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Technical Bulletin

LAND RESOURCE INVENTORY OF DHOLKA TALUKA, AHMEDABAD DISTRICT GUJARAT

ON 1:10000 SCALE

FOR OPTIMAL AGRICULTURAL LAND USE PLANNING USING GEO-SPATIAL TECHNIQUES

ICAR-National Bureau of Soil Survey and Land Use Planning
Amravati Road, Nagpur – 440 033, Maharashtra

In cooperation with

Bhaskaracharya Institute for Space Applications and Geoinformatics (BISAG)
Gandhinagar – 382 007, Gujarat
and
Agriculture, Farmers Welfare and Cooperation Department , Govt.of Gujarat
Gandhinagar – 382 010, Gujarat

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R.P. SHARMA
R.S. SINGH
S.S. RAO
S.K. SINGH
P. CHANDRAN
T.P. SINGH

ICAR-National Bureau of Soil Survey and Land Use Planning
Amravati Road, Nagpur – 440 033, Maharashtra

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and
Agriculture, Farmers Welfare and Cooperation Department, Govt. of Gujarat
Gandhinagar – 382 010, Gujarat

About the NBSS & LUP

The National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Nagpur, a premier Institute of the Indian Council of Agricultural Research (ICAR), was set up in the year 1976 with the objective to prepare soil resource maps at state and district level and to provide research inputs in soil resource mapping and its applications, land evaluation, land use planning, land resource management and database management using GIS for optimizing land use on different kinds of soils in the country. The Bureau has been engaged in carrying out agro-ecological and soil degradation mapping at the country, state and district and village level for qualitative assessment and monitoring the soil health towards viable land use planning. The research activities have resulted in identifying the soil potentials and problems and application of the soil surveys with the ultimate objective of sustainable agricultural development. The Institute is also imparting in service training to staff of the soil survey agencies and SAU's in the area of soil survey and land evaluation, soil survey interpretations for land use planning, remote sensing applications to soils and agriculture and GIS for land resource management. The Bureau in collaboration with various state agricultural universities for running post-graduate teaching and research programme in land resource management, leading to M.Sc. and Ph. D. degrees.

The publication on *"**Land Resource Inventory of Dholka Taluka, Ahmedabad District, Gujarat on 1:10000 Scale for Optimal Agricultural Land Use Planning, Using Geo-Spatial Techniques**"* is the result of soil Resource studies in the Dholka block. It will help in understanding the extent and distribution of soils, their problems and potentials and also efficient implementing the land use options and management practices and suggesting options for effective land use.

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TO OBTAIN COPIES OF THIS BULLETIN

Please write to:

Director,

ICAR-National Bureau of Soil Survey and Land Use Planning (NBSS&LUP),

Amravati Road, Nagpur – 440 033, India.

Phone: (0712) 2500386, 2500664, 2500545(O)

Telefax: +91-0712-2500534

E-mail: director.nbsslup@icar.gov.in

Head, Regional Centre

ICAR-National Bureau of Soil Survey and Land Use Planning (NBSS&LUP),

Regional Centre, Bohara Ganeshji Road, University Campus, Udaipur – 313 001

Phone: (0294) 2471421, Telefax: (0294) 2471326

FOREWORD

"Earth needs to be nurtured with mother's care because Earth gives everything for sustaining life". I quote this in the context of soils that form one of the most precious natural resources of the earth. For sustainable agricultural production, it is necessary to focus attention on the soil and climate resource base, current status of soil degradation and soil based agro-technology generation for optimizing land use.

During the past few decades, we have made significant strides in achieving self-sufficiency in food production. In order to meet ever-increasing food requirement of the growing population, there have compulsion to try to produce more and more from each unit area of land; this process is leading to depletion of natural resources and their quality. Under these conditions, knowledge of the soils, their extent, distribution, characteristics and use potentials gains prominence in optimizing land use on sustainable basis.

I am pleased to see that the ICAR-National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) is engaged in preparing soil resource maps of different states on 1:250, 000 scale and printing them on 1: 500,000 scale; of the district on 1: 50,000 scale and of the blocks/watershed/village/farms on 1: 10,000/1:5000 scale. Such soil maps of some states, districts have already been released and distributed to the user agencies to be adopted for their planning.

The present publication "**Land Resource Inventory of Dholka Taluka, Ahmedabad District, Gujarat on 1:10000 Scale for Optimal Agricultural Land Use Planning, Using Geo-Spatial Techniques**" is brought out by the ICAR-NBSS&LUP, Regional Centre, Udaipur, describes kind, extent and distribution of soils, their problems and potentials. The soil survey data have been interpreted for generating important theme based maps on the salient soil properties, which determine plant growth. In addition, soils have been evaluated for their suitability for major crops grown in the tehsil. The bulletin provides a base for planning developmental work in the field of agriculture, horticulture, forestry and to undertake soil and water conservation activities to optimize the land use on a sustainable basis.

I personally congratulate Dr. S. K. Singh, Ex-Director, Dr. P. Chandran, Director, Dr. R. S. Singh, Ex-Head, Dr. S. S. Rao, Head, Regional Centre, Udaipur, Dr. R. P. Sharma, Project Leader and his team of devoted scientists and technical officers who have work untiringly to bring out this publication for the benefit of all those who have a stake on optimal utilization of land.

Deputy Director General (NRM)
ICAR, Krishi Bhavan
New Delhi

PREFACE

The role of soil survey and mapping in optimizing land utilization of limited soil resources has been emphasized at different times and from different platforms. However, adequate attention is still not being paid resulting in either sub-optimum use or irreparable degradation due to over use of this basic resource.

The ever-increasing food requirement of the growing population in India demands optimum utilization of soil resources. The soil resource mapping and classification provides basic data, which can be used, for planning and implementing land use strategies. This ever-increasing demand is compelling more and more area to be brought under cultivation which was earlier under cover of natural vegetation or forest. This depletion of land cover leads to human- induced physical chemical and biological degradation problems. Therefore, there is an urgent need to halt deforestation and to prevent the subsequent degradation.

The National Bureau of Soil Survey and Land Use Planning have been preparing soil maps of different districts/blocks in the country. Such maps not only help in understanding the soil-physiographic relationships but also provide important information. This can be used to evolve better land use strategies leading to sustainable land use planning. The data also provide enough directions for searching beneficial land use alternatives.

The present attempt of bringing out the bulletin "**Land Resource Inventory of Dholka Taluka, Ahmedabad District, Gujarat on 1:10000 Scale for Optimal Agricultural Land Use Planning, Using Geo-Spatial Techniques**" may help the block/district level planners and policy makers to understand the soil resources, its problems and potentials in the block. The maps have been prepared using the advanced tool of Geographical Information System (GIS) on the original scale. The report is well written and it is hoped that the information content therein will help the land users to appreciate the intricacies of the formation, distribution, characterization and classification of the soils of Dholka block and use the information to the best advantage for themselves as well as to protect the environment from degradation.

I congratulate Dr. R. P. Sharma, Project Leader and other associated scientists/technical officer for bringing out this publication. It is useful to those involved in environmental studies in general and soil survey and mapping in particular.

(P. Chandran)
DIRECTOR, ICAR-NBSS&LUP

PROJECT TEAM

Project Team ICAR-NBSS&LUP

Project Leader: R. P. Sharma

Regional Coordinator: R. S. Singh and S. S Rao

National Coordinator: S. K. Singh and P. Chandran

Project Team BISAG

T. P. Singh

Vijay Singh

Apurva Dalwadi

Jaydipsinh Kathota

Technical Support Team

B. L. Tailor

R. Singh

S. S. Sharma

B. L. Jat

S. P. Singh

D. L. Oad

N. R. Ola

S. L. Sharma

Layout and design

Prakash Ambekar

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This publication **"Land Resource Inventory of Dholka Taluka, Ahmedabad District, Gujarat on 1:10000 Scale for Optimal Agricultural Land Use Planning, Using Geo-Spatial Techniques"** is the outcome of collective efforts of many officials of the National Bureau of Soil Survey and Land Use Planning. The support and cooperation of the following persons is gratefully acknowledged in bringing out the publication.

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CONTENTS

EXECUTIVE SUMMARY

A detailed land resource inventory has been prepared for the Dholka block at 1: 10000 scales. Geomorphologically, the study area represents flat topography (0-1% or 1-3% slope) with regional slope towards south. The regional slope takes a tilt from east to west and shifting of channels and courses of Sabarmati river over a period of times. The southern part of block is ends in Arabian Sea. The major portion of the block covered with recent and sub-recent formations. It is a part of Cambay sedimentary basin. The sedimentation continued in the basin from Paleocene onwards under varying depositional environments. The Dholka block belongs to agroecological subregion (AESR) 4.2, Northern Plain and Central Highlands including Aravalli's, hot semi-arid ecoregion, with alluvium-derived soils & GP 90-150 days.

In kharif season, majority of area is covered with paddy crop and it is mostly occupied in low-lying area. Durum wheat and chickpea are the major crops of Rabi season especially in saline sodic soils. Visual interpretation of LISS-IV data indicated that the block was characterized into alluvial plain, flood plain, young coastal plain and low lying young coastal plain. The landform, slope and land-use/land-cover maps were integrated in ArcGIS and LEU map was prepared with 10 LEU units.

Dholka block covers 95766 ha area. Block was delineated in four landforms and the soils are classified in 11 series with 19 mapping units. The soils representing Amliyara, Badarkha, Dholi, Girand and Saroda series were developed on alluvial plain of the block. Amliyara soils are classified as *Fine loamy, mixed, hyperthermic, Fluventic Haplustepts*, Badarkha soils are classified as *Coarse loamy, mixed, hyperthermic, Typic Haplustepts.* Soils of Dholi series are moderately saline affected with severe sodicity and classified as *Fine, smectitic, hyperthermic, Sodic Haplusterts.* Girand soils are deep, moderately well drained, dark grayish brown to very dark grayish brown on very gently sloping alluvial plain with silt loam surface texture and moderate erosion (*Fine, mixed, hyperthermic, Typic Haplustepts*). Saroda series represents the deep, moderately well drained *loamy soils and classified as Fine, mixed, hyperthermic, Typic Haplustepts.* Anandpura and Vataman series developed on flood plain of the block. Anandpura soils are classified as *Fine silty over sandy, mixed, hyperthermic, Typic Ustifluents* whereas Vataman series are classified as *Course loamy, mixed, hyperthermic, Typic Ustifluents*.

The soils representing Ganeshpur, Khanpur series developed on young upper coastal plain. Ganeshpur soils are deep, imperfectly drained, very dark grayish brown to very dark gray on level to nearly level slope in young coastal plain with silty clay to clay surface texture, slight erosion and rare to occasional flooding (*Fine, smectitic, hyperthermic, Sodic Haplusterts*). Soils of Khanpur series are classified as *Fine loamy, mixed, hyperthermic, Vertic Haplustepts*. Loliya1 and Loliya2 series developed on low lying young coastal plain. Soils are deep to very deep, very poor to imperfectly drained, high in soluble salt content and very low in productivity. They are classified as *Coarse silty, mixed, hyperthermic, Sodic Haplocambids* and *Fine, mixed, hyperthermic, Sodic Endoaquents.*

Soils of Dholka block are strongly alkaline (pH 8.5-9.0) to very strongly alkaline (pH>9.0) in reaction and majority of soils (74.3%) are medium in organic carbon content. The soils are very poor to imperfectly drained and there is no remarkable problem of soil erosion. Low lying area are suffering from moderate to strong salinity or/and sodicity problems. Soils are moderate to high in soil moisture storage capacity and capable maintain survival of crop due to water stress.

It has been observed that the soils of the block have been divided into 3 land capability classes viz. II, III and IV. The major limiting factors in the block are drainage, salinity, sodicity and flooding. The soils of the block have been grouped into four irrigability classes with further sub-divided into three sub-classes based on the limitation of soils and site characteristics. According to suitability assessment criteria the soils were assessed the fitness of major crops growing in the region. Rice is Suitable in 38.4%, moderately suitable in 45.8% and marginally suitable in 8.1% of TGA. The evaluated suitability classes of durum wheat or wheat showed that the 12.6% area of the block are highly suitable, 53.9% area is moderately suitable and 25.8% area is marginally suitable. Similarly, the soils were evaluated and mapped for cotton, sorghum, pearl millets, pulses, groundnut and sesame crops. Soils of the area are grouped in 7 LMUs for sustainable or alternate land use options.

The reported soil survey data are useful for other purposes like installation of soil drainage systems, salinity and sodicity amelioration of soils and any other agricultural land use planning after consulting the experts of line departments.

CHAPTER 1

INTRODUCTION

During the post green revolution era, the country had witnessed manifold increase in total food-grain production from 72.35 MT to 281.4 MT since 1965-66 to 2018-19. Five decayed of agriculture from 1965 to 2015 with blanket application of green revolution technology resulted in various kind of degradation, affecting 120 million ha area of cultivable land. Total and partial productivity factors declined for many crops in the different parts of the country. Furthermore, increasing incidence of flood, recurring dry-spell and declining per capita availability of land further complicated the situation for agrarian. Predicted change in the climate is not also encouraging for farming community. In such a situation, increasing productivity is the great challenge for the planners, scientists and farmers for meeting out the targeted food grain production of 350 million tons by 2030 and 450 million tons by 2050 (ICAR Vision 2030).

Land use planning consisting of right land use and adoption of right technology in site specific mode may be one of the options that may help in meeting out the demand of food as well as in preserving the quality of land for future. Land resource inventory on 1:10000 scales is the pre-requisite for developing such site-specific information, which paves the way for applying right land use, right technology at the right place. Adequate knowledge about the distribution and properties of soils is a key issue to support sustainable land management, which, among others, includes erosion control, fertility management, crop choice, and possibilities for irrigation (Van de Wauw et al. 2008; Seid et al. 2013). Detailed soil spatial and attribute information is required for many environmental modeling and land management applications. Hence, limited areas are being covered owing to high costs and limited availability of experienced soil surveyors (Manchanda et al. 2002).

Soil mapping is basically an inference process, where soil is described as a function of climate, organisms, relief, parent material and time, referred to as CLORPT (Jenny 1941) and recognition of interactions between soil-forming factors is potentially important because it is one possible source of detailed soil pattern (McBratney et al. 2003). In small areas where climate, parent material, and time are almost similar, the major factors influencing the soil properties can be attributed to variation in relief and flora and fauna (Dobos et al. 2000; Srivastava and Saxena 2004).

The application of satellite remote-sensing data products for small and medium-scale soil mapping is widely accepted. However, their utility is limited for large-scale soil mapping due to the coarse resolution of satellite data. With advancement in terms of spatial, spectral, and radiometric resolutions of the sensors with stereo capabilities, studies have been initiated to characterize soils at large scale through the physiography-land-use-soil relationship. Srivastava and Saxena (2004) discussed the technique of large-scale soil mapping (1:12500 scale) in a basaltic terrain with a Physiographic Land Unit (PLU) approach and differentiated soil types using topographic information available in the Survey of India toposheet and land-use/land-cover information from IRS-1C PAN merged data. Nagaraju et al. (2014) also prepared large-scale soil map (1:5000 scale) in a basaltic terrain with a PLU approach using landform, slope, and land-use/land-cover maps.

Sharma et al. (2019) worked out on technique of large scale soil mapping using remote sensing satellite data in basaltic terrain of peninsular region in the north-west Gujarat, India. He mapped the soil resources of Pata Meghpar village on 1:4000 scale. Sharma *et al*. (2018) linked the village level land resource data with climate and socioeconomic conditions for integrated village/block development programmes in Jamnagar district of Gujarat.

Gujarat is considered one of the economically developed states in India. Ahmedabad is one of the most important cities in Gujarat state with respect to heritage, education, trade and technology. Historically, Ahmedabad is a major producer of cotton, garments and fabrics. The district has been divided in to 11 Talukas-Mandal, Detroj-Rampura, Viramgam, Sanand, Ahmedabad city, Daskroi, Bavla, Dholka, Ranpur, Barvala and Dhandhuka. Dholka block is situated in Ahmedabad district on the banks of the Sabarmati River. Recently, the soil quality/health is deteriorating due to urbanization, industrialization, intensive use of land resources or high input agriculture. We should use the natural resources as per their potential and constraints for sustainable production. Hence, up-to-date and reliable information at appropriate scale is a requirement for proper natural resource planning. But, the soil information at large scale is lacking, particularly in the Dholka block of Ahmedabad district, Gujarat. The proposed study is an attempt to fill up this information gap in the Dholka block of Ahmedabad district, Gujarat.

1. To delineate the land use/land cover and landform map of selected block on 1:10000 scale using high-resolution temporal satellite data.
2. To characterize and map the soil resources of selected blocks on 1:10000 scale.
3. To develop block level Land Resource Information System (LRIS) in GIS environment.

GEOGRAPHICAL SETTINGS

2.1 Location and extent:

The area under investigation belongs to the Dholka block of Ahmedabad district (22º23’59” to 22º51’39” N latitude, 72º8’54” to 73º13’10” E longitude) covering an area more than 95000 hectares (Fig. 2.1) in AESR 4.2 in Central Gujarat, India (Sehgal et al.1996). It is bounded by Daskroi block in the north, south by Dhandhuka and Dholera blocks, east by Khambhat and Tarapur blocks of Anand district and Kheda block of Kheda district, and west Bavla block of Ahmedabad district. There are 65 Gram Panchayats and 72 villages in the block (*https://ahmedabad.nic.in/village-panchayats/).*

2.2 Geography and geology:

2.2.1 Geography

Geomorphologically, the study area represents flat topography (0-1% or 1-3% slope) with regional slope towards south. The areas towards north are at higher elevation. It gradually reduces towards south. The regional slope takes a tilt from east to west and shifting of channels and courses of Sabarmati river over a period of times. The southern part of block is ends in Arabian Sea.

2.2.2 Geology

The major portion of the block is covered with recent and sub-recent formations. It is a part of Cambay sedimentary basin. The sedimentation is continued in the basin from Paleocene onwards under varying depositional environments. The geological materials were deposited in the area in four stages. Trap-conglomerates, silt and clay stones deposited over the Deccan trap basalt in first stage (formative stage) and chlorites, micaceous sand with variegated clay stones, silty clays, silts and thin carbonaceous streaks were deposited in fourth stage (positive stage) (Ahmedabad district gazetteer 1984).

2.3 Climate:

The climate is moderate during the winter and hot in summer. The maximum mean temperature is 25.3ºC (four summer months; May to August) and minimum mean temperature (four winter months; November to February) is 13.7ºC (Table 2.1). The weather is intensively hot and on some days during the period of April to mid-June the day temperature occasionally rises up to 46 °C. Cold waves sometimes affect the block during the winters along with western disturbances, which move across north India (https://en.climate-data.org/asia/india/gujarat/ahmedabad-2828/).

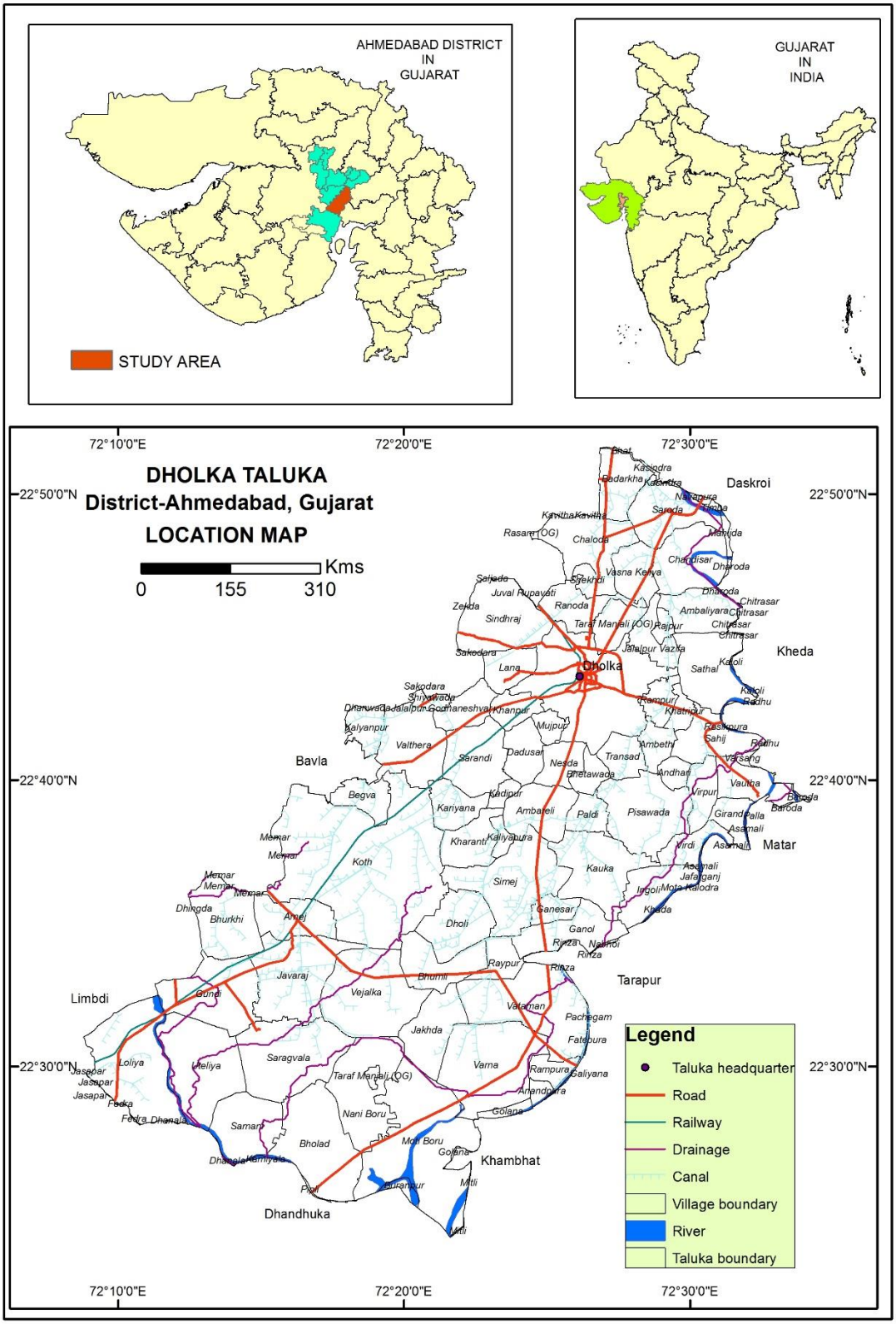

Fig. 2.1. Location map of Dholka block

The mean annual rainfall is 753 mm and about 95% of rainfall is from south-west monsoon. The difference between the mean summer and mean winter soil temperature is more than 5°C. The soil temperature class is “hyperthermic”. The soil moisture regime is “aquic” and “ustic”. The area belongs to agroecological subregion (AESR) 4.2, Northern Plain and Central Highlands including Aravalli’s, hot semi-arid ecoregion, with alluvium-derived soils & GP 90-150 days (Sehgal et al.1996).

Table 2.1. Climate of Dholka block, Ahmedabad

	Jan.	Feb.	Mar.	Apl.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. Temperature (°C)	20.1	22.8	27.1	31.2	33.4	32.6	29.4	28.1	28.6	28.4	24.5	21
Min. Temperature (°C)	11.7	14.4	18.5	22.9	26.2	27.3	25.7	24.5	24.2	21.2	16.1	12.5
Max. Temperature (°C)	28.6	31.2	35.7	39.6	40.7	38	33.2	31.8	33.1	35.6	33	29.6
Rainfall (mm)	2	0	2	1	5	81	271	216	153	14	6	2

2.4 Ground water status

Dholka block has been categorized in critical stage with respect to future ground water development whereas the district is categorized in semi-critical stage. Central Ground Water Board published a report on ground water status of Ahmedabad district in year 2014. The ground water resources of the Ahmedabad district were calculated as on March 2011in collaboration with the Government of Gujarat using the methodology suggested by Ground Water Resource Estimation Committee (GEC-97). These resources were computed after reorganization of the districts. The Annual Ground Water Recharge of Dholka block was reported 4624.67 ha.m during March 2011. The Gross Annual Ground Water Recharge in the district is 61686.37 ha.m. The net available recharge of Dholka block after leaving natural discharge from monsoon period was 4393.43 ha.m. The net available recharge in the district was 58309.42 ha.m. Over exploitation of ground water is a major issue in some parts of the district resulting in the fast depletion of water resource. Piezometric heads of deep confined aquifer has also declined sharply owing to the huge withdrawal. In some parts of the district phreatic aquifers are desaturated needing urgent attention. Flood irrigation technique which is practiced in the area is also the major cause of wastage of ground water as there is no control on the watering depth. Geological formations of Dholka block

is soft rocks therefore, percolation tanks/ ponds, recharge wells, recharge shafts are considered as suitable artificial recharge structures in the block. Awareness among the people regarding rainwater harvesting and artificial recharge can be an important step to improve the availability of ground water (CGWB 2014).

2.5 Drainage:

The drainage of the block is mainly controlled by the Sabarmati River and its tributaries like Shelwa, Andhli, Rodh and Vatrak. The drainage of the most river systems is north to southwards and mostly dendritic in nature. The meandering of river and embankment along the river helps in the concentration of greater volume of water in a small area which leads to flooding. The low lying areas affected with flooding and soil salinity/sodicity.

2.6 Natural vegetation:

Natural vegetation of the block consists of trees, shrubs, grasses and weeds. Mostly tree species are deciduous and sub-tropical in nature. The area is mostly devoid of forest cover. Some of the tree species in the block are planted by man and maintained in pure form. The major tree species are Neem (*Azadirachta indica*), Babul (*Acacia nilotica*), Mango (*Mangifera indica)*, Siras (*Albizia lebbeck*), Sisam (*Dalbergia sissoo*), Ber (*Zizyphus mauritiana*), Sanjan *(Moringa oleifera)*, Karanj *(Pongamia pinnata),* Imli *(Tamarindus indica)* Khejdi *(Prosopis cineraria) etc.*

SOCIO-ECONOMIC STATUS

Agriculture is the main source of livelihood in the block with more than 70 per cent of the working population being associated in agriculture either as cultivators or as agricultural labourers.

3.1 Population:

Dholka is a Taluka located in Ahmedabad district of Gujarat. It is one of 11 Talukas of Ahmedabad district. There are 70 villages and 2 towns in Dholka Taluka. As per the Census India 2011, Dholka Taluka has 50,721 households, population of 2,49,852 of which 1,30,113 are males and 1,19,739 are females. The population of children between age 0-6 is 32,034 which is 12.82% of total population. The sex-ratio of Dholka Taluka is relatively better (920) compared to 919 which is average of Gujarat state. The literacy rate of Dholka Taluka is 67.69% out of which 75.26% males are literate and 59.45% females are literate. The total area of Dholka is 961.21 sq.km with population density of 260 per sq.km. Out of total population, 32.4% of population lives in Urban area and 67.6% lives in Rural area. There are 13.48% Scheduled Caste (SC) and 0.72% Scheduled Tribe (ST) of total population in Dholka Taluka. In the block there are 70,944 total workers (41.6%), out of that 55,823 (78.8%) are main workers, 13,763 (19.4%) are cultivator and remaining are other workers. The industrial category of main workers composed by agricultural labours (27,238, 64.7%), house hold industry workers (659, 1.6%) and other workers (14,223, 33.8%) (https://www.indiastat.com/).

3.2 Irrigation Potential:

Crops are grown in the two cropping seasons *i.e. Kharif* (rainy season) and *Rabi* (winter season). The major source of irrigation is ground water and surface water. Dholka block has 761 dug wells, 114 shallow tube wells and 1539 deep tube wells. There are 252 surface flow canals in the block. The tube wells tapping the deeper aquifer (i.e. below 250 meters) at the “Bhal” area in Dholka taluka. Net annual ground water availability of block is 4393.43 ha m with a stage of ground water development of 92.15% which is categorized as critical stage for future ground water development programmes of Dholka. Out of 72 villages (95,768 ha) of Dholka 61 villages (47359 ha) are covered under Sardar Sarovar irrigation project (CGWB 2014).

3.3 Present land use, crops and cropping sequences:

The area is mainly double-cropped with underground tube well and canal irrigation. The major crops grown in the blocks are paddy, wheat/durum wheat, chickpea, cotton, castor, pigeon pea, Bajra Isabgul *etc.* Custard apple orchards are also planted. In *kharif* season, paddy is mainly cultivated and it is mostly occupied in low lying area. Durum wheat and chickpea are the major crops of Rabi season specially in saline sodic soils. Major cropping sequences of Dholka are paddy-wheat-fallow and sesame-rye-fallow. Pigeon pea, chickpea, Bajra and sorghum also cultivated under rainfed conditions. Present land use statistics of Dholka block is presented in table 3.1.

Table 3.1. Present land use of Dholka block, Ahmedabad (2010-11)

Land Use	Area (ha)	Area (%)
Area reported for land utilization	95577	100
Forest	1636	1.6
Barren & Unculturable Land	6345	6.6
Land put to non-agricultural uses	7657	8.0
Culturable fallow land	3220	3.4
Permanent pasture and others	4840	5.1
Current Fallow	18102	18.9
Net sown area	56784	59.4
Area sown more than once	40400	42.3
Cropping Intensity	-	171.2

(Source: https://www.indiastat.com/)

3.4 Animal Husbandry and Dairy:

Animal husbandry sector is considered to be one of the major activities for providing subsidiary income to the rural farming families in the block. Moreover, development of this sector is considered very important as a source of supply of milk, milk products and meat. Therefore, government has been encouraging and strengthening for upgradation of this sector. In Gujarat, a fair organizes every year at 'Vautha' in Dholka Taluka. This fair is very famous for sale of donkeys and also for race competition of donkeys (Source: District census handbook, Ahmedabad 2011). According to livestock census (2007) the block is having 24647 cattle's, 64318 buffaloes, 1147 sheep's, 9488 goats and 27174 poultry (Source: Statistical Abstract-2010, Directorate of Economics and Statistics).

METHODOLOGY

4.1 Data Sets:

1. Survey of India toposheets (1:50,000 scale). Area covered under the toposheet numbers 46B/2, 3, 5, 6, 7, 9 and 10.
2. Village level cadastral boundaries of block supplied by BISAC, Gandhinagar
3. Resourcesat-2, Indian Remote-Sensing Satellite (IRS)-P6 Linear Imaging Self-Scanning Sensor-4 (LISS-IV) data

4.2 Flow chart of methodology:

The flow chart showing the methodology of detailed soil mapping using LISS-IV data derived products is presented in figure 4.1.

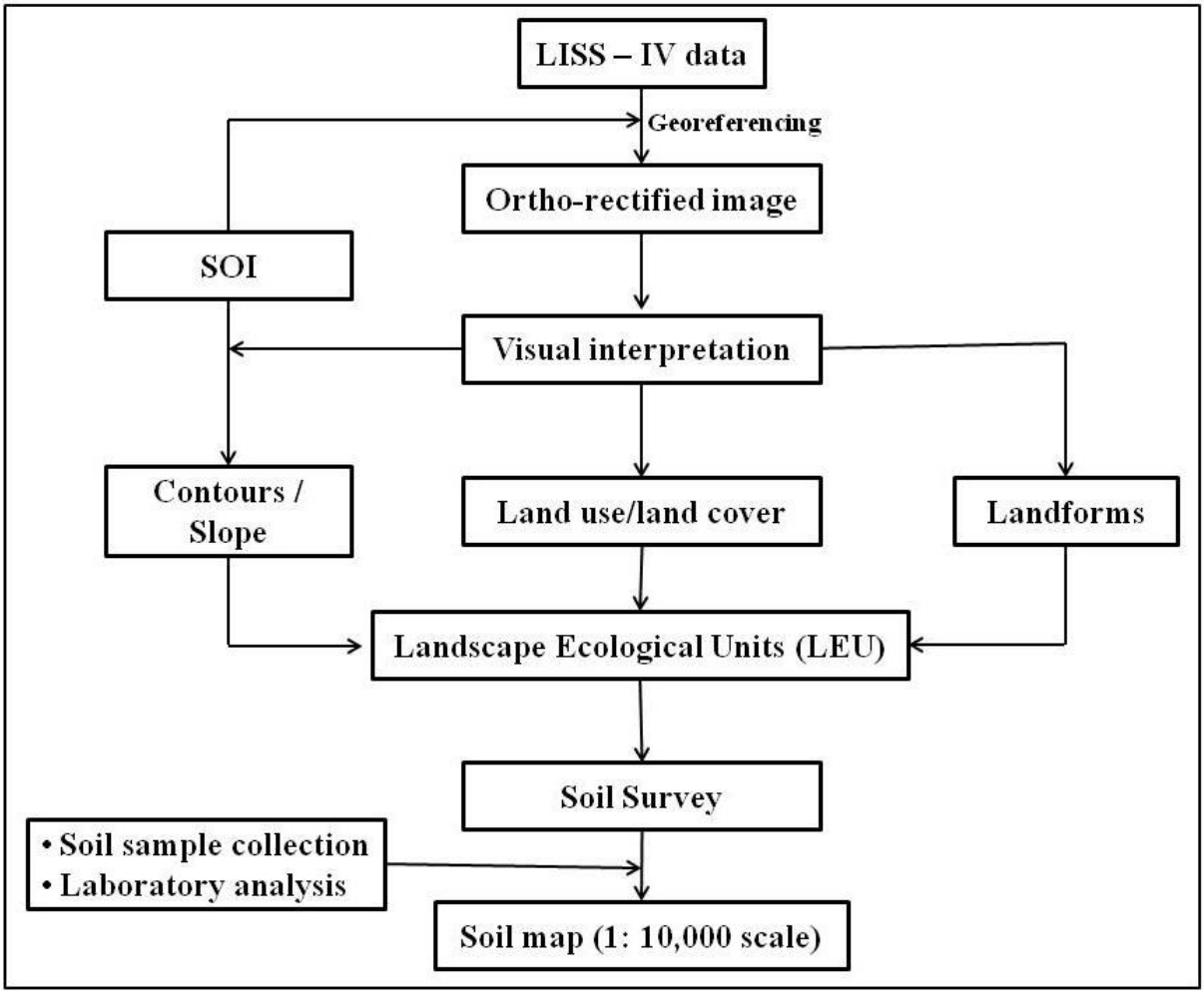

Fig. 4.1. Flowchart of the methodology

4.3 Preparation of base maps:

Survey of India toposheets on a 1:50,000 scale, IRS-R2 LISS-IV data of November 2013 and May 2014 (5.8 m resolution) were georeferenced using WGS 84 datum, Universal Transverse Mercator (UTM) projection, and ground control points (GCPs). The cadastral level map of the block was provided by BISAG, Gandhinagar, Gujarat and co-registered using orthorectified LISS-IV data as a reference. After the geo-referencing process, the rasterized map was screen digitized. Land use/land cover, landform analysis was carried out by onscreen visual interpretation using IRS-P6 LISS-IV data in ArcGIS software version10.3.

4.4 Generation of landscape ecological unit (LEU) map:

The landform, slope, and land-use/land-cover layers were integrated in ArcGIS version 10.3 and a LEU layer prepared. These LEU units are relatively homogeneous in terms of the main factors of soil formation and typical predictors of soil characteristics and used as a base map for ground truth verification.

4.5 Ground-truth verification:

The area was traversed for identification of different landform units, slope, and present land-use/land-cover classes, and correlated with image interpretation units. The boundaries that were originally derived during the base map preparation were verified and corrected wherever necessary. To understand the soil variability in the study area, representative sites on each physiographic unit were selected, located using handheld Global Positioning System (GPS) and 150 observations were taken on typically identified stripes and random basis. Finally, after field correlation total 25 master profiles were taken as per variation in phases and were described for site and soil characteristics such as slope, erosion, colour, texture, structure, etc. and recorded in the standard format (Soil Survey Division Staff 2000).

4.6 Soil sampling and analysis:

Soil samples from each horizon of all of the representative soil series were collected for laboratory studies. The soil samples collected during the fieldwork were initially air dried in the laboratory at room temperature, ground using a wooden pestle and mortar, screened through a 2 mm sieve, properly labelled, and stored in plastic boxes for laboratory analysis.

For certain soil characteristics, such as organic carbon, samples were further ground and screened through an 80-mesh sieve. Analysis of soil physical and chemical characteristics was carried out as per standard procedures (Richards 1954; Piper 1966; Jackson 1973; Page et al. 1982). Soils were classified according to Keys to Soil Taxonomy (Soil Survey Staff 2014).

4.7 Development of soil mapping legend:

The map unit considered in the present study is the phases of the soil series. The soil series is a group of soils or polypedons that have horizons similar in arrangement and in differentiating characteristics with relatively narrow range in sets of properties (Soil Survey Division Staff 2000). The soil phases considered were surface texture, slope, erosion and flooding. The soil profiles described during the ground truth were correlated in each major landform and soil series were identified. The soil series information was extended to sub-units of major landforms using the diagnostic soil characteristics from soil profile and augur observations. A soil map showing soil series and their phases was prepared at 1:10000 scale. The soil legend code developed depicts the name of the series followed by surface texture, slope, erosion and flooding (Singh et al. 2016).

4.8 Land Evaluation:

Land evaluation of the identified soil mapping units was carried out through land capability classification (LCC), land irrigability classification (LIC) (AIS&LUS 1971) and crop suitability evaluation (FAO 1976; Sys et al.1991, 1993; Naidu et al. 2006).

The FAO panel for land evaluation (FAO, 1976) defined the concept of land utilization types and suggested the classification of land for specific use. The classification is presented in four categories: orders, class, subclasses, and units. There are two orders “S” for suitable and “N” for unsuitable land, reflecting the kind of suitability. The suitable order (S) is further sub divided into 3 classes. (S1, S2 and S3) reflecting degree of suitability within the order. The unsuitable (N) order has 2 classes (N1 & N2). The subclasses reflect the kind (S) of limitation or the main kinds of improvement measures required within a class. These limitations are climate (c), topography (t), wetness (w), salinity (n), soil fertility (f) and physical soil limitation (s).

Sys (1985) proposed a scheme for evaluating the degree of limitation which is related with the following:

0 (No limitation) - Optimum crop growth.

1 (Slight limitation) – Nearly optimum for crop growth.

2 (Moderate limitation) – moderate influence on crop, growth decline.

3 (Severe limitation) – Uneconomical for the suggested land use.

4 (Very severe limitation) – Yield below profitable level not fit for suggested land use.

CHAPTER 5

RESULTS AND DISCUSSION

The land resource database generated through detail soil survey of Dholka block of Ahmedabad district provides comprehensive information on all the land resources of the block specifically on soils, landforms, climate, land use pattern and socio-economic status.

5.1 Land-use/Land-cover:

Based on the IRS-P6 LISS-IV data (November 2013, May 2014), four land-use/land-cover classes were identified. The land-use data (Fig. 5.1) indicates that about 76.5% TGA of the block is under double crops, 18.6% is under single crop, 1.5% is under wasteland and 3.4% TGA is under miscellaneous use viz., habitation, mud, canal and river. Majority of area of Dholka is under double crops (76.5%, Table 5.1).

Table 5.1. Land-use/land-cover of Dholka block

Land use	**Area (ha)**	**TGA (%)**
Single crop	17834	18.6
Double crop	73227	76.5
Wasteland	1442	1.5
Miscellaneous	3263	3.4
Total area	**95766**	**100**

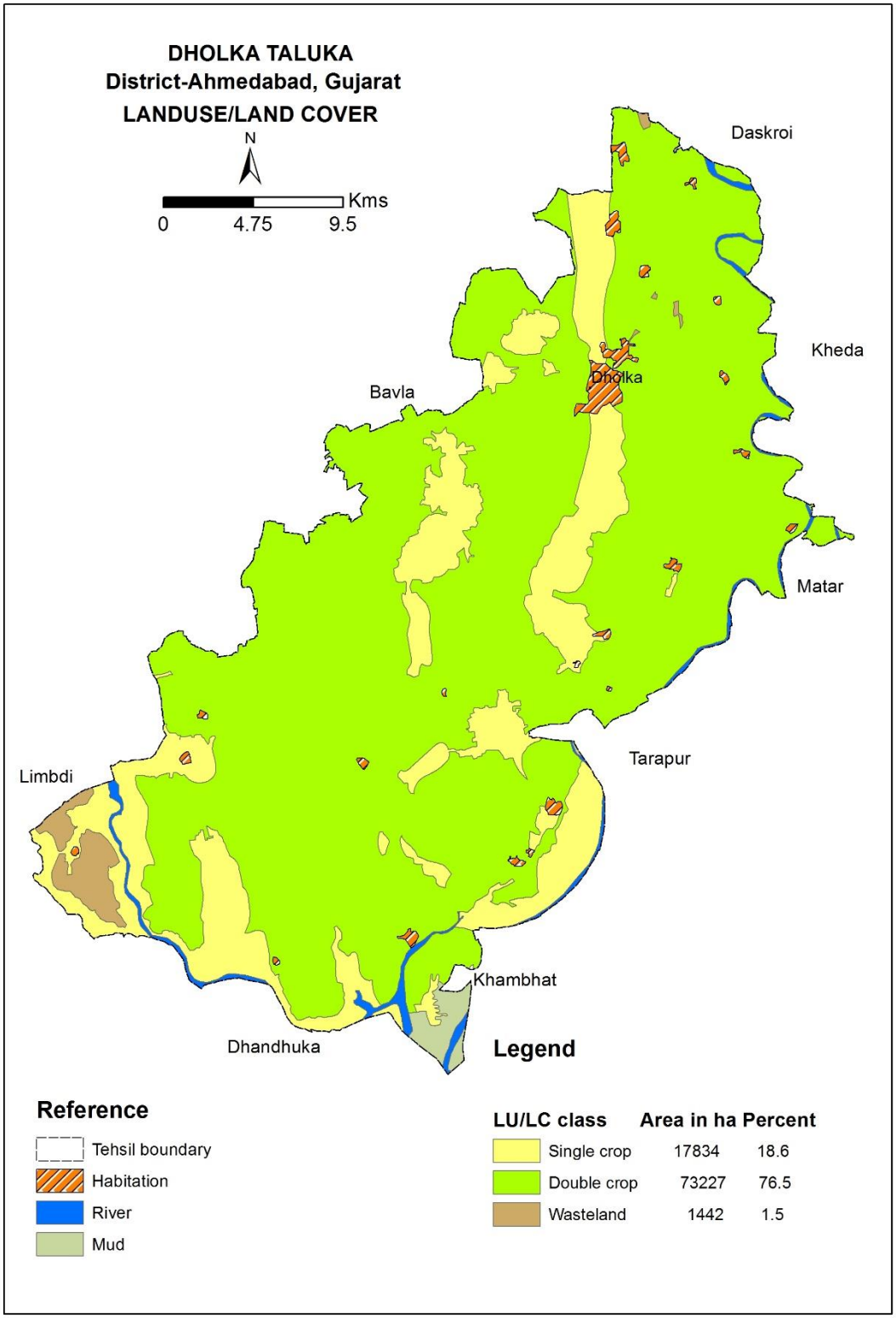

Fig. 5.1. Present land use/land cover map of Dholka block

5.2 Landform delineation:

Visual interpretation of LISS-IV data indicated that the block was characterized into alluvial plain, flood plain, young coastal plain and low lying young coastal plain. The major landforms were further subdivided based on slope, land-uses and other local features. On the basis of slope there were two categories of landforms *viz.* level to nearly level plains and very gently sloping plains. Majority of area is occupied by young coastal plain (63.5%) followed by alluvial plain (23.3%), young coastal plain (low lying) (6.3%) and remaining in flood plain (3.5%) and miscellaneous uses (3.4%). Distribution and area of different landforms in Dholka block is depicted in figure 5.2 and tabulated in table 5.2.

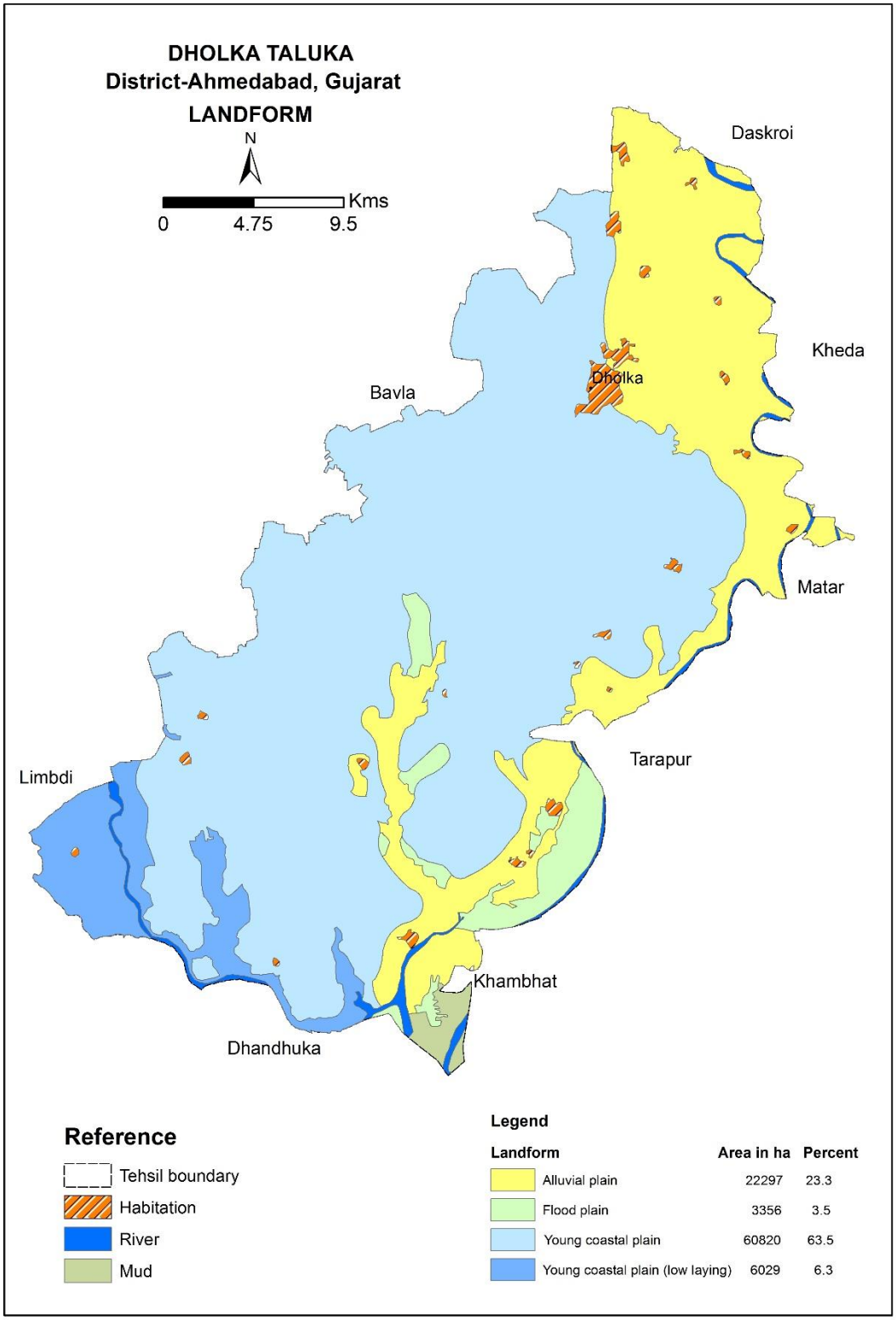

Fig. 5.2. Landform map of Dholka block

Table 5.2. Landforms of Dholka block

Landform	Area (ha)	TGA (%)
Alluvial plain	22297	23.3
Flood plain	3356	3.5
Younger coastal plain	60820	63.5
Young coastal plain (low lying)	6030	6.3
Mud	789	0.8
Built-up	1118	1.2
River/ Waterbodies/Canals	1356	1.4
Total area	**95766**	**100**

5.3. Slope:

A slope characteristic of an area is essential as it controls the erosion, surface runoff and available soil moisture. Hence, it affects soil formations which ultimately influence the land use of the area. Two classes of slope were identified (Table 5.3) and mapped (Fig. 5.3) in the block. Level to nearly level (0-1% slope) land has largest coverage of 82449 ha representing 86.1% TGA of the block followed by very gently sloping (1-3% slope) land covers 10055 ha (10.5%) TGA of the block.

Table 5.3: Extent and distribution of slope classes in Dholka block

Sl. No.	Slope class	Soil Map Unit	Area (ha)	% of TGA
1	Level to nearly level (0-1%)	2-6, 10, 11, 13-19	82449	86.1
2	Very gently sloping (1-3%)	1,7-9, 12	10055	10.5
3	**Total cultivated area**		**92504**	**96.6**
4	Miscellaneous		3263	3.4
5	**Total area**		**95766**	**100**

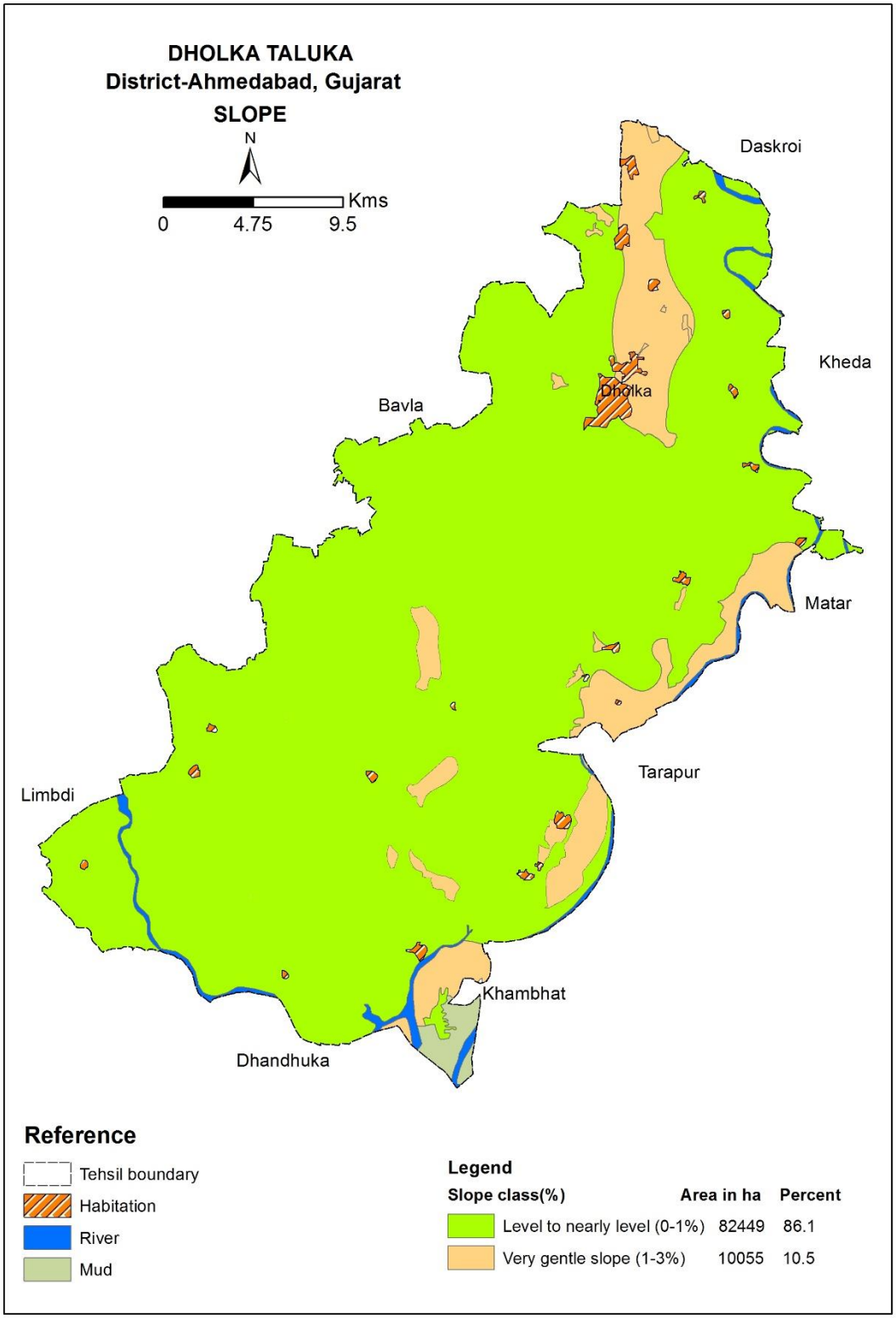

Fig. 5.3. Slope class map of Dholka block

5.4 Landscape Ecological Units (LEU):

The landform, slope and land-use/land-cover maps were integrated in ArcGIS and LEU map was prepared. Based on integration, 10 LEU were delineated in the study area (Fig. 5.4) and the characteristics of each LEU described (Table 5.4). On the alluvial plain, three LEU (GpAP1d, GpAP2d and GpAP2w) were identified based on two slope classes (0-1% and 1-3%) and three land-use/land-cover classes (single crop, double crop and wasteland). Five LEU (GpCP1d, GpCP1s, GpCP2s, GwCP1s and GwCP1w) were identified on the young coastal plain and low lying coastal plain with two slope classes (0-1% and 1-3%) and three land-use/land-cover classes (single crop, double crop and wasteland). Two LEU (GpFP1s, GpFP2s) were identified with one land-use/land-cover classes (single crop) and two slope class (0-1% and 1-3%). Among the 10 LEUs of study area, GpCP1d unit is dominant (53.2%) followed by GpAP1d (15.4%).

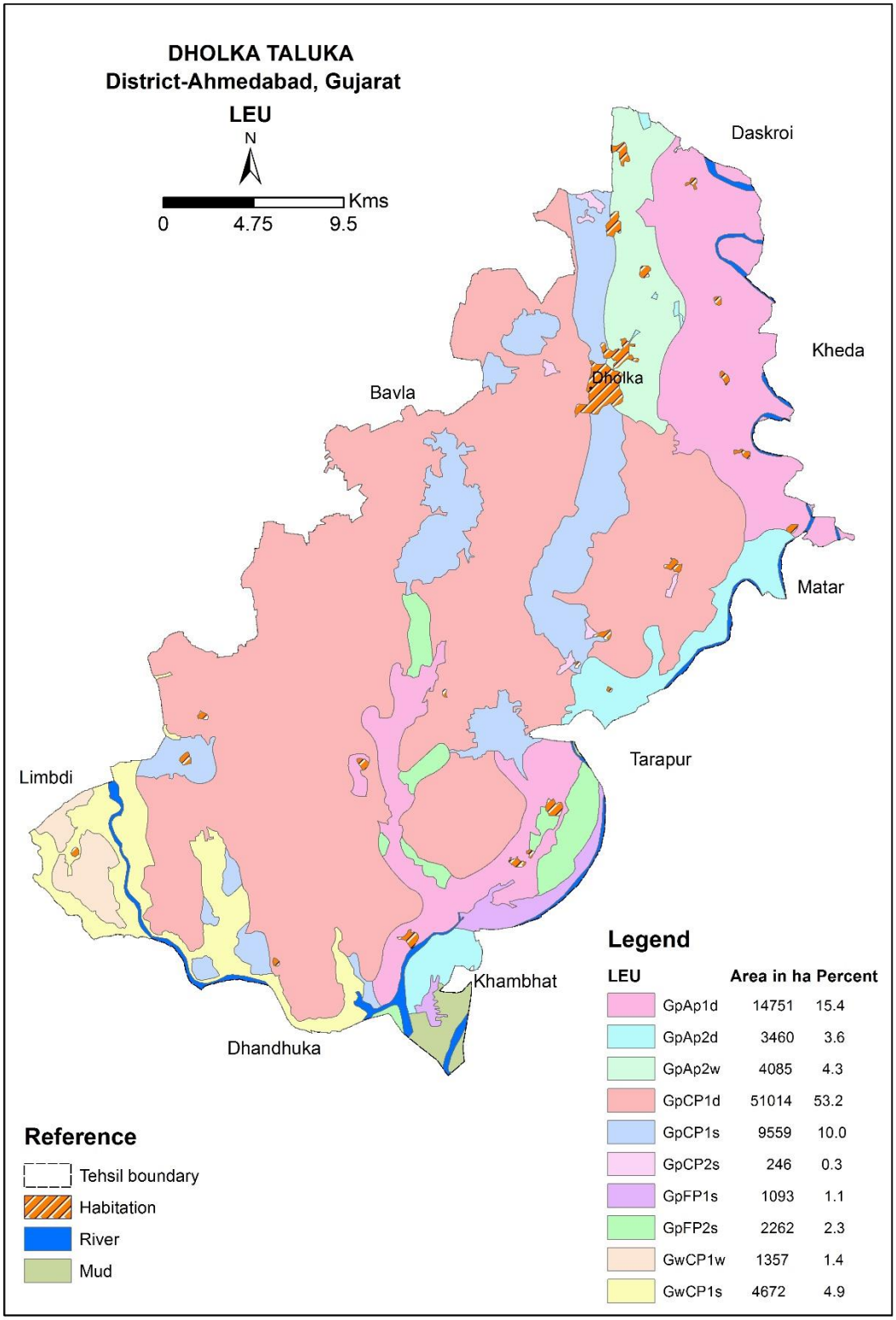

Fig. 5.4. Landscape ecological unit (LEU) map of Dholka block

Table 5.4. Landscape Ecological Units (LEU) of Dholka block

Sr. No.	Landscape Ecological Unit (LEU)	Area (ha)	TGA (%)
1	Very gently sloping alluvial plain under wasteland (GpAP2w)	4085.5	4.3
2	Very gently sloping alluvial plain under double crop (GpAP2d)	3460.6	3.6
3	Level to nearly level alluvial plain under double crop (GpAP1d)	14751.0	15.4
4	Level to nearly level young coastal plain under single crop (GpCP1s)	9559.3	10.0
5	Very gently sloping young coastal plain under single crop (GpCP2s)	246.3	0.3
6	Level to nearly level young coastal plain under double crop (GpCP1d)	51014.8	53.2
7	Level to nearly level flood plain under single crop (GpFP1s)	1093.9	1.1
8	Very gently sloping flood plain under single crop (GpFP2s)	2262.4	2.4
9	Level to nearly level low lying coastal plain under single crop (GwCP1s)	4672.4	4.9
10	Level to nearly level low lying coastal plain under wasteland (GwCP1w)	1357.1	1.4
11	Miscellaneous	3262.7	3.4
	Total area	**95766**	**100**

5.5 Physiography-Soil Relationships:

5.5.1 Soils of alluvial plain

The soils representing Amliyara, Badarkha, Dholi, Girand and Saroda series were developed on alluvial plain of the block. Amliyara soils are deep, imperfectly drained, dark grayish brown to dark brown on level to nearly level slope in alluvial plain with loamy surface texture and slight erosion. (*Fine loamy, mixed, hyperthermic, Fluventic Haplustepts*). Soils are non-saline affected with severe sodicity and occasional flooding. Badarkha soils are deep, imperfectly to moderately well to well drained, dark yellowish brown to dark brown on very gently sloping alluvial plain with loam to clay loam surface texture and moderate erosion (*Coarse loamy, mixed, hyperthermic, Typic Haplustepts*). Dholi soils are deep, moderately well drained, dark brown to very dark gray on level to nearly level slope in alluvial plain with clay loam surface texture and very slight erosion (*Fine, smectitic, hyperthermic, Sodic Haplusterts*). Soils are moderately saline affected with severe sodicity. Girand soils are deep, moderately well drained, dark grayish brown to very dark grayish brown on very gently sloping alluvial plain with silt loam surface texture and moderate erosion (*Fine, mixed, hyperthermic, Typic Haplustepts*). These soils suffer rarely with flooding. Saroda soils are deep, moderately well drained, brown to dark yellowish brown on Level to nearly level slope in alluvial plain with loamy surface texture and slight erosion (*Fine, mixed, hyperthermic, Typic Haplustepts*). Soils are mostly under cultivation of paddy in *Kharif* season and paddy, durum wheat, chickpea and caster in R*abi* season with the use of canal or underground irrigation water. Soils of the area have the major problems of high pH, sodicity and salinity. Rare to occasional (5 to 50 times in 100 years) chances of flooding is observed during the *Kharif* season. The soil mapping unit no. 2, 3, 4, 7, 8 and 9 cover 22,297 ha area (23.3% TGA).

5.5.2 Soils of flood plain

The soils representing Anandpura and Vataman series developed on flood plain of the block. Anandpura soils are deep, imperfectly drained, dark yellowish brown to dark brown soils on level to nearly level slope in flood plain with silt clay loam to sandy clay loam surface texture, moderate erosion and occasional to moderate flooding (*Fine silty over sandy, mixed, hyperthermic, Typic Ustifluents*). These soils are affected with slight to moderate salinity. Vataman soils are deep, imperfectly drained, dark brown to very dark grayish brown soils on very gently sloping flood

plain with loamy surface texture, moderate erosion and occasional flooding (*Course loamy, mixed, hyperthermic, Typic Ustifluents*). Soils are mostly under cultivation of paddy in *kharif* and durum wheat, chickpea in *rabi* season using canal or water primed from nearby Sabarmati river flow. Vegetables also cultivated in scattered fields. Soils of both the series have the major problems of imperfect drainage and occasional to moderate flooding. Soils of Anandpura series have moderate salinity problem. The soil mapping units 1, 5 and 6 cover 3,356 ha area (3.5% TGA).

5.5.3 Soils of young coastal plain

The soils representing Ganeshpur, Khanpur series developed on young upper coastal plain. Ganeshpur soils are deep, imperfectly drained, very dark grayish brown to very dark gray on level to nearly level slope in young coastal plain with silty clay to clay surface texture, slight erosion and rare to occasional flooding (*Fine, smectitic, hyperthermic, Sodic Haplusterts*). These soils are moderately saline and strongly sodic. Khanpur soils are deep, very poor to imperfectly drained, very dark grayish brown on level to nearly level slope in young coastal plain with clay loam to clayey surface texture, slight erosion and nil to occasional flooding (*Fine loamy, mixed, hyperthermic, Vertic Haplustepts*). These soils have slight salinity problem and slight to moderate sodicity problem. The soil mapping units 10 to 16 cover 60,820 ha area (63.5% TGA).

5.5.3 Soils of young coastal plain (low lying)

The soils representing Loliya1 and Loliya2 series developed on low lying young coastal plain. Loliya1 soils are deep to very deep, very poor to imperfectly drained, dark grayish brown to very dark grayish brown on very gently sloping low lying young coastal plain with silt loam surface texture, severe erosion and frequent flooding (*Coarse silty, mixed, hyperthermic, Sodic Haplocambids*). These soils have very strong salinity (EC 15-25 dsm^{-1}) problem and severe sodicity problem. Loliya2 soils are deep to very deep, moderately well drained, brown to very dark gray on very gently sloping low lying young coastal plain with silt clay loam surface texture, moderate erosion and occasional flooding (*Fine, mixed, hyperthermic, Sodic Endoaquents*). These soils have slight to moderate salinity problem and moderate sub soil sodicity problem. The soil mapping units 17 to 19 cover 6,030 ha area (6.3% TGA).

However, the study area is almost under flat topography (0-3% slope) but there is difference in micro-elevation. We have generated a soil-landform relationship diagram, which would represent the methodology of LRI in the AESR 4.2 especially in west coast of Gujarat (Fig. 5.4a).

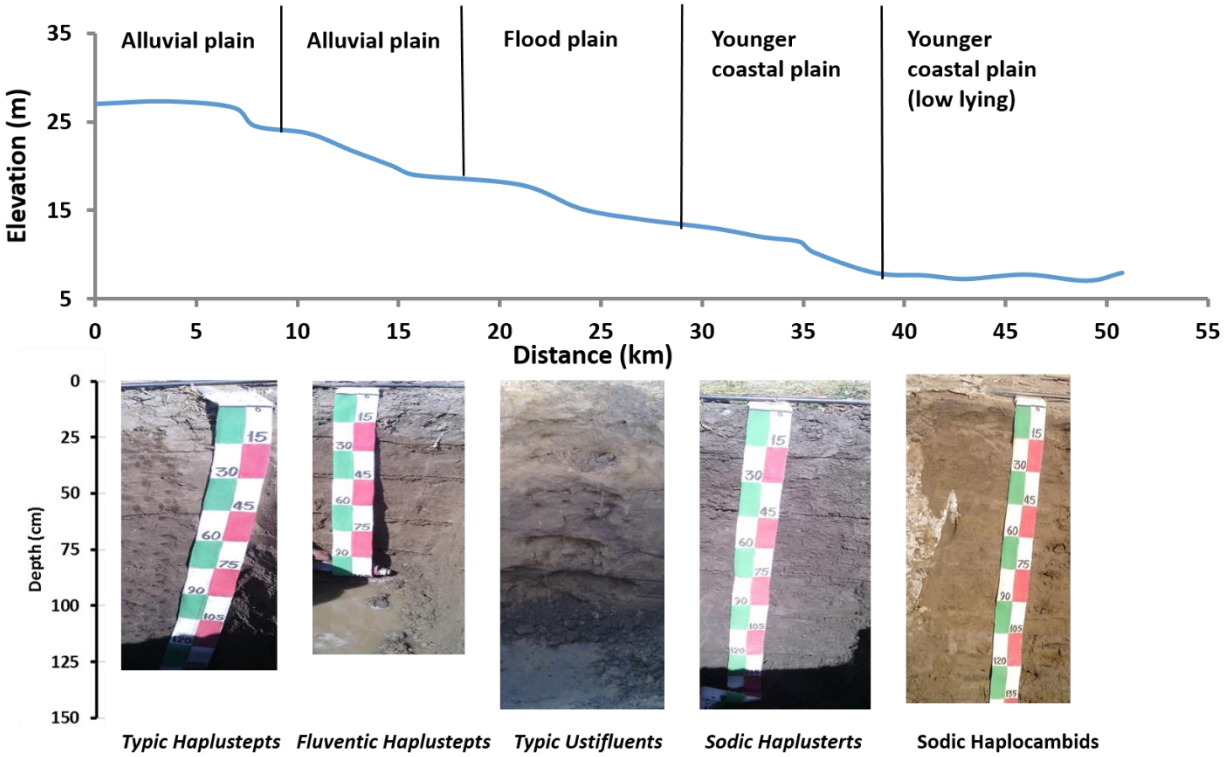

Fig. 5.4a. Soil –landform relationship diagram of Dholka block (AESR 4.2).

5.6 Soil series and mapping:

Eleven soil series have been identified (Fig. 5.5) and mapped on 1: 10,000 scale in 19 soil mapping units (phases of series) (Fig. 5.6). Codes of phases of series were developed using the variation in soil depth, surface texture, slope, erosion, salinity, sodicity and flooding (Table 5.3). The brief description of the soil series identified along with their taxonomic classification is given in the mapping legend (Table 5.4). The detailed descriptions of the morphology, physical and chemical properties of each series are given in the Appendix.

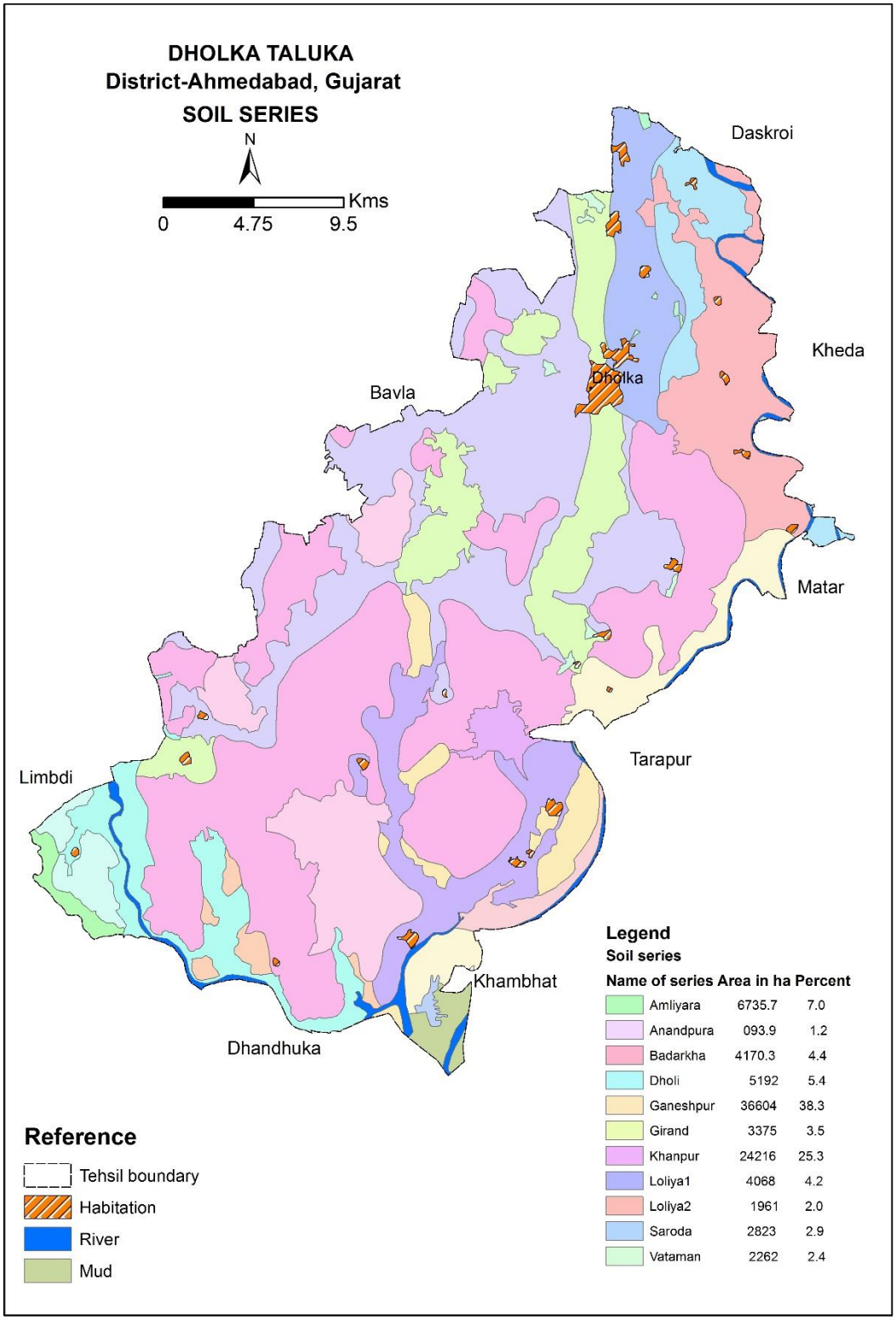

Fig. 5.5. Soil series map of Dholka block

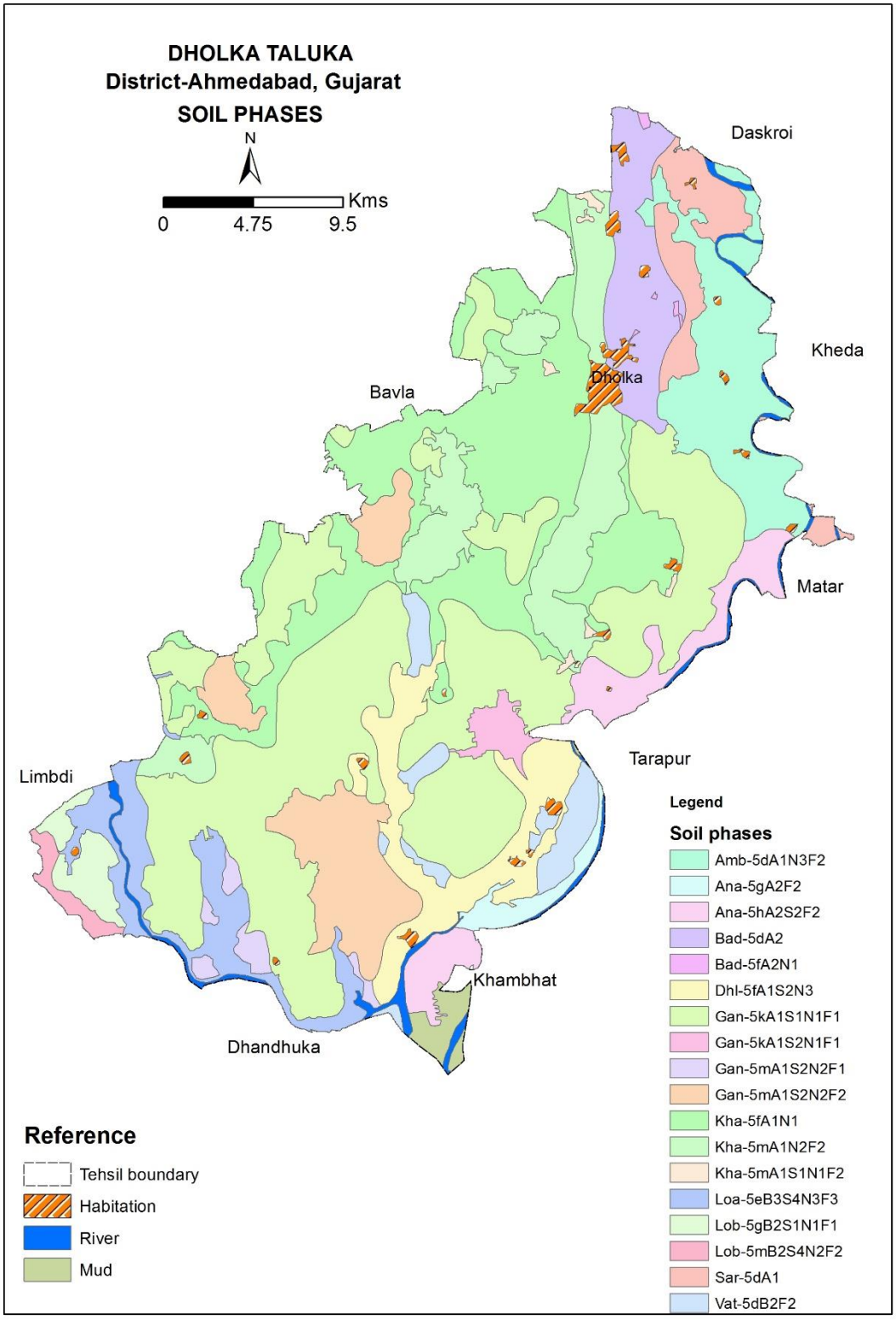

Fig. 5.6. Soil phase map of Dholka block

Table 5.3. Phases of soil series and their codes in Dholka block

Mapping unit no.	Phase code	Depth code	Surface texture code	Slope code	Erosion code	Salinity code	Sodicity code	Flooding code
1	Vat-5dB2F2	5	d-l	B	2	S0	N0	F2
2	Dhl-5fA1S2N3	5	f-cl	A	1	S2	N3	F0
3	Sar-5dA1	5	d-l	A	1	S0	N0	F0
4	Amb-5dA1N3F2	5	d-l	A	1	S0	N3	F2
5	Ana-5gA2F2	5	g-sicl	A	2	S0	N0	F2
6	Ana-5hA2S2F2	5	h-scl	A	2	S2	N0	F2
7	Gir-5eB2F1	5	e-sil	B	2	S0	N0	F1
8	Bad-5dA2	5	d-l	A	2	S0	N0	F0
9	Bad-5fA2N1	5	f-cl	A	2	S0	N1	F0
10	Kha-5fA1N1	5	f-cl	A	1	S0	N1	F0
11	Kha-5mA1N2F2	5	m-c	A	1	S0	N2	F2
12	Kha-5mA1S1N1F2	5	m-c	A	1	S1	N1	F2
13	Gan-5kA1S1N1F1	5	k-sic	A	1	S1	N1	F1
14	Gan-5mA1S2N2F2	5	m-c	A	1	S2	N2	F2
15	Gan-5kA1S2N1F1	5	k-sic	A	1	S2	N1	F1
16	Gan-5mA1S2N2F1	5	m-c	A	1	S2	N2	F1

17	Loa-5eB3S4N3F3	5	e-sil	B	3	S4	N3	F3
18	Lob-5gB2S1N1F1	5	g-sicl	B	2	S1	N1	F1
19	Lob-5mB2S4N2F2	5	m-c	B	2	S4	N2	F2

Table 5.4. Soil series and phases of Dholka block

Landform	**LEU map unit**	**Soil series**	**Soil map unit**	**Mapping legend**	**Brief description of soil series**	**Area (ha)**	**TGA (%)**
Alluvial plain	GpAp1d	Amliyara	4	Amb-5dA1N3F2	Deep, imperfectly drained, dark grayish brown to dark brown on level to nearly level slope in alluvial plain with loamy surface texture, slight erosion, severe sodicity and occasional flooding (*Fine loamy, mixed, hyperthermic, Fluventic Haplustepts*).	6735.8	7.0
Alluvial plain	GpAp2w	Badarkha	8	Bad-5dA2	Deep, imperfectly to moderately well to well drained, dark yellowish brown to dark brown on very gently sloping alluvial plain with loam surface texture and moderate erosion (*Coarse loamy, mixed, hyperthermic, Typic Haplustepts*).	4085.5	4.3
	GpAp2d		9	Bad-5fA2N1	Same as Badarkha series with clay loam surface texture and slight sodicity.	84.9	0.1

Alluvial plain	GpAp1d	Dholi	2	Dhl-5fA1S2N3	Deep, moderately well drained, dark brown to very dark gray on level to nearly level slope in alluvial plain with clay loam surface texture, slight erosion, moderate salinity and severe sodicity. (*Fine, smectitic, hyperthermic, Sodic Haplusterts*).	5192.1	5.4
Alluvial plain	GpAp2d	Girand	7	Gir-5eB2F1	Deep, moderately well drained, dark grayish brown to very dark grayish brown on very gently sloping alluvial plain with silt loam surface texture, moderate erosion and rare flooding (*Fine, mixed, hyperthermic, Typic Haplustepts*).	3375.8	3.5
Alluvial plain	GpAp1d	Saroda	3	Sar-5dA1	Deep, moderately well drained, brown to dark yellowish brown on Level to nearly level slope in alluvial plain with loamy surface texture and slight erosion (*Fine, mixed, hyperthermic, Typic Haplustepts*).	2823.1	2.9
Flood plain	GpFP1s	Anandpura	5	Ana-5gA2F2	Deep, imperfectly drained, dark yellowish brown to dark brown soils on level to nearly level slope in flood plain with silt clay loam to sandy clay loam surface texture, moderate erosion and occasional to moderate flooding (*Fine silty over sandy, mixed, hyperthermic, Typic Ustifluents*).	934.2	1.0

	GpFP1s		6	Ana-5hA2S2F2	Same as Anandpura series with sandy clay loam surface texture and moderate salinity.	159.7	0.2
Flood plain	GpFP2s	Vataman	1	Vat-5dB2F2	Deep, imperfectly drained, dark brown to very dark grayish brown soils on very gently sloping flood plain with loamy surface texture, moderate erosion and occasional flooding (*Course loamy, mixed, hyperthermic, Typic Ustifluents*).	2262.4	2.4
Young coastal plain	GpCP1d	Ganeshpur	13	Gan-5kA1S1N1F1	Deep, imperfectly drained, very dark grayish brown to very dark gray on level to nearly level slope in young coastal plain with silty clay surface texture, slight erosion and rare flooding (*Fine, smectitic, hyperthermic, Sodic Haplusterts*).	28932.2	30.2
	GpCP1d		14	Gan-5mA1S2N2F2	Same as Ganeshpur series with clayey surface texture, moderate salinity, strong sodicity and occasional flooding.	5985.9	6.3
	GpCP1s		15	Gan-5kA1S2N1F1	Same as Ganeshpur series with moderate salinity.	847.5	0.9
	GpCP1s		16	Gan-5mA1S2N2F1	Same as Ganeshpur series with clayey surface texture, moderate salinity, strong sodicity.	838.8	0.9

Young coastal plain	GpCP1d	Khanpur	10	Kha-5fA1N1	Deep, very poor to imperfectly drained, very dark grayish brown on level to nearly level slope in young coastal plain with clay loam surface texture, slight erosion and slight sodicity (*Fine loamy, mixed, hyperthermic, Vertic Haplustepts*).	16096.9	16.8
	GpCP1s		11	Kha-5mA1N2F2	Same as Khanpur series with clayey surface texture, strong sodicity and occasional flooding.	7873.1	8.2
	GpCP2s		12	Kha-5mA1S1N1F2	Same as Khanpur series with gentle slope, clayey surface texture, slight salinity, slight sodicity and occasional flooding.	246.3	0.3
Young coastal plain (low lying)	GwCP1s	Loliya1	17	Loa-5eB3S4N3F3	Deep to very deep, very poor to imperfectly drained, dark grayish brown to very dark grayish brown on very gently sloping low lying young coastal plain with silt loam surface texture, severe erosion, strong salinity, severe sodicity and frequent flooding (*Coarse silty, mixed, hyperthermic, Sodic Haplocambids*).	4068.5	4.2
Young coastal plain (low lying)	GwCP1w	Loliya2	18	Lob-5gB2S1N1F1	Deep to very deep, moderately well drained, brown to very dark gray on very gently sloping low lying young coastal plain with silt clay loam surface texture, moderate erosion, slight salinity,	1357.1	1.4

					slight sodicity and rare flooding (*Fine, mixed, hyperthermic, Sodic Endoaquents*).		
	GwCP1s		19	Lob-5mB2S4N2F2	Same as Loliya2 series with clayey surface texture, very strong salinity, strong sodicity and occasional flooding.	603.9	0.6
					Total cultivated area	**92503.7**	**96.6**
					Miscellaneous	3262.7	3.4
					Total area	**95766**	**100**

5.7 Soil survey interpretation:

Soil maps and thematic maps are the ultimate products of soil survey. They provide valuable information on various aspects like physiography/landform, geology, vegetation, soils, drainage, etc. and are useful to the planners, administrators and other user agencies. Land use/ agricultural planning of any particular area are largely based on soil resource interpretations (site-characteristics and soil properties).

Following the criteria outlined in the Land Resource Inventory on 1:10000 scale (Singh et al. 2016), various thematic maps such as surface texture, slope, drainage, soil reaction (pH), organic carbon (OC) etc. have been prepared. The site characteristics and the soil properties of the surface soils of each soil phases have been considered for the preparation of different thematic maps.

5.7.1 Soil reaction (pH)

Soil reaction (pH) is a measure of intensity of soil acidity or alkalinity. It acts as an indicator to assess the availability of different plant nutrients and also the percentage base saturation (Black 1968). The pH value also helps to determine the amount of various amendments to be added to the soils for reclamation of acidity or alkalinity. Soils of the block have been grouped into 2 soil reaction classes (Table 5.5 and Fig. 5.7). It is observed that 46537 (48.6%) area is strongly alkaline (pH 8.5-9.0) and 45967 ha (48.0%) area is very strongly alkaline (pH>9.0) in reaction. The higher pH of soils is due to the low lying situation (elevation 3 to 26m msl), flooding of sea waters and subsequent accumulation of sodium ions on exchange sites. The soils are developed on alluvium of Sabarmati river enriched with soluble salts on continuous irrigation with canal or underground waters.

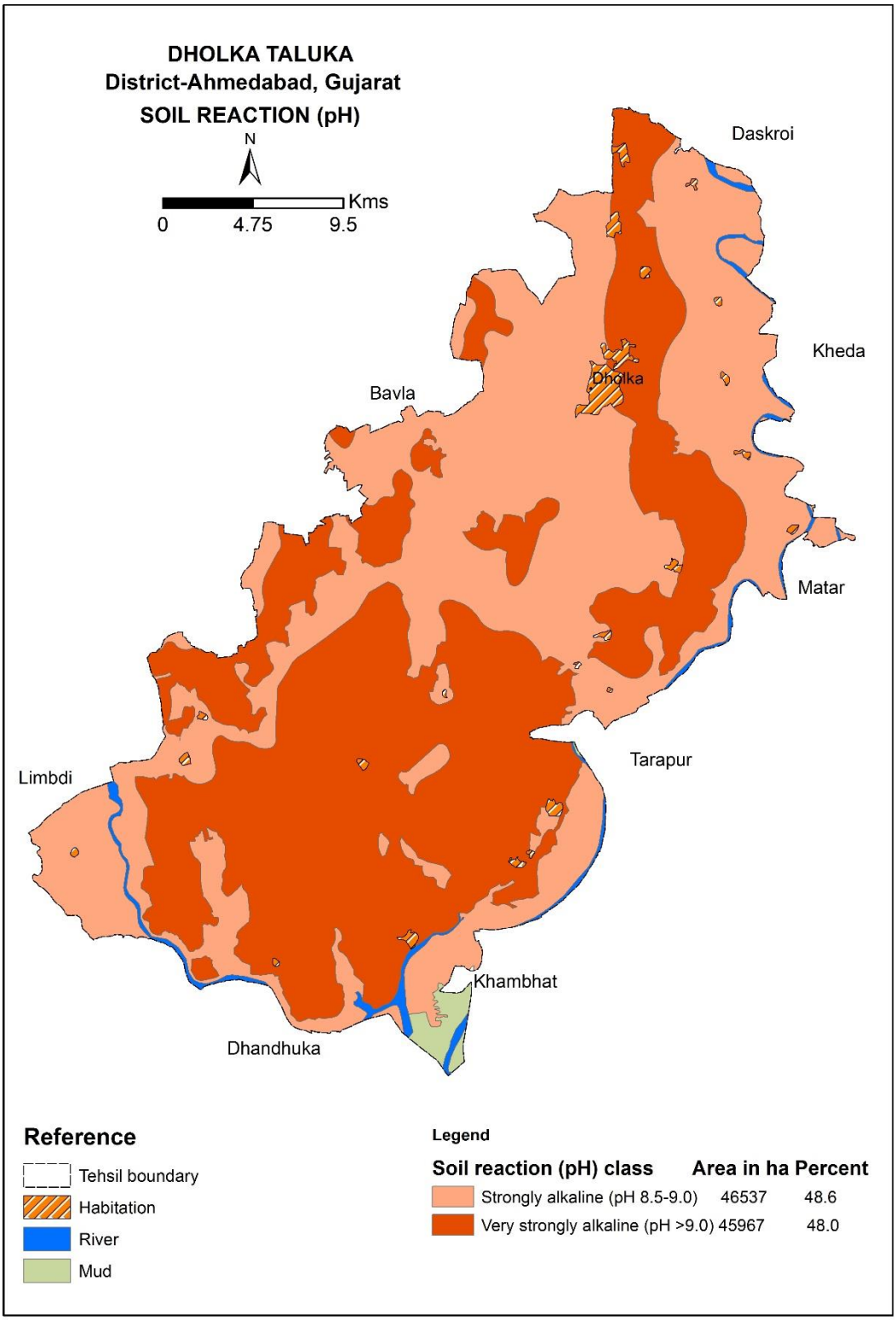

Fig. 5.7. Soil reaction (pH) map of Dholka block

Table 5.5. Area under soil reaction (pH) classes

Soil reaction (pH) classes	Area (ha)	TGA (%)
Strongly alkaline (8.5-9.0)	46537	48.6
Very strongly alkaline (>9.0)	45967	48.0
Total cultivated area	**92504**	**96.6**
Miscellaneous	3263	3.4
Total area	**95766**	**100**

5.7.2 Organic carbon (OC)

Organic matter serves as a reservoir of soil nutrients that are essential for plant growth and is therefore, considered as the vital and essential soil attribute controlling productivity. Soils of the block have been grouped into two organic carbon classes. Organic carbon status in soils of Dholka block is low to medium. Data in table 5.6 and figure 5.8 indicate that the soils with high (>0.75%) level of organic carbon occupy 12.5% TGA, soils with medium (0.5-0.75%) level of organic carbon occupy 74.4% TGA and 9.7% TGA is low (< 0.5%) in organic carbon content. The area in vicinity of Sabarmati river, which receives appropriate moisture for plant growth and development and organic carbon content is relatively better. Continuous paddy-wheat cropping and burning of paddy or wheat straw after harvesting decreased the organic carbon in soils.

Table 5.6. Area under soil organic carbon classes

Soil organic carbon classes	Area (ha)	TGA (%)
Low (< 0.5%)	9261	9.7
Medium (0.5-0.75%)	71243	74.4
High (>0.75%)	12000	12.5
Total cultivated area	**92504**	**96.6**
Miscellaneous	3263	3.4
Total area	**95766**	**100**

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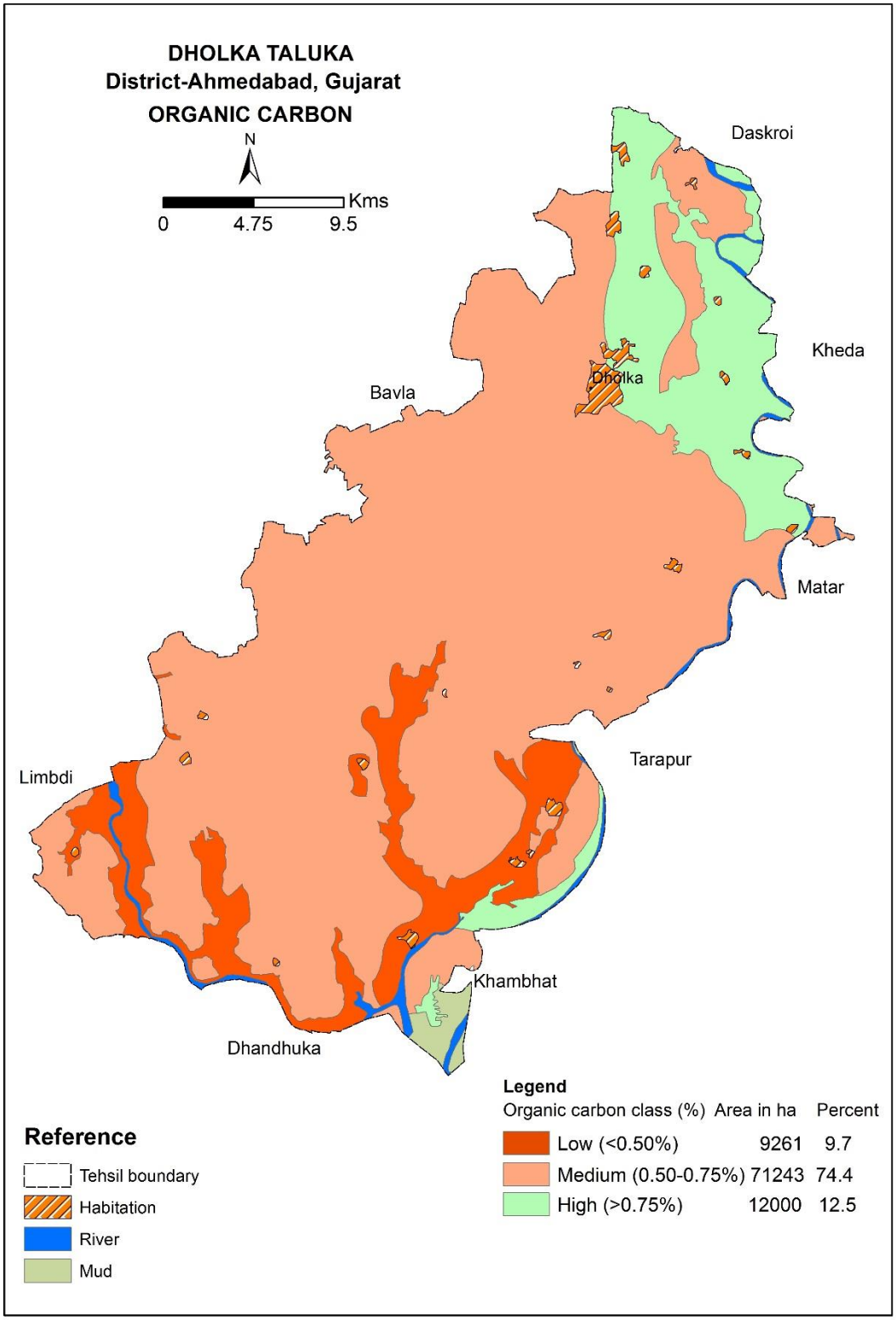

Fig. 5.8. Soil organic carbon map of Dholka block

5.7.3. Erosion:

Soil erosion is detachment of soil particles, their transportation from one place to another and deposition elsewhere through water, wind, coastal waves, snow, gravity and other forces. It is influenced by slope, rainfall, soil type, vegetative cover and any interference or disturbance which aids in the removal of soil particles from the soil surface. Soil erosion reduces soil thickness by washing off the top soil. The available water and nutrients storage are also affected by erosion.

Dholka block is situated on the banks of the Sabarmati river, in west coast of Gujarat. The dominant factors leading to soil erosion in the study area are topography and intensity of rainfall. The study of erosion assessment showed that the soils of block are suffering from three categories of erosion. The data of erosion classes and their extent of occurrence is presented in table 5.7.3 and shown in figure 5.9. The study showed that the water is major factor of erosion in soils of Dholka block. Slight erosion (e1) is the dominant erosion class which covers 81.3% area of the block followed by moderate erosion (e2) which occupies 11.1% area of the block. About 4.2 % TGA of Dholka is affected by severe erosion (e3). The soils of low-lying young coastal plain are affected by severe erosion because these soils are situated near the coast.

Table 5.7.3: Extent and distribution of erosion classes in Dholka block

Sl. No.	**Erosion class**	**Soil Map Unit**	**Area (ha)**	**% of TGA**
1	Slight (E1)	1-4, 10-16	77834	81.3
2	Moderate (E2)	5-9, 18, 19	10601	11.1
3	Severe (E3)	17	4069	4.2
4	**Total cultivated area**		**92504**	**96.6**
5	Miscellaneous		3263	3.4
6	**Total area**		**95766**	**100**

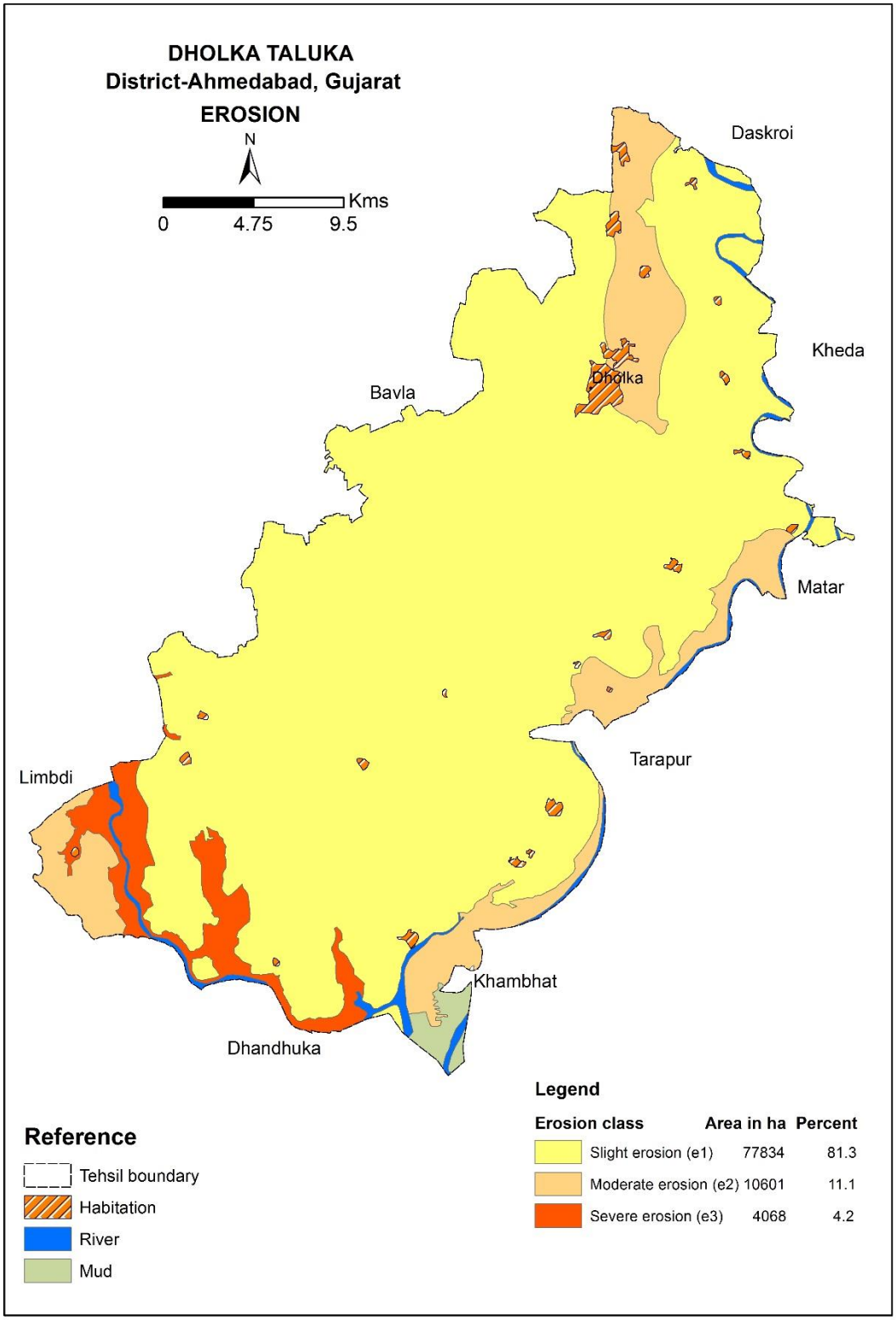

Fig. 5.9. Soil erosion map of Dholka block

5.7.4 Surface soil texture:

The relative size range of the particles is expressed by the term soil texture, which refers to the fineness or coarseness of the soil. Soil texture is defined as the relative proportion of different particles size fractions, specifically referred to as sand, silt and clay. It can be determined by feel to close approximation in the field and quantitatively in the laboratory through mechanical analysis of the soil. The soil texture is typically permanent and is intrinsic attribute of the soil that affects structure, porosity, adhesion, consistency and other related characteristics of soil.

Soil texture determines the rate at which water drains through a saturated soil; water moves more freely through sandy soils than it does through clayey soils. Once field capacity is reached, soil texture also influences how much water is available to the plant; clay soils have a greater water holding capacity than sandy soils. In addition, well drained soils typically have good soil aeration which indicated that the soil contains air very similar to the composition of atmospheric air, which is conducive to healthy root growth. Soils also differ in their susceptibility to erosion (erodibility) based on texture; a soil with a high percentage of silt and clay particles has a greater erodibility than a sandy soil under the same conditions. Differences in soil texture also impacts organic matter levels; organic matter breaks down faster in sandy soils than in fine-textured soils, given similar environmental conditions, tillage and fertility management, because of a higher amount of oxygen available for decomposition in the light-textured sandy soils. The cation exchange capacity of the soil increases with clay and organic matter content and buffering capacity of a soil (its ability to resist pH change upon lime addition), is also largely based on clay and organic matter content.

The soils of the Dholka block have been grouped into seven textural classes and tabulated in table 5.7.4 and spatial distribution of these classes is depicted in figure 5.10. The texture of the soils of the block ranges from clayey to loam. Majority of the soils occurring on alluvial plain are coarser in texture whereas the soils occurring in the coastal and flood plain are finer in texture. The data presented in the table shows that the dominant soils are silty clay (31.1%), followed by clay loam (22.3%), loam (16.6%) and clay (16.2%) of the TGA of Dholka.

Table 5.7.4: Extent and distribution of surface soil textural classes

Sl. No.	Soil textural class	Soil Map Unit	Area (ha)	% of TGA
1	Clay	11, 12, 14, 16, 19	15548	16.2
2	Clay loam	2, 9, 10	21374	22.3
3	Loam	1, 3, 4, 8	15907	16.6
4	Sandy clay loam	6, 7	3535	3.7
5	Silt loam	17	4069	4.3
6	Silty clay	13, 15	29780	31.1
7	Silty clay loam	5, 18	2291	2.4
8	**Total cultivated area**		**92504**	**96.6**
9	Miscellaneous		3263	3.4
10	**Total area**		**95766**	**100**

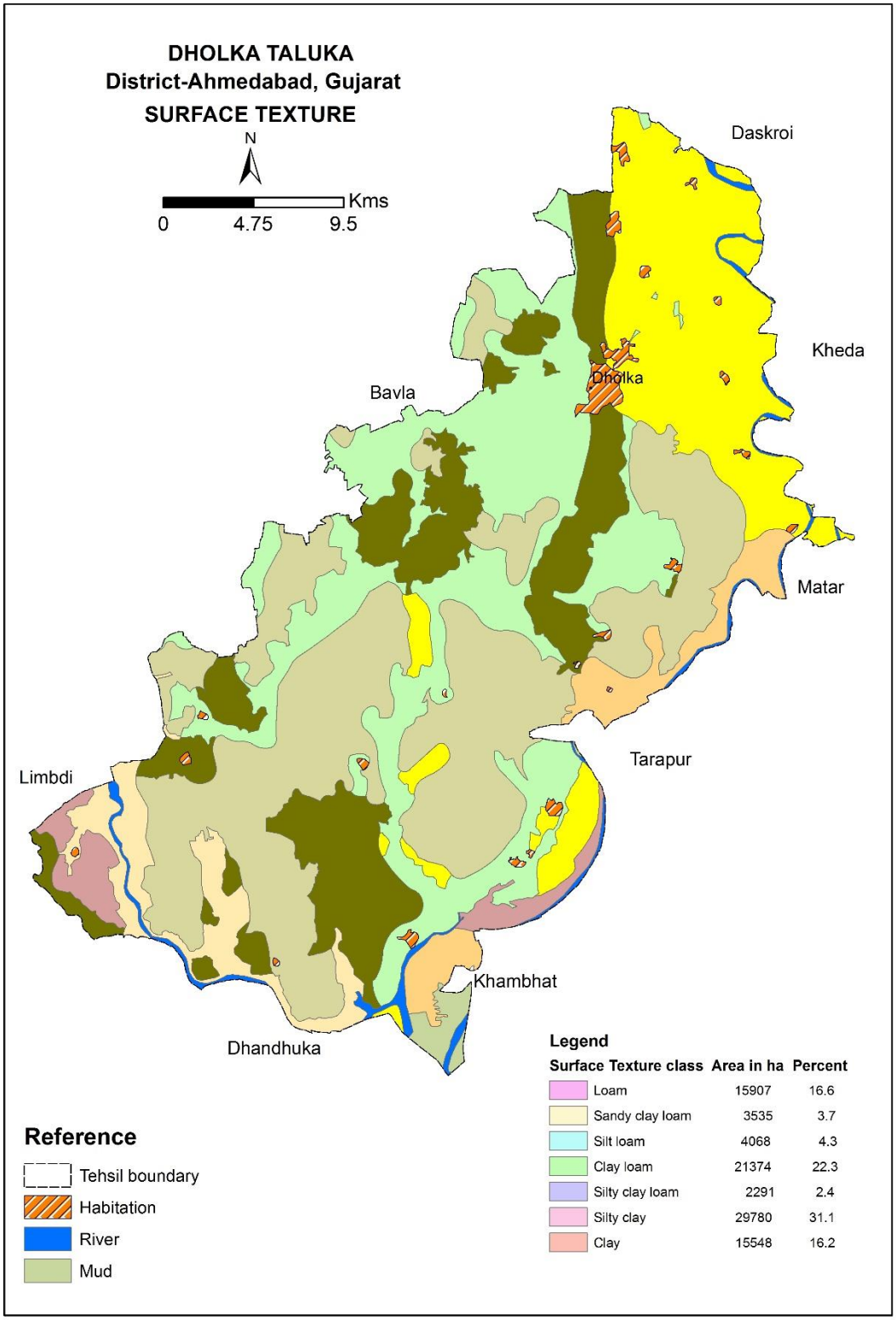

Fig. 5.10. Soil surface texture map of Dholka block

5.7.5. Soil drainage:

Soil drainage has direct influence on soil aeration thereby affecting plant growth. Soil drainage is the rate of removal of excess water (irrigation/rainfall) from the soil both by flow through the soil (sub-surface drainage) to underground storage and by runoff (surface drainage). It is an important parameter affecting crop productivity and soil management. It is influenced by soil properties like texture, structure, porosity and hydraulic conductivity. Generally, the soils developed on leveled to gentle slope exhibit poor drainage and soils developed on higher slopes are well drained to excessively drained. The high clay content and dominance of smectitic mineralogy imparts poor drainage condition to majority of black soils. Internal drainage is very poor in sodic clayey soils. Most of the arable crops except paddy prefer well drained soils and if there is any change in the drainage, productivity will affect drastically. Poor drainage causes the waterlogging in crop land. Under such environment the crop plants suffer with oxygen deprivation or anoxia as excess water itself does not react chemically with the plant. Plants need oxygen for cell division, growth and the uptake and transport of nutrients.

In the field, drainage classes identified based on soil morphology and terrain feature. Drainage is a limiting factor in the several mapping units of the block. The distribution of drainage classes is presented in table 5.7.5 and depicted in figure 5.11. The data reveals that soils with three drainage classes occur in the block, *viz.,* very poorly drained and imperfectly drained and moderately well drained. Majority of soils are imperfectly drained (69.9%) followed by moderately well drained (18.5%) and very poorly drained (8.2%).

Table 5.7.5: Extent and distribution of drainage classes in Dholka block

Sl. No.	**Soil drainage class**	**Soil Map Unit**	**Area (ha)**	**% of TGA**
1	Very poor	11	7873	8.2
2	Imperfect	1,4-6,9-10,12-14, 16,17, 19	66949	69.9
3	Moderately Well	2,3,7,8,15,18	17681	18.5
4	**Total cultivated area**		**92504**	**96.6**
5	Miscellaneous		3263	3.4
6	**Total area**		**95766**	**100**

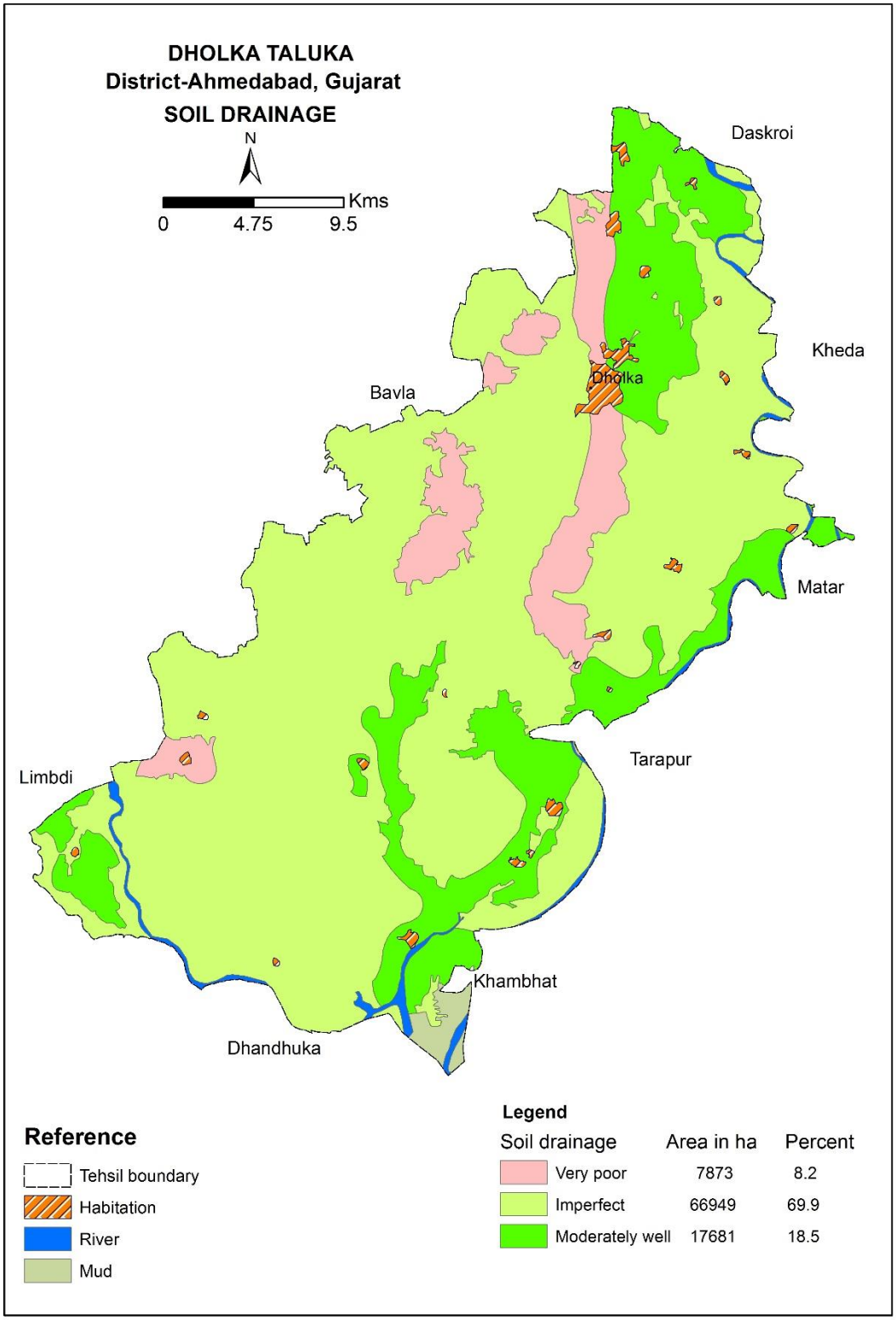

Fig. 5.11. Soil drainage map of Dholka block

5.7.6. Soil salinity hazards:

The electrical conductivity (EC) of a saturation paste extract is the standard method for measuring salinity and is denoted as ECe. Pocket electrical conductivity meters can be used in the field for measuring electrical conductivity of soil:water solutions of various ratios (e.g., 1:1, 1:2, 1:5, etc.). The EC values recorded reflect the salt concentration of the mixture. Lower readings are associated with higher amounts of water relative to soil. Electrical conductivity for soil of Dholka block was measured using the 1:2 soil:water ratio. There is no universal correction factor to equate these results to the standard saturation paste extract method performed in the laboratory. The soils were classified in four salinity classes on the basis of its degree of hazards. Data related to salinity classes are presented in table 5.6 and depicted in figure 5.12. Very slight salinity (EC 0-2 dS/m) was recorded in 42.7% area, slight salinity (EC 2-4 dS/m) in 31.9% area, moderate salinity (EC 4-8 dS/m) in 17.1% area and very strong salinity (EC 15-25 dS/m) in 4.9% area. The soils occurring on very near to coast are relatively more saline.

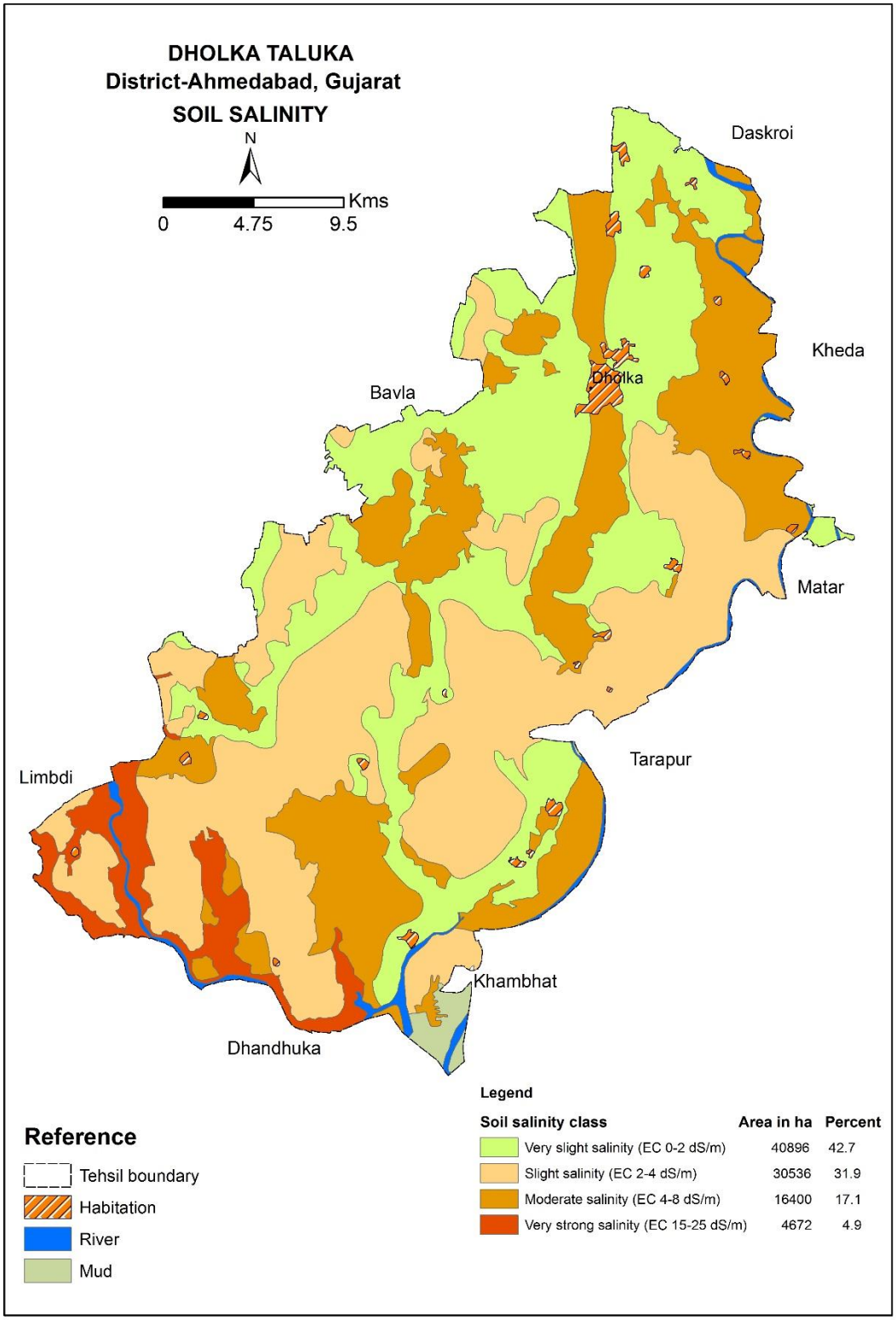

Fig. 5.12. Soil salinity hazard map of Dholka block

Table 5.7.6: Extent and distribution of salinity classes in Dholka block

Sl. No.	Soil salinity class	Soil Map Unit	Area (ha)	% of TGA
1	Very slight salinity (EC 0-2 dS/m)	1,3,4,5, 8-11	40896	42.7
2	Slight salinity (EC 2-4 dS/m)	12,13,18	30536	31.9
3	Moderate salinity (EC 4-8 dS/m)	2,6,7,14-16	16400	17.1
4	Very strong salinity (EC 15-25 dS/m)	17,19	4672	4.9
5	**Total cultivated area**		**92504**	**96.6**
6	Miscellaneous		3263	3.4
7	**Total area**		**95766**	**100**

5.7.7. Soil sodicity hazards:

The major characteristic of sodic soils from the agricultural point of view is that they contain sufficient exchangeable sodium to adversely affect the growth of most crop plants. For the purpose of definition, sodic soils are those which have an exchangeable sodium percentage (ESP) of more than 15. Excess exchangeable sodium has an adverse effect on the physical and nutritional properties of the soil, with consequent reduction in crop growth, significantly or entirely. The soils lack appreciable quantities of neutral soluble salts but contain measurable to appreciable quantities of salts capable of alkaline hydrolysis, e.g. sodium carbonate. The electrical conductivity of saturation soil extracts is, therefore, likely to be variable but are often less than 4 dS/m at 25 °C. The pH of saturated soil pastes is 8.2 or more and in extreme cases may be above 10.5. Dispersed and dissolved organic matter present in the soil solution of highly sodic soils may be deposited on the soil surface by evaporation causing a dark surface which is why these soils have also been termed as black sodic soils.

The test for exchangeable sodium percentage, however, has proved unreliable in soils containing soluble sodium silicate minerals or large amounts of sodium chloride. Sodium is toxic to some crops and affects soil physical properties, mainly saturated hydraulic conductivity. A sodic condition has little effect on hydraulic conductivity in highly saline soils. A soil that is both saline and sodic may, when artificially drained, drain freely at first. After some of the salt has been removed, however, further leaching of salt becomes difficult or impossible. The sodium adsorption

ratio (SAR) typically decreases as a soil is leached because the amount of change depends in part on the composition of the water used for leaching.

Majority of area (49.7%) of Dholka block has moderate level of sodicity (ESP 15-25), 16.7% of TGA is affected with severe sodicity (ESP>40) and 16.0% area is affected with strong sodicity (ESP 25-40). Area and distribution of sodicity hazards is presented in table 5.6 and depicted in figure 5.13. Sodicity has a marked influence on the physical soil properties, lowers the availability of some essential plant nutrients at higher pH, plant injury due to accumulation of elements at toxic levels (Na, B, Mo *etc.*)

Table 5.6: Extent and distribution of sodicity hazards

Sl. No.	**Soil sodicity class**	**Soil Map Unit**	**Area (ha)**	**% of TGA**
1	n0-Slight to negligible sodicity (ESP <15)	1,3,5-8	13641	14.2
2	n1-moderate sodicity (ESP 15-25)	9,10,12,13,15,18	47565	49.7
3	n2-Strong sodicity (ESP 25-40)	11,14,16,19	15302	16.0
4	n3-Severe sodicity (ESP>40)	2,4,17	15996	16.7
5	**Total cultivated area**		**92504**	**96.6**
6	Miscellaneous		3263	3.4
7	**Total area**		**95766**	**100**

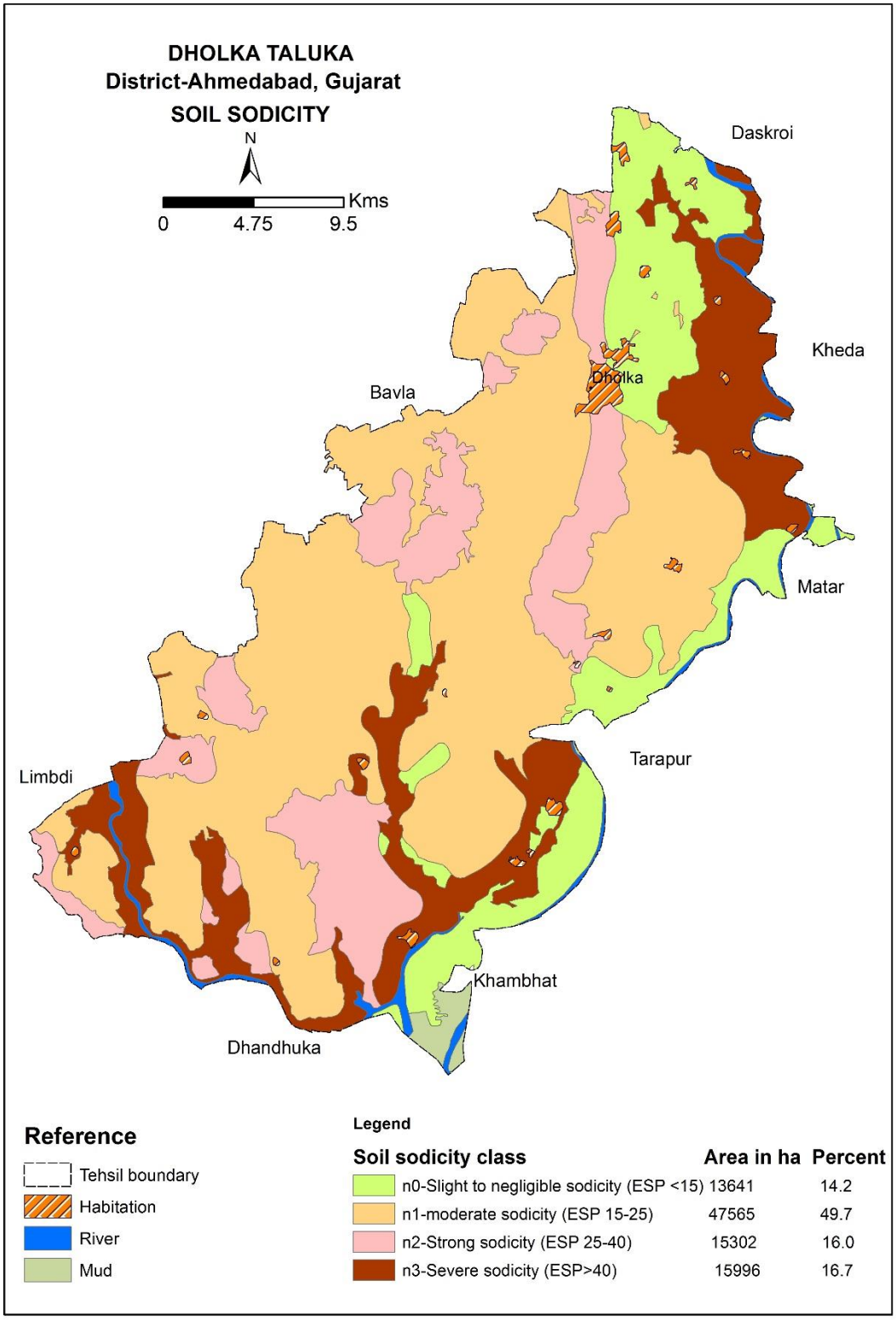

Fig. 5.13. Soil sodicity hazard map of Dholka block

5.7.8. Soil flooding hazards:

Inundation is the condition when the soil area is covered by liquid free water. Flooding is temporary inundation by flowing water. If the water is standing, as in a closed depression, the term ponding is used. Flooding and ponding are temporal conditions. In most cases, soils are not described while inundated (exceptions include subaqueous soils and some soils that are subject to ponding of very long duration). To the extent possible, estimates for inundation should include frequency, duration, and months of occurrence. Depth of inundation is also commonly recorded. Soil survey manual proposed the classes for frequency and duration of flooding. The rare and very rare frequency classes may be combined. The very frequent class takes precedence over frequent if both definitions are met. Very frequent flooding includes tidal inundation. Frequency of flooding should reflect the current conditions. A soil that would be frequently flooded in its natural state, but is now protected by a dam or levee, should be assigned the class that reflects the level of protection provided.

According to frequency of flooding the soils of Dholka block has been categorized in four classes (Table 6.6) and depicted in map figure 5.14. There is no problem of flooding in 29.5% area of block, rare chances of flooding (1 to 5 times in 100 years) in 33.4% of TGA, Occasional flooding (5 to 50 times in 100 years) in 29.4% area and frequent flooding (once in two years) may occur in mapping unit no. 17 (4.2% TGA). Standing of free water in fields may damage the crops depending on tolerance and susceptible level of crops. Therefore, crop planning should be done as per the suitability of crops.

Table 6.6: Extent and distribution of flooding frequency classes

Sl. No.	**Soil flooding frequency class**	**Soil Map Unit**	**Area (ha)**	**% of TGA**
1	No flooding (f0)	2,3,8,9,10	28282	29.5
2	Rare flooding (f1)	13,15,16,18	31976	33.4
3	Occasional flooding (f2)	1,4-7,11,12,14,19	28177	29.4
4	Frequent flooding (f3)	17	4069	4.2
5	**Total cultivated area**		**92504**	**96.6**
6	Miscellaneous		3263	3.4
7	**Total area**		**95766**	**100**

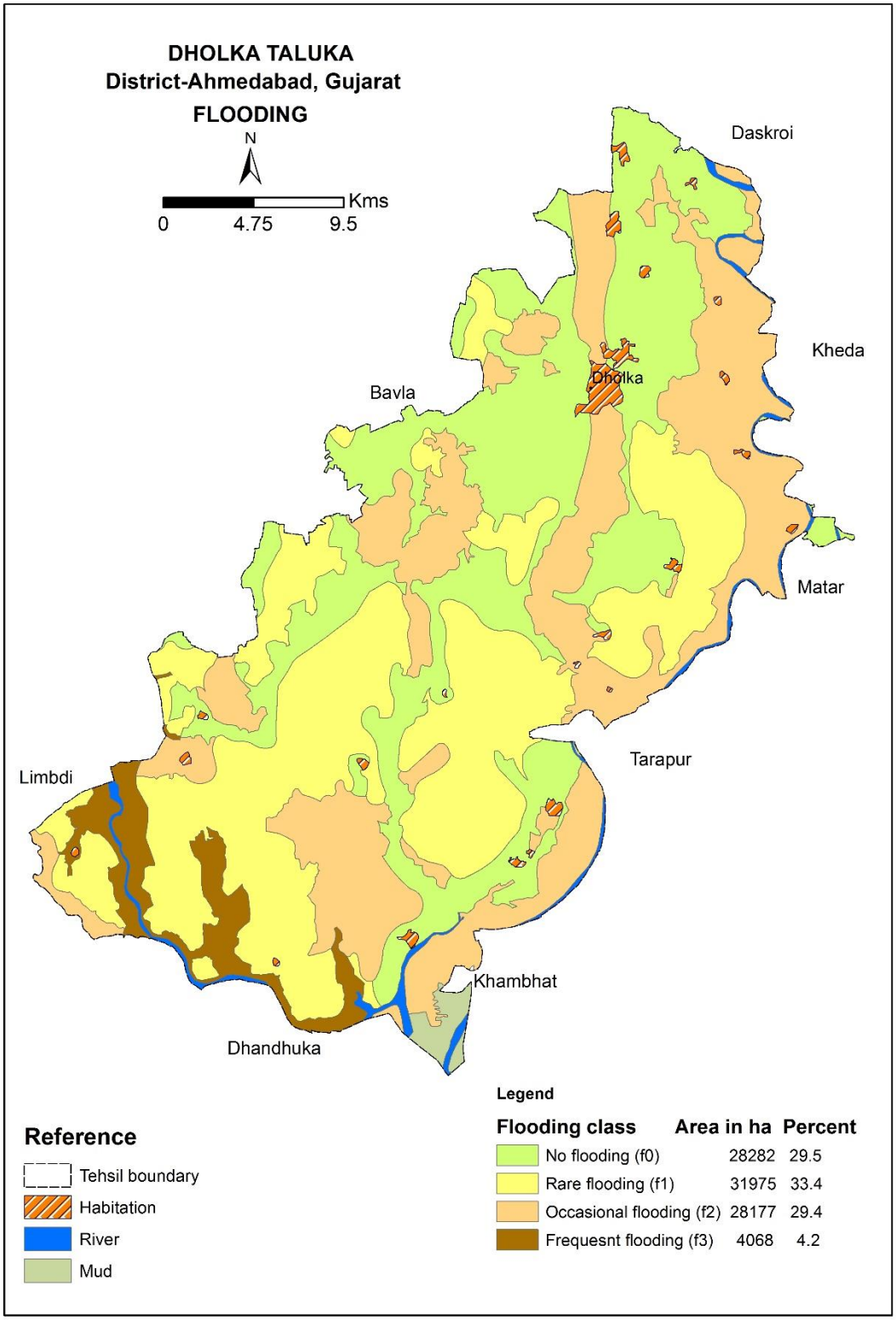

Fig. 5.14. Soil flooding hazard map of Dholka block

5.7.9. Available water capacity (AWC):

The amount of water in soil is based on total amount of rainfall and its distribution, what proportion of rain infiltrates into the soil, and its water storage capacity. Available water capacity is the maximum amount of plant available water hold in a soil. It is an indicator of a soil's ability to retain water and make it sufficiently available for plant use. Available water capacity is the water held in soil between its field capacity (33kPa) and permanent wilting point (1500kPa). Field capacity is the water remaining in a soil after it has been thoroughly saturated and allowed to drain freely, usually for one to two days. Permanent wilting point is the moisture content of a soil at which plants wilt and fail to recover when supplied with sufficient moisture. Water capacity is usually expressed as a volume fraction or percentage, or as a depth (in or cm).

Soil is a major storage reservoir for water. Water availability is an important indicator because plant growth and soil biological activity depend on water for hydration and delivery of nutrients in solution. Runoff and leaching volumes are also determined by storage capacity and pore size distribution. In areas where rain falls daily and supplies the soil with surplus water, available water capacity may have little importance. However, in areas where plants remove water higher than the total precipitation, the amount of water held by the soil may be critical for plant survival. Water held in the soil play a crucial role to sustain plants during the dry period. Available water capacity is used to develop water budgets, predict droughtiness, design and operate irrigation systems, design drainage systems, protect water resources, and predict yields. It varies with the distribution of rainfall, infiltration/permeability of soils, amount of clay, type of minerals, soil depth, volume, texture and amount of organic matter present in soil. The information pertaining to AWC have immense value in determining the length of growing period, which is essential parameter for crop planning particularly in the rainfed condition.

The soils of the block are categorized into three AWC classes (Fig.5.15) and the data is presented table 5.7.6. Soils of the Dholka block are deep with sufficient amount of clay and silt fractions which retain appropriate moisture for plant growth and development. Soils are categorized in three groups on the basis of volumetric available water content. Majority of soils are medium (64.7% of TGA) in AWC, 20.3% area is high and 11.6% area is very high in AWC. Soils of the block has good support for plants in relation water availability.

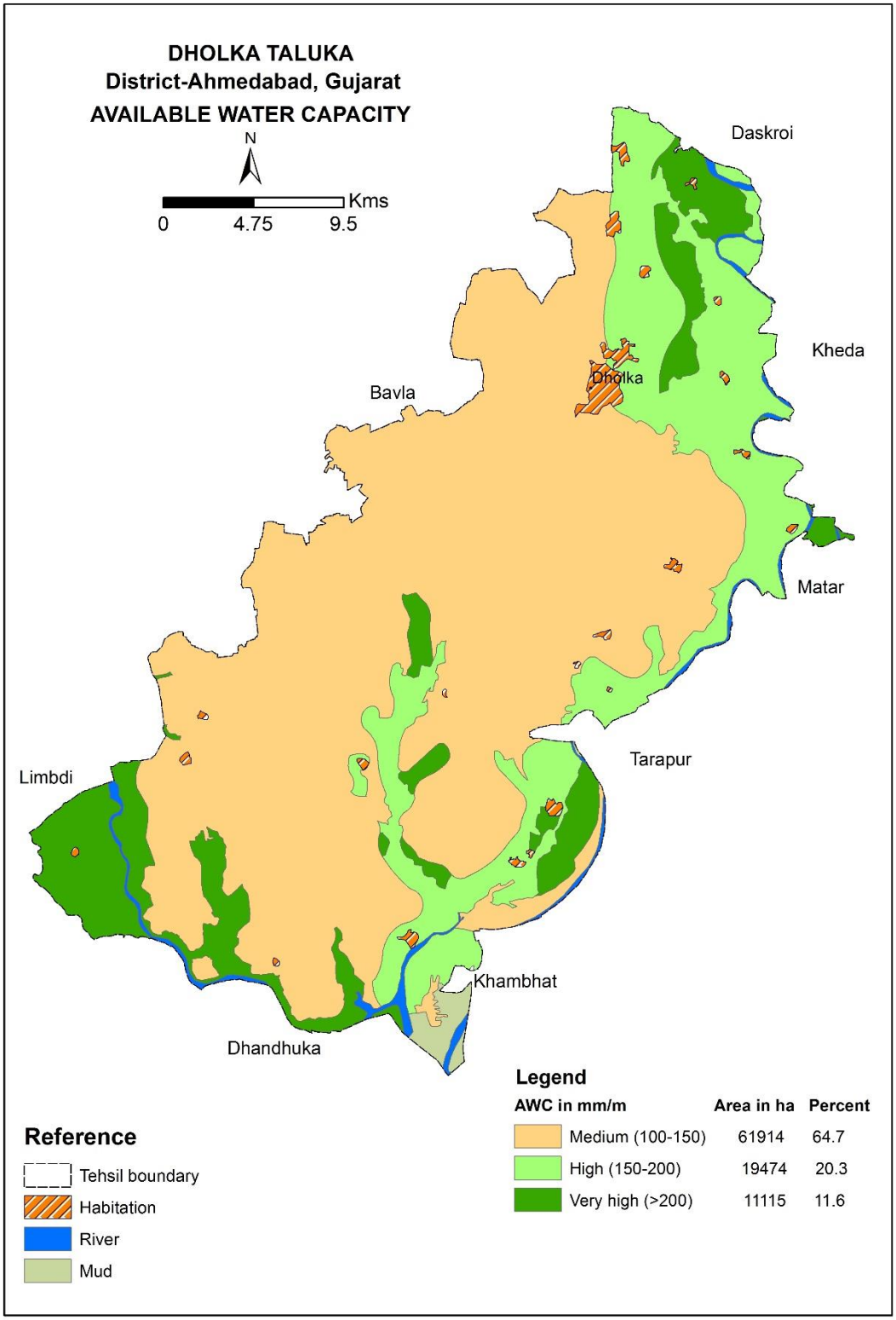

Fig. 5.15. Soil available water capacity (AWC) map of Dholka block

Table 6.6: Extent and distribution of available water capacity classes

Sl. No.	Available water capacity class (mm/m)	Soil Map Unit	Area (ha)	% of TGA
1	Medium (100-150)	5,6, 10-16	61914	64.7
2	High (150-200)	2,4,7-9	19474	20.3
3	Very high (>200)	1,3,17-19	11115	11.6
4	**Total cultivated area**		**92504**	**96.6**
5	Miscellaneous		3263	3.4
6	**Total area**		**95766**	**100**

5.7.10. Soil classification

The soils of Dholka block are classified into four orders *viz.* Entisols, Aridisols, Inceptisols and Vertisols. Entisols occupy about 5.6 per cent area of the block, while Inceptisols characterized by the formation of structural/Cambic –B- horizon occupy 43.1 per cent of the total geographical area (TGA) of the block. Vertisols characterized by presence of pressure faces/ Slickenside and do not have a lithic or paralithic contact within 50 cm depth spread about 43.6 per cent TGA of block. Aridisols covers an area of 4.2 per cent on low lying young coastal plain. Of the four soil orders Entisols occurs on flood plain and low lying young coastal plain, Inceptisols occurs on alluvial plain and young coastal plain, Vertisols mainly occurs on young coastal plain and partly on alluvial plain. The five suborders distributed in the block are Aquents (2.0%), Cambids (4.2%), Fluvents (3.5%), Ustept (43.1%) and Usterts (43.6%) in the total geographical area. Similarly, the area under the Endoaquents great group is 2.0 per cent, Haplocambids covers 4.2, Haplustepts covers 43.1, Haplusterts covers 43.6 and Ustifluvents covers 3.5 per cent of TGA. Again the soils of the 11 series are classified into four sub-group *viz.* Fluventic, Sodic, Typic and Vertic. Distribution of soils as per its taxonomy is presented in figure 5.16.

A surface mantle of new soil material 50 cm or more thick that is not derived from alluvial deposition and have an organic-carbon content (Holocene age) of 0.2 per cent or more at a depth of 125 cm below the mineral soil surface and have an ustic soil moisture regime are put under Typic Ustifluents. Similarly, the soils which showed Cambic B- horizon or structural development

with the depth more than 50 cm are put under Typic Haplustepts. The soils having cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in normal years and slickensides or wedge-shaped peds in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface are kept under Vertic Haplustepts. Vertisols that is not irrigated during the year, have cracks in normal years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for 90 or more cumulative days per year and have slickensides or wedge-shaped peds are classified as Typic Haplusterts. At the sub group level, the soils are classified in seven sub-groups, Sodic Haplusterts (43.6%), Vertic Haplustepts (25.3%), Typic Haplustepts (10.8%), Fluventic Haplustepts (7.0%), Sodic Haplocambids (4.2%), Typic Ustifluents (3.5%), and Sodic Endoaquents (2.0%) of the total geographical area of block.

At Family level, fine soils are dominant covering 52.2 per cent area of the total geographical area of the block followed by fine loamy (32.3%), coarse loamy (6.7%), coarse silty (4.2%) and fine silty (1.1%) soils. The map showing the particle size classes of Dholka block is presented in figure 5.17. Soils of Dholka block, classified at family level, are presented in table 5.7 and soil families are shown in figure 5.18.

Table 5.7: Classification of soils of Dholka block at family level

Sr. no.	Soil series	Family/Higher Taxonomic Class	Area (ha)	% of TGA
1	Badarkha	*Coarse loamy, mixed, hyperthermic, Typic Haplustepts*	4170	4.4
2	Loliya1	*Coarse silty, mixed, hyperthermic, Sodic Haplocambids*	4069	4.3
3	Vataman	*Course loamy, mixed, hyperthermic, Typic Ustifluents*	2262	2.4
4	Amliyara	*Fine loamy, mixed, hyperthermic, Fluventic Haplustepts*	6736	7.0
5	Khanpur	*Fine loamy, mixed, hyperthermic, Vertic Haplustepts*	24216	25.3
6	Anandpura	*Fine silty over sandy, mixed, hyperthermic, Typic Ustifluents*	1094	1.1
7	Loliya2	*Fine, mixed, hyperthermic, Sodic Endoaquents*	1961	2.0
8	Girand, Saroda	*Fine, mixed, hyperthermic, Typic Haplustepts*	6199	6.5
9	Ganeshpur, Dholi	*Fine, smectitic, hyperthermic, Sodic Haplusterts*	41746	43.6

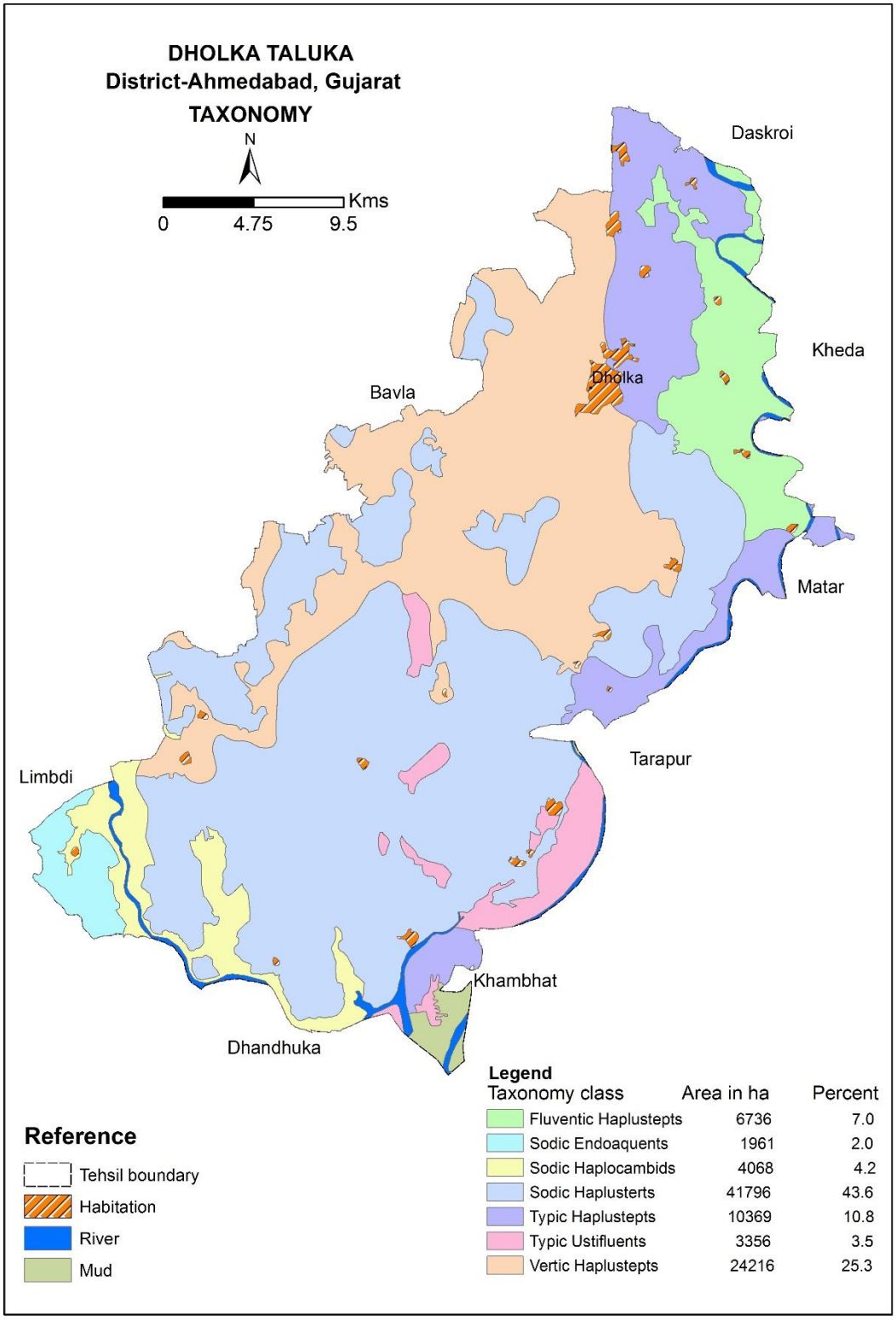

Fig. 5.16. Soil taxonomy map of Dholka block

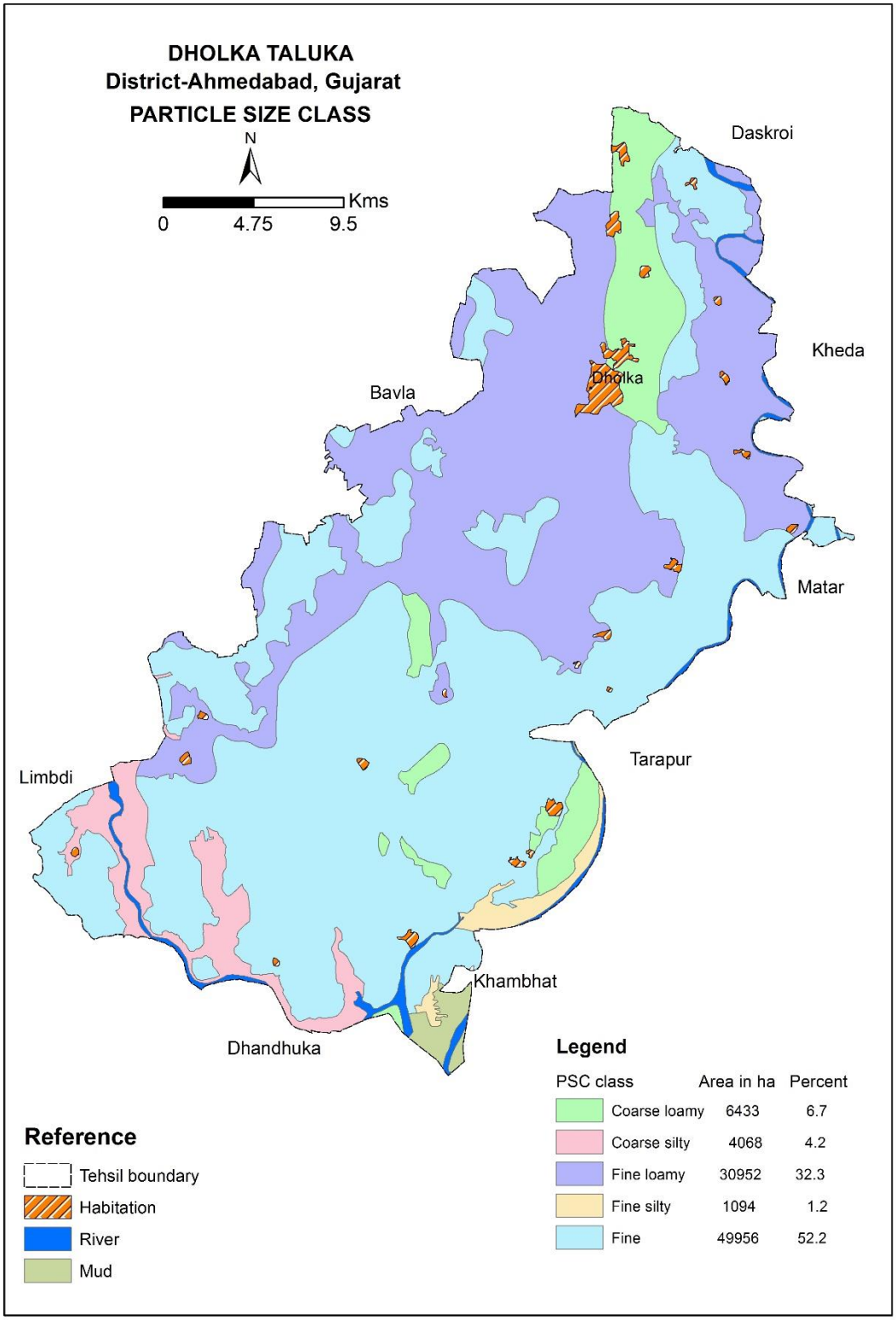

Fig. 5.17. Soil particle size class map of Dholka block

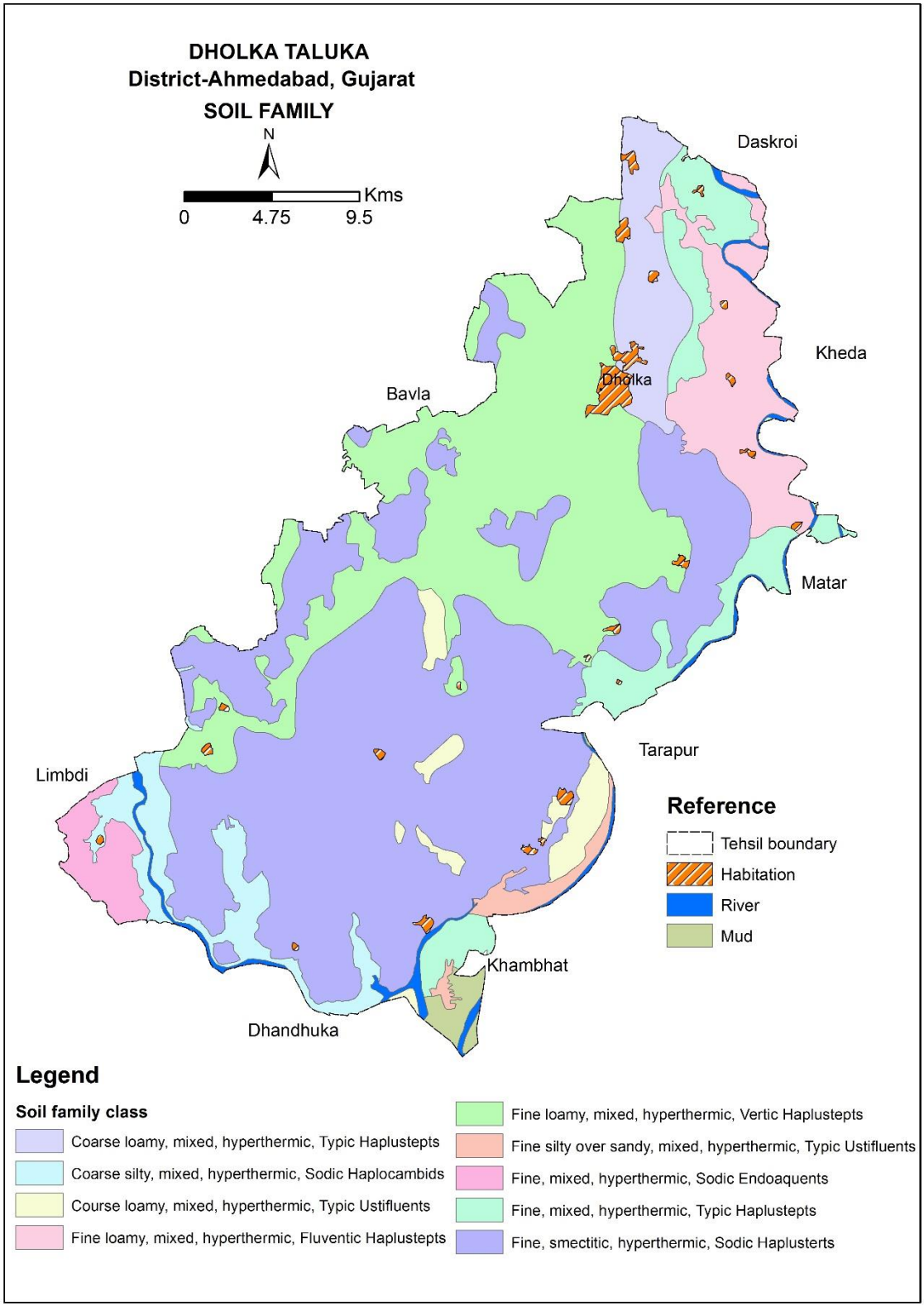

Fig. 5.18. Soil family map of Dholka block

LAND EVALUATION

The importance of land evaluation for better land use options has been receiving greater importance, as efficient land use maintains agricultural sustainability. Land evaluation has been defined by FAO (1976) as the process of assessment of land performance when used for specified purpose. It involves the execution and interpretation of surveys and the studies on landforms, soils, vegetation, climate and other related aspects of land for a comparison between the promising land use and specified land use.

Land evaluation is the ranking of the soil units on the basis of their capabilities to provide the highest return per unit area and conserving the natural resources for future use. Interpretative groupings thus serve evaluation of potential of different soils and enable prediction about their behavior under different management systems.

Various interpretative groupings are used for land evaluation and the most common is Land capability classification (Klingebiel and Montgomery, 1961), Land irrigability classification (IARI, 1971), soil productivity index (Riquier, *et al.* 1970) and Land suitability classification (FAO, 1976). These methods differ from each other in the original purpose for which they were proposed, in terms of terminology, in the number and kind of soil properties taken into account and in the logic of procedures followed to arrive at a suitability rating.

In land evaluation, there are four steps namely i) characterization of existing soils, climatic and land use conditions, ii) development of soil-site criteria for crop requirements iii) matching of the crop requirements with the existing soils and climatic conditions and iv) choosing the best fit among the crops and selecting the same as alternative crop strategy. The soils of the Dholka block have been evaluated for land capability, land irrigability and soil suitability for major crops cultivated in the area.

6.1. Land capability classification:

The land capability classification is an interpretative grouping of soils. It serves as an important means for land use planning as it indicates the relative suitability of soils for cultivation of crops, pastures, forestry, etc. In addition, it focuses on the problems that need preventive measures. It also provides clues to the management needs for improvement of different soils for increasing production.

The land capability classification groups the soils into eight classes from I to VIII, with each higher class having greater degree of a single or a combination of various limitations to crop production. Classes I to IV are fit for crop production while class V to VIII have serious limitation for crop production and hence are put to other uses *e.g.* pasture, forestry, wild life sanctuary, recreation, *etc*. Each class is further sub divided into sub classes depending upon the type and severity of limitation viz., erosion (e), wetness (w), soil root zone limitation(s) and climate(c). The classification system is mainly based on the inherent factors that cannot be corrected practically thereby giving more emphasis on physical aspects of soil such as texture rather than chemical aspect such as soil pH.

As per land capability classification criteria, land of the Dholka block is grouped into three capability classes *viz.* II, III, IV. The dominant LCC class covering largest area is II with the miner limitation of salinity, sodicity and flooding, which covers 63.4% of total geographical area of the block followed by land capability class III with the moderate limitation of salinity, sodicity and flooding and comprised of 29.0% of total geographical area. The class IV covers 4.2% of TGA with severe to very severe limitation of salinity, sodicity and flooding. The results pertaining to land capability classes and subclasses with their extent and distribution in the block are given in table 6.1 and depicted in figure 6.1. After interpretation of the soil data it is observed that the land capability classes and subclasses reflect the effects of climate and permanent soil characteristics.

Table 6.1: Land Capability Classification

Land Capability Subclass	Description	Soil Map Unit	Area (ha)	% of TGA
IIs	These are the good cultivable lands with minor soil problem such as fairly satisfactory texture and miner problem of salinity, sodicity or flooding. All climatically adapted crops can be grown under irrigation.	1,3,5,6,7,8,9, 10,12,13,15, 16	60687	63.4
IIIs	Moderately good cultivable lands with very gentle slope subject to moderate salinity, severe sodicity and occasional flooding.	2,4,11,14,18, 19	27748	29.0
IVwe	Fairly good land with on very gently to gently sloping land with severe to very severe salinity, sodicity and flooding and severe erosion.	17	4069	4.2

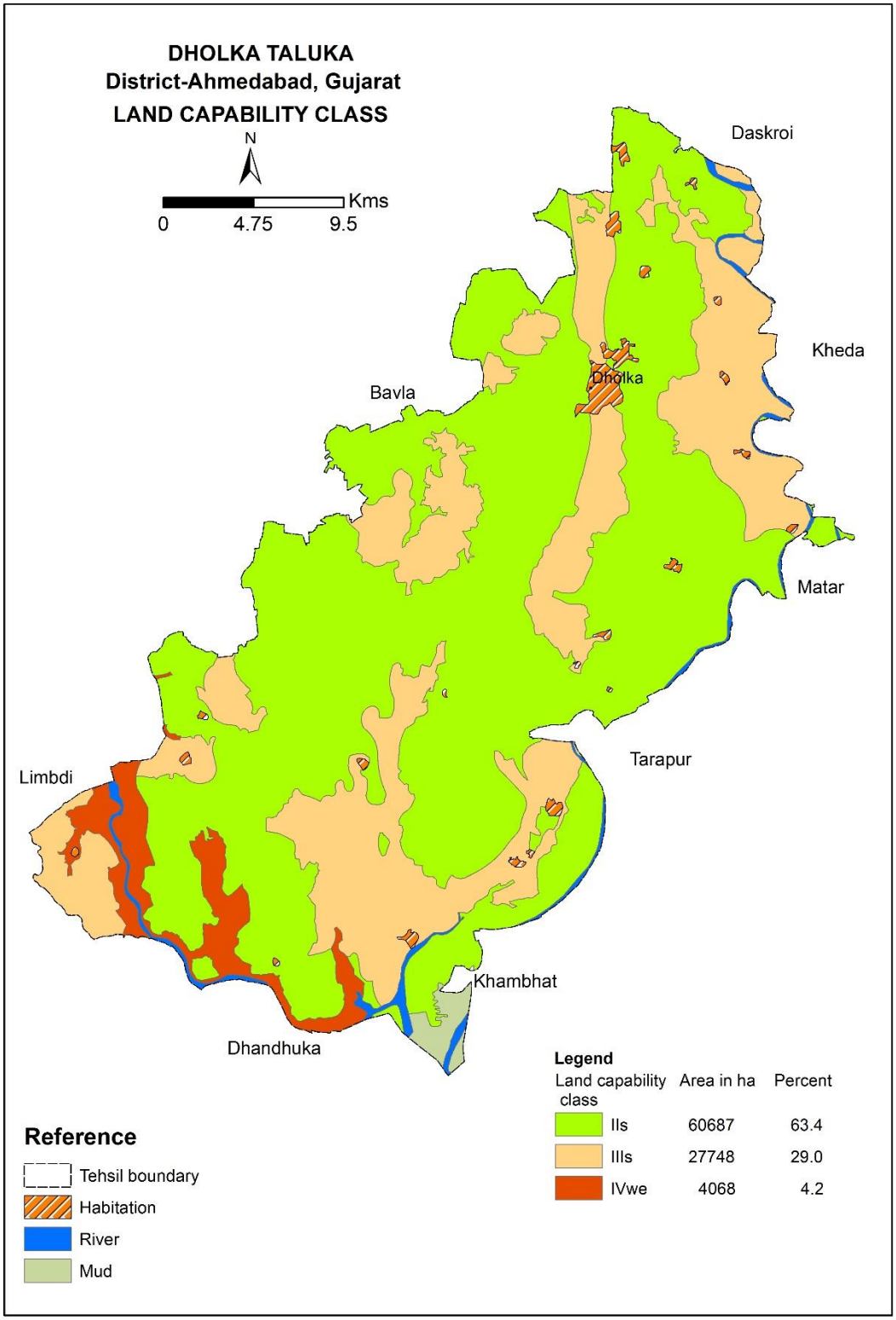

Fig. 6.1. Land capability class map of Dholka block

6.2. Land Irrigability classification

The irrigability classification is a combined effect of soil and land characteristics. Factors considered while grouping soils under different irrigability classes are slope, erosion, texture, depth, drainage, salinity, alkalinity, graveliness, infiltration capacity, permeability *etc.* According to this, land is grouped into six land irrigability classes. Criteria for classes are quantitatively defined and one soil can qualify for only one class. The suitability for irrigation is determined by first grouping the soils into a) soil irrigability classes according to their sustained use under irrigation, and b) then grouping the irrigable soils into land irrigability sub-classes.

6.2.1. Soil irrigability:

The soil irrigability classes along with soils and their definitions are given below:

Irrigability class	**Definition**
Class A	None to slight limitations for sustained use under irrigation
Class B	Moderate soil limitations for sustained use under irrigation
Class C	Severe soil limitations for sustained use under irrigation
Class D	Very severe soil limitations for sustained use under irrigation
Class E	Non suitable for irrigation (Non irrigable soil class)

6.2.2. Land irrigability:

Land is grouped into six land irrigability classes. Land belonging to class 1 to 4 is irrigable but limitations in their use for sustained irrigation increases from 1 to 4. Class 5 land is non irrigable and special investigations are required to assign this class. Class 6 land is not suitable to sustained use under irrigation. The irrigability subclass is assigned according to the limitations of soils (s), topography (t), and drainage (d).

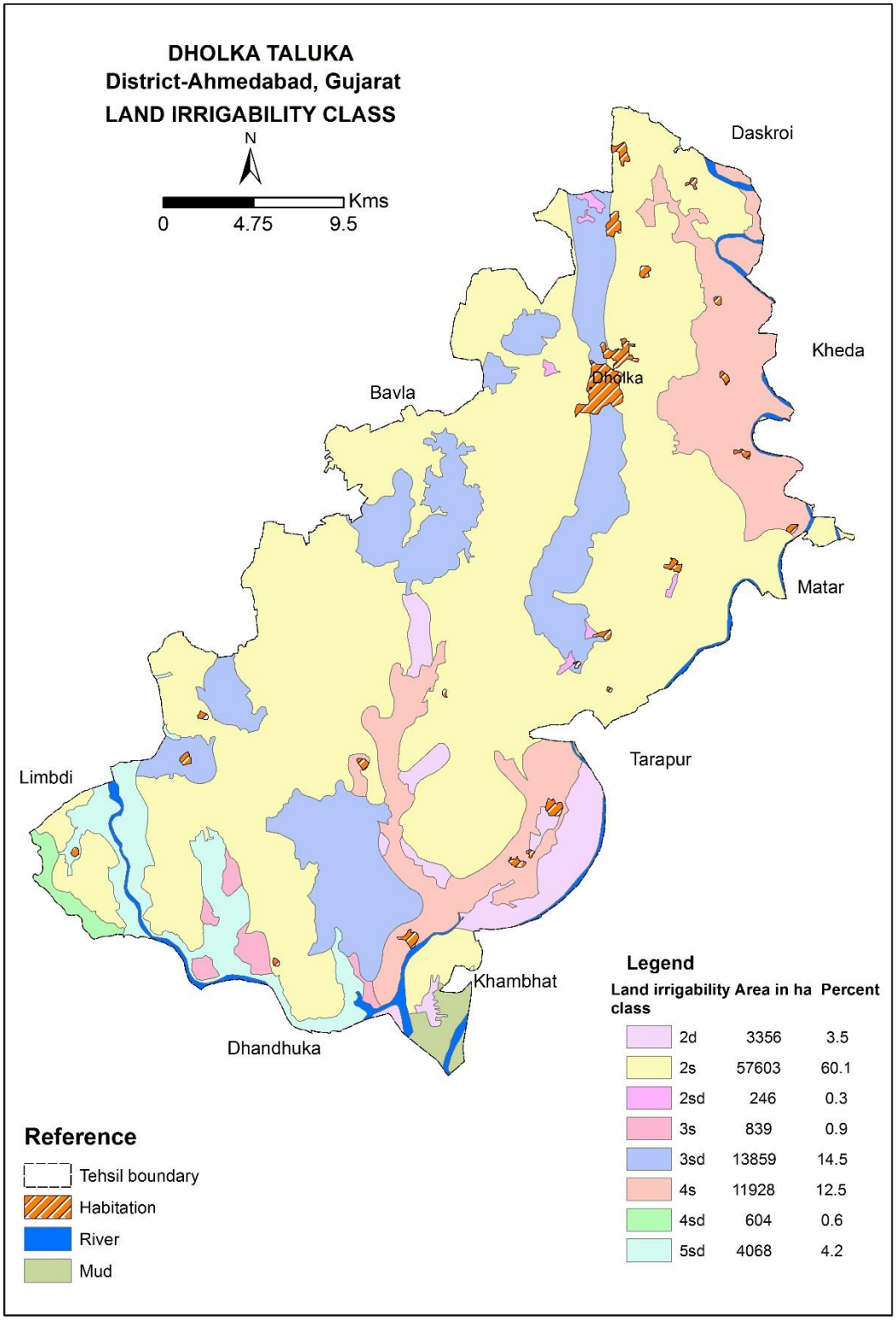

Fig. 6.2. Land irrigability class map of Dholka block

Table 6.2: Land Irrigability Classifications

Land Irrigability Subclass	Description	Soil Map Unit	Area (ha)	% of TGA
2d	These are the lands having moderate limitations for sustained use under irrigation. These soils have moderate limitations of drainage.	1,5,6	3356	3.5
2s	These are the lands having moderate limitations for sustained use under irrigation. These soils have moderate limitations of salinity and sodicity.	3, 7-10,13, 15,18	57603	60.1
2sd	These are the lands having moderate limitations for sustained use under irrigation. These soils have moderate limitations of drainage, salinity and sodicity.	12	246	0.3
3s	These are the lands that have severe limitations for sustained use under irrigation. Lands of this class has moderately severe salinity or alkali when in equilibrium with irrigation water.	16	839	0.9
3sd	These are the lands that have severe limitations for sustained use under irrigation. Lands of this class has moderately severe salinity or alkali when in equilibrium with irrigation water. These lands also has moderate limitation of permeability and drainage.	11,14	13859	14.5
4s	These are the marginal lands for sustained use under irrigation because of very severe limitations of soils. Lands of this class has severe salinity or alkali when in equilibrium with irrigation water.	2,4	11928	12.5
4sd	These are the marginal lands for sustained use under irrigation because of very severe limitations of soils. Lands of this class has severe salinity or alkali when in equilibrium with irrigation water. These lands also has severe limitation of permeability and drainage.	19	604	0.6
5sd	These are the lands that are temporarily classed as not suitable for sustained use under irrigation because of very severe limitations of soil and drainage. Lands of this class has very severe salinity or alkali when in equilibrium with irrigation water. These lands also has very severe limitation of permeability and drainage.	17	4069	4.2

The soils of the Dholka block are grouped into four land irrigability classes viz. 2, 3, 4 & 5 and their grouping at the level of subclass is presented in table 6.2. Their extent and distribution is depicted in figure 6.2. The dominant land irrigability class occurring in the block is class 2 occupying an area of 63.9% of total geographical area of the block which are classed as the lands having moderate limitations of soil and drainage for irrigation. These are the soils on level to nearly level to gently sloping plains, deep with moderate limitation of drainage, salinity, sodicity and flooding. Land irrigability class 2 soils has moderate soil limitations for sustained use under irrigation in Dholka. Land irrigability class 3 soils spread in mapping unit no. 11, 14 and 16 which covers 15.4% of TGA. Class 3 soils has moderately severe salinity or alkalinity problem when in equilibrium with irrigation water. Land irrigability class 4 covers mapping unit no. 2,4 and 19 and occupied in 13.1% area. Class 4 has severe soil limitations for sustained use under irrigation due to secondary salinization and flooding due to high water table. Land irrigability class 5 has very severe limitations of salinity and drainage due to close vicinity of seawater.

6.3 Land suitability classification:

6.3.1. Suitability for cash crops

6.3.1.1 Soil suitability for Cotton (*Gossypium sp*.)

Cotton (*Gossypium sp*.), the white gold is one of the most important commercial fiber crops. It plays prominent role in the national and international economy. Besides fiber, cotton is also valued for its oil and cotton seed cake. India ranks first in respect of area and third in total production of cotton. Cotton is basically a semi-xerophyte, warm season woody shrub with indeterminate growth habit grown over a wide range of climates. It adapts to diverse growing conditions by shortening, lengthening or even interrupting its effective blooming period. Rainfall, latitude and elevation are the dominant factors governing the distribution and growth of cotton. Latitude and elevation, through their effect on day/ night temperature and radiation set the maximum season length. The length of the season, climatic and soil factors, determine the biotic and abiotic stresses, actual crop duration and the ultimate yield. Cotton being a sub-tropical plant is very sensitive to temperature. Optimum temperature required for cotton is around 25° C.

Cotton is grown under extremely diverse soil and agro-climatic conditions ranging from arid-sub tropical to humid tropical wet climates and from deep, heavy Vertisols (Gujarat and Maharashtra) to sandy loams (Southern Rajasthan), alluvium to red and lateritic soils. The

cropping season varies from region to region as the sowing time is adjusted in such a manner that the flowering and fruiting phases occur during a period when the maximum temperature ranges from 29°C to 34°C and the mean minimum temperature range from 20 to 24°C.

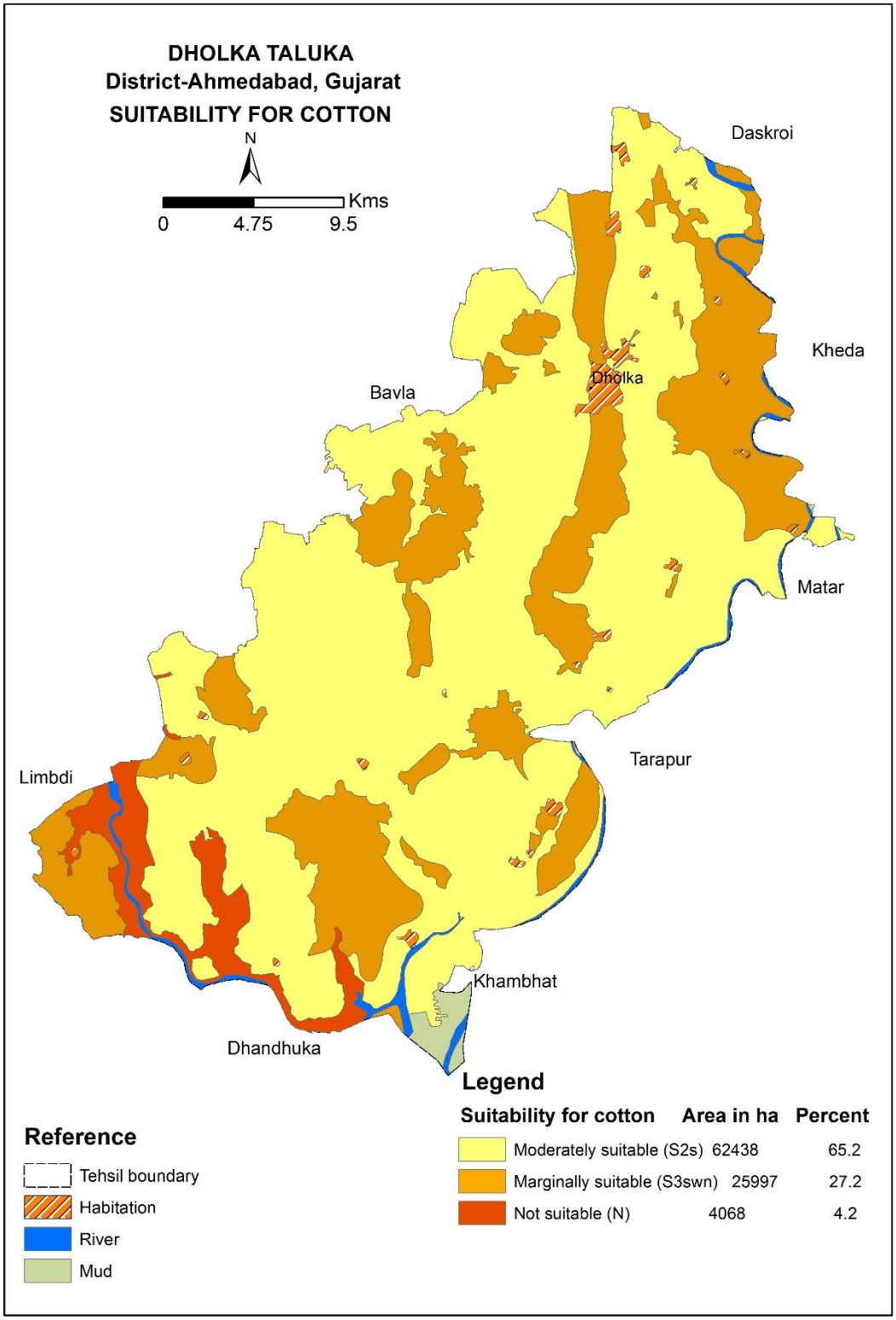

Fig. 6.3. Soil-site suitability map for cotton of Dholka block

The deep, friable, well-drained soils with good organic matter content are ideal. Under rainfed conditions, good yield is obtained from deep, fine textured soils having good structure. The soil suitability is related to a three-way interaction between soil type, rainfall characteristics and species/varietal adaptations. The areas with annual rainfall of less than 50-75 cm and well drained fine textured soils (loam to clay loam) are more productive (Hake *et al.* 1996).

Soils of Dholka block were analyzed for suitability for cotton crop. The suitability analysis (Table 6.3 and Fig. 6.3) showed that 4.2% of the total geographical area of the block is not suitable for cultivation of cotton crop due to the problems of severe erosion, severe to very severe problem of salinity, sodicity and flooding. However, 27.1% area is marginally suitable, and 65.2% area is moderately suitable. The area under suitable (S1) class is not exist in Dholka block for cotton crop.

Table 6.3: Suitability for Cotton

Sl. No.	Suitability class	Mapping units	Area (Ha)	% of TGA
1	Moderately suitable (S2s)	2, 3,5-8,10,13,16	62438	65.2
2	Marginally suitable (S3swn)	1,4,9,11,12,14,15,18,19	25997	27.2
3	Not suitable (N)	17	4069	4.2

6.3.2. Suitability for Cereals

6.3.2.1. Soil suitability for Wheat *(Triticum aestivum)* and durum wheat *(Triticum durum)*:

Wheat is a dominant rabi cereal crop of the country. It is grown under various climatic conditions however, a climate providing cool weather during vegetative development and warm weather at maturity is considered to be ideal for wheat cultivation. The congenial temperature for its cultivation is less than 25^{o}C. Fertile, well drained, medium textured (loam to clay loam) soils are considered best for wheat. Very sandy or poorly drained soils are unsuitable. It tolerates salinity and sodicity as well but grown best in the pH range of 6 to 8. Durum wheat can tolerate higher salinity and alkalinity and perform better even at higher pH level.

The soil site suitability for wheat (Table 6.4 and Fig.6.4) shows that soils of the 12.6% area of the block are highly suitable, 53.9% area is moderately suitable and 25.8% area is marginally suitable for wheat cultivation. However, 4.2% area of the block is not suitable for wheat cultivation. Major limitations that decide the suitability of these soils for wheat cultivation are soil salinity, sodicity and flooding of the lands.

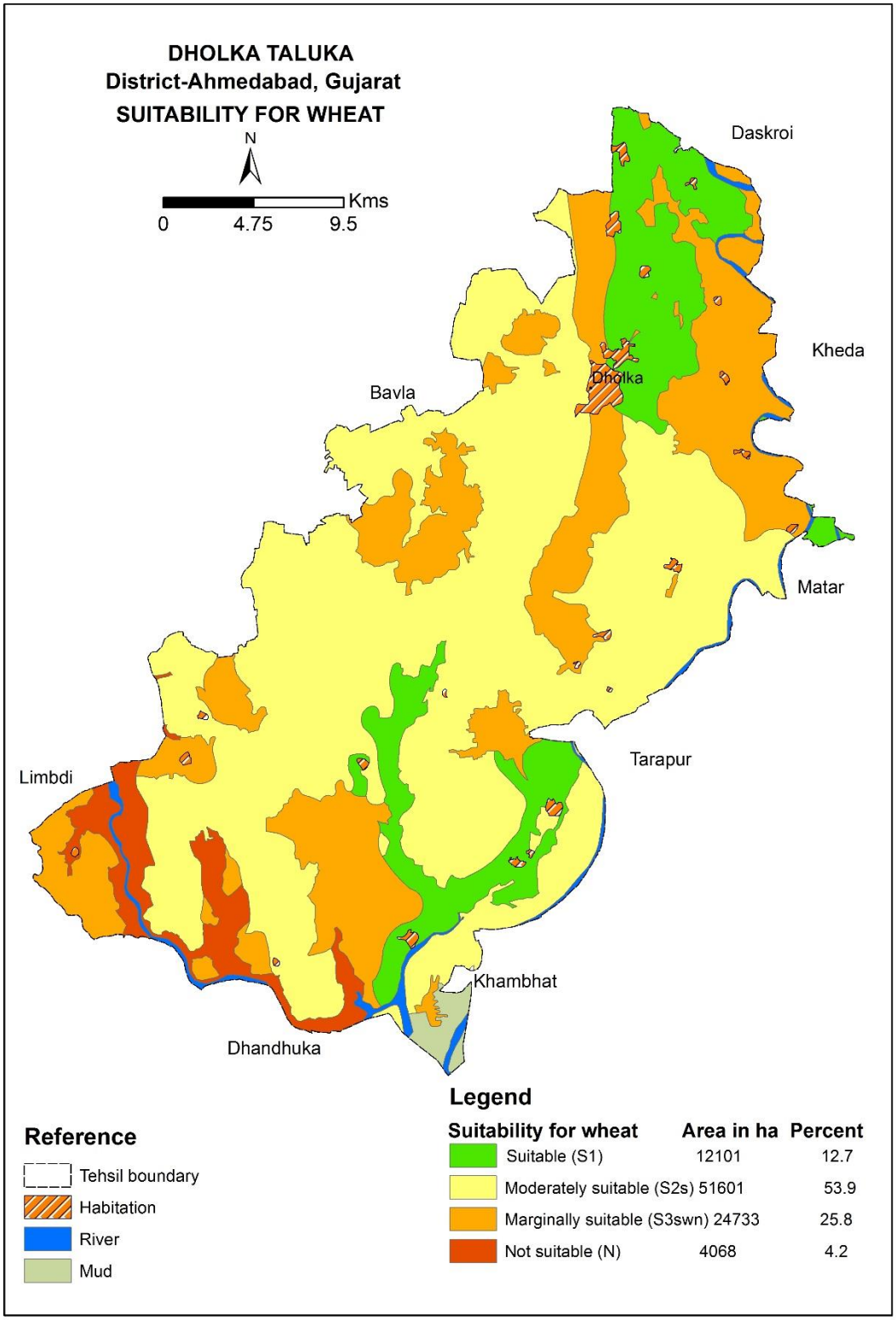

Fig. 6.4. Soil-site suitability map for wheat of Dholka block

In addition to this main constraint for wheat cultivation is low quality of underground irrigation water. At present the part of the area receive canal irrigation water and follow paddy-wheat cropping system. Durum wheat is mainly practiced on stored soil moisture under salt affected area in rabi season.

Table 6.4: Suitability for Wheat

Sl. No.	Suitability class	Mapping units	Area (Ha)	% of TGA
1	Suitable (S1)	2,3,8	12101	12.7
2	Moderately suitable (S2s)	1,5,7,10,13	51601	53.9
3	Marginally suitable (S3swn)	4,6,9,11,12,14-16,18,19	24733	25.8
4	Not suitable (N)	17	4069	4.2

6.3.2.2. Soil suitability for Rice: *(Oryza sativa)*

Rice is the staple food of more than 60 per cent of the world's population. About 90 per cent of rice grown in the world is produced and consumed in the Asia region. Rice is the crop of tropical climate. However, it is grown successfully in humid regions of sub-tropics and temperate climate. It is grown in wide variety of climate-soil-hydrological regimes. It is a heat and water loving plant. It requires high temperature and adequate water supply. Rice lands are classified according to water regimes in to upland with no standing water, lowland with 5-50 cm standing water, and deep water with >50 cm standing water. Low temperature (13-21^{0}C) at early growth stages, namely seedling, tillering, panicle initiation and anthesis is most detrimental to obtain high grain yields. High temperatures (35-45^{0}C) during the vegetative growth stage can result in reduced tillering. The average temperature required throughout the life period of the crop ranges from 21 to 35^{0}C. Temperature <30^{0}C retard the absorption of nitrogen, phosphorous, potassium and silica. In India, rice is grown under diverse soil conditions and over a wide range of soil reaction (pH 4.5 to 8.0). The soils most suited to cultivation of the crop are heavy soils (clay or clay loam and loam soils). The broad soil types under rice cultivation are alluvial soils, red soils, mixed red and brown hill soils, laterite and lateritic soils, black soil, sub-montane soils, saline and alkali soils and peaty and marshy soils.

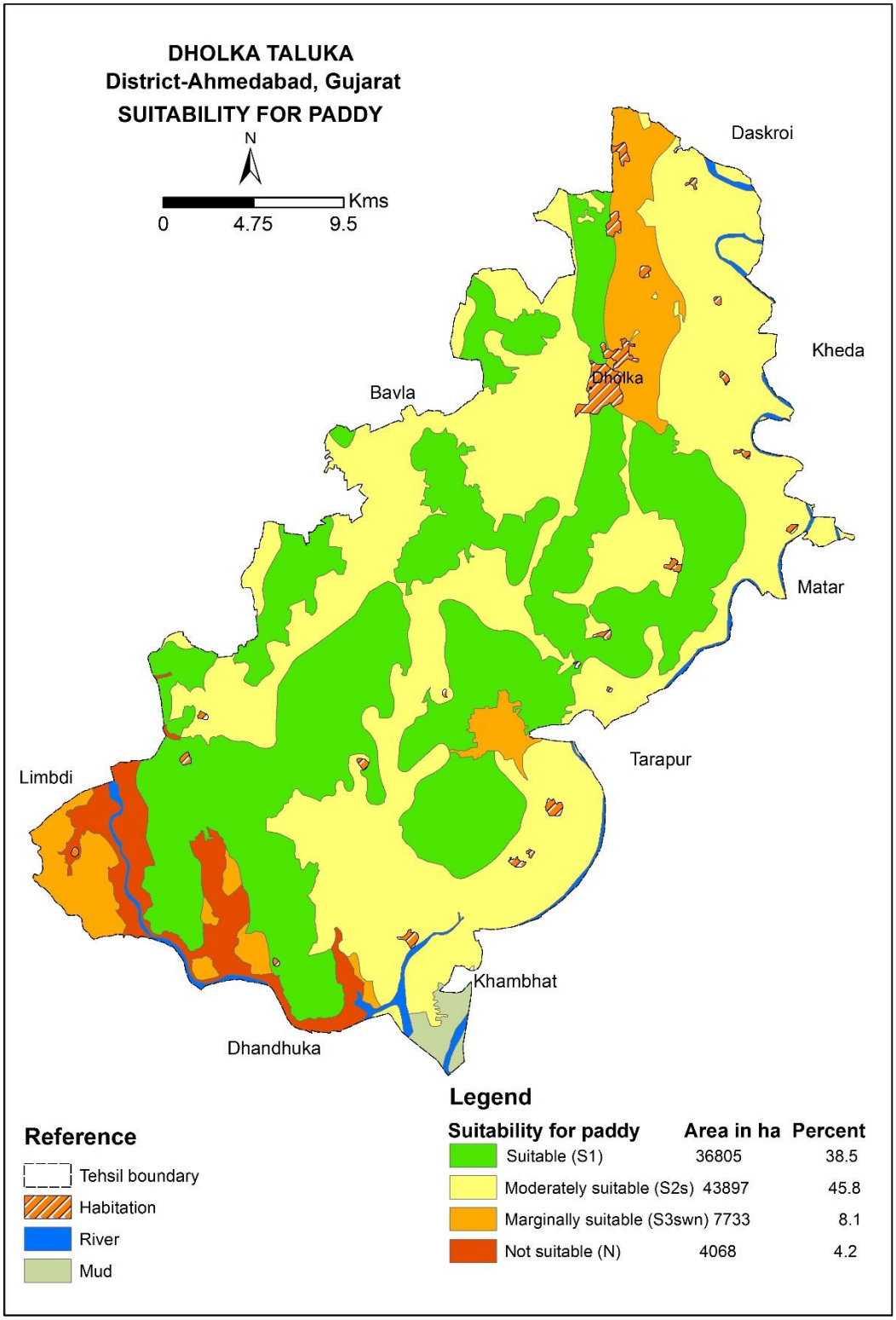

Fig. 6.5. Soil-site suitability map for rice of Dholka block

The data presented in the table 6.5 shows that the soils of Dholka block are varied from suitable to not suitable. About 4.2% of the total geographical area of the block is not suitable for rice cultivation due to severe problems of soil salinity, sodicity and frequent flooding due to lower topographical position and close vicinity of coast. Suitable, moderately suitable and marginally suitable area of the block is 38.4%, 45.8% and 8.1% respectively for rice cultivation (Fig.6.5). presently, the majority of soils are under paddy cultivation, sometimes farmers grow paddy in rabi season also due to better economic returns. Further, it is inferred that the soils have buildup a significant salt concentration (salinity and sodicity) and also having variable chances of flooding therefore, the area is brought under paddy crop.

Table 6.5: Suitability for Rice

Sl. No.	Suitability class	Mapping units	Area (Ha)	% of TGA
1	Suitable (S1)	11,13	36805	38.5
2	Moderately suitable (S2s)	1-7, 9,10,12,14	43897	45.8
3	Marginally suitable (S3swn)	8,15,16,18,19	7733	8.1
4	Not suitable (N)	17	4069	4.2

6.3.3. Suitability for Millets

6.3.3.1. Soil suitability for Sorghum *(Sorghum spp.)*:

Sorghum is called as Camel crop as it can withstand drought to a great extent. It is one of the four major food crops of the world. It is grown in two main season, kharif and rabi. A crop season receiving about 600 mm of rainfall is ideal for the optimum crop performance. The optimum temperature range for growth is 25-30^{o}C. Sorghum grows well on all types of soils but humus rich soils with clay to clay loam texture having pH 6.0-8.5 are best suited soils. The data pertaining to soil site suitability for sorghum is presented in table 6.6 and the extent of distribution is depicted in figure 6.6. The data shows that soils of alluvial plain are suitable for sorghum with areal extent of 11.9% of the block, whereas 63.6% area is moderately suitable and 16.9% area is marginal suitable. The limitations behind moderate and marginal suitability are soil salinity, sodicity and flooding. On the other hand, the soils of 4.2% area of the block are not suitable for sorghum cultivation because of severe problems of soils salinity, sodicity, flooding and drainage.

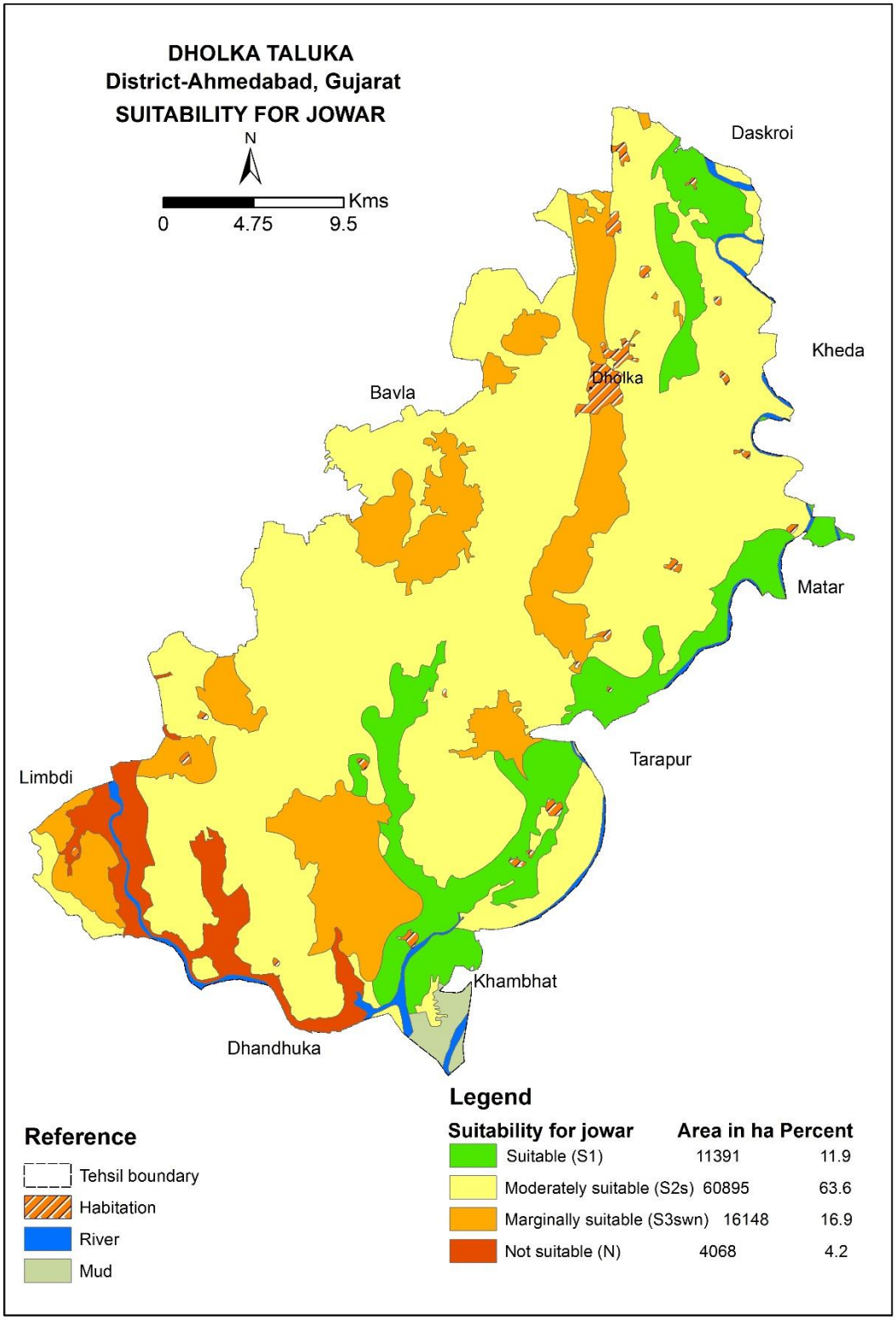

Fig. 6.6. Soil-site suitability map for sorghum of Dholka block

Table 6.6: Suitability for Sorghum

Sl. No.	Suitability class	Mapping units	Area (Ha)	% of TGA
1	Suitable (S1)	2,3,7	11391	11.9
2	Moderately suitable (S2s)	1,4-6,8,10,12,13,16,19	60896	63.6
3	Marginally suitable (S3swn)	9,11,14,15,18	16148	16.9
4	Not suitable (N)	17	4069	4.2

6.3.3.2. Soil suitability for pearl millet *(Pennisetum glaucum)*:

Pearl millet (*Pennisetum glaucum*) is the most widely grown type of millet and India is the largest producer. It is known as Bajra or Bajri in majority parts of India. It has been grown in Africa and the Indian subcontinent since prehistoric times. In India, around 58% of pearl millet area is grown in Rajasthan. Pearl millet is well adapted to growing areas characterized by drought, low soil fertility, and high temperature. It performs well in soils with high salinity or low to high pH. Because of its tolerance to difficult growing conditions, it can be grown in areas where other cereal crops, such as maize or wheat, would not survive. Pearl millet is a summer annual crop well-suited for double cropping and rotations. It does not grow well in soils prone to waterlogged conditions. Bajra is part of daily diet to make chapattis in villages of Rajasthan and Rotla in Gujrat. It became a part of traditional foods and served in five star hotels and restaurants. Although the grain is used mainly as a human food crop, it is also used to feed livestock. Additionally, the plant is used for grazing, making hay and silage.

Soils of Dholka block are assessed for soil suitability and found suitable (7.2%), moderately suitable (68.9%), and marginally suitable (16.2%) for Bajra cultivation. The crop is sensitive for waterlogging therefore the mapping unit no. 17 is not suitable due to flooding and poor draining ability of soils. Data pertaining to suitability of Bajra is presented in table 6.7 and depicted in figure 6.7.

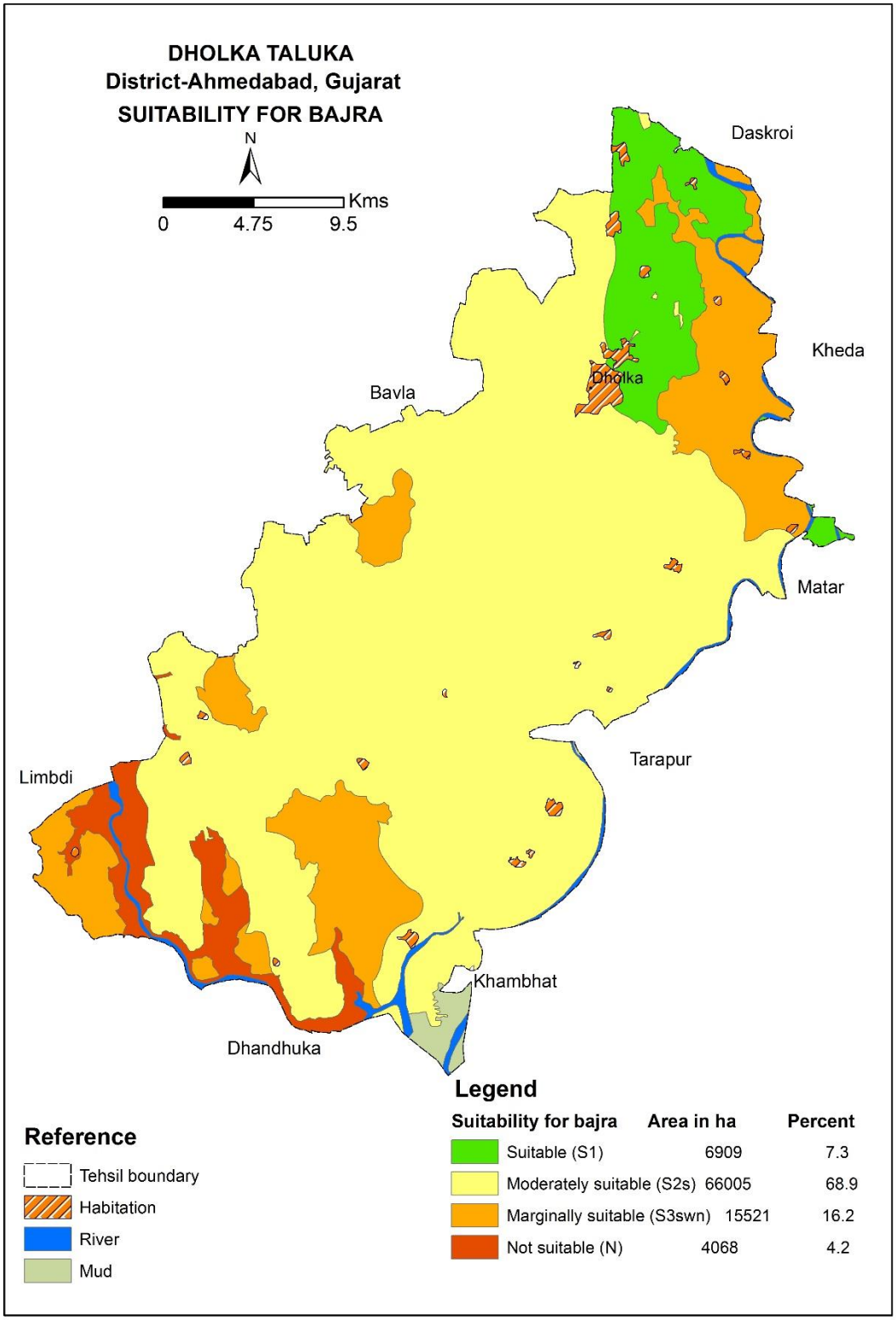

Fig. 6.7. Soil-site suitability map for Bajra (Pearl millet) of Dholka block

Table 6.7: Suitability for Pearl millet

Sl. No.	Suitability class	Mapping units	Area (Ha)	% of TGA
1	Suitable (S1)	3,8	6909	7.3
2	Moderately suitable (S2s)	1,2,5-7,9-13,15	66005	68.9
3	Marginally suitable (S3swn)	4,14,16,18,19	15521	16.2
4	Not suitable (N)	17	4069	4.2

6.3.4. Suitability for pulses:

6.3.4.1. Soil suitability for Gram *(Cicer arietinum)*:

Gram is the most important pulse crop of India. It is a short stature, annual crop grown mostly on residual moisture and about 55% of the crop is cultivated as rainfed. Gram requires cool climate for growth and high temperature for maturity. The optimum temperature range is 15-25^{o}C. Severe cold and frost are deleterious for its growth. It can be grown in areas receiving annual rainfall of 600-1000 mm. Waterlogging at any stage of the growth may injure the root system of the crop. It responds to light irrigation at flowering and grain filling stage. It is a hardy crop and can be grown on a wide range of soils from medium to heavy black soils, mixed red and black soils or in alluvial soils. The well drained and aerated soils produces good seedbed. The good yield is obtained in alluvial soils (Entisols) of North West India. The optimum pH requirement of the soils is 5.7 to 7.2.

The data of soil suitability evaluation pertaining to extent and distribution of suitability classes is given in table 6.8 and shown in figure 6.8. The data shows that the soils of alluvial plain and occupying 6.5% area of the block are suitable for gram cultivation. The soils of mapping unit 1,2,5,6,8,10,11,13 occupied 68.4% area are moderately suitable for gram whereas soils mapping unit no. 4,9,12,14-16,18,19 (17.4% area) are marginally suitable. In this region soil salinity, sodicity, flooding and drainage are the major constraint for gram cultivation. Soils of the low lying young coastal plain (mapping unit 17) covering an area of 4.2% of the block are not suitable for gram cultivation because of severe limitation of salinity, sodicity, flooding and drainage.

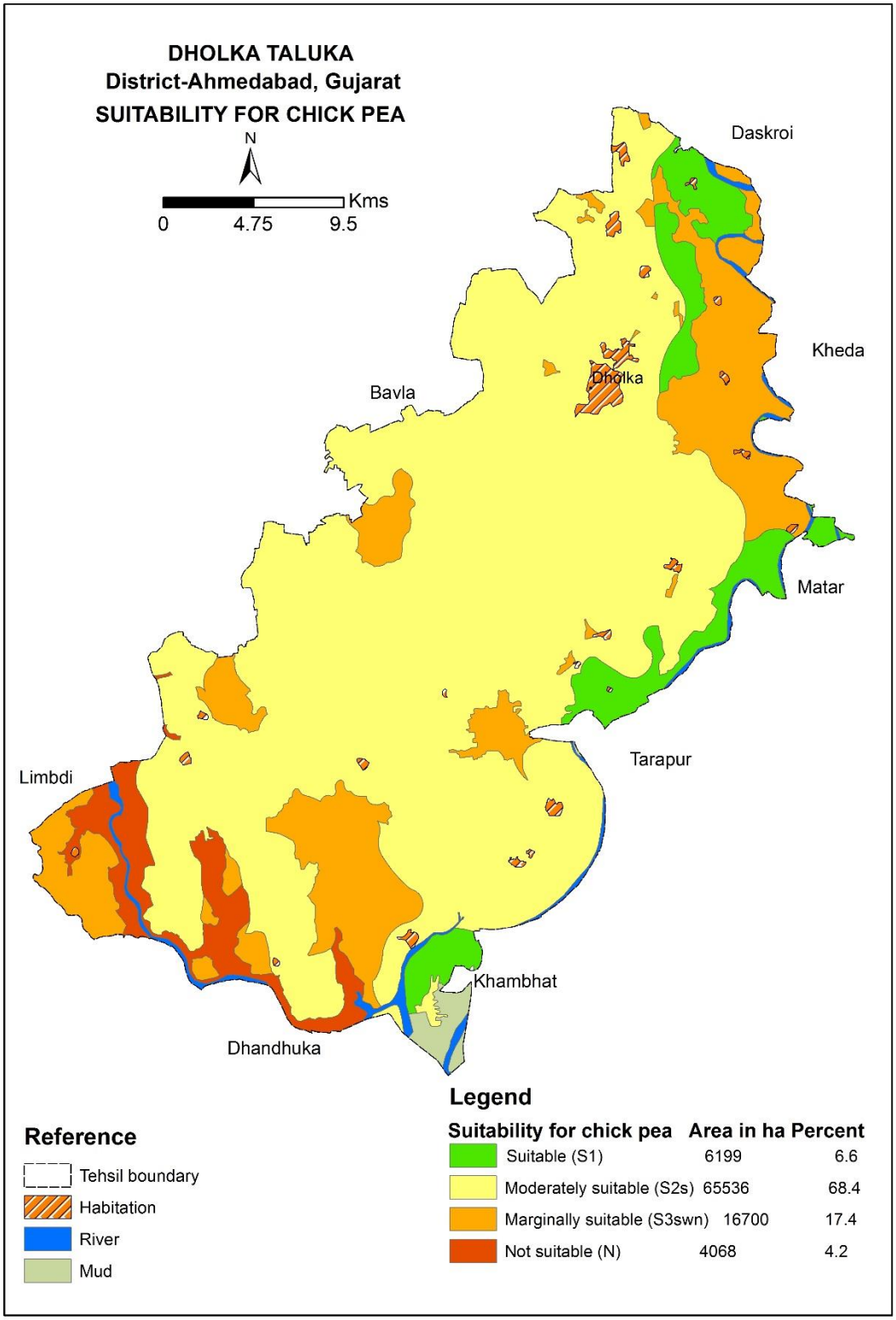

Fig. 6.8. Soil-site suitability map for gram (Chick pea) of Dholka block

Table 6.8: Suitability for Gram

Sl. No.	Suitability class	Mapping units	Area (Ha)	% of TGA
1	Suitable (S1)	3,7	6199	6.6
2	Moderately suitable (S2s)	1,2,5,6,8,10,11,13	65536	68.4
3	Marginally suitable (S3swn)	4,9,12,14-16,18,19	16700	17.4
4	Not suitable (N)	17	4069	4.2

6.3.5. Suitability for Oil seeds:

6.3.5.1. Soil site suitability for groundnut (*Arachis hypogaea*):

Groundnut also known as peanut and earthnut is one of the major oilseed crops in the world. Groundnut is an important source of oil and protein to a larger portion of the population in Asia, Africa and the Americas. It is native of South America.

Groundnut is grown in all the tropical and subtropical countries of the world. It accounts for 29 % of the area and 36 % of the production of total oilseed in India. It is grown in all three seasons. The kharif season groundnut is grown during the south-west monsoon period (June-September) accounting to 85 % of the total area under rainfed. The rabi groundnut is confined to southern parts of the country occupying 10 % of the area and is mostly grown after rice during October-March. The summer crop occupying only 5 % of the total area is restricted to the central and northwestern parts of the country and is grown from January to June. The rabi and summer crops are irrigated. It is basically a day neutral plant.

Groundnut comes up well in tracts receiving 625- 1250 mm of fairly well distributed rainfall. Heavy rains offer no advantage. The crop requires intermittent light showers for profuse flowering coupled with bright sunshine for further development of flowers. Thus, alternate spells of dry and wet weather are ideal for flowering; excessive rains are also not desirable for the development of pods since they induce vegetative growth of the plant at the cost of pod formation. The optimum reproductive growth is observed at the temperature between 24 and 27°C. A temperature range of 25-30°C appears to be optimum; flower production is adversely affected at the temperature above 35°C. Loose/friable soils facilitate good pod development. Therefore, sandy and loamy soils with fairly rich in organic matter are extremely suitable. Groundnut is grown on

many soil types such as black cotton soils and gravelly red soils. The water logging, alkalinity and soils poor in lime greatly affect the pod filling. Excellent performance was observed in the pH range of 6.0 to 8.0.

Soil site characteristics of Dholka block are evaluated for groundnut as per the existing criteria proposed by NBSS (Naidu et al. 2006) and FAO (1976). Presently very limited area is under the groundnut cultivation and the productivity of the groundnut in the block is lower than the national productivity (1411 kg/ha). Keeping the textural and other limitation the majority of soils do not qualify for suitable class (S1). It is observed that (Table 6.9 and Fig. 6.9) 7.2% area is suitable, 57.9% area of the block is moderately suitable and 27.2% is marginally suitable. However, 4.2% area of the block is not suitable for groundnut cultivation because of severe soil and topographical limitations.

Table 6.9: Suitability for Groundnut

Sl. No.	Suitability class	Mapping units	Area (Ha)	% of TGA
1	Suitable (S1)	3,8	6909	7.3
2	Moderately suitable (S2s)	2,5,7,9,10,13,15	55464	57.9
3	Marginally suitable (S3swn)	1,4,6,11,12,14,16,18,19	26063	27.2
4	Not suitable (N)	17	4069	4.2

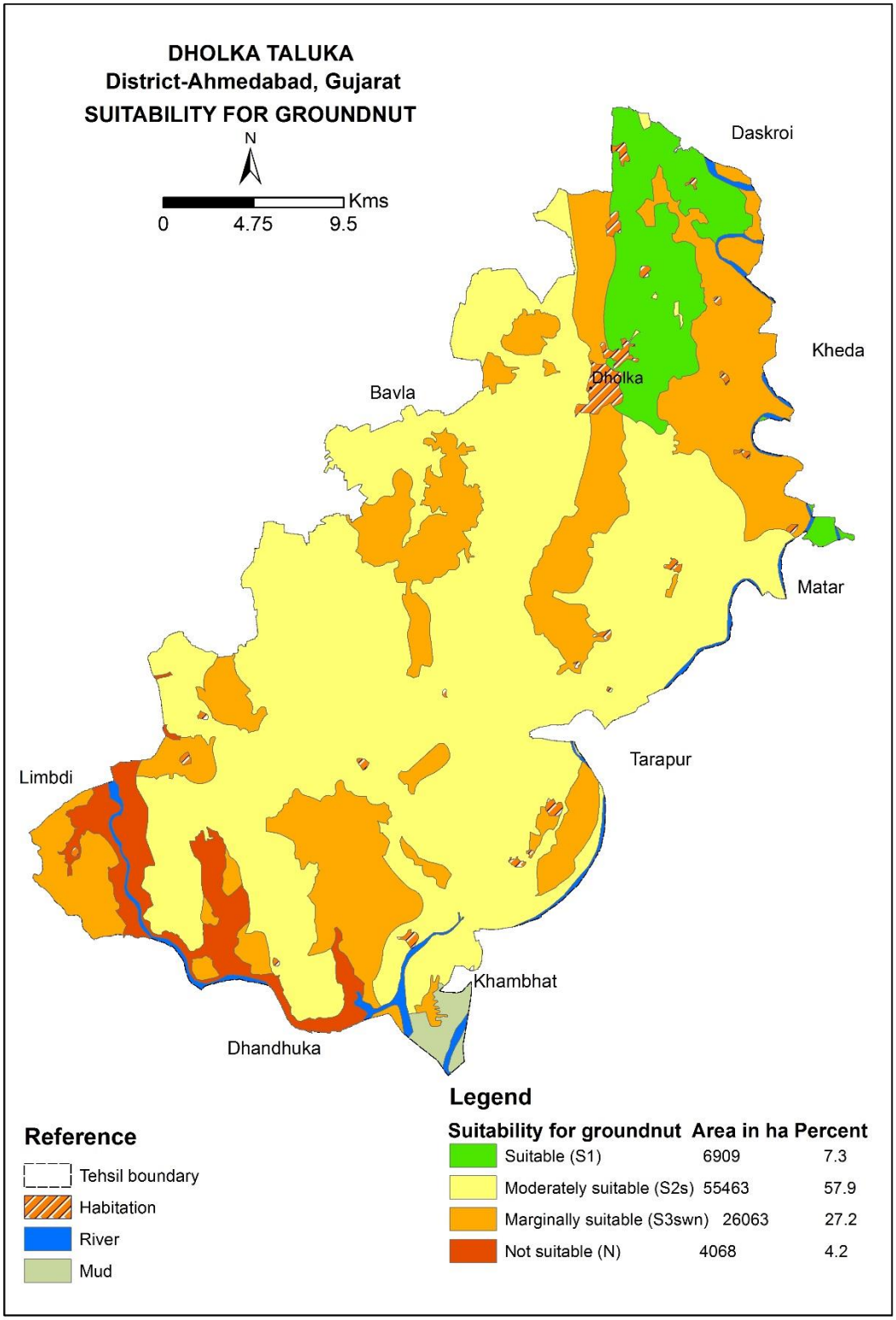

Fig. 6.9. Soil-site suitability map for groundnut of Dholka block

6.3.5.2. Soil site suitability for Sesame *(Sesamum indicum L)*:

Sesamum is also known as Sesame or Gingerly. India is the major producer of sesame accounting for nearly 27% of the world's area. In northern India it is grown during Kharif season and in the peninsular India it is grown throughout the year. It is warm weather crop and mainly cultivated in tropical and subtropical parts of the world. It is sensitive to low temperature, heavy rain and prolonged drought. As a rainfed crop it is cultivated in areas receiving around 500 mm rainfall. It can be grown on any type of soils but light, well drained soils with good water holding capacity produce good yield with pH range of 5.5 to 8.0. It is extremely susceptible to water logging. The extent and distribution of soil site suitability data is presented in table 6.10 and depicted in figure 6.10. The data shows that the majority of soils block are not suitable (28.6%) to marginally suitable (51.2%) for sesame cultivation due to moderate to severe limitation of salinity, sodicity and drainage. However, 16.8% area is moderately suitable area for sesame cultivation.

Table 6.10: Suitability for Sesame

Sl. No.	Suitability class	Mapping units	Area (Ha)	% of TGA
1	Moderately suitable (S2s)	10	16097	16.8
2	Marginally suitable (S3swn)	3,5-8,11,13,16	49022	51.2
3	Not suitable (N)	1,2,4,9,12,14,15,17-19	27384	28.6

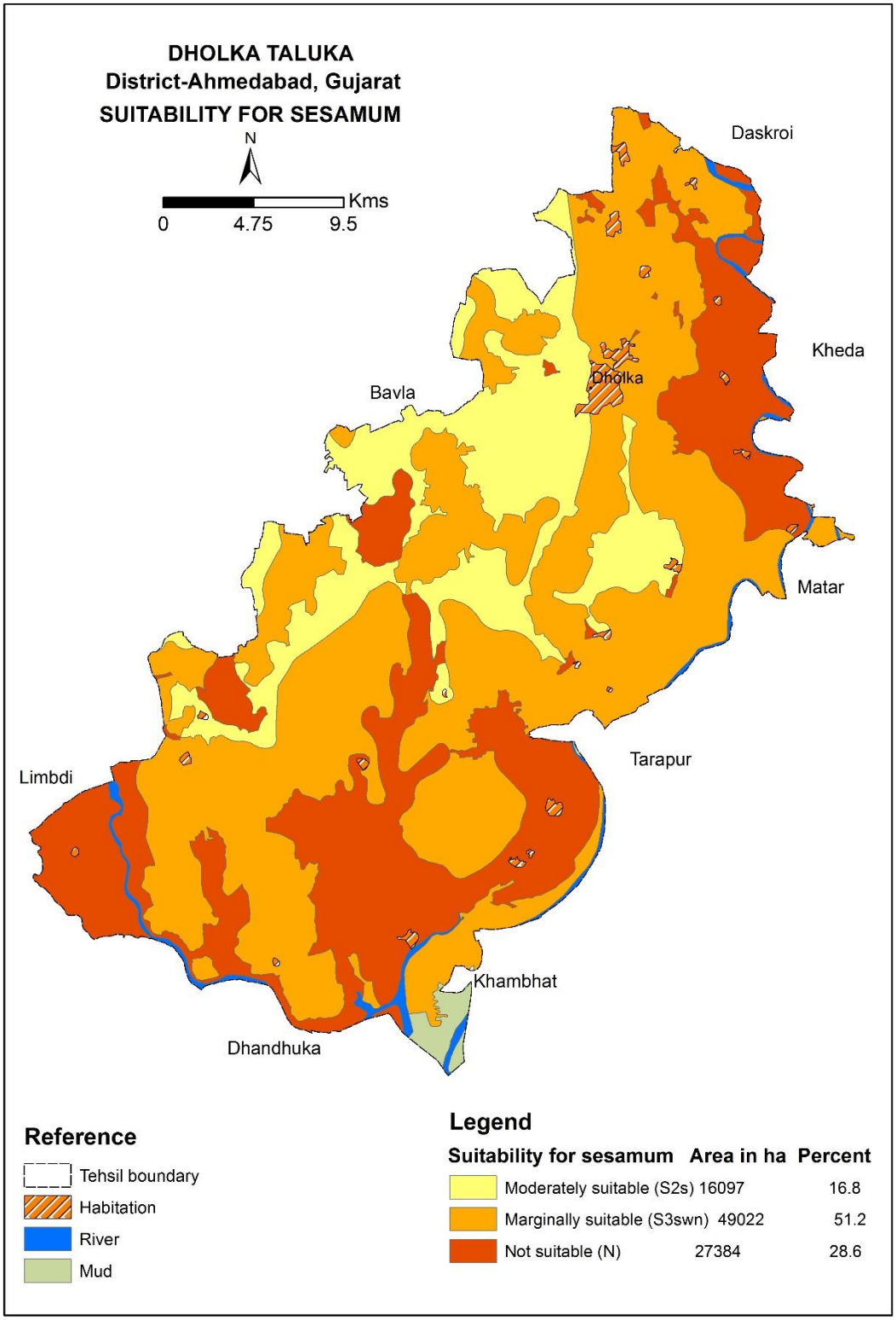

Fig. 6.10. Soil-site suitability map for Til (Sesamum) of Dholka block

6.4. Land Management Units (LMU)

Land management and planning is crucial for present and future use of land and the sustainability of land resources. Soil site characteristics and physico-chemical properties of soils can be used to define Land Management Units (LMUs) that aid in decision making for managing land and communicating information between different research and application domains. Land units as parts of a landscape having similar genesis and ecological conditions having similarity in terms of topography, soils, vegetation, and climate. A group of biotic and abiotic factors pose distinguishable structure and function within the continuum of landscape such as geomorphology, surface hydrology, microclimate and vegetation. Soils of Dholka block has been grouped in seven LMUs for their best management, planning and agricultural developments. Majority soils of the area occurring in LMU 1 (48.2%) are recommended for rice-durum wheat and planting of pigeon pea on bunds all around the rice fields. LMUs are delineated in Fig. 6.11 and recommendation are given in table 6.11

Table 6.11: Suggested land use plan for different LMUs in Dholka block

LMUs	Area (ha)	Area (%)	Major constraints	Potentials	Recommendations	Soil and water conservation/ amelioration
1	7293	7.6	Imperfectly to moderately drained, strongly alkaline, slight to moderate salinity and occasional flooding	Deep, fine to fine silty soils on level to nearly level slope, medium to high organic matter, medium to high in available water content.	Rice-durum wheat/late black gram, Pigeon pea on bunds all around the rice fields	Addition of gypsum, trench drainage or line drain system
2	46123	48.2	Imperfectly drained, strongly to very strongly alkaline, moderate sodicity	Deep, fine to fine loamy soils on level to nearly level slope, medium organic matter, medium in available water content.	Rice-durum wheat, Pigeon pea on bunds all around the rice fields	Addition of gypsum, trench drainage or line drain system
3	839	0.9	Imperfectly drained, very strongly alkaline, strong sodicity	Deep, fine soils on level to nearly level slope, medium organic matter, medium in available water content.	Rice-rice, Pigeon pea on bunds all around the rice fields	Addition of gypsum, trench drainage or line drain system
4	15820	16.5	Very poor to imperfectly drained, strongly to very	Deep, fine soils on level to nearly level slope,	Rice-durum wheat/Guar/Dhaincha,	Surface flushing of salts, addition of

			strongly alkaline, moderate to strong salinity and sodicity, occasional flooding	medium organic matter, medium to very high in available water content	Pigeon pea on bunds all around the rice fields	gypsum, trench drainage or line drain system
5	11928	12.5	Imperfectly to moderately well drained, strongly to very strongly alkaline, moderate salinity and severe sodicity	Deep, fine to fine loamy soils on level to nearly level slope, high in available water content	Rice-sorghum/Bajra/pea/Dhaincha, Pigeon pea on bunds all around the rice fields	Addition of gypsum, trench drainage or line drain system
6	4069	4.2	Imperfectly drained, strongly to very strongly alkaline, very strong salinity and severe sodicity, frequent flooding	Deep	Rice-Dhaincha/Guar, Pigeon pea on bunds all around the rice fields	Surface flushing of salts, trench drainage or line drain system
7	6433	6.7	Moderately well drained, strongly alkaline.	Deep, coarse loamy soils on gently sloping plain, medium to high in organic matter, high to very high in available water content	Cotton-wheat/custard apple/papaya/vegetables	Mulching, FYM and sprinkler or drip irrigation

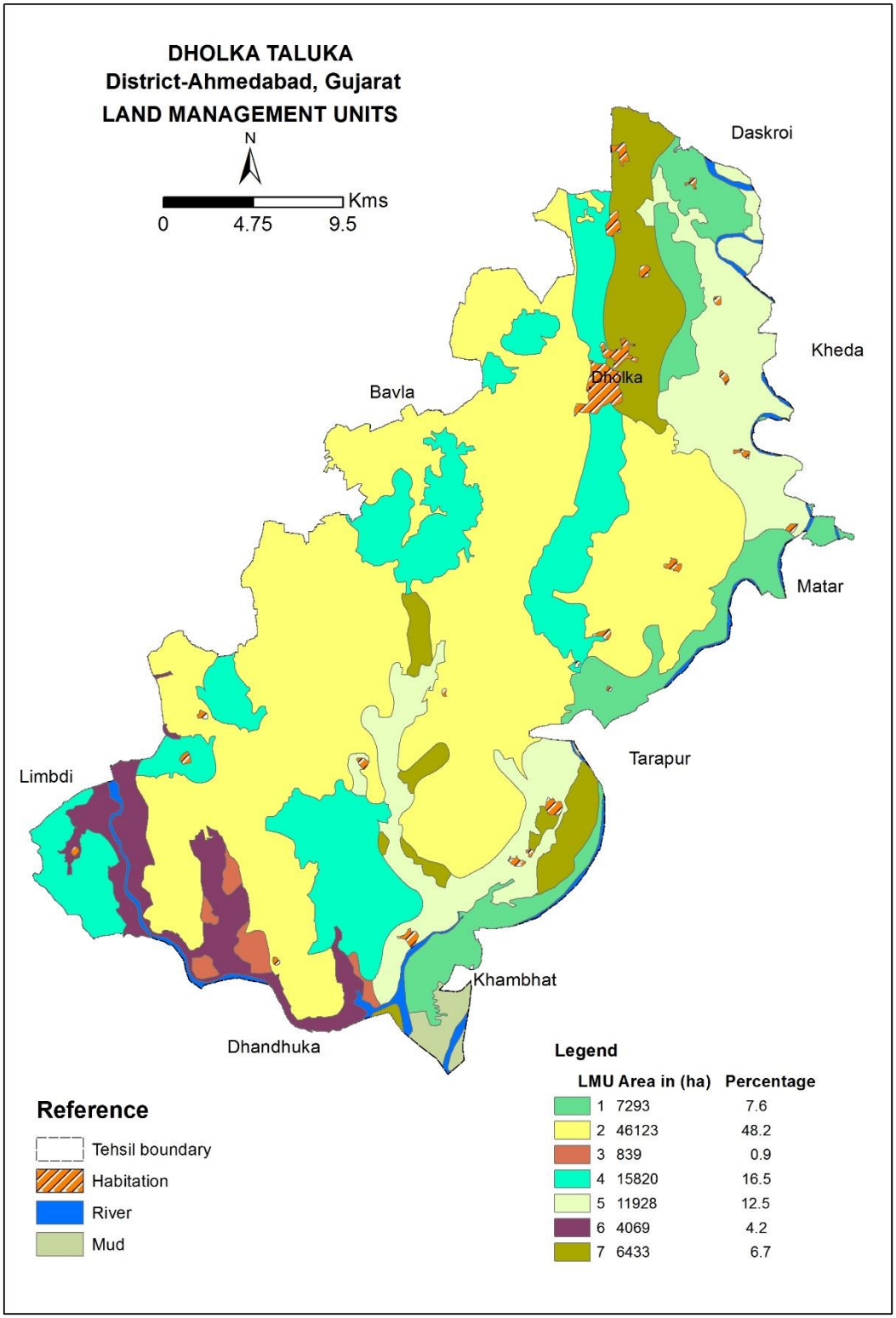

Fig. 6.10. Land management unit map of Dholka block

CONCLUSIONS

Soil survey of Dholka block, Ahmedabad district, Gujarat was carried out on 1:10k scale and soils were mapped in 19 phases of 11 soil series. Soils classified in Aridisols, Entisols, Inceptisols, and Vertisols soil orders. The findings of the present study may be concluded as:

- Geological material in study area deposited in four depositional stages. Continued sedimentation in the Dholka block during the Paleocene age and onwards, under varying depositional environments, the smectitic and vertic intergrades were formed.
- Majority of the soils (43.6%) of Dholka block are Sodic Vertisols followed by Vertic intergrades (25% area). Shrink-well type of clay minerals are dominating which were formed by weathering of limestone, basalt, or other calcium-and-magnesium rich parent materials mostly under sub-humid to semiarid climatic conditions.
- A supply of cations, iron, magnesium, calcium and sodium, excess of dissolved silica, and an alkaline environment in low-lying topography, poor drainage and base rich parent materials, positively influence the formation of Vertisols and Vertic intergrades. The smectites were mainly transformed or inherited from the parent material in soils of micro high topography and through the process of neoformation in micro low topography.
- Long-term and continuous cultivation of puddled rice under flood irrigation with underground or canal water, translocation and deposition of alluvium which is rich in soluble salts through the flow of Sabarmati river, make the soils strongly alkaline and sodic or saline sodic.

Inundation and seepage of seawater developed the salinity in soils situated on low-lying topographical positions near to ocean.

- Natural drainage is the major problem in majority of area (very poor drainage 8.2% and imperfect drainage 69.9%) due to finer soil texture and sodium saturated exchange complex, which disperse the soil aggregates and clog the natural pores. Further the soils are under continuous paddy cultivation that develop a partially impermeable layer at certain depth of soils and stop the underground movement of water. The problem is more prominent in low lying area, therefore installation of underground drainage network in Dholka block is recommended for better soil-water management and planning. Cultivation of rice with SRI technology could restore natural drainage and support for sustainable land resource utilization.
- Leaching of soluble salts below the root zone with good quality water or surface flushing of saline soils is recommended for the low lying young coastal plain. Flooding after setting of tile drains is the most effective way for ameliorating the saline soils.
- Area needs immediate attention of line departments. Fine powdered commercial grade gypsum @ 30-40 tonnes per hectare in plough layer (0-15 cm) may be applied for reclamation of sodic soils of Dholi, Ganeshpur, Loliya1 and Loliya2 series of Dholka block for sustainable land use.
- Based on degree and extent of limitations and potentials of land resources of Dholka block, soils evaluated for suitability of major crops grown in area. Identified seven LMUs for sustainable land use among the farming communities of block. The findings of the present

study may be used for up-scaling the research in adjoining blocks of Ahmedabad, Bhavnagar, Bharuch, Anand and Vadodara districts situated on west coast physiography of Gujarat.

- The soil map, suitability maps, LMU map and thematic maps of Dholka block can be viewed on BHOOMI Geoportal (http://www.bhoomigeoportal-nbsslup.in/) and digital India platform by the name of soil information system (https://ncog.gov.in/SIS/login).

REFERENCES

Ahmedabad district gazetteer 1984. Ahmedabad district gazetteer (edited by Rajyagor, S. B., Tripathy S. and Chokshi U. M.), Gujarat state gazetteers, Government of Gujarat, Printed by Government printing, stationary and publications, Gujarat state, Ahmedabad, pp 14-17.

CGWB 2014. Ground Water Brochure, Ahmedabad district, Gujarat, Technical Report Series, Central Ground Water Board, West Central Region, Ahmedabad, Government of India.

Dobos, E., Micheli, E., Baumgardner, M.F., Biehl, L. and Helt, T. 2000. Use of combined digital elevation model and satellite radiometric data for regional soil mapping. *Geoderma* 7:367–391.

FAO (Food and Agriculture Organization). 1976. *A Framework for Land Evaluation*. Soils Bulletin 32, Rome.

https://ahmedabad.nic.in/village-panchayats/ "Ahmedabad district: Census 2011 data". Archived from the original on 12 June 2019. Retrieved 28 May 2019.

https://en.climate-data.org/asia/india/gujarat/ahmedabad-2828/. Archived and retrieved from the original on 12 March 2020.

Jackson, M.L. 1973. *Soil Chemical Analysis*. New Delhi: Prentice Hall.

Jenny, H. 1941. Factors of Soil Formation. *A System of Quantitative Pedology*. New York: McGraw-Hill.

Manchanda, M.L., Kudrat, M. and Tiwari, A.K. 2002. Soil survey and mapping using remote sensing. *Tropical Ecology* 43:61-74.

McBratney, A.B., Santos, M.L.M. and Minasny, B. 2003. On digital soil mapping. *Geoderma* 117:3-52.

Nagaraju, M.S.S., Kumar, N., Srivastava, R. and Das, S.N. 2014. Cadastral-level soil mapping in basaltic terrain using Cartosat-1-derived products. *International Journal of Remote Sensing* 35:3764-3781.

Naidu, L.G.K., Ramamurthy, V., Challa, O., Hegde, R. and Krishnan, P. 2006. Soil Site Suitability Criteria for Major Crops. *NBSS Publ. No.129,* NBSS & LUP, Nagpur.

Page, A.L. 1982. Methods of soil analysis. Part 2: Chemical and mineralogical properties, 2nd eds., Am. Soc. Agron., Madison, WI, USA.

Piper, C. S. (1966). Soil and Plant Analysis. Hans Publishers, Bombay.

Richards, L.A. 1954. *Diagnosis and Improvement of Saline and Alkaline Soils*. Agriculture Handbook No. 60. Washington, DC: USDA.

Sehgal, J. L., Mandal, D. K. and Mandal, C. 1996. Agro-ecological sub-regions map of India (1: 4.4 m) prepared and published by ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur.

Seid, N.M., Yitaferu, B., Kibret, K. and Ziadat, F. 2013. Soil-landscape modeling and remote sensing to provide spatial representation of soil attributes for an Ethiopian watershed. *Applied and Environmental Soil Science* :1-11.

Sharma R.P., Singh R.S., Naitam R.K. and Singh S.K. 2019. Technique of Large Scale Soil Mapping using Remote Sensing Satellite Data in Basaltic Terrain of Peninsular Region in the North-West Gujarat, India. *Journal of the Indian Society of Soil Science,* **67 (2),** 151-159. DOI: 10.5958/0974-0228.2019.00016.1

Sharma, R.P., Singh, R.S., Singh, S.K. and Arora, S. 2018. Land Resource Inventory (LRI) for development of sustainable agricultural land use plans using geospatial techniques: A case study of Pata Meghpar village, Jamnagar district, Gujarat. *Journal of Soil and Water Conservation,* **17(1)**, 15-24. DOI: 10.5958/2455-7145.2018.00003.6

Singh, S.K., Chatterji, S., Chattaraj, S. and Butte, P.S. 2016. Land Resource Inventory on 1:10000 scale, Why and How? *NBSS Publ. No. 172*. ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur, India. pp.110.

Soil Survey Division Staff. 2000. *Soil Survey Manual*. Soil Conservation Service. USDA Handbook 18, Revised. Jodhpur: Scientific Publishers.

Soil Survey Staff. 2014. *Keys to Soil Taxonomy, 12th Eds*. Washington, DC: USDA. Natural Resources Conservation Service.

Srivastava, R. and Saxena, R.K. 2004. Technique of large-scale soil mapping in Basaltic terrain using satellite remote sensing data. *International Journal of Remote Sensing* 25:679-688.

Sys, C., Van Ranst, E. and Debaveye, J. 1991. Land Evaluation, Part-II. In: *Methods in Land Evaluation*. Agricultural Publications No.7, GADC, Brussels, Belgium.

Sys, C., Van Ranst, E., Debaveye, J. and Beernaert, F. 1993. Land Evaluation, Part-III. *Crop Requirements*. Agricultural Publications No.7, GADC, Brussels, Belgium.

Van de Wauw, J., Baert, G., Moeyersons, J., Nyssen, J., De Geyndt, K., Taha, N., Zenebe, A., Poesen, J. and Deckers, J. 2008. Soil-landscape relationships in the Basalt-dominated highlands of Tigray, Ethiopia. *Catena* 75:117-127.

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ANNEXURE-I

1. AMLIYARA SERIES

Classification	**:**	Fine loamy, mixed, hyperthermic, Fluventic Haplustepts
Type location	**:**	Village – Amliyara, Taluka - Dholka, District - Ahmedabad, Gujarat (22º46'13.6" N latitudes and 72º30'35.0" E longitudes).
Profile no.	**:**	MP20
Physiographic position	**:**	Gujarat coastal plain-West coast plain-Alluvial plain
Elevation	**:**	19 M above MSL
Ground water table	**:**	2.0-5.0 m
Rainfall	**:**	753 mm
Slope, erosion &relief	**:**	Level to nearly level slope (0-1%), slight, normal
Drainage& permeability	**:**	Imperfect with very slow permeability
Land use & vegetation	**:**	double crop, rice and natural vegetation consists of Neem, Sarni, Peepal, Lasora
Geology & parent material	**:**	Alluvial
Distribution & extent	**:**	It occurs in alluvial plain in eastern part of Dholka and occupy about 6736 ha area of Taluka.
Associated soil series	**:**	Saroda series
Soil correlation	**:**	Newly identified
Typifying pedon	**:**	Amliyara loam –double crop

Photo 1. Representative profile photo of Amliyara series

Photo 2. Landscape and land use of Amliyara series

Horizon	Depth (cm)	Description
Ap	0-20	Dark grayish brown (10 YR 4/2 M) loam; medium weak sub-angular blocky; soft, friable, slightly sticky and slightly plastic; fine many pores; fine common roots; strong effervescence; strongly alkaline (pH 8.8); gradual smooth boundary.
Bw1	20-40	Dark brown (10 YR 3/3 M) sandy loam; medium moderate sub-angular blocky; friable, slightly sticky and slightly plastic; fine many pores; fine common roots; slight effervescence; strongly alkaline (pH 9.7); gradual smooth boundary.
Bw2	40-60	Dark brown (10 YR 3/3 M) sandy clay loam; medium moderate sub-angular blocky; friable, slightly sticky and slightly plastic; fine many pores; very fine common roots; slight effervescence; strongly alkaline (pH 9.6); gradual smooth boundary.
Bw3	60-90	Dark brown (10 YR 3/3 M) sandy clay loam; medium moderate sub-angular blocky; friable, slightly sticky and slightly plastic; fine many pores; slight effervescence; strongly alkaline (pH 9.6); gradual smooth boundary.
Bw4	90-125	Dark brown (10 YR 3/3 M) sandy clay loam; medium moderate sub-angular blocky; friable, slightly sticky and slightly plastic; fine common pores; slight effervescence; strongly alkaline (pH 9.4).

Range of Characteristics: The thickness of the solum is 100-125 cm. The thickness of A horizon is 15 to 22 cm. Its colour in hue is 10 YR, value 4 and chroma 2 to 3 and texture varies from sandy clay loam to loam, structure is medium weak sub angular blocky. The thickness of B horizon 90-105 cm, colour of B horizon is in hue 10YR, value 3 to 4 and chroma 3 to 4, texture is sandy loam to sandy clay loam and structure is medium moderate sub angular blocky. After the depth of 110-125 cm soils are saturated with water.

Interpretation: These soils are deep to very deep, fine loamy on level to nearly level slope, imperfectly to poorly drained with moderate permeability, moderate in water holding capacity and

nutrient reserves. Presently majority of the soils of the series are under double crop like rice and wheat/gram. High exchangeable sodium percentage (ESP 25-67) in soil control section deteriorated the soil structure and other physical properties of soils which affects natural internal drainage. Soils are strongly alkaline with slight salinity problem and high base status. Application of soil amendments like gypsum followed by artificial draining of soluble salts is recommended to bring the soil sodicity and salinity at optimum level. The soils of the series are affected with moderate flooding problems due to nearness of Sabarmati river. At an interval of 10-15 years flood water stands up to 10-12 fit height during monsoon season and deposits fresh alluvium on soil surface.

Interpretative grouping:

(i) Land Capability subclass: IIIs

(ii) Land Irrigability subclass: 4s

(iii) Productivity potential: low

Soil Series: Amliyara Classification: Fluventic Haplustepts

Location: Village – Amliyara, Taluka - Dholka, District - Ahmedabad, Gujarat

Horizon	Depth (cm)	Particle size class and diameter in mm								
		Total (%)						Water retention		
		Sand	Silt	Clay	Texture	COLE	BD	33 kPa	1500 kPa	AWC
		2.0-0.05	0.05-0.002	<0.002			Mg m^{-3}	%	%	%
Ap	0-20	48.8	31.4	19.8	l	-	1.4	25.3	16.3	9.1
Bw1	20-40	54.4	25.9	19.7	sl	-	1.4	29.6	18.2	11.4
Bw2	40-60	50.7	27.2	22.1	scl	-	1.4	33.4	22.7	10.7
Bw3	60-90	52.7	24.5	22.8	scl	-	1.4	36.3	20.1	16.2
Bw4	90-125	52.8	22.4	24.8	scl	-	1.4	39.3	23.7	15.6

Volumetric water content: 178 mm m^{-1}

Depth (cm)	pH (H_2O)	EC (dSm^{-1})	Org. C	$CaCO_3$	Exchangeable Cations				CEC	B.S.	ESP
					Ca	Mg	Na	K		%	%
	-----1:2.5----		-------%-------		----------cmol (p^+) kg^{-1}-------						
0-20	8.8	1.6	0.8	6.1	5.6	4.0	3.8	0.3	14.8	92.7	25.6
20-40	9.7	1.8	0.3	3.5	2.8	4.0	10.5	0.2	18.9	92.8	55.7
40-60	9.6	1.7	0.2	3.7	4.8	2.0	14.3	0.3	22.0	97.4	65.3
60-90	9.6	1.9	0.2	4.0	4.4	2.8	15.3	0.2	23.7	95.9	64.7
90-125	9.4	2.2	0.2	3.3	5.6	1.2	17.4	0.2	25.7	94.8	67.7

2. BADARKHA SERIES

Classification	**:**	Coarse loamy, mixed, hyperthermic, Typic Haplustepts
Type location	**:**	Village – Badarkha, Taluka - Dholka, District - Ahmedabad, Gujarat (22º49'27.4" N latitudes and 72º27'11.1" E longitudes).
Profile no.	**:**	MP14
Physiographic position	**:**	Gujarat coastal plain-West coast plain-Alluvial plain
Elevation	**:**	25 M above MSL
Ground water table	**:**	>10 m
Rainfall	**:**	753 mm
Slope, erosion &relief	**:**	Very gentle slope (1-3%), moderate, normal
Drainage& permeability	**:**	Moderately well to well with moderate permeability
Land use & vegetation	:	double crop, rice and natural vegetation consists of Neem, moringa, tamarind
Geology & parent material	**:**	Alluvial
Distribution & extent	**:**	It occurs in western part of alluvial plain in the form of strip of Dholka town and occupy about 4170 ha area of Taluka.
Associated soil series	**:**	Girand, Saroda and Dholi series
Soil correlation	**:**	Newly identified
Typifying pedon	**:**	Badarkha loam –double crop

Photo 3. Representative profile photo of Badarkha series

Photo 4. Landscape and land use of Badarkha series

Horizon	Depth (cm)	Description
Ap	0-15	Dark brown (10 YR 3/3 M) loam; medium weak sub-angular blocky; soft, friable, slightly sticky and slightly plastic; very fine many pores; fine common roots; strong effervescence; strongly alkaline (pH 9.3); gradual smooth boundary.
Bw1	15-38	Dark brown (10 YR 3/3 M) loam; medium moderate sub-angular blocky; friable, slightly sticky and slightly plastic; very fine many pores; very fine common roots; strong effervescence; strongly alkaline (pH 9.2); gradual smooth boundary.
Bw2	38-68	Dark brown (10 YR 3/3 M) loam; medium moderate sub-angular blocky; friable, sticky and plastic; very fine many pores; very fine few roots; strong effervescence; strongly alkaline (pH 9.1); gradual smooth boundary.
Bw3	68-93	Dark brown (10 YR 3/3 M) loam; medium moderate sub-angular blocky; friable, slightly sticky and slightly plastic; fine common pores; strong effervescence; strongly alkaline (pH 8.6); gradual smooth boundary.
Bw4	93-135	Dark yellowish brown (10 YR 3/4 M) loam; medium moderate sub-angular blocky; friable, slightly sticky and slightly plastic; fine common pores; strong effervescence; strongly alkaline (pH 8.5).

Range of Characteristics: The thickness of the solum is 130-142 cm. The thickness of A horizon is 14 to 18 cm. Its colour in hue is 10 YR, value 3 and chroma 3 and texture is loamy, structure is medium weak sub angular blocky. The thickness of B horizon 118-125 cm, colour of B horizon is in hue 10YR, value 3 and chroma 3 to 4, texture is loam to clay loam and structure is medium moderate sub angular blocky.

Interpretation: These soils are deep and loam in texture on very gentle slope, moderately well well drained with moderate permeability, moderate in water holding capacity and nutrient reserves. Presently majority of the soils of the series are under double crop like rice and wheat/gram. Soils

are strongly alkaline and moderate base status. The soils are fit for growing majority of crops climatically suitable in the region without any problem except higher level of pH. Use of appropriate soil amendments are recommended to optimize soil pH.

Interpretative grouping:

(i) Land Capability subclass: IIs

(ii) Land Irrigability subclass: 2s

(iii) Productivity potential: moderate

Soil Series: Badarkha Classification: Typic Haplustepts

Location: Village – Badarkha, Taluka - Dholka, District - Ahmedabad, Gujarat

Horizon	Depth (cm)	Particle size class and diameter in mm								
		Total (%)						Water retention		
		Sand	Silt	Clay	Texture	COLE	BD	33 kPa	1500 kPa	AWC
		2.0-0.05	0.05-0.002	<0.002			Mg m^{-3}	%	%	%
Ap	0-15	47.9	31.3	20.8	l	-	1.4	26.7	12.5	14.2
Bw1	15-38	31.3	43.4	25.3	l	-	1.4	31.0	15.8	15.2
Bw2	38-68	29.3	44.1	26.6	l	-	1.3	29.4	16.3	13.1
Bw3	68-93	45.4	31.3	23.3	l	-	1.4	27.5	12.8	14.7
Bw4	93-135	50.0	28.3	21.7	l	-	1.4	25.9	11.1	14.8

Volumetric water content: 160 mm m^{-1}

Depth (cm)	pH (H_2O)	EC (dSm^{-1})	Org. C	$CaCO_3$	Exchangeable Cations				CEC	B.S.	ESP %
					Ca	Mg	Na	K		%	
	-----1:2.5----		-------%-------		----------cmol (p^+) kg^{-1}-------						
0-15	9.3	0.4	0.8	9.6	7.6	8.4	1.6	0.1	23.0	76.8	6.9
15-38	9.2	0.4	0.6	9.6	8.8	7.2	1.7	0.1	25.2	70.6	6.6
38-68	9.1	0.4	0.4	7.0	8.8	8.4	1.3	0.2	25.7	72.6	5.1
68-93	8.6	0.7	0.3	6.0	9.2	6.8	1.0	0.1	23.9	71.5	4.1
93-135	8.5	0.7	0.2	5.6	8.8	7.2	1.0	0.1	19.2	89.3	5.4

3. DHOLI SERIES

Classification	**:**	Fine, smectitic, hyperthermic, Sodic Haplusterts
Type location	**:**	Village – Dholi, Taluka - Dholka, District - Ahmedabad, Gujarat (22º34'36.3" N latitudes and 72º20'52.4" E longitudes).
Profile no.	**:**	MP24
Physiographic position	**:**	Gujarat coastal plain-West coast plain-Alluvial plain
Elevation	**:**	22 M above MSL
Ground water table	**:**	>10 m
Rainfall	**:**	753 mm
Slope, erosion &relief	**:**	Level to nearly level slope (0-1%), slight, normal
Drainage& permeability	**:**	Moderately well with very slow permeability
Land use & vegetation	**:**	Single crop, sorghum/bajra and natural vegetation consists of Khejri and Babul
Geology & parent material	**:**	Alluvial
Distribution & extent	**:**	It occurs in alluvial plain in southern part of Dholka town and occupy about 5192 ha area of Taluka.
Associated soil series	**:**	Badarkha and Anandpura series
Soil correlation	**:**	Newly identified
Typifying pedon	**:**	Dholi clay loam –Single crop

Photo 5. Representative profile photo of Dholi series

Photo 6. Landscape and land use of Dholi series

Horizon	Depth (cm)	Description
Ap	0-6	Very dark gray (10 YR 3/1 M) clay loam; medium moderate sub-angular blocky; extremely hard, very firm, sticky and plastic; fine many pores; very fine few roots; violent effervescence; strongly alkaline (pH 9.2); gradual smooth boundary.
Bw	6-42	Very dark gray (10 YR 3/1 M) clayey; medium coarse sub-angular blocky; very firm, very sticky and very plastic; very fine many pores; fine few roots; violent effervescence; strongly alkaline (pH 9.5); gradual smooth boundary.
Bss1	42-67	Very dark gray (10 YR 3/1 M) clayey; medium moderate angular blocky; very firm, very sticky and very plastic; very fine many pores; coarse few roots; violent effervescence; strongly alkaline (pH 9.3); gradual smooth boundary.
Bss2	67-90	Very dark grayish brown (10 YR 3/2 M) clayey; medium moderate angular blocky; very firm, very sticky and very plastic; very fine many pores; coarse few roots; violent effervescence; strongly alkaline (pH 8.7); gradual smooth boundary.
Bss3	90-110	Very dark grayish brown (10 YR 3/2 M) clayey; medium moderate angular blocky; very firm, very sticky and very plastic; very fine many pores; violent effervescence; strongly alkaline (pH 9.2); gradual smooth boundary.
Bss4	110-130	Dark brown (10 YR 3/3 M) clayey; medium moderate angular blocky; very firm, very sticky and very plastic; very fine many pores; violent effervescence; strongly alkaline (pH 9.2); clear smooth boundary.
BC	130-150	Dark brown (10 YR 4/4 M) clayey; medium moderate sub-angular blocky; firm, sticky and plastic; fine many pores; violent effervescence; strongly alkaline (pH 9.2); gradual smooth boundary.

Range of Characteristics: The thickness of the solum is 110-130 cm. The thickness of A horizon is 5 to 12 cm. Its colour in hue is 10 YR, value 3 and chroma 1 to 3 and texture varies from clay to clay loam, structure is fine moderate sub angular blocky to medium moderate sub angular blocky. The thickness of B horizon 90-118 cm, colour of B horizon is in hue 10YR, value 3 to 4 and chroma 1 to 4, texture is clayey and structure is medium moderate sub angular blocky to medium coarse sub-angular/angular blocky. The thickness of BC horizon is 15-20 cm with clayey to silty clay texture without presence of any gravels. Very fine few to fine many calcium carbonate nodules are present throughout the layers of profile. More than 2 cm wide and 50 cm deep cracks are observed in these soils. Slicken sides were partially masked due to the aridity and higher exchangeable sodium on clay and pressure faces were visible as usual.

Interpretation: These soils are deep to very deep, fine on level to nearly level slope, imperfectly to moderately well drained with slow permeability, very high in water holding capacity and nutrient reserves. Presently majority of the soils of the series are under single crop like sorghum and/or Bajra in rain fed conditions. High exchangeable sodium percentage (ESP 33-80) in soil control section deteriorated the soil structure and other physical properties of soils which affects natural internal drainage. Soils are strongly alkaline with slight salinity problem and high base status. Application of soil amendments like gypsum followed by leaching of soluble salts is recommended to bring the soil sodicity and salinity at optimum level.

Interpretative grouping:

(i) Land Capability subclass: IIIs

(ii) Land Irrigability subclass: 4s

(iii) Productivity potential: low

Soil Series: Dholi Classification: Sodic Haplusterts

Location: Village – Dholi, Taluka - Dholka, District - Ahmedabad, Gujarat

Horizon	Depth (cm)	Particle size class and diameter in mm								
		Total (%)						Water retention		
		Sand	Silt	Clay	Texture	COLE	BD	33 kPa	1500 kPa	AWC
		2.0-0.05	0.05-0.002	<0.002			Mg m^{-3}	%	%	%
Ap	0-6	32.8	31.8	35.4	cl	0.13	1.3	25.9	16.1	9.8
Bw	6-42	31.2	28.5	40.3	c	0.11	1.3	42.5	20.7	21.8
Bss1	42-67	26.6	27.3	46.1	c	0.17	1.3	40.5	25.1	15.3
Bss2	67-90	23.6	30.4	46.0	c	0.16	1.3	45.3	22.3	23.0
Bss3	90-110	24.7	27.4	47.9	c	0.15	1.3	46.5	23.4	23.1
Bss4	110-130	24.2	30.8	45.0	c	0.19		37.3	23.4	14.0
BC	130-150	27.7	31.4	40.9	c	0.16		34.1	21.3	12.8

Volumetric water content: 262 mm m^{-1}

Depth (cm)	pH (H_2O)	EC (dSm^{-1})	Org. C	$CaCO_3$	Exchangeable Cations				CEC	B.S.	ESP
					Ca	Mg	Na	K		%	%
	-----1:2.5----		-------%-------		----------cmol (p^+) kg^{-1}-------						
0-6	9.2	0.3	0.4	13.8	16.4	6.0	3.6	0.4	37.7	70.0	9.5
6-42	9.5	0.5	0.3	13.3	12.0	6.4	10.7	0.3	32.5	90.6	33.0
42-67	9.3	2.5	0.3	11.9	8.0	5.6	23.4	0.5	39.9	94.1	58.7
67-90	8.7	5.8	0.2	13.3	6.8	6.4	28.0	0.6	43.2	97.0	79.9
90-110	9.2	4.7	0.2	13.8	6.0	6.0	30.9	0.8	45.4	96.2	80.5
110-130	9.2	5.8	0.2	17.5	5.6	4.8	31.4	0.6	44.6	95.1	80.6
130-150	9.2	5.2	0.2	21.7	3.6	5.6	26.5	0.6	37.3	97.3	71.0

4. GIRAND SERIES

Classification	**:**	Fine, mixed, hyperthermic, Typic Haplustepts
Type location	**:**	Village – Girand, Taluka - Dholka, District - Ahmedabad, Gujarat (22º38'55.8" N latitudes and 72º31'00.2" E longitudes).
Profile no.	**:**	MP17
Physiographic position	**:**	Gujarat coastal plain-West coast plain-Alluvial plain
Elevation	**:**	20 M above MSL
Ground water table	**:**	>10 m
Rainfall	**:**	753 mm
Slope, erosion &relief	**:**	Very gentle slope (1-3%), moderate, normal
Drainage& permeability	**:**	Moderately well with moderate permeability
Land use & vegetation	**:**	double crop, rice, wheat and natural vegetation consists of Neem, Babul
Geology & parent material	**:**	Alluvial
Distribution & extent	**:**	It occurs in alluvial plain from north to south direction in the form of strip in Dholka town and occupy about 3376 ha area of Taluka.
Associated soil series	**:**	Badarkha, Ganeshpur and Dholi series
Soil correlation	**:**	Newly identified
Typifying pedon	**:**	Girand silty loam –double crop

Photo 7. Representative profile photo of Girand series

Photo 8. Landscape and land use of Girand series

Horizon	Depth (cm)	Description
Ap	0-17	Dark grayish brown (10 YR 4/2 M) silt loam; medium weak sub-angular blocky; slightly hard, firm, sticky and plastic; fine common pores; medium common roots; slight effervescence; strongly alkaline (pH 8.7); abrupt smooth boundary.
Bw1	17-44	Dark brown (10 YR 3/3 M) clay loam; medium moderate sub-angular blocky; firm, sticky and plastic; fine many pores; medium common roots; slight effervescence; strongly alkaline (pH 8.7); clear smooth boundary.
Bw2	44-70	Very dark grayish brown (10 YR 3/2 M) clay loam; medium moderate sub-angular blocky; firm, sticky and plastic; fine many pores; fine common roots; slight effervescence; strongly alkaline (pH 9.0); gradual smooth boundary.
Bw3	70-106	Very dark grayish brown (10 YR 3/2 M) clay loam; medium moderate sub-angular blocky; firm, sticky and plastic; very fine many pores; slight effervescence; strongly alkaline (pH 8.9); gradual smooth boundary.
Bw4	106-145	Very dark grayish brown (10 YR 3/2 M) sandy clay loam; medium moderate sub-angular blocky; firm, sticky and plastic; fine many pores; slight effervescence; strongly alkaline (pH 8.8).

Range of Characteristics: The thickness of the solum is 140-150 cm. The thickness of A horizon is 16 to 20 cm. Its colour in hue is 10 YR, value 4 and chroma 2 to 3 and texture varies from silty clay loam to clay loam, structure is medium weak sub angular blocky. The thickness of B horizon 124-135 cm, colour of B horizon is in hue 10YR, value 3 to 4 and chroma 2 to 3, texture is clay loam to sandy clay loam and structure is medium moderate sub angular blocky.

Interpretation: These soils are deep to very deep and silt loam to clay loam in texture on level to nearly level slope, moderately well drained with moderate permeability, moderate to high in water holding capacity and nutrient reserves. Presently majority of the soils of the series are under double

crop like rice and wheat/gram. Soils are strongly alkaline and high base status. Soils occasionally suffer with flooding in rainy season which insists the framers to grow paddy in Kharif season. Wheat or gram is cultivated in Rabi season on stored moisture along with lifesaving irrigation from Sabarmati river.

Interpretative grouping:

(i) Land Capability subclass: IIs

(ii) Land Irrigability subclass: 2s

(iii) Productivity potential: moderate

Soil Series: Girand Classification: Typic Haplustepts

Location: Village – Girand, Taluka - Dholka, District - Ahmedabad, Gujarat

Horizon	Depth (cm)	Particle size class and diameter in mm								
		Total (%)						Water retention		
		Sand	Silt	Clay	Texture	COLE	BD	33 kPa	1500 kPa	AWC
		2.0-0.05	0.05-0.002	<0.002			Mg m^{-3}	%	%	%
Ap	0-17	27.2	50.6	22.2	sil	-	1.4	31.4	13.3	18.1
Bw1	17-44	31.0	39.8	29.2	cl	-	1.3	30.9	17.3	13.6
Bw2	44-70	31.9	38.8	29.3	cl	-	1.3	28.8	17.0	11.8
Bw3	70-106	43.1	23.4	33.5	cl	-	1.3	27.9	12.0	16.0
Bw4	106-145	50.3	16.9	32.8	scl	-		26.9	14.7	12.3

Volumetric water content: 190 mm m^{-1}

Depth (cm)	pH (H_2O)	EC (dSm^{-1})	Org. C	$CaCO_3$	Exchangeable Cations				CEC	B.S.	ESP
					Ca	Mg	Na	K		%	%
	-----1:2.5----		-------%-------		----------cmol (p^+) kg^{-1}-------						
0-17	8.7	0.5	0.7	5.4	10.0	5.3	1.5	0.4	25.3	68.0	5.8
17-44	8.7	0.3	0.4	4.0	15.6	3.6	2.2	0.3	27.0	80.3	8.1
44-70	9.0	0.3	0.4	3.6	18.4	4.0	2.4	0.3	29.9	83.8	7.9
70-106	8.9	0.3	0.4	3.9	19.2	4.0	2.6	0.3	27.1	96.3	9.6
106-145	8.8	0.3	0.2	2.0	16.0	4.4	2.1	0.3	25.8	88.3	8.0

5. SARODA SERIES

Classification	**:**	Loamy, mixed, hyperthermic, Typic Haplustepts
Type location	**:**	Village – Saroda, Taluka - Dholka, District - Ahmedabad, Gujarat (22º49'12.3" N latitudes and 72º29'49.2" E longitudes).
Profile no.	**:**	MP19
Physiographic position	**:**	Gujarat coastal plain-West coast plain-Alluvial plain
Elevation	**:**	26 M above MSL
Ground water table	**:**	>10 m
Rainfall	**:**	753 mm
Slope, erosion &relief	**:**	Level to nearly level slope (0-1%), slight, normal
Drainage& permeability	**:**	Moderately well with moderately rapid permeability
Land use & vegetation	**:**	double crop, Cotton/Caster and natural vegetation consists of Neem, Jamun and Babul
Geology & parent material	**:**	Alluvial
Distribution & extent	**:**	It occurs in alluvial plain in eastern part of Dholka town and occupy about 2823 ha area of Taluka.
Associated soil series	**:**	Badarkha and Anandpura series
Soil correlation	**:**	Newly identified
Typifying pedon	**:**	Saroda loam –double crop

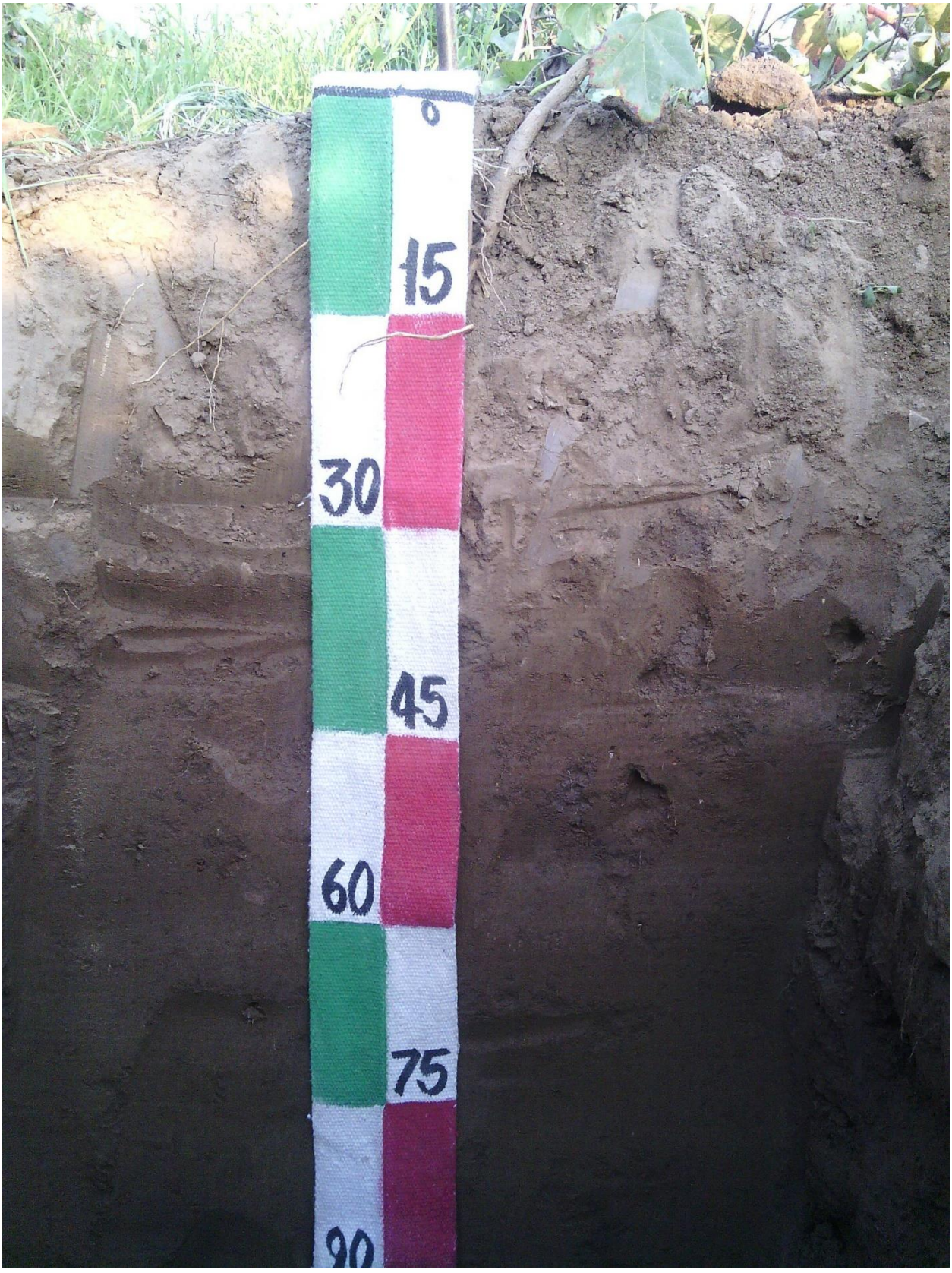

Photo 9. Representative profile photo of Saroda series

Photo 10. Landscape and land use of Saroda series

Horizon	Depth (cm)	Description
Ap	0-25	Brown (10 YR 4/3 M) loam; medium moderate crumb; slightly hard, friable, slightly sticky and slightly plastic; fine to very fine many pores; very fine many roots; slight effervescence; strongly alkaline (pH 8.7); gradual smooth boundary.
Bw1	25-40	Brown (10 YR 4/3 M) loam; medium moderate crumb; friable, slightly sticky and slightly plastic; very fine many pores; very fine many roots; slight effervescence; strongly alkaline (pH 9.2); gradual smooth boundary.
Bw2	40-62	Dark yellowish brown (10 YR 3/4 M) sandy loam; medium moderate sub-angular blocky; friable, slightly sticky and slightly plastic; very fine many pores; medium few roots; slight effervescence; strongly alkaline (pH 9.3); gradual smooth boundary.
Bw3	62-90	Dark yellowish brown (10 YR 3/4 M) sandy loam; medium moderate sub-angular blocky; friable, slightly sticky and slightly plastic; very fine many pores; medium few roots; slight effervescence; strongly alkaline (pH 9.5); gradual smooth boundary.
Bw4	90-125	Dark yellowish brown (10 YR 3/4 M) sandy loam; medium moderate sub-angular blocky; friable, slightly sticky and slightly plastic; very fine many pores; slight effervescence; strongly alkaline (pH 9.4).

Range of Characteristics: The thickness of the solum is 125-133 cm. The thickness of A horizon is 18 to 25 cm. Its colour in hue is 10 YR, value 4 to 5 and chroma 3 to 4 and texture varies from loam to sandy loam, structure is medium moderate crumby to medium moderate sub angular blocky. The thickness of B horizon 100-107 cm, colour of B horizon is in hue 10YR, value 3 to 4 and chroma 3 to 4, texture is sandy loam and structure is medium moderate crumby to medium moderate sub angular blocky. Calcium carbonate are present in powdered form throughout the layers of profile. Soils are strongly alkaline in reaction.

Interpretation: These soils are deep, loamy on level to nearly level slope, moderately well drained with moderate to rapid permeability, moderate in water holding capacity and nutrient reserves. Presently majority of the soils of the series are under double crop like cotton and/or caster under irrigated conditions. Soils are strongly alkaline in reaction (pH ranged from 8.7 to 9.5) and normal in soluble salt and exchangeable sodium percentage (ESP <8.5) in soil control section. The soils are irrigated from the water flowing in Sabarmati river which is contaminated by various pollutants mixed while flowing through Ahmedabad city. Such irrigation practice raised the soil pH. Therefore, the level of contamination in Sabarmati river at Dholka location should be tested before irrigation planning and assessing the quantity of water to be mixed with good quality water for safe use.

Interpretative grouping:

(i) Land Capability subclass: IIs

(ii) Land Irrigability subclass: 2s

(iii) Productivity potential: moderate

Soil Series: Saroda Classification: Typic Haplustepts

Location: Village – Saroda, Taluka - Dholka, District - Ahmedabad, Gujarat

Horizon	Depth (cm)	Particle size class and diameter in mm								
		Total (%)						Water retention		
		Sand	Silt	Clay	Texture	COLE	BD	33 kPa	1500 kPa	AWC
		2.0-0.05	0.05-0.002	<0.002			Mg m^{-3}	%	%	%
Ap	0-25	48.1	32.6	19.3	l	0.03	1.4	25.5	9.2	16.3
Bw1	25-40	49.2	33.2	17.6	l	0.02	1.4	24.8	8.6	16.2
Bw2	40-62	54.4	27.7	17.9	sl	0.02	1.5	24.6	8.5	16.0
Bw3	62-90	60.5	22.7	16.8	sl	0.01	1.5	20.2	7.5	12.7
Bw4	90-125	66.7	16.4	16.9	sl	0.02	1.5	18.9	7.7	11.2

Volumetric water content: 180 mm m^{-1}

Depth (cm)	pH (H_2O)	EC (dSm^{-1})	Org. C	$CaCO_3$	Exchangeable Cations				CEC	B.S.	ESP
					Ca	Mg	Na	K		%	%
	-----1:2.5----		-------%-------		----------cmol (p^+) kg^{-1}-------						
0-25	8.7	0.5	0.7	4.5	6.8	4.4	1.4	0.5	22.7	57.8	6.3
25-40	9.2	0.4	0.3	3.6	6.0	4.0	1.7	0.3	22.2	54.0	7.5
40-62	9.3	0.4	0.3	4.9	6.8	4.4	1.9	0.1	27.0	49.3	7.2
62-90	9.5	0.3	0.2	5.6	6.0	4.0	1.8	0.1	24.7	48.3	7.3
90-125	9.4	0.3	0.1	3.7	6.0	4.4	1.5	0.1	18.2	66.2	8.5

6. GANESHPUR SERIES

Classification	**:**	Fine, smectitic, hyperthermic, Sodic Haplusterts
Type location	**:**	Village – Raypur, Taluka - Dholka, District - Ahmedabad, Gujarat (22º33'43.4" N latitudes and 72º23'24.7" E longitudes).
Profile no.	**:**	MP10
Physiographic position	**:**	Gujarat coastal plain-West coast plain-Young coastal plain
Elevation	**:**	17 M above MSL
Ground water table	**:**	>10 m
Rainfall	**:**	753 mm
Slope, erosion &relief	**:**	Level to nearly level slope (0-1%), slight, normal
Drainage& permeability	**:**	Imperfect with slow permeability
Land use & vegetation	**:**	double crop, rice-rice/chickpea/durum wheat and natural vegetation consists of Neem (*Azadirachta indica*), Babul (*Prosopis juliflora*)
Geology & parent material	**:**	Alluvial
Distribution & extent	**:**	It occur on young coastal plain in south-western part of Dholka block and occupy about 36604 ha area.
Associated soil series	**:**	Khanpur, Loliya1 series
Soil correlation	**:**	Newly identified
Typifying pedon	**:**	Ganeshpur silty clay –double crop

Photo 11. Representative profile photo of Ganeshpur series

Photo 12. Landscape and land use of Ganeshpur series

Horizon	Depth (cm)	Description
Ap	0-18	Very dark grayish brown (10 YR 3/2 M) silty clay; medium moderate sub-angular blocky; very hard, very firm, very sticky and very plastic; very fine many pores; fine many roots; violent effervescence; strongly alkaline (pH 9.1); gradual smooth boundary.
Bw1	18-41	Very dark gray (10 YR 3/1 M) silty clay; medium coarse angular blocky; very firm, very sticky and very plastic; very fine many pores; fine common roots; violent effervescence; strongly alkaline (pH 9.4); gradual smooth boundary.
Bss1	41-69	Very dark gray (10 YR 3/1 M) clay; medium coarse angular blocky; very firm, very sticky and very plastic; very fine many pores; fine common roots; violent effervescence; strongly alkaline (pH 9.5); gradual smooth boundary.
Bss2	69-93	Very dark gray (10 YR 3/1 M) clay; medium coarse angular blocky; very firm, very sticky and very plastic; very fine many pores; violent effervescence; strongly alkaline (pH 9.5); gradual smooth boundary.
Bss3	93-115	Very dark gray (10 YR 3/1 M) clay; medium coarse angular blocky; very firm, very sticky and very plastic; very fine many pores; violent effervescence; strongly alkaline (pH 9.2); gradual smooth boundary.
Bss4	115-140	Very dark gray (10 YR 3/1 M) clay; medium coarse angular blocky; very firm, very sticky and very plastic; very fine many pores; violent effervescence; strongly alkaline (pH 8.4).

Range of Characteristics: The thickness of the solum is 135-150 cm. The thickness of A horizon is 14 to 18 cm. Its colour in hue is 10 YR, value 3 and chroma 2 and texture varies from clay to silty clay, structure is medium moderate sub angular blocky to medium coarse sub angular blocky. The thickness of B horizon 110-118 cm, colour of B horizon is in hue 10YR, value 3 to 4 and chroma 1 to 2, texture is clayey to silty clay and structure is medium coarse angular blocky. Very fine few to fine many calcium carbonate nodules (approx. 10% v/v) are present at 115 to 141cm

depth of profile. More than 2 cm wide and 40 cm deep cracks are observed in these soils. Slicken sides were seen with effect from third layer (41cm depth) to last layer (141 cm depth).

Interpretation: These soils are deep to very deep, fine on level to nearly level slope, imperfectly drained with slow permeability, moderate in available water content and nutrient reserves. Presently majority of the soils of the series are under double crop like rice-rice/durum wheat/chickpea in irrigated conditions. High exchangeable sodium percentage (ESP 9.6-33.3) in soil control section deteriorated the soil structure and other physical properties of soils which affects natural internal drainage. Soils are strongly alkaline with slight salinity problem in subsurface horizon and high base status. Application of soil amendments like gypsum followed by leaching of soluble salts is recommended to bring the soil sodicity and salinity at optimum level. Sodicity increased down the depth of profile.

Interpretative grouping:

(i) Land Capability subclass: IIs

(ii) Land Irrigability subclass: 2s and 3s

(iii) Productivity potential: moderate

Soil Series: Ganeshpur Classification: Sodic Haplusterts

Location: Village – Ganeshpur, Taluka - Dholka, District - Ahmedabad, Gujarat

Horizon	Depth (cm)	Particle size class and diameter in mm								
		Total (%)						Water retention		
		Sand	Silt	Clay	Texture	COLE	BD	33 kPa	1500 kPa	AWC
		2.0-0.05	0.05-0.002	<0.002			Mg m^{-3}	%	%	%
Ap	0-18	15.1	39.9	45.0	sic	0.15	1.2	28.3	19.5	8.9
Bw1	18-41	15.5	42.4	42.1	sic	0.13	1.3	31.2	20.5	10.8
Bss1	41-69	21.1	30.2	48.7	c	0.13	1.2	32.1	22.2	9.8
Bss2	69-93	22.1	25.7	52.2	c	0.17	1.2	34.9	24.1	10.8
Bss3	93-115	21.1	28.0	50.9	c	0.16	1.2	32.7	24.2	8.5
Bss4	115-140	21.4	29.8	48.8	c	0.18	1.3	36.4	24.6	11.8

Volumetric water content: 124 mm m^{-1}

Depth (cm)	pH (H_2O)	EC (dSm^{-1})	Org. C	$CaCO_3$	Exchangeable Cations				CEC	B.S. %	ESP %
					Ca	Mg	Na	K			
	-----1:2.5----		-------%-------		----------cmol (p^+) kg^{-1}-------						
0-18	9.1	1.3	0.6	17.0	18.4	10.4	5.4	3.7	38.7	98.0	13.9
18-41	9.4	0.4	0.4	15.0	18.0	10.8	3.3	0.6	34.5	94.9	9.6
41-69	9.5	0.5	0.4	15.0	16.8	10.4	5.6	0.7	35.2	95.2	15.9
69-93	9.5	0.8	0.4	13.6	14.0	11.6	8.0	0.7	36.2	94.8	22.0
93-115	9.2	1.5	0.5	13.8	15.2	11.6	12.0	0.7	40.2	98.2	29.7
115-140	8.4	3.8	0.4	11.7	12.4	8.0	11.7	0.7	35.0	93.5	33.3

7. KHANPUR SERIES

Classification	**:**	Fine loamy, mixed, hyperthermic, Vertic Haplustepts
Type location	**:**	Village – Khanpur, Taluka - Dholka, District - Ahmedabad, Gujarat (22º42'59.8" N latitudes and 72º24'28.1" E longitudes).
Profile no.	**:**	MP12
Physiographic position	**:**	Gujarat coastal plain-West coast plain-Young coastal plain
Elevation	**:**	23 M above MSL
Ground water table	**:**	>10 m
Rainfall	**:**	753 mm
Slope, erosion &relief	**:**	Level to nearly level slope (0-1%), slight, normal
Drainage& permeability	**:**	Imperfect with moderately slow permeability
Land use & vegetation	**:**	double crop, rice-rice/chickpea/durum wheat and natural vegetation consists of Neem (*Azadirachta indica*), Babul (*Prosopis juliflora*), Lasora (*Cordia dichotoma*)
Geology & parent material	**:**	Alluvial
Distribution & extent	**:**	It occur on young coastal plain in north-west part of Dholka block and occupy about 24216 ha area.
Associated soil series	**:**	Badarkha, Ganeshpur series
Soil correlation	**:**	Newly identified
Typifying pedon	**:**	Khanpur clay loam –double crop

Photo 13. Representative profile photo of Khanpur series

Photo 14. Landscape and land use of Khanpur series

Horizon	Depth (cm)	Description
Ap	0-15	Very dark grayish brown (10 YR 3/2 M) clay loam; fine weak sub-angular blocky; slightly hard, firm, sticky and plastic; very fine many pores; fine few roots; slight effervescence; strongly alkaline (pH 8.6); gradual smooth boundary.
Bw1	15-40	Very dark grayish brown (10 YR 3/2 M) clay loam; medium moderate sub-angular blocky; firm, sticky and plastic; very fine many pores; very fine few roots; slight effervescence; strongly alkaline (pH 9.1); gradual smooth boundary.
Bw2	40-70	Very dark grayish brown (10 YR 3/2 M) clay loam; medium moderate sub-angular blocky; firm, sticky and plastic; very fine many pores; slight effervescence; strongly alkaline (pH 9.2); gradual smooth boundary.
Bw3	70-100	Very dark grayish brown (10 YR 3/2 M) sandy clay loam; medium moderate sub-angular blocky; firm, sticky and plastic; very fine many pores; slight effervescence; strongly alkaline (pH 9.4); gradual smooth boundary.
Bw4	100-125	Very dark grayish brown (10 YR 3/2 M) sandy clay loam; medium moderate sub-angular blocky; firm, sticky and plastic; very fine many pores; slight effervescence; strongly alkaline (pH 9.6); gradual smooth boundary.

Range of Characteristics: The thickness of the solum is 120-135 cm. The thickness of A horizon is 12 to 18 cm. Its colour in hue is 10 YR, value 3 and chroma 2 to 3 and texture varies from silty clay loam to clay loam, structure is fine weak sub angular blocky. The thickness of B horizon 110-117 cm, colour of B horizon is in hue 10YR, value 3 to 4 and chroma 2 to 3, texture is clay loam to sandy clay loam and structure is medium moderate sub angular blocky.

Interpretation: These soils are deep to very deep and clay loam to sandy clay loam in texture on level to nearly level slope, imperfectly drained with slow permeability, moderate in available water

capacity and nutrient reserves. Presently majority of the soils of the series are under double crop like rice and durum wheat/chickpea. Soils are strongly alkaline and high in base status. On the soil surface 2-3 cm wide and 15-25 cm deep cracks were visible. Pressure faces were observed in sub-surface horizons. Coefficient of linear extensibility (COLE) in the soils were ranged from 0.09 to 0.16 indicated a significant expansion and contraction phenomenon. These soils are suitable for paddy and durum wheat or chickpea production. A high exchangeable sodium percentage (13-52 ESP) in the subsurface layers and high pH (>8.5) indicated that the soils are sodic in nature. Appropriate soil amendments are recommended to ameliorate the soils for optimization of sodic behaviors.

Interpretative grouping:

(i) Land Capability subclass: IIs

(ii) Land Irrigability subclass: 2s and 2sd

(iii) Productivity potential: moderate

Soil Series: Khanpur Classification: Vertic Haplustepts

Location: Village – Khanpur, Taluka - Dholka, District - Ahmedabad, Gujarat

Horizon	Depth (cm)	Particle size class and diameter in mm								
		Total (%)						Water retention		
		Sand	Silt	Clay	Texture	COLE	BD	33 kPa	1500 kPa	AWC
		2.0-0.05	0.05-0.002	<0.002			Mg m^{-3}	%	%	%
Ap	0-15	40.1	27.4	32.5	cl	0.12	1.3	27.9	16.5	11.4
Bw1	15-40	31.1	37.0	31.9	cl	0.16	1.3	31.5	21.1	10.4
Bw2	40-70	41.8	25.8	32.4	cl	0.14	1.3	33.8	22.1	11.7
Bw3	70-100	51.3	20.8	27.9	scl	0.12	1.4	31.3	21.2	10.1
Bw4	100-125	57.1	19.1	23.8	scl	0.09		34.0	19.8	14.3

Volumetric water content: 146 mm m^{-1}

Depth (cm)	pH (H_2O)	EC (dSm^{-1})	Org. C	$CaCO_3$	Exchangeable Cations				CEC	B.S.	ESP
					Ca	Mg	Na	K		%	%
	-----1:2.5----		-------%-------		----------cmol (p^+) kg^{-1}-------						
0-15	8.6	0.3	0.6	2.0	10.8	13.6	2.6	0.6	29.3	94.4	8.9
15-40	9.1	0.3	0.5	3.1	10.4	6.6	2.8	0.7	21.2	96.5	13.1
40-70	9.2	0.7	0.4	2.6	12.8	4.0	8.5	0.6	26.1	99.5	32.7
70-100	9.4	0.9	0.3	2.6	9.2	4.0	9.6	0.5	26.1	89.3	52.0
100-125	9.6	0.8	0.2	4.7	6.8	3.6	9.4	0.3	26.5	75.8	44.9

8. LOLIYA1 SERIES

Classification	**:**	Coarse silty, mixed, hyperthermic, Sodic Haplocambids
Type location	**:**	Village – Loliya, Taluka - Dholka, District - Ahmedabad, Gujarat (22º31'26.8" N latitudes and 72º11'07.6" E longitudes).
Profile no.	**:**	MP6
Physiographic position	**:**	Gujarat coastal plain-West coast plain-Young coastal plain (low lying)
Elevation	**:**	3 M above MSL
Ground water table	**:**	>2-5 m
Rainfall	**:**	753 mm
Slope, erosion &relief	**:**	Very gentle slope (1-3%), severe, low land
Drainage& permeability	**:**	Imperfect with moderate permeability
Land use & vegetation	**:**	Baran land and natural vegetation consists of Babul (*Prosopis juliflora*)
Geology & parent material	**:**	Alluvial
Distribution & extent	**:**	It occur on young coastal plain in extreme southern part of Dholka block in the form of long stripes and occupy about 4069 ha area.
Associated soil series	**:**	Loliya2, Ganeshpur series
Soil correlation	**:**	Newly identified
Typifying pedon	**:**	Loliya1 silty loam –non-cultivated

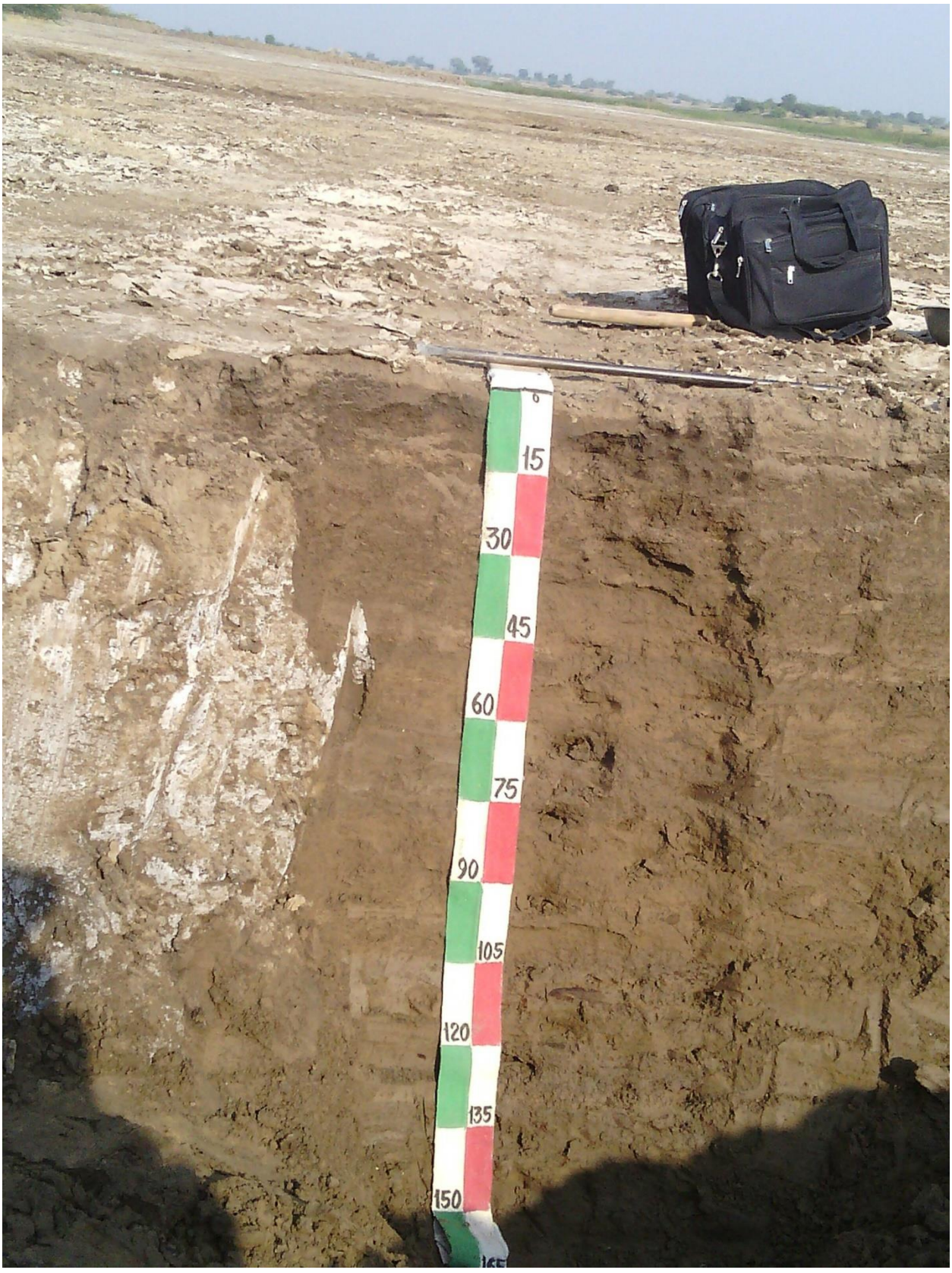

Photo 15. Representative profile photo of Loliya1 series

Photo 16. Landscape and land use of Loliya1 series

Horizon	Depth (cm)	Description
A	0-14	Very dark grayish brown (10 YR 3/2 M) silt loam; medium weak prismatic; hard, friable, slightly sticky and slightly plastic; fine to medium common pores; strong effervescence; moderately alkaline (pH 8.1); clear smooth boundary.
C1	14-24	Dark brown (10 YR 3/3 M) silt loam; medium weak prismatic; friable, slightly sticky and slightly plastic; fine to medium common pores; strong effervescence; moderately alkaline (pH 8.2); gradual smooth boundary.
C2	24-45	Dark brown (10 YR 3/3 M) silt; medium weak prismatic; friable, slightly sticky and slightly plastic; fine to medium common pores; strong effervescence; moderately alkaline (pH 8.3); gradual smooth boundary.
C3	45-60	Brown (10 YR 4/3 M) silt loam; medium weak prismatic; friable, slightly sticky and slightly plastic; fine to medium common pores; strong effervescence; strongly alkaline (pH 8.5); gradual smooth boundary.
C4	60-75	Dark brown (10 YR 3/3 M) silt loam; medium weak prismatic; friable, slightly sticky and slightly plastic; fine to medium common pores; strong effervescence; strongly alkaline (pH 8.5); clear smooth boundary.
C5	75-96	Dark brown (10 YR 3/3 M) loam; medium weak prismatic; friable, slightly sticky and slightly plastic; fine to medium common pores; strong effervescence; strongly alkaline (pH 8.6); clear smooth boundary.
C6	96-130	Dark grayish brown (10 YR 4/2 M) silt clay loam; medium weak prismatic; friable, slightly sticky and slightly plastic; fine to medium common pores; strong effervescence; strongly alkaline (pH 8.5); clear smooth boundary.

C7	130-150	Dark brown (10 YR 3/3 M) loam; medium weak prismatic; friable, slightly sticky and slightly plastic; fine to medium common pores; strong effervescence; strongly alkaline (pH 8.7).

Range of Characteristics: The thickness of the solum is 140-160 cm. The thickness of A horizon is 14 to 17 cm. Its colour in hue is 10 YR, value 3 and chroma 2 to 3 and texture varies from silt to silty loam, structure is medium weak prismatic. B horizon is absent. The thickness of C horizon 136-145 cm, colour of C horizon is in hue 10YR, value 3 to 4 and chroma 2 to 3, texture is silt to silty clay loam and structure is medium weak prismatic. A white layer of salts is appeared over the soil surface on drying the moisture. After digging of soil profile, if it is exposed to sunlight for some time for air drying then a white salt crust is visible even in sub-surface horizons. It indicates a high concentration of soluble salts in these soils.

Interpretation: These soils are deep to very deep, coarse silty on very gentle slope, imperfectly drained with moderate permeability, moderate in available water content and nutrient reserves. Presently majority of the soils of the series are not cultivated for arable crops due to several limiting factors like high salt concentration (severe salinity), ingress of sea water, and severe flooding and low lying situation (3m amsl). Salinity (EC ranged from 9.1 to 24 dSm^{-1} in SCS) and sodium hazards are the major problems in the soils. High exchangeable sodium percentage (over saturated the exchange sites)) in soil control section deteriorated the soil structure and other physical properties of soils which affects natural internal drainage. Strong alkalinity washed away the soil organic carbon. Reclamation of such soils is very difficult due to impeded or imperfect drainage conditions, ingress of sea water etc. It is better to utilize these soils for plantation crops (salt tolerant) or halophytes (grasses, succulents, herbs, shrubs date palm etc.).

Interpretative grouping:

(i) Land Capability subclass: IVwe

(ii) Land Irrigability subclass: 5sd

(iii) Productivity potential: very low

Soil Series: Loliya1 Classification: Sodic Haplocambids

Location: Village – Loliya, Taluka - Dholka, District - Ahmedabad, Gujarat

Horizon	Depth (cm)	Particle size class and diameter in mm								
		Total (%)						Water retention		
		Sand	Silt	Clay	Texture	COLE	BD	33 kPa	1500 kPa	AWC
		2.0-0.05	0.05-0.002	<0.002			Mg m^{-3}	%	%	%
A	0-14	17.0	64.2	18.8	sil	0.13	1.4	35.2	20.3	14.9
C1	14-24	11.4	77.1	11.5	sil	0.12	1.4	36.1	21.2	14.9
C2	24-45	2.9	87.1	10.0	si	0.03	1.4	37.2	15.9	21.3
C3	45-60	23.5	59.5	17.0	sil	0.02	1.4	33.2	12.9	20.3
C4	60-75	6.5	72.4	21.1	sil	0.09	1.3	39.0	18.7	20.3
C5	75-96	37.5	45.2	17.3	l	0.04	1.4	33.3	11.3	22.0
C6	96-130	6.2	65.1	28.7	sicl	0.02	1.3	38.6	18.0	20.6
C7	130-150	51.5	36.9	11.6	l	0.01		22.2	7.7	14.5

Volumetric water content: 145 mm m^{-1}

Depth (cm)	pH (H_2O)	EC (dSm^{-1})	Org. C	$CaCO_3$	Exchangeable Cations				CEC	B.S.	ESP
					Ca	Mg	Na	K		%	%
	-----1:2.5----		-------%-------		----------cmol (p^+) kg^{-1}-------						
0-14	8.1	23.9	0.3	11.0	20.8	16.4	87.0	1.6	13.0	964.2	666.7
14-24	8.2	20.7	0.2	14.2	19.2	14.4	66.6	1.2	12.0	848.5	557.3
24-45	8.3	18.5	0.1	11.5	14.8	13.2	63.4	1.4	13.0	711.3	485.8
45-60	8.5	15.0	0.1	14.0	7.2	8.4	49.8	1.1	13.7	485.2	363.4
60-75	8.5	14.9	0.1	10.2	0.0	0.0	54.3	1.1	14.9	370.9	363.6
75-96	8.6	11.8	0.1	13.7	6.8	9.6	7.6	1.1	16.0	156.8	47.5
96-130	8.5	14.5	0.2	15.7	6.8	12.8	7.2	1.1	17.4	160.8	41.7
130-150	8.7	9.1	0.0	13.5	4.8	6.8	7.9	1.4	12.2	171.0	64.5

9. LOLIYA2 SERIES

Classification	**:**	Fine, mixed, hyperthermic, Sodic Endoaquents
Type location	**:**	Village – Loliya, Taluka - Dholka, District - Ahmedabad, Gujarat (22º28'54.0" N latitudes and 72º09'49.8" E longitudes).
Profile no.	**:**	MP1
Physiographic position	**:**	Gujarat coastal plain-West coast plain-Young coastal plain (low lying)
Elevation	**:**	16 M above MSL
Ground water table	**:**	>10 m
Rainfall	**:**	753 mm
Slope, erosion &relief	**:**	Very gentle slope (1-3%), moderate, normal
Drainage& permeability	**:**	Moderately well with moderate permeability
Land use & vegetation	**:**	Duraum wheat/ chickpea and natural vegetation consists of Babul (*Prosopis juliflora*)
Geology & parent material	**:**	Alluvial
Distribution & extent	**:**	It occur on young coastal plain in extreme southern part of Dholka block and occupy about 1961 ha area.
Associated soil series	**:**	Loliya1series
Soil correlation	**:**	Newly identified
Typifying pedon	**:**	Loliya1 silt clay loam –Single crop

Photo 17. Representative profile photo of Loliya2 series

Photo 18. Landscape and land use of Loliya1 series

Horizon	Depth (cm)	Description
Ap	0-15	Very dark grayish brown (10 YR 3/2 M) silt clay loam; fine weak sub angular blocky; slightly hard, friable, sticky and plastic; fine to medium common pores; medium common roots; violent effervescence; strongly alkaline (pH 8.6); gradual smooth boundary.
A1	15-35	Very dark grayish brown (10 YR 3/2 M) clay loam; medium moderate sub angular blocky; friable, sticky and plastic; fine to medium common pores; medium common roots; violent effervescence; strongly alkaline (pH 8.7); gradual smooth boundary.
A2	35-70	Very dark grayish brown (10 YR 3/2 M) clay; medium moderate sub angular blocky; friable, sticky and plastic; fine to medium common pores; medium common roots; violent effervescence; strongly alkaline (pH 8.7); clear smooth boundary.
2A1	70-105	Very dark grayish brown (10 YR 3/2 M) silt clay loam; medium moderate sub angular blocky; friable, sticky and plastic; fine to medium common pores; fine common roots; violent effervescence; moderately alkaline (pH 8.4); gradual smooth boundary.
2A2	105-150	Very dark gray (10 YR 3/1 M) silt clay; medium moderate sub angular blocky; friable, sticky and plastic; fine to medium common pores; violent effervescence; strongly alkaline (pH 8.6); abrupt smooth boundary.
C	150-170	Brown (10 YR 4/3 M) loam; fine weak sub angular blocky; very friable, non-sticky and non-plastic; medium to coarse common pores; violent effervescence; strongly alkaline (pH 8.6).

Range of Characteristics: The thickness of the solum is 150-170 cm. The thickness of Ap horizon is 14 to 19 cm. Its colour in hue is 10 YR, value 3 and chroma 2 to 3 and texture varies from silt loam to silty clay loam, structure is fine to medium weak sub angular blocky. B horizon is absent. The thickness of sub surface A horizon is 130-140 cm, colour is in hue 10YR, value 3 to 4 and chroma 1 to 3, texture is clay to loam and structure is fine weak sub angular blocky to medium

moderate sub angular blocky. Sometimes a white layer of soluble salts is appeared over the soil surface on drying the moisture.

Interpretation: These soils are deep to very deep, fine on very gentle slope, moderately well drained with moderate permeability, high in available water content and nutrient reserves. Presently majority of the soils of the series are mainly cultivated for single crop like chickpea or durum wheat as an arable crop. Sub surface salinity and sodicity is observed at a depth of 70 cm or deeper layers that may pose the problem of root development and proper moisture supply. It is recommended to not to plant the deep rooted crops or perineal crops in this series. Reclamation of such soils is possible by leaching of soluble salts below the rhizosphere.

Interpretative grouping:

(i) Land Capability subclass: IIIs

(ii) Land Irrigability subclass: 4sd

(iii) Productivity potential: low

Soil Series: Loliya2 Classification: Sodic Endoaquents

Location: Village – Loliya, Taluka - Dholka, District - Ahmedabad, Gujarat

Horizon	Depth (cm)	Particle size class and diameter in mm								
		Total (%)						Water retention		
		Sand	Silt	Clay	Texture	COLE	BD	33 kPa	1500 kPa	AWC
		2.0-0.05	0.05-0.002	<0.002			Mg m^{-3}	%	%	%
Ap	0-15	15.6	47.0	37.4	sicl	0.15	1.3	38.0	20.4	17.7
A1	15-35	25.6	41.0	33.4	cl	0.11	1.3	35.4	17.2	18.3
A2	35-70	10.6	41.4	48.0	c	0.16	1.3	42.0	22.4	19.6
2A1	70-105	20.2	45.1	34.7	sicl	0.12	1.4	36.7	19.0	17.6
2A2	105-150	9.9	48.5	41.6	sic	0.19		40.0	24.8	15.2
C	150-170	42.1	46.0	11.9	l	0.01		20.2	10.5	9.7

Volumetric water content: 240 mm m^{-1}

Depth (cm)	pH (H_2O)	EC (dSm^{-1})	Org. C	$CaCO_3$	Exchangeable Cations				CEC	B.S.	ESP %
					Ca	Mg	Na	K		%	
	-----1:2.5----		-------%-------		----------cmol (p^+) kg^{-1}-------						
0-15	8.6	0.2	0.6	16.3	23.6	6.0	0.3	0.5	36.7	82.7	0.7
15-35	8.7	0.3	0.5	15.7	20.4	6.4	0.3	0.3	34.0	80.8	0.9
35-70	8.7	0.2	0.3	15.5	22.4	11.2	1.2	0.3	37.5	93.7	3.2
70-105	8.4	2.7	0.2	13.7	12.0	10.8	4.3	0.3	29.1	94.5	15.0
105-150	8.6	3.2	0.2	13.6	9.6	10.8	6.7	0.7	30.7	90.5	21.8
150-170	8.6	5.9	0.1	17.5	8.0	6.8	6.8	0.9	10.7	212.1	64.3

10. ANANDPURA SERIES

Classification	**:**	Fine silty over sandy, mixed, hyperthermic, Typic Ustifluents
Type location	**:**	Village – Anandpura, Taluka - Dholka, District - Ahmedabad, Gujarat (22º28'59.3" N latitudes and 72º24'13.9" E longitudes).
Profile no.	**:**	MP16
Physiographic position	**:**	Gujarat coastal plain-West coast plain-Flood plain
Elevation	**:**	19 M above MSL
Ground water table	**:**	>10 m
Rainfall	**:**	753 mm
Slope, erosion &relief	**:**	Level to nearly level (0-1%), moderate, normal
Drainage& permeability	**:**	Imperfect with moderate permeability
Land use & vegetation	**:**	double crop, rice-wheat and natural vegetation consists of Khejri, Jamun and Wakri
Geology & parent material	**:**	Alluvial
Distribution & extent	**:**	It occurs in flood plain in southern part of Taluka very near to coast and occupy about 1094 ha area of Taluka.
Associated soil series	**:**	Dholi and Vataman series
Soil correlation	**:**	Newly identified
Typifying pedon	**:**	Anandpura silty clay loam –Double crop

Photo 19. Representative profile photo and land use of Anandpura series

Horizon	Depth (cm)	Description
Ap	0-16	Dark brown (10 YR 3/3 M) silty clay loam; medium moderate sub-angular blocky; hard, firm, sticky and plastic; fine many pores; fine common roots; strong effervescence; strongly alkaline (pH 8.6); gradual smooth boundary.
A1	16-36	Dark brown (10 YR 3/3 M) silty clay loam; medium moderate sub-angular blocky; firm, sticky and plastic; fine many pores; fine common roots; strong effervescence; strongly alkaline (pH 8.9); gradual smooth boundary.
A2	36-61	Dark brown (10 YR 3/3 M) loam; medium weak sub-angular blocky; friable, slightly sticky and slightly plastic; medium common pores; strong effervescence; strongly alkaline (pH 9.2); clear smooth boundary.
2C1	61-84	Dark yellowish brown (10 YR 3/4 M) sand; single grain; vary friable, non-sticky and non-plastic; coarse common pores; strong effervescence; strongly alkaline (pH 9.4); abrupt smooth boundary.
2C2	84-125	Dark yellowish brown (10 YR 3/4 M) sand; single grain; vary friable, non-sticky and non-plastic; coarse common pores; strong effervescence; strongly alkaline (pH 9.4); abrupt smooth boundary.
	125+	Water saturated soil layer

Range of Characteristics: The thickness of the solum is 50-65 cm. The thickness of Ap horizon is 12-18 cm. Its colour in hue is 10 YR, value 3 and chroma 3 to 4 and texture varies from silty clay loam to clay loam, structure is medium moderate sub angular blocky. The thickness of sub-surface (A1and A2) horizon 40 to 50 cm, colour of subsurface A horizon is in hue 10YR, value 3 to 4 and chroma 3 to 4, texture is loam to silty clay loam and structure is medium weak sub angular blocky to medium moderate sub-angular. The B horizon is absent. Buried sandy soils are present directly below the A horizon which are designated as C horizon. It indicates the lithological discontinuity. The thickness of C horizon is 60 to 65 cm with more than 90 per cent sand content. Soils are water saturated after 125cm depth.

Interpretation: These soils are deep, fine silty over sandy texture on very gentle slope, imperfectly to moderately well drained with moderate permeability, moderate in water holding capacity and nutrient reserves. Presently majority of the soils of the series are under double crop like rice-wheat system under rain fed or irrigated conditions. High exchangeable sodium percentage (ESP 20) is observed in a layer between 61-84 cm depth and remaining horizons are below the critical ESP level (<6.6) in soil control section. Soils are strongly alkaline with high base status. Sandy soils of C layer showed base saturation more than 100%. The soil analytical data showed that presently there is no problem of salinity in the area but the field observation indicates some evidences of salt concentrations. Therefore, periodical monitoring is advised for assessment of salinity hazards in these soils.

Interpretative grouping:

(i) Land Capability subclass: IIs

(ii) Land Irrigability subclass: 2d

(iii) Productivity potential: moderate

Soil Series: Anandpura Classification: Typic Ustifluents

Location: Village – Anandpura, Taluka - Dholka, District - Ahmedabad, Gujarat

Horizon	Depth (cm)	Particle size class and diameter in mm								
		Total (%)						Water retention		
		Sand	Silt	Clay	Texture	COLE	BD	33 kPa	1500 kPa	AWC
		2.0-0.05	0.05-0.002	<0.002			Mg m^{-3}	%	%	%
Ap	0-16	11.7	48.9	39.4	sicl	0.13	1.3	35.7	20.5	15.3
A1	16-36	19.7	46.1	34.2	sicl	0.09	1.3	32.2	15.2	17.1
A2	36-61	49.1	30.7	20.2	l	0.05	1.4	24.4	9.2	15.2
2C1	61-84	92.5	1.8	5.7	s	0.01	1.7	3.2	1.3	1.8
2C2	84-125	92.1	2.7	5.2	s	0.01	1.7	3.1	1.7	1.4

Volumetric water content: 140 mm m^{-1}

Depth (cm)	pH (H_2O)	EC (dSm^{-1})	Org. C	$CaCO_3$	Exchangeable Cations				CEC	B.S.	ESP %
					Ca	Mg	Na	K		%	
	-----1:2.5----		-------%-------		----------cmol (p^+) kg^{-1}-------						
0-16	8.6	0.4	0.8	7.7	14.0	4.8	1.8	0.5	26.8	78.5	6.6
16-36	8.9	0.4	0.6	8.1	15.6	5.2	1.1	0.2	24.5	89.8	4.4
36-61	9.2	0.4	0.3	7.2	10.4	4.8	1.1	0.1	22.2	74.0	5.1
61-84	9.4	0.2	0.1	7.0	2.2	1.2	0.4	0.0	2.2	177.6	20.0
84-125	9.4	0.1	0.0	7.4	2.4	0.4	0.1	0.0	2.2	133.9	4.4

11. VATAMAN SERIES

Classification	**:**	Course loamy, mixed, hyperthermic, Typic Ustifluents
Type location	**:**	Village – Vataman, Taluka - Dholka, District - Ahmedabad, Gujarat (22º30'30.9" N latitudes and 72º25'22.6" E longitudes).
Profile no.	**:**	MP22
Physiographic position	**:**	Gujarat coastal plain-West coast plain-Flood plain
Elevation	**:**	11 M above MSL
Ground water table	**:**	>10 m
Rainfall	**:**	753 mm
Slope, erosion &relief	**:**	Very gentle slope (1-3%), moderate, normal
Drainage& permeability	**:**	Imperfectly drained with moderately rapid permeability
Land use & vegetation	**:**	Double crop, mainly rice-wheat system and natural vegetation consists of Neem and Babul
Geology & parent material	**:**	Alluvial
Distribution & extent	**:**	It occurs in flood plain near the mud flats of coastal boundary and occupy about 2262 ha area of Taluka.
Associated soil series	**:**	Anandpura series
Soil correlation	**:**	Newly identified
Typifying pedon	**:**	Vataman loam –double crop

Photo 20. Representative profile photo of Vataman series

Photo 21. Landscape and land use of Vataman series

Horizon	Depth (cm)	Description
Ap	0-15	Very dark grayish brown (10 YR 3/2 M) loam; fine weak sub-angular blocky; slightly hard, friable, slightly sticky and slightly plastic; fine many pores; fine common roots; strong effervescence; strongly alkaline (pH 8.8); gradual smooth boundary.
Bw1	15-30	Very dark grayish brown (10 YR 3/2 M) sandy loam; medium moderate sub-angular blocky; friable, slightly sticky and slightly plastic; fine many pores; fine common roots; strong effervescence; strongly alkaline (pH 8.7); abrupt smooth boundary.
Bw2	30-48	Dark brown (10 YR 3/3 M) sandy loam; fine weak sub-angular blocky; friable, slightly sticky and slightly plastic; fine many pores; strong effervescence; strongly alkaline (pH 8.7); abrupt smooth boundary.
Bw3	48-74	Very dark grayish brown (10 YR 3/2 M) loam; fine weak sub-angular blocky; friable, slightly sticky and slightly plastic; fine many pores; strong effervescence; strongly alkaline (pH 8.8); gradual smooth boundary.
C1	74-98	Dark brown (10 YR 3/3 M) loamy sand; single grained; very friable, none-sticky and none-plastic; coarse common pores; strong effervescence; strongly alkaline (pH 9.2); abrupt smooth boundary.
C2	98-110	Very dark grayish brown (10 YR 3/2 M) loamy sand; single grained; very friable, none-sticky and none-plastic; coarse common pores; slight effervescence; strongly alkaline (pH 9.2); abrupt smooth boundary.
C3	110-125	Dark brown (10 YR 3/3 M) sandy; single grained; loose, none-sticky and none-plastic; coarse common pores; strong effervescence; strongly alkaline (pH 9.5).

Range of Characteristics: The thickness of the solum is 70-100 cm. The thickness of A horizon is 15 to 18 cm. Its colour in hue is 10 YR, value 3 to 4 and chroma 2 to 3 and texture varies from loamy to sandy loam, structure is fine weak sub angular blocky to medium moderate sub angular blocky. The thickness of B horizon 60-80 cm, colour of B horizon is in hue 10YR, value 3 and chroma 2 to 3, texture varies from loam to loamy sand and structure is fine weak sub angular blocky to medium moderate sub angular blocky. The thickness of C horizon is 40-50 cm with single grain texture of alluvial sand without presence of any gravels.

Interpretation: These soils are deep, coarse loamy on gentle slope, imperfectly drained with moderately rapid permeability, moderate in water holding capacity and nutrient reserves. Presently majority of the soils of the series are under rice wheat production system. Due to imperfect drainage these soils are strongly alkaline with high base status. In future the productivity of wheat may be affected adversely.

Interpretative grouping:

(i) Land Capability subclass: IIs

(ii) Land Irrigability subclass: 2d

(iii) Productivity potential: moderate

Soil Series: Vataman Classification: Typic Ustifluents

Location: Village – Vataman, Taluka - Dholka, District - Ahmedabad, Gujarat

Horizon	Depth (cm)	Particle size class and diameter in mm								
		Total (%)						Water retention		
		Sand	Silt	Clay	Texture	COLE	BD	33 kPa	1500 kPa	AWC
		2.0-0.05	0.05-0.002	<0.002			Mg m^{-3}	%	%	%
Ap	0-15	37.8	37.0	25.2	l	0.09	1.4	31.6	15.0	16.6
Bw1	15-30	60.6	21.1	18.3	sl	0.03	1.5	21.8	7.9	13.9
Bw2	30-48	69.4	16.6	14.0	sl	0.03	1.5	22.8	7.0	15.9
Bw3	48-74	42.5	36.4	21.1	l	0.04	1.4	28.8	11.7	17.0
C1	74-98	86.8	3.9	9.3	ls	0.01	1.6	16.0	3.9	12.0
C2	98-110	84.3	5.9	9.8	ls	0.01	1.6	14.6	4.2	10.3
C3	110-125	92.4	0.6	7.0	s	0.00		9.0	2.2	6.8

Volumetric water content: 150 mm m^{-1}

Depth (cm)	pH (H_2O)	EC (dSm^{-1})	Org. C	$CaCO_3$	Exchangeable Cations				CEC	B.S.	ESP %
					Ca	Mg	Na	K		%	
	-----1:2.5----		-------%-------		----------cmol (p^+) kg^{-1}-------						
0-15	8.8	0.3	0.6	6.9	14.8	3.6	1.2	0.2	25.3	78.0	4.6
15-30	8.7	0.2	0.3	4.6	10.0	3.6	0.4	0.1	17.2	82.1	2.5
30-48	8.7	0.2	0.2	5.4	8.0	2.8	0.2	0.0	11.1	99.6	2.0
48-74	8.8	0.1	0.3	9.1	13.2	1.6	0.5	0.1	18.4	83.6	2.7
74-98	9.2	0.1	0.1	4.8	5.6	1.2	0.3	0.0	8.4	85.1	3.3
98-110	9.2	0.1	0.1	1.9	5.2	0.8	0.4	0.1	8.9	73.7	7.3
110-125	9.5	0.1	0.0	4.6	2.8	0.4	0.3	0.0	4.4	79.9	6.3

भाकृअनुप
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