	Depth (cm)	pH	EC X 10	Moisture %	Coarse sand%	Grain sand%	Silt %	Clay %	Water holding capacity	Toral Ca%	Total Mg%
Kovilpatti	0-19	7.5	0.11	2.98	12.40	8.20	25.77	53.64	56.2	3.7	1.09
,,	19-37	7.4	1.15	3.06	10.30	8.90	22.17	56.29	59.4	4.5	1.44
,,	37-87	7.4	0.95	2.65	9.20	8.15	23.20	59.76	60.0	4.2	1.67
,,	87-107	7.4	0.28	2.81	5.70	5.90	25.16	63.48	70.0	5.8	1.78
Subramaniaparam	0-15	7.6	0.60	2.31	7.95	13.85	22.56	52.76	52.2	5.7	2.42
,,	15-75	7.5	0.95	3.03	6.15	9.70	26.81	57.43	55.0	5.7	2.24
,,	75-111	7.3	0.11	2.67	14.20	11.30	20.86	54.27	52.3	5.9	2.13
Vilathikulam	0-17	7.4	0.2	1.6	36.99	40.51	7.90	12.80	26.25	0.7	0.12
,,	17-71	7.4	0.2	2.6	33.13	41.64	4.74	20.99	45.92	1.1	0.06
,,	71-107	8.2	0.4	2.5	11.28	61.45	6.13	18.18	53.19	1.5	0.23
,,	107-160	9.0	0.4	3.2	9.81	61.65	5.58	21.43	54.83	2.2	0.40
Vadamalapuram	0-14	8.1	0.094	1.6	47.44	35.12	3.28	11.34	33.46	0.5	0.5
,,	14-50	7.8	0.123	3.9	35.89	25.50	4.45	31.59	51.11	1.5	0.63
,,	50-71	7.6	0.130	4.5	31.01	29.33	5.35	32.13	45.81	3.8	0.46
,,	71-163	8.2	0.140	4.0	29.52	33.34	8.46	27.97	49.05	4.7	0.46
Nagampatty	0-17	7.0	0.2	0.5	11.30	66.48	0.45	10.49	28.95	0.5	0.58
,,	17-50	6.5	0.2	1.55	51.80	17.65	0.48	17.25	30.43	0.2	0.52
,,	50-120	6.3	0.2	3.06	42.30	10.30	1.22	19.67	42.04	0.6	0.23
Surangudi	0-11	7.0	0.2	0.76	29.06	60.29	0.45	10.47	29.11	0.3	0.29
,,	11-23	4.7	0.2	0.83	23.35	57.35	0.48	17.25	33.89	0.3	0.14
,,	23-165	4.8	0.2	1.11	13.69	65.66	1.22	19.67	34.87	0.5	0.58

have a water holding capacity ranging from 50-70% throughout the pedo unit. These soils are very deep, crack heavily in summer and are subject to sheet and rill erosion. The rainfall is scanty but sudden, heavy and of short spell, received mostly in the form of cloud-bursts. Deeper ploughing prior to monsoon may help in penetration and retention of moisture. Though these soils are on 0-3% slopes, sufficient bunding, stabilized with cuttings of *Ipomea* sp may be useful. Water harvesting techniques such as farm pond, stubble mulch, strip cropping, deep tillage, surface and subsurface tillage, trenches, dug out pits, may be tried with success. In these vertisols, the cultivation should be so adjusted and planned that the crop passes the anthesis stage before the cracks widen for maximum utilisation of moisture.

The cation exchange capacity ranges from 42 to 55 m. e/100g of soil through the pedo unit, with a good reserve of bases.

As these blacksoils occupy nearly 2200 Km^2 accounting for 70% of the total area of the taluk (2814 Km^2) the entire economy of the taluk mainly

depends on these two series. Based on the consumptive use of moisture for various crops, the sequence was found to be fodder cholam, bajra, sunflower and cotton for the taluk. Better variety coupled with better management and suitable crop rotation and mixed cropping can definitely bring better returns in these soils.

The Vilathikulam and Vadamalapuram series are alluvial soils occurring as a strip along the banks of the river Vaipar. The organic matter reserves are poor and medium in nutrient status. The clay percentage is from 18-30% and the water holding capacity is on an average 45% throughout the pedon.

The Nagampatty series are red soils occupying comparatively higher elevations and are susceptible to sheet and gully erosion and need conservation measures. The soils are neutral and the water holding capacity in consonance with the clay percentage increases with depth.

The Surangudi series are sandy aeolion deposits, poor in organic matter, cation exchange capacity and exchangeable bases. The clay content varies

TABLE III. Analytical data of soil series

Series	Acid insolubles %	R_2O_3 %	Fe_2O_3 %	Al_2O_3 %	CEC me/ 100g	Ex.Ca me/ 100g	Total P_2O_5%	Total K_2O %	Organic carbon %
Kovilpatti	67.20	13.25	4.56	8.69	51.0	—	0.115	0.68	0.56
,,	66.65	11.21	3.76	7.45	52.0	—	0.125	0.96	0.56
,,	62.22	10.80	3.84	6.96	46.8	—	—	0.69	0.40
,,	94.14	8.17	3.20	4.97	55.0	—	0.195	0.71	0.40
Subramaniapuram	61.91	9.71	3.76	5.95	42.1	—	0.205	0.59	0.43
,,	59.79	12.15	4.40	7.75	48.9	—	0.215	0.75	0.47
,,	64.74	13.65	5.12	8.53	53.1	—	0.265	0.76	0.54
Vilathikulam	93.65	2.80	2.16	0.64	8.3	0.8	0.290	0.04	0.30
,,	88.41	6.58	3.44	3.14	15.3	1.7	0.240	0.34	0.25
,,	83.91	5.09	3.52	1.57	14.2	4.3	0.375	0.13	0.10
,,	93.50	9.20	4.32	4.88	17.4	4.75	0.335	0.10	0.13
Vadamalapuram	93.55	3.29	2.48	0.81	10.1	1.95	0.130	0.34	0.17
,,	84.35	7.37	3.12	4.25	19.2	4.45	0.305	0.36	0.29
,,	79.27	7.87	3.60	4.27	25.4	9.25	0.215	0.32	0.23
,,	77.85	6.70	2.88	3.82	22.6	10.05	0.345	0.15	0.33
Nagampatti	93.50	4.30	3.04	1.24	3.4	0.25	0.085	0.04	0.56
,,	87.24	9.10	4.76	4.34	4.9	0.80	0.075	0.04	0.39
,,	73.01	20.50	8.32	12.18	7.9	1.05	0.145	0.13	0.44
Surangudi	88.20	4.85	3.92	0.96	3.7	0.2	0.080	0.15	0.26
,,	90.95	6.98	3.20	3.78	3.2	0.25	0.115	0.04	0.25
,,	90.35	7.75	3.44	4.31	3.6	0.35	0.100	0.04	0.15

from 10-19% and the soil is susceptible to wind erosion. Provision of wind belts and planting of grasses may be advocated.

The advantage of adding fertilizers in dryland agriculture has been clearly broughtout taking into consideration the soil test value, available moisture and bulk density (Ramamoorthy and Chandrasekara Rao, 1973). Split application of nitrogenous fertilizers and basal placement of phosphatic fertilizers can also be boldly adopted (Krishnamoorthy, 1974) to boost the productivity.

A geological survey to explore the underground potentials of water and crop insurance can bring hopes of improving agriculture and thereby the economic status of the cultivator.

The authors wish to thank Messrs K. S. Nair, D. M. Samuel, and M. Jayaraman for their guidance and Thiru A. C. Varkey for the preparation of the map.

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