



# JSA-CTR

## Scientific Action Plan for Rohtak



Prepared By-

Haryana Space Applications Centre (HARSAC),  
Citizen Resource Information Department (CRID)

Government of Haryana

2021



## Table of Contents

List of Figures.....	3
List of Tables.....	4
1 Introduction .....	5
1.1 History .....	5
1.3 Administrative Setup .....	8
1.4 Climate .....	9
1.4.1 Temperature.....	9
1.4.2 Rainfall .....	10
1.5 Elevation and Topography.....	13
Figure 5 Contour Map of Rohtak District.....	16
1.5.1 Geology and Lithology .....	17
1.5.2 Soil Profile.....	18
1.6 Landuse.....	20
2 District Water Profile.....	23
2.1 Sources of Water .....	23
2.1.1 Canals .....	23
2.1.2 Ponds .....	23
2.1.3 Drain .....	25
2.2 Water Harvesting System .....	26
2.2.1 Roof Top Harvesting .....	27
2.2.2 Water Harvesting System other than Roof Top.....	29
2.2.3 Sewerage Treatment Plants.....	32
3 Irrigation Profile .....	33
4 Water Availability .....	34
4.1 Surface Water Availability .....	35
4.2 Ground Water Availability .....	36
4.2.1 Ground Water Quality .....	38
5 Aquifer System.....	41
6 Water Requirement/ Demand.....	42

6.1 Water Supply and Gap.....	42
6.2 Water Budget.....	43
7 Strategies for Water Conservation.....	44
7.1 Artificial Recharge .....	46
7.2 Water Sensitive Urban Design .....	46
7.3 Plantation .....	48
7.4 Surface water management.....	50
7.4.1 Pond restoration and rejuvenation .....	50
7.4.2 Decentralize Treatment Plant .....	52
7.3 Information Education and Communication .....	53
8 Proposed Activity .....	57
8.1 Rainwater harvesting .....	57
8.2 Proposed Suitable Site based on Drainage .....	59
9 Conclusion.....	61

## List of Figures

Figure 1 Location Map of Rohtak District .....	7
Figure 2 Rainfall Map Of Rohtak.....	12
Figure 3 Digital Elevation Model of Rohtak District .....	15
Figure 4 Slope Map of Rohtak District .....	15
Figure 5 Contour Map of Rohtak District .....	16
Figure 6 Lithological Map of Rohtak District .....	18
Figure 7 Soil texture map of Rohtak District.....	19
Figure 8 General Soil health profile of Haryana .....	20
Figure 9 Landuse and Landcover of Rohtak District.....	21
Figure 10 Water bodies of Rohtak District.....	24
Figure 11 Drainage Map Of Rohtak District .....	26
Figure 12 Water Conservation Activity in Rohtak District .....	31
Figure 13 Water Treatment Plant Map of Rohtak District .....	33
Figure 14 Ground water Availability Map of Rohtak District.....	37
Figure 15 Water quality index of Rohtak District .....	40
Figure 16 Wasteland Map of Rohtak District.....	49
Figure 17 The various stakeholders of IEC Activities.....	54
Figure 18 Proposed Site Suitable Map for rain water harvesting.....	58
Figure 19 Proposed suitable sites based on drainage in Rohtak District .....	60

## List of Tables

Table 1 Major Administrative Jurisdictional Setup of Rohtak District .....	8
Table 2 Temperature and Rainfall Profile for the District of Rohtak (District Hydrology Cell) .....	10
Table 3 Distribution of drought, abnormal and normal months in Rohtak District.....	11
Table 4 The rainfall (in mm) recorded over the five years (CRIS, 2020) .....	13
Table 5 Land Use Pattern of Rohtak district .....	22
Table 6 Drainage order and total length of the drains in Rohtak district.....	25
Table 7 Water Harvesting System in Rohtak District .....	27
Table 8 Water Harvesting activities in Rural area and Urban Area .....	30
Table 9 Status of water availability (in MCM).....	35
Table 10 The Ground water resource and development potential of Rohtak district as on 31st march, 2009 in ham .....	38
Table 11 Block wise average water quality index value in Rohtak District.....	39
Table 12 Blockwise average water table depth and fluctuation in Rohtak district.....	41
Table 13 Groundwater Demand Block wise for domestic and agricultural use in the District of Rohtak .....	42
Table 14 Block wise water budget .....	43
Table 15 Expected estimation of domestic water demand till year 2022 .....	44
Table 16 The methods of water table recharge strategies in urban area.....	47
Table 17 The proposed targets for plantation in Rohtak District .....	50
Table 18 Indicators and factors to decide the type of decentralized treatment required .....	53
Table 19 The numerous activities and interventions that can be carried out for IEC.....	55
Table 20 Block wise area under very good suitable site proposed for rain water harvesting.....	58
Table 21 Assigned Weight for Criteria Parameters .....	59
Table 22 Proposed harvesting structures in Rohtak based on drainage.....	61

# 1 Introduction

## 1.1 History

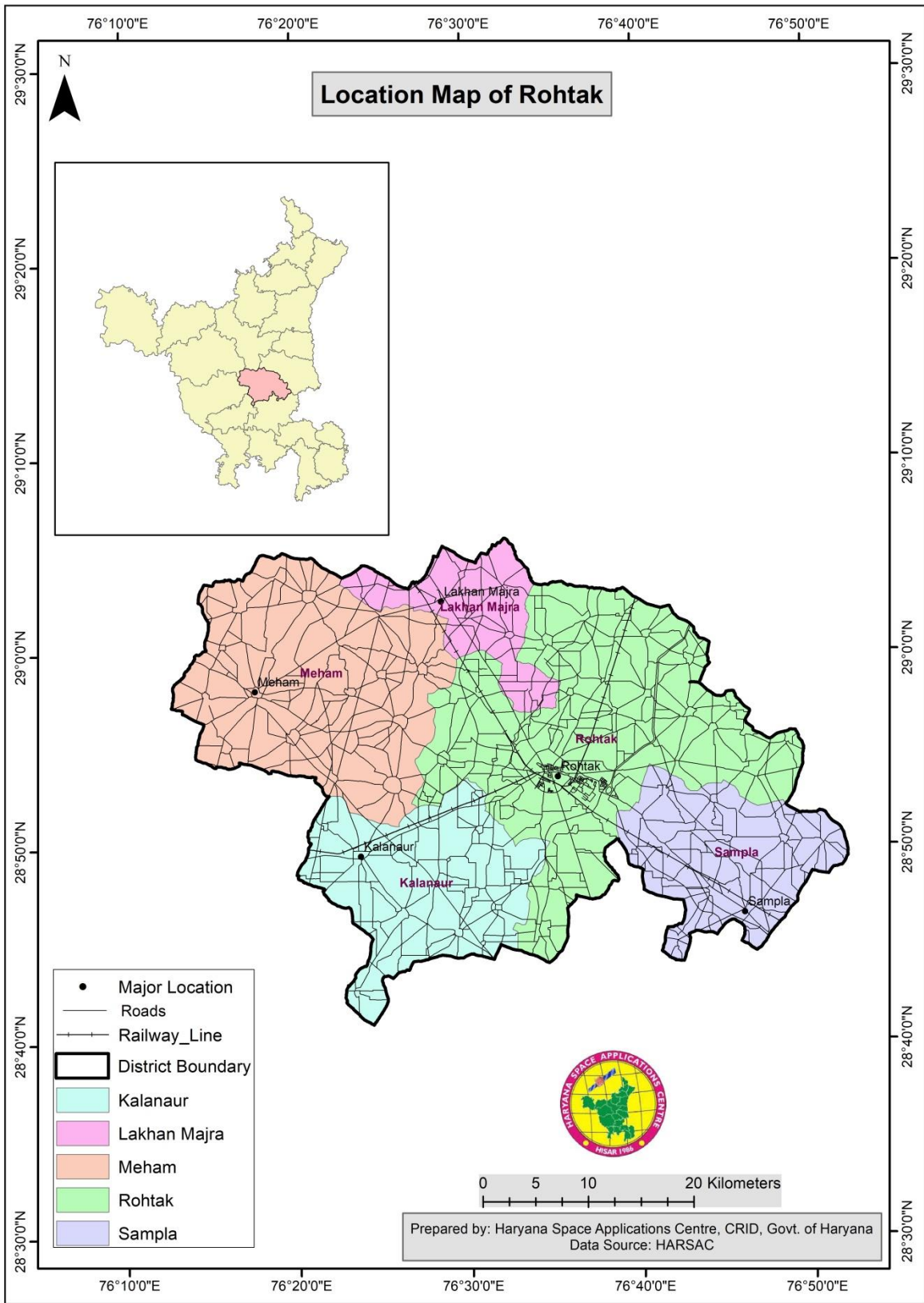
The formation of present Rohtak district began when the gift was abandoned by the Dujana Chief. The Gohana and Kharkhoda-Mandothi estates lapsed to the British Govt. after of the death of Bhai Lal Singh in A.D.1818 and Bhagh Singh in 1820. When the Hissar district was created in the latter year, the Beri and Meham-Bhiwani tehsils were included in Hisar and the other portions of the present northern tehsils in Panipat. In 1824 the Rohtak distt. was formed as a separate unit consisting of Gohana, Kharkhoda-Mandothi, Rohtak, Beri and Meham -Bhiwani tehsils. The Bahadurgarh territory formed its eastern and Jhajjar its southern boundary. Until A.D.1832, the whole area, including Rohtak, was under the resident of Delhi, but when in that year it was brought under the same regulations as the rest of North Indian, the resident became commissioner. The Distt. was abolished in A.D. 1841 Gohana going to Panipat and rest of tehsil to Delhi but in the very next year it was created again. Two Distt. of Rohtak and Jhajjar together with rest of Delhi and Hisar divisions were detached from North-western provinces after 1857 and passed to the Punjab by the Govt. of India on 13th April, 1858. The Rohtak distt. remained a part of the Hisar division until 1884.

After its transfer to the Punjab, the Rohtak Distt. experienced several changes before assuming its present form. Bahadurgarh estate was added to the Sampla tehsil, five detached villages to the east, going to Delhi. Jhajjar including some areas of Narnaul, Kanaudh and Dahari was at first created as a new distt. but was abolished shortly afterwards in 1860, when large parts of it were assigned to the Phulkian chief as a reward for their loyal services. While the Jhajjar tehsil itself was added to Rohtak several Badali villages were transferred either to Delhi or Gurgaon and two detached Jhajjar estates were given to the Raja of Jind. In the following year, the Meham tehsil was abolished and after making necessary territorial adjustments in favour of Hisar and Delhi, the rest of the area was added to Rohtak tehsil. All these changes were completed by 1st July, 1861.

### 1.2 Location

It lies 70 kilometres (43 mi) north-west of New Delhi and 250 kilometres (160 mi) south of the state capital Chandigarh on NH 9 (old NH 10). Rohtak forms a part of the National Capital Region (NCR) which helps the city in obtaining cheap loans for infrastructure development from the NCR Planning Board. The district is oval shaped and compact. Flanked by Jind district in the north, Hisar district in the North West. Sonapat district makes

boundary with the district with the district in the north- east, Jhajjar in the South and Bhiwani district in the south- west. The Location Map of Rohtak district is shown in **Figure 1**.



**Figure 1 Location Map of Rohtak District**

### 1.3 Administrative Setup

The administrative setup of the District of Rohtak has been described below, with specific sectoral development. The detailed administrative setup is shown in **Table 1**.

**Table 1 Major Administrative Jurisdictional Setup of Rohtak District**

Country	India
State	Haryana
Division	Rohtak
Headquarters	Rohtak
Tehsil	1. Rohtak, 2. Kalanaur, LakhanMajra, 3. Maham, 4. Sampla
Area	
Total	139 km <sup>2</sup>
Population (2011)	
Total	373,133
	2,700/km <sup>2</sup>
	84.4%
Density	608
Demographics	NH 9, NH 709, NH 352.
Literacy	Rohtak (Lok Sabha constituency)
Vidhan Sabha constituencies	1. Rohtak, 2. Meham, 3. Kalanaur, 4. Kilo-Sampla.
Website	<a href="http://Rohtak.gov.in">http://Rohtak.gov.in</a>
Location of Rohtak	Southeast region of Haryana
Coordinates	28°40'46" North to 29°06'08" North 76°12'40" East to 76°52'00" East
Total Area	54 sq mi
Elevation	720 ft above the sea level

Source: [https://en.wikipedia.org/wiki/Rohtak\\_district](https://en.wikipedia.org/wiki/Rohtak_district)

Sub Divisions (3)	Rohtak, Meham, Sampla.
Tehsils (5)	Rohtak, Meham, Sampla. Kalanaur

Sub-Tehsils (1)	Lakhan Majra(NA)
Blocks (4)	Rohtak, Sohna, Farrukh Nagar, Pataudi
Municipal Corporation (2)	Municipal Corporation, Rohtak Municipal Corporation, Manesar
Municipal Council (1)	Rohtak
Municipal Committees (3)	Pataudi, HailyMandi, Farrukh Nagar
Population (Census 2011)	10,58,683

Source: <https://Rohtak.gov.in/about-district/administrative-setup/>

Local Institutions: -

Total Villages	140
Total Panchayats	147

Source: <https://Rohtak.gov.in/about-district/administrative-setup/>

## 1.4 Climate

### 1.4.1 Temperature

The climate of the district is characterized by its dryness and extremes of temperature and scanty rainfall. The district has a sub-tropical continental monsoon climate where we find seasonal rhythm, hot summer, cool winter, unreliable rainfall and great variation in temperature. Air is generally dry during the greater part of the year. Scorching dust laden winds that blow during hot season render the weather very tiring. Dense fog sometimes occurs during winter months.

Four seasons are observed in a year. Mid-March to end of June is summer season, followed by rainy season from July to mid-September, after which a transition period of two months follows, then comes the cold season from mid-November to mid-March. With the start of cold season temperatures begin to decrease rapidly. January is the coldest month when mean daily maximum temperature is about 21.2°C and mean daily minimum at 6.4°C. Cold waves affect the region in the wake of passing western disturbances and the minimum temperatures drop down to about 2.1° to 3.1°C occasionally. The highest maximum temperature recorded at Rohtak was 46.6°C on June 11, 1972 and the lowest minimum temperature was 0.2°C on December 30, 1973 and 0.2°C on February 8, 1978. With the onset of summer season temperatures begin to rise rapidly. May and June are the hottest months. The mean daily maximum temperature during May is around 39.5°C. On individual days, the day temperature may occasionally exceed 44.2°C. Hot westerly winds locally known as 'looh' begin to blow from the month of April. With the beginning of monsoon season, day temperatures drop appreciably whereas nights continue to be as hot as in summer. During rainy season, weather is unpleasant due to increased moisture in the air. After the monsoon season, day temperatures remain high but night temperatures go down rapidly.

### 1.4.2 Rainfall

An analysis of the rainfall over the past 50 years has been done, in order to understand the average rainfall that can be possibly received. Globally while the annual rainfall overall has been decreasing, the intensity of the rainfall has been increasing. It has therefore been increasingly important to understand the changes in the rainfall pattern. The change in rainfall pattern is crucial and essential to understand how to build resilience in order to build these structures.

Rainfall records reveal that average annual rain fall in the districts low i .e.594mm, and about 89 percent of the normal annual rainfall in the district is received during June to September, July and August being the rainiest month. Rainfall generally increases from west to east. Rainfall in the month of June is significant mostly in the form of thundershowers.The variation in the annual rainfall from year to year is very large. On an average there are 27.8 rainy days in a year. The heaviest rainfall in 24 hours recorded in the district was 298 mm at Rohtak on June 30, 1981when streets were traversable by boats. The area/levels of District Rohtak is like Saucer and thus flood prone.

Winds are generally light in the district with some strengthening in force during late summer and monsoon seasons. Cloudiness is moderate to heavy during monsoon season, rest of the year, skies are generally clear or lightly clouded. Easterly or south easterly winds blow during monsoon season but for the rest of year winds are westerly or north-westerly. Air is dry for most part of the year. Relative humidity is generally high in the mornings during monsoon season and from December to February. During summer season relative humidity is as low as 28 percent in the afternoons. The deficiency of moisture is felt over the greater part of the year. Thunderstorms occur throughout the year but the highest incidence is during monsoon season. Dust storms and high velocity winds are quite common during summer.

**Table 2 Temperature and Rainfall Profile for the District of Rohtak (District Hydrology Cell)**

Month	Temperature(°C)			Rainfall(mm)
	Mean Min	Mean Max	Average	
January	6.7	21.5	14.1	21
February	9.3	24.7	17.0	13
March	14.3	30.6	22.4	11
April	19.8	36.7	28.2	4

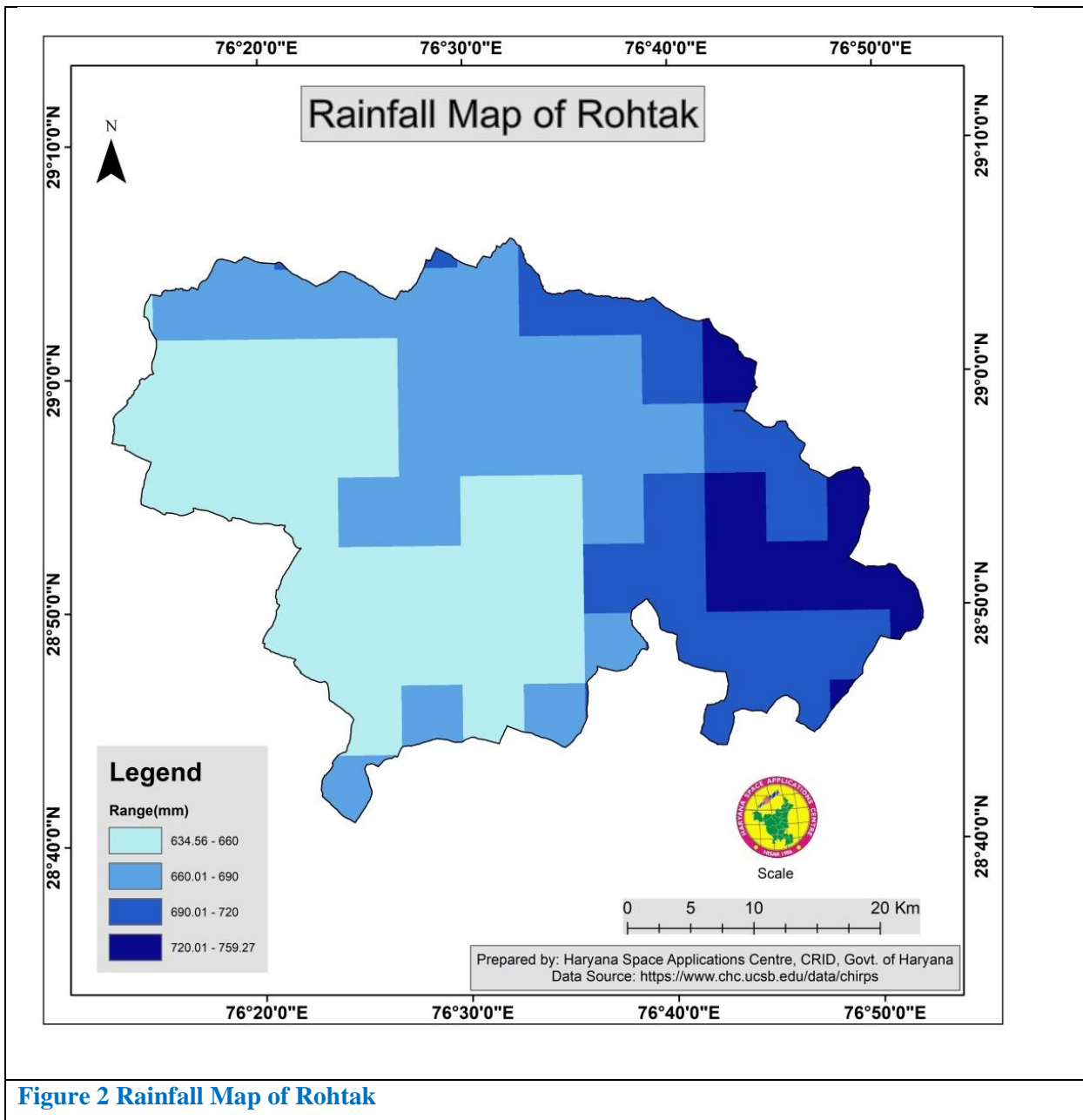
May	25.2	40.8	33.0	10
June	27.7	40.4	34.0	32
July	26.8	35.8	31.3	186
August	25.6	33.9	29.7	178
September	24.0	34.5	29.2	102
October	17.8	33.3	25.5	23
November	11.2	29.0	20.1	5
December	7.6	24.0	15.8	4

For reference, the average profile of temperature and rainfall (in mm) that has been plotted in the above **Table 2**. The satellite derived average annual rainfall map (showing average annual rainfall from 2010 to 2020) of Rohtak district is shown in **Figure 2**. This shows little over estimation in the rainfall measurements. The annual average of rainfall ranges 600 to 720 mm (obtained both from ground and satellite observations). The amount of rainfall occurs in Rohtak shows a huge potential of rain water harvesting in the district. Since the impervious surfaces have been increasing continuously, it is again necessary to manage excess runoff water through suitable water harvesting mechanisms. The climate extremes and related risks as expected in near future again compel to make suitable mechanism for the rain water harvesting.

The Indian Meteorological Department (IMD) monitors rainfall patterns throughout the country, at a District level as well as at a State Level. For the State of Haryana, piezometers, and there are 16 piezometers in the District of Rohtak, according to the Central Groundwater Board (CGWB).

**Table 3 Distribution of drought, abnormal and normal months in Rohtak District**

Stations	Total months	Drought Months	Normal months	Abnormal months
Annual Rainfall (mm)	504	252(50)	174(34.52)	78((15.48)



**Figure 2 Rainfall Map of Rohtak**

Another database that provides the past annual rainfall data (in mm) is Customised Rainfall Information System provided by IMD. The following **Table 3** shows the rainfall values recorded over the five years from 2016 to 2020. The green cells refer to the highest amount of rainfall experienced in the respective years. The following graph shows the variation of rainfall for the past five years for the District of Rohtak

**Table 4 The rainfall (in mm) recorded over the five years (CRIS, 2020)**

Months	Year				
	2016	2017	2018	2019	2020
January	0	24.6	5.6	7	10.9
February	0.2	0	6.2	9.2	4.3
March	15.3	8.8	0	5	41.8
April	0	0.6	6.7	1.7	66.7
May	21.4	5.7	18.8	35.8	4.6
June	16.5	128.2	74.6	7.8	25.2
July	107.2	30.8	100.9	88.0	19.4
August	122.7	43.9	31.4	42.5	95.8
September	0.8	52.1	99.4	3.3	88.3
October	10	0	0	18.0	12.4
November	0	0.5	3.7	2.3	0
December	0	2.7	1	12.7	0.5

### 1.5 Elevation and Topography

The height above mean sea level of the district as shown by Digital Elevation Model ranges from 132 to 282 m (**Figure 3**). Plain And undulating sandy alluvial plains marks the overall topography of Rohtak district of Haryana. Physiographically the area is flat terrain. The area slopes towards northeast to southwest with an average gradient of 0.19 m/km.. The north-western part of the district is covered with sand dunes lying in the westerly direction due to south-western winds. Slope ranges almost flat terrain (**Figure 4**).. Contours of 5 meters interval showed similar topography as in digital elevation model (**Figure 5**).

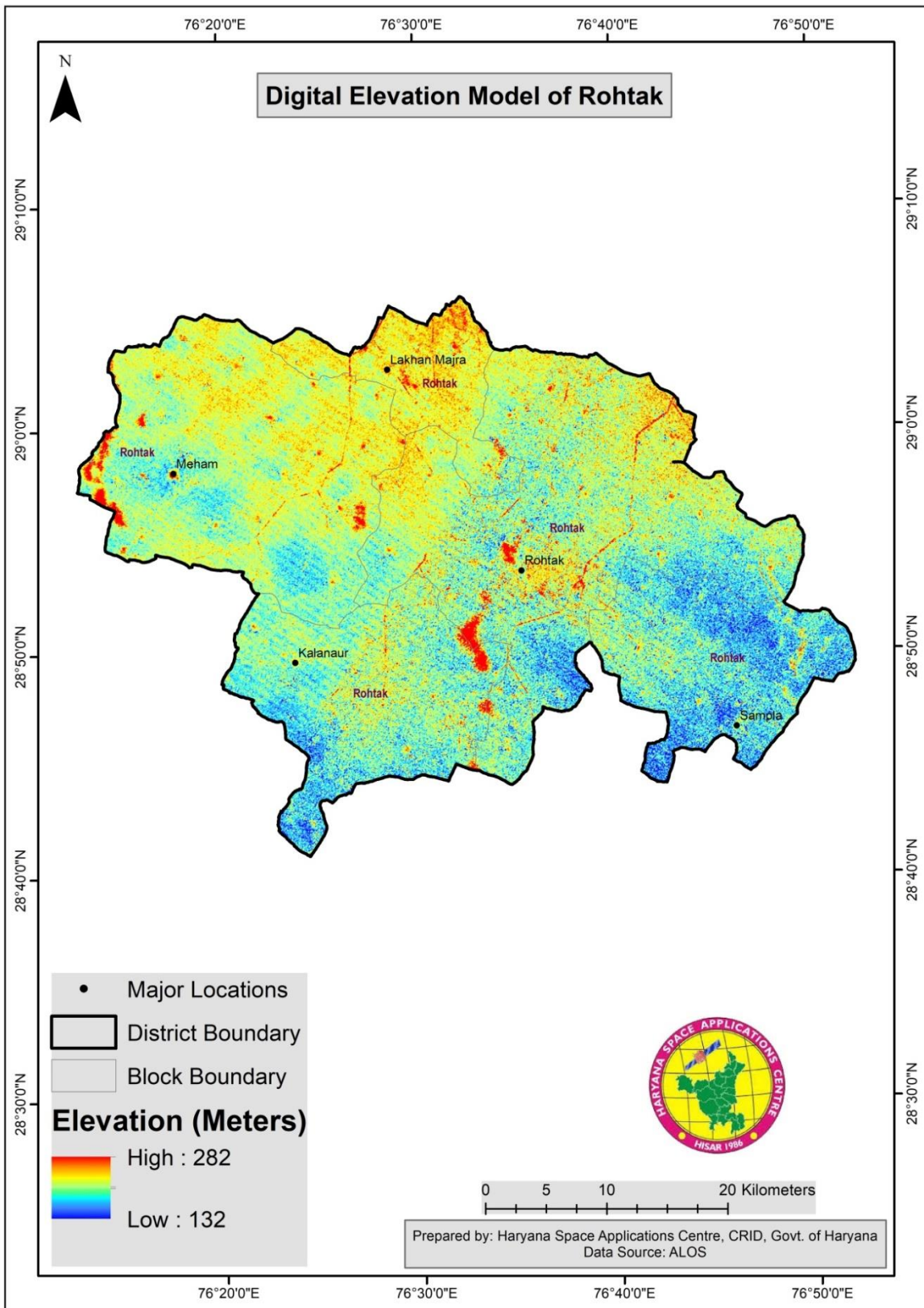


Figure 3 Digital Elevation Model of Rohtak District

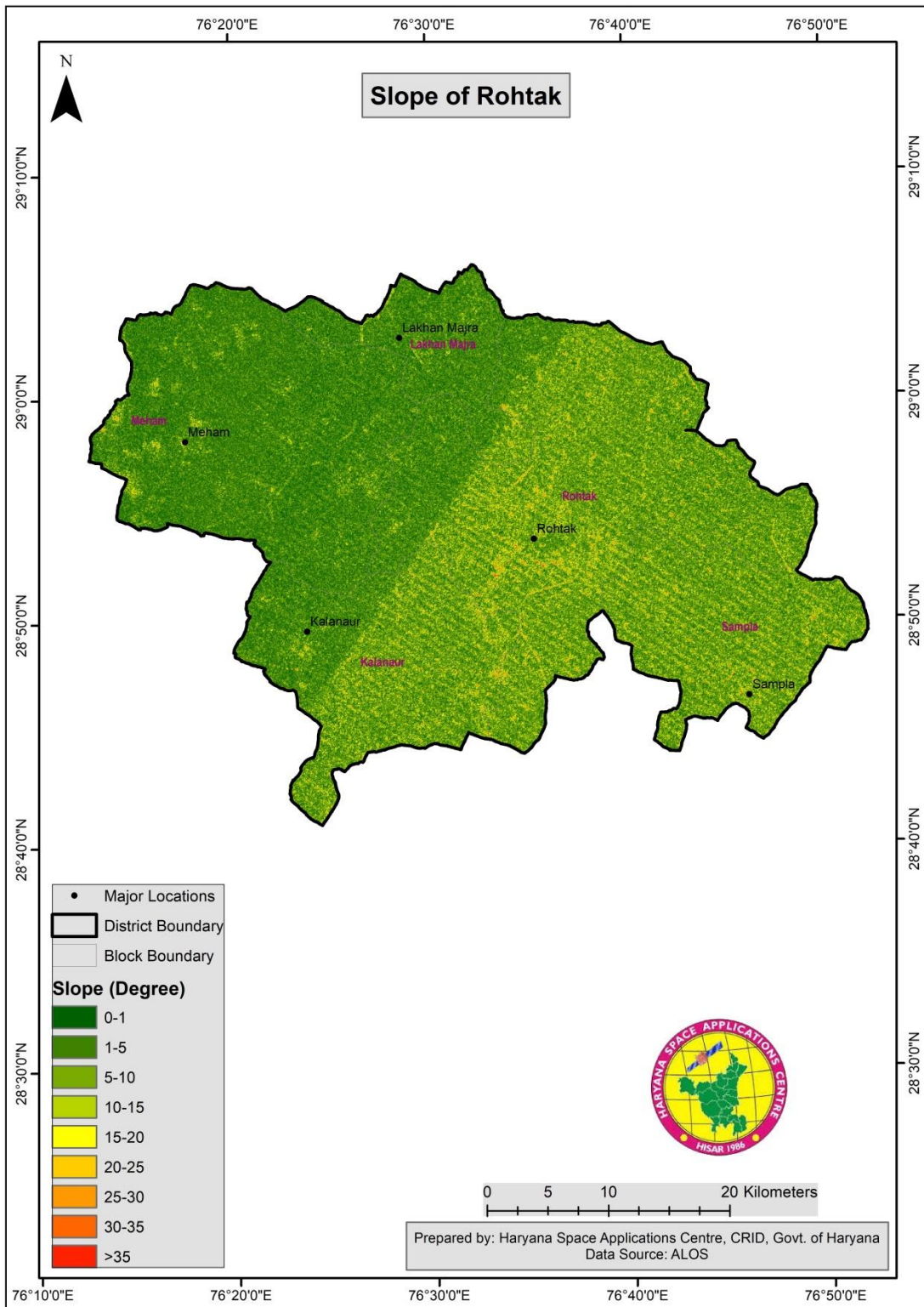
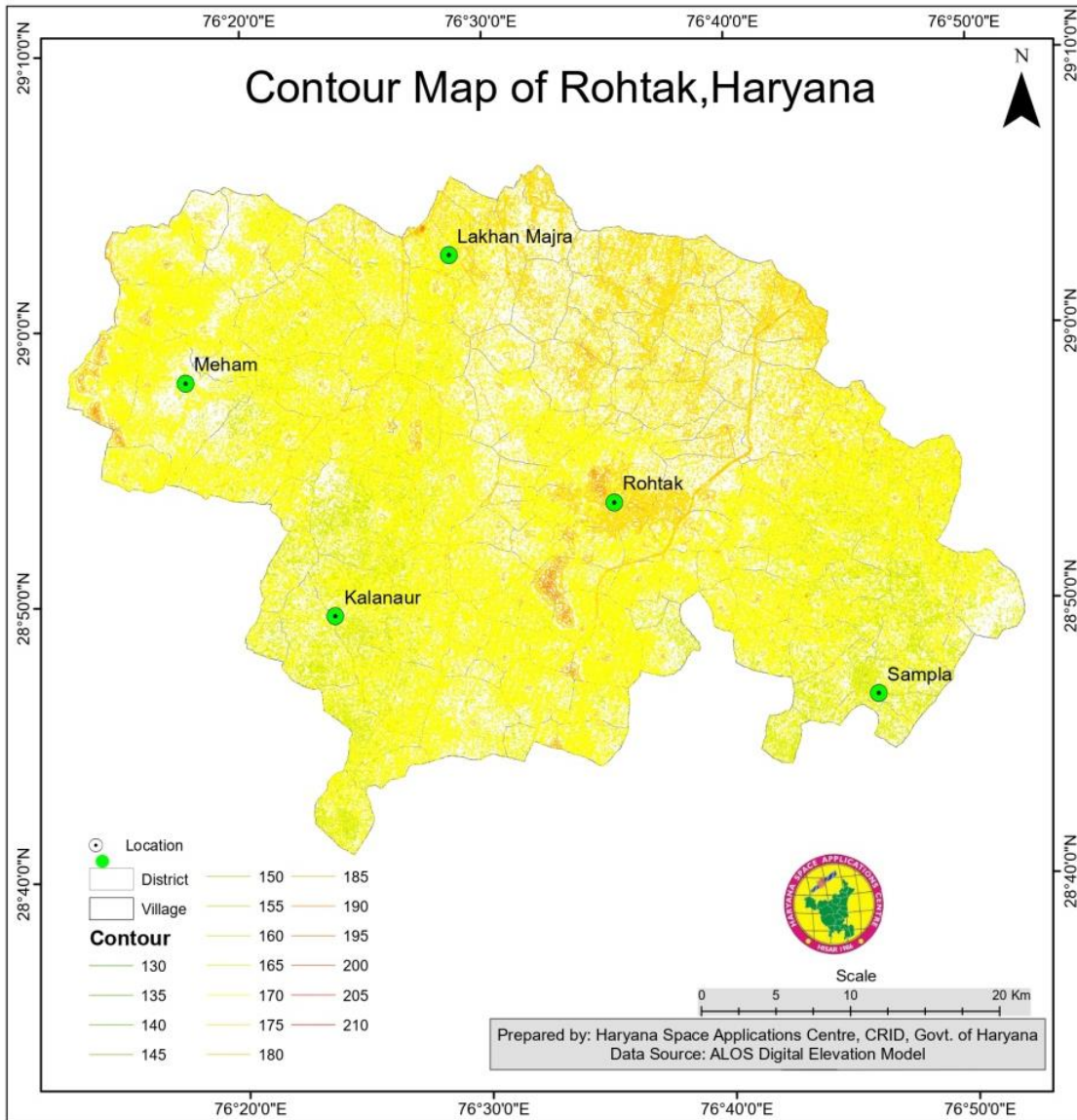


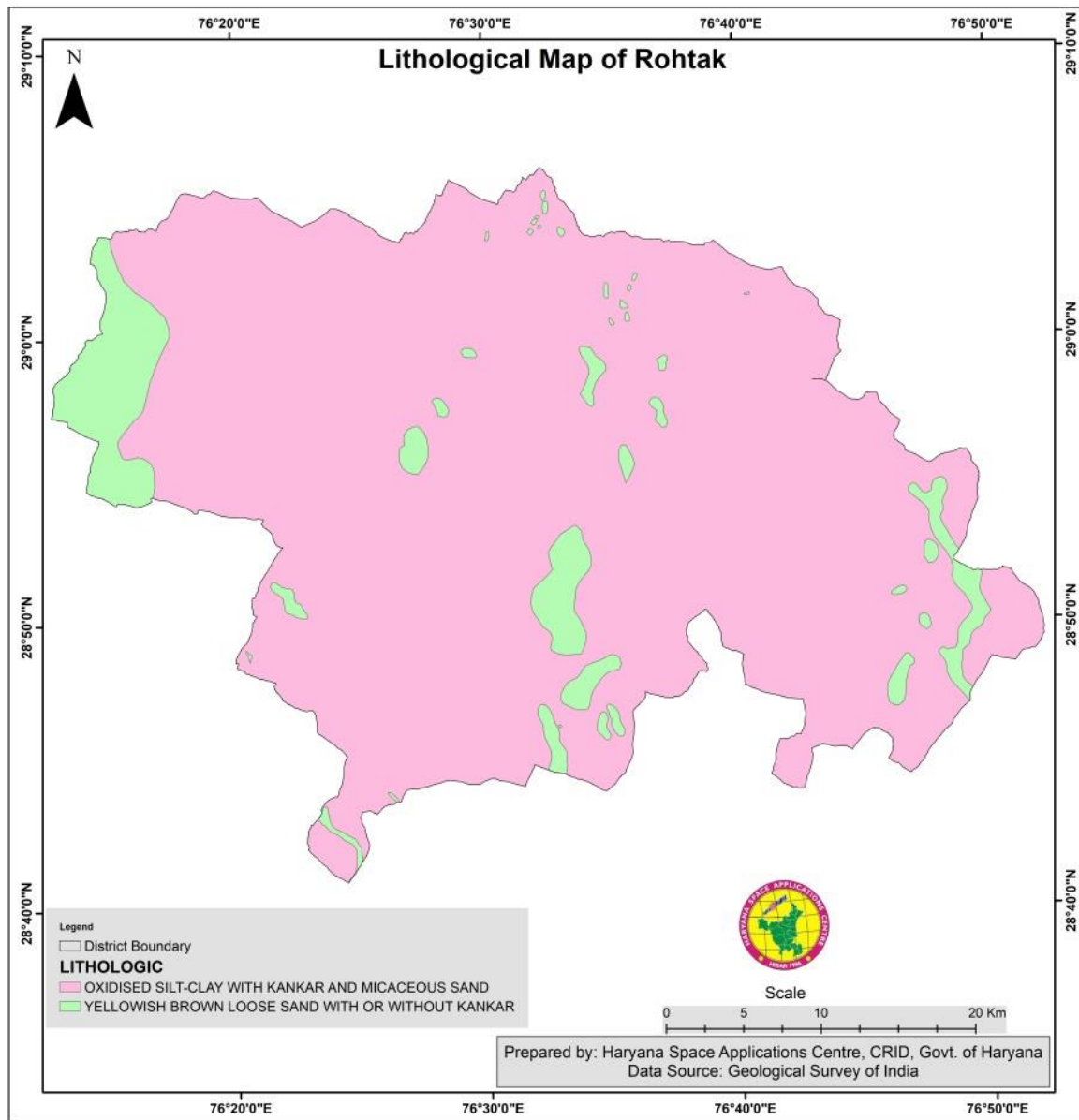
Figure 4 Slope Map of Rohtak District



**Figure 5 Contour Map of Rohtak District**

### 1.5.1 Geology and Lithology

The district can be broadly divided into two major geomorphic units as Older Alluvial Plain and Recent Sahibi Flood Plain (**Figure 6**). These are the sediments derived mostly from the Himalayan rivers, as a part of the Indo-Gangetic alluvium, having a heterogeneous composition with frequent calcium carbonate concretion layers at shallower depths. The soils are tropical arid brown to arid brown with alluvial origin, calcareous in nature, sandy to loam with, low to medium in organic carbon, low in available nitrogen, low to high in available phosphorous and medium to high in potash availability. The available moisture capacity is good with imperfectly drained and moderate permeability.

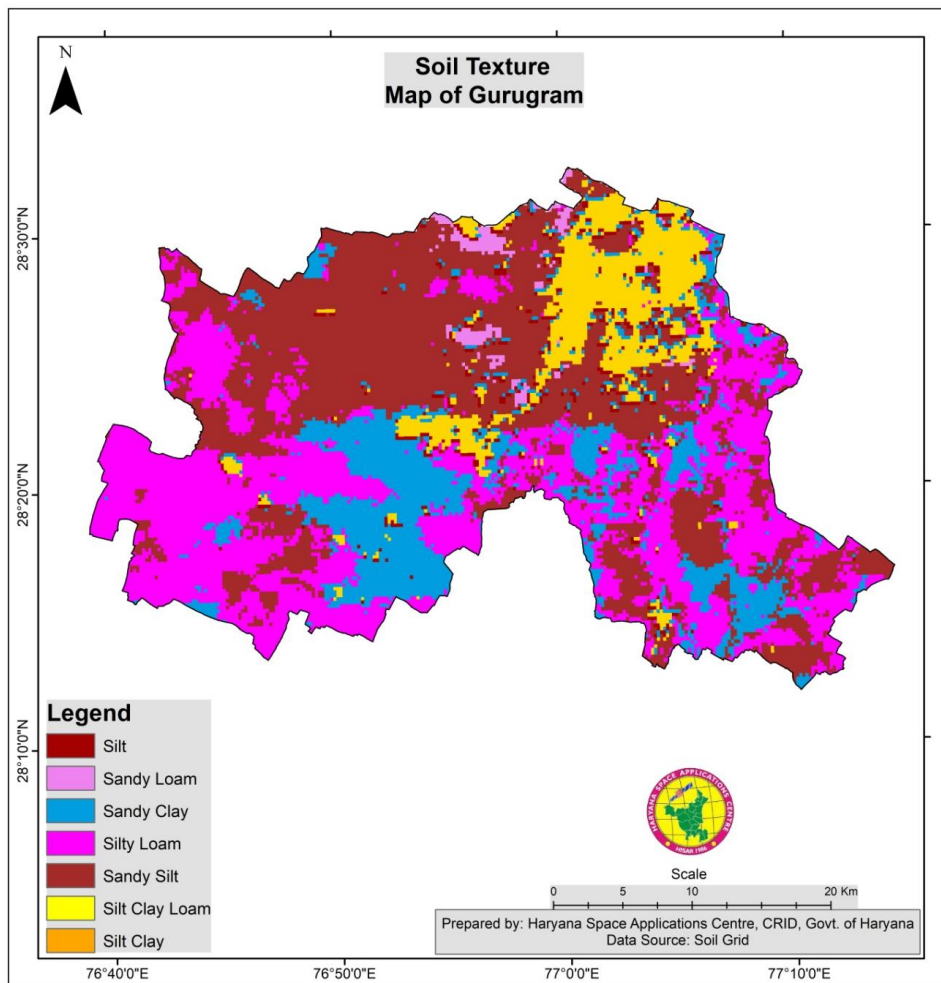


**Figure 6 Lithological Map of Rohtak District**

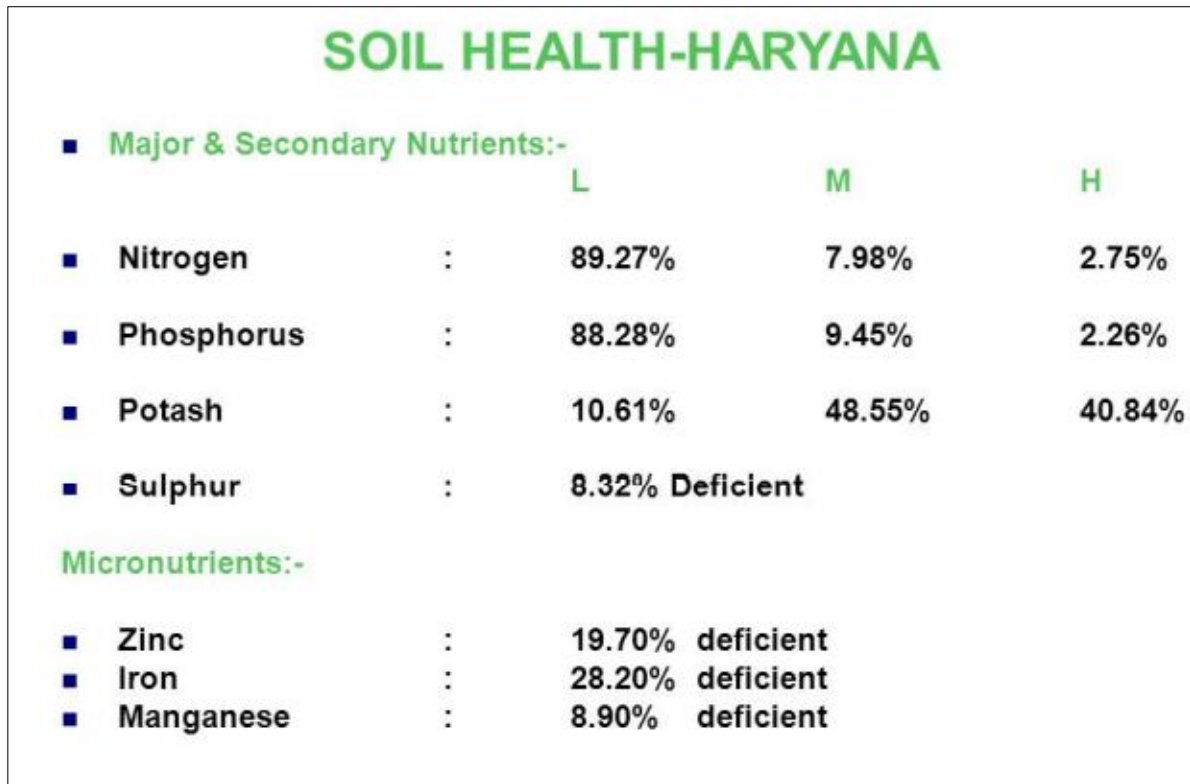
### 1.5.2 Soil Profile

Rohtak contains loamy (Bhangar and Nardak) soils. Sizeable chunk of the tract is characterized by the presence of saline and alkaline soils. The district can be categorized into two agro-ecological situations

(AES). In the first AES (Rohtak and Sampla blocks), the soil is loamy with normal pH and prone to flood with variable duration. The water table depth (3m) is within critical limit and the substantial area is under saline condition, mainly dependent on canal system of irrigation and tube wells with problematic water. In the second AES (Meham, Kalanaur and Lakhan Majra blocks), the soil is sandy loam with a significant saline area. The alluvium in the area comprises silt, sand, gravel, clay and kankar (**Figure 7**). The general profile of soil health of Haryana state is shown in **Figure 8**.



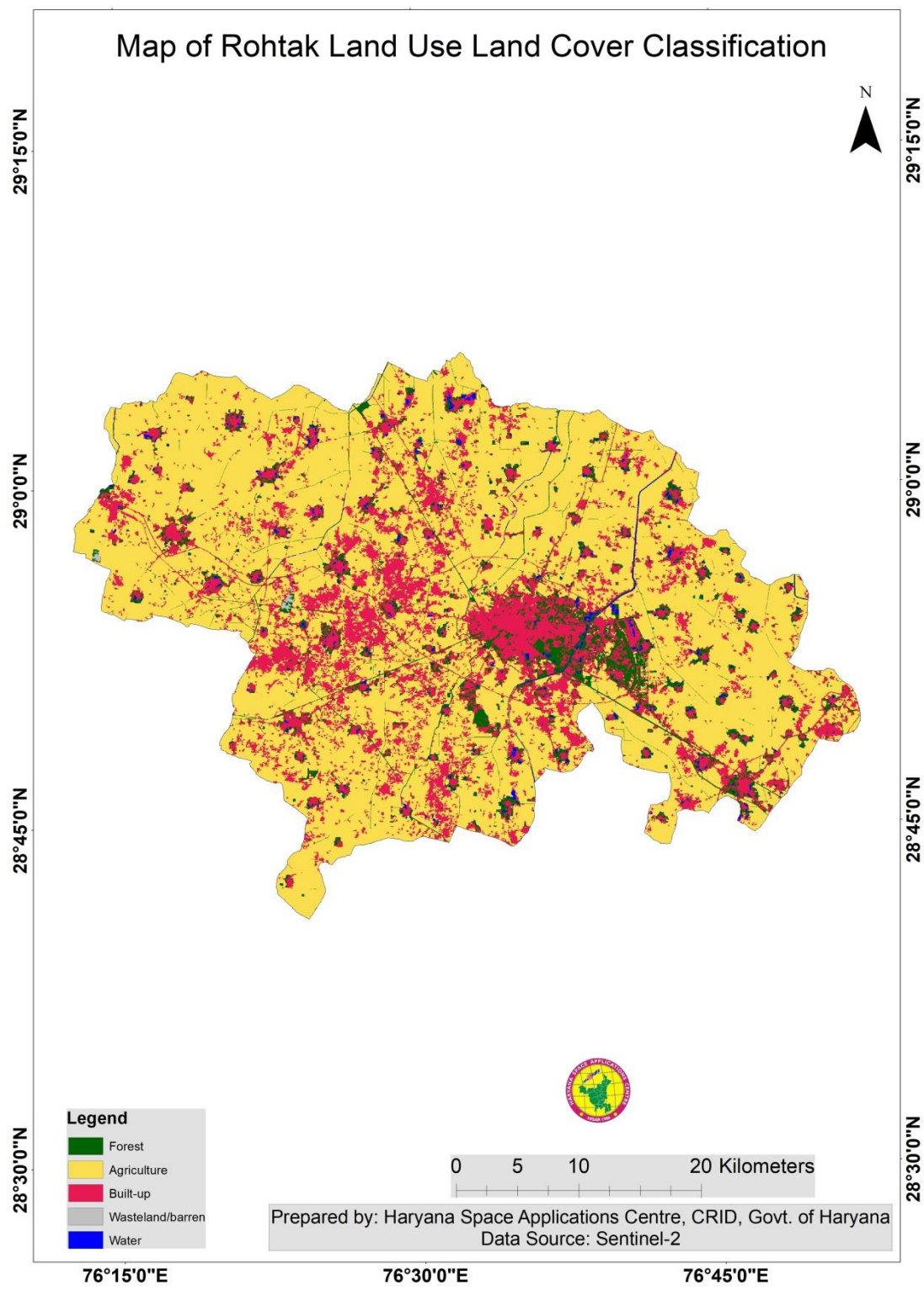
**Figure 7 Soil texture map of Rohtak District**



**Figure 8 General Soil health profile of Haryana**

### 1.6 Landuse

In the year 2010-11, against a geographical area of 1745.00\* sq km (includes 105.98 sq km of urban area); the area of the district according to village papers supplied by the revenue authorities is 1568.09 sqkm (rural area only). This shows difference in two sets of areas arrived at by different methods of measurement adopted by two separate agencies. Of the total area of 156,809 hectares, 133,274 hectares is net sown area; 2,672 hectares is culturable waste (including gauchar and groves) and 2,382 hectares of area is not available for cultivation (barren and unculturable land). Net area sown in the district is 84.99 percent of total area. Rohtak tehsil has a rural area of 853.25 sqkm whereas Maham tahsil and Sampla tehsil possesses 507.41 sq km and 207.43 sq km of rural area respectively. The land use land cover map of Rohtak District is shown in **Figure 9**.



**Figure 9 Landuse and Landcover of Rohtak District**

**Table 5 Land Use Pattern of Rohtak district**

Block	Total Geographical Area	Area under Agriculture			
		Gross Cropped Area	Net Sow nArea	Area sown morethan once	Cropping Intensity
<b>Kalanaur</b>	28833	41425	24620	16805	168%
<b>Lakhan Majra</b>	16958	26010	14079	11931	185%
<b>Maham</b>	41894	63942	35825	28117	179%
<b>Rohtak</b>	56622	75890	42501	33389	179%
<b>Sampla</b>	22660	31531	17979	13552	175%
<b>Total</b>	166967	238798	13500	103794	177%

4

The crops grown in the district are divided into two main categories viz. kharif and rabi, locally called as sawani and sadhi. The former is the summer season harvest and the latter the winter season harvest. Any crop which does not strictly fall within these two harvests is known as a zaidcrop and its harvest is called the zaid kharif or zaid rabi, according to the harvest with which it is assessed. Toria (an oil seed) is cultivated as zaid kharif and vegetables, melon and green fodder as zaid rabi.. Major Kharif crops of the district are sugarcane, American and desi cotton, jowar, bajra, and paddy while the minor ones are pulses (moong, mash, moth), vegetables, til, san, patsan, gwara (guar), groundnut and fruits etc. The major Rabi crops are wheat, gram, barley and oilseeds (sarson, taramira) while the minor ones are barseem, lucerne, methi, tobacco, potatoes and vegetables etc.

## 2 District Water Profile

### 2.1 Sources of Water

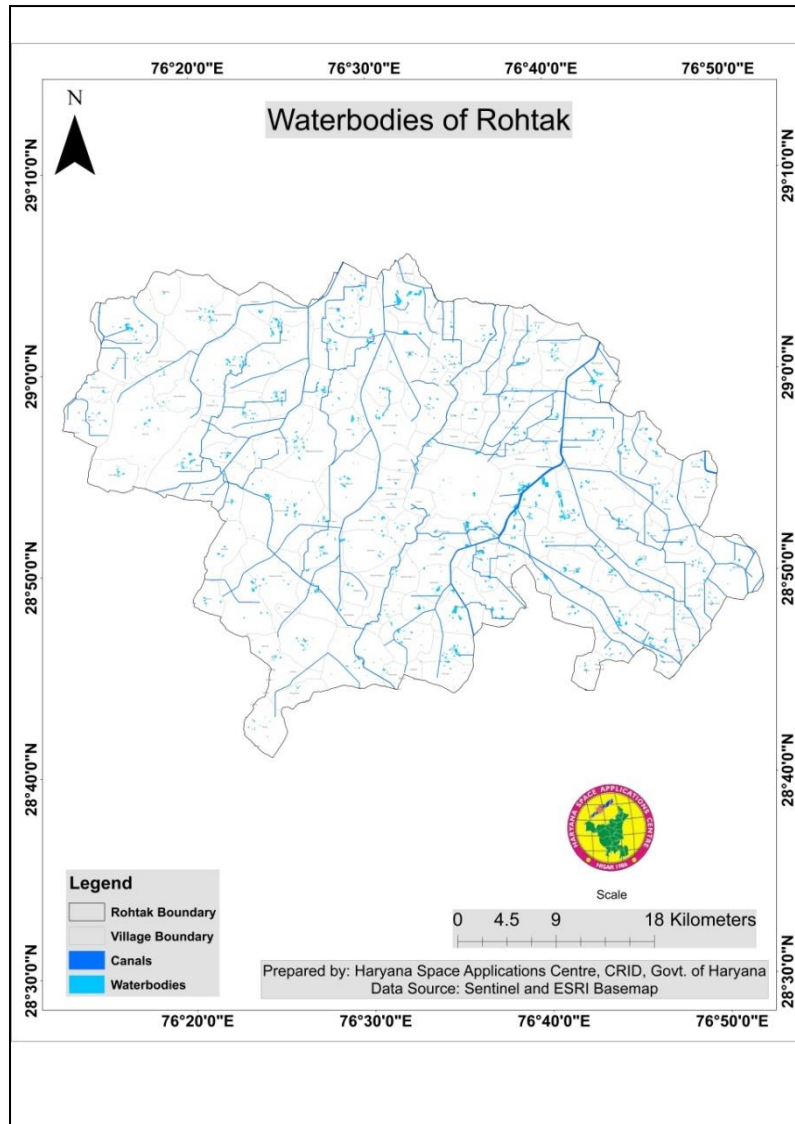
Rohtak district forms part of the region which is liable to frequent draughts. The rainfall is seasonal and subject to variations. Such type of rainfall makes it necessary to have artificial irrigation.

#### 2.1.1 Canals

There is no perennial river in Rohtak district. General slope of the district is from north to south. Canals, sub branches, distributaries emanating from Delhi Branch of the Western Yamuna Canal irrigate the district. Western Yamuna Canal is the only source of canal irrigation in the district. The canal takes off from the Yamuna at Tajewala head works (Yamunanagar district) where a very strong masonry weir is built across the river. At Indri Regulator (Karnal district) canal bifurcates into Sirsa Branch and Main Branch. Further 48 kilometres down at Munak (Karnal district), Main Branch bifurcates into Hansi and Delhi Branches and Gohana distributary.

#### 2.1.2 Ponds

A **pond** is a body of standing water, either natural or man-made, that is usually smaller than a lake (**Figure 10**).



**Figure 10 Water bodies of Rohtak District**

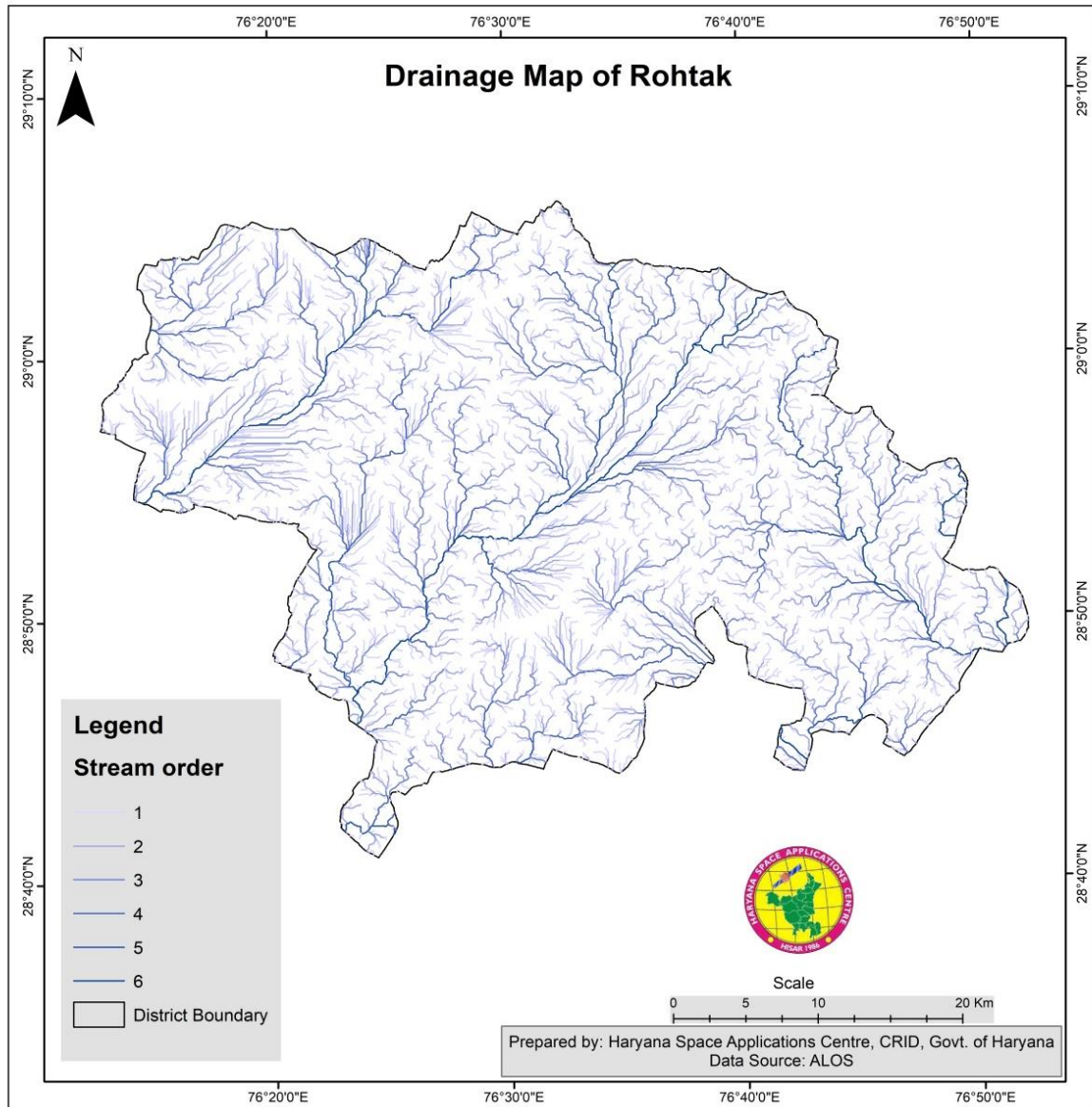
They may arise naturally in floodplains as part of a river system, or they may be some what isolated depressions (examples include vernal pools and prairie potholes). Usually they contain shallow water with marsh and aquatic plants and animals. A wide variety of man-made bodies of water are classified as ponds. Some ponds are created specifically for habitat restoration, including water treatment. Others, like water gardens, water features and koi ponds are designed for aesthetic ornamentation as landscape or architectural. In Rohtak district total 2879 ponds/waterbodies found on satellite data. The map of total ponds/waterbodies that include ponds, canals are shown in **Figure 10**.

### 2.1.3 Drain

Natural drainage means a drainage consisting of native soils such as a natural swale or topographic depression, which gathers or conveys run-off to a permanent or intermittent watercourse or waterbody. During rain or irrigation, the fields become wet. The water infiltrates into the soil and is stored in its pores. When all the pores are filled with water, the soil is said to be saturated and no more water can be absorbed; when rain or irrigation continues, pools may form on the soil surface. Surface drainage is the removal of excess water from the surface of the land. Shallow ditches, also called open drains, normally accomplish this. The shallow ditches discharge into larger and deeper collector drains. In order to facilitate the flow of excess water toward the drains DEM is very important. The drainage map of Rohtak District is shown in **Figure 11**. The statistics of length of drainages under each order are shown in **Table 6**.

**Table 6 Drainage order and total length of the drains in Rohtak district**

Sr. No.	Order of Drainage	Total Length (in meter)
1	1 <sup>st</sup> Order	9109
2	2 <sup>nd</sup> Order	4141
3	3 <sup>rd</sup> Order	2409
4	4 <sup>th</sup> Order	1312
5	5 <sup>th</sup> Order	595
6	6 <sup>th</sup> Order	610



**Figure 11 Drainage Map Of Rohtak District**

## 2.2 Water Harvesting System

A rainwater harvesting system comprises components of various stages - transporting rainwater through pipes or drains, filtration, and storage in tanks for reuse or recharge. Water harvesting profile of Rohtak district is shown as followed:

### 2.2.1 Roof Top Harvesting

There are a number of different ways to harvest rain water. But the one most essential thing that is common in all of the available water conservation techniques is to utilize natural rainwater to supplement the daily life's water consumption. People in the city are becoming all the more conscious day by day in implementing the best possible water conservation techniques. The major benefits of harvesting natural rainfall that the water can be harvested on a small-scale basis, such as on a bungalow or in housing societies, and it can also be done on a large scale basis, such as at industrial level. Many commercial premises have incorporated rainwater harvesting system in their building. And slowly, a lot of housing societies are also incorporating this technique. Harvesting rainwater involves the installation of a very simple technology that can be used by both commercial as well as residential places to make a tiny difference for a good cause.

In general, there are three main types of rainwater harvesting systems, which include direct pump, indirect pump and indirect gravity. Mentioned below (**Table 7**) is some of the most popular rain water harvesting techniques:

Rooftop Rain Water Harvesting is the technique through which rain water is captured from the roof catchments and stored in reservoirs. Harvested rain water can be stored in sub-surface ground water reservoir by adopting artificial recharge techniques to meet the household needs through storage in tanks. The Main Objective of rooftop rain water harvesting is to make water available for future use. Capturing and storing rain water for use is particularly important in dryland, hilly, urban and coastal areas.

**Table 7 Water Harvesting System in Rohtak District**

Sr. No.	Name of Tasks	Departments Involved	Targets	Achievement as on 27/07/2021	Expenditure (Rs. In Lakh)	Remarks
1	Water Conservation and Rainwater Harvesting Structure	1. I&WRD	0	0	0	Covered at Sr. No. 03
		2. Rural Development & Panchayats	327	250	42.50	Estimated cost @Rs.20, 000 per unit
		i) AWCs				
		ii)	151	22	6.50	131 No.s are in

		MGNREGA & Others Schemes				progress
		3. Agriculture	0	0	0	
		4. Building & Roads	49	24	29.49	WIP on 25 No.s
		5. PHED	0	0	0	Already completed in phase-I
		6. Urban Local Bodies(ULB)	10	7	111.00	Target of 3 each in all M.Cs
		7. HSVP	0	0	0	No target is assigned by H.Q.
		8. Forest Department	3	3	1.25	Near Completion
		<b>Total</b>	<b>540</b>	<b>306</b>	<b>190.74</b>	
<b>2</b>	<b>Reuse, New Bore well recharge structures (In No.s)</b>	1. I & WRD	14	6	0.20	01 No. Estimate = 4 Structures Tender recalled and will be opened on 04.08.2021. 01 No. Estimate = 1 Structure, Tender called and will be opened on 02.08.2021. 1 No. Estimate = 5 Structure, 2 No. complete and 03 No. work in progress.
		2. Rural Development & Panchayats	20	15	15.00	
		<b>Total</b>	<b>34</b>	<b>21</b>	<b>15.20</b>	

3	Reuse, New Bore well recharge structures(In No.s)	1. I & WRD	14	6	0.20	01 No. Estimate = 4 Structures Tender recalled and will be opened on 04.08.2021. 01 No. Estimate = 1 Structure, Tender called and will be opened on 02.08.2021. 1 No. Estimate = 5 Structure, 2 No. complete and 03 No. work in progress.
		2. Rural Development & Panchayats	20	15	15.00	
		<b>Total</b>	<b>34</b>	<b>21</b>	<b>15.20</b>	

### 2.2.2 Water Harvesting System other than Roof Top

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be a terrace, courtyard, or paved or unpaved open ground. The terrace may be a flat RCC/stone roof or sloping roof. Therefore the catchment is the area, which actually contributes rainwater to the harvesting system. Rainwater from the rooftop should be carried through down to take water pipes or drains to the storage/harvesting system. Water pipes should be UV resistant (ISI HDPE/PVC pipes) of the required capacity. The total no of activities achieved in Rohtak District for rain water harvesting is shown in **Table 8** at rural and urban area. The map of water conservation activity in Rohtak at rural and urban level is shown in **Figure 12**.

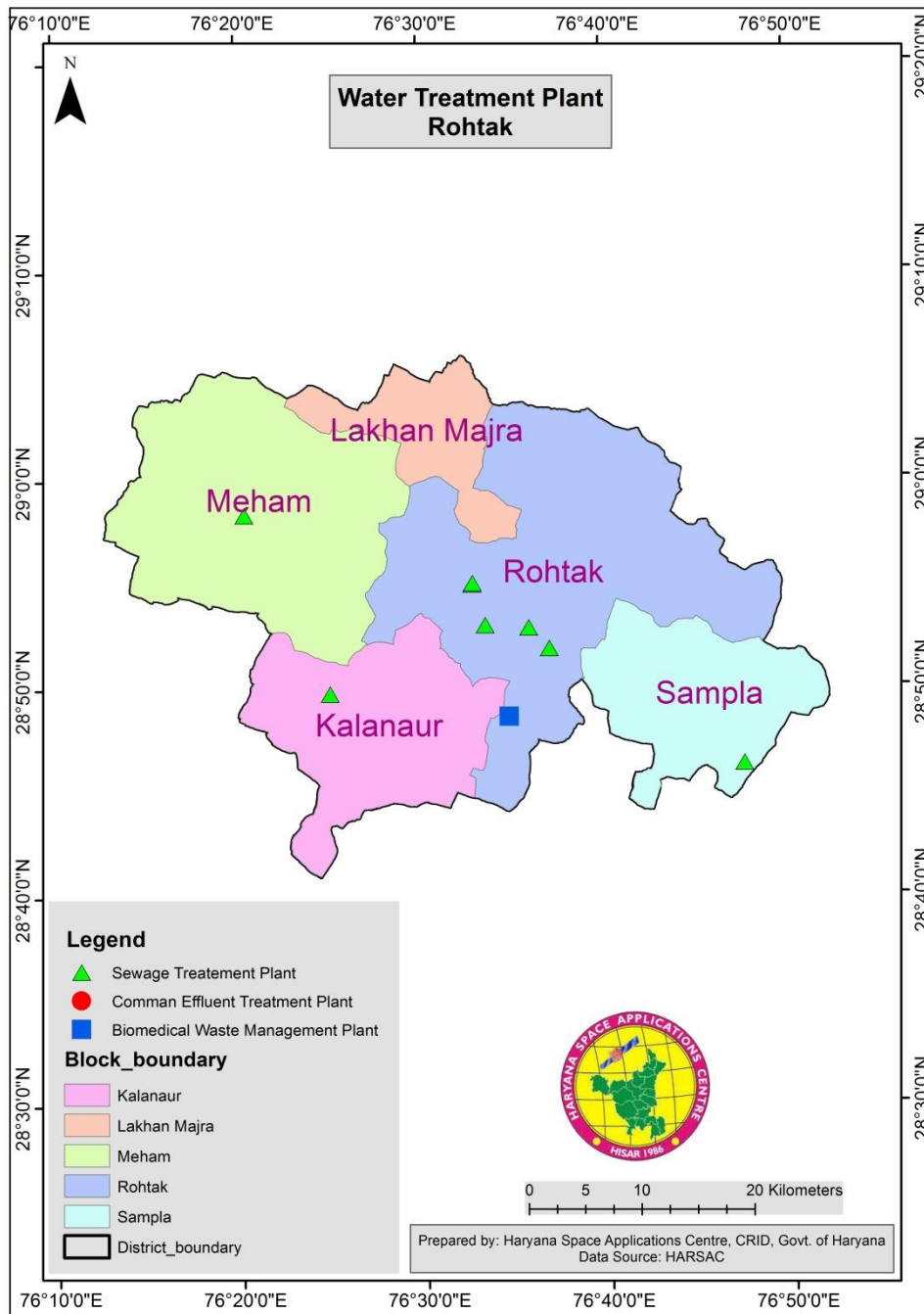
**Table 8 Water Harvesting activities in Rural area and Urban Area**

<b>In Rural Area</b>		
<b>Sr. No</b>	<b>Block Name</b>	<b>Total No of Activity (no.)</b>
<b>1</b>	Rohtak	155
<b>2</b>	Kalanaur	128
<b>3</b>	Lakhan Majra	83
<b>4</b>	.Maham,	0
<b>5</b>	Sampla	36
<b>In Urban Area</b>		
<b>1</b>	Rohtak	45



### 2.2.3 Sewerage Treatment Plants

Sewage from every residential colony, hotel, or corporate office collected in the sewage collection system. The purpose of a sewage treatment plants (STPs) is to thoroughly treat wastewater. The sewerage treatment plant map is shown in **Figure No 13**. In Rohtak District a total of 8 treatment plant are installed having total capacity of aprox 30-400 MLD. In Rohtak District there is one major biomedical waste management site in Rohtak Block.



**Figure 13 Water Treatment Plant Map of Rohtak District**

### 3 Irrigation Profile

Irrigation is the agricultural process of applying controlled amounts of water to land to assist in the production of crops as well as to grow landscape plants and lawns, where it may be known

as watering. Agriculture that does not use irrigation but instead relies only on direct rainfall is referred to as rain-fed. Irrigation helps to grow agricultural crops, maintain landscapes, and create greening over disturbed soils in dry areas and during periods of less than average rainfall. Irrigation also has other uses in crop production, including frost protection, suppressing weed growth in grain fields and preventing soil consolidation. Unmanaged and unplanned irrigation requirements due to various reasons costs water availability and affect the water resources drastically. This a managed plan for improving irrigation profile of the district is required. Irrigation based classification for Rohtak may be based on water availability and described below.

If the condition is “Delayed/ limited release of water in canals due to low rainfall” measures like Change in crop/cropping system, Agronomic measures etc. is required. For Sandy soils/sandy loam soils irrigated with canal Pearl millet + Moong- Raya is suggested in place of Pearl millet/Wheat. For Well drained, medium alluvial soils, canal irrigated conditions, Cotton-Wheat is suggested. For Clay soils, canal irrigated condition; Summer Moong-Rice is suggested in place of Rice-Wheat cropping pattern and Vegetables/ flowers in place of Sorghum fodder- Wheat. Similarly, for a major condition “Non release of water in canals under delayed onset of monsoon in catchment” where the dominance of Sandy soils, and canal tube well irrigated system is present the Pulses-Raya is suggested in place of Pearl millet-Raya. For the similar major condition where Well drained, medium alluvial soils, canal irrigated system is present the Cotton-Wheat is suggested in place of Cluster bean-Barley.

Similar measures in of crop pattern changes, agronomic measures etc. are required for condition like “Lack of inflows into tanks due to insufficient /delayed onset of monsoon”, and “Insufficient groundwater recharge due to low rainfall”. For unusual rainfall the suggested contingency measures would be different for Vegetative stage, Flowering stage, Crop maturity stage, and Post-harvesting stage. Continuous high rainfall in a short span leading to water logging, where the crops like Rice and Cotton are grown after suitable conditions arrived. Drainage of excess water from these areas is suggested specially if the depth of standing water is > 5-6 cm in vegetation stages, flowering stage and fruiting stage. The Shifting the produce to dry place is suggested during the post-harvest stage.

#### **4 Water Availability**

There is neither perennial nor seasonal river in the district Rohtak and the canal system is very limited. J.L.N. feeder and Bhalaut sub branch are the two main canals which make the passage through the

district and spreading a network of sub branches, minors and distributaries. Besides, the Bhiwani sub branch and Kalanaur distributaries irrigate most of the area of the district. There is no natural source of drainage of rain and flood water. A network of drainage system has created to link drains for collecting excess water. These link drains are joint together at different places and carries the water into the main drain (No. 8) and in the last merged into the river Yamuna. Water channels that irrigate the district include Bhiwani Distributary, BC Pal sub Minor, Kalanaur Distributary, Bohar distributary, Jhajjar Sub Branch, Bhalaut Distributary, Ismaila Distri butary, Dulehra Sub Branch, Rithal Distributary and Pai Distributary which emanate from Delhi Branch of Western Yamuna Canal.

#### 4.1 Surface Water Availability

From the description of surface and ground water sources discussed in previous sections above, we summarize below, the direct source water availability at present in the Rohtak districts of Haryana sub-region. **Table 9** shows the type of water resources available in Rohtak District.

**Table 9 Status of water availability (in MCM)**

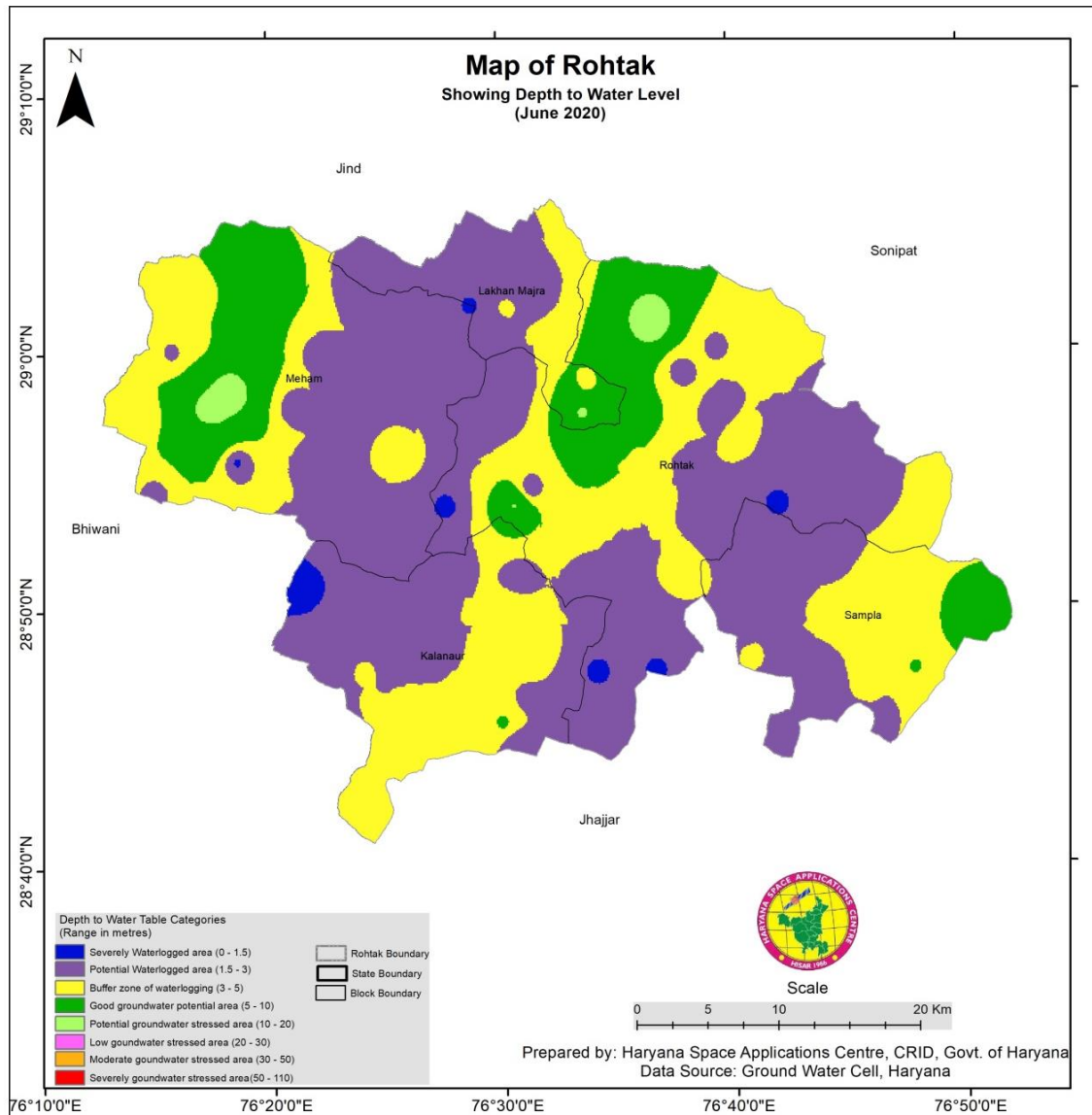
Sl.	Source	Kharif		Rabi		Total	
		Area In Ha	Volume of water	Area in Ha	Volume of water	Area in Ha	Volume of water
<b>1</b>	<b>Surface Irrigation</b>						
(i)	Canal, Major & Medium Irrigation)	4629	290.8	4922	174.4	9551	465.3
(ii)	Minor Irrigation Tank (FIS)	8	9	0	6	8	5
(iii)	Lift Irrigation/Diversion	0	0	0	0	0	0
(iv)	Various Water Bodies including Raina in water Harvesting	0	0	0	0	0	0
(v)	Treated Effluent received from STP	0	0	0	0	0	38.69

(vi)	UntreatedEffluent	0	0	0	0	0	0
(vii)	Perennialsourcesofwater	0	0	0	0	0	0
)							
<b>II</b>	<b>GroundWater</b>	0	0	0	0	0	0
(i)	Openwell	0	0	0	0	0	0
(ii)	DeepTubewell	0	0	0	0	0	0
(iii)	MediumTubewell	0	0	0	0	0	0
(iv)	ShallowTube well	0	0	0	0	0	0

Source: Irrigation Department, Rohtak

## 4.2 Ground Water Availability

The bed rock in the district area was encountered at a depth of 370.0 m at Hasangarh in Sampla block. The boreholes drilled in the district were abandoned either due to bad quality of water or poor discharge. Ground water in the district occurs in the alluvium under water table and semi confined to confined conditions. Two to four granular zones with aggregate thickness from 23m to 52m are present in the area up to bed rock. There has however been a successful well at Sondhi, Rohtak block, tapping the zones 27m-34m, 37m- 40m, and 46m-52m. The discharge of the well was 870 lpm at a drawdown of 7.5m. The transmissivity 'T' value 207m<sup>2</sup> /day was determined. Shallow tube wells for irrigation use are generally constructed upto a depth of 20 m and are of cavity type. The discharge of these shallow tube wells/ cavity wells range 360 -600 litres per minutes. Deep tubewells are not constructed in the district due to increase in salinity with depth. The block-wise ground water resource potential in the district has been assessed as per GEC-97. The stage of ground water development ranges between 50 percent (block Kalanur) to 59 percent (block Rohtak and Maham). The Central Ground Water Board has drilled 6 exploratory boreholes to delineate and determine potential aquifer zones, evaluation of aquifer characteristics. The permeable granular zones comprising fine to medium grained sand and occasionally coarse sand and gravel. Their lateral and as well as vertical extent is limited. The borehole data reveals that clay group of formations dominate over the sand group in the district area. The following map (**Figure 14**) depicts the ground water depth in Rohtak district and the **Table No 10** gives the description of ground water resource and development potential of Rohtak District.



**Figure 14 Ground water Availability Map of Rohtak District**

**Table 10 The Ground water resource and development potential of Rohtak district as on 31st march, 2009 in ham**

Assessment Unit / Block	Net Annual Ground water Availability (Ham)	Existing Gross Ground water Draft for Irrigation (Ham)	Existing Gross GW Draft for Domestic & Industrial water supply (Ham)	Existing Gross & Groundwater Draft for all uses (Ham)	Allocation Domestic industrial upto next 25 years (Ham)	Net GW availability for future irrigation development (Ham)	Stage of Groundwater Development	Category of the Block
Rohtak	12137	10789	775	11564	1183	165	95%	Semi Critical
Kalanaur	8307	4715	403	5118	449	3143	62%	Safe
LakhanMajra	3223	3357	229	3586	229	-363	111%	Semi-Critical
Meham	11451	6053	578	6631	459	4939	58%	Safe
Sampla	9899	3522	312	3844	342	6025	39%	Safe
Total	45017	28446	2297	30743	2662	13909	68%	Safe

#### 4.2.1 Ground Water Quality

Groundwater is the water found underground in the cracks and spaces in soil, sand and rock. It is stored in and moves slowly through geologic formations of soil, sand and rocks called aquifers. Ground water quality index determines the purity of water. Higher the values on index represent the more turbid water which cannot be used for drinking purpose. In contrast to that lower values on quality index represent the purity of water and are suitable for drinking purpose. According to ([http://www.sarasota.wateratlas.usf.edu/library/learn-more/learnmore.aspx?toolsection=lm\\_wqi](http://www.sarasota.wateratlas.usf.edu/library/learn-more/learnmore.aspx?toolsection=lm_wqi)) water quality range from 0-45 is good, 45-60 is fair and >60 is very poor quality of water. So, based on that Rohtak district's water quality is Very Poor (**Figure 15**) for the whole district. Whereas block wise water quality index value is shown in **Table 11**.

**Table 11 Block wise average water quality index value in Rohtak District**

<b>Block Name</b>	<b>Average Water Quality Index Value</b>
Rohtak	208.54
Kalanaur	201.11
LakhanMajra	128.79
Meham	180.89
Sampla	200.21

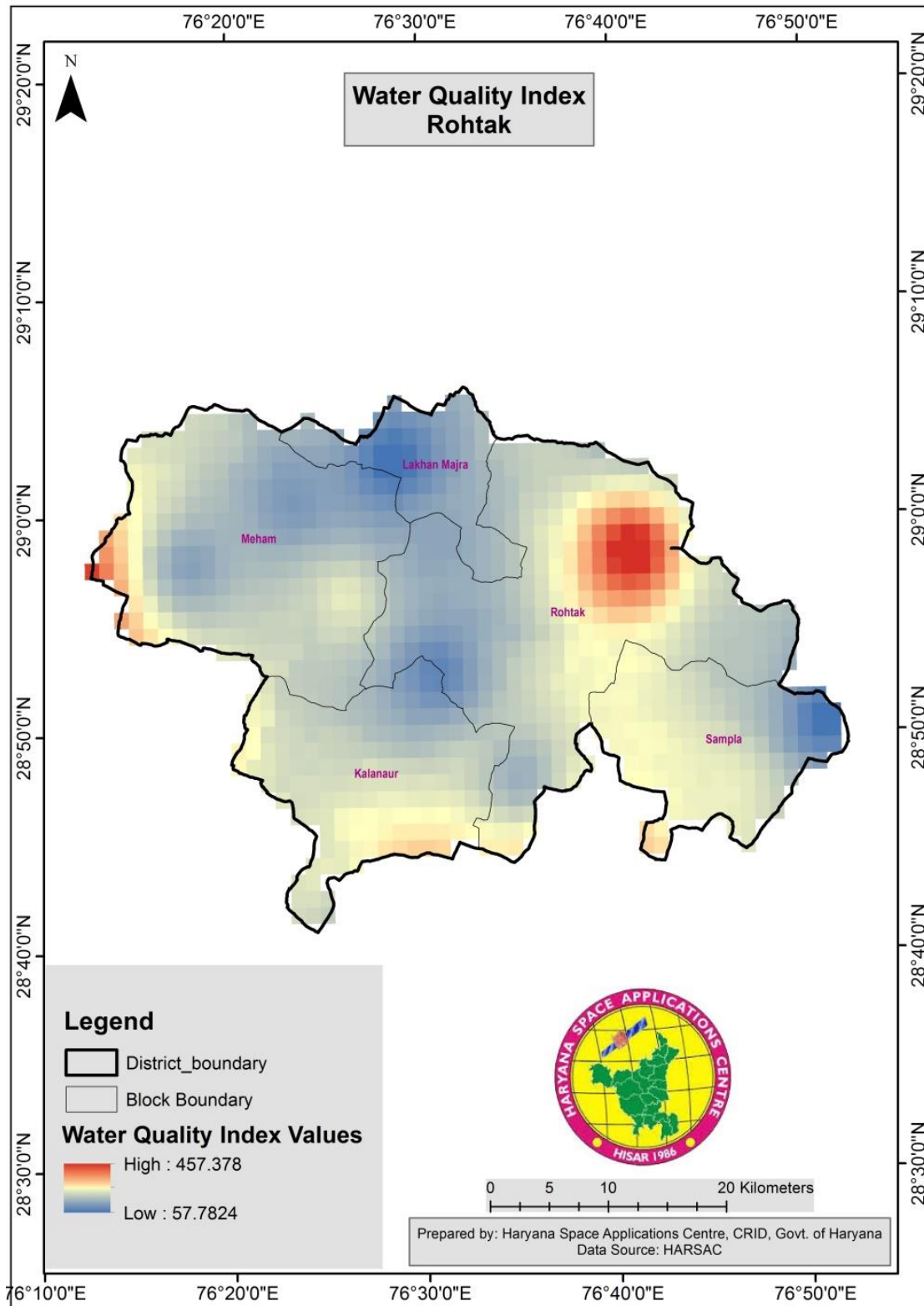


Figure 15 Water quality index of Rohtak District

## 5 Aquifer System

The district is occupied by Indo-Gangetic alluvial plain of Quaternary age, and falls in Yamuna sub-basin of Ganga basin. The Central Ground Water Board has drilled 6 exploratory boreholes to delineate and determine potential aquifer zones, evaluation of aquifer characteristics. The permeable granular zones comprising fine to medium grained sand and occasionally coarse sand and gravel. Their lateral and as well as vertical extent is limited. The borehole data reveals that clay group of formations dominate over the sand group in the district area. The bed rock in the district area was encountered at a depth of 370.0 m at Hasangarh in Sampla block. The boreholes drilled in the district were abandoned either due to bad quality of water or poor discharge. Ground water in the district occurs in the alluvium under water table and semi confined to confined conditions. Two to four granular zones with aggregate thickness from 23m to 52m are present in the area up to bed rock. There has however been a successful well at Sondhi, Rohtak block, tapping the zones 27m-34m, 37m- 40m, and 46m-52m.

The hydrogeological details of some of the tube wells drilled by Central Ground Water Board and state Govt. agencies are given in Table 9

**Table 12 Block-wise average water table depth and fluctuation in Rohtak district**

Block	Average water table (m)				From 1981 to 2011		
	1981	1991	2001	2011	Water table fluctuation (m)	Average fluctuation (cm/year)	annual
Kalanaur	5.70	5.90	4.59	2.86	2.84	9.5	
Lakhan Majra	4.23	4.92	5.01	3.50	0.73	2.4	
Meham	11.11	8.42	4.98	4.11	7.00	23.3	
Rohtak	3.15	3.74	3.89	2.85	0.30	1.0	
Sampla	2.52	4.56	4.53	3.05	-0.53*	-1.8*	
Rohtak district	5.34	5.51	4.60	3.27	2.07	6.9	

\* -ve sign reflects decline in water table

## 6 Water Requirement/ Demand

### 6.1 Water Supply and Gap

In the previous sections, it is made evident that Rohtak is one of the fastest evolving Districts of the State inevitably accompanied by an increasing water demand. In the past few decades' population of Rohtak has steadily increased manifold which has directly impacted the infrastructure of the Rohtak.

Apart from the supply of water from this canal, the main water source is groundwater. However, the increase in freshwater demand has led to the over exploitation of groundwater. The over exploitation of available freshwater resources, and the lack of implementation of a contingency plan to meet the projected growing water demands, is concerning. The following table shows the net water draft (consumption) according to each of the block of the Rohtak is given in the following **Table 13**.

**Table 13 Groundwater Demand Block wise for domestic and agricultural use in the District of Rohtak**

Block	Annual Draft of Ground Water Resources	
	Domestic	Irrigation
Kalanaur	4.10	187
LakhanMajra	1.91	113.5
Maham	5.65	272
Rohtak	29.81	347
Sampla	4.29	137.5
Total	<b>45.76</b>	<b>1057</b>

Currently due to the rapid infrastructure development, and introduction of schemes such as JalJeevan Mission, availability of freshwater has been made available. The total number of households with tap water connection stood at 16.87% in August 2019, which has increased to 38.09% till date as reported by the Ministry of Jal Shakti. With the advent of freshwater availability, the wastewater generated would also be increased. However, in rural and peri urban areas, the problem of discharging wastewater without prior treatment is prevalent.

As access to the piped water supply became more prevalent, these life-giving waterbodies started to become neglected. According the District Revenue Records of Rohtak, the water bodies have reduced from a total of 641 in 1956 to 487 in 1976 to only 123 remaining in the year of 2018. The water bodies that do remain have severely been polluted.

The wastewater generated out of the local community usually is leads to water pollution of surface waters, with unregulated release of polluted effluents with high concentrations of toxic constituents. The eventual percolation of these toxic surface waters to ground water, have shown a very high potential of contributing to the pollution of already depleting ground water table.

While several laws and acts have been passed post-independence regarding the abatement of unregulated pollution activities, much remains to be done in order for better enforcement of these regulations on ground in order to gain control of India's water ways.

## 6.2 Water Budget

### 1. Water Budget (MCM)

**Table 14 Block wise water budget**

Block	Previous Year/Average Annual Demand	Demand for Present Water Year	Previous Year/Average Annual Supply				Previous Year/Average Annual Waster Water	Previous Year/Average Annual Consumptive Use
			Rain Water	Surface Water	Ground Water	Total Supply		
<b>Rohtak</b>	357750	357750	0	0	357750	357750	17888	3,57,750
<b>Meham</b>	262350	262350	0	0	262350	262350	13118	2,62,350
<b>Kalanpur</b>	119250	119250	0	0	119250	119250	5963	1,19,250
<b>Sampla</b>	5425875	5425875	0	0	5425875	5425875	271294	54,25,875
<b>Lakhan Majra</b>	5270850	5270850	0	0	5270850	5270850	263543	52,70,850

## 2. Domestic Water Demand

**Table 15 Expected estimation of domestic water demand till year 2022**

<b>Block</b>	<b>Present water demand (MLD) 2021</b>	<b>Expected water demand in 2022 (MLD)</b>
<b>Kalanaur</b>	3.82	4.10
<b>LakhanMajra</b>	1.78	1.91
<b>Maham</b>	5.26	5.65
<b>Rohtak</b>	27.76	29.81
<b>Sampla</b>	4.00	4.29

**Table no 14** and **Table 15** depict the block wise domestic water demand and block wise water budget in Rohtak district.

## 7 Strategies for Water Conservation

The ground water availability in Rohtak is limited and presently being over exploited results in decline of ground water levels. Due to heavy urbanization and industrialization, most of the storm runoff goes to the sewer or storm drains and reduces the recharge contribution from rainfall. The over exploitation of this vital resource along with the ground water pollution may lead to adverse environmental impact. Thus there is an urgent need for protection of this vital resource by adopting the following measures.

1. In order to arrest the declining trend of water levels in the district, the rooftop rainwater harvesting technology should be adopted and recharge structures may also be constructed in depression areas where water gets accumulated during rainy season. This will help in enhancing the recharge to ground water reservoir.
2. The crops consuming less quantity of water may be grown in place of crops requiring more water in the over exploited block
3. The abandoned dug wells may be cleaned and should be used for recharging the ground water by utilizing the surface monsoon runoff.

4. The water level monitoring network needs to be increased in the block.
5. The contribution of surface water to irrigation in the district is very less. Measures should be made to increase the canal water supply for irrigation and also for drinking purposes.
6. Local populaces to be educate regarding consequences of mining of ground water and need for its effective and economic use.
7. Roof top rain water harvesting for factories institutional buildings, housing complexes and other big buildings has been made mandatory to augment the ground water recharge and may be included in building laws. The law should be strictly implemented.
8. Water harvesting and artificial recharge structures should be constructed in Delhi ridge area, which is one of the major recharge zones for Rohtak. The run off should be diverted to abandoned mining pits. Small check dams can be constructed in hilly areas to recharge/ utilize surplus run off.
9. The industrial effluents causing ground water pollution should be treated before discharge so as to curb ground water pollution.
10. Strict regulatory measures are required for ground water pumpage, particularly for industrial use. Water meter should be fitted on every tube well and be allowed to withdraw fixed quantity of ground water.
11. Industries should be persuaded to recycle the effluents to minimize consumption of water.
12. Construction of new tube wells by individuals for domestic purpose should be regulated.
13. The municipal sewage should be treated properly to avoid ground water contamination. The same may be utilized for horticulture and other industrial uses, thus reducing the pressure on ground water.
14. Periodic monitoring of chemical quality should be carried out, particularly with reference to heavy metals, fertilizers, nitrates etc,
15. Some areas of north- western portions of Rohtak block is underlain by shallow ground water level where quality is also poor i.e. saline. Such areas should be de- notified.
16. Strict regulatory measures are required for ground water pumpage, particularly for construction and infrastructural development purposes.
17. As per state govt. record, In and around Rohtak city, there are 47 no. of ponds whose area ranges from 2 acre to 8 acre. These ponds which are either dried up or filled with municipal waste and

garbage needs repair, renovation and restoration which will help to augment ground water resources by natural recharge.

18. There are 7 no. of natural drain along the foothill of Aravalli range in Rohtak town which can be utilized for rain water harvesting and artificial recharge to ground water.

19. More artificial recharge structures should be constructed in Udyog Vihar area and peripheral areas by factories, NGO and state government department where water level is declining at fast rate.

Understanding the climatic water crises that India could potentially face, the Jal Shakti Abhiyan was launched as a dedicated mission by the Hon'ble Prime Minister of India, in order to ensure that the maximum amount of water was being conserved, treated and reused. While all of the schemes introduced under the campaign are not applicable to the water conservation efforts for the District, the notable suggestions of authorities and research institutions have been mentioned in this chapter. This will thus serve as a strategic framework for which water conservation structures are to be made.

## **7.1 Artificial Recharge**

The scope for increasing the depleting groundwater tables all across the District remains to be tremendous. In fact, as elaborated in Chapter 1, the sand type in the District is loamy in majority and therefore allows a higher percolation rate of water. In such cases, water retention structures will be crucial in these areas, such as the development of check dams and trenches. Given the decreasing trend of rainfall received in Rohtak, as discussed in Chapter 1, it is further imperative to put in measures that can The District has the target of implementing the following measures and construction of both infrastructural and non-infrastructural methods to increase the artificial recharge rates.

In fact in order to encourage WSUD element design, major building certification and by laws, including the Haryana Building Code of 2016, has made it mandatory for the construction and presence of rainwater harvesting structures in any property of above 500 m<sup>2</sup> and has recommended it for any property above 100 m<sup>2</sup> to have a recharge structure on the premises.

## **7.2 Water Sensitive Urban Design**

As more and more portions of the District becomes urbanized, it is crucial to integrate water sensitive urban design into planning of the major upcoming clusters of towns and cities that are in the satellite of the main city of Rohtak. Water Sensitive Urban Design (WSUD) is a familiar concept for engineers and architects practicing and designing in the face of overwhelming environmental changes brought in by climate change. A major part of WSUD also allows us as a society to grow more resilient towards

more intensive changes in rainfall patterns, as they grow more intensive, however more scarce in terms of frequency. The methods of water table recharge strategies in urban area are shown in **Table no 16**.

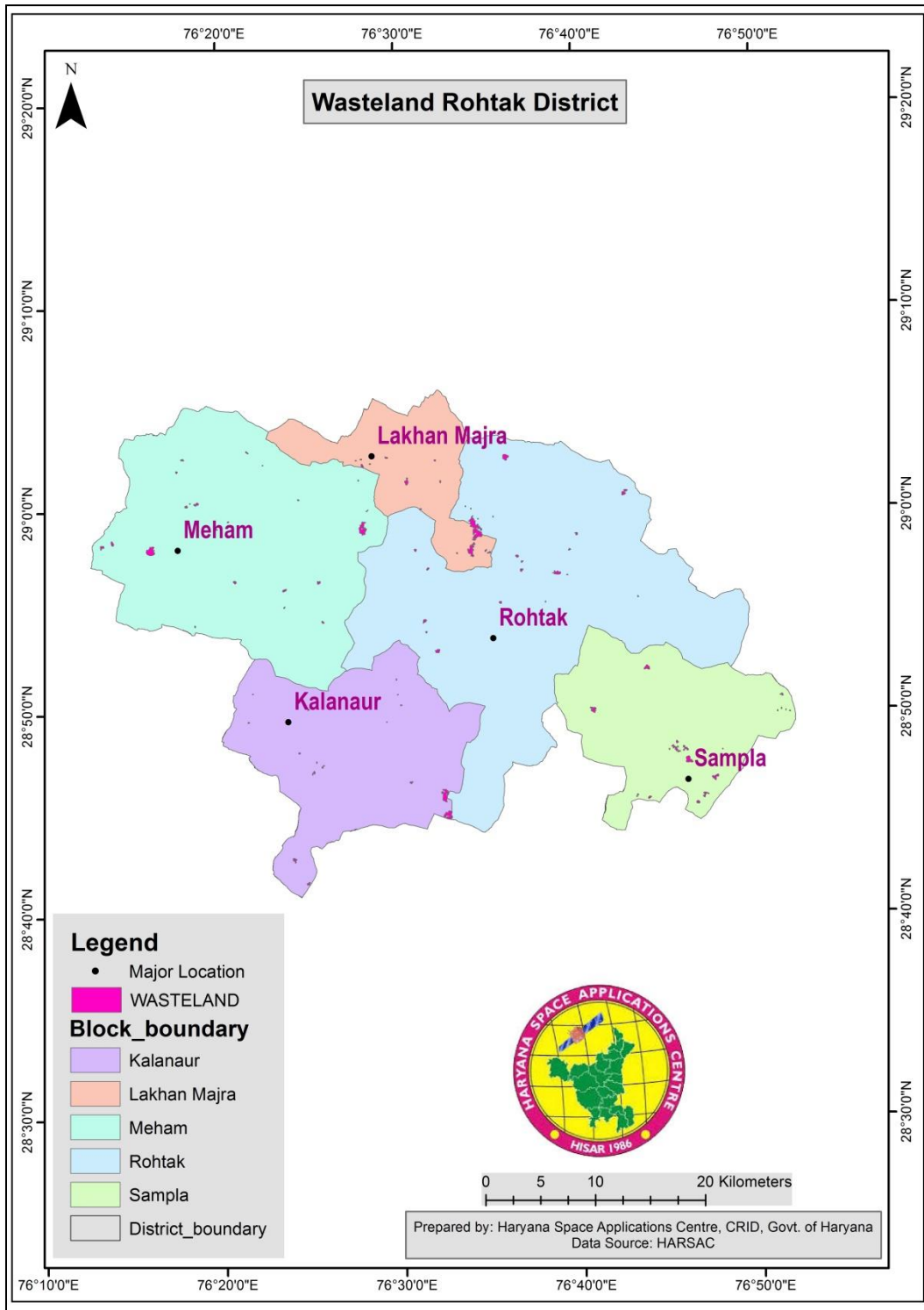
**Table 16 The methods of water table recharge strategies in urban area**

Sr. No.	Method	Image
1	Flow Through Planters	
2	Pervious Strips	
3	Pervious Pavement	

4	Storm water Tree	
---	------------------	--

### 7.3 Plantation

A major portion of WSUD that is popular within the Government Departments is plantation of various species of plants, both in public and private spaces, to encourage community participation and increase green cover. While increasing the aesthetic value of a location, plants are heavily influential to change microclimates and in fact playing a factor to rainfall patterns. Along with benefits of carbon sequestration, they contribute to increasing the local biodiversity of the region by attracting several types of fauna as well. Currently a multi-departmental approach within Rohtak is being undertaken both within and outside of government with the engagement of several active citizen stakeholders and non-governmental organizations. Geo-tagging of these plantations and survival monitoring would be undertaken actively by engagement of the mentioned stakeholders. Although there is large amount of land is in wasteland form that could be used for plantation. The wasteland that could be used for plantation for conservation of water in Rohtak district is shown in **Figure 16** and **Table 17** shows the proposed no of plantation targets in Rohtak District.



**Figure 16 Wasteland Map of Rohtak District**

**Table 17 The proposed targets for plantation in Rohtak District**

<b>Block Name</b>	<b>Wasteland Area (acre)</b>	<b>Plantation at 5 feet spacing</b>
<b>Kalanaur</b>	250.53	2182673
<b>LakhanMajra</b>	284.31	2476980
<b>Maham</b>	4834.49	42118059
<b>Rohtak</b>	360.93	3144477
<b>Sampla</b>	282.28	2459271

## **7.4 Surface water management**

### **7.4.1 Pond restoration and rejuvenation**

As earlier mentioned, in Chapter II, the number of surface water bodies such as ponds and lakes are continuously disappearing from the landscape. However, their preservation, restoration and rejuvenation would be essential to not only survival of biodiversity, but also to maintain microclimates, and ultimately essential to preserve human civilization.

Research also shows that that storage of water within a single pond structure contributed to a range of 26,000 to 62,000 m<sup>3</sup> to groundwater recharge over a year, that was equivalent to 1.3 to 3.6% of the total water recharge volumes in the study carried out in Ramganga Basin, India, which would serve to irrigate lands of 8 to 18 hectares of land cropped in the rabi season. As such ponds demonstratively serve as an essential structure for water security. Although it serves to only hold a relatively small volume of water, the stored water becomes vital for food security and economic stability within a small community.

Ponds are also essential structures that provide water security in areas where groundwater has grown extremely saline and cannot be used for irrigation purposes. Irrigation channels have been built in such areas during the Green Revolution in these areas in order to meet irrigation demands in this region. However, in order to supply to the increasing demands of high yield production, a lot of pressure has been put on the agriculture industry, as a result of which freshwater demand has increased. The original channels are therefore not sufficient to meet the current water demands. Without accesses to enough water, structures such as ponds become of essential service to allow for agriculture to be sustained in areas of water scarcity.

These traditional water bodies are what saved drought hit villages from the brink of extinction and starvation in the great spell of droughts that the nation faced in the 1970's. Examples led by pioneers

such as Anna Hazare and P R Mishra who revolutionized and reinstated the importance of having water storage and wise utilization for increasing crop yield have served as models for reviving these traditional lifelines within the rural eco-system, while setting important benchmarks for its urban counterparts. Culturally, due to its life-sustaining properties, ponds have also been the centres or natural hubs for monthly or annual fairs to be held, and have been biodiversity hotspots that encourage the link between human and wildlife.

Therefore ponds form a fundamental part of the hydrological cycle in the environment and has allowed a rich cultural, agricultural and societal practices to flourish in India Since ponds can be formed in a much broader range of environments and landscapes, they demonstrate a wide range of physiochemical activities that allows a wide range of flora and fauna to flourish. However the ground reality suggests that there are a lot of unmapped points of discharge of wastewater that pollute the local waterbodies. These localized incidents of pollution of water bodies contribute to the loss of biodiversity and pose a threat to water security. In the recent years, it has been realized that wastewater may be an essential commodity and tool that may be used to close the demand supply gap and augment freshwater supply.

In order for pond restoration and rejuvenation to be done in a scientific and methodical manner, following 11 step procedures that is accommodative of each individual pond site requirements is given below

1. Pond Identification and Pond profiling
2. Project Feasibility Assessment
3. Administrative Approvals (Demarcation, GIS mapping, and Panchayat Resolution)
4. Detailed Project Report
5. Financial Approval
6. Community Mobilization
7. Cleaning and Levelling
8. Civil Work, Micro-STP Installation and Waste Management
9. Landscaping and Beautification
10. Sustainability Plan (O & M)

## 11. Monitoring and Evaluation

While the above methodology has been described in a step wise fashion, the cycle of pond rejuvenation and restoration functions on a feedback system and therefore inputs from each step can be integrated into steps proceeding and after as well.

### 7.4.2 Decentralize Treatment Plant

It is recognized that in the absence of 100% sewerage network connectivity just managing the gray water component would be an incomplete solution. In the rapidly urbanizing cities of developing countries, decentralized wastewater treatment systems are an attractive solution for addressing the problems of water pollution and scarcity.

Decentralized wastewater treatment consists of a variety of approaches for collection, treatment, and dispersal/reuse of wastewater for individual dwellings, industrial or institutional facilities, clusters of homes or businesses, and entire communities. An evaluation of site-specific conditions is performed to determine the appropriate type of treatment system for each location. These systems are a part of permanent infrastructure and can be managed as stand-alone facilities or be integrated with centralized sewage treatment systems. They provide a range of treatment options from simple, passive treatment with soil dispersal, commonly referred to as septic or onsite systems, to more complex and mechanized approaches such as advanced treatment units that collect and treat waste from multiple buildings and discharge to either surface waters or the soil.

Decentralized wastewater treatment systems could be a feasible alternative for areas which are not connected to sewer networks as well as ones which are newly developed, so that the construction of their infrastructure is inadequate, not ready or would be executed in the future. Therefore, for local communities in the peripheries of urban development that exist outside the city center and rural areas where open drainage systems still exist. Over the past three decades, the city limits of Rohtak city have been continuously growing as evidenced by the satellite images of increasing urban infrastructure.

However, planning for sewage infrastructure and pipelines are a long term investment, with the advent of exponential population increase also has been a challenge. Instead, decentralized wastewater management approach can be considered as a sustainable and cost-effective alternative as it treats discharges or reuses the effluent in the relative vicinity of its source of generation. Therefore, decentralization of wastewater treatment facilities are a feasible solution that may allow for localized

treatment which may eventually be reused for secondary purposes. Like other systems, decentralized systems must be properly designed, maintained, and operated to provide optimum benefits.

The following table (**Table 16**) shows a list of generic conditions that are most often found in Rohtak according to the type of treatment considerations and other main constraints such as land availability and population, given that finances are a constant.

**Table 18 Indicators and factors to decide the type of decentralized treatment required**

Type of Effluent Received	Land Availability	Number of people	Type of Treatment Required
Grey and Black Water Effluent	Yes	<5000 people	Natural Based Technology
Grey + Black Water Effluent	Yes	>5000 people	Hybrid Technology
Grey and Black Water Effluent	No	>5000 people	Mechanized
Black Water	Yes	<5000 people	Hybrid
Black Water	No	>5000 people	Mechanized FSTP for a cluster

Currently, the District has the following target for activities related to Pond Restoration and Rejuvenation (**Table 18**).

### 7.3 Information Education and Communication

Through open exchange of information, education and communication established between the community and the implementing agency, ownership of the projects and interventions is reinstated; from inception to implementation and beyond. Selected committee members that form groups such as self-help groups, youth groups are in fact chosen to carry out regular capacity building of the community at large, with special attention paid to children, women and those belonging most vulnerable groups are carried out. Knowledge exchange and capacity building are at the core of IEC activities. The following image shows the various stakeholders involved in IEC Activities (**Figure 17**) and **Table 19** shows the numerous activities and interventions that can be carried out for IEC.

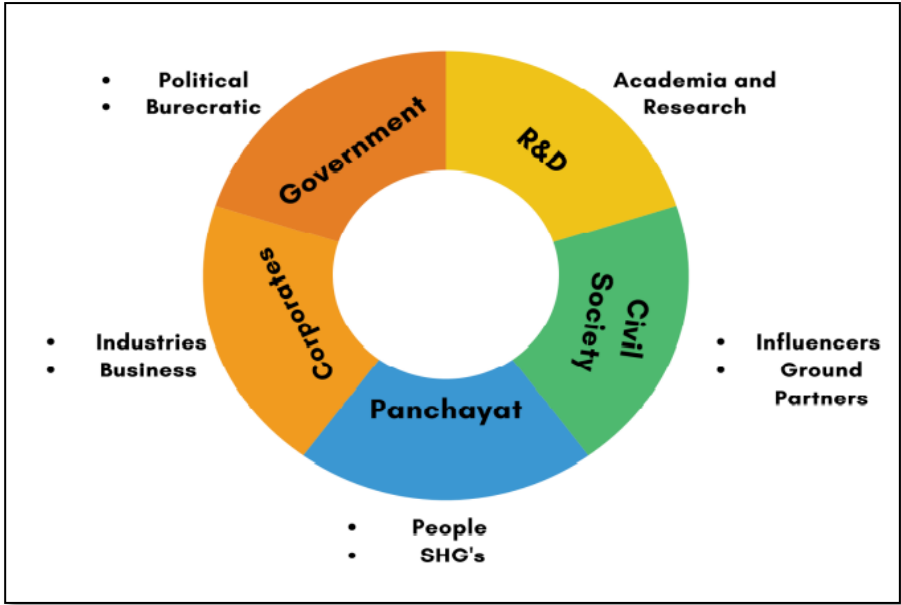


Figure 17 The various stakeholders of IEC Activities

Table 19 The numerous activities and interventions that can be carried out for IEC

S. No.	IEC	Intervention / Topic	Target Group	Objective	Collaterals	Outcome/ Result
1	Webinars	- Role of RWA, Schools and Citizen in Rain water harvesting - How to Harness and Harvest Rain	- RWA(through MCG) - Schools (3rd party) - Corporates(3rd Party)	- To Engage Local People in Rain water Harvesting - To make them aware of the facts and rules of RWH	Letter from which dept. Letter to Mayor and Commissioner for inviting for webinar	- Knowledge about Rain water harvesting - Respective roles and duties towards RWH
2	Capacity Building Sessions	- Technical Training sessions - Awareness Training Sessions - Workshops	- MCG Workers - MCM Workers	- Training of ground worker of MCG - Implementation Work	Presentation Retrofitting Checking list Repair and Cleaning List	1. The workers will clean and repair the RWH post training - Training on Real time Problems - Generate Employment Opportunities
3	Competitions in RWA's (Same type of Settlements)	- Water Man agent and Conservation	- RWA	-To save water - To bring the best practices through RWA	- Competition brief with parameters	- To recognise and reward the best RWA - Lead by by Example
4	Formation of Clubs	-how do we know about good vendor? - how do we identify places for RWH - How do we build RWH?	RWA	To make water representative from every RWA	Check list of water auditing for the water representative	1. do the meetings with respective water representative from every RWA. -Team building for the Society
5	Guidelines	- Guidelines for All the drops of the Society	- RWA - govt institutions - Schools - Corporates	Information Flow	- guidelines and poster	- Information and Awareness on Water

		regarding Rain water harvesting and its maintenance	- Rural Public buildings			conservation and Rules
6	Information Boards	- Water awareness (Ponds, RWH, Plantation)	- Schools - Public Institutes Open Spaces Roads -	- To change the perspective of people	Location, Capacity, Design OF RWH, information board	Awareness , mobilise citizens - Information about the RWH in Their vicinity
7	Rain Centre	- Any Problems related to water	- All the Citizens	To Resolve the issue related to RWH	FAQ (Technical)	Acts as Point of Contact for all the queries in Water Management
8	Social Media	- All the updates of the Events and posts	- All the Citizens	- Digital marketing - Awareness	FAQ TYPES Best Practices Video clips of Officers and celebrities	Awareness , mobilise citizens
9	Recognitions/Awards	- Rain water Harvesting - Best Practises - Best RWA in Water management	- RWA - In Panchayats - NGO - Schools - Corporates - Active Citizens	to recognise best practices	-Parameters list for best practices	To encourage more practices and people - Increase interest and motivation for the end users
10	Video Clips and Interviews	- Individual water Conservation steps - Best Water Management Practices	- RWA - In Panchayats - NGO - Schools - Corporates - Celebs	Digital marketing - Awareness - virtual presence	- letters for the celebs, script.	To recognise people, encourage more
11	Working Models	- Rain water Harvesting Models - GuruJal Pond Sites	- Schools	To aquire more prototypes for District Administration	- Proper Guidelines	Showcasing Children work in Administration

12	Plantation Drives	- Awareness on Plantation drives	- Urban (RWA, MCG, MC ) - Rural (Pond Sites) - Schools -NGO's - NYK - District Youth Affairs and Sports	-To increase the green Cover To increase the water holding Capacity  To involve stakeholders to facilitate sessions	- Plant List Nursery Database - Distribution Chain Management Posters  - Letter of Collaboration -Google form	Better environment for Future Generations  - No Overlapping of the work or activities - More effectiveness in Catch the rain Campaign
13	Collaborations	- For IEC	-Kalagram -NGO's -Durga Shakthi -Civil Defence -Lion Club			

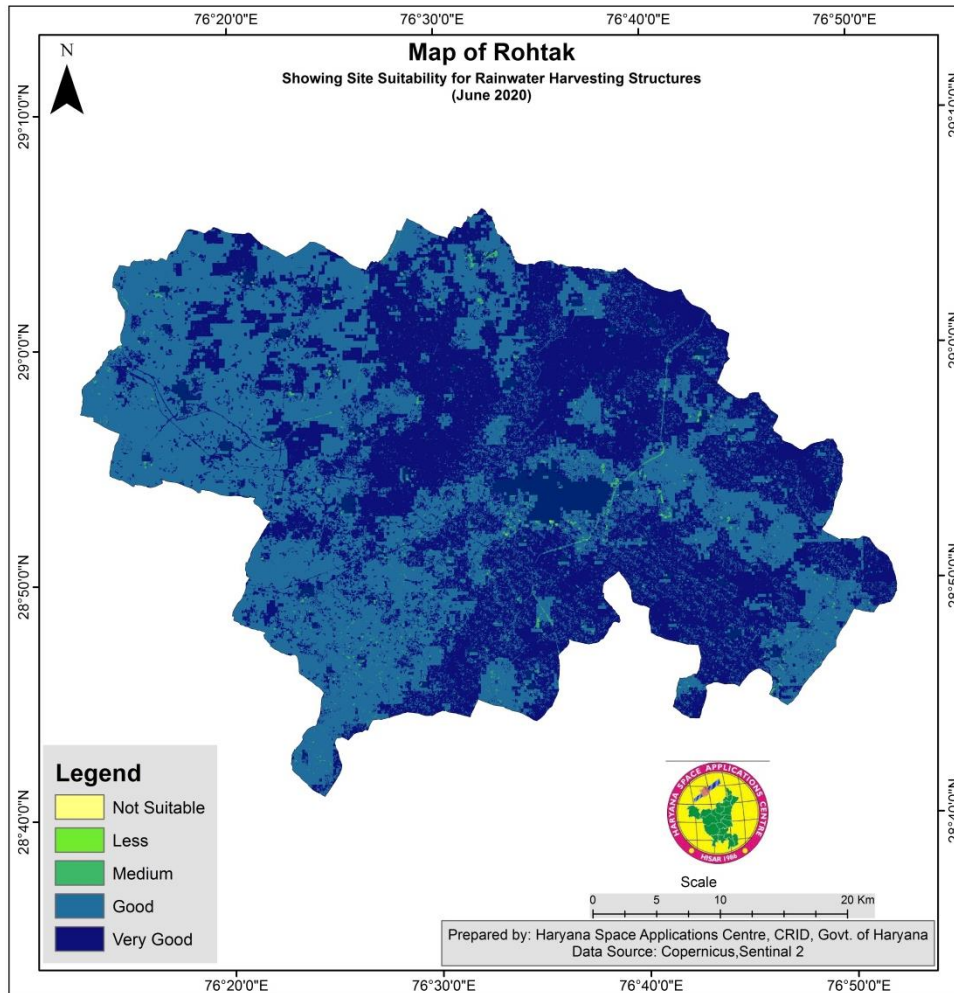
## 8 Proposed Activity

### 8.1 Rainwater harvesting

Rain water harvesting primarily consists of the collection and storage of rainwater for subsequent use as source of water. The harvested water can be used for both potable and non-potable applications. There are many examples of rainwater harvesting systems which provide water for domestic, commercial, institutional and industrial purposes as well as agriculture, livestock, groundwater recharge, flood control, process water and as an emergency supply for firefighting. There are different criteria and techniques to select suitable sites for harvesting rainwater. In recent years, the analytical hierarchy process (AHP) and multi-influencing factors (MIF) are most widely used model for identification of rainwater harvesting sites. The AHP technique determines the weights of thematic layers and their rank to process identify the zones of rainwater harvesting sites. MIF analysis is an effective tool for water management because it is comparatively simple and reliable.

There are some factors that affect the rainfall water harvesting which needs to be focused for the development of suitable sites of water harvesting. These factors include rainfall, slope, soil texture, drainage, topography and land use / land cover and integration of these factors using weighted overlay analysis that results in suitable sites for rainwater harvesting. These sites are then classified into various suitability levels, namely, not suitable, less, medium, good and very good. The most suitable

sites for rainfall water harvesting are shown in map (Figure 18). The block wise area proposed for rainwater harvesting under most suitable sites is shown in Table 20. For the process of calculating suitable site a fixed weightage is needed to be applies on the above mentioned criteria (Table 21).



**Figure 18 Proposed Site Suitable Map for rain water harvesting**

**Table 20 Block wise area under very good suitable site proposed for rain water harvesting**

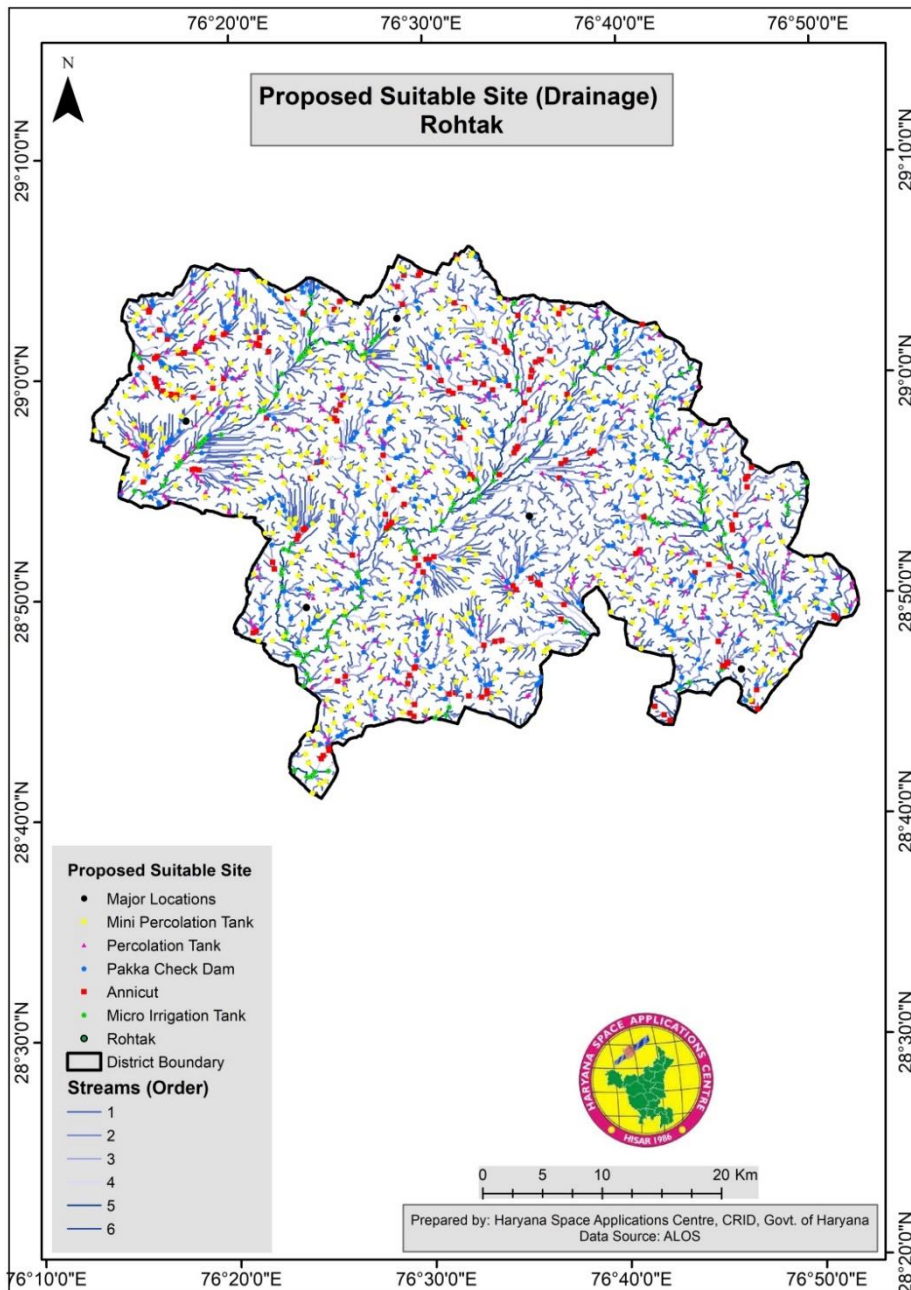
<b>Block Name</b>	<b>Area (Very Good suitability area in Sq meter )</b>
<b>Kalanaur</b>	285033880
<b>LakhanMajra</b>	124913951
<b>Maham</b>	447157414
<b>Rohtak</b>	583410682
<b>Sampla</b>	223823872

**Table 21 Assigned Weight for Criteria Parameters**

<b>Parameters</b>	<b>Weightage</b>
Rainfall	35
Slope	25
Drainage Density	5
Soil Texture	20
Lulc	15

## **8.2 Proposed Suitable Site based on Drainage**

The drainages that are created from satellite imagery can be used as base for the water harvesting structure (**Figure 19**).



**Figure 19 Proposed suitable sites based on drainage in Rohtak District**

Stream order system is a simple method of classifying stream segments based on the number of tributaries upstream. So, based on the order of streams we can propose the suitable sites for water harvesting structures. A general idea says that Mini percolation Tanks on 1<sup>st</sup> order Stream, percolation Tanks on 2<sup>nd</sup> Order Stream, pakka check Dams on 3<sup>rd</sup> Order Stream, Annicut on 4<sup>th</sup> order, Micro

Irrigation tanks 5<sup>th</sup> Order can be build. **Figure 19** shows the proposed suitable sites based on drainage structure in Rohtak district. Proposed harvesting structures in Rohtak based on drainage **Table 22**.

**Table 22 Proposed harvesting structures in Rohtak based on drainage**

Sl. No.	Block Name	Mini percolation Tank	Percolation Tank	Pakka Check Dam	Annicut	Micro Irrigation Tank
1	<b>Kalanaur</b>	82	42	60	30	42
2	<b>LakhanM ajra</b>	40	15	30	15	4
3	<b>Maham</b>	144	114	99	59	44
4	<b>Rohtak</b>	188	66	119	59	53
5	<b>Sampla</b>	55	44	47	22	22

## 9 Conclusion

Due to rapid urbanization, the Rohtak has seen problems related to water resources. There is water scarcity in lean season and waterlogging in monsoon season. Water logging over roads due to insufficient/unmanaged drains is the major problem. Current scientific report includes required information for the water harvesting where it is excess especially during monsoon/rainy season. The current water infrastructure information related to ponds/waterbodies, canals, natural drains, and drains based on slope is helpful in taking decisions on the construction of new structures for water harvesting.

# “Jal Shakti Abhiyan: Catch The Rain”



**WATER CONSERVATION  
AND RAIN WATER HARVESTING**

**RENOVATION OF  
TRADITIONAL WATER BODIES**

**REUSE AND RECHARGE  
STRUCTURES**

**WATERSHED DEVELOPMENT**

**INTENSIVE AFFORESTATION**

**ENUMERATION OF WATER  
BODIES**

**TRAINING / AWARENESS  
PROGRAMS BY KVK**

**Catch The Rain**  
**Where it falls, When it falls**

