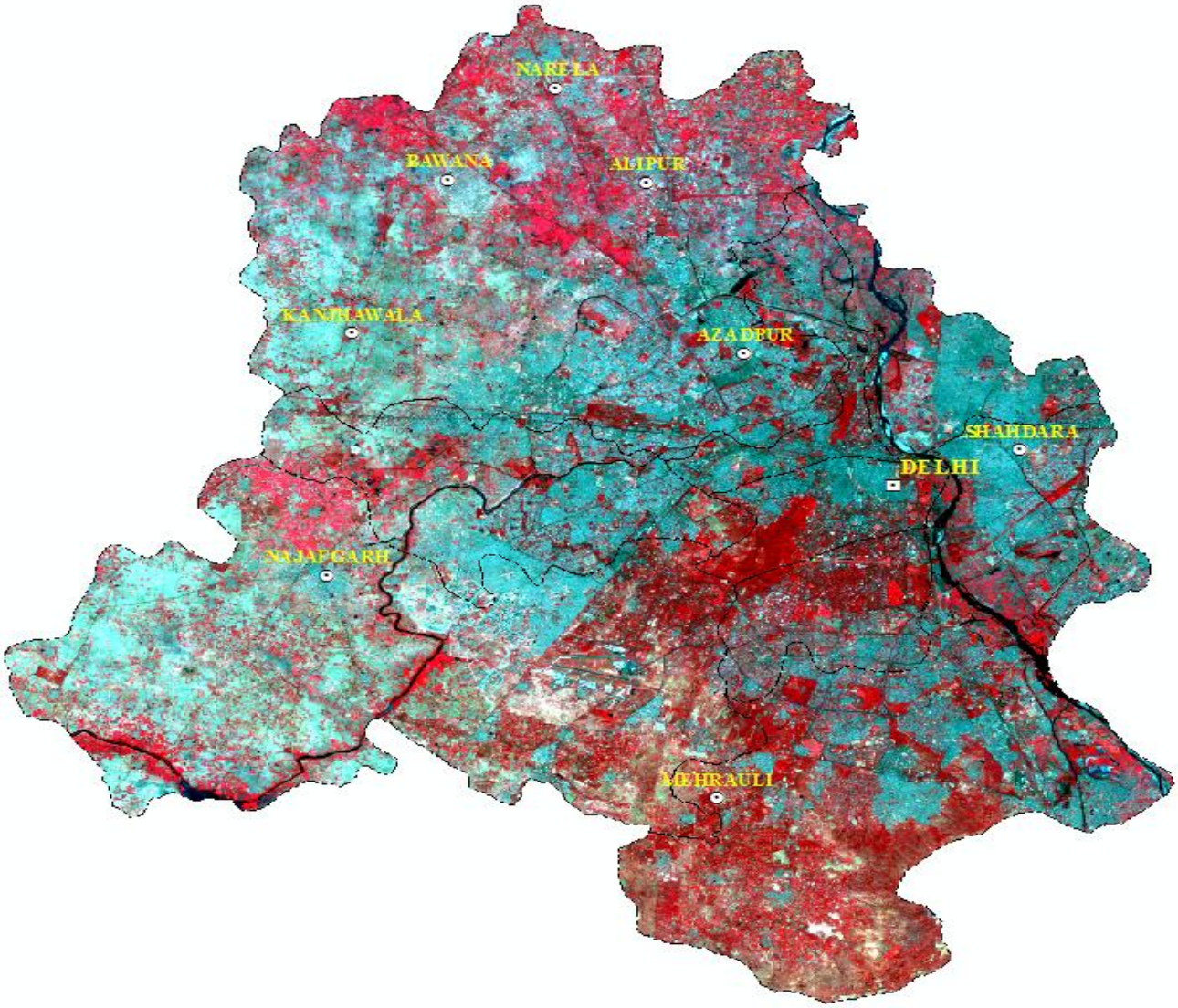
REPORT NO.422

SOIL SURVEY AND LAND USE PLAN OF DELHI TERRITORY



REGIONAL CENTRE

DELHI

National Bureau of Soil Survey & Land Use Planning

(Indian Council of Agricultural Research)

Nagpur - 440 033, Maharashtra, India

Report No. 422 (ICAR) April 1979

SOIL SURVEY AND LAND USE PLAN
OF
DELHI TERRITORY

REGIONAL CENTRE
DELHI

NATIONAL BUREAU OF SOIL SURVEY AND LAND USE PLANNING
SEMINARY HILLS, NAGP UR – 440 006

PREFACE

The Regional Centre, Delhi of the National Bureau of Soil Survey & Land Use Planning (ICAR) has completed the reconnaissance Soil Survey and mapping of Delhi Territory. Although Soil Survey had been in progress for some years, finalization of soil maps took some time in view of other commitment, shift in priorities, etc. The report contains a full inventory of soils in, relation to the geomorphological setting, their morphological and physico-chemical properties, taxonomic classification, problems and potentialities associated with the soils, their-management needs and recommendations for scientific land use planning. Fran the survey conducted in the Territory, it has been possible to assess the potential soils for wheat cultivation. Cropping patterns are also suggested depending on soil variations and occurring under different situatierts. The release of the report is timely when a land and water use Task Force for Delhi Area has bees constituted to examine problems relating to rising water table and water management, salinity, pest control and post-harvest technology, etc. The Regional Committee meeting of the ICAR for Haryana, Gujarat and Rajasthan held at-Hissar. Haryana in January, 1979 has shown its concern to make the best use of soil, water and human resources available near large urban centers for increasing the earnings of the landless labourers. The report supported by a set of maps will be helpful to the planners, Project implementing agencies and Extension Departments in the preparation of blue prints to initiate various development programmers on is priority basis in the Territory. Particular attention needs to be paid to the en croachment of industrial townships and urban development on agricultural lands, leasing good agricultural lands for brick kilnspetc. The State Governments should enforce/amend acts so as to restrict agricultural lands for intensification of agriculture and maxima - station of production to meet the food demands of the growing population.

(R.S.MURTHY)

DIRECTOR

National Bureau of Soil Survey and Land Use Planning
Nagpur – 440 006
23 April, 1973.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Meta Data for Soil Reports of Delhi Territory, India

Sr.No.	Elements	Scheme	Value
1.	Identification Information	Name of the Dataset	Soil Survey and Land Use Plan of Delhi Territory
		Contents	Soil Survey Reports, Maps and Imagery
		Keywords	Soil Survey Report
		Report/Map Language	English
		Map Scale	1:63,360
		Survey Year	1975 - 1976
		Imprint Year	1979
		Edit Year	-
		Value-addition Year	2013
		Purpose of Value-addition	To Create Interactive Maps and Reports and Disseminate to the End-User Agencies.
		Access Constraints	Permission Required
		Use Constraints	Permission Required
2.	Contact Information	Generating Agency	NBBSS & LUP, Nagpur
		Contact Person	Director, NBSS & LUP, Nagpur
		Mailing Address	National Bureau of Soil Survey & Land Use Planning Sankar Nagar P.O. Amarabati Road, Nagpur - 440 033 Maharashtra, India
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		Country	India
		Contact Telephone	+91- 712- 2500386, 2500545
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		Contact Email	director@nbsslup.ernet.in
3.	Spatial Domain	Bound Left	77° 20' 37" E
		Bound Right	76 50' 24" E
		Bound Top	28° 53' 00" N
		Bound Bottom	28° 24' 17" N
		Area/Coverage	1, 47,488 ha
		Projection	UTM
		Datum	WGS 1984
		Unit	Meter
		Administrative Location	State: Delhi.
4.	Citation	Data Prepared By	NBSS & LUP, Delhi (Regional Centre)
		Associated Project	H.S.Shankaranarayana
		Associated Value- additions	-
		Associated Publications	-
		Coordinator Value- added Publication	-
5.	Storage	Data Format	PDF/GeoPDF
		Data File Size	
		Data Physical Location	\\GIST6\D:\GeoPDF Mapping Project _2013\Delhi
		Download Location	-
6.	Quicklook	Graphic file in jpg format	Y
7.	Image Data	Name of the Satellite	Landsat
		Sensor	ETM+
		Date of Image	14 October 2002 and 21 January 2002
		File Format	TIFF
		Spatial Resolution	30 m
		Image Downloaded From	http://earthexplorer.usgs.gov/
		Credit	USGS
8.	Rights	Copyright	NBSS & LUP, Nagpur
		Distributor Contact	Director, NBSS & LUP, Nagpur

1.

INTRODUCTION

A reconnaissance soil survey of the Union Territory of Delhi was conducted by the Regional Centre Delhi, National Bureau of Soil Survey and Land Use Planning (ICAR) with the primary object of preparing a reconnaissance soil map on a scale of 1:63,360 to (i) characterize the soils and delineate their location and extent, evaluate their problems and potentials and prepare interpretative maps on soil and land resources of the Territory, (ii) correlate the soils, establish the various soil series and classify them according to Soil Taxonomy, (iii) develop interpretations based on present land use and inherent soil properties, management interactions, soil and water use management needs, (iv) develop suitable legends for soil and interpretative maps based on the principles of correlation and experimental data from Research Stations and management recommendations and (v) provide soil maps based on actual surveys to compile small scale soil and interpretative maps based on progressive generalization, abstraction and synthesis of significant mapping units for use by Planners, Decision Makers and Scientists at national and international levels by correlating soils with recognized systems of soil and land suitability classification viz. FAO/UNESCO etc.

Two field units carried out the survey during the period April 1975 to Apri1, 1976.

2.

GENERAL DESCRIPTION OF THE AREA

2.1 Location & Extent:

The Union Territory of Delhi is a narrow strip forming a part of the Indo -Gangetic plain, lying between North latitudes 28° 24' 17" and 28° 53' 00" and East longitudes 76° 50' 24" and 77° 20' 37". It comprises an area of about 1, 47,488 ha of which 1,03,328 ha are classified as rural and 44,160 ha as urban (Fig.1). It is covered by Survey of India toposheets 53H/1, 53H/2, 53H/3, 53D/13 and 53D/14.

2.2 Physiography, Relief and Drainage

The Territory consists of four major physiographic zones namely (i) Flood plains of the Yamuna basin, (ii) Aravalli ridge (iii) Piedmopt plains and (iv) Undulating to level plains of the Aravalli alluvium.

Flood plain consists of (a) Flood plain with recent river deposits, (b) Lower alluvial plain and (c) Upper alluvial plain.

Three major drainage channels drain the entire area falling in the Territory Viz. the Najafgarh drain, the Bawana distributary and the Munghaspur drain. All the three drains ultimately join the river Yamuna. The Najafgarh drain and the Bawana escape contribute to the major drainage of the rural areas. The source of Najafgarh drain is the Najafgarh jheel, which lies in the south-west corner of the Territory.

The Bawana escape was constructed to allow the surplus water from Delhi Tail distributory to escape into the river Yamuna.

The Mungashpur drain which serves the western part drains into Najafgarh drain which joins the Yamuna.

Another drainage channel passing through Shamspur and Pindrala villages is not working.

During heavy rains and high floods in the River Yamuna the drainage system becomes ineffective. This is due to the natural relief of the area and the floods in Sahibi River coming from Rajasthan in addition to the drainage waters from the adjoining Haryana State and flood in Yamuna.

The relief and soil conditions cause localised stagnation during rainy season. The problem gets aggravated due to choking of drainage ways caused by the construction of roads, embankments and canals.

2.3 Climate

The climate of the area is semi-arid. Both summer and winter are severe. June is generally the hottest month and January, the coldest.

Dust storms are received in May and June when the day temperature exceeds 40.0° C.

The mean annual rainfall based on 1931-60 data is 714 mm. The rainfall pattern reveals that it remains maximum during the months of July and August.

Evaporation exceeds rainfall during the period October to April, which is the season for growing *Rabi* crops. Still, wheat, barley and gram are grown as dryland crops to some extent in the Territory.

LOCATION MAP

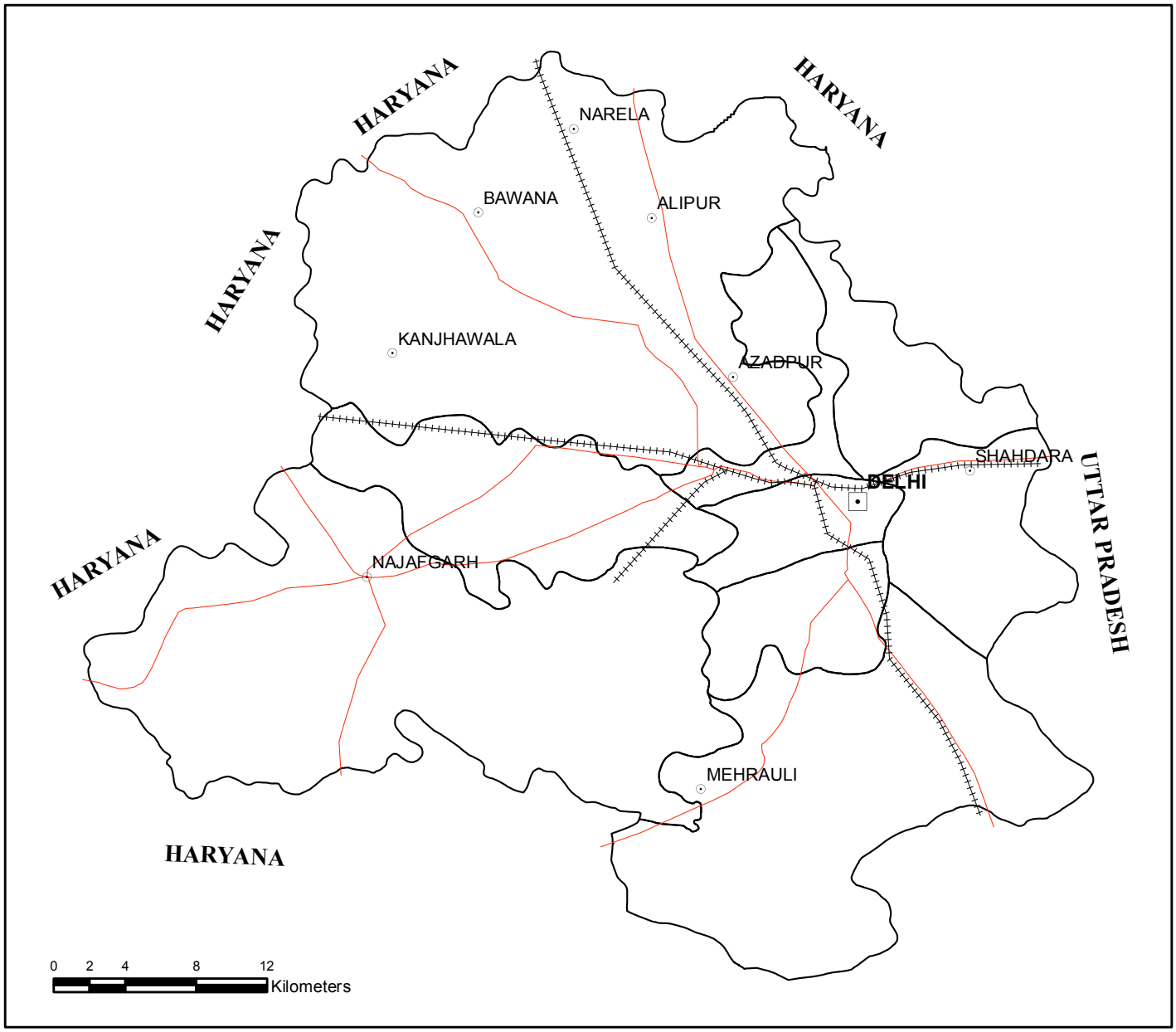


Fig. 1: Location Map

2.4 Geology

The area is a part of the Indo-Gangetic plain. A spur of the Aravalli hills from Rajasthan enters Delhi through Gurgaon on the southern border and expands into an elongated ridge of 5-6 km wide forming ridges along north to north east and south to south west separated by flat lands and depressions filled with alluvial material.

Quartzites are interbedded with micaceous stets that belong to the Alwar formatioms of the Delhi system which are believed to be of pre-Cambrian age. They also include pegmatites and quartz vein representing the acid igneous phase of post Delhi age.

Quartzite out-crops are fine grained to coarse grained with variegated colours viz. grey, pink, brick red and buff. The rocks indicate evidences of surface weathering and disintegration into loose grains of quartz with slight pressure.

Major part of the Territory is covered by a mantle of the Yamuna alluvium which forms a part of the Indo-Gangetic system. They are unconsolidated fluvial deposits and are wind modified. Nodular concretions of calcium carbonate are present at places.

2.5 Natural Vegetation

The natural vegetation consists of trees, herbs and shrubs. The comon trees are Acacia a*rabic*a Wild (Babul). *Balanites roxburgil; Butea monosperma* (Pales); *Dalbergia sisoo; Ficus bengalensis Linn*. (Banyan); F. *glomerata Roxb; F. religiosa Linn*. (Peerul); *Morus alba L*. (Saitoot); *Prosopis spicigera L.; Zizyphus jujube* Lank. (Ber); *Azadirachta indica* (Neem).

The herbs and shrubs include *Anogeissus pondula; Calotrors procera* (AX*); Cassia fistula L*. (Chakunda); *Euphorbia antiguorum*; *Salvadora persica; Tribulus terrestris L*. (Gohkru); *Tizyphus numelaria*.

The common weeds occurring in this area are Hyena *fatual* (Wild oat); *Cenchrus spp*. (Anjan); *Cyperus rotundus L*. (Motha); *Erianthus ravennae Beauv*. (Dolser, Dolu); *Phalaris minor Katz*. (Chiraya Bajra); *Saccharum soontaneum Linn*. (Kans); *S. Munja; Anagalis arvensis* (Krishna neel); *Euphorbia hirta* (Bari Duddhi); *Fumaria indica* (Gajri); *Lathyrue sativus* (Khesari); *Parthenium hysterophorus* (congress grass); *Phyllanthns niruri* (Hazardana*); Solanum nigrum* (Makoi).

2.6 Present Land Use

As mentioned earlier, the total geographical area of the Delhi Territory is 1,47,488 ha of which nearly 70 percent i.e. 103, 328 ha is rural while the remaining 30 percent i.e. 44.160 ha is urban. Detailed data on land use are given in Table 1.

From the table it is seen that 51.4 percent of the total geographical area of the Territory is net area sown. There has been a gradual decrease in the cultivated area, which may be due to rapid rate of urbanisation, land leased for brick making, etc.

2.6.1 Irrigation

Water resources in the area are generally satisfactory. Ground water is relatively at shallow depth except in areas around Mehrauli. Details regarding irrigation sources and area under irrigation are given in Table 2 and 3 (p.7).

A comparative study of five years data shows that the area irrigated by canals remains unchanged whereas the area irrigated by Lanes has decreased substantially. Owing to increase in the number of tube wells, well-irrigated area has increased considerably. The net area irrigated during the year 1974-75 was 56,396 ha which shows a steady increase in the irrigated area since 1971.

About 25 percent of the total irrigated area of the Delhi Territory receives water from three Government canals i.e. (i) Western Yamuna Canal, (ii) Eastern Yamuna Canal and (iii) Agra Canal. The total length of these canals is about 56 km. But major portion of the canal-irrigated area is from western Yamuna canal, which irrigates parts of Alipur and Kanjhawala Development Blocks. Eastern Yamuna canal irrigates the Shahadra Development Block.

In the recent flood plain (i.e. adjacent to river Yamuna), the water table is sufficiently high and the cost of construction of wells is comparatively low. Therefore, some areas of Alipur and Shahadra Blocks near Yamuna are irrigated by wells.

Due to uncertainty of water supply from canal, farmers depend on wells. In the old alluvial plain where water-table is comparatively low, farmers have installed tube-wells and thus parts of Najafgarh, Kanjhawala an. Alipur stocks are irrigated by tube wells. In spite of the low level of water in Mehrauli Block, cultivators are installing tube-wells for irrigation.

In the Mehrauli area experiments were conducted to conserve rain water by constructing tanks but it is not so common.

Crop-wise area under irrigation and dry-farming in different years, year-wise production of different crops and average yield per ha of principal crops are presented in Table 3,4, 5, 6 & 7 (2.), 10, 11 & 12) respectively.

Cereal crops, in this region, are grown in two seasons. Rice jowar, bajra and maize are taken in *kharif*. Wheat, barley and grit are taken in *Rabi*. Wheat occupies about 90% of the *Rabi* sown area in the Territory and nearly 90% of the area under wheat is irrigated.

Pulses like urd, mung and cowpea are grown in *kharif* season green gram and masoor are raised in *Rabi* But the area under pulses is very small. Arhar is grown near Mehrauli and Palam.

Table 1: Land Utilisation Classification

S. No.	Classification	1970-71	1972-73	1973-74	1974-75
			(Area in ha)		
1.	Area according to village records.	1,47,612	1,47,488	1,47,488	1,47,488
2.	Forest	1,143	722	1,064	1,559
3.	Area not available for cultivation.	47,314	49,768	57,211	48,975
4.	Land put to non-agricultural uses.	34,207	36,799	39,880	37,179
5.	Barren unculturable land.	13,107	12,789	17,331	11,796
6.	Other uncultivated land excluding fallow land.	3 ,602	2,139	2,732	2,571
7.	Permanent pasture and other grazing land.	402	476	782	689
8.	Land under Misc.Tree crops and groves not included in the net area sown.	41	-	243	467
9.	cultivable waste land	3,159	1,663	1,707	1,415
10.	Fallow land	15,043	15,703	15,517	16,537
11.	Net area sown	80,510	79,246	70,964	77,846
12.	Area sown morethan once	36,075	30,757	39,398	35,511
13.	Total cropped area	116 585	1,10,003	1,10,362	1,13,357

(Source: Delhi Statistical Hand Book 1976)

Table 2: Irrigation Resources of Delhi for the Year 1962-63 & 197C-71

S. No.	Source of Irrigation	1962-63	1970-71
1.	No. of canals	3	3
2.	Length (km)	56	56
3.	No. of tanks	3	3
4.	Wells (including Kachha and Pucca)	8,347	6,097
5.	Tube-wells	61	3,597
6.	(Electric/Diesel)		
7.	Pump sets	N.A.	2,511

Source: Agricultural Census 1970 - Union Territory Delhi

Table 3: Area (in hectares) Irrigated by Different Sources

S. No.	Source of irrigation	1970-71	1972-73	1973-74	1974-75
1.	Canal	12,540	11,748	12,446	13,857
2.	Tank	497	2,774	4,779	787
3.	Wells	34,696	37,774	37,538	41,752
	a) Tube-well	19,463	27,369	28,120	35,394
	b) Other wells	15,233	10,405	9,418	6,358
4.	Net area irrigated (1+2+3)	47,733	52,296	54,763	54,396
5.	Area irrigated under more than one crop.	8,492	9,156	4,364	14,144
6.	Gross area irrigated (4+5)	56,225	61,452	59,127	70,540

Source: Delhi Statistical Hand. Book, 1976

Table 4: Cropped Area (ha) Irrigated - Delhi Territory

S. No.	Food crops	1970-71	1971-72	1972-73	1973-74	1974-75
1.	Wheat	38,944	44,538	42,564	39,766	47,267
2.	Barley	452	467	639	1,140	1,981
3.	Bajra	999	246	352	264	1,386
4.	Maize	371	359	495	297	650
5.	Jowar	1,474	960	1,270	1,260	2,898
6.	Rice	2,075	2,054	2,101	1,872	1,672
7.	Gram	376	253	277	385	422
8.	Fruits, Vegetables & commercial crops	4,450	5,106	5,732	1,143	4,592
9.	Sugarcane	1,792	921	1,002	1,125	906
10.	Cotton	140	244	516	198	211
11.	Oil seeds	97	402	145	241	366
12.	Tobacco	46	66	38	40	44
13.	Fodder	3,121	3,053	4,250	4,250	4,250

Source: Delhi Statistical Hand Book, 1976

Table 5: Cropped Area (ha) Dry Land Farming

S. No.	Food crops	1973-74	1974-75
1	Wheat	5,375	3,015
2	Barley	1,861	1,783
3	Bajra	22,166	18,763
4	Maize	1,212	741
5	Jowar	8,100	5,151
6	Rice	325	244
7	Gram	7,026	1,861
8	Fruits, vegetables, commercial crops	nil	735
9	Sugarcane	37	36
10	Cotton	24	27
11	Oil seeds	460	1,554
12	Tobacco	nil	-
13	Fodder	3,197	2,214
14	Others	1,452	6,793

Source: Delhi Quarterly Digest of Economics and Statistics

Table 6: Crop Production (Metric Tons)

S. No.	Crops	1970-71	1972-73	1973-74	1974-75
1	Wheat	87,903	87,633	76,108	10,086
2	Barley	1,933	2,017	2,524	3,704
3	Bajra	25,153	7,017	16,980	7,858
4	Maize	677	682	790	881
5	Jowar	3,956	3,858	3,732	3,500
6	Rice	2,359	1,604	1,817	1,808
7	Gram	5,685	3,172	3,698	1,594
8	Other pulses	1,111	1,315	1,177	670
9	Potatoes	2,426	2,911	2445	2,604
10	Sugarcane	1,049	571	641	514
11	Cotton	76	264	95	102

Source: Delhi Statistical Hand Book, 1976

Table 7: Average yield (kg/ha) of principal Crops in Delhi

S. No.	Crops	1970-71	1971-72	1972-73	1973-74	1974 95
1	Wheat	1,933	1,809	1,715	1,686	2,006
2	Barley	943	952	675	841	984
3	Bajra	980	619	753	757	390
4	Maize	562	410	641	524	633
5	Jowar	379	335	382	399	435
6	Rice	9,922	920	708	827	944
7	Grain	572	684	589	499	638
8	Potatoes	7,374	7,480	7,351	8,317	7,211
9	Sugarcane	535	523	555	552	546
10	cotton	392	399	413	428	429

Source: Delhi Statistical Hand Book, 1976

3.
SOILS

3.1 Soil Survey Technique

Soil mapping was done using base maps of scale 1:63,360 Survey of India toposheets and aerial photographs of scale 1:30,000.

Aerial photographs were available for a part of the area between latitude 28°45'30" N to 28° 55' N and longitude 78°55' E to 77°22'30" E. After analysis and delineation of physiographic units, soil pedons were examined in different positions for morphological characteristics. In the rest of the area, topographical maps were made use of. Soils were examined as mentioned above duly supported by transect studies.

Identification legend was prepared with initial field review and correlation. Soils were then examined at regular intervals.of one kilometer or less depending upon change in terrain conditions. Soil series were identified as per the criteria. The series associations, which formed the mapping units, were established according to landforms. The mapping unite were delineated on the map by drawing boundaries. The soil series associations are shown in figure 2 by appropriate symbols on the map along with an index legend describing the Soils. Table 8 (p.14 to 16) gives the identification legend for the soil map of Delhi Territory.

3.2 General Description of Legend

Detailed Descriptions of the Series are given in Appendix.

3.2.1 Razapur-Kakra Association: 2,953 ha, 2.0%

The soils of the association occur on old levees of 3-5%.slopes. They are coarse textured loamy sands and sandy loans. Razapur soils occur on top or upper slopes of the levees. They are low in available water capacity and their capacity to retain nutrients is low.

Estimated available moisture capacity of Razapur soils in 60 cm depth is 4.1 cm and in 100 an depth 6.8 on and in Kakra soils it is 4.4 an in 60 cm depth and 8.4 an in 100 cm depth.

3.2.2 Kakra-Holambi Association: 28,800 ha, 17.8796:

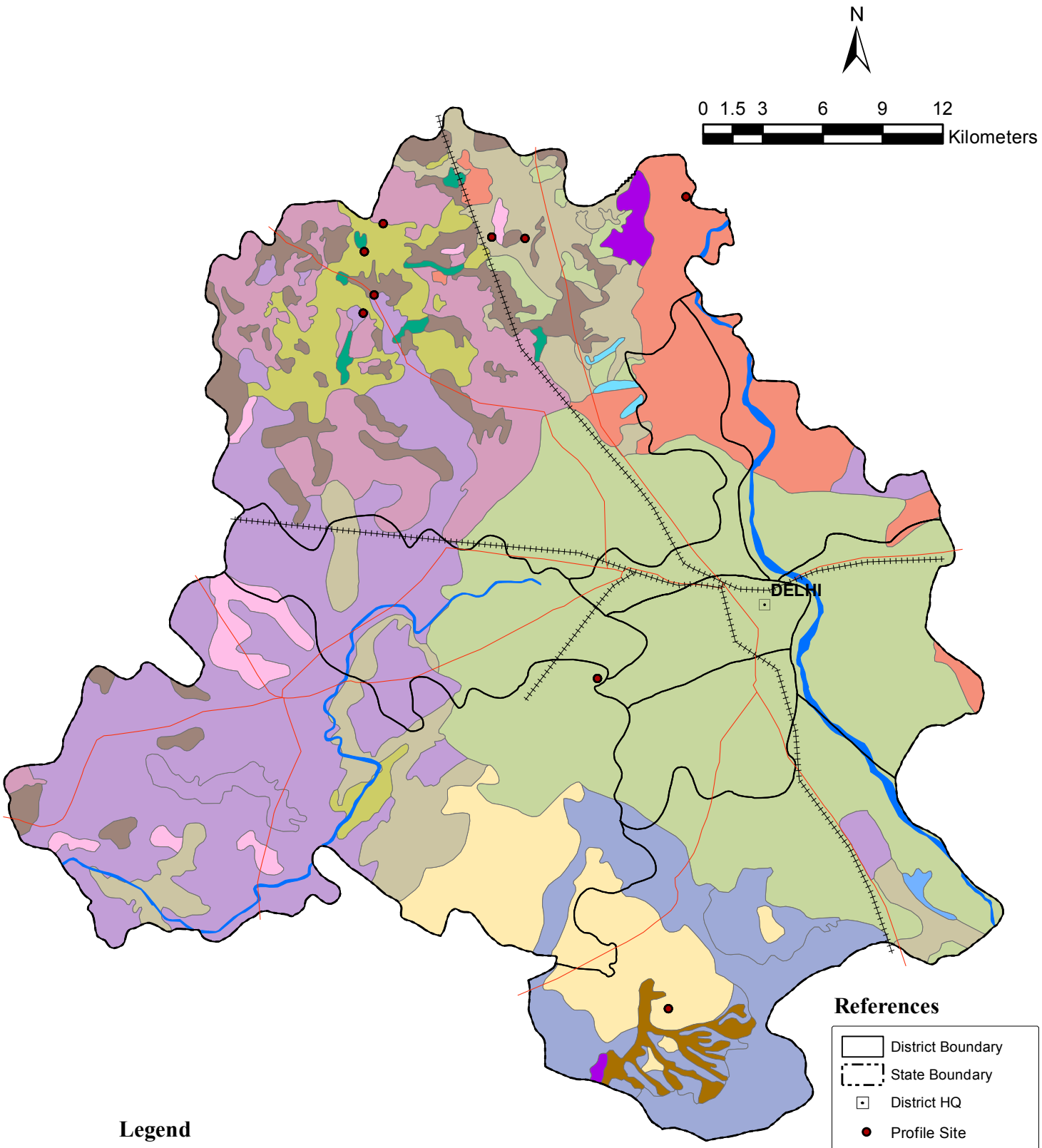
These soils occur on old alluvial plains on 1-3% slopes. Kakra soils are coarse loamy i.e. sandy loam and Holambi soils are fine loamy i.e. loam and silt loam in the profile depth.

Surface soil texture varies from loamy sand to fine sandy loam in Kakra series whereas it varies from loamy fine sand to loam in Holambi series.

Available moisture capacity of Kakra soils is 4.4 cm at 60 cm and 8.4 cm in 100 cm depth and it is 9.0 cm and 15.7 cm for the same depths in Holambi. In loamy sand and fine sandy loam phases of Holambi soil moisture deficiency is expected. Holambi soils are good in moisture and fertility retention properties. Holambi soils are one of the best soils in the Territory and are highly productive. They are suited to all climatically adapted crops under rainfed and irrigated agriculture.

DELHI TERRITORY

Soil Series Association



Legend

- Daryapur-Hamidpur
- Daryapur-Hissar
- Hamidpur-Palla
- Hiranki-Wazirabad
- Holambi-Daryapur
- Holambi-Nabha
- Kakra-Holambi
- Khampur-Hissar
- Mehrauli-Garhi
- Nabha-Ghoga
- Palam-Undifferentiated soils
- Razapur-Kakra
- Rocky land-Miscellaneous land
- OX BOW
- Pond

References

- District Boundary
- State Boundary
- District HQ
- Profile Site
- Contour
- Road
- Railway
- River
- Drainage
- Watershed Boundary

Fig. 2: Soil Series Association

Table 8: Soil Legend

Physiographic unit	Soil series association	Soil series name	Description (Texture 15-100 cm Depth)
(1)	(2)	(3)	(4)
Old levees	1	Razapur	Very deep, sand to loamy sand (sandy on levees) Typic Ustipsamments
		Kakra	Very deep, sandy loam (coarse Ioany) on A-B slopes-Udic Ustochrepts.
Old flood plain interfluves on level and concave slopes.	2	Kakra	Very deep, sandy loam (coarse loamy) on A-B slopes-udic Ustochrepts.
		Holambi	Very deep, loam silt loam (fine loary)-Udic Ustochrepts
	3	Nabha	Very deep Ioam to silt loam (fine loamy)-Typic Ustochrepts.
		Ghoga	Very deep,silty clay loam to silty clay (claycy)-Udic Ustochrepts
	4	Holambi	Very deep loam to silt loam (fine loamy) Udic Ustochrepts.
		Nabha	Very deep, loam to silty clay loam (fine loamy)-Udic Ustochrepts.
	5	Daryapur	Very deep calcareous, loam to silt loam or clay loam (fine loamy)- Typic Ustifluvents.
		Hissar	Very deep, calcareous, silt loam to silty clay loam (fine loamy) Typic Ustochrepts.
	6	Khampur	Very deep, calcareous, silty clay loam to silty clay or clay (clayey) Fluventic Haplaquepts.
		Hissar	Very deep. Calcareous, silt loam to silty clay loam (fine loamy) Typic Ustochrepts.
	7	Daryapur	Very deep, calcareous, loam to silt loam or clay loam (fine loamy) Typic Ustifluvents.
		Hamidpur	Very deep, Calcareous, sandy loam to loam (coarse loamy)-Typic Ustochrepts.
	8	Holambi	Very deep, loam to silt loam or clay loam (fine loamy)-Udic Ustochrepts.
		Daryapur	Very deep, calcareous loam to silt loam or clay loam (fine loamy.) Typic ustifluvents.
	9	Hamidpur	Very deep, calcareous, sandy loam to loam (coarse loamy)-Typic Ustochrepts.
		Palla	Very deep, sandy loam over sand –Typic Ustifluvents.
Recent flood-plains	10	Hiranki	Very deep, calcareous, clay loam, loam over sandy loam, loamy sand-Typic Ustifluvents.
		Wazirabad	Very deep, calcareous, very highly variable stratified textures-Typic Ustifluvents.
Aravalli piedmont plains	11	Mehrauli	Very deep, sandy loam to loam (coarse loamy) Typic Ustochrepts.
		Garhi	Very deep, loam to silt loam or clay loam (fine loamy)-Typic Haplustalfs.
Broken rocky lands and Aravalli ridge.	12	Palam	Very deep, calcareous, sandy loam to loam (coarse loamy)-Typlc Ustochrepts.
		Undifferentiated soils	Shallow to moderately deep, sandy loam to loam –Lithic Typic Ustocherpts.
	13	-do-	Shallow to moderately deep sandy loam to loam- Lithic Typic Ustochrepts.
		Rocky land.	Rocky Aravalli Rddges.
Dissected piedmont plains.	14	Miscellaneous land	Disgected qullied land, severely eroded.

Note: As Indicated on the map.

i) S – Saline phase
ii) W – High Ground Water
iii) Most of the soils have 10 YR hue.

3.2.3 Nabha - Ghoga Association: 4,326.40 ha, 4.18%:

These soils occur on level to nearly level lands up to 1% slope. Ghoga soils occupy lower macro-relief. Nabha soils are loam to clay loam whereas Ghoga soils are clay loam to clayey in texture. Both the soils have well developed structure.

Available water capacity of Nabha soils is 12.4 cm in 60 cm and 21.2 cm in 100 cm depth and it is about 14 and 24 cm at the same depths in Ghoga series. Ghoga soils have limitations of low moisture-air relationships and hence crops that are sensitive to excess moisture and water logging cannot be grown without providing for proper surface drainage.

Nabha soils are one of the best soils of the Territory suited to all climatically adapted crops under rainfed and irrigated conditions.

Nabha soils vary from fine sandy loam to clay loam on the surface and Ghoga soils vary from loam to clay loam.

3.2.4 Holambi - Nabha Association: 10,071.04 ha, 9.74%:

These soils occur on level to early level land on old flood plains having slopes ranging from 1to 3%. Holambi soils are loam to silt 1oam and Nabha from loam to silty clay loam. The water holding capacity is medium. The available water capacity ranges from 9.0 to 15.7 cm for 60 an and 12.4 to 21.2 cm for 100 cm Profile depths respectively in the two series.

3.2.5 Daryapur - Hissar Association: 7,316.40 ha, 7-08%:

These soils occur on level to nearly level lands of 1 to 2%. Slopes on old alluvial plains and interfluves. They are loam to silty clay loam and calcareous.

Daryapur soils are loam to silt loam and Hissar from loam to silty clay loam. Available moisture capacity of Hissar 5911 is 12.5 at in 60 cm and 22.0 cm in 100 cm depth of the profile and it is 9.0 at and 15.6 that in the same depths in Daryapur soils. These soils are suited to all climatically adapted or pa. Due to calcareous nature of soils fixation of phosphates may post same problem.

Daryapur soils have fine sandy loam-to-loam surface textures and Hissar soils fine sandy loam to clay loam.

3.2.6 Khampur - Hissar Association: 153.60 ha, 0.14%:

The soils of this association occur on old flood plains on 1-3% slopes. Khampur series is silty clay loam to clayey and Hissar series; silt loam to silty clay loam in texture. Available moisture capacity for Khampur soils is 14.1 cm in 60 cm and 24.0 cm at 100 cm, it is 12.5 cm, and 22.0 cm in Hissar soils for the same depths.

Khampur soils are saline - sodic, clayey and occur on lower relief. Calcium carbonate is more than 1% within 50 cm depth.

3.2.7 Daryapur - Hamidpur Association: 11,182.08 ha, 10.82%:

This association occurs on nearly level to gently sloping lands on old flood plain as well as interfluves and deander plains. They are characterized by sandy loam to loam or silt loam texture and may pose problem or management due to free lime.

Available water capacity ranges from 9.0 cm in 60 cm to 15.6 cm in 100 cm depth in Daryapur and 7.0 cm and 11.3 cm for the same depths in Hamidpur series.

Hamidpur soils occur in parts of the old meander plain on slopes varying from 1 to 3% adjacent to levees. They are dominantly of fine sandy loam-to-loam texture and calcareous throughout the profile. Surface texture of Hamidpur soils ranges from loamy fine sand to Iowa.

3.2.8 Holambi-Daryapur Association: 655.36 ha, 0.63%:

This association occurs on old alluvial plain little above the meander plain. The soils are characterized by loam to silt loam textures. Daryapur series is calcareous with calcium carbonate of more than 1% within 50 cm depth. The available water capacity is good. Holambi soils are one of the potential soils of the Territory. Daryapur soils are equally good but for the presence of free lime.

3.2.9 Hamidpur - Palla Association: 6,574.08 ha, 6.36%:

The soils of this association mostly occur on meander plains and to some extent in interfluves on level plains. The slopes vary from 1 to 3%. The soils of this association are coarse loamy and calcareous with calcium carbonate of more than 1% in the upper 50 cm depth of the soil. The water holding capacity is low.

Available water capacity of Hamidpur soils is 7.0 cm in 60 cm and 11.3 cm in 100 cm depth soil profile and it is 7.7 cm and 13.4 cm for the same depth in Palla series.

Palla series occurs on nearly level to gently sloping land on slopes of 1-3% developed on alluvial plain. The soils are sandy loam to loam over loamy sand or sand. Free lime is more than 1%.

3.2.10 Hiranki-Palla-wazirabad Association: 7,224.32 ha, 7.00 %:

The soils of this association occur on recent flood plain of Yamuna River. The slopes vary from 1 to 3 %. Soils are highly variable and calcareous. Water holding capacity is low to medium and available water capacity of Hiranki soils is 16.1 cm in 60 cm and 19.7 cm in 100 cm depth soil profile and it is 7.6 cm and 14.7 cm for the same depth in Wazirabad series.

Hiranki soils are fine loamy over coarse loamy and subject to seasonal flooding. Slope varies from 1-2%.

Wazirabad soils occur on nearly level to gently sloping land on slopes ranging from 1 to 2% in recent flood plains these are highly variable, stratified and calcareous soils.

3.2.11 Mehrauli-Garhi Association: 8,468.48 ha, 8.19%:

The soils of this association occur on piedmont plains of Aravallis. The slope varies from 3 to 5%. The soils are characterized by coarse loamy and fine loamy textures in the control section and have colours yellowish brown to strong brown in 10 YR and 7.5 YR hues and developed on alluvium derived from Aravallis. Available water capacity of Mehrauli series is 7.2 as in 60 cm and 12.7 cm in 100 cm and it is 8.1 cm and 15 8 cm for the same depth in Garhi series.

Mehrauli series occurs on nearly level to gently sloping land on slopes 1 to 5% on mixed alluvium of the Aravallis. The-series are coarse loamy with sandy loam-to-loam textures.

Garhi soils occur on nearly level to gently sloping land having slopes ranging from 1to 3% as lower piedmont plains developed on mixed alluvium of the Aravallis The soils have yellowish broom to strong brown colours (7.5 YR and 10 YR hues) and are fine loamy with loam to silt loam textures.

3.2.12 Palam-undifferentiated Soils: 2,247.68 ha, 2.17%:

The soils of this series occur on nearly level to gently sloping piedmont slopes of 1 to 3% with intervening rocky ridges. The soils are coarse loamy, with sandy loam to loam texture and have colours yellow-wish brown to dark yellowish brown. Lime nodules are present, to the extent of 10-15% by volume. Water holding capacity is medium and available moisture capacity is 8.2 cm in 60 cm and 14.3 cm at 100 cm profile depth.

3.2.13 Undifferentiated Soils of Variable Depths - Rocky Lands 7,613.44 ha, 7.36%:

Undifferentiated soils exist on slopes upto 8%. The soils are shallow to moderately deep, coarse loamy, sandy loam to loam of strong brown colour in 7.5 YR hue. The soils are calcareous at some places. They cannot be separated in the present scale of mapping. The rocky lands comprising the ridge and rockout crops occur intermittently in this unit that can be separated.

3.2.14 Miscellaneous Land: 1,254.40 ha, 1.21%:

This comprises dissected and severely eroded land occurring on dissected piedmont plains.

The table 9 shows the distribution of soils and miscellaneous Land types in Delhi Territory.

Table 9: Distribution of Soils and Miscellaneous Land Types in Delhi Territory

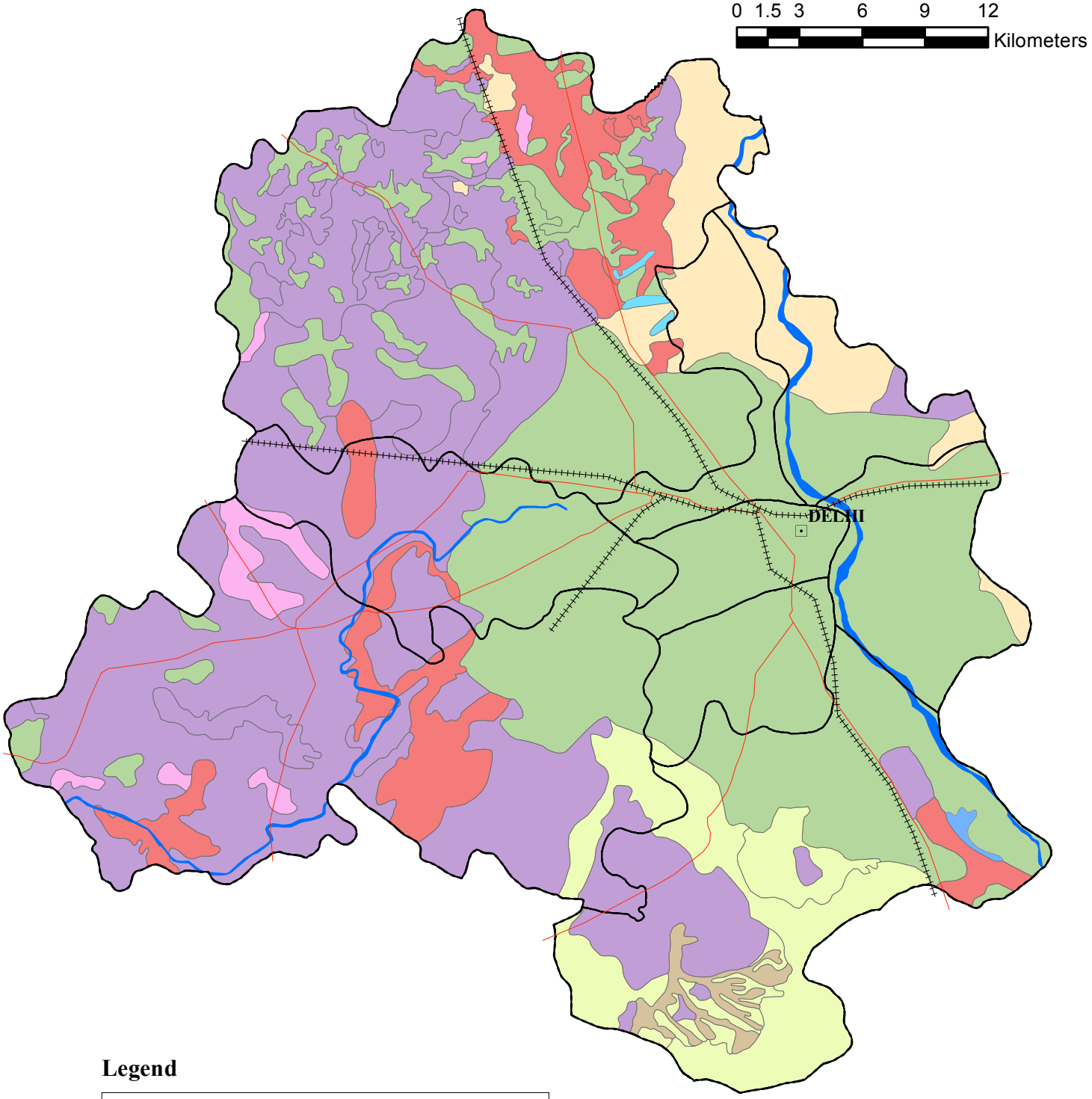
S. No.	Soil Series Association	Area in ha		Percentage
1.	Razapur-Kakra	2,053.28		2.0
2.	Kakra-Holambi-Salt affected	27,729.92 1,070.08	28,800.00	27.87
3.	Nabha-Ghoga	4,326.40		4.18
4.	Holambi-Nabha	10,071.04		9.74
5.	Daryapur-Hissar-Salt affected	5,560.32 1,756.16	7,316.48	7.08
6.	Khampur-Hissar-Salt affected	97.28 56.32	153.60	0.14
7.	Daryapur-Hathidpur-Salt affected	9,291.80 1,889.28	11,182.08	10.82
8.	Holambi-Daryapur-Salt affected	599.04 56.32	655.36	0.63
9.	Hamidpur-Palla-Salt affected	6,241.28 332.80	6,574.08	6.36
10.	Hiranki-Palla -Salt affected with high groundwater.	5,447.68 1,776.64	7,224.32	7.00
11.	Mehrauli-Garhi	8,468.48		8.19
12.	Palam-Undifferentiated soils	2,247.60		2.17
13.	Undifferentiated soils-Rocky land	7,613.44		7.36
14.	Miscellaneous land (gullied and severely eroded).	1,254.40		1.21
15.	Land under road, canal and habitation etc.	5,388.00		5.21
	Total Rural Areas:	**1,03,328.00**		**100.00***
16.	Urban Area	44,160.00		30.00
17.	Salt affected Area	6,937.60		7.73
	Total Area of Delhi Territory	**1,47,488.00**		**100.00**

* It is 70% of the total area of Delhi Territory

The thematic maps on slope, surface form, parent material, soil depth, surface drainage, texture, particle size and soil taxonomy were shown in figure 3 to 10.

DELHI TERRITORY

Slope



Legend

- Level to nearly level
- Level to nearly level-Very gently sloping
- Very gently sloping-Level to nearly level
- Gently sloping-Level to nearly level-Very gently sloping
- Very gently sloping
- Very gently sloping-Undifferentiated soils
- Rocky land-Miscellaneous land
- OX BOW
- Pond

References

- District HQ
- District Boundary
- State Boundary
- Road
- Railway
- Drainage
- River

Fig. 3: Slope

DELHI TERRITORY

Surface Form

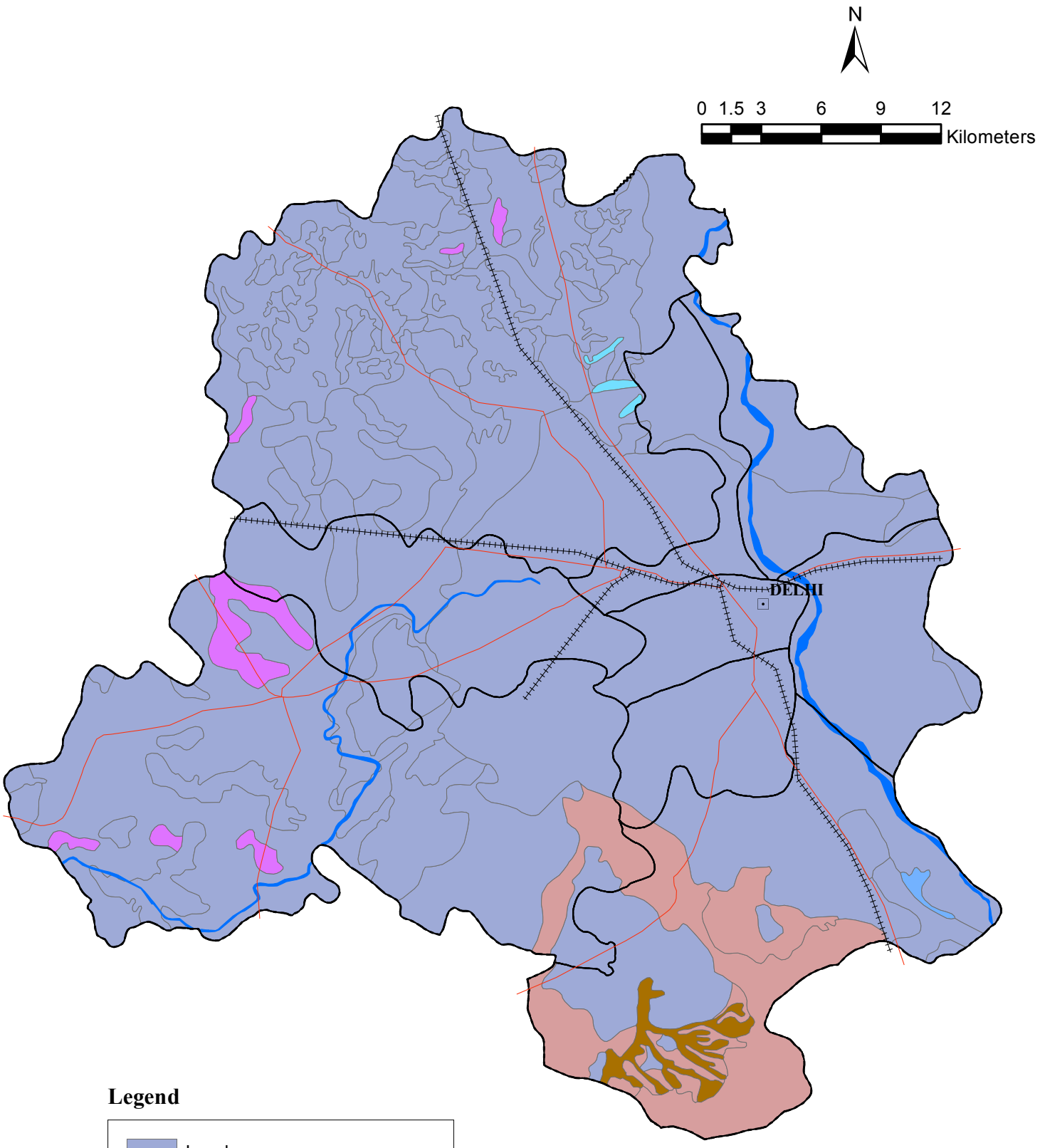
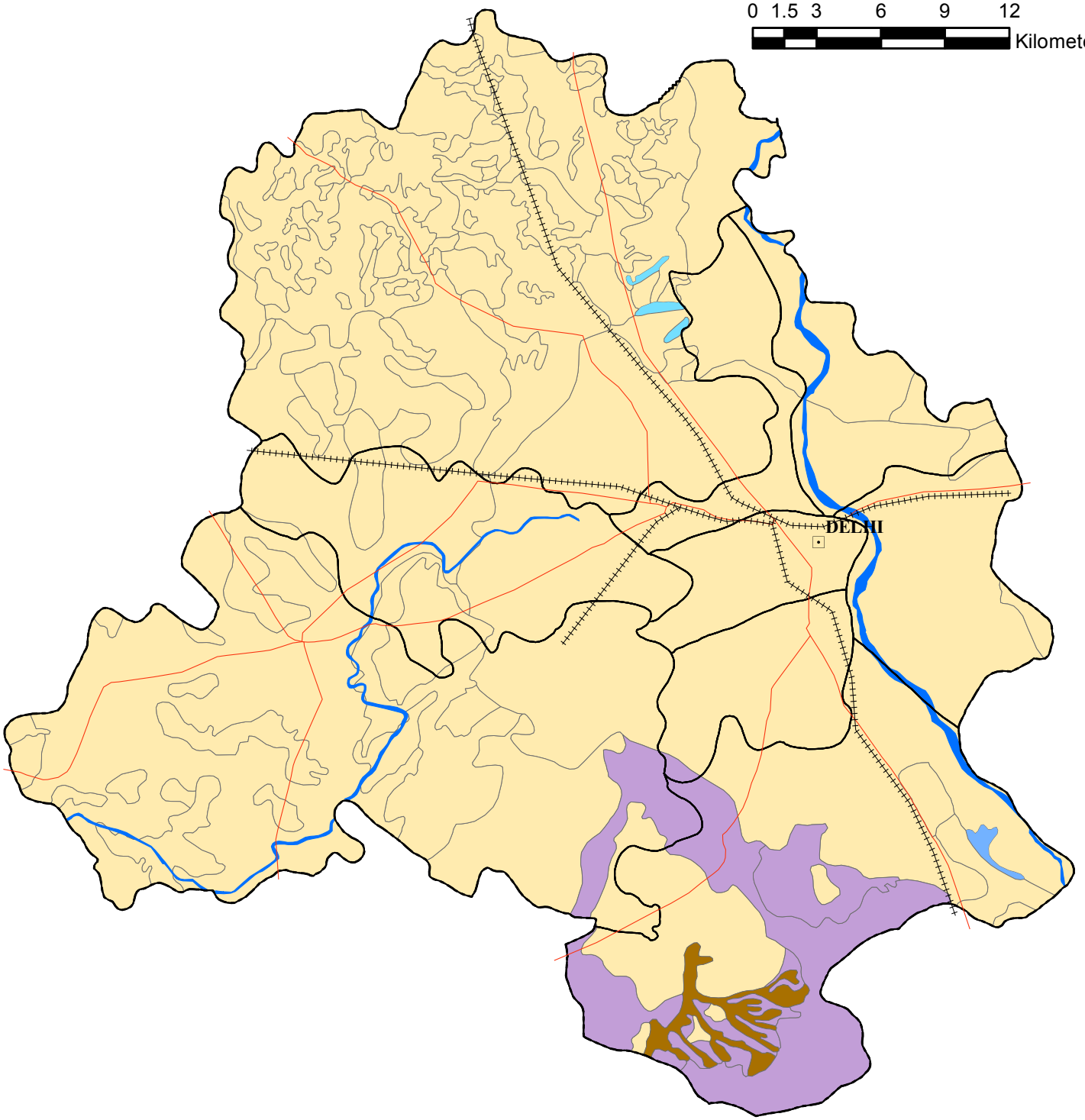


Fig. 4: Surface Form

DELHI TERRITORY

Parent Materials



Legend

- Alluvium
- Alluvium-Undifferentiated soils
- Rocky land-Miscellaneous land
- OX BOW
- Pond

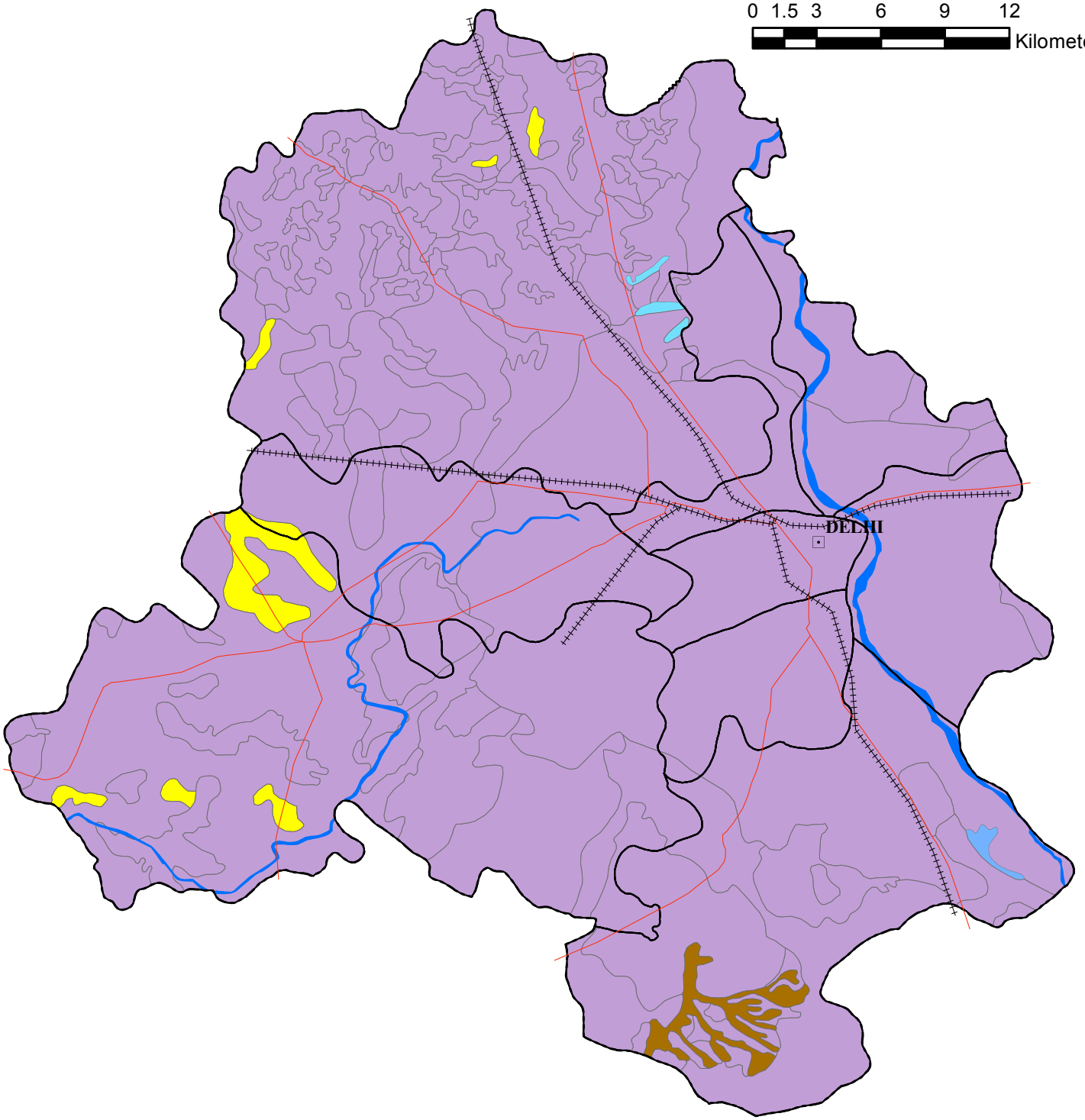
References

- District HQ
- District Boundary
- State Boundary
- Road
- Railway
- Drainage
- River

Fig. 5: Parent Materials

DELHI TERRITORY

Soil Depth



Legend

- Very deep
- Very deep-Undifferentiated soils
- Rocky land-Miscellaneous land
- OX BOW
- Pond

References

- District HQ
- District Boundary
- State Boundary
- Road
- Railway
- Drainage
- River

Fig. 6: Soil Depth

DELHI TERRITORY

Soil Drainage

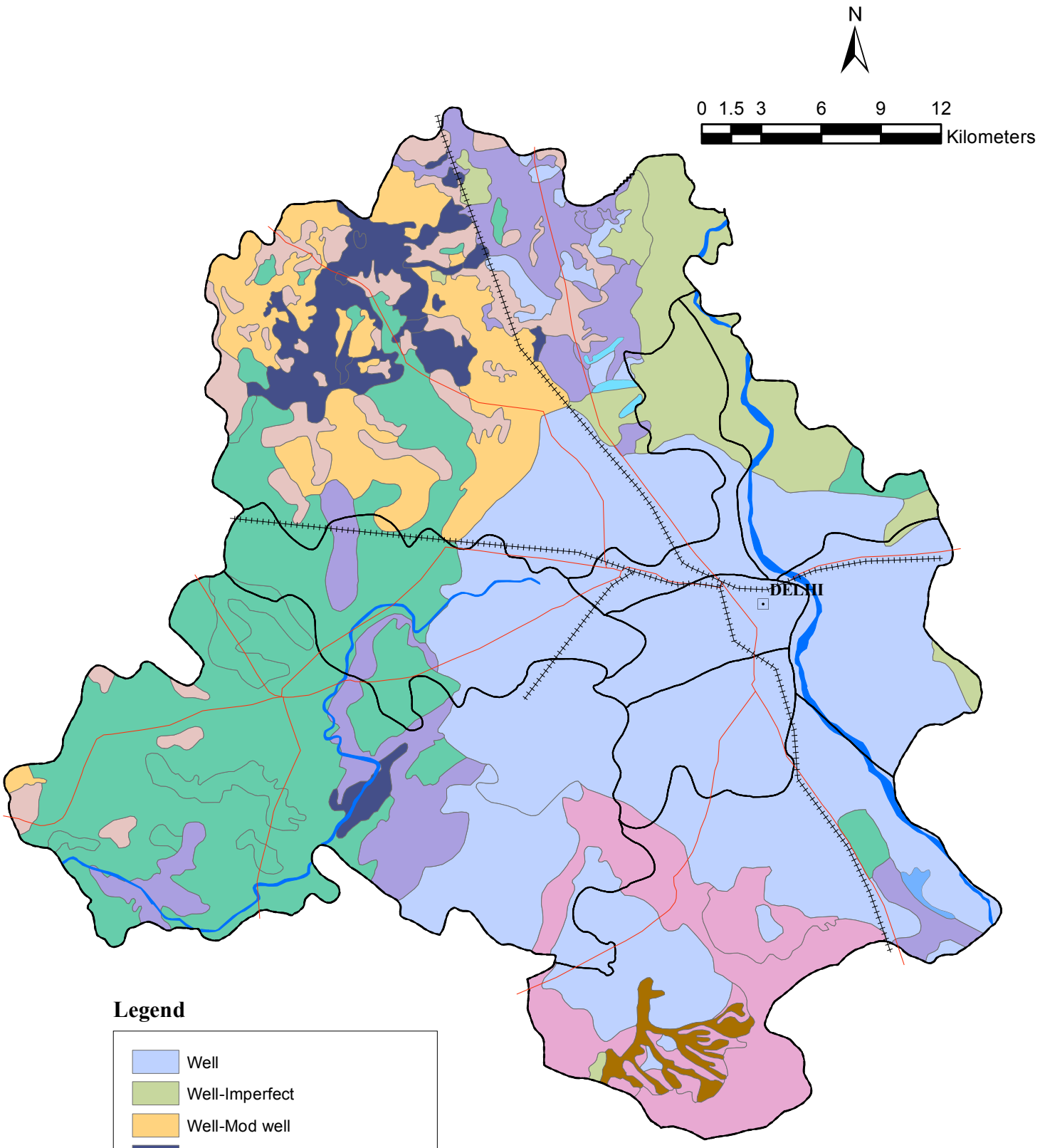
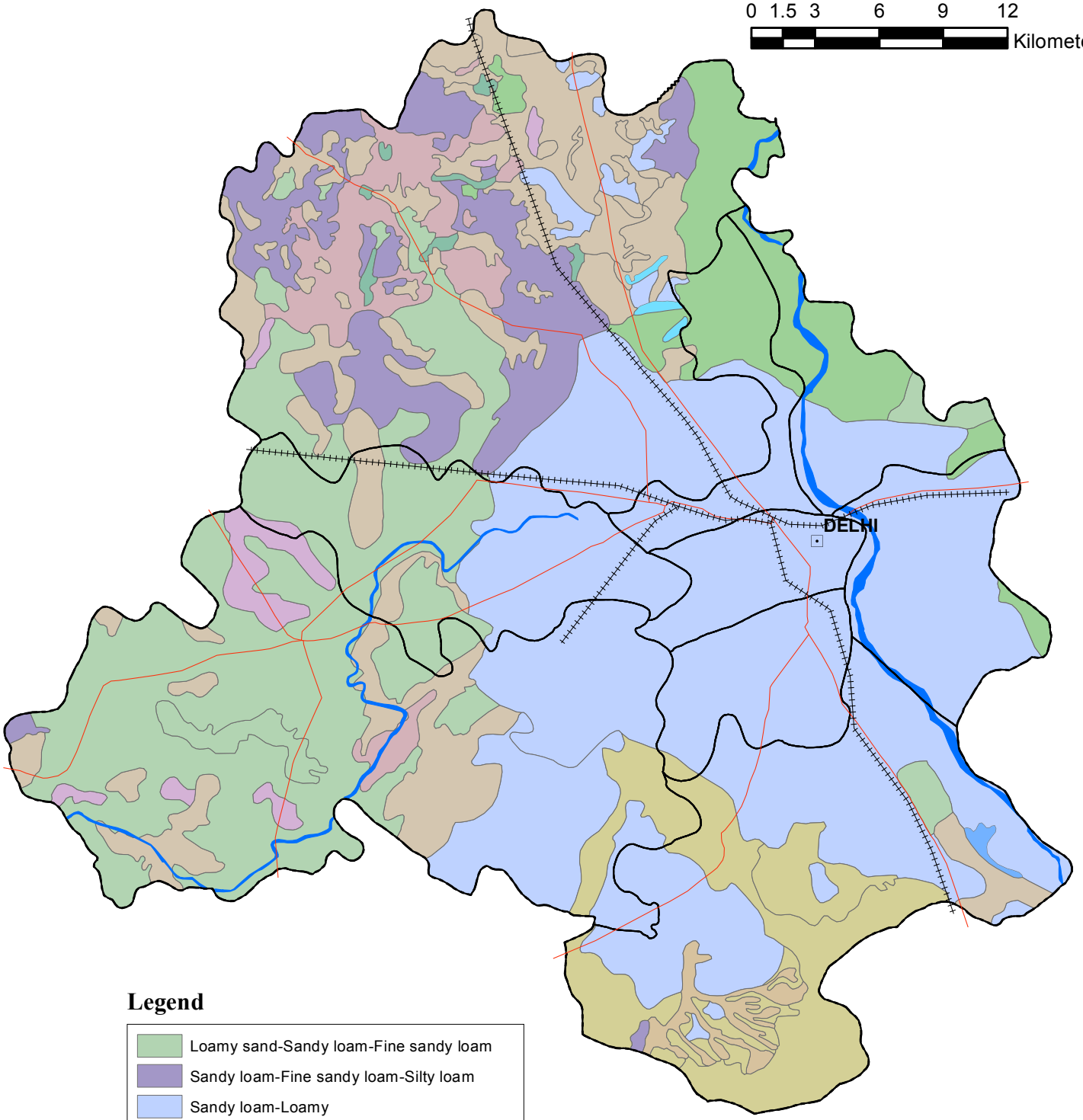


Fig. 7: Soil Drainage

DELHI TERRITORY

Surface Texture



Legend

- Loamy sand-Sandy loam-Fine sandy loam
- Sandy loam-Fine sandy loam-Silty loam
- Sandy loam-Loamy
- Sandy loam-Loamy-Undifferentiated soils
- Sandy loam-Silty loam-Loamy
- Sandy loam-Silty loam-Silty clay loam
- Sandy-Loamy sand-Sandy loam
- Silty loam-Silty clay loam-Sandy-Loamy sand
- Silty loam-Silty clay-Sandy loam-Loamy
- Rocky land-Miscellaneous land
- OX BOW
- Pond

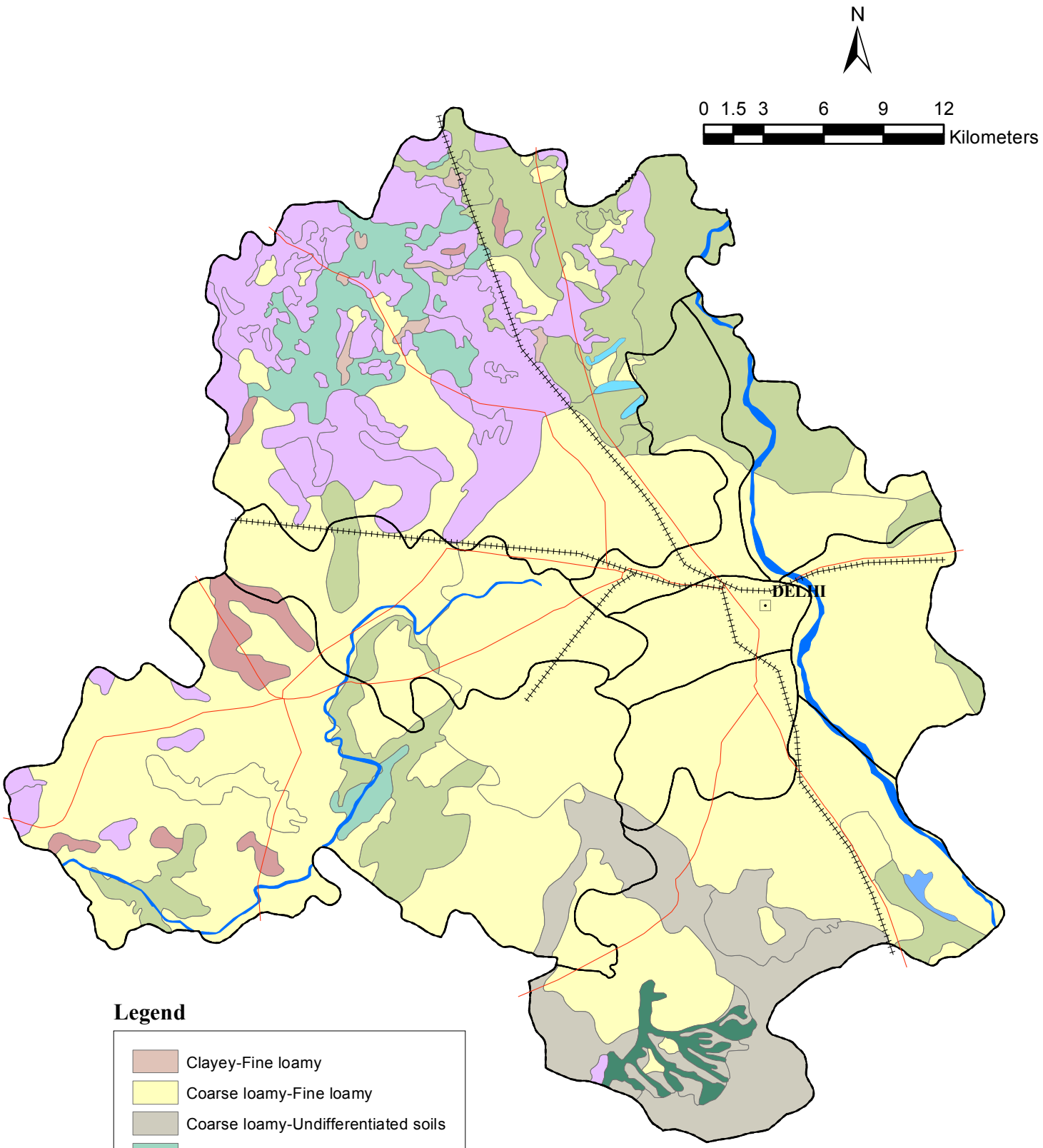
References

- District HQ
- District Boundary
- State Boundary
- Road
- Railway
- Drainage
- River

Fig. 8: Surface Texture

DELHI TERRITORY

Particle Size Class



Legend

- Clayey-Fine loamy
- Coarse loamy-Fine loamy
- Coarse loamy-Undifferentiated soils
- Fine loamy-Clayey
- Fine loamy-Coarse loamy
- Fine loamy
- Sandy-Coarse loamy
- Rocky land-Miscellaneous land
- OX BOW
- Pond

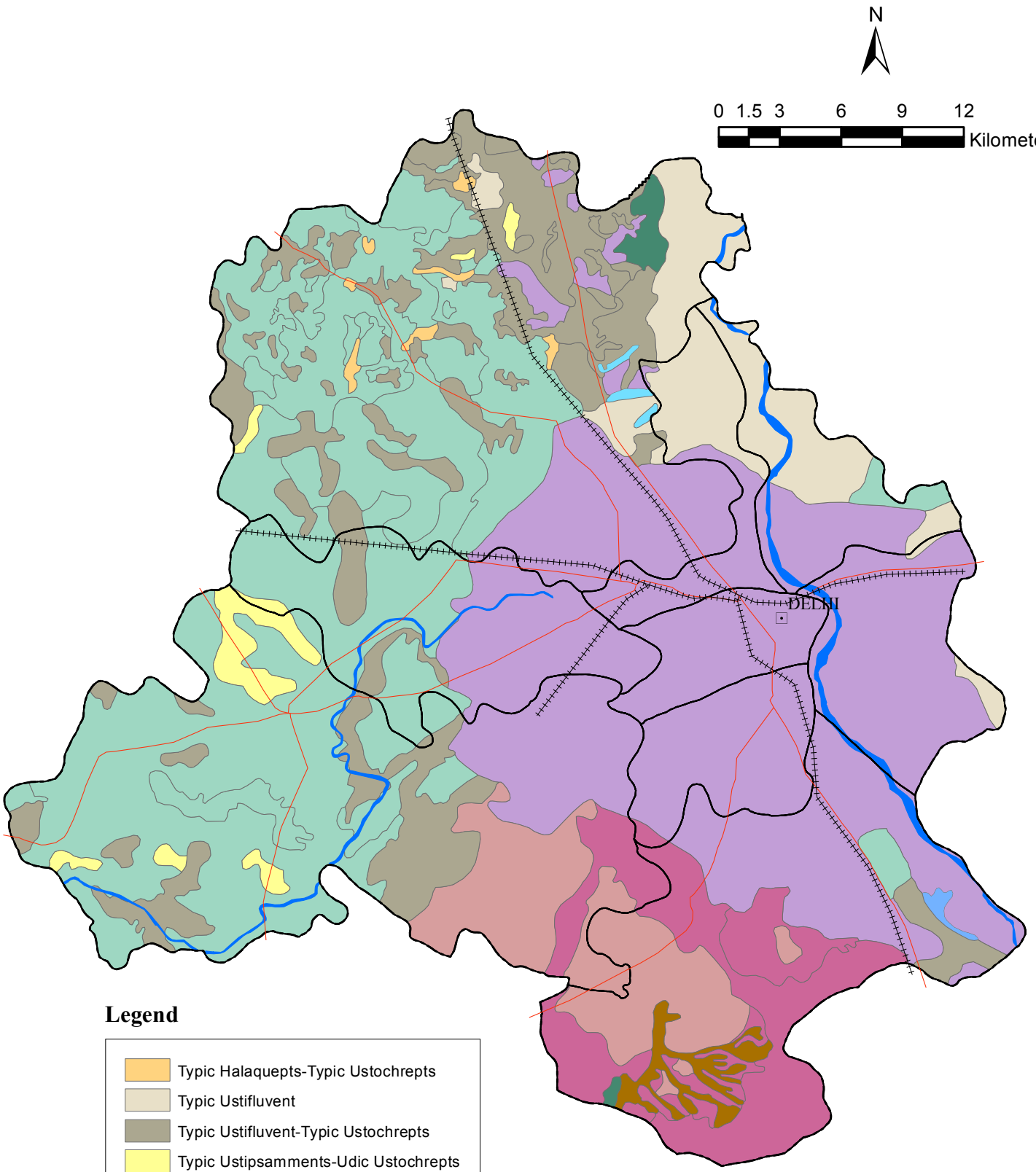
References

- District HQ
- District Boundary
- State Boundary
- Road
- Railway
- Drainage
- River

Fig. 9: Particle Size Class

DELHI TERRITORY

Soil Taxonomy



Legend

- Typic Halaquepts-Typic Ustochrepts
- Typic Ustifluvent
- Typic Ustifluvent-Typic Ustochrepts
- Typic Ustipsamments-Udic Ustochrepts
- Typic Ustochrepts-Typic Ustifluvents
- Typic Ustochrepts-US
- Udic Ustochrepts-Typic Haplustalfs
- Udic Ustochrepts-Typic Ustifluvent
- Udic Ustochrepts
- Rocky land-Miscellaneous land
- OX BOW
- Pond

References

- District HQ
- District Boundary
- State Boundary
- Road
- Railway
- Drainage
- River

Fig. 10: Soil Taxonomy

4.

INTERPRETATIONS

4.1 Principles of Interpretation

The soil map of the Territory shows the delineation of soil series associations, which are named units but inclusion of other soils to the, extent of 20 to 25 percent-is natural in reconnaissance soil maps. Soil series are distinguished on the basis of differentiating characteristics like texture, and free lime, drainage and depth in the area. Assuming that soil mineralogy in a given area is common; interpretations have to be based on considerations of interactions between soil characteristics. Hence, differentiating characteristics that influence moisture and fertility status of the soils become important to assess management responses and manipulation needed for growing crops or putting then under other uses. Therefore, the basis of interpretation should be the taxonomic unit at series level or groups of series based on the differentiating characteristics. The soil map helps to ascertain the qualities and properties of different soils or to locate them with reference to the interpretations that are important for intended use of soils/land.

The interpretation grouping of the soils of the territory are made for land capability classification, irrigability classification and evaluation of land resources up to sub-class levels based on the differentiating characteristics of the identified and mapped soils.

4.2 Land Capability Classification:

Capability classification is an interpretative grouping made primarily for agricultural use. Cultivable soils are grouped according to their potentialities' and limitation for sustained production of the commonly cultivated crops. The crops considered are listed under presently cultivated crops.

Land capability classes are grouped as sub-classes to indicate the kinds of dominant limitations for agricultural use. Four kinds of limitations for agricultural use. Four kinds of limitations come across at the sub-class level are ‘e’ for wind or water erosion hazard; ‘w’ for drainage difficulties, wetness or over-flow; ‘s’ for soil limitations affecting plant growth and ‘c’ for limitations due to climate.

Influence of climate in land use classification has to be considered when the soil conditions are considered favorable. Soils in semi-arid climate quality for Class III/IV lands. But in Delhi Territory considering the rainfall pattern during the crop season i.e. July to September, crops mature within 120 days. The average rainfall is about 68.0 cm and as such the Land Capability Classification starts with Class II (Fig.11). Though this is considered enough to grow climatically adapted crops, rainfall is erratic and its distribution cannot be predicted as a result of deviation from normal through the growing season of the crops Hence, the best soils of the area quality for Class IIc lands. They have no other limitations. Other limitations identified in the area are due to soil salinity, erosion and wetness.

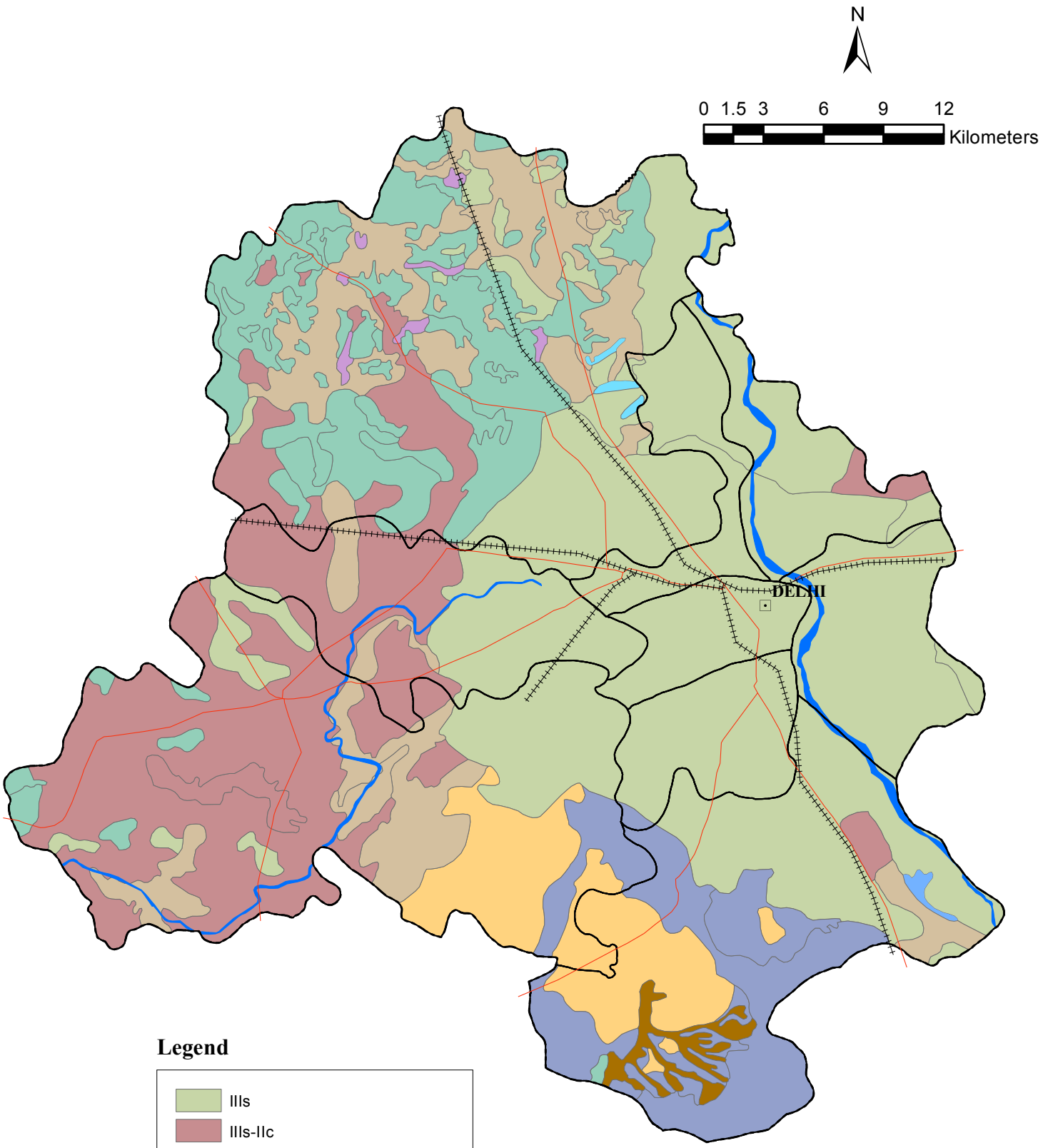
4.2.1 Land Capability Sub-Class IIc:

Class IIc are level lands having very deep, well drained fine loamy soils. Estimated available moisture capacity ranging from 9 to 12 cm in 60 cm depth and 13 to 22 cm in 100 cm soil profile depth is enough to support *kharif* crops. Capacity of the soils to retain nutrients is satisfactory. The soils can grow all climatically adapted crops of the region like jowar, bajra, maize and *kharif* legumes. Their response to alternative management is expected to be good as they are by far the most productive soils.

Mapping units grouped in II c are Associations Holambi - Nabha series (4), Daryapur-Hissar series (5) and Holambi-Daryapur series (8).

DELHI TERRITORY

Land Capability



Legend

- IIIs
- IIIs-IIc
- IIIsw-IIc
- IIc-IIIs
- IIc
- IIc-IIe
- IIe-US
- Rocky land-Miscellaneous land
- OX BOW
- Pond

References

- District HQ
- District Boundary
- State Boundary
- Road
- Railway
- Drainage
- River

Fig. 11: Land Capability

4.2.2 Land Capability Sub-Class IIe

Class IIe lands include very deep, fine loamy soils. The lands are gently sloping and susceptible to erosion. Estimated available moisture is 7 to 9 cm in 60 cm depth and 11 to 15 cm in 100 cm depth profile. There is enough moisture from rainfall to support *kharif* crops if run-off is checked. The soils can grow all climatically adapted crops of the region. Their response to alternative management is expected to be good like IIc lands.

Mapping units ground in IIe are Association Mohruili-Garhi series (11).

4.2.3 Land Capability Sub-Class IIs:

Class IIs are level lands which include very deep, fine loamy soils. Estimated available moisture capacity ranges from 9 to 12 cm in 60 cm depth and 13 to 22 cm in 100 cm profile depth. These lands are affected by salt and alkali and hence leaching of salts, application of gypsum, growing dhaincha and salt resistant crops are recommended.

Mapping units grouped in IIs are Associations salt affected Daryapur-Hissar soils (5s) and salt affected Holambi-Daryapur soils (8s)

4.2.4 Land Capability Sub-Classes Ile and IIIe:

Class Ile and IIIe lands include very deep, coarse loamy, sandy loam to loam on nearly level to undulating lands susceptible to erosion. Estimated available moisture capacity is 8 cm in 60 cm depth and 14 cm in 100 cm in IIe lands and 7 to 8 cm in 60 cm in IIIe lands. These lands require appropriate treatment to conserve soil and water by contour bunding.

Mapping units grouped are association Palam-Undifferentiated soils (12).

4.2.5 Land Capability Sub-Class IIIe and VIIIe:

Classes IIIe and VIIIe lands include shallow to moderately deep undifferentiated soils and rocky lands of the Aravallis and dissected severely eroded lands. These are subject to run-off and erosion.

The above association of land capability sub-classes also include other interpretative sub-classes due to varying soil depths of land within the delineation. They need severe soil conservation measures like check dams; permanent vegetation through forest and grasses besides contour bunding on IIIe Garhi soils.

Mapping units grouped are Association Undifferentiated CRY) soils - Rocky lands (13) and Miscellaneous gullied lands.

4.2.6 Land Capability Sub-Class IIs and IIIs:

Class IIs and IIIs lands include salt affected phases of fine loamy and coarse loamy soils of Daryapur-Hissar (7s); Kakra Holambi (2s); Palla-Hamidpur (9s) and Hiranki-Palla-Wazirabad Associations (108). Leaching of salts and growing salt resistant crops during reclamation are essential.

IIs lands in saline phase of Daryapur-Hissar, Kakra-Holanad Associations. Ills lands include saline phase of Pall-Hamidpur and Hiranki-Palla-Wazirabad Associations.

4.2.7 Land Capability Sub-Class IIIs:

Class IIIs lands include soils that have limitations of available moisture capacity due to coarse texture i.e. loamy fine sand and fine sandy loam. Available moisture capacity of the soils is 4 to 5 cm in 60 cm and 6.5 to 12 cm in 100 cm depth profile. The soils are also susceptible to wind erosion. They cannot hold enough moisture from

precipitation curing *kharif* to support climatically adapted crops. They are suited to bajra and *kharif* legumes during years of normal rainfall. If the July rains fail these lands should be preferred to legumes.

Mapping units grouped are Associations Hanadpur-Palla series (9), Razapur-Kakra series (1) and Hiranki-Palla-Wazirabad series (10).

4.2.8 Land Capability Sub-Class IIc and IIIs:

Class IIc and IIIs lands include highly potential soils with good available moisture capacity described under IIc and soils with problem of low available moisture capacity described under IIIs /IIs. Separation of units of individual sub-classes will be necessary for specific management.

Mapping units included are Associations Daryapur-Hamidpur series (7) and Kakra-Holambi series (2).

4.2.9 Land Capability Sub-Class IIc-IIIs:

Class IIc lands include fine loamy soils with available moisture capacity of 9 to 12 cm in 60 cm depth and 13 to 22 cm in 100 cm profile depth. These are among the best soils ice and with good fertility status and high productivity.

Soils grouped under IIIs and IIc are those, which are clay loam to clay, situated in low micro-relief (concave relief) with low infiltration and subject to temporary stagnation restricting the choice of crops. They may also be affected by saline-alkali. The soils of this sub-class are not suited to crops like bajra and maize. Even a crop like jowar needs efficient management like provision of adequate surface drainage and early planting. With good rains in September, these soils with more than 13 cm and 25 cm available moisture capacity in 60 cm and 100 cm depth profile, respectively can support *rabi* crops.

Mapping units included are Associations Ghoga-Nabha -series (3) and Rhampur-Hissar series (6).

4.3 Irrigability Classification:

From the present land use data, it is observed that a greater part of the Territory is used for rainfed agriculture during *kharif* whereas more than 70% of the area under *rabi* cultivation is irrigated. Canal irrigation contributes to 25% of the irrigated area. Wells and tube-wells are the major sources of irrigation. Regulating irrigation according to the crop needs is thus possible in a major part of irrigated lands. But ground water salinity is prevalent in some areas and it will be necessary to have data for water analysis for individual wells.

Irrigability classification is made taking note of the fact that temperature and sunshine conditions are favourable throughout the year for climatically adapted crops. Still, there are occasional frost days during January. Soil irrigability classification is made on the basis of important soil characteristics namely soil texture, depth, available moisture holding capacity of soils, infiltration, permeability and saline-sodic conditions. Irrigability Class 1 lands do not have any limitation. Hence, they are not classified into sub-groups. These include soil series that have good available moisture capacity and which do not pose the problems of drainage and salinity.

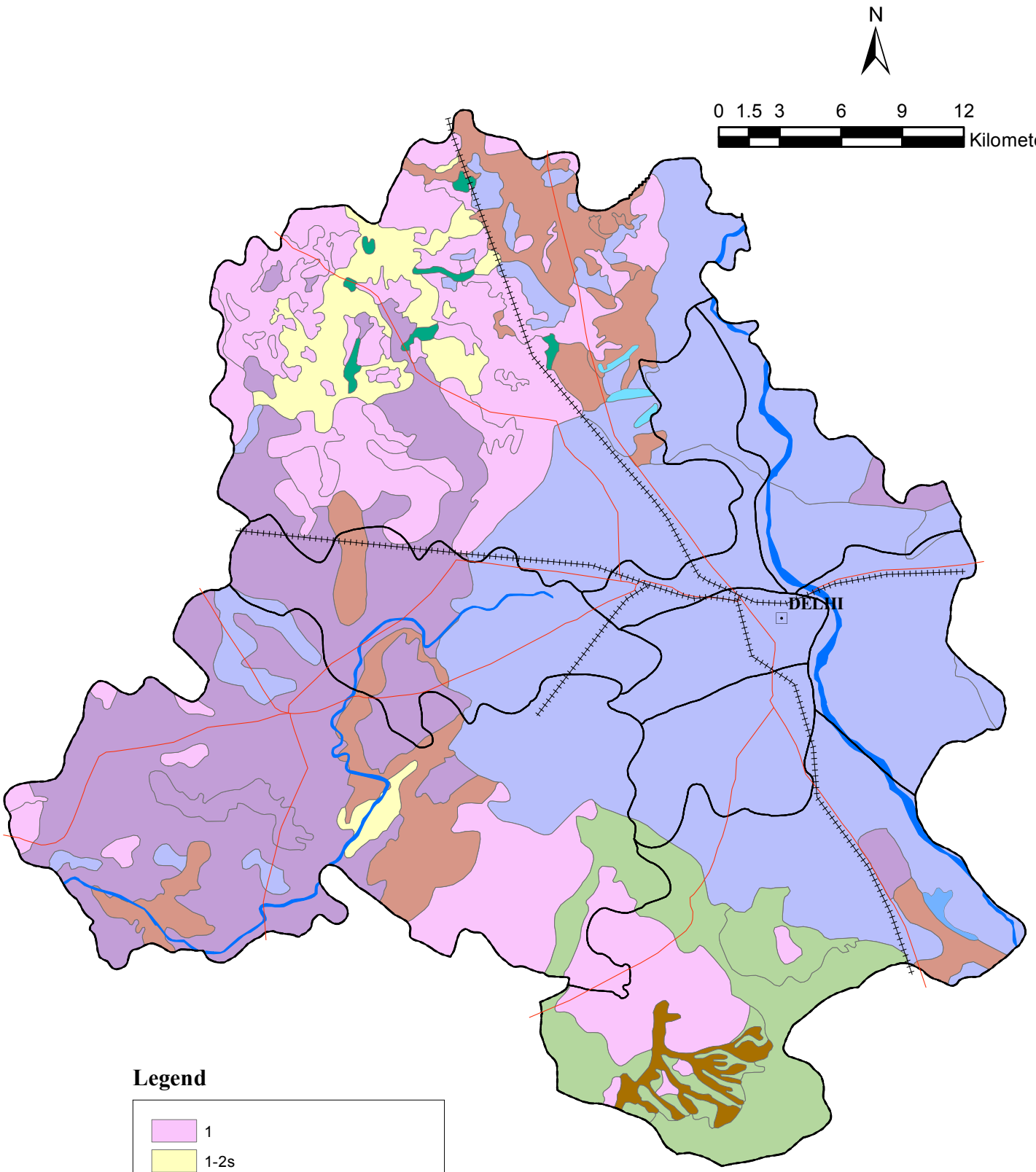
Assumption made in classifying the soils is that within irrigability sub-class, soils have similar limitations.

Availability of irrigation water is assumed to be adequate. Quality of irrigation water where ground water is used is not taken into account. However, quality of ground water is to be considered for the individual, situations with respect to soil-water-relationships, crop selection and management. Canal water and majority of well waters are of good quality.

Limits of salts in irrigation water considered harmful to the plants are recognized in the following villages by Paliwal and Yadav (1975) as seen from the water quality map of the Union Territory of Delhi.The land irrigability map of the Delhi Territory is shown in figure 12.

DELHI TERRITORY

Land Irrigability



Legend

- 1
- 1-2s
- 1-3s
- 1-US
- 2s-1
- 3s-1
- 3s
- Rocky land-Miscellaneous land
- OX BOW
- Pond

References

- District HQ
- District Boundary
- State Boundary
- Road
- Railway
- Drainage
- River

Fig. 12: Land Irrigability

Very Harmful (6000 Micromhos/cm):

Villages - Deorala, Galibpur, Nankheri, Raghopur, Badusara, Raganheri, Paporawat, Malikour, Gheora, Rasalpur, Prahaladpur, Pansal and Surakhpur.

(a) Harmful (4001 - 6000 Micrannhosin/cm):

Villages - Raota, part of Dhansa, part of Jafarapur kalan, Ladpur, part of Katewara and Bakargarh.

4.3.1 Irrigability Class 1:

These include soils, which are deep with available moisture capacity of more than 12 cm/100 at depth soil profile and with no hazards of drainage or salinity. Under irrigation these lands can support all the agricultural crops and fruit trees climatically adapted to the region. They will respond to the recommended irrigation schedule. The soils are expected to show the most favourable response to management.

Mapping units included in this Class are Associations Holambi - Nabha series (4), Hiszar-Daryapur series (5), Daryapur - Hamidpur series (7), Holambi-Daryapur series (8) and Mehrauli-Garhi series (11).

4.3.2 Irrigability Sub-Class 1-2 a Lands:

Irrigability sub-class 1-2s lands include soils of Class 1 lands with good soil-moisture-air relationships in association with land of 2s soils which have problems due to heavier textures,low infiltration and problem due to low relief that causes stagnation during rainy season. They limit the choice of crop and may need surface drainage during rainy season. The soils are well suited to forage crops like berseem and paddy under irrigation.

Mapping units included are Associations Nabha-Ghoga series (3) and Khampur-Hissar series (6).

4.3.3 Irrigability Sub-Class 1-3s Lands:

Irrigability sub-class 1-3s lands include soils of Class 1 lands with good soil-moisture-air relationships in associating with lands of 3s soils that are coarse textured with low available moisture capacity in the soil profile. The soils pose the problem of loss of irrigation water due to percolation and lose of nutrients due to leaching Choice of crops is restricted and selection of crops to use moisture and fertilizer at greater depths of soil profile is necessary.

Mapping units included are Associations Kakra-Holambi series (2). Hamidpur-Palla series (9) and Hiranki-Palla-Wazirabad series (10)

4.3.4 Irrigability sub-class 3s Lands:

Irrigability sub-class 3s lands include soils that are low in available moisture capacity. Avail moisture capacity ranges from ranges from 9 cm in 100 cm depth profile. These soils present problems due to excessive Percolation losses and frequent irrigation needs. Leaching losses and low nutrient retention capacity of nitrogenous fertilizers is obvious. Choice of crops is restricted and selecting crops that use moisture and fertilizer at lower depths of soil profile is necessary.

Mapping units included is Association Razapur-Kakra (1).

4.3.5 Irrigability Sub-Class 2s Lands:

These include salt and alkali affected soils with good available moisture capacity. They pose problems due to high salts that restrict germination and root growth. Leaching of salts, application of gypsum, surface drainage and selection of salt resistant crops are recommended.

Mapping units included are Associations salt affected girlies of Daryapur-Hissar series (5s), salt affected phases of Daryapur-Hamidpur series (7s) and salt affected phases of Holambi-Daryapur series ills)

4.3.6 Irrigability Sub-Class 2s-3s Lands:

These included soils of very deep course loamy or clayey soils, which are droughty or excessively wet with salinity and low relief problems. At some places, clayey soils are also subjected to high ground water. In this situation, cultivation under irrigation is not possible without providing surface drainage. In coarse textured soils leaching of salts, application of gypsum, growing of Dhaincha and salt tolerant crops like barley, wheat, beroeem, paddy and salt resistant vegetables are recommended.

Mapping units included are Associations salt affected phases of Kakra-Holambi series (2s), salt affected phases of Khampur - Hissar series (6s), salt affected phases of Hamidpur-palla series (9s) and salt affected and high ground water phases of Hiranki-Palla-Wazirabad series (10sw).

4.3.7 Irrigability Sub-Class 2s-6s Lands:

This association sub-classes 2s-6s lands include soils of subclass 2s lands which nave good soil-moisture-air relationships with moderate limitation if topography in association with lands of 6s soils that are shallow to moderately deep. They may pose problems due to variable depths and susceptibility to erosion. Land are not suitable for sustained use under irrigation. On 2s land conservation measures to check erosion and on 6s lands forest and grasses are recommended.

Mapping unit included is Association Palam-Undifferentiated Lands (12).

4.3.8 Irrigability Sub-Class 6t Lands:

Irrigability sub-class 6t lands include undifferentiated, shallow to moderately deep, severely eroded soils due to steep slopes. These land are not suited for use under irrigation. Construction of check dam & growing forest and grass species and proper land shaping to check erosion are recommended.

Mapping unite included are Associations undifferentiated Rocky Aravallis ridges (13) and miscellaneous dissected gullied lands (14).

4.4. Productivity and Yield Predictions:

Soil productivity is the capacity of a soil in its normal environment to produce a specified plant or sequence of plants under a system of management. Productivity hence specifies the capacity of soil to produce crops and may be expressed in terms of yields.

The interpretation of soils with respect to productivity is post accomplished by gathering yield data and preparation of a table of yield estimates under alternate systems of management.

In land capability and irrigability classification, soil and land characteristics are taken into account to classify them under different categories. Productivity and yield prediction estimates may be considered as a further step for developing interpretation of soils for land use alarming. In the area surveyed wheat is the most important crop. It is grown on most of the soils mapped. There is more awareness to use the improved technology for obtaining better yields. Hence, a study was made to estimate productivity of different soils in respect wheat crop under defined management levels.

The data were collected through observation of crops in the field from time to time and making enquiries from the farmers on the performance and management.

Different units at soil series level were chosen as soil variables from areas of detailed soil mapping. Management as input was an important variable to estimate productivity under specific combination of treatments. As the study was made on the basis of individual farmer's management efforts, there were several variations. Nevertheless, it was possible to classify management levels into three identifiable levels. Following are the three levels of management defined on the basis of information collected during survey from individual farmers.

a) Low level of management

Use of local variety of seeds: less than 20 kg

N/ha: 4 to 5 ploughings: limited source of irrigation and no plant protection measures.

b) Medium level of management

Use of improved varieties of seeds: 20 to 40 kg.

N/ha: 5 to 6 ploughings: adequate irrigation and no plant protection measures.

c) High level of management

Use of improved variety of seeds; 40 to 60 kg

N/ha; 30 to 40 kg.P_2O_5/ ha; 6 to 7 ploughings: adequate irrigation and sane plant protection measure.

Generally the farmers over-irrigate when the water is available.

Limited number of soil series were selected at the initial stages of study for enquiries which included Holambi, Daryapur and Hisser which are fine loamy and Hamidpur which is coarse loamy.

The yield prediction and management information are generated from the interviews with the farmers. The indications according to observations made are that sandy soils have low yield levels than coarse loamy soils and clayey soils may equal coarse loamy soils in yield levels. For these soils (Razapur and Ghoga series) similar information was not collected to enable to give firm range in yield based on different management levels. Table 10 (p.33) gives the information on predicted yield of wheat on coarse loamy and fine loamy soils. Table 11 gives the distribution of different soils in the area surveyed in Delhi Territory.

Table 10: Predicted yield of wheat on coarse loamy and fine loamy soils

Levels of Management	Management definitions	Soil Characteristics	
		Coarse loamy	Fine loamy
		Wheat Yield q/ha	Wheat Yield q/ha
Low	Local variety 0-20 kg N, 4 to 5 ploughings and irrigation not adequate.	10-13	20-25
Medium	S-308, H.D.1553, 30 to 40 kg No 15-20 kg P_2O_5, 5 to 6 ploughings and irrigation average.	20-25	25-30
High	S-308, H.D.1553, 40-60 kg N, 30-40 kg P_2O_5 irrigation adequate.	25-30	35-40

Table11: Distribution of Different Soils

S. No.	Soil family class	Area in ha	Percentage
1.	Sandy-coarse loamy	2,053.28	2.00
2.	Coarse loamy-over sandy	6,574.08	7.00
3.	Coarse loamy-fine loamy	48,450.55	46.88
4.	Fine loamy	18,042.88	17.45
5.	Fine loamy-clayey	4,580.00	4.32
6.	Stratified	7,224.32	7.00
7.	Coarse loamy- Undifferentiated	2,247.00	2.17
8.	Undifferentiated and Miscellaneous land.	14, 255.84	13.78.

Broadly speaking the differential response to management may be attributed to differences in soil moisture relationship and soil variations. On fine loamy soils, highest yield is obtained under irrigation (under assured moisture supply). Lower yields on sandy soils is obviously due to low available moisture and nutrient holding capacity. The performance of coarse loamy soils compared with fine loamy soils hill be explained for similar reasons.

Average yield of wheat in Delhi Territory for 1974-75(Delhi Statistical Hand Rook: 1976) was at 20 q/ha and over 94% of the area under wheat crop is irrigated. By following medium to high level of management, the wheat yields can be raised by 25 to 100 per cent over the average for the Territory. With the present policy of village as a unit for development and to make the village self sustaining, land use planning to produce various climatically adapted crops like cereals, pulses, oil seeds and fibre should be possible with the available land. This approach should be easy to follow in areas having irrigation facilities. Soil maps help in under standing the distribution of soils and decide the choice of crops which can mention the proper balance of soil-plant-water relationships. Reconnaissance Soil Map of Delhi Territory has brought out the distribution of different soils occurring in the Territory. They may be used to make assessments of soil-crop interaction under different levels of management and to rationalise land use for self-reliance. This adequately proves that productivity is a function of soil characteristics and management. Further, it should be possible to think in terms of equivalent returns from management of different crops which is so essential for balanced production of agricultural crops in the context of micro-level and macro-level planning and meeting the food needs of the growing population

5.
CROP AND MANAGEMENT RECOMMANDATIONS

The area is already put to intensive agricultural use as indicated by information collected during survey. Based on soil survey Information and present land use, land evaluation has been made for rainfed and irrigated farming. Information on productivity and yield prediction should make it possible to choose package of practices for projected yields or to make contingency plans.

Management requirements and adapted crops are listed for various land classes. The recommendations gives furnish general guidelines for cropping and management. However, these do not take the place of detailed recommendations made by Extension Agronomists. The recommendations are with respect to identified and mapped soil units. Adapted crops on different soil series is given in Table 12.

5.1 Soils of High Ground Water:

Proper drainage of affected lands is essential. The drainage ways that drain the surveyed are described in the report. Proper surface drainage will mitigate the problem of high ground water and/or overflow and stagnation. Paddy may be grown with supplemental irrigation followed by barley mustard, gram and lentil. The mapping units indicate such soils that are affected due to poor drainage. On-site problems will have to be tackled for individual fields.

5.2 Salt Affected Soils:

Leaching of salts and reclamation of alkali soil are necessary. Drainage will be necessary where gound water is high. The salt affected soils generally do not pose problems to reclaim. Leaching may be followed by dhaincha for green manuring or paddy based on removal of salts and alkali in the upper part of the profile. With partial reclamation, mustard, barley, wheat and berseem can be grown.

5.3 Dry Land Farming:

During *rabi*, mustard and gram may be grown on fine loamy and clayey soils, On sandy soils castor is a good choice.

5.4 Soils of Sloping Land:

Lands having 1-3% slope should be leveled up to 0.05 to 0.5% based on soil textures for irrigation. On the hills and piedmont plains more elaborate soil conservation measures are necessary based on watershed principle.

5.5 Bed Length:

Length of seedbed should not-be more than 90 to 120 metres in case of Razapur, Kakra, and Hamidpur series for better distribution of irrigation water.

5.6 Small Holdings:

On holdings of less than half ha vegetable crops can be selected for coarse loamy and fine loamy soils. Recent flood plain soils of Hiranki, Palla and Wazirabad series are eminently suited for vegetables due to high ground water of good quality.

5.7 Fertilizer and Manure:

Recommended doses of fertilizers need to be applied to different soils. Recommended dose economic dose and half the recommended dose that have been worked out are expected to give good results on fine loamy soils which are grouped under IIe sub-class and with free lime within first 50 as soil profile and saline-sodic appropriate modifications are necessary. Recommendations for marginal land holders should be modified to apply fertilizers for maximum return per unit of applied fertilizer to keep down the input need.

Table 12: Crop Adaptability for Different Soil Series *Kharif* season

Soil Series and Texture Family	Available moisture capacity in cm upto 60 cm depth	Unirrigated	Irrigated	
			Cereals & Oil seeds	Vegetables & Flowers
1	2	3	4	5
Razapur series (Sandy)	4.1	Guar, Moong, Til, Castor	Bajra, Guar, Moong, Groundnut	-
Kakra Series (Coarse loamy)	4.4	Bajra, Arhar, Guar, Moong, Til, Castor (mixed cropping)	Bajra, Arhar, Guar, Moong, Groundnut, Maize	Tomato, Brinjal, Chillies, Cucurbits, Potato, Bhindi
Hamidpur series (Coarse loamy)	7.0	Bajra, Guar, Moong	Bajra, Guar, Moong, Maize	Turnip, Palak, Sonf, Cucurbite, Rose
Holambi series (fine loamy)	9.0	Bajra, Guar, Moong	Maize, Jowar, Bajra, Cotton, Moong, Urd	Tomato, Brinjal, Bean, Palak, Chillies, Cucurbits, Sonf, Bhindi
Daryapur Series (Find loamy)	9.0	Chari, Jowar, Dhaincha	Jowar, Bajra, Guar, Chari	-
Nabba Series (Fine loamy)	12.4	Chari, Jowar, Dhaincha	Chari, Jowar, Maize, Paddy, Suggarcane, Cotton, Moong, Urd	Tomato, Brinjal, Bean, Palak, Chillies, Cucurbits, Sonf, Bhindi
Hissar Series (fine loamy)	12.5	Chari, Jowar, Dhaincha for Green Manuring or Sticks	Paddy, Jowar, Sugarcane	-
Ghoga Series (Clayey)	14.4	Chari, Jowar, Dhaincha	Paddy	-
Khampur Series (Clayey)	14.1	Dhaincha for Green Manuring or Sticks	Paddy, Dhaincha	-
Palla (Coarse Loamy)	7.7	Bajra, Guar	Bajra, Cowpea, Moong	Chari, Cowpea + Bajra as green fodder before monsoon starts
Hiranki (Coarse loamy over fine loamy)	16.1	Fallow or Chari	Chari, Sugarcane	-do-
Wazirabad (stratified)	7.6	Fallow	Fallow	Summer Chari & Cucurbits
Mehrauli (Coarse loamy)	7.2	Bajra + Arhar	Bajra, Maize, Castor	Summer Vegetables – Ladies finger,

				Tinda, Tomato, Rose
Garhi (Fine loamy)	8.1	Bajra + Arhar, Chari	Bajra, Jowar, Maize, Moong, Urd, Castor	-Do-
Palam (Coarse loamy)	8.2	Bajra, Moong	Bajra + Moong	- Do-

***Rabi* Season**

Soil Series and Texture Family	**Available moisture capacity in cm upto 60 cm depth**	**Unirrigated**	**Irrigated**	
			Cereals & Oil seeds	**Vegetables & Flowers**
1	2	3	4	5
Razapur Series (sandy)	4.1	Fallow, Gram, Taramira, Barley	Barley, Gram, Sunflower	-
Kakra Series (Coarse loamy)	4.4	Fallow, Barley, Gram, Mustard Taramira	Barley, Mustard Sunflower	Potato, Pea, Carrot, Radish, Turnip, Onion, Marigold, Cucurbits, Melon, Sugar beet
Hamidpur Series (Coarse loamy)	7.0	Fallow, Barley, Mustard, Gram	Barley, Mustard, Toria, Sunflower	-do-
Holambi Series (fine loamy)	9.0	Mustard, Barley, Gram	Wheat	Potato, Pea, Onion, Marigold, Garlic, Coriander, Cauliflower, Cabbage
Daryapur Series (fine loamy)	9.0	Mustard, Barley, Gram	Wheat	Onion, Cauliflower, Pea
Nabha Series (fine loamy)	12.4	Mustard, Barley, Gram	Wheat, Berseem	Pea, Cauliflower
Hissar Series (fine loamy)	12.5	Gram, Lentil	-do-	Pea, Cauliflower
Ghoga Series (clayey)	14.4	Gram, Lentil	Wheat, Lentil	-
Khampur Series (clayey)	14.1	Barley, Mustard	Barley, Mustard	
Palla (coarse loamy)	7.7	Barley, Gram	Wheat, Barley	Vegetables, tomato, Pea, Onion
Hiranki (fine loamy over coarse loamy)	16.1	Barley, Gram	Wheat, Berseem	Cucurbits during summer
Wazirabad (Stratified)	7.6	Barley	Barley	Cucurbits during summer
Mehrauli (coarse loamy)	7.2	Barley, Gram, Mustard	Wheat, Barley, Pea, Toria	Rose, other flowers
Garhi (fine loamy)	8.1	Barley, Gram, Mustard	-do-	-
Palam (coarse loamy)	8.2	Gram	Barley, Mustard, Gram, Wheat	-

5.8 Soils of high Maximum potential for wheat

Nabha, Hissar, Daryapur, Holambi and Garhi series are soils of high productive potential for wheat crop. The soils will respond most under different levels of management. Wheat crop was chosen to estimate the productive potential of soils because this crop is systematically replacing other crops like legumes and oil seeds, which are also important to fulfill pulses and oil seeds requirements. About 19 per cent of the territory is demarcated for association of soil series of fine loamy namely Holambi-Nabha, Daryapur, Hissar and Holambi-Daryapur. Coarse loamy-fine series associations account for about 45 percent of the area delineated, Daryapur-Hamidpur aril Mehrauli- Rest of use area covers sandy-coarse loamy and fine loamy-clayey and other soils. Soils maps should help to develop the concept of area planning to meet the requirement of macro and micro level planning.

5.9 Alternate Crops:

The major problem identified in the alluvial plains is failure of bajra and/or jowar and even maize due to excess rainfall. Observation in the field revealed that such failures might be either due to excess rainfall or due to nature of the soils and site characteristics that lead to stagnation of water.

Following suggestions are made for alternate cropping strategy:-

a) Under irrigation where bajra crop fails due to heavy showers in July-August alternate crops may be vegetables and potato. September sown vegetables (carrot) or potato may be followed by wheat sown up to mid December.
b) In similar condition, alternate crop to rainfed bajra could be toria followed by wheat with irrigation.
c) Peas should become an important alternative crop especially on those soils that are identified as less productive for wheat. Peas and/or mustard should be alternative crops for wheat under rainfed or limited irrigation.
d) On salt affected lands mustard may be an alternative crop to wheat.
e) Mixed cropping should be encouraged for complementing the utilization of moisture and model fertilizer from lower depths of soil profile. Mixed cropping should be encouraged on marginal farm holdings.

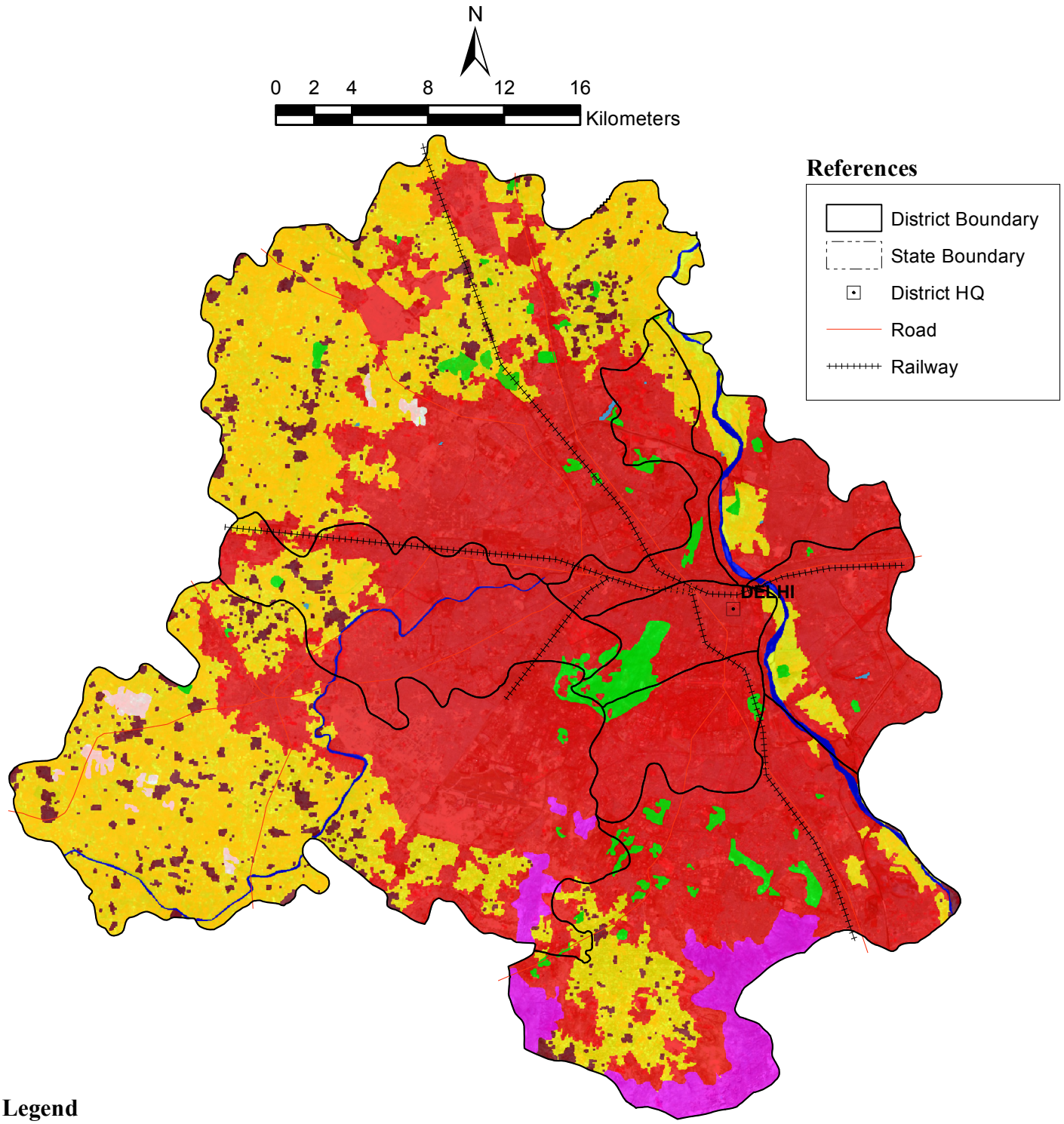
5.10 On Site Problems:

Onsite problems of stagnation due to construction of roads or embankments are to be tackled on individual field basis. Provision of surface drainage may become on site requirement and also for specific crops.

The land use/land cover map of Delhi territory is shown in figure 13.

DELHI

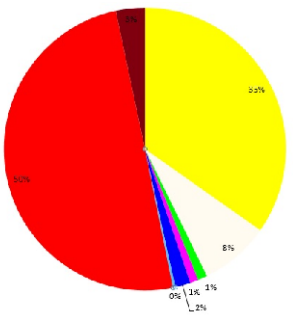
Land Use/Land Cover
2002



Legend

Classes	Area [sq.km]
Agriculture	
Agriculture, Cropland	512
Agriculture, Single Crop, Fallow	118
Builtup	
Built-up, Rural	49
Built-up, Urban	735
Forest	
Forest, Deciduous	16
Uncultivable	
Barren/Uncultivable/Wastelands, Scrub Land	14
Water	
Wetlands/Water Bodies, Reservoir/Lakes/Ponds	4
Wetlands/Water Bodies, River/Stream/Canals	26

LULC (2002): Area Statistics for Delhi District
Total Geographic Area: 1474 sq.km



Note: Refer Legend for Category

Data Source: Landsat ETM+ Satellite data of Kharif (2002) and Rabi (2002), SRTM DEM, Existing Soil Maps & Reports (NBSS & LUP), and other Statistical Data

Fig. 13: Land Use/Land Cover 2002

6.

FORMATION MORPHOLOGY AND CLASSIFICATION OF SOILS

Any identified soil can be explained in relation to its environment. Each soil exhibits certain characteristics as determined by climate and living organisms operating over a peril of time on soil forming materials and on landscapes of varying relief.

6.1 Climate:

The climate of the area is semi-arid. Both summer and winter are severe. June is generally the hottest month and January the coldest.

The maximum summer temperature varies from 43.9°C to 45.0°C. The mean maximum and minimum temperatures are 33°C and 25.4°C, respectively. The mean maximum and mean minimum temperature during winter are 22.7 and 8.4°C respectively. Mean summer temperature is 32.1°C and mean winter temperature is 15.5°C. Mean annual temperature is 25.3°C. The difference between mean summer and mean winter temperature is more than 5°C. Thus it qualifies for hyperthermic temperature regime. Frost is uncommon.

Dust storms are received in May and June when the day temperature exceeds 40°C. The mean wind velocity during this period may be more than 10 km per hour.

The mean annual rainfall based on the 30 years record (1931-60) is 714 mm. Paliwal and Yadav (1975) have reported in Quality of Irrigation Water in Delhi Territory average rainfall for 45 years from 1930-75 as 754 mm. Highest rainfall of 1230 mm was recorded in 1954 and lowest of 321.9 mm in 1938. The rainfall in 1975 as well as 1973 was also very high during June to September when it was 1156 mm. About 90% of the rainfall is received during July to September by south-west monsoon and the rest in winter.

Table 13 and figure 14 and 15 show the information on rainfall and temperature pattern in territory.

The rainfall pattern reveals that it remains maximum during the months July and August. Mean monthly potential evaporation is 206 mm during April to June, 124 mm during July to October, 82 mm during November to February and 143 mm during March and April. The above data will be helpful for understanding differences in soil-water-plant relationships.

Evaporation rates reveal that evaporation exceeds rainfall during the period October to April, which is the season for growing *rabi* crops. The crops are generally irrigated in *rabi*. Still, wheat, barley and gram are grown as dry land crops to some extent in the Territory.

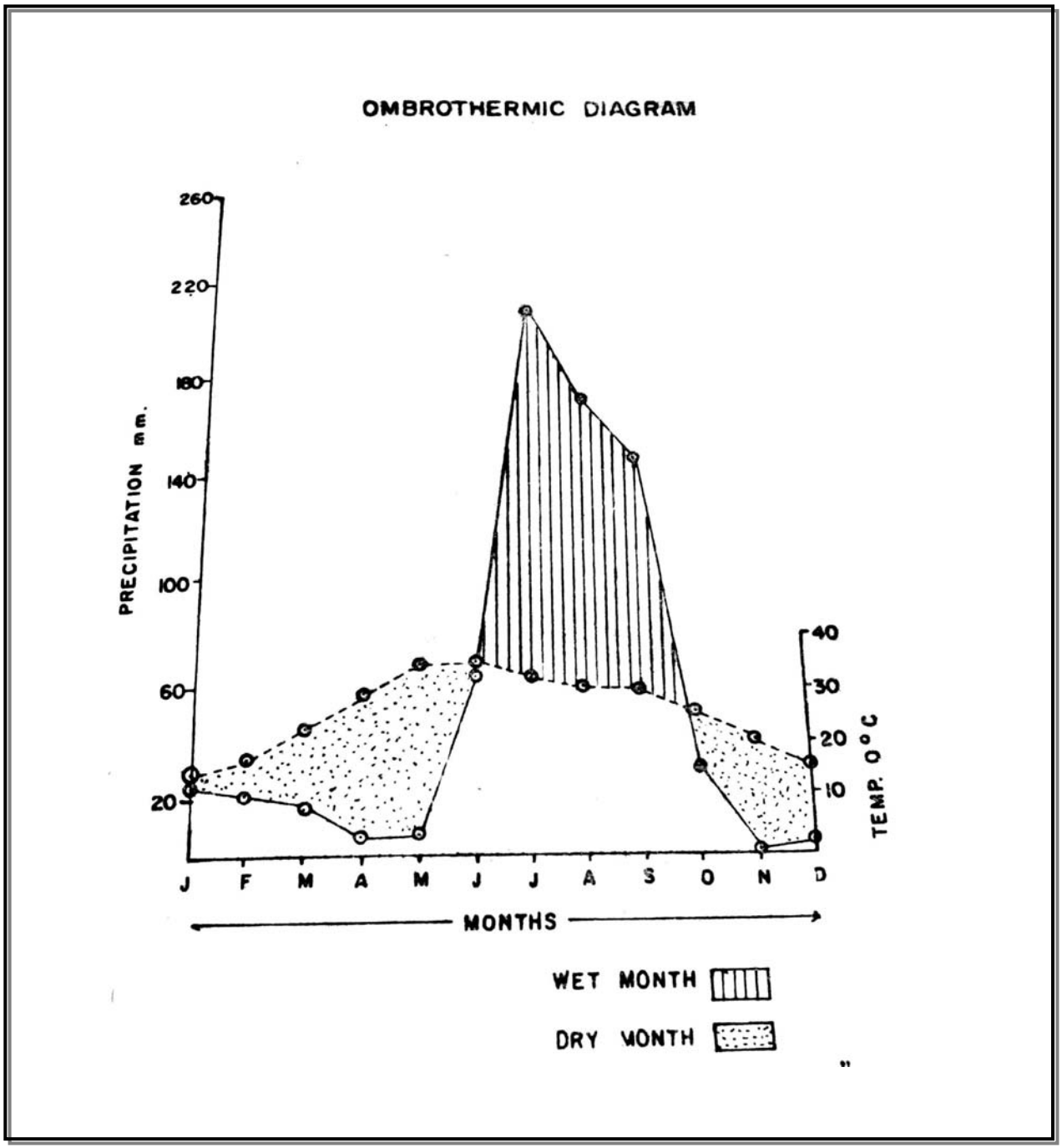


Fig. 14: Quality of Irrigation Water (Delhi Territory, Paliwal & Yadav 1976)

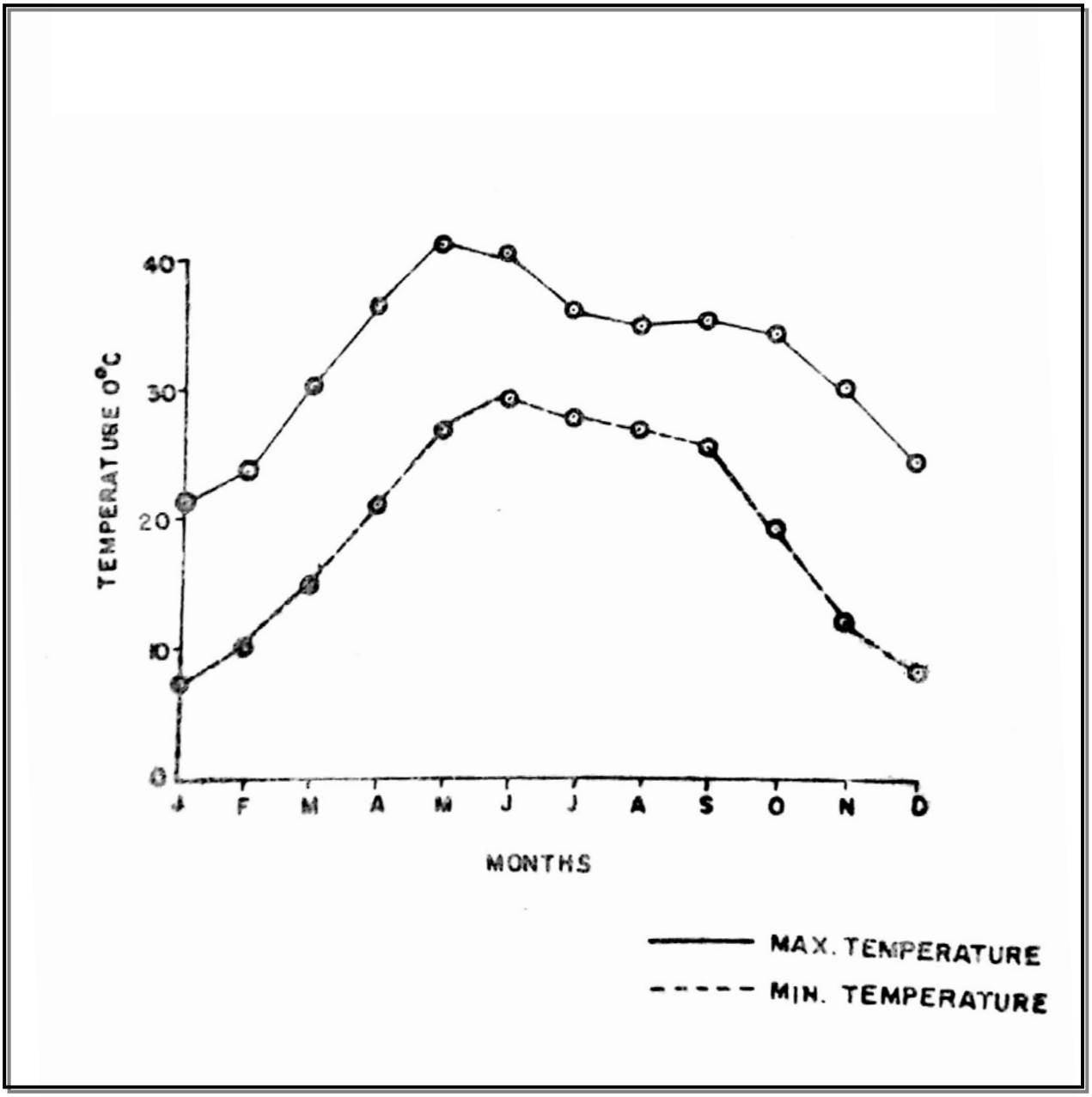


Fig. 15: Mean Monthly Maximum & Minimum Temperatures

During the two to three months of maximum precipitation under high temperature conditions weathering of soil forming material is intensive whereas during other months moisture deficit is apparent.

6.2 Physiography Relief and Drainage:

The Territory consists of four major physiographic zones namely (i) Flood plains of the Yamuna basin (ii) Aravalli ridge (iii) Piedmont plains and (iv) Undulating to level plains of the Aravalli alluvium.

Descriptions of these physiographic units are given below:-

6.2.1 Flood Plains of Yamuna Basin:

This can be sub-divided into the following:-

(a) Flood plain with recent river deposits: - This constitutes the area along the river Yamuna characterized by highly stratified river deposits. It also includes the river base. They are subject to seasonal inundation.

(b) Lower alluvial plain:- It is a comparatively narrow strip of low lying plain situated in the eastern sector of the Territory. The riverine tract, about 8 km wide, has an average elevation of about 205 m above MSL. Flood plain is susceptible of flooding and inundation during monsoon. The land is almost flat &loping (larch-south.

(c) Upper Alluvial plain: - This forms the major unit the area surveyed. The plain extends westward. The upper plain is 215 m above MSL. Levees basins and channels occur in the upper plain. The former standouts as low ridges while the basins and channel present low concave relief. Levees are generally modified due to leveling.

Table 13: Land Utilization

S. No.	Classification	1970-71	1972-73	1973-74	1974-75
		(Area in ha)			
1.	Area according to village records.	1,47,612	1,47,488	1,47,488	1,47,488
	Forest	1,143	722	1,064	1,559
	Area not available for cultivation.	47,314	49,768	57,211	48,975
	Land put to non- agricultural uses	34,207	36,799	39,880	37,179
	Barren unculturable land.	13,107	12,789	17,331	11,796
	Other uncultivated land excluding fallow land.	3,602	2,139	2,732	2,571
	Permanent pasture and other grazing land.	402	476	782	689
	Land under Misc. tree crops and groves not included in the net area sown.	41	-	243	467
	Cultivable waste land	3,159	1,663	1,707	1,415
	Fallow land	15,043	15,703	15,517	16,537
	Net area sown	80,510	79,246	70,964	77,846
	Area sown more than once	36,075	30,757	39,398	35,511
	Total cropped area	1,16,585	1,10,003	1,10,362	1,13,357

Source: Delhi Statistical Hand Book, 1976

6.2.2 Aravalli Ridge:

This region represents the highest relief with the hills stretching in the north-south direction at an altitude of 260 m above MSL. The ridge is predominantly rocky with undulating relief and steep slopes.

The upper as well as lower piedmont plains are characterized by undulating topography with erosion of varying degree.

6.2.3 Piedmont Plains:

The upper and lower piedmont plains are further sub-divided as below:

(a) Upper piedmont plain :-

Upper piedmont	Level
-do-	Undulating
Upper piedmont	Eroded
-do- Severely eroded	

(b) Lower piedmont plain:

Lower piedmont	Undulating
-do-	Level
Lower piedmont	Eroded
-do-	Severely eroded

6.2.4 Undulating to level plains of the Aravalli alluvium:

Alluvial Plain	Level
-do-	Undulating, eroded
-do-	Undulating, severely eroded.

6.3 Soil Forming Material:

The soil forming material of the area consists of the alluvium derived from the Aravalli through the innumerous ephemeral drainage ways and the alluvium derived from the Yamuna that consists of the material from the Siwalik and the Himalayas. Dominant influence of the Aravalli alluvium is apparent in Mehrauli area including a part of the I.A.R.I. Farm whereas Yamuna alluvium is dominant in the rest of the Territory. Still the influence of the mixed alluvium of the Aravallies and the Yamuna alluvium should be expected in some parts of the Territory. Wind modification of soils is common. Yamuna and Aravalli alluvium form the distinct soil forming materials in the area. When we consider variation within different alluviums, texture of the material becomes an important differentiating characteristic. Quartz dominates in the sand fraction with iron oxide minerals up to 5-10% and biotites from 5-25%. Quantitative mineralogy of the clay fraction in the soil of I.A.R.I. Farm has shown that smectite is the dominant double layer mineral, which is from 23-40%, followed by mica 10-28% and kaolinite 12-19%. Amorphous mineral varies from 6 to 24%. Presence of smectite and amorphous minerals seem to have their effect on CEC and available moisture capacity of the soils of the Territory. Thus, mineralogy of the soils may be described as mixed.

6.4 Natural Vegetation:

To natural vegetation can be broadly distinguished as of Aravallies and Alluvial plains.

Tae natural vngetatlon in Aravallis consists of trees namely *Acacia arabica* (Wild Babul), *Balanites roxburgii*; *Butea monosperma* (Palas), *Prosopis spicigera L.;* Shrubs of *Anogeissus pondula, Capparis decidua, Cassia fistula L. (*Chakunda*), Grewia lenax, Gyptostegia grandiflors;* Hurbacious species comprising *Boerhaavia diffusa L, Bidens bipinnata L.* (Spanish needles), *Cloose viacasa, Corchorus* spp., *Euphorbia hirta* (Bari Dudhi), *Tephrosia purpurea* (Wild indigo*), Tribulus terrestris L.* (Gohkru); *Grasses of Cyperus spp. Chrysopogon* spp. (Surwala), *Cenchrus* spp. (Anjan), *Aristida* spp., *Heteropogon* spp. (Kusal).

In the Alluvial plains, the only timber tree worthy of mention is *Dalbergia sisso*. Among other trees mention may be made of *Acacia arabica* (Wild Babul), *Azadirachta indica* (neem), *Butea monosperma* (Palas), *Ficus bengalensis Linn.* (Banyan), *F. glomerata* Roxb, *F. religiosa Linn.* (Peepal*), Prosopis spicigera L.*

Fruit trees commonly found are *Mangifera indica L.* (Mango), *Morus alba L.* (Saitoot); *Psidium guava L.* (Guava), *Zizyphus jujuba* (Ber). The shrubs are *calotropis gigentea, Euphorbia antiquorum, Opuntia* spp. (Prickly pear).

In the soils covered by recent alluvium, trees like *Salvadora persica* and *Eruca sativa* (Taramira); *shrubs* of *Calotropis procera* (AK) and *grasses* of *Erianthus ravennae* Beauv, *Dolserm dulu and Saccharum spontaneum Linn.* (Kans) are commonly observed.

In low lying lands Chara and *Nitela, Hydrilla, Vallisnersa, Certophyllum Potamogoton, Utricularia are* conspicuously seen.

Besides the above, several weeds are also noticed. In *kharif,* weeds like *celosia argentia* (Safed murga), *Euphorbia dranculoides* (Dudhi), *Cenchrus* spp. (Anjan), *Cyperus rotendus L.* (Motha), *Leucas aspera* (Gamma), *Mollugo cerviana* (Akh Jau), *Parthenium hysterophorus L.* (Congress grass), *Phyllanthus niruri* (Hazardnna).

The *rabi* season weeds consit of *Anagalis arvensis* (Krishin neel), *Asphodelus tenuifolius* (Piazi), *Avena fatual* L. (Wild oat), *Euphorbia hirta* (Bari Dudhi), *Fumaria indica* (Gajri), *Lathyrus sativus* (Khesari); *Solanum nigrum* (Makoi), *Chenopodium* spp. (Bathva), *Vicia* spp. (Akri) and a *parasitic* herb *Orobanche aegyptiaca* (Gudiya or Billi).

6.5 Time:

Age of the soils of the Territory may be largely described as different periods of the pleistocene. Landforms described may have relationship with their age but time as a Major factor of soil formation is not important to differentiate the soils of the area.

6.6 Morphology and Classification:

Morphology of the soils of the area is distinguished by the nature of soil forming material, which varies from loamy fine sand to clay within the soil series control section. This is besides the two major alluviums on which the soils of the Territory have been identified to have been formed. Other characteristics of dominant morphological differentiation are Stratification of soil forming material, drainage as indicated by mottles or groundwater and relief, and presence of free and nodular lime. There is not much difference in soil structure in the soils of similar textural origin in the area.

Soil classification and mapping of the soils of the area is based on the soil morphology as influenced by the various environmental factors described. Soil series have been the fundamental units of classification, which are shown as delineation of series associations in the map. The soils series is a group of soils having soil horizons similar in differentiating characteristics and arrangement in the profile and developed from the same parent material. The soils within a series are essentially homogeneous in all characteristics except in texture of surface horizon slope, erosion, and topographic position when these factors do not modify greatly the kind of arrangement of horizons.

In view of textural importance, the soil series are identified as textural families as the series differentiae are defined. Similarly, lime in the soil profiles is taken to differentiate either as series characteristics or as family differentiae.

With the knowledge of moisture regime through meteorological and soil morphological data and the laboratory analysis, soil classification into higher categories is made by developing suitable keys to the soil in Soil Taxonomy.

Detailed descriptions of soil series are given in the Appendix.

APPENDIX

Tentative

RAZAPUR SERIES

Razapur series comprises well drained to excessively drained very deep, loamy sand-to sandy loam soils of dark yellowish brown to yellowish brown colour. They occur on gently undulating relief (up to 5% slope). The climate is semi-arid with mean annual temperature of more than 22°C and means annual rainfall of 714 mm.

Razapur series is a member of sandy, non-acid, mixed, hyperthermic family of Typic Ustipsamments.

Typifying Pedon: Razapur sand - cultivated.

Horizon	Depth	Description
Ap	0-20 cm	Pala brown (10 YR 6/3D), yellowish brown (10YR 5/4M), sand; single grain loose; many fine to medium roots, clear smooth boundary.
Al2	20-89 cm	Yellowish brown (10 YR 5/6 D), yellowish brown to dark yellowish brown (10 YR 5/ 4,4/4), loamy sand; weak, fine granular; soft, very friable; many fine to medium roots; few fine to medium pores; gradual smooth boundary.
C2	89-140 cm	Yellowish brown (10 YR 5/6 D), yellowish brown to dark yellowish brown (10 YR 5/4, 4/4) sandy loam; weak, fine granular, friable common fine to medium roots: few fine medium pores; clear smooth boundary.
C3	140-170 cm	Light grey (10 YR 7/2 D), pale brown (10 YR 6/3 M), loamy sand; single grain 41 loose; common fine medium pores.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-20	40.74	43.00	1.15	9.25	6.50
A12	20-89	38.35	34.00	14.25	6.00	8.00
C2	89-140	30.63	35.66	20.00	6.50	7.75
C3	140-170	54.24	28.55	9.00	1.25	7.50

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.60	8.00	0.20	0.50	0.10	3.46
A12	1.58	8.30	0.20	-	0.15	4.27
C2	1.56	8.65	0.20	3.47	0.15	4.09
C3	1.60	8.70	0.20	2.52	0.15	3.27

RANGE IN CHARACTERISTICS: The colour of the surface soil ranges from brown to light yellowish brown and texture from sand to loamy sand. Sub-soil colour varies from yellowish brown to dark yellowish brown and texture loamy sand to sandy loam. The structure varies from crumb to sub-angular blocky.

Available moisture capacity of the soil is 4.1 cm for 60 cm and 6.8 cm for 100 cm profile depth from the surface.

Surface texture and slope phases are identified.

DRAINAGE AND PERMEABILITY: Excessively to well drained with rapid permeability.

USE AND VEGETATION: Mainly used for cultivation of bajra, cowpea, wheat and barley. Natural vegetation consists of *Saccharum sponteneum* as well as weeds; *Dalbergia sisoo, Acacia arabica* as trees.

DISTRIBUTION & EXTENT: Series extent is 1180.0 ha approximately. Not extensive and found in small scattered patches in the North-west part of the Delhi Territory on old levees.

TYPE LOCATION: The profile is located about 300 metres on Alipur-Narela road towards east near Holambi link road crossing (approximately latitude 28°49' N and longitude 77°7' E).

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1.	Land Capability Sub-Class	IIIs
2.	Irrigability Sub-Class	3s
3.	Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching)	Low
4.	Management potential/productivity	Medium

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	**q/ha**	**Rating of productivity**
Low	3-5	
Medium	5-10	Low
High	10-15	

Tentative

KAKRA SERIES

Kakra series comprises well. drained to excessively drained, very deep sandy loam to loam soils of dark yellowish brown to strong brown colours. The soil occurs on nearly level to gently sloping levees on alluvium.

Kakra series is a member of coarse loamy, mixed, hyperthermic family of Udic Ustochrepts.

Typifying Pedon: Kakra loamy sand-cultivated.

Horizon	Depth	Description
Ap	0-16 cm	Light yellowish brown (10 YR 6/4 D), dark yellowish brown (10 YR 4/4 M), loamy sand; single grain, loose when dry and moist, few fine roots; few coarse pores; very rapid permeability gradual wavy boundary.
B1	16-39 cm	Reddish yellow (7.5 YR 6/6 D) strong brown (7.5 YR 5/6 14), sandy loam; weak fine granular; loose when moist, slightly sticky when wet; few fine and very few medium roots; common medium pores; rapid permeability, gradual wavy boundary.
B2	39-81 cm	Strong brown (7.5 YR 5/6 M), sandy loam; weak coarse angular blocky breaking into sub-angular blocky structure; firm when moist, slightly sticky when wet; few fine and very few medium pores; moderately rapid permeability; thin patchy clay film bridging the sand grains; diffuse wavy boundary.
B3	81-132 cm	Strong brown (7.5 YR 5/6) sandy loam; weak medium sub-angular blocky structure; firm when moist, slightly sticky when wet; few fine roots; few medium pores, moderately rapid permeability; diffuse, smooth boundary.
Cl	132-182 cm	Strong brown (10 YR 5/6) sandy loam; weak medium sub angular blocky; firm when moist, slightly sticky when wet; few very fine roots; few coarse pores, moderate permeability; krotovinas present.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-16	0.36	79.52	11.17	4.00	4.50
B1	16-39	-	72.25	10.82	4.25	12.25
B2	39-81	-	69.40	8.50	6.50	14.25
B3	81-182	-	63.04	13.51	9.25	13.25
C1	132-182	-	67.25	14.10	10.25	18.75

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.58	8.00	0.20	0.06	0.13	3.00
B1	1.55	7.65	0.20	0.17	0.12	5.70
B2	1.55	7 .45	0.40	0.11	0.12	5.16
B3	1.52	7.65	0.20	0.11	0.12	6.52
C1	1.55	7.65	0.40	0.06	0.12	5.80

RANGE IN CRARACTERISTICS: The colour of the surface soil varies from strong brown (7.5 YR 1/6) brown (10 YR 5/3) to dais yellowish brown (10 YR 4/4); texture varies from loamy sand to sandy loamy. Colour of the sub-soil ranges from strong brown (7.5 YR 5/6) brownish yellow (10 YR 6/6) to dark yellowish brown (10 YR 4/4); texture of the sub-soil ranges from sandy loam to loam. Clay is less than 18% in the texture control section. Soil structure is moderately developed. The-soils are non-calcareous. Mineralogy is mixed. CEC is somewhat low.

Available moisture capacity of the soil is 4.4 cm for 60 cm and 8.4 cm for 100 cm profile depth from the surface texture, slope and calcareous phases are identified.

DRAINAGE AND PERMEABILITY: Excessively well drained with rapid permeability.

USE & VEGETATION: The soil is used for wheat cultivation and dry land crops like guar etc. Natural vegetation consists of *Saccharum spontaneum, Cyperus rotundus* as grasses and weeds, *Saccharum munja, Calotropis procera* as *herbs* and *shrubs, Acasia arabica, Zizyphus jujuba, Dalbergia sissoo, Azadirachta indica* as trees.

DISTRIBUTION AND EXTENT: The extent of series is 16182 ha approximately and occur in other parts of Delhi Territory and Haryana State extensively.

TYPE LOCATION: The profile is located on nearly level cultivated tract of levee 1 km from Bawana on Bawana - Delhi (via Putch Ehurd) road and on field No. 155/21 (approximately N latitude 28° 47' 30" and E longitude 77° 2' 20").

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1.	Land Capability Sub-Class	IIIs
2.	Irrigability Sub-Class	3s
3.	Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching)	Low
4.	Management potential/productivity	Medium

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	Q/ha	Rating of productivity
Low	10-15	
Medium	20-25	Medium
High	25-30	

Tentative

HAMIDPUR SERIES

Hamidpur series comprises well-drained, very deep, calcareous, sandy loam soils of yellowish brown colour. They occur on nearly level to gently sloping lands with slopes of 1-3%. The climate is semi-arid with Mean annual temperature of more than 22°C and mean annual rainfall of 714 mm.

Hamidpur series is a member of coarse loamy, calcareous, mixed hyperthermic family of Typic Ustochrepts.

Typifying pedon: Hamidpur sandy loam-cultivated.

Horizon	Depth	Description
Ap	0-19 cm	Pale brown (10 YR 6/3 D) yellowish brown (10 YR 5/4 M) sandy loam; weak, fine, crumb; loose when dry and moist, slightly sticky; strong effervescence with dil. HCL; many fine rotate; many fine and medium pores; clear smooth boundary.
A3	19-90 cm	Pale brown (10 YR 6/3 D) yellowish brown (10 YR 5/4 M) sandy loam; weak fine crumb; loose when dry and moist, slightly sticky; violent effervescence with dil.HC1; many fine roots; many fine and sodium pores; gradual smooth boundary.
B2	90-119 cm	Pale brown (10 YR 6/3 D) light yellowish brown to yellowish brown (10 YR 5.5/4 M) sandy loam; strong, fine to medium, ea,- angular blocky; slightly hard when dry, friable when moist, slightly sticky; violent effervescence with dil.HCl; few fine roots; many fine pores; clear smooth boundary.
C	119-165 cm	Pale brown (10 YR 6/3 D), yellowish brown (10 YR 5/3 M), sandy loam; single grain; few fine roots; many fine pores.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-19	33.38	36.64	3.75	19.00	6.26
A3	19-90	15.07	30.50	27.50	16.25	10.25
B2	90-119	20.94	32.05	28.00	10.25	8.75
C	119-165	39.05	25.86	19.03	7.25	8.50

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.58	8.40	0.50	0.78	0.30	4.62
A3	1.50	8.60	0.80	6.72	0.15	5.44
B2	1.55	8.90	0.80	4.09	0.13	4.89
C	1.55	9.10	0.40	2.63	0.16	4.27

RANGE IN CHARACTERISTICS:

The colour of the surface soil varies from, light yellowish brown to yellowish brown and texture from loamy sand to sandy loam. The structure of the surface soil varies from crumb to sub-angular blocky. The colours of the sub-soil vary from yellowish brown to dark yellowish brown tad texture varies from sandy loam- to loam. Clay per cent is less than 18 in texture control section, CEC is somewhat low.

Available moisture capacity of the soil is 7.0 cm for 60m and 11.3 cm for 100 cm profile depth from the surface.

Surface texture, slope and saline phases are identified.

DRAINAGE & PERMEABILITY: Well drained with rapid to moderate permeability.

USE & VEGETATION: The soils of this series are mostly cultivated to bajra, guar. wheat and barley. Natural vegetation comprises *Sacchurum spontaeum, Cyperus rotundus* as grasses and weeds, *Saccharun munja, Calotropis proceri* as herbs and shrubs, *Acacia jujuba, Dalbergia sisoo, Azadirachta indica* as trees.

DISTRIBUTION AND EXTENT: Series extent is 9206 ha approximately. It is extensive in the surveyed area but not very extensive in other parts of Delhi Territory.

TYPE LOCATION: Along Alipur-Narela road near Arbind Garden. Field No. 9 of Mustateel No. 57 (approximately N latitude 28°49' and E longitude 77°7').

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1.	Land Capability Sub-Class	IIIs
2.	Irrigability Sub-Class	3s
3.	Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching)	Low
4.	Management potential/productivity	Medium

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	**Q/ha**	**Rating of productivity**
Low	10-15	
Medium	20-25	Medium
High	25-30	

HOLAMBI SERIES

Hulambi series comprises well-drained, very deep, loam to silt loam soils of yellowish brown to dark yellowish brown colour hey occur on level to neatly level lands with slopes of less than 1 per cent. The climate is semi-arid with mean annual temperature of more than 22°C.and mean annual rainfall of 714 mm.

Holambi series is a member of fine loamy, mixed hyperthermic family of Udic Ustochrepts.

Typifying pedon: Holambi sandy loam - cultivated.

Horizon	Depth	Description
Ap	0-12 cm	Light yellowish brown (10 YR 6/4 D) light yellowish brown to yellowish brown (10 YR 5.5/4 M), sandy loam; moderate medium crumb; slightly hard when dry, friable when moist, slightly sticky; many fine to medium roots; clear smooth boundary.
B1	12-46 cm	Light yellowish brown (10 YR 6/4 D) yellowish brown (10 YR 5/6 M) loam; strong, medium to coarse, sub-angular blocky; hard when dry and firm when moist, sticky and slightly plastic; many fine and medium roots; many fine and medium pores: gradual smooth boundary.
B3	46-108 cm	Yellowish brown (10 YR15/6 D & M) loam; strong, medium to coarse, sub-angular blocky; hard when dry and firm when moist, sticky and slightly plastic; slight effervescence with dil. HCL common fine roots; many fine and medium pores, gradual smooth boundary.
Cl	108-148 cm	Yellowish brown (10 YR 5/6 D & M) loam; moderate, medium, sub angular blocky; hard when dry, friable when moist, slightly sticky and slightly plastic; slight effervescence; few fine roots, many pores, clear smooth boundary.
C2	148-168 cm	Yellowish brown (10 YR 5/8 D) yellowish brown (10 YR 5/6 M) loam; moderate, fine to medium, granular; slightly hard when dry, friable when moist slightly sticky and slightly plastic; slight effervescence with dil. HC1; few fine roots; few fine pores.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-12	11.11	44.20	20.00	9.25	15.00
B1	12-46	0.40	32.20	31.00	12.50	24.25
B3	46-108	0.36	43.04	18.00	12.00	26.00
C1	108-148	0.26	44.04	24.00	10.25	21.50
C2	148-168	0.19	44.51	28.00	8.50	18.75

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.58	8.00	0.25	0.32	0.26	5.16
B1	1.50	8.00	0.55	0.32	0.22	9.24
B3	1.52	8.00	0.55	0.28	0.09	9.24
C1	1.52	8.00	0.55	0.34	0.06	9.43
C2	1.55	8.00	1.00	0.28	0.47	8.15

RANGE IN CHARACTERISTICS:

The colour of the surface soil varies from light yellowish brown to yellowish brown and texture sandy loam to fine sandy loam. The colour of sub-surface soil varies from light yellowish brown to dark yellowish brown and texture) loam to silt loam; sometimes below 80 cm depth soil is clay loam. Clay percent is more than 18 in the texture control section. The structure is sub angular blocky to angular blocky. The CEC is moderate with good fertility retention capacity.

Available moisture capacity of the soils is 9.0 mm for 60 cm and 15.7 cm for 100 cm profile depth from surface.

Surface texture, slope, calcareous and saline phases are identified.

DRAINAGE & PERMEABILITY: Well drained with moderate permeability.

USE & VEGETATION: The soils of this series are mostly cultivated to jowar, maize, bajra, cotton, tomato, wheat, pea and mustard. The vegetation consists of trees, *Acacia* spp., *Dalbergia sisoo* and *Morus alba: shrubs* like *Zizyphus numeraria, Tribulus terrestris and Cyperus rotundus, Phyllanthus niruri* and some grasses.

DISTRIBUTION & EXTENT: Extent of this series is 19702 ha approximately and it is very extensive.

TYPE LOCATION: The profile is located near village Holambi Kalan, about 1/2 km south-west, in the 25th plot of 47 block (approximately latitude N 28°49' arid E longitude 77°7').

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1.	Land Capability Sub-Class	IIc
2.	Irrigability Sub-Class	I
3.	Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching)	Good
4.	Management potential/productivity	High

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	Q/ha	Rating of productivity
Low	20-25	
Medium	30-35	High
High	35-40	

Tentative

DARYAPUR SERIES

Daryapur series comprises moderately well drained to imperfectly drained, very deep, calcareous, loan to clay loam soils of yellowish brown to dark yellowish brown colours. They occur on nearly level to gently sloping lands of 1-3% on the alluvial plains. Perromanganese concretions and calcium carbonate coated nodules are occasionally present.

Daryapur series is a member of fine loamy, calcareous, mixed, hyperthermic family of Typic Ustifluvents.

Typinfying pedon: Daryapur silt loam - cultivated.

Horizon	Depth	Description
Ap	0-14 cm	Pale brown (10 YR 6/3 D) and brown 10 YR 5/3 M) silt loam; weak medium sub angular blocky structure; slightly hard when dry, firm when moist, slightly sticky, when wet; strong effervescence with dil. HC1, common coarse and medium pores: gradual wavy boundary.
Cl	14-45 cm	Yellowish brown (10 YR 5/4) silt loam; weak medium angular blocky breaking into sub angular blocky structure firm when moist, slightly sticky and non-plastic when wet; strong effervescence with dil. HC11 common fine roots; common fine and few medium pores; moderate permeability; diffuse, smooth boundary.
C2	45-416 cm	Yellowish brown (10 YR 5/4) loam; weak medium angular blocky breaking into sub-angular blocky structure; firm when moist, slightly sticky; strong effervescence with dil. HC 1 few (1-2 mm) soft ferromanganese concretions; few fine roots; few medium and fine pores; moderately slow permeability; diffuse smooth boundary.
C3	76-101 cm	Yellowish brown (10 YR 5/4) and dark yellowish brown (10 YR 4/4) silt loam; moderate medium sub angular blocky structure; firm when mist, slightly sticky and slightly plastic when wet; slight effervescence with dil. HCl; few (1-2 mm) soft ferromanganese nodules; very few fine roots; few coarse pores; moderately slow permeability.; gradual wavy boundary.
C4	101-156 cm	Dark yellowish brown (10 YR 4/4) silt loam; massive when wet; weak medium sub-angular blocky structure; hard when dry: firm when moist, slightly sticky and plastic when wet; slight effervescence with dil. HCl: few (1-3 mm) soft ferro-manganese concretions; very few fine pores; slow permeability

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-14	1.37	32.37	28.40	25.50	12.25
C1	14-45	0.30	27.60	32.10	25.50	14.25
C2	45-76	0.65	36.00	42.10	2.50	18.50
C3	76-181	0.50	15.50	33.00	25.50	25.00
C4	101-156	1.10	18.25	29.80	27.75	23.50

RANGE IN CHARACTERISTICS: The colour of the surface soil ranges from pale brown (10 YR 6/3) to dark yellowish brown (10 YR 6/4); texture ranges from sandy loam to silt loam; sub-soil colour ranges from dark brown, brown (10 YR 4/3) to yellowish brown (10 YR 5/6): texture ranges from loam to Clay loam. The soils have moderately developed structure. C E C is moderate. The soils are slightly calcareous. Associated relief is sub-normal.

Available moisture capacity of the soil is 9.0 cm for 60 cm and 15.6 cm for 100 an profile depth from surface. Surface texture, slope, calcareous and saline phases are identified.

DRAINAGE AND PERMEABILITY: Imperfectly drained with moderate permeability.

USE & VEGETATION: Used for wheat cultivation. Natural vegetation consists of *Cyperus rotundus, Cynodon dectylon* as grasses; *Chenopodium* Spp., *Asphodelus tunuifolius, Lathyrous sativa*; as weeds; *Accacia Arabica, Zizyphus jujuba*, Data palm as trees.

DISTRIBUTION & EXTENT: The extent of this series is 96339 ha approximately and towel to our in other parts of Delhi Territory.

TYPE LOCATION: On nearly level cultivated lands, 1/2 km from Bawana on Bawana-Narela road (approximately N latitude 77°47' 20" and E longitude 28°2' 40").

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1. Land Capability Sub-Class — IIIe
2. Irrigability Sub-Class — I
3. Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching) — Good.May present problem due to free lime
4. Management potential/productivity

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	**Q/ha**	**Rating of productivity**
Low	20-25	
Medium	25-35	High
High	35-40	

Tentative

NABHA SERIES

Nabha serirs comprises well-drained, very deep, loam to silty clay loam soils of brown to dark yellowish brown colours. The soil occurs on nearly level to gently sloping lands and are derived from old alluvium. They have well developed horizons and strongly developed structure.

Nabha series is member of lomy, mixed hyperthermic family of Udic Ustochrepts.

Typinfying pedon: Nabha silt loam - cultivated.

Horizon	Depth	Description
Ap	0-11 cm	Pale brown (10 YR 6/3 D) and brown 10 YR 4/3 M) silt loam; moderate coarse sub angular blocky structure. Slightly hard when dry, firm when moist, sticky when wet, few fine roots, few coarse pores moderate permeability gradual wavy boundary.
B2l	11-25 cm	Pale brown (10 YR 6/3 D).Brown (10YR 4/3M) silt loam; Moderate coarse angular blocky structure, fine when moist, sticky when wet few fine and medium roots, few coarse and medium pores, moderate permeability, strong biological activity; gradual wavy boundary.
B22	25-52 cm	Brown (10 YR 5/3 M) silt loam; moderate medium and coarse angular blocky breaking into sub angular blocky structure common fine faint yellowish brown (10 YR 5/6) mottlings firm when moist sticky and slightly plastic, when wet ;few fine roots; few coarse and common medium pores; moderately slow permeability; diffuse wavy boundary.
C1	52-91 cm	Brown (10 YR 4/3 M) moderate medium and coarse angular blocky structure. firm when moist, Sticky and slightly plastic when wet; slight effervescence with dil. HC1; few fine roots; few coarse and common medium pores; moderately slow permeability, diffuse - smooth boundary.
C2	91-126 cm	Yellowish brown (10 YR 5/4 M) and dark yellowish brown (10 YR 4/4 M) clay loam; massive; firm when moist, sticky and slightly plastic when wet; slight effervescence with dil. HCl; very few fine roots; few medium pores; slow permeability.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-11	0.40	33.40	26.55	24.75	16.00
B21	11-25	0.30	22.80	26.25	27.75	21.75
B22	25-52	0.15	21.10	25.24	27.50	26.00
C1	52-91	1.45	30.20	15.35	26.50	26.50
C2	91-126	1.10	17.90	26.10	24.50	29.75

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.45	8.25	0.40	0.17	0.52	5.52
B21	1.45	8.00	0.35	0.17	0.27	8.69
B22	-	8.00	0.50	0.17	0.22	9.79
C1	-	7.85	1.30	0.28	0.19	10.60
C2	-	8 .20	1.35	1.12	0.18	11.96

RANGE IN CHARACTERISTICS:

Colour of the surface soil ranges from pale brown (10 YR 6/3) to yellowish brown (10 YR 5/6) and texture from sandy loam to silt loam. Colour of the subsoil is brown (10 YR 4/4) and texture is loam to silty clay loam or clay loam with clay percent more than 18 in textural control section. Available moisture capacity is 12.4 cm for 60 cm and 21.2 cm for 100 cm profile depth from the surface.

Surface texture, slope, calcareous and saline phases are identified.

DRAINAGE & PERMEABILITY: Moderately well drained with moderate permeability.

USE AND VEGETATION: Mostly cultivated to wheat. Natural vegetation consists of *Cynodon dectylon*, as grass; *Chenopodium* Spp, *Asphodehus tunifolius, Lathyrus sativus* as weeds; *Accadia arabica*, *Dalbergia* sisoo and *Azadirachta indica* as trees.

DISTRIBUTION AND EXTENT: It occupies 7631 ha of land approximately and is very extensive series; it is also found in Delhi Territory and Haryana State.

TYPE LOCATION: The profile is located on nearly level cultivated land. (Approximately N latitude 28° 47' and E longitude 77° 2').

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1. Land Capability Sub-Class — IIc
2. Irrigability Sub-Class — I
3. Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching) — High
4. Management potential/productivity — High

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	q/ha	Rating of productivity
Low	20-25	
Medium	30-35	High
High	35-40	

HISSAR SERIES

Hisser series comprise, well drained very deep calcareous, brown to yellowish brown soils with silty clay loam texture. They occur on nearly level to gently sloping lands and are derived from old alluvium. Nodular lime and ferromanganese concretions are occasionally present. Hissar series is a member of fine loamy, mixed, hyperthermic family of Typic Ustochrepts.

Typifying pedon: Silt loam - cultivated.

Horizon	Depth	Description
Ap	0-11 cm	Very pale brown (10 YR 7/3 D), yellowish brown (10 YR 5/4 M) silt loam; weak coarse sub angular blocky structure; slightly hard; firm when moist, slightly sticky when wet; slight effervescence with dil. HC1; common fine, few medium roots; few medium tubular pores moderately slow permeability; gradual wavy boundary.
El	11-49 cm	Yellowish brown (10 YR 5/4) silty clay loam; moderate coarse and very coarse angular blocky structure; firm moist, sticky and slightly plastic when wet; few fine faint yellowish brown (10 YR 5/6) mottles; slight effervescence with dil. HC1; very few coarse, for medium and common fine roots; common medium tubular pores; slow permeability; few weak (2.5-3.5 cm) rodent holes present; diffuse, smooth boundary.
B2	49-82 cm	Yellowish brown (10 YR 5/4) silty clay loam; moderate coarse subangular blocky; firm when moist, sticky and slightly plastic when wet: common fine faint yellowish brown (10 YR 5/6) mottles; strong effervescence with dil. HCl; very few (1-2 mm) soft ferromanganese concretions; thin patch clay films; few fine roots; common tubular pores; slow permeability; few rodent holes; diffuse-smooth boundary.
B22	82-123 cm	Yellowish brown (10 YR 5/4) clay 10mm, moderate, very coarse, angular blocky structure; firm, sticky and plastic when wet; common fine faint (10 YR 5/6) mottles-strong effervescence with dil. HC1; few very fine roots; few medium and common coarse
Cca	123-147 cm	Yellowish brown (10 YR 5/4) clay loam; massive when wet; weak coarse angular blocky structure; firm when moist sticky and slightly plastic when wet; few fine faint yellowish brown (10 YR 5/6) mottles; violent effervescence with dil.HC1, few medium and coarse pores; very slow permeability; small calcium carbonate coated nodules (5% by volume) present.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-11	0.44	22.98	36.00	25.00	16.25
B1	11-49	0.44	16.99	32.35	22.75	28.00
B2	49-82	1.16	20.11	0.50	48.00	31.00
B22	82-123	0.99	21.61	23.00	22.75	32.00
Cca	123-147	0.50	19.25	25.00	22.50	33.50

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.45	8.40	0.70	0.84	0.37	8.43
B1	1.43	8.60	0.40	0.85	0.27	9.24
B2	1.40	8.50	0.30	1.29	0.27	10.60
B22	-	8.40	0.60	1.57	0.18	11.42
Cca	-	8.20	0.90	1.18	0.16	11.69

RANGE IN CHARACTERISTICS: The colour of the surface soil ranges from dark brown (10 YR 4/3) to yellowish brown (10 YR 5/4) and texture from sandy loam to loam; surface structure is coarse sub angular blocky. Colour in the sub-soil ranges from dark brown (10 YR 4/3)to dark yellowish brown (10 YR 4/4) and texture loam or silty clay loam. Clay is more than 18 per cent in the texture control section. Structure is sub angular blocky to angular blocky; mottles are present mostly below 50 cm depth. The soils are calcareous; CaCO3 is more than 1% in the first 50 cm profile. Nodular lime is present within 1 meter depth of the profile. C.E.C. is good. Available moisture capacity is 12.5 cm for 60 cm and 22.0 cm for 100 cm, profile depth from the surface.

Surface texture, slope, calcareous and saline phases have been identified.

DRAINAGE & PERMEABILITY: Moderately well drained with moderate permeability.

USE & VEGETATION: Intensively cultivated; one of the best soils of the area. Natural vegetation consists of *Cyperus rotundus, Cynodon dactylon* as grasses; *Chenopodium* sp. *Asishodelus tunifolius, Lathyrous sativus* as weeds *Acacia arabica, Zizvnhus jujube,* Date palm as trees.

DISTRIBUTION & EXTENT: It occupies an area of 3716 ha approximately and is extensive. It also occurs in other parts of Delhi Territory and Haryana State.

TYPE LOCATION: About 2 km from the Bawana-Narela road and Delhi Tail distribution croesine, 400 m east of Bawana escape (approximately N. latitude 28°48' 40" and E. longitude 77° 2' 4").

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1. Land Capability Sub-Class — IIs
2. Irrigability Sub-Class — I
3. Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching) — Good.May present problem due to free lime
4. Management potential/productivity — High

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	q/ha	Rating of productivity
Low	20-25	
Medium	30-35	High
High	35-45	

Tentative

GHOGA SERIES

Ghoga series comprises moderately well drained, very deep brown to dark yellowish brown clayey soils, on nearly level to low relief lands of upper alluvial plain, developed on old alluvium.

Ghoga series is a member of clayey, mixed, hyperthermic family of Udic Ustochrepts.

Typifying pedon: Ghoga silty clay loam - cultivated.

Horizon	Depth	Description
Ap	0-15 cm	very pale brown (10 YR 7/1 D) yellowish brown (10 YR 5/4
B1	15-37 cm	Brownish yellow (10 YR 6/6) and yellowish brown (10 YR 5/4) clay loom, strong very coars angular blocky tending to be prismatic, firm, sticky and slightly plastic; few fine roots; few medium tubular pores' slow permeability; diffuse smooth boundary.
B21	37-69 cm	Dark yellowish brown (10 YR 4/4) silty clay loam; moderate coarse angular blocky ten-lomy to be prismatic; firm when moist, very and slightly plastic when met: very few (2-3 um) soft-ferromanganese nodules; thin patchy clay film along the pores; few fine roots: common medium tubular pores: slow permeability, diffuse smooth boundary.
B22	69-107 cm	Dark brown (10 YR 4/3) silty clay loam; moderate very coarse angular blocky tending to prismatic: firm when moist, very sticky and slightly plastic when wet, few (2-3 Mm) soft ferromanganese nodules: thin clay films along the pores; few fine roots; common medium tubular pores: gradual wavy boundary.
C1	107-157 cm	Dark yellowish brown (10 YR 4/4) clay loam massive when wet; moderate coarse angular blocky structure; firm when moist; very sticky and slightly plastic when wet; common (5 mm) soft and hard ferromanganese nodules; few coarse and common medium tubular pores; slow permeability.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-15	0.15	17.61	32.62	29.75	20.75
B1	15-37	-	13.90	23.00	31.60	32.50
B21	37-69	0.50	16.24	16.25	31.50	35.50
B22	69-107	0.31	13.06	20.48	28.00	38.00
C1	107-157	0.52	17.57	19.71	28.00	33.75

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.45	8.10	0.20	0.45	0.45	12.51
B1	1.45	8.15	0.20	0.11	0.28	12.51
B21	1.43	8.10	0.20	0.39	0.27	13.68
B22	-	7.70	0.20	0.22	0.22	13.55
C1	-	7.85	0.50	0.11	0.18	13.68

RANGE IN CHARACTERISTICS: Colour of the surface soil ranges from grayish browns (10 YR 5/3) to yellowish brown (10 YR 5/4); texture varies from silt loam to silty clay loam. Sub-soil colour varies from dark brown (10 YR 3/3) to dark yellowish brown (10 YR 4/4). Texture is silty clay loam to clay and clay presence is more than 35 in texture control section. Structure is coarse angular blocky to prismatic and it is massive in C horizon. C E C is good; clay mineralogy is mixed. Available moisture capacity is 14.4 cm for 60 cm and 24.4 cm for 100 cm profile depth from the surface. Surface texture and slope phase are identified. Ghoga series occupies an area of 164.75 ha.

DRAINAGE & PERMEABILITY: Moderately well drained with slow permeability, susceptible to stagnation.

USE & VEGETATION: Used for wheat cultivation: natural vegetation consists of *Cyodon dactylon* as grass: *Lathyrous sativus, Chenopodium* sp., and *Orabanche aegyptiaca* as weeds and *Acacia arabica, Dalbergia sisoo* as trees.

DISTRIBUTION & EXTENT: Series occupies an area of 1730 ha approximately and is not much extensive. It is found to occur to a smaller extent in Delhi Territory.

TYPE LOCATION: Located on flat (nearly level) plain, 2.5 km from Delhi Tail distributory and Bawana-Narela Road crossing and about 100 m east of unmetalled road (approximately N latitude 28°49' 25" and E longitude 77° 2' 40").

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1. Land Capability Sub-Class — IIIs
2. Irrigability Sub-Class — 2s
3. Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching) — Medium
4. Management potential/productivity — Medium

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	q/ha	Rating of productivity
Low	20-25	
Medium	25-30	Medium
High	30-35	

Tentative

KHAMPUR SERIES

Khampur series comprises very deep, moderately well drained to poorly drained fine textured soils of pale brown to dark grayish alluvium. They are found to occur on nearly level lands on concave reliefs in depressions. Mottles are present in series control section.

Khampur series is a member of clayey, mixed calcareous hyperthermic family of Typic Halaquepts.

Typifying pedon: Khampur clay loam - cultivated.

Horizon	Depth	Description
A	0-12 cm	Grayish brown (2.5 Y 5/2 D) dark grayish brown (2.5 Y 4/2 M) clay loam- medium weak subangular blocky structure: hard firm, sticky and plastic; few fine loots: strong effervescence; clear and wavy boundary.
A3	12-29 cm	Dark grayish brown (2.5 YR 4/2 M) clay loam, medium moderate sub angular blocky structure, fine roots; common medium pores; strong effervescence with dil. HC1; clear and wavy boundary.
B21	29-60 cm	Dark grayish brown (2.5 YR 4/2 M) clay; moderate coarse angular blocky structure; firm sticky and plastic; onion fine distinct iron mottles of strong brown 0.5 YR 5/6) colour, slight effervescence with dil HC1, few fine roots; common medium pores, gradual and wavy boundary.
B22	60-84 cm	Dark grayish brown (10 YR 4/2 M) clay, coarse strong angular blocky structure; firm sticky and plastic; slight effervescence with dilute acid; few medium roots, few coarse pores; few fine faint iron mottles: diffuse and way boundary.
Cl	84-104 cm	Dark grayish brown to grayish brown (10 YR 4.5 M) clay medium to coarse angular blocky structure; firm, sticky and plastic; strong effervescence; few medium roots; common pores; soft ferro-manganese concretions; 15-20% small acid soft calcium carbonate coated nodules; few fine faint iron mottles; diffuse and wavy boundary.
C2	104-113 cm	Dark grayish brown (10 YR 4/2 M) clay; medium moderate angular blocky structure; firm, sticky and plastic; strong effervescence with dil. HCl; common fine faint iron mottles; 10% lime concretions by volume, few medium roots; common coarse pores; clear and wavy boundary.
C3	113-135 cm	Dark grayish brown (10 YR 4/2 M) clay; massive; firm very sticky and very plastic; strong effervescence with dil. HC1; many medium distinct iron mottles; 5 to 40% small to medium concretions in pockets.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
A	0-12	24.10	22.80	1.30	26.50	28.00
A3	12-29	16.80	25.30	1.30	24.50	33.50
B21	29-60	17.50	27.30	2.00	18.20	36.50
B22	60-84	9.70	14.40	1.90	33.20	43.00
C1	84-104	5.90	8.60	2.00	35.00	45.00
C2	104-113	9.00	4.10	2.00	36.30	51.20
C3	113-155	4.30	8.30	1.30	46.00	40.00

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
A	1.45	7.90	9.00	2.35	0.54	10.34
A3	-	7.90	6.00	0.56	0.27	8.16
B21	-	7.50	6.00	0.25	0.18	16.32
B22	-	7.60	3.30	0.25	0.20	12.51
C1	-	7.50	4.50	0.25	0.21	27.20
C2	-	7.70	5.00	1.94	0.22	25.02
C3	-	7.70	5.00	2.56	0.27	19.58

RANGE IN CHARACTERISTICS: The colour of the surface soil ranges from grayish brown to brown and texture from silt loam to silty clay Sub-soil colour ranges from dark grayish brown to grayish brown and texture from loam to silty clay. Mottles are present in the soil profile. Texture control section is clayey with clay percent more than 35.

Available Moisture Capacity is 14.1 cm for 60 cm and 24.0 cm for 100 can profile depth from the surface.

DRAINAGE & PERMEABILITY: Imperfectly drained with slow permeability.

USE & VEGETATION: Cultivated to paddy, wheat and berseem. Natural vegetation consists of trees like *Acacia arabica, Zizyphus jujuba, Butea monosperma* and grasses i.e. *Cynodon dactylon, Orabanche aeogyptiaca*.

DISTRIBUTION & EXTENT: It occupies an area of 100 ha approximately and of limited extent.

TYPE LOCATION: About 3/4 Km from the Sanoth village to the east (apoioximutely N latitude 28°49' and E longitude 77°6').

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1.	Land Capability Sub-Class	IIIs-w
2.	Irrigability Sub-Class	2s
3.	Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching)	Low
4.	Management potential/productivity	Poor

Tentative

HIRANKI SERIES

Hiranki series comprises well-drained, very deep, silt loam and clay loam over loamy sand or sandy soils of brown to yellowish brown colour They are found to occur on nearly level to level land of recent Yamuna flood plain.

Hiranki is tentatively classified as a member of fine loamy mixed hyperthermic family of Typic Ustifluvents.

Typifying pedon: Silt loam-cultivated.

Horizon	Depth	Description
Ap	0-16 cm	Light gray (10 YR 7/2 D) yellowish brown (10 YR 5/4 M) silt loam; moderate, medium to coarse sub-angular blocky structure; hard when dry, firm when moist, sticky and plastic; strongly calcareous with dil. HCl; fine plentiful roots; many fine pores; clear smooth boundary.
Al2	16-45 cm	Brown (10 YR 5/3M) silty loam; moderate, medium to coarse sub-angular blocky structure; hard when dry, firm when moist, sticky and plastic; strongly calcareous with dil. HCl; many fine roots; many fine pores; clear wavy boundary.
A3	45-85 cm	Brown (10 YR 5/3 M) loam; weak fine to medium, granular structure; soft when dry, friable when moist, slightly sticky strongly calcareous with dil. HCl; common many roots; many fine pores; abrupt wavy boundary.
IIc	85-165 cm	Light gray (10 YR 7/2 D) light brownish gray (10 YR 6/2 M) coarse sand; single-grain structure; few fine roots.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-16	3.56	7.44	6.08	61.15	24.62
A12	16-45	1.00	11.15	11.16	48.40	22.25
A3	45-85	13.67	30.15	23.53	23.02	7.87
IIc	85-165	20.15	68.61	2.68	0.75	4.90

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.50	8.15	0.85	2.80	0.72	11.42
A12	1.50	8.40	0.50	2.86	0.48	9.79
A3	-	8.50	0.30	1.10	0.18	5.44
IIc	-	8.60	0.20	0.38	0.18	2.45

RANGE IN CHARACTERISTICS: The colour of the surface soil varies from brown (10 YR 5/3) to yellowish brown (10 YR 5/4). The texture varies from silt loam to silty clay load and structure from granular to sub-angular blocky. The colour of the sub-surface soil varies from brown (10 YR 5/3) to yellowish brown (10

YR 5/4) and dark yellowish brown (10 YR 4/4) and texture from silt loam to silty clay loam up to 50 cm and below sandy loam to loamy sand or sand. The structure varies from pub-angular blocky to single grain sandy.

The available moisture capacity is 16.1 cm for 60 cm and 19.7 cm for 100 cm profile depth from the surface.

DRAINAGE & PERMEABILITY: Moderately well drained with moderate permeability.

COMPETING SERIES & THEIR DIFFERENTIAE: Competing series is Santosh but it differs from Santosh series in having absence of high ground water, ferruginous nodules. Santosh soils have well developed horizons while stratification is observed in the Hiranki soils.

USE & VEGETATION: Mainly cultivated for jowar, sugarcane, wheat and summer vegetables. Natural vegetation like *Acacia arabica, Saccharum munis, Saccharum spontenium* are found.

DISTRIBUTION & EXTENT: Found to occur along yamuna riverbed and occupies 2167 ha of land approximately.

TYPE LOCATION: About 1 km from the village Burari north along the Yamuna embankment.

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1.	Land Capability Sub-Class	IIIs
2.	Irrigability Sub-Class	3s
3.	Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching)	Medium
4.	Management potential/productivity	Medium

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	**q/ha**	**Rating of productivity**
Low	15-20	
Medium	20-25	Medium
High	25-30	

Tentative

PALLA SERIES

Palla series comprises well drained, very deep stratified sandy loam to loam up to 50 cm below loamy sand to sandy soils of brown to yellowish brown colours. They occur on nearly level to gently sloping lands with slopes of 1-3%.

Palla series is a member of coarse loamy over sandy mixed (nonacid) hyperthermic family of Typic Ustifluvents.

Typifying pedon: Palla sandy loam-cultivated.

Horizon	Depth	Description
Ap	0-18 cm	Pale brown (10 YR 5/3 D), brown (10 YR 5/3 M) loam; moderate, fine to medium crumb structure; slightly hard when dry, friable when moist, slightly sticky; fine many roots; many fine pores; strong effervescence with dil. HC1; clear and smooth boundary.
A3	18-62 cm	Dark yellowish brown (10 YR 4.5/4 M) loam; moderate, fine to medium, sub-angular blocky; slightly hard when dry friable when moist, slightly sticky; violent effervescence with dil. HC1; fine many roots; many fine pores; clear and smooth boundary.
CI	62-87 cm	Yellowish brown (10 YR 5.5/4 M) sandy loam; weak, fine sub-angular blocky structure; slightly hard when dry friable when moist, slightly sticky; fine common roots; many fine pores; clear and smooth boundary.
C2	87-165 cm	Yellowish brown (10 YR 5/4 11) sandy loam, single grain structure: loose when dry, loose when moist; sometimes effervescence due to silt pocket fine common roots: many fine pores.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-18	13.4	36.60	19.43	18.70	11.95
A3	18-62	4.34	35.96	26.68	28.10	13.22
C1	62-87	1.77	54.65	19.53	18.80	10.75
C2	87-165	1.80	65.97	16.75	5.92	8.82

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.58	6.45	0.60	0.39	0.39	5.93
A3	1.50	8.90	0.32	0.16	0.16	6.26
C1	1.55	8.80	0.35	0.12	0.12	4.98
C2	1.55	8.60	0.45	0.09	0.09	3.26

RANGE IN CHARACTERISTICS: The colour of the surface soil ranges from pale brown to brown (10 YR 6/3 to 10 YR 4/3 D) and brown to dark brown (10 YR 4/3 to .10 YR 4/4 M). The texture is sandy loam to loam. Thu colour of the sub-surface soil un to 55 cm depth ranges from yellowish brown to dark brown (10 YR 5/4 to 10 YR 4/3 M). The texture up to 50 cm to 75 cm is loam below loamy sand to sandy loam.

The available moisture capacity of soil is 7.7 cm for 60 cm and 13.4 cm for 100 cm profile depth from surface.

DRAINAGE & PERMEABILITY: Well Drained with rapid permeability.

USE & VEGETATION: Intensively cultivated under irrigation; bajra, jowar, cotton, wheat, barley and sugarcane are important Crops. *Acacia* sp. and *Dalbergia sisoo* are the major trees

DISTRIBUTION AND EXTENT: Series Extent is 4764 ha approximately and found to occur along Yamuna old and recent flood plains.

TYPE AND LOCATIONS: About 100 m from Akbarpur village to the north with approximate latitude 28°50' N and Longitude 77°12' E

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1.	Land Capability Sub-Class	IIIs
2.	Irrigability Sub-Class	3s
3.	Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching)	Low
4.	Management potential/productivity	Medium

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	**q/ha**	**Rating of productivity**
Low	10-15	
Medium	20-25	Medium
High	25-30	

Tentative

WAZIRABAD SERIES

Wazirabad series consists of very deep, imperfectly drained, highly stratified soils of light brownish gray to yellowish brown colours. They occur on meander plains as well as recent flood plain of Yamuna river. They remain under flood. water every year for a few days.

Wazirabad series is a member of coarse loamy, mixed (calcareous) hyperthermic family of Typic Ustifluvents.

Typifying pedon: Wazirabad fine sandy loam-cultivated.

Horizon	Depth	Description
Ap	0-15 cm	Light brownish gray (10 YR 6/2 D) yellowish brown (10 YR 5/4 M) firm sandy loam, weak; fine to medium, gradual, slightly hard when dry friable when moist, slightly sticky, strong effervescence with dil. HCl common fine roots, many fine pores, clear smooth boundary.
A3	15-40 cm	Light brownish gray (10 YR 6/2 D) yellowish brown (10 YR 5/9 M) fine sandy loam weak fine to medium, crumb; slightly hard, friable, slightly sticky strong; effervescence with dil. HCl few fine roots; many fine pores; gradual smooth boundary.
C1	40-70 cm	Light brownish gray (10 YR 6/2 D)
C2	70-99 cm	Light gray (10 YR 7/2 D) light brownish gray (10 YR 6/2 m) sand single grain
II C3	99-165 cm	Dark yellowish brown (10 YR 4/4 M) silt loam: moderate, fine, sub angular blocky; hard, firm, sticky and plastic; strong effervescence; few fine roots; many fine to medium pores; few medium size roots throughout the profile.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-15	2.03	31.41	37.45	18.45	12.85
A3	15-40	0.53	27.28	44.05	22.17	8.70
C1	40-70	0.28	25.46	48.67	21.67	7.23
C2	70-99	1.29	67.62	22.30	5.70	6.50
IIC3	99-165	3.21	7.63	21.98	51.00	19.00

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.45	8.20	1.05	1.37	0.33	7.07
A3	1.45	8.20	0.70	1.65	0.22	7.62
C1	-	8.10	0.60	1.46	0.19	7.34
C2	-	8.20	0.35	1.04	0.09	6.26
IIC3	-	7.50	0.85	3.74	0.35	13.60

RANGE IN CHARACTERISTICS: The surface soil colour varies from light yellowish brown to yellowish brown. The textures are variable and have sand, loamy sued, fine sandy loam or sandy loam. They are calcareous exlepet coarse sand. The colours of sub-soil range from light brownish gray to dark yellowish brown (10 YR 6/2 to 10 YR 4/4). The strata of sand, fine sand, loamy sand, sandy loan, fine sandy loam and silt loam are found without any sequence. All variable textured strata are calcareous and stratified within the horizon.

Available moisture capacity is 7.6 cm for 60 cm and 14.7 cm for 100 cm profile depth from the surface.

DRAINAGE & PERMEABILITY: Moderately well drained to imperfectly drained with moderate permeability.

USE & VEGETATION: Mainly cultivated to jowar, sugarcane, wheat and vegetables.

DISTRIBUTION & EXTENT: These are extensive and have hardly 3250 ha of land approximately.

TYPE LOCATION: About 1/2 km from village Hiranki towards southeast near Bawana escape end.

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1.	Land Capability Sub-Class	IIIs
2.	Irrigability Sub-Class	3s
3.	Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching)	Low
4.	Management potential/productivity	Low

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	q/ha	Rating of productivity
Low		
Medium		Information not collected
High		

Tentative

MEHRAULI SERIES

Mehrauli series comprises well-drained, very deep, sandy loam to loam soils of dark yellowish brown to yellowish brown colour developed on alluvium derived from the Aravallis. They are found to occur on nearly level to level piedmont plain of the Aravallis and have well developed structure.

Mehrauli series is a member of coarse loamy, mixed, hyper-thermic family of Udic Ustochrepts.

Typifying pedon: Sandy loam-cultivated.

Horizon	Depth	Description
Ap	0-19 cm	Light brownish yellow (10 YR 5.5/4 D), dark yellowish brown (10 YR 4/4 M) sandy loam; moderate fine to medium granular structure; slightly hard when dry, friable when moist, slightly sticky; fine and medium plentiful pores• many fine and medium pores; clear and smooth boundary.
B1	19-45 cm	Yellowish brown (10 YRS.5/6 M) sandy loam; moderate fine to medium granular structure; slightly hard when dry, friable when moist slightly sticky; fine to medium many roots; many fine pores; gradual smooth boundary.
B2	45-84 cm	Yellowish brown (10 YR 5/6 M) sandy loam; moderate medium sub angular blocky breaking into granular, slightly hard when dry, friable when moist, slightly sticky, fine and medium common roots; many fine pores, gradual smooth boundary.
B3	84-165 cm	Light brownish yellow to yellowish brown (10 YR 4.5/4.M) loam; moderate fine to medium sub-angular blocky structure breaking into granular, fine common pores.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-19	1.29	57.70	15.89	13.30	12.82
B1	19-45	0.32	58.47	17.35	3.80	18.87
B2	45-84	7.83	52.41	17.22	12.50	16.25
B3	84-165	0.30	49.20	18.31	14.57	17.32

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.41	8.50	0.32	0.05	0..42	10.34
B1	1.41	8.30	0.20	nil	0.15	10.34
B2	1.41	8.25	0.20	nil	0.12	11.88
B3	1.47	8.35	0.30	nil	0.12	11.97

RANGE IN CHARACTERISTICS: The colour of the surface soil varies from light yellowish brown (10 YR 5/4, 6/6) to dark yellowish brown (10 YR 4/4) and dark brown (10 YR 4/3). The texture is dominantly sandy loam. Structure is crumb to granular. The colour of the sub-soil ranges from yellowish brown (10 YR 5/4, 5/6) dark yellowish brown (10 YR 4/4) and from sandy loam to 1oam (coarse loamy). The structure is granular to sub-angular blocky. Clay is less than 18 % in series control section.

The available moisture capacity of soils is 7.2 cm for 60 cm and 12.7 cm for 100 cm profile depth from the surface.

COMPETING SERIES AND THEIR DIFFERENTIAE: Competing series is Kakra but differs from Mehrauli in respect of parent material. Mehrauli series is derived from, the Anvalli alluvium while Kakra from Yamnna-alluvium.

DRAINAGE AND PERMEABILITY: Well drained with moderately rapid permeability.

USE AND VEGETATION: Cultivated to crops like bajra and wheat and flowers like rose. The natural vegetation like *Acacia arabica, Azadirachta indica, Morus alba Zizyphus jujuba, Zizyphus numalaria; Boebvia diffuse, Acaranthus aspera.*

DISTRIBUTION & EXTENT: Series occupies 5504 ha of land approximately. Extensive in Mehrauli Block of Delhi Territory.

TYPE LOCATION: North West of Chaandanhaula village approximately 77°11' E longitude and 28°28' N latitude.

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1.	Land Capability Sub-Class	IIe
2.	Irrigability Sub-Class	I
3.	Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching)	Good
4.	Management potential/productivity	High

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	Q/ha	Rating of productivity
Low		
Medium		Information not collected
High		

Tentative

GARHI SERIES

Garhi series occupies very deep, well drained loan to silt loam soil of yellowish brown (10 YR 5/6, 7/8) to strong brown (7.5 YR 5/6, 3/8) colour dveloped on alluvial derived from the Aravallis. They are found to occur nearly level to gently sloping lower piedmont plain and have well developed structure.

Garhi series is a member of fine loamy, mixed, hyperthermic family of Typic Haplastalfs.

Horizon	Depth	Description
Ap	0-15 cm	Brownish yellow (10 YR 6/6 D), yellowish brown (10 YR 5/8 M) sandy loam moderate medium sub angular blocky structure; hard when dry friable when moist, slightly sticky when wet; plentiful fine roots; clear smooth boundary.
A12	15-40 cm	Yellowish brown (10 YR 5/6 D), yellowish brown (10 YR 5/8 M) loam, strong medium to coarse sub angular blocky structure; hard when dry, friable when moist. Slightly sticky and plastic when wet; plentiful fine roots many fine and medium pores; clear smooth boundary.
Bl_t	40-66 cm	Yellowish brown (10 YR 5/8 0 & M) loam; strong medium to coarse angular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet thin continuous clay skins on ped faces, pores and root channels; many fine roots; many tine and medium pores; clear smooth boundary.
$B2_t$	66-96 cm	Brownish yellow (10 YR 6/6 D), yellowish brown (10 YR 5/6 M) loam, strong medium to coarse angular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; thin continuous, clay films on ped faces, pores and root channels; few fine roots, many fine to medium pores; gradual smooth boundary.
B3	96-131 cm	Brownish yellow (10 YR 6/6 D), yellowish brown (10 YR 5/8 M) loam; strong medium to coarse angular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; few fine roots; many fine medium pores; gradual smooth boundary.
C	131-165 cm	Brownish yellow (10 YR 6/6 D), yellowish brown (10 YR 5/8 M) loam; moderate medium sub angular blocky; hard when dry, friable when moist slightly sticky and plastic when wet; very few and fine roots; many fine pores.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-15	3.78	54.55	17.65	10.15	13.05
A12	15-40	2.45	58.67	8.67	7.35	19.57
$B1_t$	40-66	5.14	41.06	12.59	16.77	24.65
$B2_t$	66-96	1.13	38.60	14.96	17.52	27.60
B3	96-131	0.96	40.15	17.62	15.40	25.85
C	131-165	0.68	45.15	16.20	17.70	19.87

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.58	8.35	0.30	0.05	0.30	7.62
A12	1.50	8.45	0.25	Nil	0.12	9.79
$B1_t$	1.52	8.30	0.45	"	0.07	15.23
$B2_t$	1.52	8.40	0.30	"	0.12	16.32
B3	1.55	8.30	0.25	"	0.12	15.23
C	1.55	8.20	0.30	"	0.06	13.60

RANGE IN CHARACTERISTICS: Colour of the surface soil varies from light yellowish brown (10 YR 6/4) to brownish yellow (10 YR 6/6) or dark yellowish brown (10 YR 4/4). Texture is sandy loam or loam. Colour of the subsoil ranges from brownish yellow (10 YR 6/8) to dark brown (10 YR 4/4) and strong brown (7.5 YR 5/6, 5/8). Texture is dominantly loam but clay loam texture is also met with. The structure ranges from sub angular blocky to angular blocky.

The available moisture capacity of the soils is 8.1 cm for 60 cm and 15.8 cm for 100 cm profile depth from the surface.

DRAINAGE & PERMEABILITY: Well drained with moderate permeability.

COMPETING SERIES AND THEIR DIFFERENTIAE: Palam series are coarse loamy calcareous and Mehrauli are coarse loamy non-acid.

USE AND VEGETATION: Cultivated to Bajra and wheat; also floricultural crops like roses and grapes.

DISTRIBUTION & EXTENT: Extensive and occupies 5504 ha of land approximately. The soils occur on the lower piedmont plain of Aravalli.

TYPE LOCATION: Between Maidangarhi and Rajpur villages with approximately latitude 23°30 ' N and longitude 77°16' E.

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1. Land Capability Sub-Class — IIe
2. Irrigability Sub-Class — I
3. Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching) — High
4. Management potential/productivity — High

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	q/ha	Rating of productivity
Low		
Medium	Information not collected	
High		

Tentative

PALAM SERIES

Palam series comprises moderately well drained; very deep, sandy loam to loam soils of yellowish brown to dark yellowish brown colours. They occur on nearly level to gently sloping lands with slopes of 1-3%. They have well developed structure. Calcium carbonate concretions to the extent of 10-15% by volume are present in most of the cases.

Palam series is a member of coarse loamy, mixed, hyperthermic family of Typic Ustochrepts.

Typifying Pedon: Palam sandy loam-cultivated.

Horizon	Depth	Description
Ap	0-9 cm	Yellowish brown (10 YR 5/4 D), dark yellowish brown (10 YR 4/4 M), sandy loam; angular blocky structure; slightly firm when moist, slightly sticky and plastic when wet; violent effervescence with dilute HCl few fine roots; about 5% lime concretions by volume ranging in size from 0.5 to 1 cm; clear smooth boundary,
B1	9-22 cm	Yellowish brown (10 YR 5/5 M) sandy loam; weak, moderate angular blocky structure friable when moist, slightly sticky and plastic when wet; violent effervescence with dilute HCl; few fine roots; about 10 % lime concretions by volume ranging in size from 0.5 to 1 cm common very fine and faint iron and manganese mottles; clear and smooth boundary.
B2	22-52 cm	Yellowish brown (10 YR 5/5 M) loam; weak, moderate, angular blocky structure friable when moist, slightly sticky and plastic when wet; violent effervescence with dilute acid; few very fine roots; about 25% lime concretions by volume ranging from 1-3 cm size; common very fine and faint iron and manganese mottles; gradual smooth boundary.
C1	52-93 cm	Yellowish brown (10 YR 5/4 M) loam; weak moderate, angular blocky structure
C2	93-140 cm	Dark yellowish brown (10 YR 4/4) sandy loam; weak, moderate angular blocky structure; friable when moist, slightly sticky and plastid when wet; violent effervescence with dilute acid• about 5% lime concretions by volume- clear smooth boundary.
C3	140-150 cm	Yellowish brown (10 YR 5/6 M) sandy loam, weak, moderate angular blocky structure; friable when moist, slightly sticky and plastic when wet; strong effervescence with dilute acid; about 5 to 10 % lime concretions by volume.
	150 cm	Water table.

Particle Size Distribution

Horizon	Depth (cm)	Coarse sand%	Fine sand%	Coarse silt%	Fine silt%	Clay%
Ap	0-9	3.40	50.10	18.75	13.13	11.75
B1	9-22	2.55	46.50	21.55	13.50	13.00
B2	22-52	1.40	41.55	21.55	19.50	13.38
C1	52-93	0.95	41.90	25.20	19.18	11.38
C2	93-140	1.75	50.60	24.65	13.00	8.50
C3	140-150	1.05	41.90	35.00	13.08	7.80

Physico-Chemical Properties

Horizon	Bulk Density (g/cc)	pH (1:2.5)	Electrical conductivity mmho/cm	$CaCO_3$ %	Organic Carbon %	CEC m.eq/100 g
Ap	1.46	8.65	0.45	4.56	0.24	1.46
B1	1.55	8.50	0.70	7.17	0.15	1.55
B2	1.48	8.75	0.65	12.70	0.12	1.48
C1	1.52	8.90	0.60	14.79	0.07	1.52
C2	1.54	8.50	0.70	10.44	0.07	1.54
C3	1.56	8.50	0.60	11.00	0.06	1.56

RANGE IN CHARACTERISTICS: Colour of the surface soil ranges from dark brown (10 YR 4/3) to yellowish brown (10 YR. 5/4) throughout the depth and texture from sandy loam to loam. The sub-soil is dominantly loam with clay percent less than 18. The soils are calcareous and nodular lime is generally 10-15% by volume in the sub-soil, in some cases going up to 30% C E C ranges from 7-13 m.eg/100 gm. soil. Free iron oxide is in the range of 0.7 - 1.15%.

Available moisture capacity is 8.1 on and 14.3 cm for 100 cm profile depth indicating low moisture capacity of the soils.

DRAINAGE & PERMEABILITY: Well drained with moderately rapid permeability.

COMPETING SERIES AND THEIR DIFFERENTIAE: Garhi and Mehrauli series. Garhi series are fine loamy and Mchrauli series are coarse loamy non-calcareous.

USE AND VEGETATION: Cultivated to Bajra and wheat. Natural vegetation are *Dalbergia siaoo*, *Acacia arabica* and *Cyanodon dectylon*.

DISTRIBUTION AND EXTENT: Not extensive and occupies 1460 ha of land approximately. These soils are found to occur in Mehrauli block of Delhi Territory around Aravalli ridges.

TYPE LOCATION: IARI Farm, New Delhi with approximate latitude 28° 37' N longitude 77° 9' E.

INTERPRETIVE GROUPINGS

(a) QUALITATIVE: (based on physical productive potential of the series).

1. Land Capability Sub-Class — IIe
2. Irrigability Sub-Class — I
3. Fertility Management Potential (potential to retain fertilizer elements low fertilizer due to leaching) — Low Medium (May present problem due to free lime)
4. Management potential/productivity — Medium-High

(b) QUANTITATIVE: (Management potential for wheat production based on enquiries from farmers)

Management level	Q/ha	Rating of productivity
Low		
Medium		Information not collected
High		

CONTRIBUTORS

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