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# technical bulletin



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DEPARTMENT OF AGRICULTURE,  
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**Detailed Soil Survey Report  
of VARSODA Ravine  
Reclamation Project  
District : Mehsana**

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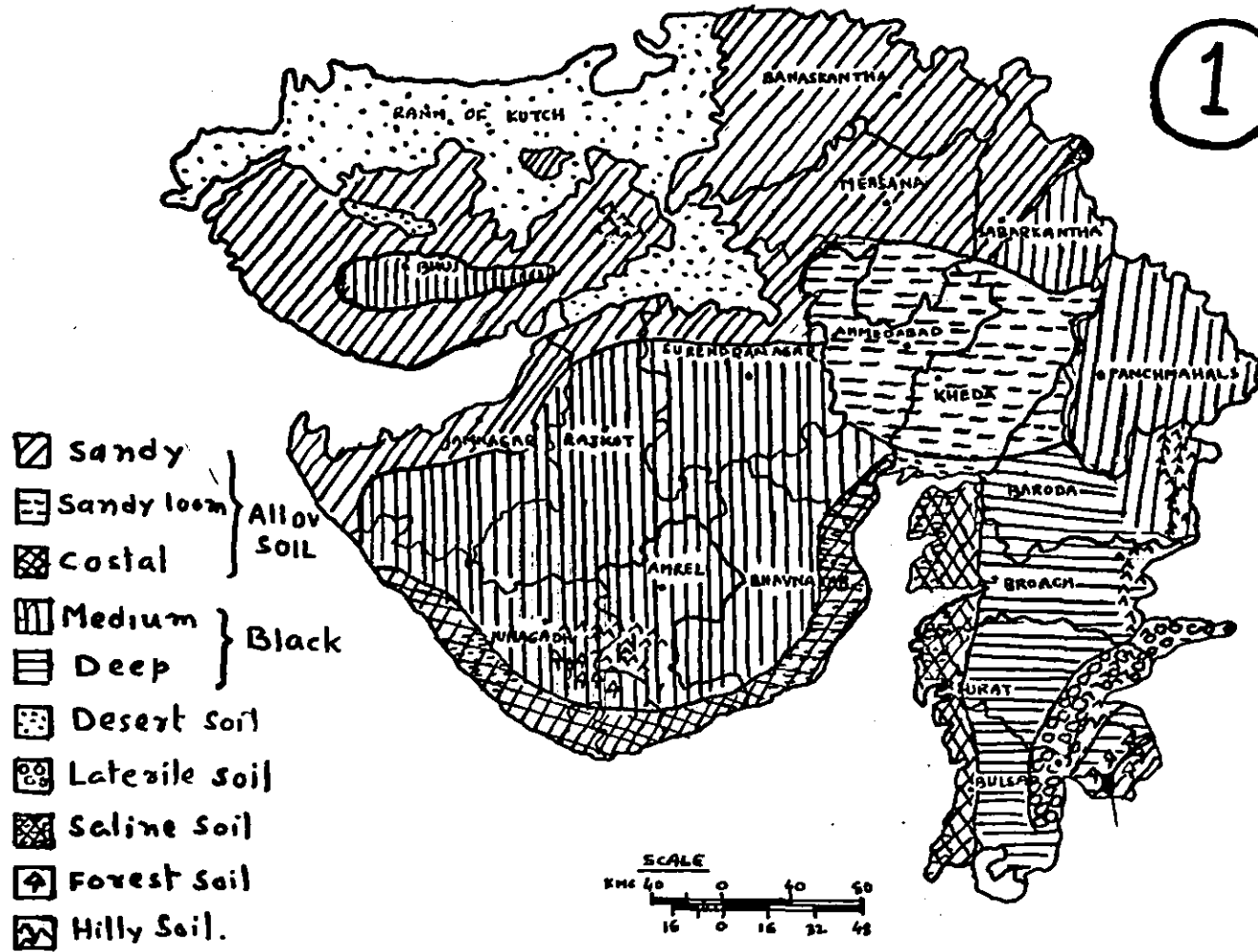
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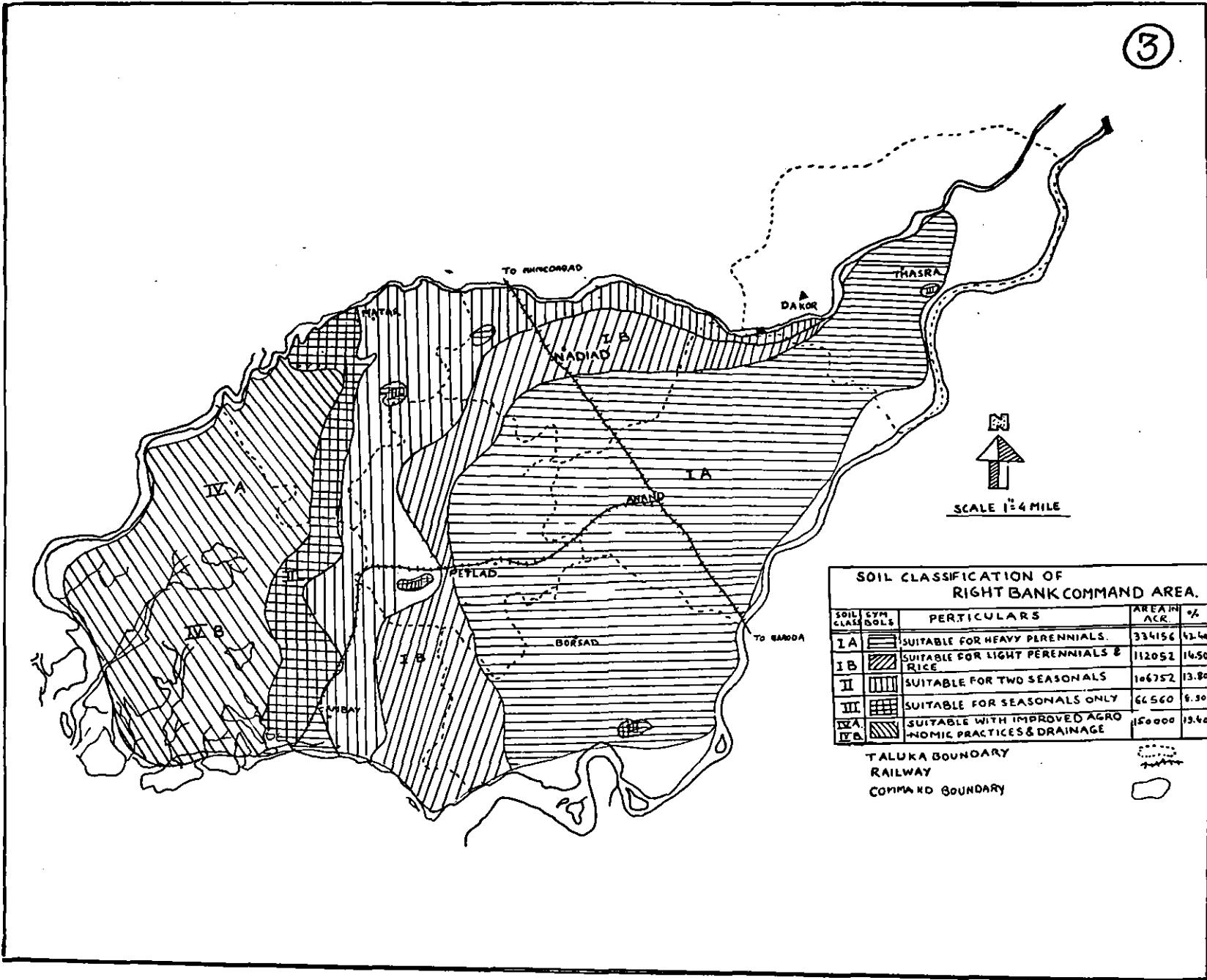
# GUJARAT

## SOILS

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**SOIL CLASSIFICATION OF  
RIGHT BANK COMMAND AREA.**

SOIL CLASS	PERTICULARS	AREA IN ACR.	%
IA	SUITABLE FOR HEAVY PERENNIALS.	33456	43.44
IB	SUITABLE FOR LIGHT PERENNIALS & RICE	112052	14.50
II	SUITABLE FOR TWO SEASONALS	106752	13.80
III	SUITABLE FOR SEASONALS ONLY	66560	8.30
IV A	SUITABLE WITH IMPROVED AGRONOMIC PRACTICES & DRAINAGE	150000	19.40
IV B			

TALUKA BOUNDARY  
RAILWAY  
COMMAND BOUNDARY

## How to use and Read Soil Survey Report :

This report begins with introductory chapter followed by general description of the area giving details about location and extent of the area, physiography, relief and drainage, geology, climate and natural vegetation and Socio-economic conditions in chapter-II, present land use, crop rotation, irrigation, manures, and fertilizers in Chapter-III

The soil and land use map of village on the scale of 8"=1 mile as discussed in the report is appended herewith. In order to use the soil map, first we have to locate the particular point of our interest on the map. For doing this map should be oriented on the ground with the help of the permanent features like village site, road, path, nalas survey numbers, survey stones etc. The distance for any of these reference point to the field of our interest is noted on the corresponding distance on the ground is calculated. After locating the particular place, the detailed information about the land capability morphological features etc can be obtained from the soil units marked on the map. The soil units are marked in a symbolic way as  $\frac{1-Ls-d5}{B-e2}$

means - 1=Lawarpur-1 series.

Ls=Loamy sand texture (surface)

d5=Very deep - i.e. 90 cms. deep.

B=Very gently sloping (1 to 3% slope)

e2=Moderate erosion.

While the ravines are marked in a way like Ls-D2-W2-S2-L2-2 which indicates that

Ls = Loamy sand texture (surface)

D2 = Medium ravines-1.5 to 5.0 mtrs deep.

W2 = Narrow ravines-3 to 15 mtrs. wide

S2 = Steep slope-45° to 90° with "V" shaped ravines.

L2 = Medium length-1 to 3 kms. long ravines.

2 = Small catchment area of ravines i.e. X 2 hectares.

The explanation of various such symbols can be read from the attached table under explanation of symbol for "Map legend". The details of the soil series and their profile characteristics are described in the chapter "Soils of the area".

The definitions for land use capability classes, subclassed and units and their recommendations made for soil conservation and proper land use management depending on the degree of limitations is referred in the chapter "Land capability classification and recommendations". Information furnished therein is useful for capability assessment of the area and its perspective planning, in respect to the management of soils for stepping up Agricultural production without deterioration of soils.

## Detailed Soil Survey Report of Varsoda Ravine Reclamation project, Ta : Vijapur Dist. : Mahesana.

### INTRODUCTION

Extensive productive agricultural lands along the banks of rivers of Gujarat viz. Narmada, Orsang, Mahi, Watrak, Shedhi, Meswo, Khari, Sabarmati, Saraswati, Banas and their tributaries are affected by severe gully erosion which are popularly termed as "Kotar" lands. These areas extend longitudinally upto six to eight kilometres along the banks of these rivers. It is estimated that Gujarat has a ravineous area of about 4 lack hectares. The principal causes of gully erosion are high intensity of rainfall during a short rain storm, high erodibility of alluvial soils due to its loose geology and faulty land management practices.

Ravines are extensive systems of gullies running more or less paralld to each other generally in alluvial terrain and draining into a major river or its tributary with development of deep gorges and riverian terraces at the end e. g. Ravines system along Narmada, Mahi, Sabarmati and their tributaries. The magnitude of the problems of eorsion presents a stretygic challenge to the existance of the people in the areas around ravines assuming alarming proportion for its urgency to stop erosion of land which is the main supporter of life is being wornout year after year by ravines, which are spreading their tentacles in the cultivated land.

The extension of ravines year after year renders the adjoining fertile lands unfit for cultivation. At places, the ravines are not only damaging the agricultural lands beyond manageable repairs but also encroach into the village habitations forcing the people to shift the entire village. Thus ravines are causing untold miseries and hardships, as village roads, cart tracks, railways and public property are being damaged by the ever increasing ravines. The deep ravines have become a hideout for decoits. Further, the production potential of food grains, timber, fuel and industrial raw materials from these ravineous areas fall below the margin.

Since the ravines are formed by a process of soil erosion and they may be in a stage of continuous active growth, the remedy lies in adopting comprehensive soil conservation approach on a watershed basis.

For further lateral expansion of area aiming at increasing agricultural production and rehabilitation of landless labour, the ravinous lands are the only land resources. With this aim in mind ravines need to be stabilised and the lands thus reclaimed be brought under cultivation, Pasture and forest as per its suitability on the watershed basis.

Soil and land use survey is prerequisite for any treatment of land. Detailed soil survey of the ravines would serve as a guide line for prospective detailed planning for the development of land and water resources as survey would furnish detailed comprehensive informations on the type of ravine, system and its extent, extent of table land etc. of the entire watershed, cropping pattern and human and cattle interference etc. as well as water resources. With a view to study the characteristics of soils and present management and causative factors of ravines. Detailed survey of Varsoda Ravine Reclamation Project was under taken by Soil Survey Organisation, G. S. Navsari headed by Shri M. Z. Patel and D. B. Patel Soil Survey Asstts. from 1-5-1975 to 11-6-1975.

#### 1.2 Objectives of Ravine Survey :

(a) To ascertain the magnitude of ravine devastation, scientific survey and collecting basic data with regard to the extent and type of ravine system, land utilization, cropping pattern and human and cattle population helping to obtain a lateral expansion of lands to help in increasing agricultural production and rehabilitation of landless labour etc.

(b) To arrest further growth of ravines and to save the valuable agricultural table land for its encroachment by the rapidly growing ravines and further deterioration studying the causative factors for formation of ravines.

(c) To design structures and practical and economical feasible methods for treatment, reclamation and improvement of the areas for substained production as per inherent soil characteristics of table, peripheral, humps, ravines and hummocks based on erodibility of land, cover, slope etc.

(d) For devising a scientific system for watershed planning and development based as per needs of the area and soil-water-crop-ecology relationship.

(e) To improve the water regime of the area and better land use as per land capability of the entire watershed based on the inventory of soil characteristics viz. texture, structure, depth, slope, present land use, drainage etc.:

## SECTION I

### General description of the area

#### (a) Location and extent :

The surveyed area lies between 72°-46' to 72°-49' E Longitude and 23°-8' N to 23°-10' N Latitude. The project area is situated in south to south-east about 30 kms. from Gandhinagar, about 9 kms. to the east of Mansa, about 22 kms. to the North of Vijapur, about 7 kms. away to the North from Mahudi in Vijapur Taluka, Dist. Mahesana and about 7 to 8 kms. away to the west from Prantij, Dist. Sabarkantha.

The project area is surrounded by Lakroda village to the East, Ambod and Badpura village to the west, Pundhra and Nawapura village to the North and Gunma village and Sabarmati river to the south.

#### (b) Physiography, Relief and Drainage :

The average elevation of the area is 325' i. e. 97.5 metres above the mean sea level. The average slope of the table land is 0 to 3%, while it is 3% to 5% for peripheral land and 3% to 10% for ravine land. This area is physiographically covered under dissected alluvial plain as the alluvial plain is dissected by numerous ravines flowing through it. This is the middle region between hilly track of vindhyans from where the river sabarmati originates to its meeting point in the Arabian sea. The ravines generally run parallel to river or its tributary which includes shallow, medium, deep and very deep ravines but the magnitude of very deep and deep ravines is more than two third than shallow and medium types.

The dissected alluvial plain can be divided into the following sub-units.

(1) Table land and Marginal land. (2) Hump land and middle terraces. (3) Lower terraces of the river and narrow ravine beds.

The description of the above sub units run as under.

(1) The table land is situated in the upper catchment of the watershed which is flat and under intensive irrigated agriculture having a slope of 0-3% having slight erosion. Adjoining to this table land dissected gently sloping peripheral land or marginal land occur having a slope of 2% to 5% and having moderate to severe erosion.

(2) The hump land of middle terraces is highly dissected gently sloping to moderately sloping undulating to rolling land which is partly cultivated and the rest is uncultivated having severe to very severe erosion hazard.

(3) The lower terrace land is slightly dissected, very gently sloping and wide bottomed as well as narrow bottomed valley land having a slope, of 0-3% and under-going slight to moderate erosion as well as remains flowing during monsoon.

The drainage direction of the surveyed area is generally from North to South but Northeast to southwest and south is also observed at places. All the ravines drain in sabarmati or its tributaries. The drainage of the tributaries is mostly subparallel to parallel and is structurally controlled.



The ravinous area has predominantly dendritic type of drainage pattern but some ravines have sub-dendritic to sub parallel type of drainage pattern. The soils of the catchment are perfectly well drained.

The relief of the area is almost normal.

#### (c) Formation of Ravines :

When the rain water falls on soils, Unprotected by any vegetative cover resulting in splash, sheet, rill or gullies, depending upon the topographical factor. Ravine does not denote an isolated gully but a system of gullies running more or less parallel to each other in deep alluvium and entering in a near by river. The loose nature of alluvial soil in which a major river cuts a channel very deep from its banks leads to the problem of the run-off from the table land to travel a steep vertical fall in a short horizontal distance. This conditions attributes to the development of numerous gullies running along their river banks and form ravine. This ravine grows by the phenomenon of saturation of head and sides resulting in slips and erosion accelerate further the head and its sides. Depending upon the soils vegetation, topography and concentration of the run off from the watershed, different shapes, stages and sizes of the ravines are developed. Virtually the levels of lower terraces are generally the erosion bases for the ravines and three distinct stages of development of ravine lands are recognised viz. Juvenile, Matured, and senile.

Initially the ravine formation may be due to run-off and the extension and deepening may be due to the spring sapping and slumping of the top soil. Thus it can be said that bad land management both in catchment area of ravines as well as in the catchment area of the river, play a major role in the formation and extension of ravines.

#### (d) Geology :

Calcareous Sand stone in form of conglanated alongwith little mica & mica schist is met throughout the plain area below the depth ranging from 40 to 70 mts deep. The rocks are of recent origin. They are in the initial process of consolidation and mostly in loose condition. The sand stone forms the single biggest geological formation within the catchment of river Sabarmati in this area and as such the valley abounds in sand deposits.

The thickness of the alluvium varies from 30 mts to 50 mts deep. This has encourage deep rooted trees like Ficus, Mango, Babul, Neem etc.

#### (e) Hydrology :

Sabarmati river traverses through the area and deposits alluvium at the meanders and the recent deposits are very deep varies from 30 mts to 50 mts deep. This region is at present fully dependent on the under-ground water resources. No major tank is available which can provide water for irrigation purpose. Undergorund water is either pumped out by tubewells or open wells. As per the report from the ground water investigation division, Ahmedabad the area can yield sufficient potable water if tube wells are located at proper distance to avoid interference of each other. But during the survey work it is observed that many tubewells had failed to yields sufficient water for irrigation. Even many Government tube wells have failed to yield sufficient water. The average depth of the ground water ranges from 35 to 50 metres.

The average rainfall of the area is 663 mms with 37 rainy days and is mostly received during monsoon season. The large amount of rainwater is drained into the river Sabarmati and small quantity is accumulated in the field tanks and village tanks. These tanks are shallow in depth and narrow in width. The tank water is utilized for cattle drinking and washing purpose.

#### (f) Climate :

The climate of the area is semiarid steepe as per Goppen's and Thornth-wait's classification. The terrain experience mild winter and hot summer. The bulk of the precipitation of 663 mms ( Average of 1963-74 ) is received in 37 rainy days having a span of wet season of about 122 days followed by 243 days of dry period.

It is summarised from Average rainfall ( average of 1961 to 1974 ) recorded at pilwai Agril. Research Station, Ta. Vijapur Dist. Mahesana ( Table No. 1 ) that 90% of the mean annual rainfall is received in the monsoon season. July receives the maximum precipitation and then gradually receding.

From table No. 2 (a) it is observed that the temperature begins to rise onwards from March to May. May is the hottest month of the year. The mean annual maximum temperature in this month ranges from 29.6°C to 37.8°C with the onset of monsoon in the second or third week of June, there is a considerable fall in the temperature which continues till September. The temperature slightly rises in the month of October. There is again a fall in the temperature with onset of winter and remains more or less same. The mean maximum temperature ranges from 29.6°C to 23.9°C, during December to February months. Generally December and January are the coldest months of the year.

The diurnal variation of temperature is maximum in the winter months, the mean being 12.6°C while it is the lowest in the monsoon months, the mean being 8.4°C.

It can be roughly stated that the mean annual temperature of the surveyed area is more than 22°C, while the mean summer and winter temperature differ by more than 5°C ( 11°C difference ) which categorises the soils of this area under the hyperthermic temperature family.

The humidity remains the maximum in the early morning and the minimum in the after-noon. It is about 55% to 60% in the winter months and 80% to 85% during monsoon months, during morning, while it is about 25% in winter and about 70% in the monsoon months during afternoon. Occasional dust or hail storms in summer and at some time frost in winter season are common features in the surveyed area.

#### (g) Natural vegetation :

Natural vegetation ( farm forestry ) comprises of dry deciduous type mostly xerophytes. Due to Tropical semi arid climatic conditions and excessive biotic interference, the vegetal cover is sparse and restricted to sparse grass, bushes, shrubs and xerophytic species. The trees remain stunted as excessively browsed by cattle.

Efforts made by state Department of Forest to afforest, certain patches of ravine land on both the sides of Sabarmati river are noteworthy.

Following natural species were observed in the surveyed area.

1. *Tamarindus indica* (Khati amla) 2. *Azadirachta indica* (Neem) 3. *Mangifera indica* (Mango) 4. *Acacia arabica* (Babul) 5. *Ficus bengalensis* (Banyan tree) 6. *Ficus religiosa* (Pipal) 7. *Zizyphus jujuba* (Bor) 8. *Zizyphus nummularia* (Chinibor) 9. *Capparis aphylla* (Kerado) 10. *Calotropis gigantea* (Ankado) 11. *Casia aniculata* (Aval) 12. *Casia tora* (Kunvadio) 13. *Euphorbia* species 14. *Solanum nigrum* (Piludi) 15. Makrod tree (Local name).

Amongst the grasses, the following are observed. Most of them are of Bioedaphic in nature.

1. *Cynodon dactylon* (Dharo) 2. *Dicantium annulatum* (Zingavo) 3. *Cyperus rotundus* (Chido) 4. *Sachharam spontaneum* (Dabhado) 5. *Cenchrus ciliaris* (Moshi) 6. *Eliolopsis binata* 7. *Aristida* Sp.

**SECTION - II PART - A**  
**Agriculture and present land use practices**

**(a) Land use :**

About 40 to 50% of flat area of the project is under intensive Agriculture and fiat. Varieties of crops are grown. Out of the total area under cultivation 50% of the area is under cultivation of kharif and Rabi, crops, while the rest 50% of the area is under cultivation of kharif, Rabi and hot weather crops. Almost all cereals, legumes, pulses and cash crops are grown, as the soil is ideal for most of the crops.

Large acreage of submarginal land termed as Gochar land remains fallow in ravine area. This area is recorded as Govt. Waste land in revenue records. As a result of extension of ravines every year, the area of gochar land is reducing. Every village has such gocher land.

The details of land use of the surveyed are is given below :

	Area in hectares	% of Total
1. Village site & tank	49.00	2.17
2. Area under cultivation	1469.00	65.14
3. Area under Gocher land	244.00	10.83
4. Area under wide valley bottom ravines	461.00	20.44
5. Area under Narrow valley bottom ravines.	32.00	1.42
Total project area	2255.00	100.00

**(b) Agriculture :**

Some of the important crops grown in the area are Bajara, Jowar, Wheat, Cotton, Tur, vegetables, Tobacco, Cumin, Fennal etc.

As the area is very close to the Capital, the agriculture is keeping pace with the modern development

Use of mechanised implements, fertilizers, insecticides, pesticides and irrigation for ensured production are being adopted by majority of the farmers. Mixed cropping is followed in dry conditions, to get some crop in the event of failure of rains. Efforts are always made by farmers to get their fields irrigated through tube wells or open wells. However, one third of the surveyed area produce top or more crops in the year.

**(c) Irrigation :**

One third of the total area i. e. 30% to 38% is under irrigation by tube wells/open wells. The remaining area depends on rains. There are sixty tube wells in the surveyed area. Irrigation in some area is also given through tube wells situated near by the average water table of the surveyed is about 35 to 40 metres during hot months, and the tubewell water is sufficient to run the pumps throughout the year.

**(d) Crop rotation (Crop sequence)**

Common sequences followed in the irrigated fields are as under.

1. Bajra-wheat-vegetables
2. Bajara-Cumin-Vegetables.
3. Fennel-Vegetables.
4. Cotton-vegetables.
5. Castor-Vegetables.

Crop sequence followed in the dry land agriculture are as under.

1. Bajra-Jowar (fodder)
2. Bajra-Tur (mixed)
3. Castor-fallow.
4. Tobacco-fallow
5. Cotton-fallow.

**(e) Pasture and grazing :**

Every Grampanchayat has got some area earmarked as "Gochar" land. As the holding of cultivators is small, they have to depends on this "Gochar" land to graze their domestic animals. Due to continuous over grazing, misuse and bad management practices of this "Gochar" land, ex-

tension of ravines has resulted with the result that gochar land is reduced considerably every year. Some people also depend mainly upon gochar land for their fuel requirements. They uproot small shrubs and bushes for this purpose and expose the soils resulting in severe erosion and thus damaging the gochar land.

Following grasses are met in the surveyed area :

1. *Eliolopsis binata*
2. *Cenchrus ciliaris*
3. *Aristida* Sp.
4. *Sachharam*
5. *Spontanium*
6. *Cynodon dactylon*

**(f) Manures and Fertilizers :**

Farmers generally apply 15 to 20 cart loads of F.Y.M. per hectare. Manuring by sheep and goat is also practiced by the cultivators.

The chemical fertilizers such as Urea, D.A.P., Ammonium Sulphate, Super phosphate, Muriate of potash, N.P.K. and other mixed fertilizers are also used by cultivators.

The recommended doses of fertilizers for main crops as for dry farming and irrigated agriculture are shown in table No. 4.

## SECTION - II PART - B

### Socio-economic Conditions

**(a) Occupation :**

Agriculture is the main occupation of the people. Dairying is also a most remunerative subsidiary occupation with Agriculture. Landless people are engaged for farm labour work; grazing of sheep, goats etc. Some people are engaged in brick making industry, while some are engaged for rural and household industry. During summer some people raise water melon and musk melon in the river bed.

**(b) Communication and Transport :**

Best communication and transport is possible through Mansa-Gandhinagar-Ahmedabad state high way road. Although some motorable S. T. routes joining to Mansa-Prantij Via Lakroda, Mansa, Lakroda, Mahudi-Gandhinagar Via Rangpur etc are available. All the villages are connected by cart track and foot ways. During rainy season transport becomes difficult due to deep and very deep ravines encroaching the roads and cart tracks. Even some villages become isolated during flood or high rains. Yet the flow in the river remains so slow or partially nil for more than six months (generally during January to middle of June months) so that any transport vehicle can cross the river.

**(c) Health service and Education facilities :**

Private dispensaries are available at, Varsoda, Rangpur, Makahad, Mansa, Vijapur, Prantij. Primary health centres are situated at Varsoda, Mahudi, Vijapur, Mansa. Civil Hospitals are situated at Gandhinagar, Mahesana, Kalol. Veterinary service is available at Mansa and Varsoda.

The primary education is imparted almost in all villages through primary schools. Secondary education is available through secondary schools at Varsoda, Mansa, Mahudi, Prantij, Vijapur, Gandhinagar. The College education is available at Vijapur, Gandhinagar, Kalol, Ahmedabad Prantij.

**(d) Animal Husbandary and Live stock :**

Mahesani and Surati buffaloes are maintained by cultivators for Milk. They are generally stall fed and grazed by nutritive lucerne, Sundhia jowar Jowar and Bajra Bantu, different types of goats. Cotton seed and groundnut cakes and other feeds. Sheep and goats are grazed on pasture or gochar land.

## SECTION III

### Soils of the Area

#### (a) Method of Soil Survey :

Detailed Soil Survey of the area was conducted as per instructions laid down in the soil survey Manual I. A. R. I. New Delhi (Revised edition (1970) adopting ravines survey standard and Morphometry proposed by central ravine reclamation Board.

Cadastral map of 8"=1 mile, supplied by D. S. C. O., (P P), Ahmedabad was used as a base map for conducting Detailed Soil Survey. Traversing was done at an interval of 200 metres in the plain area while 30 to 40 metres or less in the ravinous area depending upon the heterogeneity in soils of plain and ravinous area. The traversing interval of ravinous area was kept less to study the different phases such as depth, width, side slope, stage, length and catchment area of ravine which are helpful in marking the ravines.

The detailed field study includes deep bores for noting variation of surface soils and morphological characteristics and profile pits for morphological characteristics of soil. Soil profiles thus examined were grouped into soil series/association as per similar or slightly varying morphological characteristics like texture, structure, Colour, consistency, Presence and amount of concretions and other features. Soil series is further sub-divided into soil type on the basis of difference in the texture of the surface soils. The mapping units for plain area and ravine area on the cadastral map are "Soil phases" which are the subdivision of the soil types. Each mapping unit is shown on the map

by a symbol <sup>1</sup> N-Ls-d5/A-e1 which indicates Lawarpur-I soil series, Loamy sand texture very deep levelled to nearly levelled land with nil to slight erosion and the symbol Ls-D3S2L2-2, which indicates soils loamy sand texture, deep wide, steep-U shaped, ravine having medium length with small catchment area.

Physiographic position, present land use, drainage, permeability and other relevant features were also studied and noted during traversing. Twenty eight profile pits were dugout upto 180 to 200 cms depth, to study the morphological characteristics. At the site of the profile pit, important features viz. slope, depth of the soil, erosion, water table physiographic position, land form of the surrounding country, present land use etc were noted.

#### (b) Soil formation :

The soils of the area being originated from the heterogeneous parent Material viz. Schist, Gneisses, Slate, Granite, Quartzite and Cretaceous lime stone of Aravalli hills and redeposited as a river alluvium, falls under broad soil group of sand deposits.

The soil genesis in this area is mainly governed by the influence of climate and topography and unlike other areas parent materials have played passive role. The soil formation under the direct influence of climate is loose and open, having more of disintegrated coarser primary minerals due to semiarid climate of the area either of aeolian or alluvial effect indicating pronounced mechanical weathering over chemical weathering and less leaching of alkali and alkaline secondary products. The resulting soils are with Ac profiles with yellowish brown to grayish brown colour. These soils are usually deep to very deep, loose and open having more disintegrated coarse primary materials and underlain by (C<sub>0a</sub>) layer impregnated with carbonate and hard compact pan having mild to moderately alkaline reaction.

The soil heterogeneity in the plain area is observed due to the effect of moisture regime as affected by prevailing effects of climate.

These soils are of recent alluvium of Sabarmati and its tributaries nearer the river & have not attained soil development due to erosion and the soils flooding (Entisols). There is some evidence of alternation in the soil profiles are observed in this area. Leaching of calcium carbonate in substratum was observed in the flat area. Similarly the ravinous area which are highly dissected and eroded, the soils have not been long enough in place to be affected by pedogenic processes. These are mapped under "Inceptisols" and "Entisols" respectively.

According to the physiography, in relation to the drainage pattern the soils of the dissected alluvial plain (the surveyed area) are classified into the following five geomorphic units.

1. Flat to very gently sloping table land having 0-3% slope.
2. Moderately dissected gently sloping table land having 3-5% slope. (periphery areas anjoining the ravins.)
3. Highly dissected gently sloping undulating hump land having 3-5% slope.
4. Highly dissected moderately sloping rolling hump land having 5-10% or more slope.
5. Slightly dissected very gently sloping wide valley bottomed land of lower terrace (Fluventic materials) and miscellaneous ravine bed lands having 0-3% slope.

The table showing the different soils occurring under different geomorphic units in the area with their slope and erosion features.

Physiography	Geomorphic units	Soil Series	Slope	Erosion
Dissected Alluvial plain.	1. Flat to very gently sloping table land.	Lawarpur-I Rangpur-I	0-5% 0-3%	Slight to moderate erosion.
	2. Moderately dissected very gently to gently sloping table land	Rangpur-II Lawarpur-II	2%-5% 2%-5%	Moderate to severe erosion, do
	3. Highly dissected gently sloping undulating hump land of middle terraces.	Ratanpur-I	3%-5%	Severe to very severe erosion.
	4. Highly dissected moderately sloping rolling hump land of middle terrace.	Ratanpur-II	5%-10%	Very severe erosion.
	5. Slightly dissected very gently sloping wide valley bottomed land of lower terrace and Sabaramati narrow ravine bed lands.	Firozpur and Sabaramati ravine bed land.	0-3% 0-3%	Slight to moderate erosion. Very severe erosion.

### (c) Soil Classification :

The soils occurring in this area are classified as per U. S. D. A. VII the approximation as under.

Sr.No.	Soil series	Soil family	Sub-group	Great group	Sub-order	Order
1	2	3	4	5	6	7
1.	Lawarpur-I	Lawarpur-I fine loamy deep, illitic, hyperthermic, deep, vertic Ustochrepts.	Vertic Ustochrepts	Ustochrepts	Ochrepts	Inceptisoils
2.	Rangpur-I	Rangpur-I fine loamy moderately deep to deep illitic, hyperthermic, moderately deep vertic Ustorthents.	Vertic Ustorthents	Ustorthents	Orthents	Entisols
3.	Lawarpur-II (Calcarious)	Lawarpur-II fine loamy, deep 1:1 type illitic, hyperthermic, deep, calcarious, vertic Ustochrepts.	Vertic Ustochrepts	Ustochrepts	Ochrepts	Inceptisols

1	2	3	4	5	6	7
4.	Rangpur-II (salty and calcareous)	Rangpur-II fine loamy to loamy, shallow, calcareous 1:1 illitic mixed, hyperthermic, typic- ustochrepts.	Typic Ustorthents.	Ustorthents	Orthents	Entisols.
5.	Ratanpur-I	Ratanpur-I, fine loamy, moder- ately deep to deep, calcareous, loamy illitic, hyperthermic vertic usto-orthents.	Vertic Ustorthents.	Ustorthents	Orthents	Entisols.
6.	Ratanpur-II	Ratanpur-II, fine loamy, shallow, illitic, hyperthermic, calcareous, (shallow), typic Ustorthents.	Typic Usto-orthents	Ust-orthents ,,	Orthents	Enttsols.
7.	Firozpur	Firozpur, deep, mixed, illitic, hyperthermic, typic Ustifluents.	Typic Ustifluents.	Ustifluents.	Fluents	Entisols.
8.	Sabarmati ravine bed soils	Sabarmati ravine bed land, shallow to moderately deep, coarse loamy, mixed hyper- thermic, shallow Ustipsamments.	Shallow Usti- psamments	Ustipsa- mmments.	Psamments.	Entisols.

## (d) Soil Series :

Lawarpur-I, Rangpur-I, Lawarpur-II, Rangpur-II, Ratanpur-I, Ratanpur-II, Firozpur and Sabarmati ravine bed soils series are tentatively indentified and mapped. Their extent and boundaries as per their physiographical situations is given in Table No. 5.

## 1. LAWARPUR-I SERIES :

Tentative

Lawarpur-I series includes very deep, well drained, fine loamy soils occurring on nearly level to very gently sloping midland-table land situated with gradient ranging from 0.5% to 2% developed on older alluvium. The thickness of the solum ranges from 140 cms. to 160 cms. The soil is dark brown to yellowish brown in colour. The control section is free from lime concretions, while C horizon gives either nil or slight effervescence with dil Hcl.

These soils have about 20-25 cms. thick surface horizon (AP), which is yellowish brown to dark brown in the hue of 10 YR., values 3 to 4 and chromas 3 to 4. The main soil types are loamy sand, sand and sandy loam with crumb to single grain structure. The sub soil underlain by Ap is dark brown to very dark grayish brown in the hue of 10 YR., values 3 and chromas 2 to 4; sandy loam texture and weak columnar breaks into weak fine subangular blocky to weak medium subangular blocky peds. The C horizon is dark yellowish brown to dark brown in colour of hue 10 YR to 7.5 YR., values 3 to 4 and chromas 2 to 4 with single grain to crumb in structure, loamy sand to sand in texture and gives slight effervescence with dil Hcl.

Lawarpur-II series which is deep, Vertic, Ustochrepts, Rangpur-I series and Rangpur-II series are dark yellowish brown to yellowish brown in colour but Rangpur-I soils do not give effervescence with dil HCL up to about 60 cms deep, while Rangpur II is calcareous and gives strong to violent effervescence throughout the profile depth and the C horizon has sandy texture.

These soils (Lawarpur-I series) have been classified under very deep, loamy, illitic, hyperthermic, deep, vertic Ustochrepts (Inceptisols).

Lawarpur-I soils are well drained with moderately rapid to rapid permeability. Available water holding capacity is low. The soils have low to medium natural fertility. They are susceptible to erosion especially sheet erosion associated with rills and gullies at places.

The soils are cultivated under rainfed as well as irrigated condition. Prominent crops grown are Hybrid Bajra, Tobacco, Cotton, Jowar, Wheat, Tur, Sesamum, Castor, Vegetables, Cumin, Fennel etc.

The soils give good response to application of manures and fertilizers. Higher yield can be obtained through water conservation practices and soil management practices like ploughing, sowing across the slope and contour bunding. This would help in reducing the erosion hazards consequently available moisture would be utilized by growing crops. Irrigation by tube wells is better but due to about 35° meters deep water table, the construction and digging of wells become costlier. Development of pastures around the periphery will be helpful for hay making and to check erosion. The insect and ant burrows and crotovinas are observed throughout the profile depth.

## 2. RANGPUR-I SERIES :

Rangpur-I series includes deep, well drained, fine loamy, dark yellowish brown to yellowish brown soils of hue 10 YR., occurring on nearly level to very gently sloping table land with gradient ranging from 1% to 3% slope. The thickness of the solum ranges from 50 to 90 cms deep. The control section is free from lime concretions while C horizon contain common to many lime concretions giving strong to violent effervescence with dil HCl. Many white streaks of some salts are observed in 'C' horizon. The insect and ant burrows are observed in throughout the profile depth. They have slight to moderate erosion hazards.

These soils have surface soil horizon (Ap) about 20-25 cms. which is dark yellowish brown to yellowish brown of hue 10 YR., values 4 to 5 and chromas 3 to 4 loamy sand texture and crumb to weak fine subangular blocky peds. The subsoil underlain by surface soil horizon have colour ranges from dark brown to dark yellowish brown of hue 10 YR., values 3 to 5 and chromas 3 to 4; weak fine to medium subangular blocky peds and loamy sand to sandy loam texture. This is followed by calcarious thick "C" horizon which have yellowish brown to dark yellowish brown and pale brown colour of hue 10 YR., values 4 to 6 and chromas 3 to 4; loamy sand to sand texture and massive to single grain structure.

Lawarpur-I, Lawarpur-II and Rangpur-II series occurs on table land having same physiography, Lawarpur-I soils are very deep, illitic, soils occurring on nearly level to gently sloping land. Lawarpur-II soils are deep, illitic soils occurring on gently slopy to undulating dissected physiography peripheral to ravine land and Rangpur-II soils are generally calcarious, having many white streaks of some salts and loamy sand to sandy loam texture.

These soils (Rangpur-I soils) have been classified under deep, fine loamy, 1:1 lattice illitic, hyperthermic, deep, vertic Ustorthents (Entisols).

Rangpur-I soils are well drained with moderately rapid to rapid permeability. Available water holding capacity is low and the soils have low to medium fertility. They are susceptible to slight to moderate erosion hazards which is associated with sheet erosion rill erosion and gully erosion.

The area is under cultivation of crops like wheat, Bajra, Paddy, Jowar, Lucerne, Tur, Vegetables castor, Sesamum, Cotton etc crops in irrigated as well as rainfed condition. The main natural vegetation comprises of Mango, Meem, Bebul, Banyan, Zizyphus, Euphoribia species, capparisa aphylla etc trees.

The soils give good response to application of manures and fertilizers in both irrigated as well as rainfed condition. Higher yields can be obtained through water conservation practices and soil management practices like ploughing, sowing across the slopes and contour bunding. The transplanting of trees and thorns (Euphoribia species) help in reducing the erosion hazards and consequently available moisture would be utilised by growing crops.

Development of pastures around the shallow ravines and gullise and in very gently slopy land will be helpful for hay making and check the movement of water & reducing the sediments from the slopy area.



### 3. LAWARPUR-II SERIES

Lawarpur-II series includes deep, well drained fine loamy, dark brown to yellowish brown soils occurring on gently slopy to strongly slopy undulating peripheral ravine lands with gradient ranging from 2% to 5%. The thickness of the solum ranges from 80-120 cms deep. The soils are mostly free from lime concretions but 'C' horizon gives strong effervescence with dil HCl. The mica flakes, sand gravels and quartz gravels are present in the soil. The insect and ant burrows and crocovinas are observed throughout the profile depth of the soil. They have moderate to severe erosion hazards.

These soils have about 20-25 cms thick AP (surface soil) horizon which is yellowish brown to dark brown of hue 10 YR and 7.5YR, values 4 to 5, and chromas 2 to 4, loamy sand and fluventic sandy texture and crumb to single grain of weak fine subangular blocky structure. The subsoil (B) underlain by surface soil horizon have colour ranges from dark brown to dark yellowish brown of hue 10YR and 7.5YR, values 3 to 4 and chromas 2 to 4, sandy loam, sandy clay loam or loam texture and weak fine to medium subangular blocky structure. This is followed by a calcarious, thick "C" horizon which have dark brown to pale brown of hue to 10 YR and 7.5 YR, values 3 to 5 and chromas 4 to 6, sandy loam, loamy sand and sand texture and crumb to single grain structure.

Lawarpur-II Rangpur-I, and Rangpur-II series occurs on table land having same physiography Lawarpur-I soils are very deep, illitic to soils occurring on nearly level to very gently sloping land. Rangpur-I soils and Rangpur-II soils are dark yellowish brown to yellowish brown soils. Rangpur-I soils are noncalcarious upto about 60 cms and then gives strong effervescence with dil HCl while Rangpur-II soils are generally calcarious throughout the soil depth or after 20 cms depth and having loamy sand and sand texture.

These soils (Lawarpur-II Soils) have been classified under deep, fine loamy 1:1 lattice hypothermic, deep, vertic Ustochrepts (Inceptisols).

Lawarpur-II soils are well drained, with moderately rapid to rapid permeability. Available water holding capacity is low and the soils have low to medium natural fertility. They are susceptible to moderate to severe erosion hazards which is associated with sheet, rills and gully erosion.

Some of the area is under cultivation of crops like Bajra, Castor, Sesamum, Cotton, Jawar, Tur, Cumin, Fenal etc crops mostly in rainfed condition while few area are under irrigation. While other ravine area is under pasture and grass land. The natural vegetation comprises of Mango, Neem, Babul, Bagan, Zizyphus, Capparis, Aphylla, Aval, Casia etc trees and shrubs. While grasses like Sachharm, Spontanium, Aristida Sp., Cynodon dactylon, Eliolopsis binata etc.

The soils give good response to application of manures and fertilizers, even under rainfed condition. Higher yields can be obtained through irrigation water conservation practices and soil management practices and soil management practices like ploughing, sowing across the slopes, contour bunding, terracing, plugging of gullies and shallow and medium ravines by bulldozers and transplanting of trees and thorns (Euphorbia species) in ravine beds and periphery of the fields and ravines. This would help in reducing the erosion hazards, consequently available moisture would be utilized by growing crops.

Development of pastures around the periphery of the ravines will be helpful for hay making and check the momentum of water, reducing the sediments from the slopy area.

### 4. RANGPUR-II SERIES :

Rangpur-II series includes moderately deep, to deep well drained, fine loamy, dark yellowish brown to yellowish brown of hue 10YR. to 7.5YR. Soils occurring on very gently slopy to gently slopy midland table land with gradient ranging from 2% to 5% slope. The thickness of the solum ranges from 70 to 78 cms. The soils are calcarious throughout the profile depth except at few places where soils are noncalcarious upto about 25 cms. depth. The lime concretions are common to many in abundance and

gives strong to violent effervescence with dil Hcl. Many white streaks of some salts are observed throughout the profile depth but mostly from 20 to 100 cms. depth from the surface of the soil. Ant burrows and insect burrows are observed throughout the profile depth. They have moderate to severe soil erosion hazards.

These soils have about 20 to 25 cms. thick surface soil horizon (Ap) which is dark yellowish brown to yellowish brown of hue 10 YR. values 4 to 5 and chromas 3 to 4; loamy sand texture and crumb to weak fine subangular blocky peds. The subsoil underlain by surface soil horizon have colour ranges from Dark brown to dark yellowish brown and brown of hue 10 YR. values 3 to 4 and chromas 3 to 4; sandy loam and loamy sand texture and weak fine to medium subangular blocky peds. This is followed by highly calcareous thick "C" horizon which have dark yellowish brown to pale brown colour of hue 10 YR. values 4 to 6 and chromas 3 to 4; sand to loamy sand texture and crumb to single grain structure.

Rangpur-II, Rangpur-I, Lawarpur-I & Lawarpur-II series occurs in the same physiography but Rangpur-I and Rangpur-II SOILS occurs on very gently to gently slopy eroded land. Rangpur-II soils are generally calcareous throughout the profile depth and have white streaks of salts from 25 to 100 cms. depth. Rangpur-I soils have white streaks of some salts after 90 cms. depth and is noncalcareous upto about 60 cms. depth. Lawarpur-II soils occur on very gently slopy to gently slopy peripheral land adjoining the moderately dissected ravines. Lawarpur-I soils are noncalcareous and very deep soils, occurring on nearly level to very gently sloping lands.

These soils (Rangpur-II soils) have been classified under deep, loamy, to coarse loamy, mixed, (illitic), hyperthermic, deep, shallow typic Ustorthents (Entisols).

Rangpur-II soils are well drained, with moderately rapid to rapid permeability. Available water holding capacity is low and soils have low to medium fertility. They are highly susceptible to moderate to severe erosion hazards which is associated with sheet, rills and gully erosion.

The surveyed area of these soils are under cultivation of crops like Bajra, Wheat, Tur, Castor, Fennel, Cumin, Cotton, Sesamum, Jowar etc either by irrigation or rainfed condition. The natural vegetation comprises of Mango, Neem, Babul, Banyan, Zizyphus capparidis aphylla, Euphorbia species and thorny bushes and shrubs.

These soils give good response to application of fertilizers and manures both in irrigated as well as rainfed condition. Higher yields can be obtained by application of manures to improve soil structure, water conservation practices and soil management practices like ploughing, sowing across the slope, proper methods of application of irrigation and contour bunding. The transplanting of thorns and trees help in reducing the erosion hazards and consequently available moisture would be utilised by growing crops.

Development of pastures around the gullies and gently slopy fields, will be helpful for hay making and check the movement of water reduce the sediments from the slopy area.

## 5. RATANPUR-I SERIES :

Ratanpur-I series includes deep well drained, fine loamy, dark brown to brown coloured soils of hue 10YR. to 7.5YR. occurring on gently slopy to strongly undulating middle terraced humped land having gradient ranging from 3% to 7%. The thickness of the solum ranges from 60 to 80 cms. deep. The control section is free from lime concretion while C horizon contain common to many lime concretions giving strong effervescence with dil Hcl. The insect and ant burrows and crotonas are observed throughout the profile depth of the soil. They have severe to very severe erosion hazards.

These soils has about 20-25 cms. thick surface soil horizon (Ap of A<sub>1</sub>-1) which is dark brown to brown of hue 10 YR. to 7.5 YR. values 3 to 4 and 2 to 4; loamy sand and (fluventic) sand texture and weak columnar breaks into single grain to weak fine subangular blocky peds. The sub soil underlain by surface soil horizon have dark yellowish brown to dark brown colour of

hue 10YR. to 7.5YR. value 3 to 4 and chromas 4; Sandy loam and loamy sand textures and weak columnar breaks into weak fine to medium subangular blocky peds. This is followed by a calcareous "C" horizon having dark yellowish brown to dark brown colour of hue 10 YR. to 7.5 YR values 3 to 5 and chromas 4. sandy loam, loamy sand or sand texture and massive to crumb structure.

Ratanpur-I, Ratanpur-II soils occur in the same dissected middle terraced physiographic sub unit. Ratanpur-II soils are calcareous soils and are shallow, loamy to coarse loamy, typic ustorthents occurring on highly dissected and very severely eroded narrow humps while Lawarpur-II soils are deep, well drained, fine loamy, soils occurring on gently slopy table land periphery adjoining the ravine land which suffers from moderate to severe erosion.

Ratanpur-I soils have been classified under moderately deep to deep, fine loamy, 1:1 lattice illitic to mixed, hyperthermic, vertic Ustorthents ( Entisols ).

Ratanpur-I soils are well drained to excessively well drained, with rapid permeability. Available water holding capacity is very low, and have low to medium natural fertility. They are highly susceptible to severe to very severe erosion hazards which are associated with deep ravines, sheet erosion, rill erosion and gully erosion.

The area is under pasture, grass land and grazing land under ravines. The natural vegetation comprises of Mango, Neem, Babul, Zizyphus, Capparis aphylla, thorns plants and bushes, casia tora, Euphorbia species etc trees as shrubs while grasses like Sacharam spontanium, Asistida species, Cynodon dactylon, Eliolopsis binata etc.

The soil is not able to give good response to application of manures and fertilizers due to severe to very severe erosion hazards. The plantation of horticultural plants can be done with water conservation practices and soil management practices like planting across the slopes, contour bunding, contour terracing, plugging of shallow and medium ravines by bulldozers and transplanting of trees and thorns in ravine beds and periphery of the fields and ravines. The constructions of engineering structures, grass wears, earthen bunds in ravine area would help in reducing the momentum of water flow and sedimentation in the ravine beds complete closure from the entrence of sheeps, goats and grazing animals in the ravine area and to leave ( to stop ) the cutting of bushes, shrubs and trees for fuel purpose would help in stabilization of ravines. The development of a pasture in the hump area will be helpful for hay making and to check the momentum of water, reduciag the sediments from the slopy area.

## 6. RATANPUR-II SERIES

Ratanpur-II series includes shallow to moderately deep, excessively drained, loamy to coarse loamy soils occurring on highly dissected, highly undulating and very severely eroded narrow ravine humps with gradient ranging from 6% to 10% or more. The thickness of the solum ranges from 32 cms to 40 cms. The size and abundance of lime concretions are increasing with depth giving slight to violent effervescence with dil. Hcl with increase in depth. Numerous white veins or streaks observed after 40 cms depth indicate the presence of some salts in large amount, Few of mica flakes, gravels etc are present throughout the profile depth. The insect and ant burrows and crotovinas are observed throughtout the profile depth. These soils suffers from wind erosion during the summer. The important characteristic of these soils is that the soils are very loose very severely eroded resulting in narrow humps which hava very loose geological material susecptible to very severe erodibility and it is the main reason for formation of very deep ravines on the bank of Sabarmati.

These soil have about 15 to 18 cms thick surface soil horizon (A1-1) which is yellowish brown to dark brown of hue 10 YR to 7.5 YR, values 4 to 5, and chromas 3 to 4, loamy sand to sand texture and weak fine subangular blocky to crumb structure. The subsoil underlain by the surface soil horizon is dark yellowish brown to dark brown of hye 10 YR to 7.5 YR values 4 to 6 and chromas 3 to 4, loamy sand to sandy loam texture and weak fine subangular blocky to single grain structure. This is followed by a highly calcareous, thick, loose "C" horizon which is very pale brown to he-

lloish brown of hue 10 YR to 7.5 YR, values 5 to 7 and chromas 4 to 6, silt loam, loamy sand or sandy texture and massive to loose single grain structure.

Ratanpur-II and Ratanpur-I soils occur on middle terraced narrow humps of ravine land. Ratanpur-I soils are deep, well drained, dark brown to brown soils occurring on strongly undulating middle terrace humps having gradient ranging from 3% to 7%.

Ratanpur-II are classified into shallow, loamy, mixed to 1:1 lattice, illitic hyperthermic, shallow, vertic ustorthents (Entisols).

Ratanpur-II soils are excessively drained with rapid permeability, available water holding capacity of the soils is very low and the soils have low natural fertility. They are highly susceptible to very severe erosion hazards due to its physiographic position and loose geological material. The formation of rills, gullies are observed here which are associated with sheet erosion.

The area is under waste land, grass land or grazing land which is converted into ravine land year by year. The main natural vegetation comprises of Banyantree, Neem, Mango, Babul, Aal, Zizyphus, Samadi, Thorny trees and casia tora, capharis aphylla, Euphorbia species etc as trees bushes and shrubs and natural grasses like Sachharam spontanium, Aristida species, Cynodon dactylon, Eliolopsis binata etc.

The soil gives low response to application of manures and fertilizers as it is highly susceptible to very severe erosion hazards. The plantation of some horticultural plants can be done with a great care with water conservation practices and soil management practices like soil working and planting across the slopes, contour terracing and contour bunding, plugging of shallow and medium ravines by bulldozers and transplanting of trees and thorns on the periphery of humps but it is costlier so it is better to leave the humps as such. It is better to restrict grazing and complete closure from the sheeps, goats, camels and complete restriction on cutting of the trees, bushes or shrubs in ravine would help to stabilize ravines and would also help in stopping the extension of ravine formation. The construction of engineering structures, diversion ditches and diversion bunds, bench terracing of shallow ravine land, with light bulldozing, bench terracing of medium ravines by medium dozers, construction of grass weirs, earthen bunds, chute structures, pipe drop inlets Or a planting of bamboos or other resistant trees in the ravine beds will help to reduce the momentum of water flow and help in sedimentation, and help in controlling the extension of ravines.

The development of pasture in the humped area after some soil management work and restriction of grazing would be helpful for hay making and check the velocity of water and reduce the sedimentation from the slopy area.

## 7. FIROZPUR SERIES :

Firozpur series includes deep to very deep, well drained, fine loamy fluventic soils occurring on very gently slopy to gently slopy lower river terraced soil with gradient ranging from 1% to 3%. The ground water table is about 7 to 8 meters deep during dry season and does not affect the soil condition. The thickness of the solum ranges from 85 to 120 cms. deep. The soils do not contain any lime concretions but gives strong to violent effervescence with increase in depth with dil Hcl. These soil is brown to yellowish brown in colour.

These soils have about 15 to 25 cms. thick surface soil horizon (Ap) which is brown to yellowish brown of hue 10 YR. values 4 to 5, and chromas 3 to 4; silt loam, loamy sand and sandy texture and single grain to weak fine subangular blocky structure. The subsoil underlain by the surface soil which is dark brown to yellowish brown and weak fine subangular blocky to crumb or single grain structure. This is followed by chromas having dark yellowish brown to yellowish brown of hue 10 YR. values 4 to 6 and chromas 3 to 4; loamy sand gravelly sand of fine sandy texture and single grain to massive structure.

Sabarmati ravine bed soils which have sand and silt loam texture up-to about 20-25 cms. depth and after that gravelly sand to sand of alternate layers starts and continues upto about 100 cms. and more deep. The Sabarmati ravine bed soils occur in the same physiography with Firozpur soils.

These soils (Firozpur) have been classified under deep, loamy, mixed or lil type illitic, hyperthermic, deep, Ustifluvents ( Entisols ).

Firozpur soils are well drained to excessively drained with rapid to very rapid permeability. Available water holding capacity is low but medium in natural fertility in soils having silt loam surface soil texture and low in fertility in soils having sand surface soil texture. They are highly susceptible to moderate to severe erosion, gully erosion, rill erosion and wind erosion. The wind erosion. The wind erosion is generally observed during summer season.

These soils are cultivated land under rain fed as well as irrigated condition. The important crops raised are Jowar, Wheat, Vegetables, Tur, Mug, Math etc. The main natural vegetation comprises of Neam, Babul, Mango, Tamarind, Capparisaphylla, Euphorbia species, Zizyphus species etc. The soils give good response to application of manures and fertilizers. Higher yield can be obtained through water conservation practices and soil management practices like ploughing, sowing across the slope and contour bunding. This would help in reducing the erosion hazards consequently available moisture would be utilized by the growing crops. Irrigation by tube wells is better but requires great care for the construction of well.

Development of pastures around the ravines and gullied area would be helpful for hay making and to check the soil erosion.

The insect burrows and ant burrows are observed throughout the profile depth of the soil.

## 8. SABARMATI RAVINEBED SOILS :

These soils are shallow to moderately deep, well drained to excessively drained, occurring on very gently slopy to gently slopy ravine beds with gradient ranging from 1% to 3%. The colour of the soils is brown to pale brown on the surface soils and pale brown to very pale brown in sub soil and light gray in substratum of C horizon. The main soil types are sand to loamy sand on surface soils, loamy sand and silt loam in sub soil and sand to gravelly sand in lower substratum or in lower C horizon. The soil does not contain lime concretions upto about 32 cms. depth contain common to many lime concretions giving violent effervescence with dil Hcl. The loose deposited gravelly material starts after about 32 cms. depth, tends to form loose conglomerate. The structure development is very weak i. e. single grain throughout the profile depth. Many quartz gravels and mica flakes are observed in the soil which gives shining appearance in Sun rays.

These soils have been classified under shallow to moderately deep coarse loamy, mixed, hyperthermic, shallow Ustipsamments, ( Entisols ).

The cuttings of wide valley bottomed ravine bed soil in the some of the project area show loamy sand upto about 20 cms. depth, full of lime concretions and give violent effervescence with dil. Hcl: while after 20 to 30 cms. depth loose single grain sand starts which indicates that the construction of engineering structures in wide valley bottoms are not effective to control the movement of water which is not the case in narrow ravine beds and hence constructing engineering structure would be helpful in controlling the movement of water. The construction structures, diversion ditches, diversion bunds and cutting and preparing of contour terraces, construction of grass weirs, earthen bunds, chnte structures, pipe-drop outlet or planting of bamboos or resistant trees in the ravine beds would be helpful to reduce the velocity of water and help in controlling the extension of ravines.

### (e) Distribution of soils under different soil series and phases :

Series wise distribution of the survey area under various classes of depth, slope, erosion, banded and unbanded areas is presented in table No. 6. This data has been derived from different soil mapping units recorded on village maps surveyed in detail.

From the table, it is clear that the Lawarpur-I series occupies the largest area of 866 hectares. The next large occupant is the Lawarpur-II to the extent of 287 hectares.

## SECTION IV

### Soil Survey Interpretation

#### (a) Land capability classification :

The land capability classification is an interpretive groupings of the soils that provide information at three levels of generalisation viz. (1) capability unit (2) class and (3) Sub class. These are mainly based on (1) The Inherent soil characteristics (2) External land features (3) Environmental factors that limit the use of land. Classification of soil units into capability groupings enables us to get a picture (i) of the soil hazard, factors responsible for such hazards causing soil damage, deterioration and lowering in fertility and (ii) its potentiality for production.

It is a hypothetical groupings of lands grouped according to their potentialities and limitations for sustained use for production of common cultivated crops, permanent vegetations and risk of soil damage if misused. Hence the soil characteristics such as soil depth, texture, structure, soil reaction, plant nutrients, environments past erosion hazards, susceptibility of erosion, present land use etc are the basic points of such interpretive Groupings.

Capability units are formulated from one or more mapping units which have similar inherent potentialities and limitations of similar nature to the same extent. Hence the soils in a particular land capability units are homogenous in respect of raising suitable crops, pasture adaptability management practices and general levels of yield response.

The subclass is a sub division of capability classes and groupings of similar units on the basis of similar kinds of predominant hazards and limitations operation on the land. Thus four kinds of limitations are recognised and the symbol indicated against each is used to suffix to the concerned land use class.

Hazards	Symbol
1. Erosion and runoff. ( includes risk of erosion and past erosion damage )	.....e
2. Excess of water (wetness, high water table, problem of drainage or overflow)	.....w
3. Rootzone limitations :- (shallow depth, low water holding capacity salinity or Alkalinity)....S	S
4. Climatic limitation.....	C

The subclasses are given as per above hazards. There may be one or more number of limitations, that can be operating then all are suffixed to the capability class.

The capability classes are based on the permanent characteristics and limitations of the soils affecting its use, risk of soil damage, need for soil management and risk of crop failure. They are grouped into eight capability classes-class I to class VIII and subclasses are suffixed to it. In class I, lands, the soils have few limitations, the widest range of use and the least risk of damages when these are used. The soils in the other classes have progressively increasing limitations. In soils of class I to class III, lands are generally suitable for short and long duration crops. The soils of class IV lands should be cultivated occasionally and should be under very careful management. The lands covered under class V is wet soils generally marshy and peat soils. The lands of Class VI to Class VII are unsuitable for common cultivated crops but suited to permanent vegetation i. e. Kept under pasture, forest or wildlife. The lands under class VIII are neither suited for crop husbandary nor for pasture and silviculture but are left for wildlife, watershed protection, recreation, and other purposes.

Table No. 7 shows the land capability units with their extent in hectares. The description of each capability unit is as under.

#### (b) Description of capability units :

##### 1. Capability unit : II-1. 37.00 Hectares.

The soils in this unit are good cultivated, level to nearly level, very deep fine to coarse loamy soils of Lawarapur-I series. The soils have rapid to moderately rapid permeability with slight erosion. The area is under irrigation by tubewells and soils give higher yields in all

the seasons. The common cultivated crops are Bajra, Wheat, Lucerne, Fennel, Cumin, Castor, Cotton, Vegetables, Tobacco, Tur, Sesamum etc. The texture of the subsoil becomes heavier with increase in solum depth. The available water holding capacity is medium with medium fertility.

**Mapping unit :**

1. 1-SL-d5 / A-e1 Lawarpur-I, dandy loam, very deep, nearly 1 level (0-1%) slightly eroded.
2. 2-SL-d5/A-e1-Rangpur-I sandy loam, very deep, nearly level (0-1%) slightly eroded.

**Improvable or correctable problems :**

1. Medium fertility status.
2. Unbunded fields
3. Draught condition.

**Inherent problems :**

1. Unfavourable weak to single grain structure.
2. Medium to low available water holding capacity.
3. Moderately rapid permeability.

**2. Capability unit : II es-1-556.00 Hectares.**

The soils in this unit are good cultivated, nearly level to very gently sloping, very deep, dark brown to dark yellowish brown, coarse loamy soils. The soils have rapid to moderately rapid permeability with slight erosion hazard. The soil gives higher yield by the application of irrigation water at frequent periods in all the seasons. The texture of the surface soil is coarse but subsoil texture becomes heavier with increase in solum depth. The available water holding capacity and soil fertility are low in the surface soil. The fields are unbunded.

**Mapping units :**

1. 1-SL-d5 / B-e2 Lawarpur-I, sandy loam, very deep, very gently sloping (1-3%), moderately eroded, irrigated.
2. 1-SL-d5 / B-e2 Lawarpur-I, sandy loam, very deep, very gently sloping (1-3%), moderately eroded, Rainfed.

**Improvable or correctable problems :**

1. Low fertility status.
2. Coarse texture of the surface soil.
3. Draught condition.
4. Unbunded fields.

**Inherent problems :**

1. Unfavourable structure-single grain to weak, fine to medium, subangular blocky peds.
2. Low available water holding capacity.
3. Rapid permeability.

**3. Capability unit : II S-1 49.00 Hectares.**

The soils in this unit are good cultivated with irrigation facilities, nearly level, very deep, dark brown to dark yellowish brown (Lpr-I) and dark yellowish brown to yellowish brown (Rgp) coarse loamy soil. The soils have rapid permeability with slight erosion hazard. The soil gives higher yield by the application of irrigation water at a frequent period in all the seasons. The texture of the surface soil is coarse but subsoil texture becomes heavier with increase in solum depth. The available water holding capacity and soil fertility are low in the surface soil. The soil deficiency as a low water holding capacity is taken into consideration.

These soils are same as II-1, except texture, which is coarser i.e. LS instead of SL, so it is put in lower capability unit than II-1, but as these soils have less slope and erosion than II es-1 So this soil is separated as II S-1.

**Mapping units :**

1. 1-LS-d5 / A-e1 Lawarpur-I, loamy sand very deep, nearly leveled (0-1%), slightly eroded, irrigated fields.
2. 2-LS-d5 / A-e1 Rangpur-I, loamy sand, very deep, nearly leveled (0-1%), slightly eroded, irrigated fields.
3. 4-LS-d4 / A-e1 Rangpur-II, loamy sand, deep nearly level (0-1%), slightly eroded, irrigated fields.

**Improvable or correctable problems :**

1. Low fertility status.
2. Coarse texture of the surface soil.
3. Unbundled fields.
4. Semi-arid climate.

**Inherent problems :**

1. Unfavourable structure-single grain to weak, fine and medium subangular blocky peds.
2. Low available water holding capacity.
3. Rapid permeability.

**4. Capability unit : II-ES-2 - 207.00 Hectares.**

The soils in this unit are good cultivated, nearly level to very gently slopy, very deep, dark brown to dark yellowish brown (Lawarpur-I) and dark yellowish brown to yellowish brown (Rangpur-II) fine to coarse loamy soils of low water holding capacity. The soils have rapid to moderately rapid permeability with slight to moderate erosion hazard. The soils give higher yield only by the application of frequent irrigations and different crops could be raised in all the seasons. The texture of the surface soil is loamy sand to sandy loam but subsoil texture becomes heavier with increase in depth. The available water holding capacity and soil fertility are low to medium.

**Mapping unit :**

1. 1-SL-d5 / B-e2 Lawarpur-I, sandy loam, very deep, very gently slopy (1-3%) moderately eroded, rainfed fields.
2. 1-LS-d5 / A-e1 Lawarpur-I, Loamy sand, very deep, nearly level (0-1%), slightly eroded.
3. 1-LS-d5 / B-e1 Lawarpur-I, loamy sand, very deep, very gently slopy (1-3%), Slightly eroded irrigated fields.
4. 1-LS-d5 / B-e2 Lawarpur-I, Loamy sand, very deep, very gently slopy, (1-3%) Moderately eroded irrigated fields.
5. 2-LS-d5 / B-e2 Rangpur-I, loamy sand, very deep, very gently slopy (1-3%) moderately eroded, irrigated fields.
6. 4-LS-d4 / B-e2 Rangpur-II, loamy sand, very deep, very gently slopy (1-3%) moderately eroded, irrigated fields.

**Improvable or correctable problems :**

1. Low fertility status.
2. Coarse texture of the surface soil.
3. Drought condition
4. Unbundled fields,

**Inherent problems :**

1. Unfavourable structure.
2. Low available water holding capacity.
3. Rapid to moderately rapid permeability.

**(5) Capability Units II-es-3 13.00 Hectares**

These soils are level to nearly level, very deep, cultivated, coarse loamy soils of low water holding capacity having dark brown to dark yellowish brown colour. The soil is underlain by a calcareous coarse loamy alluvial deposits. The permeability is very rapid on the surface soil while ra-



pid to moderately rapid in the subsoil. The coarse texture of the soil is responsible for slight to moderate erosion hazard. The available water holding capacity of the soil is low due to coarse texture which leads draughtiness on the surface soil. These soil require higher fertilizers and manures due to moderate erosion and low fertility status of the surface soil.

#### Mapping Unit :

1. 1-LS-d5/A-e1 Lawarpur-I, sand, very deep, nearly level (0-1%), slightly eroded.
2. 3-LS-d5/A-e1-G Lawarpur-II, sand, very deep, nearly level (0-1%), slightly eroded with narrow gullies.
3. 3-LS-d5/A-e1 Lawarpur-II, loamy sand, very deep, nearly level (0-1%) slightly eroded,

#### Improvable or correctable problems :

1. Low fertility status
2. Coarse texture of the surface soil.
3. Unbunded fields.
4. Slight to moderate erosion.
5. Drought condition.

#### Inherent problems :

1. Unfavourable structure
2. Low available water holding capacity.
3. Rapid to very rapid permeability.

#### (6) Capability Unit III es-I 77 00 Hectares.

These soils are nearly level to very gently sloping, very deep, fine loamy to coarse loamy soils of low water holding capacity. The colour of the soil is dark brown to dark yellowish brown which is underlain by a calcareous coarse loamy alluvial deposits. The permeability is rapid on the surface soil but moderately rapid in the sub soil. The available water holding capacity of the soil is low and fertility is low to medium. The gentle slope associated with coarse texture is responsible for moderate erosion.

These soils are partly irrigated while most of the fields are under cultivation of crops like cotton, Sesamum, Bajra, Jowar, Mug, Math, and other crops which require less amount of moisture. As the irrigation facilities are not available in most of the surveyed area, there is likelihood of draught condition due to semi-arid zone of low rainfall area. (Although these soils give good food yield by application of irrigation water), these soils are grouped into class III,

#### Mapping units :

1. 1-LS-d5/B-e1 Lawarpur-I loamy sand, very deep, very gently slopy (1-3%) moderately eroded rainfed area.
2. 1-LS-d5/B-e2 Lawarpur-I, loamy sand, very deep, very gently slopy (1-3%), moderately eroded rainfed area.
3. 3-LS-d5/A-e1 Lawarpur-II, loamy sand very deep, nearly level (0-1%), slightly eroded, rainfed area.
4. 3-SL-d5/B-e2 Lawarpur-II, sandy loam, very deep, very gently slopy (1-3%), moderately eroded-rainfed fields.
5. 3-LS-d5/A-e2 Lawarpur-II, loamy sand, very deep, nearly level (0-1%), moderately eroded irrigated fields.

#### Improvable or correctable problems :

1. Low fertility status.
2. Frequent droughts.
3. Unbunded fields.
4. Past slight to moderate erosion hazard.
5. Level to very gentle slope.

#### Inherent problems :

1. Unfavourable structure.
2. Low available water holding capacity.
3. Rapid permeability.

**(7) Capability Unit : III eS-2 – 317.00 Hectares.**

These soils are generally very gently slopy to gently slopy and nearly level at places, slightly to moderately dissected, well drained very deep dark yellowish brown to dark brown (Rangpur) and dark brown to yellowish brown (Lawarpur-II) soil having rapid permeability. The texture of the soil becomes heavier with increase in solum depth. The lighter texture of the surface soil is responsible for medium to low water holding capacity of the soil. Lawarpur-II soils are subjected to slight to moderate erosion in forms of sheet, rills, gully and shallow to medium ravines, while in soils of Rangpur-I series, some salts are visible in the profiles. Both the soils give strong effervescence with dil Hcl. in "C" horizon. The crops are raised in irrigation condition in one third of the area while in two thirds of the area, it is in rainfed condition. The common cultivated crop grown are Bajra, Jowar, Wheat, Pulses, Castor, Sesamum, Tur, Cotton, Tobacco etc. Gentle slope and moderate to severe erosion hazard in Lawarpur-II series and high amount of salts (Rangpur-I soils) giving slight to strong effervescence with dil. Hcl., are the main problems.

N. B. : The soil gives higher yield by application of irrigation water, this was observed during field survey.

**Mapping Units :**

1. 2-LS-d5/A-e1 Rangpur-I, Loamy sand, very deep, nearly level (0-1%), slightly eroded, rainfed fields.
2. 2-LS-d5/B-e2 Rangpur-I, Loamy sand, very deep, very gently slopy (1-3%), moderately eroded, rainfed fields.
3. 3-LS-d5/B-e2 Lawarpur-II, Loamy sand, very deep, very gently slopy (1-3%), moderately eroded, rainfed fields.
4. 3-LS d5/B-e2-G3 Lawarpur-II, loamy sand, very deep, very gently slopy (1-3%), moderately eroded with deep gullies, Irrigated fields.
5. 3-SL-d5/C-e3-G3 Lawarpur-II, sandy loam, very deep, gently slopy (3-5%), severely eroded with very deep gullies, irrigated fields.
6. 4-LS-d4/B-e2 Rangpur-II, loamy sand, deep, very gently slopy (1-3%) moderately eroded, rainfed area.

**Improvable or correctable problems :**

1. Medium to low fertility status. 2. Unbunded fields. 3. Frequent droughts. 4. Moderate to severe erosion hazard. 5. Moderate erosion hazard. 6. Very gently slopy to gently slopy area.

**Inherent problems :**

1. Unfavourable structure. 2. Rapid permeability. 3. Low to medium available water - holding capacity of the surface soil. 3. Presence of salts in Rangpur-I series.

**(8) Capability Unit : III eS-3 – 129.00 Hectares.**

These soils are very gently slopy, moderately to severely eroded, moderately dissected land, well drained, dark brown to dark yellowish brown (Lawarpur-II) and dark yellowish brown to yellowish brown (Rangpur-II) soils having rapid permeability. The structure of the soil is weak to single grain. The texture is lighter to medium and becomes heavier with increase in solum depth. The lighter texture of surface soil is responsible for low water holding capacity of the soil. These soils are subjected to moderate to moderate to severe erosion in forms of sheet, rills, gully and shallow ravines in both the soils but medium ravines are observed in only Lawarpur-II soils. The salts of CO<sub>3</sub> and HCO<sub>3</sub> are observed in profiles of Rangpur-II series. The common rainfed crops grown are Bajra, Jowar, Castor, Sesamum, Cotton, Tur, Pulses etc. Severe and very severe erosion in both the soils with accumulation of salts in subsoil of Rangpur-II soils are the main problems.

**Mapping Unit :**

1. 4-SL-d4/C-e3 Rangpur-II, sandy loam, deep, gently slopy (3-5%), severely eroded.
2. 3-LS-d5/B-e3 Lawarpur-II, loamy sand, very deep, very gently slopy (1-3%), severely eroded.

**Improvable or correctable problems :**

1. Medium to low fertility status.
2. Unbunded fields.
3. Frequent droughts.
4. Moderate to severe erosion hazards.
5. Very gently to gently slopy area.

**Inherent problems :**

1. Unfavourable structure.
2. Rapid permeability.
3. Medium to low available water holding capacity of surface soil.

**(9) Capability Unit : IV eS-1 - 95.00 Hectares.**

These soils are gently slopy, moderately to highly dissccted, moderately to severely eroded, well drained to excessively drained, deep to very deep, dark brown to dark yellowish brown (Lawarpur-II) and (Ratanpur-I) and dark yellowish brown to yellowish brown ( Rangpur-II ) soils having rapid permeability. The structure development varies from single grain to weak fine subangular blocky and soil texture is sandy loam and loamy sand. The lighter texture is responsible for low to medium water holding capacity and fertility of the soil. The lighter texture, weak structure and gentle slope are responsible for severe to very severe erosion hazard and formation of rills, gullies and medium deep ravines with exception of medium deep ravines in Rangpur-II soils. The crops are grown generally in rainfed condition. The common crops raised are Castor, Sesamum, Bajra, Jowar, Tur etc while some area is under grass land and waste land.

**Mapping Units :**

1. 3-LS-d5/B-e3-G2 Lawarpur-II, loamy sand, very deep, very geuntly slopy (1-3%) severely eroded with deep and wide gullies.
2. 3-LS-d5/C-e4 Lawaapur-II, loamy sand, very deep gently slopy (3-5%) very severely eroded.
3. 3-SL-d5/C-e4 Lawarpur-II, sandy loam, very deep, gently slopy (3-5%) very severely eroded.
4. 5-SL-d4/C-e3 Ratanpur-I, sandy loam, deep, gently slopy (3-5%), severely eroded.
5. 5-SL-d5/C-e4 Ratanpur-I, sandy loam, deep, gently slopy (3-5%), very severelyd eroded.
6. 5-LS-d5/C-e3 Ratanpur-I, loamy sand, deep, gently slopy (3-5%), severely eroded.
7. 3-LS-d4/C-e4 Lawarpur-II, loamy sand deep, gently slopy (3-5%), severely eroded.  
( This is to be put in seperate unit as IV eS-2 but as it is a single units it is included in IV eS, unit. )
8. 4-LS-d4/C-e3 Ratanpur-II, loamy sand, deep, gently slopy (3-5%), severely eroded.

**Improvable or correctable problems :**

1. Unbunded fields.
2. Frequent droughts.
3. Severe to verp severe erosion hazard.
4. Low fertility of the surface soil.
5. Gently slopy area.

**Inherent problems ;**

1. Unfavourable structure of soil and parent material.
2. Rapid to very rapid permeability.
3. Medium to low available water holding capcity of the surface soil.
4. Lighter texture of the sub-soil and parent material.

**(10) Capability Unit : IV W-1 & IV W-2 – 6.00 + 30.00 = 36.00 Hectares.**

The soils in this unit are deep to very deep, very gently sloping to gently sloping land, well drained, brown to yellowish brown and dark yellowish brown loamy fluventic soils having rapid to very rapid permeability. The structure of the soil is single grain, crumb and weak fine subangular blocky peds on the surface soil and the texture varies from silt loam to loamy sand and sand at places. The lighter texture of the soil, weak structure and wide valley bottom of the lower river terrace are responsible for frequent overflow and a crop failure due to submergence consequent to high intensity of rain. The soils are highly fertile due to lighter texture and rapid permeability of the soil. Frequent irrigations are required to get higher yields. Special attention is warranted to seeding and harvest dates to minimise crop failure during over flow is required to get good yields. Cultivation of summer crops is only possible less danger of crop failure is always present.

**Mapping Units :**

1. 7-LS-d5/B-e3 Firozpur, loamy sand, very deep, very gently slopy (1-3%) severely eroded.
2. 7-Sil-d5/B-e2 Firozpur, silty loam, very deep, very gently slopy (1-3%) moderately eroded.
3. 7-LS-d5/B-e2 Firozpur, loamy sand, very deep, very gently slopy (1-3%) moderately eroded.
4. 7-LS-d4/B-e2 Firozpur, loamy sand, deep, very gently slopy (1-3%) moderately eroded,
5. 7-Sil-d4/B-e3 Firozpur, silt loam, deep, very gently slopy (1-3%) severely eroded.

**Improvable or correctable problems :**

1. Medium to low fertility status. 2. Unbunded filds. 3. Frequent draughts. 4. Very gently to gently slopy land, 5. Wide valley bottom land subject to moderate to severe erosion. 6. Frequent overflow and crop failure.

**Inherent problems :**

1. Unfavourable structure. 2. Unfavourable texture. 3. Rapid to very rapid permeability. 4. Low available water holding capacity.

**(11) Capability Unit : VI eS-1 & IV eS-2 – 9.00 + 24.00 = 33.00 Hectares.**

The soils in this unit are deep, moderately to strongly dissected, gently slopy to moderately slopy, excessively drained, dark brown to dark yellowish brown and yellowish brown humped soils of low water holding capacity having rapid to very rapid permeability. The structure of the soil is single grain to weak fine subangular blocky and the texture is lighter on the surface soil and light to medium in the subsoil. The lighter texture of the surface soil, excessive slope and weak structure are responsible for formation of rills, and medium to deep, deep ravines. The lighter texture and severe to very severe erosion are responsible for low fertility status of the surface soil. Some of the area is under grass land while other area is under waste land, gaucher and natural vegetation. The area is fit for horticultural plantation with moderate reclamation operations for narrols width terraces serves as protection from entrance of human beings, animals and livsstock, sheep & goats is recommended so as to stop the that extension of ravines,

**Mapping Units :**

1. 5-LS-d5/C-e4 Ratanpur-I loamy sand, very deep, gently slopy (3-5%) very severe eroded.
2. 5-SL-d5/D-e4 Ratanpur-I, sandy loam, very deep, moderately slopy (5 to 10%) very severe eroded.
3. 6-SL-d4/D-e4 Ratanpur-II, sandy loam, deep, moderately slopy (5 to 10%) very severe eroded.

**Improvable or correctable problems : Unreclanimable,**

1. Unbunded survey numbers. 2. Frequent draughts. 3. Low fertility status. 4. Very severe erosion hazards. 5. Gentle to moderate slop. 6. Medium to deep, deep and wide ravines.

**Inherent problems :**

1. Unfavourable texture. 2. Unfavourable structure. 3. Excessive drainage and rapid to very rapid permeability. 4. Low available water holding capacity. 5. Higher amount of lime concretions in C horizon.

**(12) Capability Unit : VII cS-1 - 64 00 Hectares.**

The soils in this unit are deep, moderately slopy, very severely eroded, strongly dissected, excessively drained, dark brown to dark yellowish brown and yellowish brown humped soils, of low water holding capacity having very rapid permeability. The structure of the soil is single grain to weak fine subangular blocky. The texture of the surface is lighter and light to medium in sub-soil. The lighter texture of the surface soil excessive slope and weak structure are responsible for formation of rills, and medium to deep and deep ravines. The fertility status is medium due to uncultivated grass land organic matter added from leaves and stems of shrubs, bushes etc. some area is under grass land while other area is under the natural vegetation. The area is fit for horticultural plantation with moderate reclamations operations for small width terraces to serve as protection from entrance of human being animals and livestock, sheep and goats to stop the extension of ravines.

**Mapping Unit :**

1. 5-LS-d4/C-e4 Rataapur-I, loamy sand, deep, gently slopy (3 to 5%) very severe erosion.
2. 5-LS-d4/D-e4 Ratanpur-I loamy sand, deep, moderately slopy (5-10%) very severe erosion.

**Improvable or correctable problems : Unreclaimable.**

1. Unbundled survey numbers. 2. Medium fertility status. 3. Frequent droughts. 4. Very severe erosion hazards. 5. Gently to moderately slopy area. 6. Medium to deep and deep and wide ravines.

**Inherent problems :**

1. Unfavourable texture. 2. Unfavourable structure. 3. Excessive drainage and very rapid permeabilities. 4. Low available water holding capacity. 6. Looseness of parent material.

**(13) Capability Unit : VII eS-2 - 27.00 Hectares.**

These soils are moderately deep to deep, strongly slopy, very severely eroded, strongly dissected, excessively drained, occurring on narrow humps having dark yellowish brown, yellowish brown and dark brown colour with very rapid permeability and steeply slopy humps. The ravines are deep to very deep, wide to very wide and V to U in shape and 1/3 km. to 2 km. in length.

The other characteristics of the soil is the same as capability unit VII eS-1.

**Mapping unit :**

1. 5-SL-d4/E-e4 Ratanpur-I, sandy loam, deep, strongly slopy (10-15%) severe erosion.
2. 5-LS-d4/E-e4 Ratanpur-I, loamy sand, deep, strongly slopy (10-15%), very severe erosion.

**Improvable or correctable problems :**

1. Unbundled survey numbers. 2. Frequent droughts. 3. Medium fertility status. 4. Very severe erosion. 5. Strongly slopy area. 6. Deep, very deep and wide and very wide ravines.

**Inherent problems :**

1. Unfavourable texture and structure. 2. Excessive drainage and very rapid permeability. 3. Low available water holding capacity of surface soil. 4. Abundance lime concretions in "C" horizon. 5. Looseness and lighter texture of parent materials.

**(14) Capability unit : VIII eS-1 - 14.00 Hectares.**

The soils in this unit area moderately deep, strongly slopy to moderately steep, strongly dissected, excessively drained occurring on narrow humps having dark yellowish brown, yellowish brown and dark brown colour, very rapid permeability and steeply slopy humps. The ravines are very deep, very wide "V" to "U" in shape, and 1 to 2 kilometer or more in length. The structure of the soil is single grain and crumb to very weak fine subangular blocky. The texture is lighter and water holding capacity is low. The soils are strongly calcareous below the solum depth of the soil. The soils are subjected to very severe erosion and form rills, gullies and very deep and very wide ravines. The entire area is under pasture, gouchar, grass land and natural vegetation. These lands should be left as it is to serve grass waterways, water storage, or other such purpose. The area should be protected from entrance of human beings, sheep, goats, animals, camels etc. The planting of horticultural trees or forestry on the narrow humps would be useful to utilise the wood for fuel purpose. The very deep and very wide ravines should be used as waterways and construction of engineering structures, chutes, grass water ways, earthen bunds and planting of bamboos etc. are recommended.

**Mapping units :**

1. 6-SL-d3/E-e4 Ratanpur-II, sandy loam, moderately deep, strongly sloping (10-15%), very severe erosion.
2. 6-LS-d3/E-e4 Ratanpur-II, loamy sand, moderately deep, strongly sloping (10-15%), very severe erosion.
3. 6-LS-d3/F-e4 Ratanpur-II, sandy loam, moderately deep moderately steep to steep (15-25%), very severe erosion.
4. 6-LS-d3/F-e4 Ratanpur-II, loamy sand, moderately deep moderately steep to steep (15-25%), very severe erosion.

**Improveble or correctable problems :**

1. Unbunded survey numbers. 2. Frequent draughts. 3. Medium to low fertility status. 4. Very severe erosion hazards. 5. Strongly slopy and moderately steep to steep humps. 6. Very deep and very wide ravines-protection from entrance of human beings animals, sheep, goats, camel etc. Warranted.

**Inherent problems :**

1. Unfavourable texture and structure. 2. Excessive drainage and vary rapid permeability. 3. Low available water holding capacity. 4. Higher amount of lime concretions in "C" horizon. 5. Looseness and lighter texture of the parent material.

**(15) Capability Unit : VIII eS-2 - 59 00 Hectares.**

The soils in this unit are shallow to moderately deep, moderately steep to steep and steep, strongly dissected, excessively drained occurring on narrow humps having dark yellowish brown, yellowish brown and dark brown colour, very rapid permeability and steeply slopy humps.

The other description of this unit is the same as capability unit VIII eS-1.

**Mapping units :**

1. 6-LS-d3/G-e4 Ratanpur-II, loamy sand, moderately deep, steep (25-33% and more); very severe erosion.
2. 6-LS-d2/F-e4 Ratanpur-II, loamy sand, shallow moderately steep to steep (15-25%), very sery severe erosion.
3. 6-LS-d2/G-e4 Ratanpur-II, loamy sand, shallow, steep (25%-33% and more), very severe erosion.

**Improvable or correctable problems :**

1. Unbunded survey numbers. 2. Frequent droughts. 3. Medium to low fertility status. 4. Very severe erosion hazards. 5. Moderately steep to steep and steep hump land. 6. Very deep and very wide ravines. 7. Protection from entrance of human being, sheep, goats, animal and camels etc.

**Inherent problems :**

1. Unfavourable texture and structure. 2. Excessive drainage and very rapid permeability. 3. Low available water holding capacity. 4. Higher amount of lime concretions in "C" horizon. 5. Looseness and lighter texture of the parent material.

(16) Capability unit : VIII eS-3 - 493.00 Hectares.

Miscellaneous ravine bed land. The description is the same as per given in section III, "Soils of the area in (d) Soil series misc. ravine bed land.

(17) Village Site & Tank : 39.00 + 10.00 = 49.00 Hectares.

**(c) Ravine reclamability classification :**

**For Agriculture :** Class-I Fit for reclamation into agricultural land with minor reclamation operation.

Class-II Fit for reclamation into agricultural land with medium intensity reclamation operations.

Class-III Fit for reclamation into agricultural land with major reclamation operations.

Class-IV Fit for horticulture with reclamation operations narrow width horticulture terraces.

**For nonagricultural use :**

Class-V Fit for grass land, and forestry by closure alone.

Class-VI Fit for grass land and forestry by closure and less intense afforestation measures.

Class-VII— Fit for grass land and forestry with closure and intensive afforestation measures.

Class-VIII—Not fit for regular grass land and forestry but fit for utilisation as a water-storage or other such purposes.

The reclamability classification is to be decided by interpretation of the field data collected. Generally the shallow ravines (less than 1.5 meter deep) may be economically brought under cultivation. The width will also have to be interpreted along with the depth for this purpose. Ravines with large watershed area will require diversion of runoff and construction of ravine head control structures on a waterway ravine which may be selected to drain safely the catchment of a particular ravine system.

**(d) Soil and land use suitability :**

Soil survey should aim scientifically to interpret the soil data for different purposes so as to make it helpful to a greater extent for an efficient and purposeful planning. In this section an attempt has been made to interpret the important soil qualities of a set of mapping units under different soil series of the area. Table No. 8 shows the details of such mapping units with their capability unit and corresponding suitability for hybrid Bajra crop, irrigation and hydrological grouping with land use potential and special limitations. The guidelines used in fixing irrigability classes and suitability for Hybrid Bajra crop is briefly given below.

**(1) Irrigability classes :**

These are special interpretations of the suitability of soil and land for irrigation. The soil irrigability classes are defined in terms of soil properties that express their degree or limitation for de-

velopment and their requirements for irrigation management. The criteria for each class are quantitatively defined and exclusive in that a soil can qualify for only one class, with the most limiting property determining the irrigability class into which a soil will fall.

In view, five classes of soil irrigability and six classes of land irrigability defined in soil survey Manual—All India soil and Land use Survey (1970), attempts on similar lines have been made to interpret the soils of the surveyed area for irrigability.

#### Soil irrigability classes :

The five soil irrigability classes are defined as under.

Class-A—None to slight limitations for sustained use under irrigation.

Class-B—Moderate soil limitation for sustained use under irrigation.

Class-C—Severe „ „ „ „ „

Class-D—very severe „ „ „ „ „

Class-E—Non suited for irrigation (or non irrigable soil class).

#### Land irrigability classes :

The definitions and explanation of the land irrigability classes are given below :

Class-1 Lands that have few limitations for sustained use under irrigation,

Class-2 Lands that have moderate limitations for sustained use under irrigation.

Class-3 Lands that have severe limitations for sustained use under irrigation.

Class-4 Lands that have (very severe limitations) for sustained use under irrigation.

Class-5 Lands which are temporarily classed as not suitable for sustained use under irrigation pending further investigation.

Class-6 Lands not suitable for sustained use under irrigation.

#### Factors affecting land irrigability classes :

Land irrigability classes of the soil depends on the following important characteristics.

##### 1. Quality and quantity of water :

(1) Equilibrium salinity level. (2) Equilibrium ex. Na % levels (3) Availability of water to the land in relation to water requirements of crops.

##### 2. Drainage requirements :

(1) Permeability of substrata and feasibility of providing needed drainage (2) Cost of drainage measures.

##### 3. Other economic considerations :

(1) Production costs and yield potentials. (2) Land development costs. (3) Other factors affecting benefit-cost ratio.

#### Land irrigability sub class :

Subclasses are groups of land irrigability units which have the same kinds of dominant limitations for sustained use under irrigation. when lands are placed in class lower than 1, the reason should be indicated by appending the letters "S" "t" or "d" to class number to show weather deficiency is in "Soils", "topography" or "drainage" Lands with more than one major deficiency may be indicated with the relevant letters after the class. For example, if the lands have both 25 and 29 deficiencies this should be indicated by the designation 2 st.

#### Land irrigability units :

Land irrigability units are groupings of lands that are nearly alike in suitable for irrigation and having similar crop adaptation, yield potential and soil and water management needs.



In formulating irrigation projects the use of land irrigability units permits the presentation of specific and detailed information concerning adapted crops, water requirements, irrigation methods, costs and benefits of land development, land treatment measures and the like.

Land irrigability units are designated by letters in brackets appended to the class or subclass for example, 1 (a), 1 (b), 2s (a), 2s (b), 2s (c) etc. Irrigability classification arrived is mentioned in Table No. 8 along with the capability classification and suitability of crops.

## (2) Soil Suitability for Hybrid Bajra :

Bajra requires well drained, sandy to goraadu soils for better growth, development and better grain production. The surveyed area principally belongs to fine loamy soils and hence Bajra is grown to a large extent as Rainfed Hybrid Bajra in a deep and well drained soils according to their suitability and moisture retention. The soil characteristics used in establishing these groupings includes texture, drainage, permeability of the subsoil, depth of soil, kind of substratum, salinity or Alkalinity and slope. An attempt to group set of different mapping units into defined hybrid Bajra group has been shown in the table. Four groups have been developed on the above said lines in the project area report which are as under.

1. Very good. 2. Good 3. Fair 4. poor to unsuitable.

## (3) Hydrological soil groups :

These groups are used in determining hydrological soil cover complexes, which are used for estimating runoff from rainfall. Further it is useful for hydrological studies particularly in watershed management programmes. Attempt to classify the soils of the surveyed area under reports have been made into hydrological soil groups. On the basis of series, profile studies and important soil characteristics like texture of surface soil, Subsoil texture, permeability and soil structure which are considered and tabulated in table No. 8.

The two hydrological groups have been defined as under

- A low runoff potential Soils are deep, well excessively drained, sand and loamy sands and have high infiltration rates.
- B Moderately low runoff potential - Moderately well to well drained, fine to moderate coarse textured having moderate infiltration rates.

## (4) Suitability for other crops :

In table No. 9 an attempt has been made to work out the soil suitability for different important crops of the area under rainfed and irrigated conditions. Five classes have been designated viz. VG- very good, G-Good, F-Fair, P-Poor and VP-Very poor. This has been based on the studies of probable yields of the crops under existing conditions, Soil characteristics, drainage condition in irrigated crops and runoff potentials. The table is self explanatory and such interpretations can be useful for selection of crops in relation to suitability of soils.

## (5) Suitability for irrigated Agriculture :

It is seen from the entire surveyed area that the soils are lighter to medium in texture with rapid permeability and are moderately well responsive to irrigation. These soils are deep to very well drained and without ills of salinity and alkalinity. Cultivators themselves have tried to put maximum area under irrigation.

In the lower terraced area shallow wells are common and tube well irrigation is prominent in upland area. About 50% of the upper catchment of ravines remain unirrigated due to paucity of funds etc with the cultivators. Neither a single tank is observed in this area which could provide water for irrigation, nor the area is covered under any irrigation system. Under ground water is found suitable for irrigation with extremely low quantity of soluble salts (500-700 ppm).

Since every village in this area has been electrified and promising findings by Geo-hydrologists for ground water there is a heavy demand for putting up of tubewells. This has created some difficulty in putting tube wells without interference and appropriate distance between two tube wells is not maintained creating drop of watertable in the hot season. Unirrigated patches of land are occupied by single cropping system and remain fallow during summer and crops like Jowar, Bajra, Sesamum, Castor, Pulses etc are grown in kharif season. While wheat Hybrid cotton, Tobacco, Vegetables etc are grown where irrigation facility is available. As the rains are uncertain and there is not a single place in this region where water is being stored during off period, possibility of providing irrigation by putting a bund/barrage over Sabarmati should not be ruled out. If this is not done tubewell programme will face serious difficulties in future. It is hoped that due to nearness of state capital, sufficient attention will provide storage of run-off water and thus improving the water regime of the area.

### (c) Suitability for pasture and forestry :

For the balance development of the bad land terrain, each area of the land should be treated and used according to its capability and this area should be afforested by the forest department of state on both the banks of Sabarmati river and its tributaries. Great efforts have been made by the State Forest Department to afforest part of the area on the bank. Deep rooted trees, perennial grasses were tried with success but illicit cutting and grazing in certain blocks viciate the programme and protection could not be provided due to extremely rugged terrain for growing trees.

As the soils are quite suited for deep rooted trees, it is proposed to grow fuel trees in all ravine area coming under medium or deep ravine and steep slopes to conserve soil and moisture and to utilise these remains most profitably and scientifically because of very high cost of reclamation of these areas.

Since all such areas cannot be stopped altogether from grazing of cattle, it is suggested to have a large blocks where rotational or deferred system of grazing can be tried. These would meet the immediate measure by providing sufficient time for grasses for regeneration and also would provide proper cover during rainy season to bare land which is subjected to further severe erosion. The nature of the soil is slightly alkaline and is much suited for zizyphus growing. The best and quickest method is to be used to graft the local inferior variety with improved one to ensure high and assured yield. Following trees can be tried successfully, in this region.

1. *Acacia arabica* (Babul)
2. *Acacia catechu* (Khair)
3. *Acacia toltalis* (Babul Exotic)
4. *Albezzia lebbeck* (Sevan)
5. *Azadirachta indica* (Neem)
6. *Salmalia malabaricum* (serus)
7. *Euphorbia species* (thor)
8. *Butea frandosa* (Khakhar)
9. *Acacia Specigera* (Khijudi)
10. *Dandrocalamus Spa* (Bamboos)
11. Cactus.

N. B. : For afforestation purpose, complete control of land should be transferred to the Forest department. The ravine land must be protected from entrance of human, sheeps, goats and other animals.

### (7) Suitability for Ravine reclamation :

Individual efforts to reclaim a ravine lands are not promising and successful due to high capital investment. Yet some Co-operative bodies have realised the urgency of the work and at places they have started reclamation of shallow ravine fringes. Another reason for slow-rate of reclamation is due to paucity of funds and very small are left under shallow ravines where land could be reclaimed at normal cost.

Government has already taken up the programme of reclamation both for agriculture and forest but lack of whole hearted co-operation from local population is yet another reason for slow movement. It was observed that the population wanted to get even deep ravines reclamation for agriculture provided every bit of expenditure was met by the government.

The ravine area near the city could best be utilised for drainage alignment, for town compost or even brick making. The soil is extremely good for this work. Actually at places brick industry has already been established. It needs scientific exploitation so that we may get terraces of uniform size for habitation and bricks for building purposes.

It is suggested that due to nearness of state capital & excellent transport facilities reclamation of shallow and medium ravines for agriculture should be carried out at a slightly higher cost and deep ravines should be reserved for afforestation.

#### (8) Suitability for Habitation :

From habitation point of view, ravines do not pose a very receptive picture because of dissected terrain and difficulties in transport and movement. Outwardly these present an awkward view for city population but looking to the soaring prices of land for buildings in the city and heavy demand by public for any kind of land for building purpose, it is justified to do land levelling and land shaping even if the cost goes high by employing heavy earthmoving machinery. These ravines present excellent natural drainage system and if dwellings are planned on small patches with advance planning of road, power and water, these would accommodate large families who cannot afford to go to high priced land. For this purpose corporate body exclusively for ravine development for habitation would be more suitable.

Besides providing shelter, these ravines can also accommodate small home industry. The brick industry which destroys thousands of acres of good fertile and level land at the periphery of the city, which creates problem for adjoining fields and polluting the air of city by messy smokes. In fact soils of these ravines are just suitable for brick manufacturing with right amount of sand and clay. These can give employment to thousands of rural labourers besides creating terraced land for building if it is exploited scientifically.

Deep ravines can very well be utilised for storage of arms communication and probably the best training ground for young cadets in modern infantry for army centre. The excellent protection and camping is provided by these ravines during modern warfare. Even a few long range firing centres could also be established in these evenly expanding ravines. These will not only halt the further advancement of ravines into good land but will reduce pressure and clear to some extent the congestion in the city which is harbouring large slums and slum colonies.

## SECTION-V

### Specific Problems and Recommendations

Central sector ravine project of Varsoda comprises of 2255 hectares out of which 1217 hectares are under table land, 287 hectares under marginal land and the remaining 751 hectares are under ravines consist of humps, hummocks and ravine bed land. The table land is tentatively co. related under Lawarapur-I and Rangpur-I soil series, areas marginal land is co. related under Lawarapur-II and Rangpur-II soil series, highly dissected gently sloping undulating hump land co. related under Ratanpur-I soil series highly dissected land co. related under Ratanpur-II soil series, and ravine bed land of wide valley bottom is co-related under as Firozpur series and misc. land types.

The morphological characteristics of the soils observed in the area is described in section III as "Soils of the area" and interpreted as its suitability for various purposes.

In order to stabilise the ravines, soil conservation measures like bunding terracing, (cutting permitted upto 50 cms) and water ways are necessary in the table and marginal or peripheral land. Shallow and medium ravines where irrigation is available, should be considered for agriculture, purpose. The other ravineous area i. e. deep and very deep ravines, should be retired for permanent vegetation and Horticulture plantation with closure specifically aiming at vegetative growth where necessary.

It was decided by as a national policy that reclamation of the ravines for agriculture would be carried out only where irrigation facilities are available. The mechanical control measures like bunding, and/or bench terracing on peripheral land above the ravine head and on the sides of shallow ravines by light bulldozing and bench terracing of medium ravines by medium bulldozing should be adopted, as these measures are economical in comparison to bulldozing work in deep and very deep ravines. peripheral bund line should also be prepared to control the encroachment of the ravi-

nes further in the table land. The control of ravine head may be tried by providing engineering structures like drop structures, chute structures, pipe-drop-inlets etc. Gully plugging in the table and peripheral land is also one of the essential control measures to stabilize the ravine. Main run-off should be diverted off the numerous ravines head into a particularly chosen water way ravine which can be protected with head control and bed gradient control structures. The banks of river and the outer boundary of humps and hummocks should be afforested for fuel, timber or industrial raw material so as not cut the bed channel further. The block should be completely prohibited from interference of human beings sheep goats and other animals. The cutting of trees and bushes for fuel purpose should also be prohibited. The boundaries of each fields should be prepared by growing thorns or Agve, so that the roots of these bind the soil particles, which will ultimately be helpful to control the extension of ravines and fibre from agave can be used as raw material. The ravine heads should also be protected by growing thorns, agave etc. The narrow and wide ravines should also be afforested for fuel, timber or other raw material and grass waterways should be provided in narrow ravines, where it is necessary, which will help in controlling velocity of running water and ultimately to control further cutting of ravine.

The reallocation of reclaimed land to progressive farmers or land less labour on a self contained colonisation bases may be attempted. Special legislation to enable land take-over from various parties and redistribution would become necessary. Special legislative provisions for transfer of individual and village common lands to forest department for afforestation work are also necessary measures.

Looking to the above recommendations, the reclamation of ravines should only be attempted in shallow and medium ravines with suitable structures. The deep and very deep ravines should be put under permanent vegetation. As far as possible before construction of engineering structures, the back flow of the river and flood water should be considered and safest limit of reclamation of ravines be fixed for avoiding the damage by natural calamities i. e. flood. This main two ravines are very deep and very wide, so it is advisable not to reclaim the main ravines but their distributaries shallow and medium ravines may be tried for reclamation by constructing suitable structures and bunds. The banks of river, lower area below safest limit and outer boundaries of each humps and hummocks and ravine beds should be afforested as per species given d-(6) Suitability for pasture and forestry of section IV of "Soil Survey Interpretation". The bunding work in table and marginal land should be carried out so that erosion of can be controlled.



## APPENDIX - I -

The description of typifying pedons of different series marked in the surveyed area are as below :—

1. *Typifying pedon of Lawarpur-I series*—Lawarpur-I loamy sand cultivated, very comp, vertic Ustochrepts (Inceptisols).

(Colour notations are for dry soils unless otherwise noted).

Horizon	Depth in cms.	Description.
AP	0.25 Cms.	Yellowish brown (10YR/4) and dark yellowish brown (10YR 3/4M) loamy sand; weak columnar breaks into crumb structure; wet nonsticky and non plastic, dry slightly hard and moist friable; rapid permeability; free from lime concretions but gives slight effervescence with dil Hcl. in irrigated field; few quartz, mica flakes and sand gravels present; common, fine impeded roots; presence of insect and ant burrows, crotovinas; clear and smooth boundary ; PH 8.5.
B1	25.68 cms.	Dark Yellowish brown (10YR 4/4) and (10 YR 3/4 M;) sandy loam to loam; weak columnar breaks into weak fine subangular blocky peds; wet slightly sticky and slightly plastic, dry hard moist friable; rapid permeability; free from lime concretions; few quartz gravels, mica flakes and sand gravels present; few fine impeded roots; insect and ant burrows and crotovinas are present; clear and wavy boundary ; PH 8.6.
B2	68.110 cms	Dark brown (10YR 3/3) and dark yellowish brown (10 YR 3/3M) sandy loam; weak fine to medium subangular blocky peds; wet slightly sticky and slightly plastic moist friable; moderately rapid permeability; free from lime concretions; few quartz gravels; sand gravels and mica flakes present; few fine impeded roots; insect and ant burrows and crotovinas are present; clear and wavy boundary ; PH 8.3.
B3	110.150 cms.	Dark yellowish brown (10YR 3/4 M); sandy loam; weak fine subangular blocky peds; wet slightly sticky and and slightly plastic, moist friable; moderately rapid permeability; free from lime concretions few quartz sand gravels and mica flakes present; very few very fine and impeded roots; insect and ant burrows and crotovinas are present; diffuse smooth boundary ; PH 8.0.
C1	150-170+cms.	Dark yellowish brown (10 YR 3/4 M) and (10YR 3/4 M); loamy sand; single grain structure; wet nonsticky and not plastic, moist loose; rapid permeability; free from lime concretions; few insect and ant burrows and crotovinas are present; PH 8.0.

*Physiography and Relief*—Mid table land with nearly level to very gently sloping land having 9.5% to 2% slope.

*Drainage* —Well drained.

*Associated Soils*—Rangpur-II soils are flat to very gently slopy, vertic Ustorthents (Entisols); Rangpur-II soils are very gently to gently sloping moderately dissected shallow, type Ustorthents (Entisols) and Lawarpur-II soils are deepmoderately dissected very gently to gently sloping table land of vertic Ustochrepts (Inceptisols).

*Vegetation*—Banyan, Neem, Mango, Samadi, Babul, Aml, Capparis aphylla, Zizyphus etc trees and local grasses.

*Use*—Crops like Jawar, wheat, cotton, castor, Sesamum, Tur, Vegetables, Bajra, Fennel, and local grasses.

*Soil—Type location*—Profile No. 1, was dug in south about 3/4 Kilometer away from Arjanpura (Rangpura Village) in plot No. 59 on Rangpur to Arjanpura car track of Rangpura Village, Taluka Vijalpur, District Mahesana.

2. *Typifying pedon of Rangpur-I series*—Rangpur-I loamy sand cultivated.

Rangpur-I, Moderately deep to deep, fine loamy, 1:1 lawice illitic, hyperthermic, deep, vertic, Ustorthent (Entisols).

(Colour notations are for dry soils unless otherwise noted).

Horizon	Depth in cms.	Description.
AP	0-18	Yellowish brown (10YR 5/4) and dark yellowish brown (10YR 3/4 3/4 M); loamy sand, weak columnar breaks into crumb structure; wet non sticky and non plastic, dry slightly hard and moist friable; Rapid permeability; free from lime concretions; few quartz gravels, sand gravels and mica flakes are present; insect and ant burrows and crotovinas present; few fine, inped roots; clear and smooth boundary; PH——.
A1-2	18-55	Dark yellowish brown (10YR 4/4) and (10YR 3/4 M); loamy sand; weak columnar breaks into weak fine subangular blocky peds; wet, slightly sticky and nonplastic, dry slightly hard, moist friable, rapid permeability free; from lime concretions; few quartz gravels, sand gravels and mica flakes are present; few insect and ant burrows and crotovinas present; common fine inped roots; clear and wavy boundary; PH——.
A1-3	55-98	Dark brown (10YR 3/3) and dark yellowish brown (10YR 3/4); sandy loam; weak medium subangular blocky peds; wet slightly sticky and slightly plastic, dry hard, moist friable, rapid permeability; free from lime concretions; few quartz gravels, mica flakes and sand gravels present; insect and ant burrows and crotovinas are present; common, fine inped roots; clear and wavy boundary; PH
C1Ca	98-125	Dark yellowish brown (10YR 3/4 D and M); loamy sand; weak fine subangular blocky peds; wet nonsticky and nonplastic, moist friable; rapid permeability; few 1-2 mm size lime concretions giving strong effervescence in pockets; for quartz gravels, sand gravels and mica flakes are present; insect and ant burrows present; many white streaks of some salts are observed; few fine inped, roots; diffused boundary PH——.
C2Ca	125-165 +	Pale brown (10YR 6/4) and dark yellowish brown (10YR 4/4 M); loamy sand to sand texture; digule grain structure; wet non-sticky and non-plastic, dry and moist loose; Rapid to very rapid permeability; many 1-3 mm size lime concretions giving violent effervescence with dil Hcl; few sand gravels, mica flaks and quartz gravels are present; insect and ant burrows and crotovinas are present; many whitish veins or streks of some salts are present; PH 8.3.

*Physiography and Relief*—Mid table land occuring on nearly level to gently sloping land having 0.5 to 3% slope.

*Drainage*—Well drained.

*Vegetation*—Mango, Neem, Babul, Banyan, Zizyphus, Capparis aphylla, Euphorbia species etc trees and local grasses.

*Use*—Wheat, Bajra, Jowar, Lucerne, Tur, Vegetables castor Sesamum, Cotton, etc. crops in rainfed as well irrigated condition.

*Associated soils*—Lawarapur-I soils are flat to very gently sloping, very deep vertic Ustochrepts (Inceptisols); Lawarapur-II soils are moderately dissected, very gently to gently sloping table land of deep vertic Ustochrepts (Inceptisols) and Rangpur-II are moderately dissected, very gently to gently sloping, shallow vertic Ustochrepts (Entisols).

*Type location*—In south 1/2 km. away from Rangpur on Rangpur to Varsoda Cart track, profile No. 3 Survey No. 438 of village Ranpur, Taluka Vijapur, District Mahesana.

### 3. *Typifying pedon of Lawarapur-II series*—Lawarapur-II sand (Aeolian) cultivated.

Lawarapur-II, deep, fine loamy ; 1:1 lattice illitic; hytherthermic, deep, vertic Ustochrepts (Inceptisols).

(Colour notation are for dry soils unless otherwise noted).

Horizon	Depth in cms.	Description.
AP	0-22	Yellowish brown (10YR 5/4) and dark brown (7.5 Yr 3/2 M), Aeolian sand; weak columnar breaks into weak fine subangular blocky peds; wet nonsticky and nonplastic, dry slightly hard, moist friable; rapid to very rapid permeability free; from lime concretions; few quartz gravels, sand gravels and mica flakes are present insect and ant burrows and crotovinas are present; few fine inped roots; clear and smooth boundry ; PH 7.5.
B1	22-63	Dark brown (7.5YR 4/4) and dark yellowish brown (10YR 3/4M), sandy loam texture., weak columnar breaks into weak medium subangular blocky peds., wet slightly sticky and slightly plastic, dry hard, moist friable., rapid permeability., free from lime concretions., few quartz gravels, mica flakes and sand gravels are present., insect and ant burrows and crotovinas are present., few, fine inped roots., clear and wavy bounday., PH 7.5.
B2	63-120	Dark brown (7.5 YR 4/4) and 7.5YR 3/4MO., sandy loam sand., weak fine subangular blocky peds., wet slightly sticky and nonplastic., dry slightly hard, moist friable., rapid permeability., free from lime concretions., few quartz gravel, mica flakes and sand gravels are present, insect and ant urrows and ant burrow crotovinas are present., very few, very fine inped roots., clear and wavy boundary PH 8.1
B3	120-137	Dark brown (7.5YR 4/4 D& M), loamy sand., single grain structure., wet nonsticky and nonplastic, dry slightly hard, moist friable., rapid permeability., free from lime concretions, few quartz gravels, sand gravels and mica flakes are present., insect and ant burrows and crotovinas are present., clear and wave boundary., PH 8.3.
C1Ca	137-175	Strong brown (7.5 YR 5/6) and dark brown (7.5YR 4/4 M), sand, single grain structure., wet nonsticky and nonplastic, dry loose and moist loose., vary rapid permeability., few-1-2 mm.size lime concretions giving strong effervescence with dil. HCL, few quartz gravels and mica flakes are present., insect and ant burrows and crotovinas are presently PH 8.3.

*Physiography and Relief*:-Mid table land, perephery to ravines i.e. moderately dissected periphery land Having 2% to 5% slope.

*Drainage*:- Well drained.

*Vegetation*:- Mango Neem Babul Banyan, Zizyphus Species, Cappuris aphylla, piludi Samadi, etc. and local grasses.



**Use--** Bajra, Wheat Jowar, Castor, Sesamum, Fennel, Cotton Mug Math etc. as cultivated crops and the rest of the area is under grass.

**Associated Soils:-** Lawarpur-I soils are flat to very gently sloping very deep, vertic Ustochrepts (Inceptisols) Rangpur-I & Rangpur-II soils are flat to very gently sloping deep, vertic Ustorthents (Entisols) and moderately dissected very gently sloping to gently sloping, shallow vertic Ustorthents (Entisols) respectively.

**Type location--**Profile No.2, was dug in west about 1/4 km. away from Varsoda in Survey No. 149 on Varsoda to Makahad cart track of Varsoda village., Ta. Vijapur Dist., Mahesana.

4. **Typifying pedon of Rangpur-II series--**Rangpur-II loamy sand cultivated.

Rangpur-II, deep loamy to coarse loamy, mixed, to illitic, hyperthermic, shallow typic ustorthents (Entisols).

[Colour notations are for dry soils unless otherwise noted]

Horizon	Depth in cms.	Description.
AP	0-25	Dark yellowish brown to yellowish brown (10YR 4.5/4 and dark yellowish brown (10YR 3/4M)., loamy sand., weak columnar breaks-into weak fine subangular blocky to crumb structure., wet nonsticky and nonplastic. dry slightly hard, moist friable., rapid permeability., free from lime concretions., few quartz gravels and mica flakes are present., few insect and ant burrows and crotonas are present., few to common fine, inped roots., clear and smooth boundary., PH
A1-2	25-70	Dark brown (10YR 3/3) and dark yellowish brown (10YR 3/4M) sandy loam., weak columnar breaks into weak, medium subangular blocky peds., wet slightly sticky and nonplastic, dry hard and moist friable, rapid permeability., few 1mm size lime concretion giving slight effervescence with dil Hcl., sand gravels and mica flakes are present., insect and ant burrows and crotonas are present., few to common, fine, inped., roots Many white streaks of some salts present, clear and wavy boundary., PH
6/AC	70-106 cms.	Dark brown to brown (10YR 4.5/3) and dark yellowish brown (10YR 3/4M)., sandy loam to loamy sand., weak fine subangular blocky peds., wet slightly sticky and nonplastic dry hard, rapid permeability., common-1-3 mm. size lime concretions giving strong effervescence with dil. Hcl, few quartz gravels mica flakes and sand gravels., insect and ant borrows and crotonas are present many, white streaks of some salts are present., few fine inped roots., clear and wavy boundary., PH
C1Ca	406-132	Dark brown (10YR 4/3) and dark yellowish brown (10YR 3*5/4)., loamy sand., massive to crumb structure., wet nonsticky and nonplastic, dry hard and moist friable., Rapid permeability., Many 1-3 mm. size lime concretions giving violent effervescence with dil. Hcl. few quartz. mica flakes and sand gravels are present., insect and ant burrows and crotonas are present., diffuse boundary, PH
C2Ca	132-160	Brown to pale brown (10YR 5.5/3) and dark yellowish brown (10YR 4/4M)., sand., single grain structure., wet non sticky and non plastic moist loose., very rapid permeability., many 1-3mm size lime concretions giving violent effervescence with dil Hcl.; few quartz gravels and mica flakes are present., insect and ant burrows and crotonas are present., PH 8.3.

**Physiography & Relief--**Mid land with very gently slopy to gently slopy land having 2% to 5% slope-

**Drainage--** Well drained.

**Vegetation**-- Mango, Neem, Babul, Banyan, *Zizyphus capparidis* aphylla, *Euphorbia* species and thorny bushes and shrubs and local grasses.

**Use**-- Bajra, Wheat, Tur, Castor, Fennel, Cumin, Cotton, Sesamum, Jowar, etc. crops in rainfed as well as irrigated condition.

**Associated Soils**-- Rangpur-I and Lawarapur-I soils are flat to very gently sloping deep vertic Ustorthents (Entisols) very deep, vertic Ustochrepts (Inceptisols) respectively. While Lawarapur II soils are deep moderately dissected very gently to gently sloping table land of Vertic Ustochrepts (Inceptisols)

**Type location**-- Profile No.4 was dug in east about 1/4 to 1/2 km. away from Rangpur villages in Survey No. 154 on Rangpur to Himatpura cart track of Rangpur village Ta. Vijapur Dist., Mahakana.

5. **Typifying pedon of Rangpur-I Series**--Ratanpur-I sand uncultivated waste lands.

Ratanpur-I, Moderately deep to deep, fine loamy 1:1 lattice illitic to mixed, hyperthermic vertic (Ustorthents) Entisols).

(Colour notations are for dry soils unless otherwise noted).

Horizon	Depth in cms.	Description.
A1-1	0-25	Dark brown to brown (10YR 4/3) and dark yellowish brown (10YR 3/4M), loamy sand, weak columnar breaks into weak fine subangular blocky peds., wet nonslicky and nonplastic, dry-hard, and moist friable., rapid permeability free from lime concretions., few quartz gravels, mica flakes and sand gravels are present., insect and ant burrows and crotovinas are present., Common coarse inped roots, clear and smooth boundary., PH 8-0.
A2-2	25-70	Dark brown (10YR 3/3) and dark yellowish (10 YR 3/4 M), sandy loamy, weak columnar breaks into weak medium subangular blocky peds., wet slightly sticky and slightly plastic dry slightly hard and moist friable., rapid permeability., free from lime concretions., few quartz gravels, sand gravels and mica flakes are present., insect and ant burrows and crotovinas are present., few fine inped roots., clear and wavy boundary., PH 8.1.
C	70-115	Dark brown to brown (10YR 4/3) and dark yellowish brown (10YR 3/4M), sandy loam to loam., weak fine subangular blocky peds., wet slightly sticky and slightly plastic dry slightly hard, moist friable., rapid permeability., few 1-2 mm. size lime concretions giving slight efferevescence with dil. Hol., few quartz gravels are present., insect and ant burrows and crotovinas are present., white veins of some salts are observed., clear and wavy boundary., PH 8.1.
C1Ca	115-150	Dark yellowish brown (10YR 4/4 D & 10YR 3/4M), silt loam., massive structure., wet slightly sticky and slightly plastic, dry hard and moist friable., rapid permeability., many 2-3 mm size lime concretions giving strong to violent efferevescence with dil. Hol., few quartz gravels, sand gravels and mica flakes are present insect and ant burrows and flakes are present., insect and ant burrows and crotovinas are present., many white veins of some salts are observed., few fine inped roots, PH 8.4.

**Physiography & Relief**-- Highly dissects gently sloping undulating middle terraced humped land. having 3% to 7% slope.

**Drainage**-- Well drained to excessively drained.

**Vegetations**-- Mango, Neem, Babul, *Zizyphus*, *Capparis* aphylla, *Casia* tora, *Euphorbia* species, Amla, Piludi etc, trees and thorny shrubs and bushes and local grasses.

**Use:-** Generally used as Pasture, grass land and grazing land under ravines.

**Associated soils--** Lawarpur -II which are deep, moderately dissected very gently to gently sloping table land of vertic Ustochropts (Inceptisols) and Ratanpur-II soils which are shallow loamy mixed to illitic, highly dissected moderately sloping humped land of shallow typic Ustorthents (Entisols.)

**Type location--** Profile No. 16 was dug in southeast, about 1 1/2 km. away in Survey No. 747 of Varsoda Village on Varsoda to Sabarmati river cart track of Varsoda Village Tal. Vijapur Dist. Mahesana.

**6. Typifying pedon of Ratanpur-II series:-**

Ratanpur-II shallow, loamy, mixed to 1:1 latice illitic, hyperthermic, shallow, typic Ustorthents(Entisols)

(Colour notations are for dry soil unless otherwise noted).

Horizon	Depth in cms.	Description.
A1-1	0-14	Yellowish brown (10YR 5/4) and dark brown (7.5 YR 3/2) ; loamy sand, crumb to massive structure; wet nonsticky and nonplastic; dry slightly hard and moist friable; very rapid permeability; insect and ant burrows and crotovinas are present; few quartz, gravels, sand gravels and mica flakes are present; few 2-3 mm size lime concretions giving strong effervescence with dil Hcl; common, fine inped roots; clear and smooth boundary; PH 8.5
A1-2	14-40	Dark brown (7.5YR 4/4 & 7.5 YR 3/2 M); sandy loam to loamy sand; weak fine subangular blocky peds; wet slightly sticky and nonplastic, dry slightly hard and moist friable; rapid to very rapid permeability; few quartz gravels, sand gravels and mica flakes are present; insect and ant burrows and crotovinas are present; few to common 2.5 mm size lime concretions giving strong effervescence with dil Hcl. few, fine inped roots; clear and wavy boundary PH 8.6.
C1Ca.	40-100	Yellowish brown (10YR 5/4) and dark brown (7.5 YR 4/4M), loamy sand to sand., massive to single grain structure., wet nonsticky and non-plastic, dry slightly hard and moist friable., very rapid permeability., few quartz gravels and mica flakes are present. insect and ant burrows and crotovinas are present., common 2-5 mm size lime concretions giving violent effervescence with dil. Hcl., few, inped roots., clear and wavy boundary PH. 8.5.
C2Ca	100-130	Brown to pale brown (7.5 YR 5.5/4) and dark brown (7.5 YR, 4/4 M), loamy sand., single grain structure., wet nonsticky and nonplastic dry loose and moist loose., very rapid permeability., insect and ant burrows and crotovinas are present., quartz gravels and crotovinas are present., quartz gravels and mica flakes are present., Many 5-10 mm size lime concretions giving violent effervescence with dil Hcl., PH. 7.8.

**Physiography & Relief--** Highly dissected highly undulating, middle to lower terraced narrow ravine humps with gradient ranging from 5% to 10% or more slope.

**Drainage--** Excessively drained.

**Vegetations:-** The common vegetation observed are Neem Zizyphus species., Banyan, Mango, Babul, Aal, Casia Tora, Euphorbia species. Capparis aphylla etc. trees and thorny bushes and shrubs and local grasses.

**Use--** The area of ravine land is used as waste land, grass land grazing land

**Associated Soils:-** Ratanpur-I soils are highly dissected gently sloping undulating hump land of moderately deep to deep vertic Ustorthents (Entisols) and Lawarpur-II soils are moderately dissected, very gently to gently slopy table land of deep vertic, Ustochropts (Inceptisols).

*Type location*:- Profile No. 22 was dug out in south west direction about 2 to 2 1/4 km. away of Varsoda in Survey No. 799 and in north about 150-200 meters away from Sabarmati River of Village Varsoda, Ta. Vijapur Dist., Mahesana.

7. *Typifying pedon of Firozpur series*:- Firozpur silt loam cultivated.

Firozpur deep to very deep, fine loamy, mixed to 1:1 lattice illitic, hyparthermic, deep Ustifluvisols (Entisols).

(Colour notations are for dry soils unless otherwise noted)

Horizon	Depth in cms.	Description.
Ap	0-20	Brown (10YR 5/3) and dark yellowish brown (10YR 3/4 M), silt loam., weak columnar breaks into weak fine subangular blocky peds., wet slightly sticky and slightly plastic dry slightly hard, moist friable rapid permeability., many fine mica flakes, quartz gravels and sand gravels present., free from lime concretions but giving strong effervescence with dil Hcl., few coarse impeded roots clear and smooth boundary PH. 8.8.
A1-2	20-75	Dark brown to brown (10YR 4/3) and dark yellowish brown (10YR 4/3), silt loam weak columnar breaks into weak fine to medium subangular blocky peds., wet slightly sticky and slightly plastic, dry hard, and, moist friable., rapid permeability few quartz gravels sand gravels & mica flakes present., free from lime concretions but giving strong effervescence with dil Hcl. few, fine impeded roots., clear and wavy boundary PH. 8.2.
A1-3	75-120	Dark yellowish brown (10 YR 4/4 D & 10 YR 3/4M), sandy clay loam., weak fine subangular blocky peds., wet slightly sticky and slightly plastic., dry slightly hard, moist friable., rapid permeability few quartz gravels, mica flakes and sand gravels are present., mica flakes gives shining appearance in sunrays., free from lime concretions but giving violent effervescence with dil. Hcl. few, fine impeded roots., clear and wavy boundary .pH 9.0.
A1-C4	120-160+	Dark brown (10YR 3/3M), sandy loam., massive structure., wet slightly sticky and slightly plastic., dry slightly hard., moist friable, rapid permeability. mica flakes and quartz gravels giving shining appearance in sun rays., free from lime concretions (at some places. few 2-5 mm size conca) giving violent effervescence with dil Hcl pH., 8.8.

*Physiography & Relief*—Lower River Terrace with very gently slopy to gently slopy land having 2/s to 4/ slope.

*Drainage*—Well drained to excessively drained.

*Vegetation*—Mango, Babul, Avel, Zizyphus species, Banyan, Neem, Tamarind, Euphorbia species, Capparis aphylla etc. trees and thorny shrubs and bushes.

*Use*—The common cultivated crops are Jowar, Bajra, Wheat, Vegetables, Tur, Mug, Math etc.

*Associated soils*—Sabarmati Ravine bed land. which are shallow to moderately deep, coarse loamy, shallow usipsamments (Entisols).

*Type location*—Profile No. 19 was dug in Survey No. 781, about 1 1/2 Km. away in south from Varsoda village near the temple on the bank of Sabarmati river of Varsoda village, Ta. Vijapur, Dist. Mehsana.

**3. Typifying pedon of Sabarmati-Ravine bed soils—Sabarmati Ravinebed- sandwaste Ravine bed land.**

Shallow to moderately deep, coarse loamy, mixed, hyperthermic, shallow Utipasamments (Entisolts).

(Colour notations are for dry soils unless otherwise noted).

Horizon.	Depth in cms.	Description.
<b>A1-1</b>	0-15 cms.	Brown (10YR 5/3) and dark yellowish brown (01YR 4/4 M); sand single grain structure; wet nonsticky and nonplastic, dry loose, moist loose, very rapid permeability; quartz gravels and mica-flakes giving shining appearance in sun rays; free from lime concretions; but giving strong effervescence with dil Hcl. Ca gravels are present common, fine inped roots, clear and smooth boundary; PH 8.6.
<b>AC</b>	15-36	Very pale brown (10YR 7.5/4) and yellowish brown (10YR 5/6 M) silt loam; weak fine subangular blocky peds; wet slightly sticky and slightly plastic, dry slightly hard and moist friable; rapid permeability mica flakes and quartz gravels giving shining appearance in sun rays; calcium gravels are present free from lime Concretion but giving strong effervescence with dil Hcl few coarse inped roots; clear and wavy boundary PH 8.8.
<b>C1Ca</b>	36-76	Very pale brown (10YR 7/3) and pale brown (01YR 6/3 M); gravelly sand texture, loose single grain structure; very rapid permeability; many minute mica flakes giving shining appearance in sun rays; calcium gravels are present; Many 5-12 mm size lime concretions giving violent effervescence With dil Hcl, clear and wavy boundary; PH 8.8.
<b>HC1Ca</b>	76-78	Brown to pale brown (10YR 5.5/3) and Brown (10YR 5/3 M); loose sand; loose single grain structure; wet nonsticky and non plastic; dry loose and moist loose, very rapid permeability quartz gravels and minute mica flakes giving shining appearance in sun rays; calcium gravels are present; common 3-7 mm size lime concretions giving violent effervescence with dil Hcl; clear and wavy boundry; PH 8.5.
<b>HC2Ca</b>	88-110	Light gray (10YR 7/2 & M); gravelly sand; loose single grain structure; wet nonsticky and non-plastic; dry loose and moist loose, very rapid permeability; quartz gravels and minute mica flakes giving shining appearance in sun rays; calcium gravels are present; many 5-12 mm size lime concretions giving Violent effervescence with dil Hcl; PH 8.6.

**Physiography & Relief:**—Lower Ravine bod with very gently slopy to gently slopy land having 1% to 3/ slope for more at place.

**Drainage**—Excessively well drained.

**Vegetation**—The common vegetation observed are Neem, Zizyphus Species, Mam'orego, Banyan, Casia, Tore Capparis aphylla, Euphorbia species; Babul, Aval etc. trees and thorns and thorny bushes and shrubs and local grasses.

**Use**—The area of Sabarmati ravine bed is generally used as drainege coarse and they are waste land.

**Typelocation**—Profile No.12 was dug in ravine bed in east to Notrth east about 1 1/4 km. away from Varsoda Village, Ta. Vijapur Dist. Mehsana.

## Appendix-III

## List of explanation of Symbols:—

## 1. Soil Series—

Series Name	Abbreviation	Symbol
Lawarpur-I	Lpr-I	I
Rangpur-I	Rgp-I	2
Lawarpur-II	Lpr-II	3
Rangpur-II	Rgp-II	4
Ratanpur-I	Rtr-I	5
Ratanpur-II	Rtr-II	6
Firozpur	Fpr-	7
Misc. land types bed lands.	Misc. and bed lands.	8-9

## 2. Textural classes—

Sandy loam	Sl.
Sand	S
Loamy san	Ls.
Silt loam	Sil.
Sandy clay loam.	Scl.
Loam.	L

## 3. Soil Depth classes—

Depth	Symbol	Description.
Shallow	d2	0-22 cms.
Moderately deep.	d3	22-45 "
Deep	d4	45-90 "
Very deep	d5	7-90

## 4. Soil Slope classes—

Slope class	Range	Description
A	0-1/	Nearly level to level Very gently sloping.
B	1-3/	Very gently sloping.
C	3 & 5/	Gently sloping.
D	5-10/	Moderately sloping.
E	10-15/	Strongly sloping
F	15-25/	Moderately steep to steep.
G	25/-33/	Steep.

5. *Erosion classed---*

<i>Description</i>	<i>Symbol.</i>
No or slight erosion	e1
Moderate erosion	e2
Severe erosion	e3
Very severe erosion	e4

*Ravine field Standards.*

<i>6. Length of Ravine.</i>	<i>Abbreviation</i>
Short .. .. .less than 1km.	L1
Medium .. .. .1-3 kms.	L2
Long .. .. .3-6 kms.	L3
Very long More than 6 kms.	L4

<i>7. Ravine depth :</i>	<i>Description</i>	<i>Abbreviation</i>
Shallow ravines	less than 1.5 mts deep	D1
Medium ravines	1.5 to 5 mts deep	D2
Deep ravines	5 to 10 mts deep.	D3
Very deep ravines	More than 10 mts deep.	D4

<i>8. Width of Ravines -</i>	<i>Description</i>	<i>Abbreviation.</i>
	Very narrow-less than 3 mts wide	W1
	Narrow-3-15 mts wide.	W2
	Wide-15-30 mts wide.	W3
	Very wide-More than 30 mts wide	W4

9. *Side slope and stage of Ravines--*

Flate-45 or flatter with "V" shape ravines-S2  
 Steep-45 to 90 with "U" shape ravines-S2  
 Vertical or back stop with "W" shape ravines-S3

10. *Catchment of the Area:--*

No catchment above the ravine head-1  
 Small catchment more than 2 hectares-2  
 Medium catchment 2 to 20 hectares-3  
 Large catchment - 7 20 hectres-4.

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## SUMMARY

Detailed soil Survey of Varsoda Ravine reclamation project, Ta' Vijapur. Dist : Mahesana covering an area of 2255 hectares has been completed. The detailed ravine soil survey report is appended with soil and land capability map of the project area. In the Surveyed area in all eight soil series including Sabarmati ravine bed soils are delineated on the soil map. The ravine area is also delineated on the basis of depth of ravine, length of ravine and catchment area of ravine. The soils of the area is grouped under suitable land capability classes, sub classes and units as per soil characteristics and similar in herent potentials and limitations. Following land capability classes, sub classes and units namely II-1, IIs-1, IIes-1, IIes-3, IIIes-1, IIIes-2, IIIes-3, IVes-1, IVw-1, VIes-1, VIes-2, VIIes-1, VIIes-2, VIIes-3, VIIIes-1, VIIIes-2, and VIIIes-3, are recognised in the surveyed area. Stabilization of ravines upto 5 meters depth i.e. upto medium ravines depth is recommended. Various mechanical measures to stabilize the ravines are also recommended. Recommendation for better land use and improved agriculture are specified in the report.

## ACKNOWLEDGEMENT

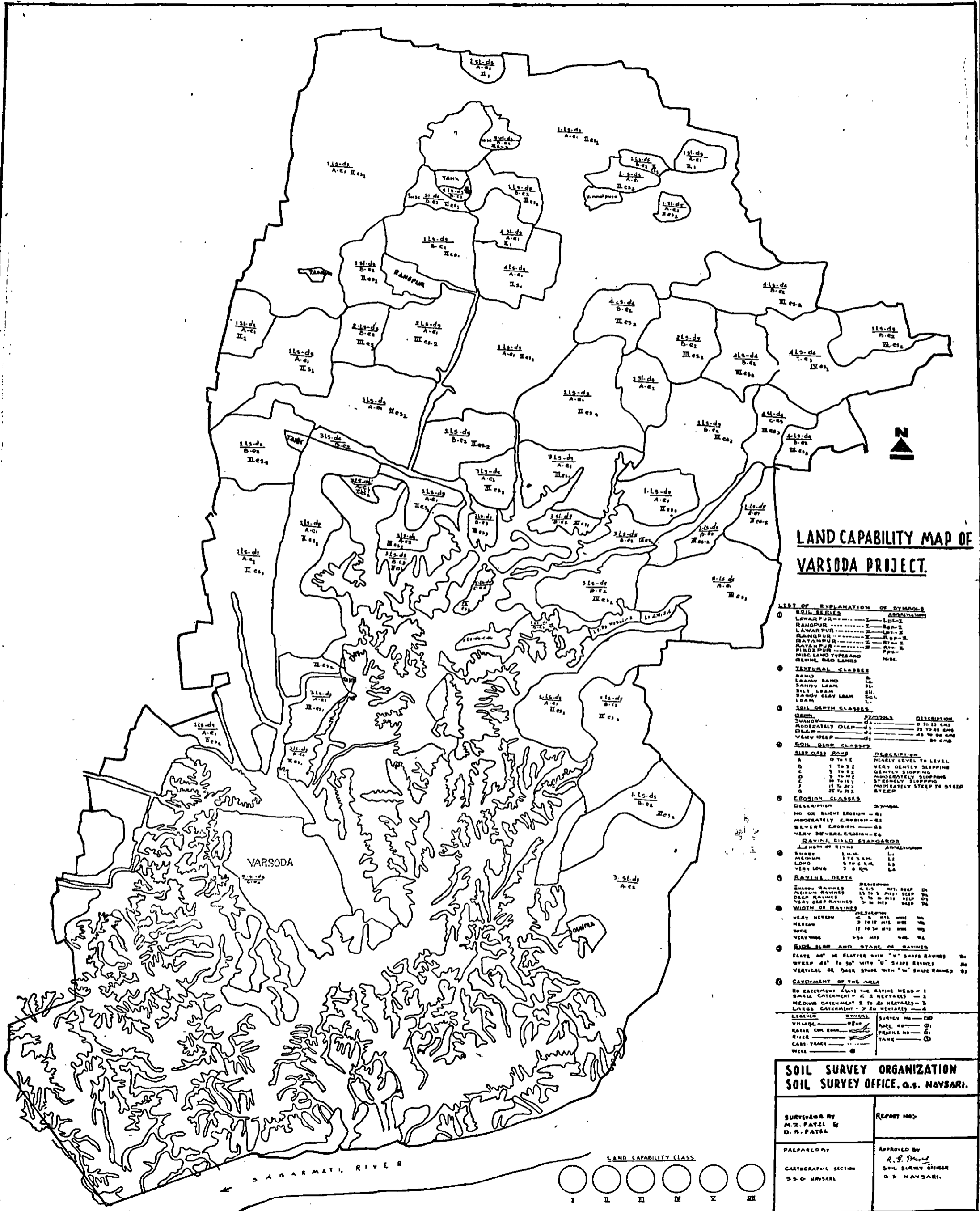
Help and assistance rendered by the following persons are gratefully acknowledged.

1. Divisional soil Conservation Officer, (Pilot Project) Paldi, Ahmedabad-6.
2. Sub-Divisional Soil Conservation Officer (P.I.) C/o : Divisional soil conservation Officer, Ahmedabad.
3. Agriculture Supervisor and Agriculture Assistants of Varsoda project.

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| 1. Detailed Survey of Pricity areas of Ukal Catechument.                  | Govt. of India-All India Saisa Land use survey New Delhi (I.A.R.I. buildings).  |
| 2. Ravine reclamation   | Review and approach Government of India Ministry of Agril. (Deptt. of Agril) Soil Conservation Division, New Delhi by Dr. Rega and Yashpal.           |
| 3. (i) Aerial photo interpretation in ravine survey.                      | By A. Kamphorst and others.   |
| (ii) Methods & legends for the use of aerial photographs in the Survey.   | By. A. Kamphorst and others.  |
| (iii) Stabilization and reclamation of ravines.                           | By Bali etc.  |
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| 7. Gazetter of Mahesana District  | Director of publicity G.S.  |





# LAND CAPABILITY MAP OF VARSDA PROJECT.

**LIST OF EXPLANATION OF SYMBOLS**

SOIL SERIES	ABBREVIATION
LEWARPUR	LDT-2
RANGPUR	RSP-2
LAWARPUR	LSP-2
RANGPUR	RSP-2
RAYANPUR	RSP-2
PIROZPUR	RSP-2
MISC. LAND TYPELAND	MISC.
REVENUE BAG LANDS	MISC.

TEXTURAL CLASSES	SYMBOL
SAND	S
LOAMY SAND	LS
SANDY LOAM	SL
SANDY CLAY LOAM	SCL
LOAM	L

SOIL DEPTH CLASSES	SYMBOL	DESCRIPTION
SHALLOW	S <sub>1</sub>	0 TO 15 CM
MODERATELY DEEP	S <sub>2</sub>	15 TO 30 CM
DEEP	S <sub>3</sub>	30 TO 45 CM
VERY DEEP	S <sub>4</sub>	45 TO 90 CM

SOIL SLOPE CLASSES	SYMBOL	DESCRIPTION
FLAT	0	0 TO 1%
A	1	1 TO 2%
B	2	2 TO 3%
C	3	3 TO 5%
D	4	5 TO 10%
E	5	10 TO 15%
F	6	15 TO 25%
G	7	25 TO 35%

EROSION CLASSES	SYMBOL
NO OR SLIGHT EROSION	E <sub>1</sub>
MODERATELY EROSION	E <sub>2</sub>
SEVERE EROSION	E <sub>3</sub>
VERY SEVERE EROSION	E <sub>4</sub>

RAVINE EROSION STANDARDS	SYMBOL
LENGTH OF RAVINE	L
SHOULDER	LS
MEDIUM	LM
LONG	LO
VERY LONG	LV

RAVINE DRAIN	SYMBOL
SHALLOW RAVINES	DR <sub>1</sub>
MEDIUM RAVINES	DR <sub>2</sub>
DEEP RAVINES	DR <sub>3</sub>
VERY DEEP RAVINES	DR <sub>4</sub>

WIDTH OF RAVINES	SYMBOL
VERY NARROW	WR <sub>1</sub>
NARROW	WR <sub>2</sub>
MEDIUM	WR <sub>3</sub>
WIDE	WR <sub>4</sub>
VERY WIDE	WR <sub>5</sub>

SIDE SLOPE AND STAGE OF RAVINES	SYMBOL
FLATE 40° OR FLATTER WITH "V" SHAPE RAVINES	SR <sub>1</sub>
STEEP 45° TO 50° WITH "U" SHAPE RAVINES	SR <sub>2</sub>
VERTICAL OR BACK SLOPE WITH "W" SHAPE RAVINES	SR <sub>3</sub>

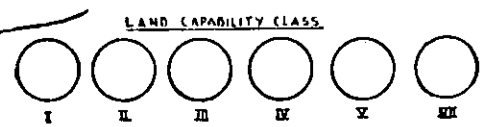
CATCHMENT OF THE AREA	SYMBOL
NO CATCHMENT ABOVE THE RAJINE HEAD	C <sub>1</sub>
SMALL CATCHMENT - 2 HECTARES	C <sub>2</sub>
MEDIUM CATCHMENT 2 TO 20 HECTARES	C <sub>3</sub>
LARGE CATCHMENT - 20 HECTARES	C <sub>4</sub>

LEGEND	SYMBOL	DESCRIPTION
VILLAGE	○	VILLAGE NO. 01
NATURAL CANAL	—	PROFILE NO. 02
RIVER	—	TANK
CANAL	—	TANK
WELL	⊙	

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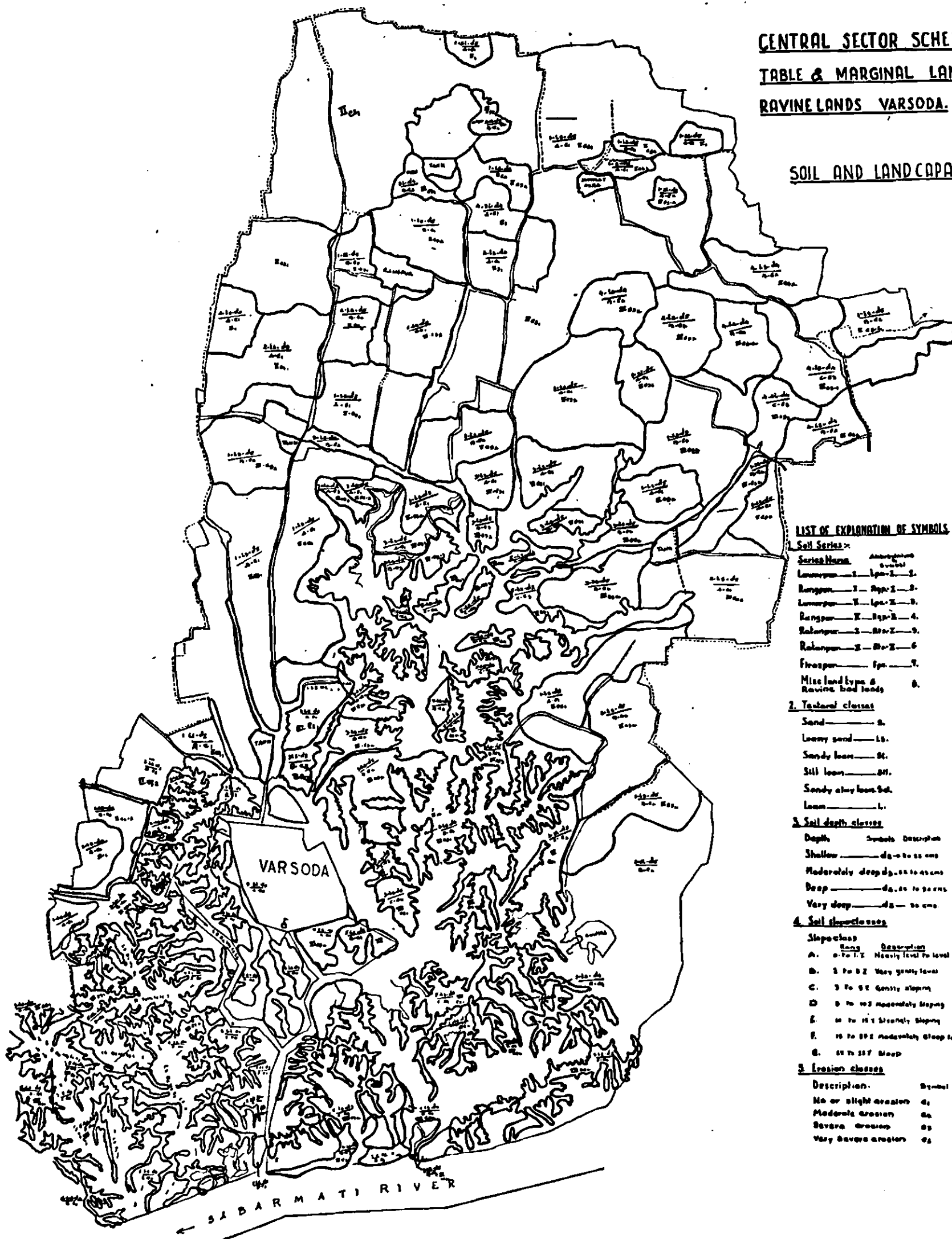
SURVEYOR BY M.R. PATEL & D.R. PATEL	REPORT NO.:
PALPARCOTY	APPROVED BY R.S. MEHTA SOIL SURVEY OFFICER G.S. NAVSARI.
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**CENTRAL SECTOR SCHEME FOR PROTECTION OF  
TABLE & MARGINAL LAND AND STABILIZATION OF  
RAVINE LANDS VARSODA. Dist. MOMBASA.**



**SOIL AND LAND CAPABILITY MAP OF VARSODA PROJECT.**



**LIST OF EXPLANATION OF SYMBOLS.**

**1. Soil Series:-**

Series Name	Abbreviation
Lumpur	Lp-1
Rangpur	Rp-1
Lumpur	Lp-2
Rangpur	Rp-2
Lumpur	Lp-3
Rangpur	Rp-3
Lumpur	Lp-4
Rangpur	Rp-4
Lumpur	Lp-5
Rangpur	Rp-5
Lumpur	Lp-6
Rangpur	Rp-6
Lumpur	Lp-7
Rangpur	Rp-7
Misc land type & Ravine bad lands	B

**2. Textural classes**

Sand	S
Loamy sand	Ls
Sandy loam	Sl
Silt loam	Sll
Sandy clay loam	Scl
Loam	L

**3. Soil depth classes**

Depth	Symbol	Description
Shallow	dg-0 to 25 cm	
Moderately deep	dg-25 to 45 cm	
Deep	dg-45 to 75 cm	
Very deep	dg-75 to 100 cm	

**4. Soil slope classes**

Slopes	Range	Description
A	0 to 1%	Nearly level to level
B	1 to 2%	Very gently sloping
C	2 to 5%	Gently sloping
D	5 to 10%	Moderately sloping
E	10 to 15%	Steeply sloping
F	15 to 25%	Moderately steep to steep
G	25 to 35%	Steep

**5. Erosion classes**

Description	Symbol
No or slight erosion	e1
Moderate erosion	e2
Severe erosion	e3
Very severe erosion	e4

**6. Ravine field standards**

Length of ravine	Abbreviation
Short - 1 to 2 km	Ls
Medium - 2 to 5 km	Lm
Long - 5 to 10 km	Ll
Very long - 10 km	Ld

**7. Ravine depth**

Description	Abbreviation
Shallow ravines 1 to 2 m deep	Ds
Medium ravines 2 to 3 m deep	Dm
Deep ravines 3 to 4 m deep	Dd
Very deep ravines 4 to 5 m deep	Dv

**8. Width of Ravines**

Description	Abbreviation
Very narrow < 2 m wide	Wv
Narrow 2 to 10 m wide	Wn
Wide 10 to 20 m wide	Ww
Very wide > 20 m wide	Wv

**9. Side slope of ravines**

Flats 45° or flatter with "v" shape ravines	Sv
Steep 45° to 90° with "u" shape ravines	Su
Vertical or back slope with "w" shape ravines	Sw

**10. Catchment of the area**

No catchment above the ravine head	C1
Small catchment - < 2 hectares	C2
Medium catchment - 2 to 20 hectares	C3
Large catchment - 20 to 100 hectares	C4

**LEGENDS**

Symbol	Description
⊙	Village
⊙	Kolar canal road
⊙	River
⊙	Cart-track
⊙	Well
⊙	Survey no
⊙	Road no
⊙	Profile no
⊙	Tank

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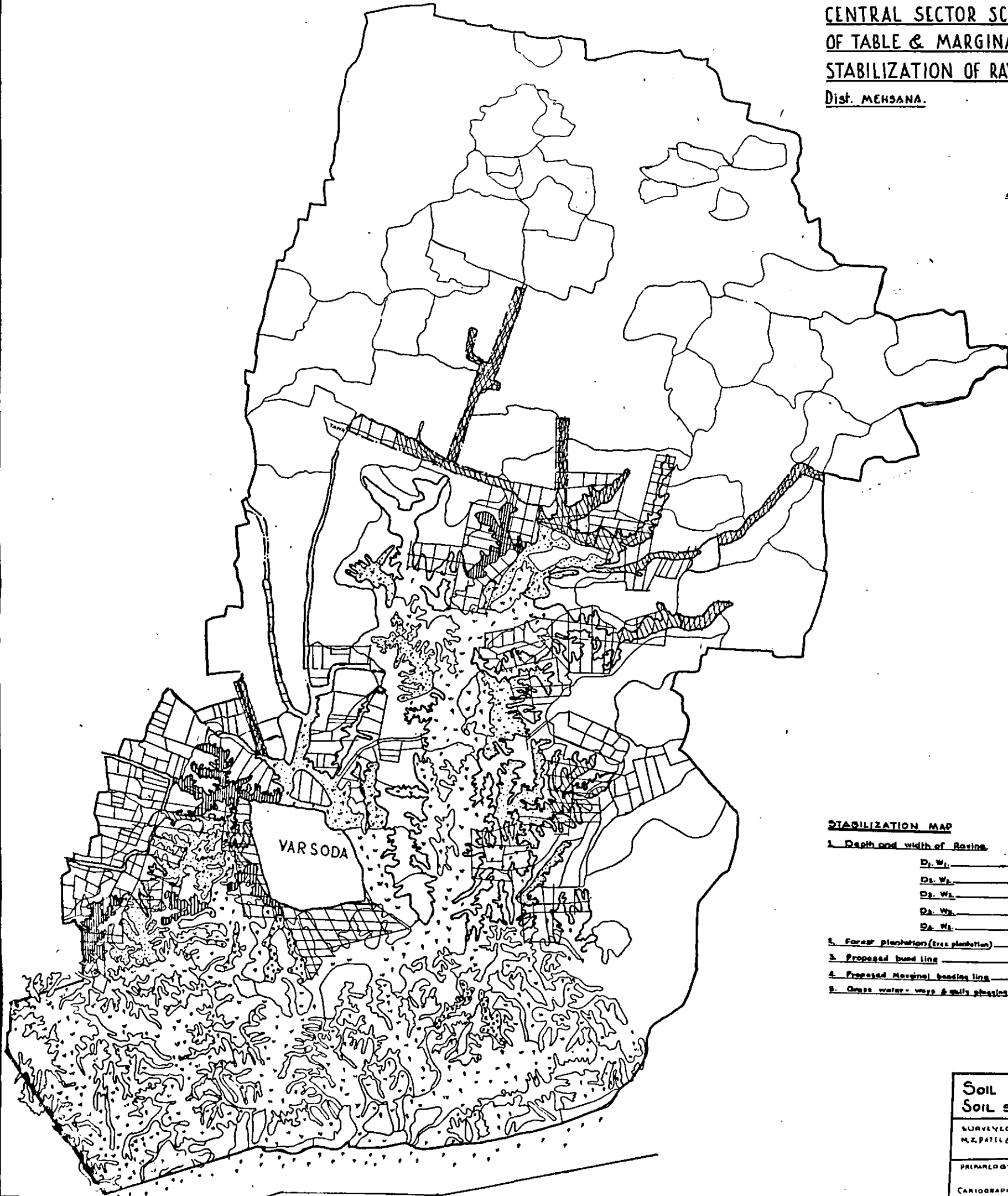
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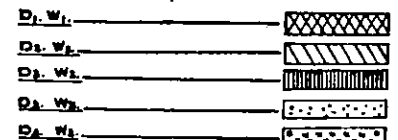
**CENTRAL SECTOR SCHEME FOR PROTECTION  
OF TABLE & MARGINAL LAND AND  
STABILIZATION OF RAVINE LAND VARSODA.**

Dist. MEHSANA.



**STABILIZATION MAP**

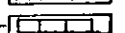
1. Depth and width of Ravine.



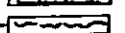
2. Forest plantation (Euc. plantation)



3. Proposed bund line



4. Proposed Marginal bunding line



5. Cross water - ways & gully plugging by crosses



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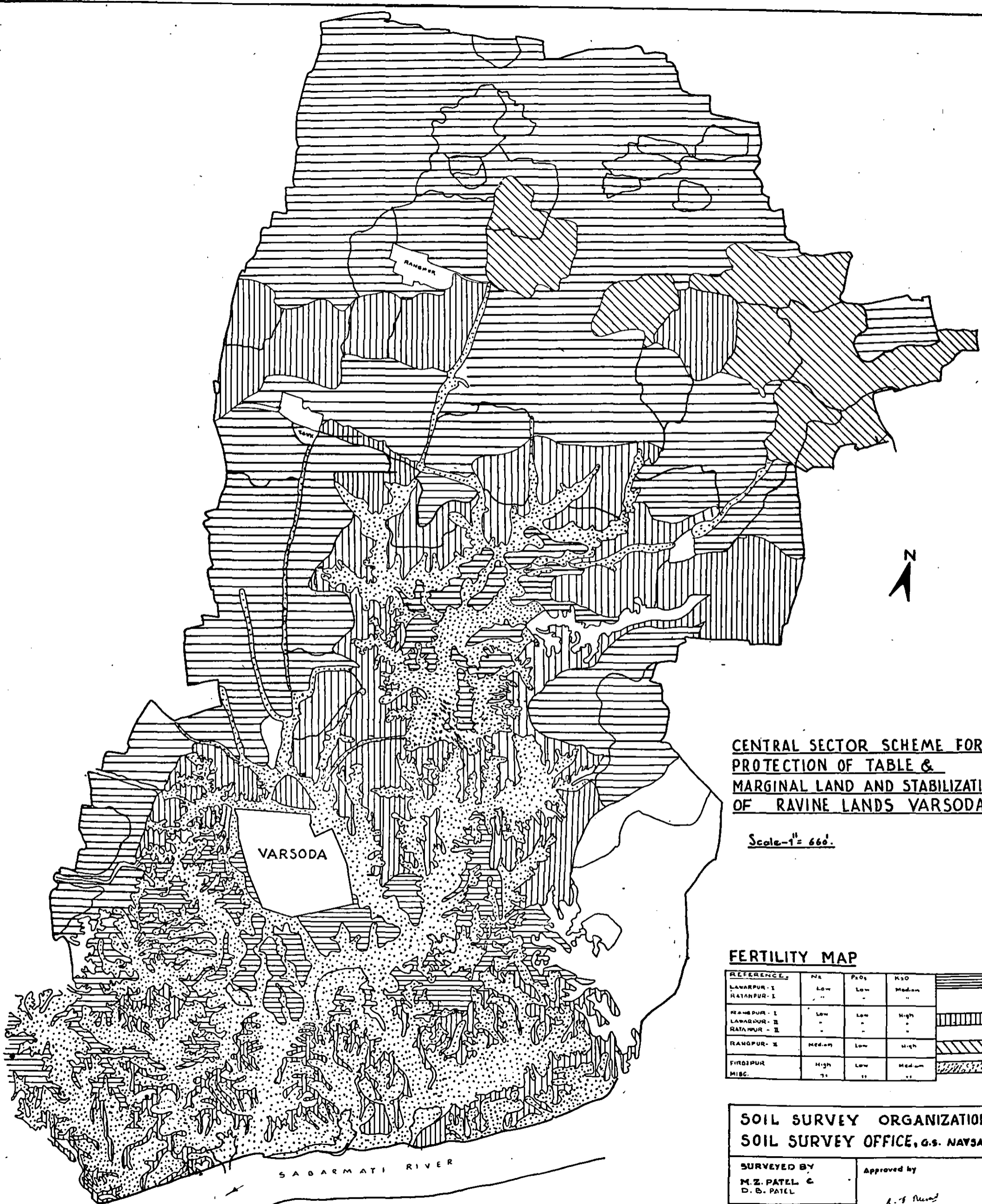
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**CENTRAL SECTOR SCHEME FOR  
PROTECTION OF TABLE &  
MARGINAL LAND AND STABILIZATION  
OF RAVINE LANDS VARSODA**

Scale-1"= 660'

**FERTILITY MAP**

REFERENCE	N <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	
LAWARPUR - I	Low	Low	Medium	[Horizontal hatching]
RATANPUR - I	"	"	"	
RANGPUR - I	Low	Low	High	[Vertical hatching]
LAWARPUR - II	"	"	"	
RATANPUR - II	"	"	"	[Diagonal hatching]
RANGPUR - II	Medium	Low	High	
FIRSIPIPUR	High	Low	Medium	[Cross-hatching]
MISC.	"	"	"	[Dotted pattern]

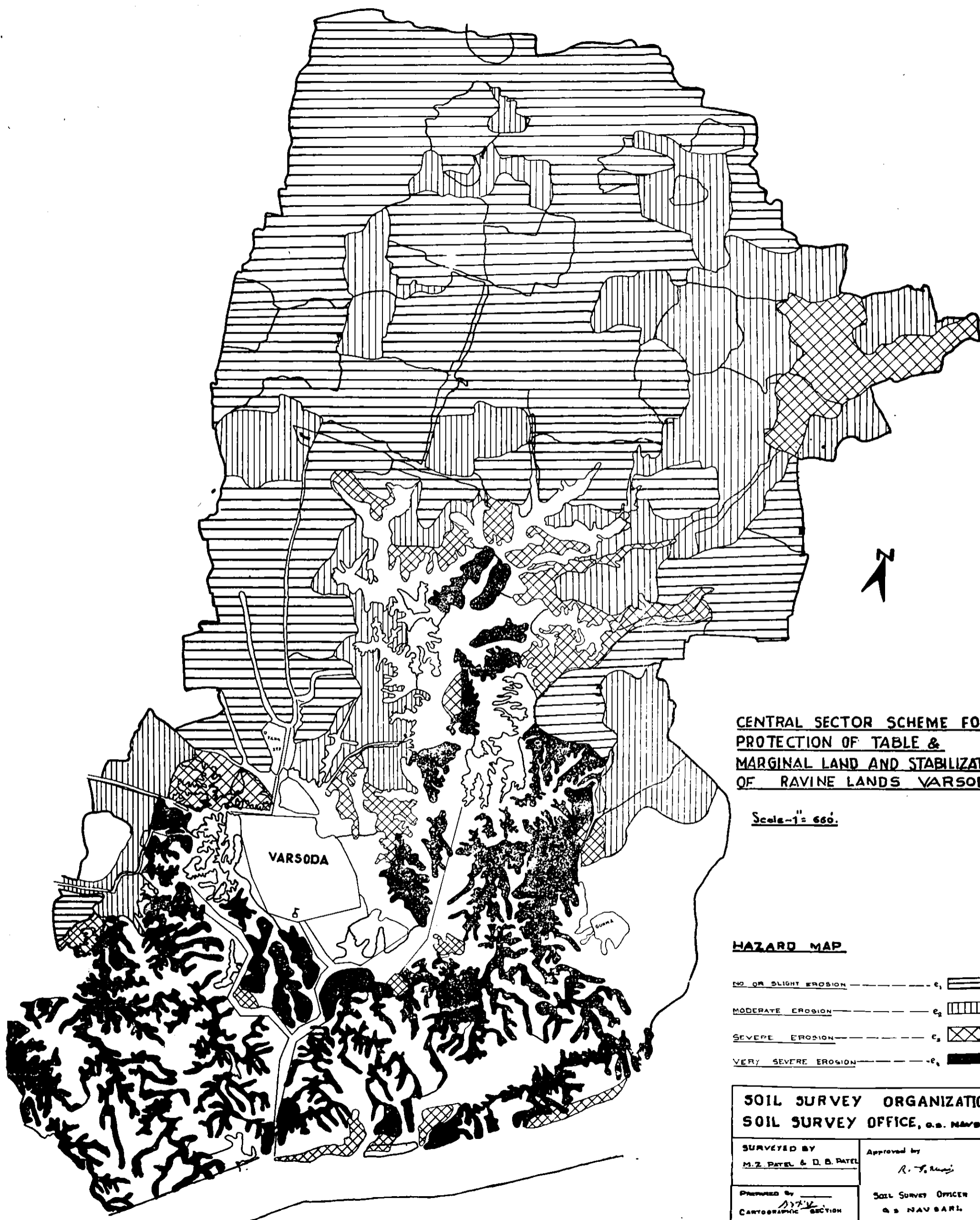
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**CENTRAL SECTOR SCHEME FOR PROTECTION OF TABLE & MARGINAL LAND AND STABILIZATION OF RAVINE LANDS VARSODA**

Scale-1" = 660'

**HAZARD MAP**

- NO OR SLIGHT EROSION ----- e<sub>1</sub> 
- MODERATE EROSION ----- e<sub>2</sub> 
- SEVERE EROSION ----- e<sub>3</sub> 
- VERY SEVERE EROSION ----- e<sub>4</sub> 

**SOIL SURVEY ORGANIZATION  
SOIL SURVEY OFFICE, G.S. NAVSARI.**

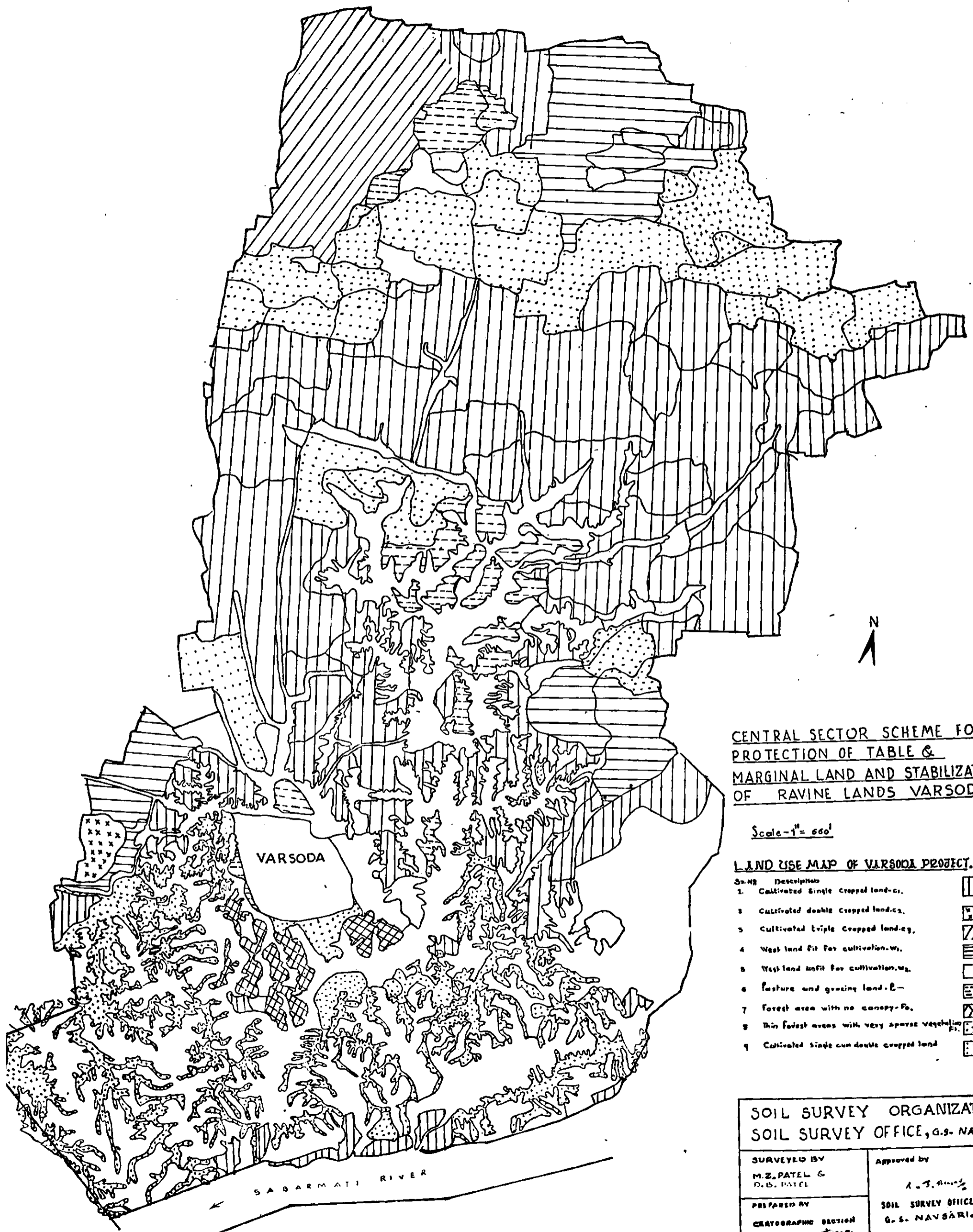
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CARTOGRAPHIC SECTION

SOIL SURVEY OFFICER  
G. S. NAVSARI.





**CENTRAL SECTOR SCHEME FOR PROTECTION OF TABLE & MARGINAL LAND AND STABILIZATION OF RAVINE LANDS VARSDA**

Scale-1"= 600'

**LAND USE MAP OF VARSDA PROJECT.**

Sr. No.	Description	Symbol
1.	Cultivated Single Cropped land-c <sub>1</sub> .	Vertical lines
2.	Cultivated double Cropped land-c <sub>2</sub> .	Horizontal lines
3.	Cultivated triple Cropped land-c <sub>3</sub> .	Diagonal lines (top-left to bottom-right)
4.	Wast land fit for cultivation-w <sub>1</sub> .	Diagonal lines (top-right to bottom-left)
5.	Wast land unfit for cultivation-w <sub>2</sub> .	Blank space
6.	Pasture and grazing land-P.	Stippled pattern
7.	Forest area with no canopy-F <sub>0</sub> .	Diagonal lines (top-left to bottom-right) with dots
8.	Thin forest areas with very sparse vegetation-F <sub>1</sub> .	Diagonal lines (top-right to bottom-left) with dots
9.	Cultivated single cum double cropped land	Stippled pattern

**SOIL SURVEY ORGANIZATION  
SOIL SURVEY OFFICE, G.S. NAVSARI.**

SURVEYED BY M. Z. PATEL & D. B. PATEL	Approved by  A. S. Navsari
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TABLE NO. 2 (a)

Statement showing the Average temperature Recorded at Agril. Research station Pilwai, Taluka Vijapur, District Mehsana

From 1969 to 1975

Temperature in C

	1969		1970		1971		1972		1973		1974	
	Maxi	Mini	Maxi	Mini	Maxi	Mini	Maxi	Mini	Maxi	Mini	Maxi	Mini
January .. ..			27.90		24.60		27.30		22.00	4.40	12.20	10.00
February .. ..			28.70		28.40		26.70		30.40	11.60	14.15	10.05
March .. ..			33.80		35.50		34.80		35.20	15.38	20.20	17.36
April .. ..			39.80		37.40		36.90		40.90	23.90	25.28	22.46
May .. ..			40.20		40.20		41.30		40.40	23.30	27.06	23.73
June .. ..			36.20		36.10		39.10		37.90	26.60	28.24	26.12
July .. ..			33.40		32.40		33.60		31.30	25.00	28.93	26.02
August .. ..	31.50	16.10	32.60		33.90		32.00		23.60	24.40	26.54	25.04
September .. ..	33.80	14.60	31.50				35.20		24.80	23.60	27.03	24.68
October .. ..	38.40	13.70	35.50				35.90		29.10	20.60	24.64	22.25
November .. ..	30.60	13.30	31.40				33.10		23.80	15.70	15.56	
December .. ..	29.50	9.70	28.20				27.40		15.50	13.20	15.08	12.29
Total .. ..	103.80	67.40	309.20	60.00	205.50	60.00	403.30	60.00	359.60	227.68	264.91	220.60

	1975		Total		Average		Mean C
	Maxi.	Mini.	Maxi.	Mini.	Maxi.	Mini.	
January .. ..	11.20	7.70	125.80	22.10	20.97	7.37	14.17 °C
February .. ..	14.80	11.30	143.16	33.55	23.86	11.18	17.52 "
March .. ..	18.00	14.10	177.50	86.84	29.58	15.61	22.59 "
April .. ..			180.28	46.36	36.05	23.18	29.61 "
May .. ..			189.10	47.03	37.81	23.51	30.66 "
June .. ..			177.54	52.72	35.51	26.36	30.93 "
July .. ..			159.63	51.02	31.93	25.51	28.72 "
August .. ..			183.14	65.54	30.51	21.85	26.18 "
September .. ..			152.43	62.88	30.40	20.96	25.72 "
October .. ..			101.54	50.55	32.31	18.85	25.58 "
November .. ..			134.40	20.00	26.89	14.50	20.70 "
December .. ..			115.08	35.10	23.14	11.73	17.43 "
Total	44.00	33.10	1000.31	548.78	359.05	220.61	
	Mean				20.92	18.38	24.45 °C

Maxi—Maximum Temperature in °C  
Mini—Minimum Temperature in °C

Av. winter Maxi—23.71 °C  
Temp. Mini—11.10 C

Av. Rainy Maxi—32.11 °C  
Temp. Mini—23.67 °C

Difference between mean summer and mean winter Temperature 11 °C

Abbreviation use :- Mean winter temp. (Nov. to February) 60.82 ÷ 4 = 17.45 °C  
Mean Summer Temp. (March to June) 113.79 ÷ 4 = 28.45 °C

Table No. 2 (b)

Average weather record Recorded at Agri. Research Station Filwai Tal. Vijapur, Dist. : Mehasana

From 1960 to 1975

Year	1969				1970				1971				1972			
	Month	D.B.	W.B.	EVP	Temp.	D.B.	W.B.	EVP.	Temp.	D.B.	W.B.	EVP.	Temp.	D.B.	W.B.	EVP.
January	..	..	..	..	15.50	10.20	..	..	11.43	9.30	..	..	13.75	9.91	42.2	11.75
February	..	..	..	..	16.80	11.00	..	..	13.50	11.50	..	..	14.05	10.28	53.3	11.62
March	..	..	..	..	20.10	13.40	..	..	20.30	14.50	..	..	21.34	15.78	83.3	17.22
April	..	..	..	..	25.30	19.20	..	..	25.60	20.00	..	..	26.31	21.37	109.5	21.85
May	..	..	..	..	29.60	23.80	..	..	27.70	22.30	..	..	29.59	25.05	130.0	25.02
June	..	..	..	..	27.90	25.60	..	..	27.10	25.20	..	..	30.14	26.54	148.4	26.54
July	..	..	..	..	26.30	24.70	..	..	26.80	24.70	..	..	27.33	25.43	78.0	25.89
August	25.40	24.50	..	..	26.40	25.20	..	..	25.70	24.20	..	..	26.26	25.23	62.5	25.23
September	24.50	22.80	..	..	22.40	22.40	..	..	..	..	..	..	26.62	23.46	72.2	24.10
October	22.90	18.40	..	..	26.40	22.60	..	..	..	..	..	..	27.72	23.22	97.6	22.00
November	23.10	16.20	..	..	18.20	13.10	..	..	20.30	14.30	..	..	23.34	17.61	59.0	15.89
December	16.90	15.00	..	..	14.40	11.10	..	..	16.00	10.97	..	..	17.66	13.10	43.5	13.85
Total	112.80	96.90	..	..	269.30	222.30	..	..	213.43	177.57	..	..	284.11	235.98	954.5	240.96
Average	22.56	19.38	..	..	22.44	18.52	..	..	21.34	17.78	..	..	23.07	19.66	79.54	20.08

ce

	1973				1974				1975				Total				Average			
	D B	W B	EVP	Temp	D B	W B	EVP	Temp	D B	W B	EVP	Temp	D B	W B	EVP	Temp	D B	W B	EVP	Temp
January	13.46	9.81	38.8	10.95	12.96	10.14	36.1	11.89	12.30	8.00	35.1	12.30	70.40	58.26	152.2	40.80	13.47	9.71	38.00	11.72
February	13.73	14.44	52.7	13.73	11.08	10.03	54.0	11.86	15.40	11.40	52.6	12.50	85.46	68.66	213.2	49.71	14.22	11.44	53.30	12.5
March	21.47	14.65	82.5	15.78	19.97	16.40	74.3	17.93	17.10	13.30	77.2	12.40	120.28	88.03	317.3	63.33	20.05	14.67	79.32	15.8
April	26.82	20.75	119.0	21.60	24.80	20.18	111.5	20.94	..	..	..	..	128.80	102.10	340.6	64.39	25.78	20.42	113.53	21.4
May	27.47	25.09	117.2	25.84	26.71	23.34	96.3	23.79	..	..	..	..	141.07	120.18	343.5	74.05	28.21	24.04	114.50	24.8
June	28.25	25.91	85.5	26.32	27.66	25.11	122.0	25.46	..	..	..	..	141.05	128.36	356.5	78.32	28.20	25.67	118.83	26.1
July	25.23	24.88	38.1	25.30	27.21	25.06	48.4	25.79	..	..	..	..	132.87	124.77	162.5	76.98	26.57	24.95	54.17	25.66
August	25.12	24.78	39.7	25.34	26.01	24.35	43.3	25.00	..	..	..	..	154.89	148.20	145.5	75.57	25.51	24.71	48.50	25.19
September	24.71	23.74	39.2	24.07	26.67	23.88	64.1	24.95	..	..	..	..	124.90	116.28	175.5	73.72	24.98	23.26	58.50	24.57
October	22.26	19.76	61.5	19.97	24.70	21.87	61.5	23.18	..	..	..	..	123.88	104.85	100.6	65.15	24.77	20.97	63.53	21.72
November	17.75	13.62	51.2	15.03	17.84	13.36	62.6	14.82	..	..	..	..	120.53	88.09	172.8	46.34	20.09	14.68	57.60	15.45
December	15.82	12.86	44.8	13.37	15.06	12.47	48.1	12.64	..	..	..	..	94.84	75.50	141.4	39.46	15.81	12.58	47.13	13.20
Total	261.99	230.79	768.8	238.50	261.63	226.19	823.4	238.23	44.80	33.00	164.09	37.20	1448.06	1223.33	2711.6	754.91	269.96	227.10	846.91	238.41
Average	21.83	19.23	64.07	19.88	21.80	18.85	68.02	19.85	14.03	11.20	54.07	12.40	..	..	..	..	22.49	18.92	70.57	19.86

1. D. B.—Dry Bulb Temp in degree C  
2. W. B.—Wet Bulb Temp. in degree C.

3. EVP.—Evaporation  
4. Temp.—Temperature of water at the time of reading °C



TABLE NO. 3

Statement showing the practices for different Agricultural crops in the area

Sr. No.	Name of crop	Season, Kharif rabi or Hot weather	Time of sowing	Seed rate per hectare	Time of harvest	Yield per hectare in quintal	Fertilizer used as supplement, to F.Y.M./hectare
1	2	3	4	5	6	7	8
1	Hybrid-4 cotton	Kharif	3rd week of June to 1st week of July	2.5 Kgs.	December	10.15 quintals	250 Kgs. Urea + 100-150 Kgs D.A.P./Hectare.
2	Cotton Digvijay	"	June-July	10 "	February	2.5 to 5	30 kgs. Urea + 25 kgs. D.A.P.
3	Tur	"	"	20 "	"	10-12 "	
4	Hybrid Jowar	"	"	7.5 "	Oct. Nov	10-15 "	100-150 Kgs. Urea.
5	Local Jowar	"	"	15 "	Feb.-March	7.5-10	
6	Hybrid Bajra	Kharif & Hot weather	June-July Feb.-March	2.5-3 "	Sept.-Octo. May-Juen	12-15 "	150 Kgs. Urea.
7	Local Bajra	Kharif	June-July	7.5 10 Kgs.	Sept.-October	7.5 "	
8	Mug	"	"	20 "	Aug.-September	7.5 "	
9	Adid	"	"	20 "	December	6.7 "	
10	Wheat Irrigated	Rabi	November	100 "	March-April	12-15	250 Kgs. Urea.
11	Rabi Jowar (Dadar)	"	October	10-15 "	February	7.8 "	
12	Castor S-20	Kharif	June-July	8-10 "	February-March	6-8 "	
13	Castor Hybrid	"	August	8-10 "	December-January	10 "	
14	Kennel	"	July-August	3.5 "	February-March	8-10 "	200-250 Kgs. Urea.
15	Cumin	Rabi	October-November	5.7 "	March-April	6-8 "	200 Kgs. Urea.
16	Vegetables	Kharif Rabi Hot weather	June-July October February-March	Depends on vegetable	September-October February-March April-May	Variable.	
17	Tobacco	Kharif	July	80-100 gms	February-March	12-18 quintals	50N2 25P2 <sup>o</sup> 5+10K2 <sup>o</sup>

TABLE NO. 4

Table showing recommended doses of fertilizers for main crops as Dry farming and Irrigated Agriculture

Sr. No.	Crops and its varieties	Rainfed			Irrigated		
		N <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	N <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
1	2	3	4	5	6	7	8
1	Cotton : Hybrid-4 CO <sub>2</sub> -134 and 174 SE T.1	50	25	25	125	62 1/2	62 1/2
		50	25	25	100	50	50
		50	25	25	100 to 125	50-60	50-60
2	Bajara Local All Hybrid Bajara	25	12 1/2	0	50	25	0
		50	25	0	75	37 1/2	0
3	Jowar C.S.H. 1 C.S.H. 2 Doshi-Local	40	20	0	50	25	0
		20	20	0	50	25	0
4	Wheat : N. P. 824 All Mexican Varieties J-1.7, J-24 etc.	..	..	..	100-125	50-60	40
		..	..	..	100-125	50	40
5	Tur T-15-15	25	12 1/2	0	50	25	0
6	Tobacco K-20, K-49 & Anand-3 S-57, A-145 and Pilla	..	..	..	180	62 1/2	62 1/2
		..	..	..	150	61	61
7	Mug Gujarat-1 & 2	..	..	..	12 1/2	0	0
8	Paddy Musuri L. R. 8 Formosa-3 K-20, Z-31, J-280, Dad 176-12, Kamod-118 Pankhali 203, etc.	..	..	..	112 1/2	50	50
		..	..	..	112 1/2	62 1/2	37 1/2
		..	..	..	87 1/2	37 1/2	37 1/2
		..	..	..	50	25	0
9	Bottle gourd	..	..	..	50	25	50
10	Cluster bean	..	..	..	25	37 1/2	37 1/2
11	Brinjal	..	..	..	100	37 1/2	37 1/2
12	Chillies	..	..	..	75	25	50
13	Lady's finger	..	..	..	50	25	0
14	Custor, Sesamum, Fennal, Mustard, Cumin etc.	20	20	0	40	40	0

TABLE NO. 5

Table showing the differentiating characteristics of soil series.

Soil series and symbol	Physiography and predominant slope range	Effective depth in cms	Colour		Texture.	
			i. Surface soil	ii. Subsurface soil	i. surface soil	ii. Subsurface soil
1.	2.	3.	4.		5.	
<u>Lawarpur-I</u> 1	Flat to very gently sloping table land having 0-3% slope (0-2% slope)	very deep 140-160 cms.	1. yellowish brown to dark brown. ii. dark brown to very dark grayish brown.		i. Loamy sand, sandy loam and sand ii. Sandy loam to loam.	
<u>Rangpur-I</u> 2	Flat to very gently sloping table land having 0-3% slope	Deep to very deep 60 to 110 cms.	i. Dark yellowish brown to yellowish brown. ii. Dark brown to dark yellowish brown		i. Loamy sand, sand and sandy loam ii. Loamy sand, and sandy loam.	
<u>Lawarpur-II</u> 3	Moderately dissected gently sloping table land having 3%-5% slope (peripheral land adjoining the ravines)	Deep to very deep 80-120 cms.	i. Yellowish brown to dark brown ii. Dark brown to dark yellowish brown		i. Loamy sand, sandy loam and sand. ii. Sandy loam sandy clay loam or loam	
<u>Rangpur-II</u> 4	Moderately dissected gently sloping table land having 3% to 5% slope.	Moderately deep to deep 50-78 cms.	i. dark yellowish brown to yellowish brown. ii. dark brown dark yellowish brown		i. Loamy sand and sand. ii. Loamy sand sandy loam.	
<u>Ratanpur-I</u> 5	Upper and middle terraced hump land gently to strongly undulating (3% 7%)	deep 60-80cms.	i. dark brown to brown. ii. dark yellowish brown to dark brown		i. Loamy sand sand and sandy loam ii. sandy loam and loamy sand	
<u>Ratanpur-II</u> 6	Lower middle terraced highly undulating humped land 5% to 10% or more	shallow to moderately deep 30-40 cms.	i. Yellowish brown to dark brown ii. dark yellowish brown to dark brown		i. sand and loamy sand. ii. Loamy sand, sand and sandy loam	
<u>Firozpur</u> 7	Lower river terraced very gently to gently slopy (2% to 4%)	deep to very deep 85-120cms.	i. brown to yellowish brown ii. dark brown to yellowish brown		i. Silt loam loamy sand and sand. ii. Loamy sand and silt loam	
8. Sabarmati Ravine bed land Misc-8	Lower river terraced ravine bed. Very gently to gently slopy (1%-3%)	shallow to moderately deep 15-30 cms.	i. brown to pale brown ii. Pale brown to very pale brown.		i. sand loamy sand or gravelly sand. ii. silt loam sand loamy sand or gravelly sand.	

Structure	Rock fragments	Special features	Remarks
i. Surface soil ii. Subsurface soil	i. Surface soil ii. Subsurface soil		
6	7	8	9
1 i. Crumb to single grain ii. Weak columnar breaks in to weak medium subangular blocky peds.	i. Quartz gravels and sand gravels. ii. -do-	Slightly mature soils with textural B horizon.	Slight effect of winde erosion.
2 i. Crumb to weak fine subangular blocky peds. ii. Weak, fine to medium subangular blocky peds.	ii. Sand gravels, mica flakes and quartz gravels. ii. -do-	Bangpur-I is a eroded phases of Lawar-pur-I soils having accumulated salts of CO <sub>3</sub> & HCO <sub>3</sub>	Slight to moderate erosion hazard
3 i. Crumb, single grain or weak fine subangular blocky peds. ii. Weak, fine to medium subangular blocky peds.	i. Sand gravels, mica flakes and quartz gravels. ii. -do-	Slightly mature soil with textural B horizon.	Effect of wind erosion.
4 i. Crumb to weak fine subangular blocky peds. ii. Weak fine to medium subangular blocky.	i. Sand gravels, mica flakes and quartz gravels. ii. -do-	It is a eroded phase and various salts are accumulated in this soil.	Effect of wind erosion.
5 i. Weak columnar breaks into weak fine sub angular blocky. ii. Weak fine to medium subangular blocky.	i. Sand gravels, quartz gravels, and mica flakes. ii. -do-	It is a eroded phase of Lawarpur-II series.	Effect of wind erosion.
6 i. Crumb to weak fine subangular blocky. ii. Weak fine subangular blocky to single grain.	i. Sand gravels, mica flakes and quartz gravels. ii. -do-	Very severly eroded, highly dissected land.	Effect of wind erosion.
7 i. Single grain to weak fine subangular blocky. ii. Weak fine subangular blocky to crumb.	i. Minute mica flakes & quartz gravels. ii. -do-	The minute mica flakes giving shining appearance in suns rays.	Wind blown to fluventic material.
8 i. Sin le grain. ii. -do-	i. minute mica flakes, and quartz gravels. ii. -do-	Very loose fluventic soils with various textured layers.	Very severe erosion hazard during flood and high rainfall.

TABLE NO. 6

Serieswise distribution of areas in hectare under various classes of depth slope, erosion, banded or unbanded for in VARSODA PROJECT, Taluka-Vijapur District:-Mehsana

Sr. No.	Soil Series and symbol	Total area Hect.	% of area	Depth classes				Slope classes							Erosion classes				un banded
				Shallow	Moderately deep	Deep	Very deep	A	B	C	D	E	F	E1	1	2	3	4	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
1	Lawarpur-I-1	866	38.40	..	..	..	866	636	230	..	..	..	..	658	208	..	..	866	
2	Lawarpur-II-2	287	12.73	..	..	20	267	60	144	77	6	..	..	53	84	122	28	287	
3	Rangpur-I-7	133	5.90	..	..	..	133	103	30	..	..	..	..	103	30	..	..	133	
4	Rangpur-II-8	147	6.52	..	..	147	..	27	68	52	..	..	..	27	68	52	..	147	
5	Ratanpur-I-3	141	6.25	..	..	70	71	..	6	75	38	22	..	..	..	14	127	141	
6	Ratanpur-II-4	81	3.59	5	68	8	..	..	..	..	6	6	60	..	..	..	81	81	
7	Firozpur-5	36	1.60	..	..	21	15	..	36	..	..	..	..	..	6	30	..	36	
8	Sabarmati ravine bed-land	493	21.86	Shallow to moderately deep (40% : 60%)		..	..	..	254	230	..	..	..	..	..	..	493	193	
9	Miscellaneous	22	0.98	..	..	197	206	..	22	..	..	..	..	..	10	12	..	22	
10	Village site and Tane	39+10	2.17	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Total		2255	100%	5	265	578	1358	826	790	443	50	28	69	841	400	230	729	2255	

TABLE NO. 7

Series wise distribution of Areas in hectares under various land capability classes and Land capability units.

Sr. No.	Name of soil Series and symbol	Total area in ha.	II-1	IIa-1	IIcs	IIpa-3	III-ca 1	IIcs-3	IIIcs-2	IIIcs-3	IV-ca-1 +IVca-2	IVw-1 +IVw-2	VIcs-1 +VIcs-2	VIIcs-1	VIIcs-2	VIIIcs-1	VIIIcs-2	VIIIcs-3
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Lawarpur-I (Lpr-I)	866	18	..	550	181	6	..	105	..	..	..	..	..	..	..	..	..
2	Rangpur-I (RGP-I)	133	10	31	..	..	..	..	92	..	..	..	..	..	..	..	..	..
3	Lawarpur-II (Lpr-II)	287	..	..	..	..	7	67	72	108	33	..	..	..	..	..	..	..
4	Rangpur-II (RGP-II)	147	9	18	..	26	..	..	42	13	39	..	..	..	..	..	..	..
5	Ratanpur-I (Rpr-I)	141	..	..	..	..	..	..	..	2	18+5 (23)	..	6+24 (30)	64	22	..	..	..
6	Ratanpur-II (Rpr-II)	81	..	..	..	..	..	..	..	..	..	..	3+0 (3)	..	5	14	59	..
7	Firozpur (Fpr.)	36	..	..	..	..	..	..	..	..	..	6+30 (36)	..	..	..	..	..	..
8	Savarnati ravine bed lands	493	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	493
9	(Misc.) Misc.	22	..	..	..	..	..	10	6	6	..	..	..	..	..	..	..	..
10	Village site + tank	39+10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Grand Total		2255	37	49	550	207	13	77	317	129	95	36	33	64	27	14	59	..
																		493

Analytical Statement of Soils of Ravine Project (Varoda and Ratanpur Ravine Project)

Lab. No.	Name of series.	Depth in cms.	Gravel %	Type of Soil	Clay %	Silt %	C. Sand. %	F. Sand %	Moisture %
1	2	3	4	5	6	7	8	9	10
8611	Lpr-I	0-25	0.0	..	..	..	..	..	1.91
8612	(Lawarpur village)	25-62	0.0	..	..	..	..	..	1.93
8613		62-112	0.0	..	..	..	..	..	2.35
8614		112-153	0.0	..	..	..	..	..	2.60
8615		153-175+	0.0	..	..	..	..	..	2.35
8616	Lpr-I (Rangpur village)	0-25	0.0	..	20.79	4.92	28.50	45.78	2.76
8617		25-68	0.0	..	23.19	11.05	18.48	43.26	3.74
8618		68-110	0.0	..	31.26	8.93	18.65	41.15	5.37
8619		110-150	0.0	..	28.43	7.66	27.32	36.60	3.66
8620		150-170+	0.0	..	25.92	17.28	19.65	37.15	3.94
8626	Epr-II (Ratanpur village)	0-20	0.0	..	20.14	12.63	38.19	29.03	2.61
8627		20-63	0.0	..	25.85	5.69	30.90	35.48	2.88
8628		63-95	0.0	..	28.26	1.07	34.17	34.37	3.55
8629		95-127	0.0	..	27.50	4.23	34.50	35.0	3.99
8630		127-160+	0.0	..	24.16	12.08	30.47	33.28	3.48
8631	Lpr-II (Varoda village)	0-22	0.0	..	16.67	3.76	21.39	58.18	1.95
8632		22-63	0.0	..	20.69	3.14	23.22	53.77	1.95
8633		63-120	0.0	..	20.29	6.41	17.95	55.35	2.25
8634		120-157	0.0	..	19.35	3.25	19.63	63.77	2.54
8635		157-170+	0.0	..	9.60	14.44	9.00	66.96	1.98
8641	Epr-I (Firokpur Village)	0-22	1.0	-	13.76	8.47	41.66	16.11	1.31
8642		22-58	0.0	..	18.95	7.89	35.58	37.58	1.25
8643		58-90	0.0	..	14.84	5.30	40.28	39.58	1.40
8644		90-148	0.0	-	14.73	5.65	38.51	41.10	1.35
8645		148-180+	0.0	..	13.88	7.22	42.36	56.54	1.30

Lab No.	Name of series	PH	E. C. msh/cm.	O. C. %	Organic matter %	Av. P <sub>2</sub> O <sub>5</sub> %	Av. K <sub>2</sub> O %	Lime Reserve	Exchangeable M. e. 100 gms soil			C. E. C. of me/100cms
									Ca	Mg.	Na	
1	2	11	12	13	14	15	16	17	18	19	20	21
8611	Lpr-I (Lawarpur village)	8.2	0.072	0.304	0.524	0.0001	0.017	4.46	7.6	2.2	..	10.3
8612		8.5	0.049	0.304	0.524	0.0001	0.014	3.66	8.8	1.7	..	11.0
8613		8.3	0.036	0.160	0.275	0.0000	0.011	3.06	9.9	0.6	..	13.0
8614		8.6	0.032	0.224	0.306	0.0003	0.012	2.46	10.0	1.4	..	13.0
8615		8.7	0.044	0.224	0.346	0.0006	0.012	5.86	6.6	4.0	..	10.2
8616	Lpr-I(Rangpur village)	8.5	0.084	0.720	1.241	0.0000	0.022	5.06	7.5	2.5	..	11.0
8617		8.6	0.040	0.800	1.379	0.0000	0.015	2.86	11.4	4.0	..	15.5
8618		8.3	0.044	0.320	0.551	0.0000	0.012	3.46	12.0	3.4	..	15.5
8619		8.0	0.036	0.272	0.468	0.0000	0.018	3.46	13.0	3.0	..	15.0
8620		8.2	0.040	0.272	0.468	0.0000	0.017	3.06	12.6	2.8	..	15.9
8626	Lpr-II(Ratanpur village)	7.5	0.044	0.336	0.579	0.0000	0.013	1.66	8.4	3.6	..	12.20
8627		7.3	0.093	0.224	0.386	0.001	0.010	2.46	11.0	2.4	..	16.5
8628		7.3	0.056	0.160	0.275	0.0008	0.012	2.46	13.2	3.0	..	16.0
8629		7.8	0.073	0.112	0.193	0.0000	0.012	1.46	13.8	2.6	..	17.0
8630		8.2	0.073	1.280	2.206	0.0006	0.012	12.26	13.0	2.0	..	16.0
8631	Lpr-II(Varasoda village)	7.5	0.028	0.413	0.717	0.0001	0.017	4.46	..	..	..	9.3
8632		7.5	0.036	0.112	0.193	0.0001	0.011	2.86	..	..	..	10.4
8633		8.1	0.024	0.118	0.220	0.0006	0.018	3.66	9.4	2.2	..	13.0
8634		8.3	0.060	0.096	0.165	0.0000	0.014	3.46	9.6	2.0	..	13.5
8635		8.3	0.060	1.440	2.482	0.0001	0.016	11.56	8.60	1.4	..	10.0
8641	Lpr-I(Firospur village)	8.2	0.044	0.304	0.524	0.0009	0.018	3.66	7.0	0.4	..	8.0
8642		8.3	0.044	0.176	0.30	0.0003	0.014	3.66	7.0	1.2	..	8.8
8643		8.5	0.044	0.176	0.303	0.0000	0.016	3.66	7.4	1.2	..	13.90
8644		8.6	0.036	0.240	0.418	0.0000	0.014	10.26	8.0	0.8	..	13.0
8645		8.8	0.048	0.240	0.413	0.0000	0.014	8.06	8.8	0.4	..	9.8



1	2	3	4	5	6	7	8	9	10
8651	Bpr-I (Varsoda village)	0-25	0.00	..	15.15	13.57	23.78	47.50	2.04
8652		25-70	0.00	..	19.96	7.88	13.81	58.35	2.20
8653		70-115	0.00	..	21.17	8.01	11.33	59.49	2.12
8654		115-150+	1.00	..	19.68	7.45	10.11	62.76	2.14
8655	Bpr-II (Ratanpur village)	0-15	4-00	..	12.36	0.54	31.18	55.92	1.67
8656		15-38	0.0	..	16.15	9.80	25.37	48.68	1.92
8657		38-97	10.00	..	19.78	7.69	16.50	56.97	2.12
8658		97-150+	25.00	..	11.76	22.94	10.95	54.35	2.23
8671	Bpr-II (Varsoda village)	00-14	3.00	..	14.92	5.37	28.40	51.31	1.65
8672		14-40	5.00	..	22.62	1.78	17.27	58.33	1.16
8673		40-100	10.00	..	12.71	13.34	32.02	41.93	1.23
8674		100-130+	0.00	..	11.07	7.22	23.53	58.18	1.13
8679	Bpr- (Tirozpur village)	0-18	0-00	..	7.69	9.34	17.54	56.43	0.73
8680		18-75	0.00	..	7.73	12.71	20.58	58.98	1.03
8681		75-110	0-00	..	9.72	10.80	12.52	66.96	1.15
8682		110-140	0-00	..	7.79	9.45	14.68	68.08	0.81
8683		140-165+	0-00	..	5.39	5.39	25.75	63.75	6.40
8692	Bgp-I (Rangpur village)	0-18	0-00	..	17.72	16.11	45.35	20.81	1.04
8693		18-55	0-00	..	18.83	9.46	34.81	36.80	1.63
8694		55-098	0-00	..	22.24	5.30	40.66	31.80	2.22
8695		98-25	0-00	..	10.12	14.91	45.35	29.62	1.52
8696		125-65+	0-00	..	7.73	17.23	46.74	28.30	1.30
8711	Bgp-II (Rangpur village)	0-25	0-05	..	13.72	11.84	66.76	27.68	1.39
8712		25-70	0-00	..	17.84	4.76	45.98	31.42	1.88
8713		70-106	0-00	..	14.46	10.84	28.92	45.78	2.05
8714		106-132	0-00	..	13.85	15.66	13.77	56.75	2.12
8715		132-160	0-05	..	11.69	12.99	18.44	58.88	2.30

1	2	11	12	13	14	15	16	17	18	19	20	21
8651	Rpr-I (Varsoda village)	8.0	0.058	0.320	0.557	0.0003	0.010	1.06	11.4	2.8		14.4
8652		8.1	0.048	0.272	0.408	0.0008	0.017	2.06	11.2	3.0		14.7
8653		8.1	0.052	0.544	0.037	0.0003	0.010	2.66	12.0	2.2	..	15.4
8654		8.4	0.044	1.392	2.399	0.0001	0.019	7.86	11.2	1.4	.	12.3
8663	Rpr-II (Ratanpur village)	8.2	0.072	0.816	1.406	0.0000	0.030	3.46	8.0	1.6	..	9.4
8664		8.3	0.062	0.336	0.579	0.0001	0.019	11.06	10.0	2.6	..	20.0
8665		8.4	0.058	1.188	2.013	0.0009	0.015	10.86	11.6	1.6	..	16.0
8666		8.3	0.052	1.184	2.041	0.0001	0.014	10.86	13.6	1.2	..	15.1
8671	Rpr-II (Varsoda village)	8.5	0.000	1.648	2.841	0.0000	0.015	12.26	8.0	1.2	..	9.0
8672		8.6	0.050	0.806	1.544	0.0000	0.013	13.20	6.8	0.8	..	8.0
8673		8.5	0.068	1.056	1.820	0.0000	0.007	18.26	6.0	0.2	..	6.6
8674		7.8	0.077	0.000	1.655	0.0003	0.012	21.66	7.0	0.6	..	15.0
8679	Fpr- (Firozpr village)	8.6	0.044	0.288	0.496	0.0001	0.013	5.86	5.0	0.6	Trace	5.3
8680		8.6	0.044	0.400	0.680	0.0000	0.015	5.66	6.0	0.8	,	7.1
8681		8.7	0.056	0.256	0.441	0.0006	0.015	5.66	7.0	8.0	..	4.2
8682		8.3	0.052	0.288	0.496	0.0001	0.012	8.26	7.2	0.8	..	6.6
8683		8.3	0.014	0.102	0.341	0.0001	0.010	7.26	3.8	8.4	..	6.3
8692	Rgp-I (Rangpur village)	8.6	0.064	0.592	1.020	0.0001	0.020	3.26	7.2	3.4	0.87	10.8
8693		8.5	0.044	0.368	0.634	0.0000	0.011	3.26	10.0	2.4	Trace	12.7
8694		8.5	0.056	0.400	0.680	0.0000	0.010	2.26	12.6	8.6	0.98	14.5
8695		8.4	0.085	0.720	1.241	0.0000	0.028	3.46	12.4	1.8	1.30	14.2
8696		8.3	0.085	1.680	2.896	0.0000	0.011	11.26	11.8	1.6	0.43	13.4
8711	Rgp-II (Rangpur village)	8.3	0.052	0.528	0.910	0.0001	0.015	17.46	9.0	2.2	0.21	12.2
8712		8.4	0.050	1.520	2.620	0.0000	0.012	11.86	8.4	1.2	0.22	9.4
8713		8.4	0.056	1.392	2.399	0.0003	0.010	12.86	13.0	2.4	Trace	15.0
8714		8.4	0.064	0.820	0.551	..	..	15.26	12.8	1.4	..	14.4
8715		8.3	0.022	1.120	1.930	0.0000	0.008	19.06	..	..	=	..

1	2	3	4	5	6	7	8	9	10
8716	Sabarmati Ravine bed (Varsooda village)	0.15	0.5	..	7.10	4.15	42.96	45.97	0.97
8717		15.36	1.5	..	8.06	16.12	49.62	46.20	1.70
8718		36.76	25.0	..	6.37	7.64	62.14	23.85	0.90
8719		76.88	3.0	..	7.27	4.85	41.28	46.60	0.44
8720		88.110 †	..	..	6.30	6.12	74.16	12.92	0.60
8884	Epr (Varsooda)	0.20	..	..	24.80	5.93	17.03	52.15	2.10
8885		20.75	..	..	22.51	2.192	17.54	38.03	2.11
8886		75.120	..	..	22.23	15.51	20.63	35.93	1.83
8887		120.160 †	..	..	13.70	16.00	33.09	36.61	2.12

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8716	Sabarmati Ravine bed Vadodfirri Village	8.6	0.048	1.120	1.930	0.0000	0.010	12.86	5.8	1.8	..	6.3
8717		8.8	0.040	1.206	2.234	0.0000	0.012	10.06	10.0	1.8	..	10.8
8718		8.8	0.040	0.896	1.544	0.0003	0.006	10.40	1.0	1.6	..	4.5
8719		8.5	0.068	0.352	0.606	0.0003	0.007	16.86	3.2	3.2	3.4	3.6
8720		8.6	0.056	0.170	0.303	0.000	25.86	..	..	..	..	..
8784	EPr(Varsooda)	8.8	0.132	1.088	1.875	0.0001	0.20	11.90	12.08	3.8	..	16.8
8785		8.2	0.101	0.800	1.379	0.0001	0.012	9.28	9.0	3.8	..	10.7
8886		9.0	1.121	1.584	2.730	0.0000	0.018	0.66	13.2	3.4	..	1775
8887		8.8	0.185	1.440	27482	0.0000	07016	10.46	776	5.4	..	1372

TABLE NO. 3

Soil and Land use suitability for different purposes

Sr. No.	Soil Series	Land capability Unit	Mapping units	Important soil characteristics and qualities
1	2	3	4	5
1	Lawarpur-I (Lpr-I-1)	II-1	1-SL-d5 A-6e1	Very deep, well drained medium textured soils dark brown to dark yellowish brown red colour, on level table land subsurface permeability rapid low to medium available water holding capacity.
2	Rangpur-I (Rgp-I-2)	II-1	2-SL-d5 A-e1	Same as above except colour ranging from dark yellowish brown to yellowish brown and in horizon salts are accumulated.
3	Lawarpur-I (Lpr-I-1)	IIa-1	1-JS-d5 A-e1	Very deep, well drained light textured soils of dark brown to dark yellowish brown colour, occurring on level to very gently sloping table land, subsurface permeability rapid, low water holding capacity.
4	Rangpur-I (Rgp-I-2)	IIa-1	2-JS-d5 A-e1 A-e1	Same as above except colour and C horizon colour is dark yellowish brown to yellowish brown having solum depth 60-110 cms.
5	Rangpur-II (Rgp-II-4)	IIa-1	A-JS-d4 Ac-1	Same as Sr. No. 3 except colour dark yellowish brown to yellowish brown solum depth 50-78 cms.
6	Lawarpur-I (Lpr-I-1)	IIca-1	1-SL-d5 B-e2  1-SL-d5 B-e2 (Rainfed)	Very deep, well drained, medium textured, very gently slopy, moderately eroded, red coloured soil occurring on level table land having subsurface permeability rapid low fertility and low water holding capacity.
7	Lawarpur-I (Lpr-I-1)	IIca-2	1-SL-d5/B-e2 1-JS-d5/A-e1 1-JS-d5/B-e1 1-JS-d5/B-e2	-do-
8	Rangpur-I and Rangpur-II (Rgp-I-2 & Rgp-II-4)	IIca-2	2-JS-d5/B-e2 4-JS-d5/B-e2	Same as Sr. No. 6 here colour and C horizon is exceptional dark yellowish brown to yellowish brown Rgp-I-solum depth 60-110 Cms. Rgp-II-Solum depth 50-78 Cms.
9	Lawarpur-I (Lpr-I-1) and Lawarpur-II (Lpr-II-3)	IIca-3	1-S-d5/A-e1 3-S-d5/A-e1 3-JS-d5-A-e1	Very deep, well drained, light textured red coloured soils occurring on flat to very gently sloping table land and moderately dissected marginal land having subsoil permeability rapid, low water holding capacity and low fertility.
10	Lawarpur-I (Lpr-I-1) and Lawarpur-II (Lpr-II-3)	IIca-1	1-JS-d5/B-e1 1-JS-d5/B-e2 3-JS-d5/A-e1 3-JS-d5/B-e2 3-SL-d5/A-e2	Very deep, well drained, nearly level to very gently slopy, moderately eroded, light textured occurring on very gently slopy to moderately dissected table land, subsurface permeability rapid, low water holding capacity, low fertility only rainfed crops are taken.

Specific problems and limitation			Broad land use potentials	Irrigability Classes		Suitability for Hybrid Bajra	Hydrological groupings
6			7	Soil 8	Land 9	10	11
1	I	Low to medium fertility status	Multicrop potential	A	1	Very good	A
	II	Unbunded fields	-do-				
2	1	Accumulated salts in C horizon	-do-	A	1	Very Good	A
	2	Unbunded fields	-do-				
	3	Medium to low fertility status	-do-	A	1	Very Good	A
3	1	Low fertility status	-do-	A	1	Very Good	A
	2	Low water holding capacity					
4	1	Low fertility status	-do-	A	1	Very Good	A
	2	Low available water holding capacity					
5		-do-	-do-	A	1	Very Good	A
6	1	Low water holding capacity	-do-	A	1	Very Good	A
	2	Unbunded fields					
7		-do-	-do-	A	1	Very Good	B
			and Limited Kharif crop in rainfed area				
8		-do-	Chorizon has accumulated salts	A	1	Very Good	B
9	1	Low water holding capacity	Multicrop potential and Limited Kharif crop in rainfed areas	A	1	Very Good	B
	2	Unbunded fields					
	3	Unfavourable structure					
10	1	Low fertility status	Limited crops confined to Kharif crops only	B	2	Good	B
	2	Low available water holding capacity					
	3	Moderate severe erosion hazard					

11	Rangpur-I (Rgp-I-2) Lawarpur-II (Lpr-II-3) Rangpur-II (Rgp-II-4)	IIIc-2	2-LS-d5/A-e1 2-LS-d5/B-e2 3-LS-d5/B-e2 3-LS-d5/B-e2-G2 3-LS-d5/C-e-3G-3 4-LS-d4/B-e2	Deep to very deep, well drained to excessively drained, light textured, dark brown to dark yellowish brown (only Lpr-II) and dark yellowish brown to yellowish brown. (both Rgp-I and Rgp-II) coloured soils occurring on very gently slopy to gently slopy moderately dissected gently slopy table land low water holding capacity, subsoil permeability rapid to very praid, soils have shallow ravines (Rgp-I and Rgp-II) and shallow and medium ravines (Lpr-II).
12	Lawarpur-II (Lpr-II-3) and Rangpur-II (Rgp-II-4)	IIIc-3	3-LS-d5/B-e3 4-LS-d4/C-e3	Same as above except moderate to severe erosion hazard in both and the column depth of Rgp-II varies from 50-78 cms., after which C horizon contain accumulated salts mostly CO <sub>3</sub> and HCO <sub>3</sub> which gives strong effervescence with dil Hcl.
13	Lawarpur-II (Lpr-II-3) Rangpur-II (Rgp-II-4) and and Ratanpur-I (Rtr-I-2)	IV-cs-1	3-LS-d5/B-e3G-2 3-LS-d5/C-e4 3-LS-d5/C-e4 5-LS-d4/C-e3 5-SL-d5/C-e4 5-LS-d5-C-e3 3-LS-d4-C-e4 4-LS-d4/C-e4	Deep to very deep, well drained to excessively well drained, moderately to strongly dissected, severe to very severely eroded, dark brown to dark yellowish brown and yellowish brown, very rapid permeability lighter in texture, low water holding capacity only Kharif crops are grown. Accumulated salts in C horizon of Rgp-II soil giving strong effervescence with dil Hcl.
14	Firozpur (Fpr-7)	IV W1	7-LS-d5/B-e1 7-Sil-d5/B-e2 7-LS-d5/B-e2 7-LS-d4/B-e2 7-Sil-d4/B-e3	deep to very deep, very gently to gently slopy, moderately to severely eroded, well drained, brown to yellowish brown and dark yellowish brown fluventic wide valley bottom land of lower river terrace, rapid to very rapid permeability, lighter in texture, low available water holding capacity and fertility.
15	Ratanpur-I (Rtr-I-5) and Ratanpur-II (Rtr-II-6)	VIcS-I	5-LS-d3/C-e4 5-SL-d5/D-e4 5-SI-d4/D-e4	Deep to very deep, gently slopy to moderately slopy, very severely eroded, highly dissected excessively drained undulating to rolling hump land of middle terrace, dark yellowish brown to yellowish brown lighter textured soil very rapid permeability, weak structure. Most of the area is under grass land and natural vegetation deep to very and wide to very wide ravines.
16	Ratanpur-I (Rtr-I-5)	VIIcS-2	5-LS-d4/C-e4 5-LS-d4/D-e4	-do- i.e./The Soil description is same as Sr. No.15 or VI cS-I. capability unit.
17	Ratanpur-I (Rtr-I-5)	VIIcS-2	5-SI-d4/F-e4	Deep, strongly slopy, very severely eroded, highly dissected, undulating to rolling humped land, dark yellowish brown to yellowish brown, excessively drained soils. Very rapid permeability light in texture weak structure, low fertility and water holding capacity; Loose and light textured parent material responsible for formation very deep and wide to very wide ravines

		6	7	8	9	10	11
11	1	Low water holding capacity	-do-	B	2	Good	B/C
	2	Low fertility status					
	3	Unfavourable structure					
	4	Moderate to severe erosion hazard					
	5	Accumulated salts in O horizon in Rgp-I and Rgp-II Soils					
12		-do-	-do-	C	3	Good to fair	C
13	F	Low water holding capacity and fertility	Limited crops confined to Kharif crops only and Rtr-I limited to grass land only.	D	4	Fair	D
	2	Moderate to severe erosion hazard					
	3	Unfavourable texture and structure					
	4	Medium to deep ravines in Rtr-I and shallow ravines in Lpr-II and Rgp-II					
14	1	Lighter to medium in texture	Multicrop potentials in irrigated area while limited to Kharif crops only in rainfed area	B/C	2/3	Good	C
	2	Frequent over flow and crop failure					
	3	Moderate to severe erosion					
	4	Unfavourable structure					
15	1	Low water holding capacity	Limited to grassland and natural vegetation	E	6	Fair/Poor	E
	2	Light texture and medium fertility					
	3	Very severe erosion hazard					
	4	Deep to very deep and wide very to wide ravines					
16		-do-	Limited to grassland and natural vegetation	E	6	Poor	E
17	1	Light texture and weak structure	-do-	E	6	Poor	E
	2	Low water holding capacity					
	3	Highly dissected moderately sloping hump land					
	4	Very severe erosion hazard					
	5	Deep to very deep and wide to very wide ravines					
	6	Looseness of parent material					

18	Ratanpur-II (Rtr-II-6)	VIII eS-I	6-SL-d3/E-e4 6-LS-d3/E-e4 6-SL-d3/F-e4 6-LS-d3/F-e4	Moderately deep, strongly slopy to moderately steep. strongly dissected, excessively drained occuring on rolling barrowhumps having dark yellowish brown to yellowish brown and dark brown soils very rapid permeability, excessively drained. The ravines are "V" to "U" in shape, very deep, very wide, 1 to 2 kilometer or more in length, light texture and weak structure. The area is under grass land and natural vegetation. Light texture of parent material.
19	Ratanpur-II (Rtr-II-6)	VIII eS-2 VIII eS-2	6-LS-d3/G-e4 6-LS-d2/F-e4 6-LS-d2/G-e4	Same as above capability class VIII es-1 except the soil depth and slope, which are shallow to moderately deep depth and moderately steep to steep and steep slope.
20	Sabarmati ravine bed land Series named and class are not given in map but ravines are classified according to ravine standard.	VIII eS-3	Same as unit list from Appendix-II	Shallow to moderately deep, excessively drained, Occuring on very gently to gently slopy ravine beds having brown to pale brown and very pale brown colour. Main Soil types are loamy sand, and silt loam. After about 32 cms. depth common to many lime concretions giving strong to violent effervescence with dil Hcl. starts. Many mica flakes and quartz grav?ls are observed in the soils.

		6	7	8	9	10	11
18	1 Light texture and weak structure		Unsuitable for cultivation and grass land. The ravines should be used as watershed management plan and recreation purpose.	E	6	Very Poor	F
	2 Low water holding capacity						
	3 Highly dissected undulating to rolling hump land						
	4 Very deep, very wide V to U shape ravines						
	5 Very weak structure of parent material						
19	-do-		-do-	E	6	Very Poor	F
20	1 Frequent over flow during rain		Limited to watershed protection and growing of selected natural vegetation	E	6	Very Poor	F
	2 Lower river terrace						
	3 Low to medium fertility status						
	4 Very weak, single grain structure						
	5 Severe erosion						
	6 Shallow rootzone depth.						



TABLE NO. 9  
Suitability for Arbio crops

Land capability units deposited for corresponding mapping units	Cotton		Jowar		Wheat		Tur		Tobacco		Castor		Paddy		Chola vegetable		Bottle ground		Vegetables		Fannel		Cumin	
	Rain-fed	Irrigated	Rain-fed	Irrigated	Rain-fed	Irrigated	Rain-fed	Irrigated	Rain-fed	Irrigated	Rain-fed	Irrigated	Rain-fed	Irrigated	Rain-fed	Irrigated	Rain-fed	Irrigated	Rain-fed	Irrigated	Rain-fed	Irrigated	Rain-fed	Irrigated
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1 II-1	F	G	F	V	..	VG	G	VG	G	VG	F	G	..	F	..	VG	..	VG	..	VG	..	VG	..	VG
2 II S-1	F	G	F	VG	..	VG	G	G	F	G	F	G	..	F	..	VG	..	VG	..	VG	..	VG	..	VG
3 II cs-1	F	G	F	G	..	G	F	G	F	G	F	G	..	F	..	G	..	G	..	G	..	G	..	G
4 II cs-2	P	G	F	F	..	G	F	G	F	G	F	F	..	F	..	G	..	G	..	G	..	G	..	G
5 II cs-3	P	G	F	F	..	F	F	F	F	G	P	F	..	F	..	G	..	G	..	G	..	G	..	G
6 III cs-1	P	G	F	P	..	F	P	F	F	G	P	F	..	F	..	F	..	G	F	F	..	G	..	G
7 III cs-2	P	G	F	P	..	F	P	F	F	G	P	F	..	P	..	F	..	F	..	F	..	F	..	F
8 III cs-2	P	G	F	P	..	F	P	VP	P	F	F	VP	..	P	..	F	..	F	..	F	..	F	..	F
9 IV cs-1	VP	P	VP	P	..	P	P	VP	P	F	P	VP	..	VP	..	F	..	P/F	..	P/F	..	P/F	..	P/F
10 IV w-1 & w-2	P	G	F	G	..	G	F	G	F	G	F	G	..	F	..	G	..	G	..	G	..	G	..	G
11 VI cs-1 & VI cs-2	..	..	..	..	..	..	..	..	..	..	..	Unsuitable	..	..	..	..	..	..	..	..	..	..	..	..
12 VII cs-1	..	..	..	..	..	..	..	..	..	..	..	Unsuitable	..	..	..	..	..	..	..	..	..	..	..	..
13 VII cs-2	..	..	..	..	..	..	..	..	..	..	..	Unsuitable	..	..	..	..	..	..	..	..	..	..	..	..
14 VIII cs-1	..	..	..	..	..	..	..	..	..	..	..	Unsuitable	..	..	..	..	..	..	..	..	..	..	..	..
15 VIII cs-2	..	..	..	..	..	..	..	..	..	..	..	Unsuitable	..	..	..	..	..	..	..	..	..	..	..	..
16 VIII cs-3	..	..	..	..	..	..	..	..	..	..	..	Unsuitable	..	..	..	..	..	..	..	..	..	..	..	..

- (i) VG Very good
- (ii) G Good
- (iii) F Fair
- (iv) VP Very poor

**APPENDIX-II**  
**SOIL UNIT LIST FORM**

Sr. No.	Soil Unit	Village Name	Area of soil unit for hectares	Predominant slope%	Physio graphic position	Bunded or unbunded	Present land use	Land capability classes subclasses and unit
1	2	3	4	5	6	7	8	9
1(a)	1-sl-d5/A-e1	Rangpur Varsoda Lakroda		~1%	Flat to very gently undulopy table land,	Unbunded	Bajra, vegetable lucerno etc.	II-1
1(b)	1-sl-d5/A-e2	"		"	"	"	"	IIeS-1
2	1-ls-d5/A-e1	"		"	"	"	"	IIeS-1
3	1-sl-d5/D-e2	"		1-3%	"	"	"	IIeS-1
4	1-ls-d5/B-e1	"		"	"	"	"	IIeS-1
5	1-ls-d5/B-e2	"		"	"	"	"	IIeS2
6	1-S-d5/A-e1	Lakroda		0-1%	"	"	"	IIeS3
7	1-ls-d5/A-e1 (Dry)	"		"	"	"	"	IIeS1
8	1-sl-d5/A-e1 (Dry)	"		0-1%	"	"	"	IIeS1
9	1-ls-d5/B-e2 (Dry)	"		1-3%	"	"	"	IIeS2
10	1-ls-d5/B-e1 (Dry)	"		"	"	"	"	IIIeS1
11	1-ls-d5/B-e2 (Irri)	"		"	"	"	"	IIIeS2
12	2-sl-d5/A-e1 (Irri)	Rangpur, Lakroda		0-9%	"	"	"	II-1
13	2-ls-d5/A-e1 (Irri)	-do-		"	"	"	"	II S1
14	2-ls-d5/A-e1 (Dry)	-do-		"	"	"	"	III S2
15	2-ls-d5/B-e2 (Irri)	Rangpur, Lakroda		1-3	"	"	"	III eS-2
16	2-ls-d5/B-e2 (Dry)	"		"	"	"	"	III eS-2
17	3-ls-d5/A-e1 (Dry)	Varsoda, Lakroda, Ranpur		0-1%	Moderately dissected gently slopy Periphara-ral land (Marginal land)	unbunded	Bajra, Vegetables, Juncerne cotton etc.	III S-1
18	3-ls-d5/A-e1 (Irri)	"		"	"	"	"	II eS3
19	3-ls-d5/A-e2	"		"	"	"	"	III eS1
20	3-ls-d5/A-e1-G1	"		"	"	"	"	II eS3

1	2	3	4	5	6	7	8	9
21	3-1a-d5/B-e2			1-3%				III eS2
22	3-1a-d5/B-e2			"				III eS1
23	3-1a-d5/B-e2-G2							III eS2
24	3-1a-d5/B-e3-G3			"	"			IV eS1
25	3-1a-d5/C-e3-G3			3-5%				III eS3
26	3-1a-d5/C-e4			"	"			IV eS-1
27	3-1a-d5/C-e4			"	"			IV eS-1
28	3-1a-d5/B-e3			1-3%	"			III eS-3
29	3-1a-d5/C-e4			3-5%	"			IV eS-1
30(a)	4-1a-d4/A-e1 (Irri)	Rangpur Lakroda		0-1%	"			II S1
30(b)	4-1a-d4/A-e4	"		"	"			II-1
31	4-1a-d4/B-2 (Irri)	"		1-3%	"			II eS-2
32	4-1a-d4/C-e3 (Dry)	"		3-5%	"			IV eS-1
33	4-1a-d4/B-e2	"		1-3%	"			III eS-2
34	4-1a-d4/C-e3			3-5%	"			III eS-3
35	5-1a-d5/C-e3	Varsoda, Rangpur Lakroda		3-5%	Highly dissected gently sloping undulating Jump land	Jnbunded	Bajra, Vegetables, castor, Tur etc.	IV eS1
36	5-1a-d4/C-e4	"		"	"	"	"	VII eS1
37	5-1a-d4/C-e3	"		"	"	"	"	IV eS
38	5-1a-d5/C-e4	"		"	"	"	Grass land, cotton, Bajra etc.	IV eS1
39	5-1a-d5/C-e4	"		"	"	"	"	VI eS-2
40	5-1a-d5/D-e4	"		5-10%	"	"	Grass land	VII eS1
41	5-1a-d4/D-e4	"		"	"	"	"	VII eS1
42	5-1a-d5/D-e4	"		"	"	"	"	VI eS-1
43	5-1a-d4/E-e4	"		10-15%	"	"	"	VII eS-2
44	5-1a-d4/E-e4	"		"	"	"	"	VII eS-2

1	2	3	4	5	6	7	8	9
45(a)	6-sl-d4/D-e4	"		5-10+	Highly, dissected moderately sloping rolling hump land	"	Grass land and waste land	VI eS-1
	(b) 6-ls-d4/F-e4	"		15-25+	"	"	"	VII eS-2
46	6-ls-d3/E-e4	"		10-15%	"	"	"	VIII eS-2
47	6-ls-d3/F-e4	"		15-25+	"	"	"	VIII eS-2
48	6-ls-d2/F-e4	"		"	"	"	"	"
49	6-sl-d3/E-e4	"		10-15%	"	"	"	VIII eS-1
50	6-sl-d3/F-e4	"		15-25%	"	"	"	VIII eS-1
51	6-ls-d3/G-e4	"		25-33+ or more	"	"	"	VIII eS-2
52	6-ls-d2/G-e4	"		"	"	"	"	VIII eS-2
53	7-ls-d5/B-e2	Varacoda		1-3%	Slightly dissected gently sloping wide valley bottomed land	Unbunded	Bajra, vegetables, castor, wheat tur etc.	IV w1
54	7-ls-d5/B-e3	"		"	"	"	"	IV w2
55	7-sl-d4/B-e3	"		"	"	"	"	IV w2
56	7-sl-d4/B-e2	"		"	"	"	"	IV w1
57	7-sl-d5/B-e2	"		"	"	"	"	IV w1
58	7-ls-d4/B-e2	"		"	"	"	"	IV w2
59	7-ls-d5/C-e3	"		3-5+	"	"	"	IV w2
60	7-ls-d4/B-e3	"		"	"	"	"	IV w2
61	8-sl-d-4/B-e2	"		"	Very gently slopy to gently slopy, slightly dissected table land having miscellaneous land type	"	Pasture-cum-waste land	III eS1
62	8-ls-d5/B-e2	"		"	"	"	"	III eS-2
63	8-sl-d5/B-e2	"		"	"	"	"	III eS2