Report No.-13

JSA-CTR

Scientific Action Plan for Mahendragarh

Prepared By-

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1 Introduction

1.1 History

The city of Mahendragarh was formerly known as Kanoud because of Kanauadia populated by Brahmins. It is said that Malik Mahadud Khan, a servant of Babar had settled. In the seventeenth century, Maratha ruler Tanti Tope built a fort here. In 1861, ruler Maharaja Narendra Singh of Patiala principality had named this fort in Mahendergarh in honor of his son Mohinder Singh. Because of the name of the fort, this town came to be known as Mahendragarh and the name of Narnaul Nizam was changed to Mahendragarh Nizam.

In 1948, with the formation of PEPSU Mahendragarh territory from Patiala State, Dadri territory (Now Charkhi Dadri) from Jind and Bawal territory from Nabha State were constituted into Mahendragarh district with the headquarters at Narnaul. At that time, there were three tehsils, namely; Narnaul, Charkhi Dadri and Bawal and Mahendragarh was a sub-tehsil. In 1949, Mahendragarh sub-tehsil was made a tehsil. In 1950, Bawal tehsil was broken up and 78 villages were transferred to Gurgaon district forming Bawal as a sub-tehsil and remaining villages were added to Narnaul and Mahendragarh.

In 1956 the Rewari tehsil (except 61 villages) was excluded from Gurgaon district and included in Mahendragarh district. The Charkhi-Dadri sub- division was excluded from Mahendragarh district and included in the newly constituted district of Bhiwani. In 1977, 81 villages of Rewari tehsil were constituted into Bawal tehsil. In 1978 the district comprised 4 tehsils (Mahendragarh, Rewari, Narnaul and Bawal).

Rewari and Bawal tehsils (taken from Mahendragarh district) and Kosli tehsil except 10 villages (taken from Rohtak district) were constituted into a new district of Rewari as on 1st November, 1989. Presently district has 3 sub-divisions (Narnaul, Mahendragarh and Kanina), 5 tehsils (1. Narnaul, 2. Mahendragarh, 3. Nangal Chaudhary, 4. Ateli, 5. Kanina) and 1 sub-tehsil (Satnali)

1.2 Location

Mahendergarh district is situated at the extreme end of the south-west end of Haryana state. Its west-south borders and a large part of the eastern boundary touching the boundary of Rajasthan state and the rest of the eastern boundary touching the boundary of district Rewari and northern part touches the Bhiwani district of Haryana. The total area of this district is 1899 square kilometers. In this, the total area of Narnaul sub-division is 922.34 square kilometers and the total area of Mahendergarh and Kanina sub-division is 976.66 square kilometers. The number of villages in Mahendergarh district is 374. Agriculture is the major source of district economy. The area of Mahendergarh district is dry due

to its sandy and mountainous areas and has very less rainfall during the year. The growth of agriculture in the district mainly have to depend over rainfall, which can be increased by adopting proper water management and expansion of net sown area under dry land horticultural crops and vegetable along with drip irrigation system. Wheat, Bajra, mustard, Gram and cotton crops are major crops of the district.

Mahendragarh district lies between 27 ° 47 ' 50" N and 28° 28' 00" N latitude and between 75° 54' 00"E and 76° 22' 11" E longitude. It has a geographical area of 1899.00 square kilometers comprising 1866.02 square kilometers of rural area and 32.98 square kilometers of urban area. Mahendragarh district, located in southern part of the State in north-south elongated shape, makes bulge in Rajasthan State in Southern and South western part of Haryana State. The district makes northern boundary with Bhiwani district, its upper eastern side is bounded by Rewari district. Rest of the district is bounded by Rajasthan State from all the remaining sides. The Location Map of Mahendragarh district is shown in **Figure 1**.

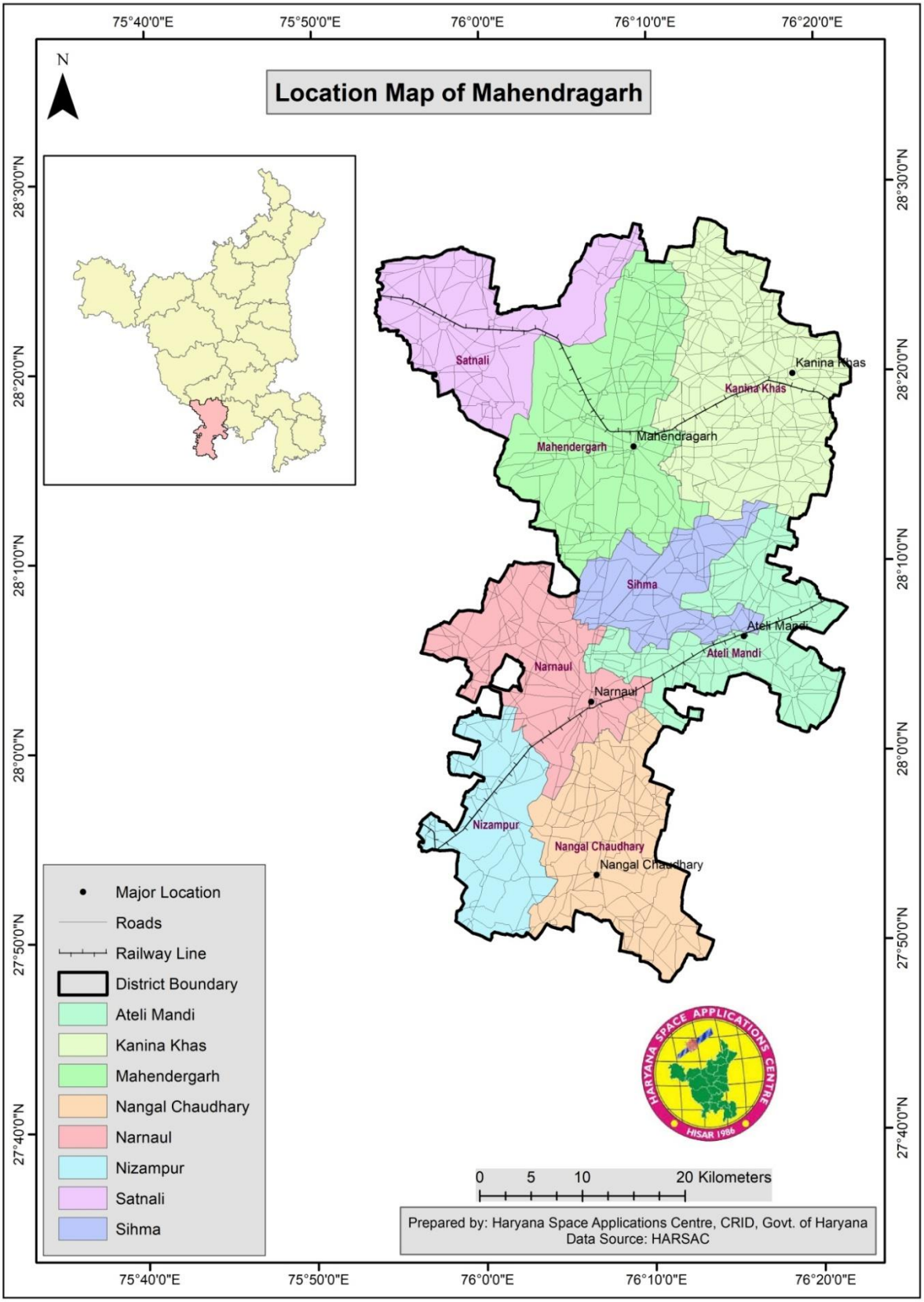


Figure 1 Location Map of Mahendragarh District

1.3 Administrative setup

The administrative setup of the District of Mahendragarh has been described in the following table, with specific sectoral development such as water, animal husbandry, agriculture, roadways is operated under specific departments. The detailed administrative setup is shown in **Table 1**.

Table 1 Major Administrative Jurisdictional Setup of Mahendragarh District.

Country	India
State	Haryana
Division	Gurgaon
Headquarters	Narnaul
Tehsil	1. Narnaul, 2. Mahendragarh, 3. Kanina, 4. Ateli, 5. Nangal Choudhary 6. Satnali
Area	
Total	1,899 km2 (733 sq. mi)
Population (2011)	
Total	1033269
Density	490/km2 (1,300/sq. mi)
Demographics	
Literacy	77.72%
Vidhan Sabha constituencies	Bhiwani-Mahendragarh (4)
Website	https://mahendragarh.gov.in
Location of Mahendragarh	South-west end of Haryana state
Coordinates	27 ° 47 ' 50" N and 28° 28' 00" N latitude and between 75° 54' 00"E and 76° 22' 11" E longitude
Total Area	1,899 km2 (733 sq mi)
Elevation	594 m above mean sea level

Source: https://en.wikipedia.org/wiki/Mahendragarh_district

Sub Divisions	Mahendragarh and Narnaul
Tehsils	1. Narnaul, 2. Mahendragarh ,3. Kanina, 4. Ateli, 5. Nangal Choudhary 6. Satnali

Blocks	Ateli Nangal, Kanina, Mahendragarh, Nangal Chaudhary, Narnaul, Sihma, Nizampur and Satnali
Municipal Corporation	
Municipal Council	
Municipal Committees	Ateli Nangal, Kanina, Mahendragarh, Nangal Chaudhary, Narnaul
Population (Census 2011)	1033269

Source: https://mahendragarh.gov.in/administrative-setup/

Name of District	Name of Block	No. of Villages
Mahendragarh	Ateli Nangal	76
	Kanina	61
	Mahendragarh	91
	Nangal Chaudhary	78
	Narnaul	67

1.4 Climate

The Climate of Mahendragarh District can be classified as tropical, semi-arid and hot, which is mainly dry with very hot summer and cold winter except during monsoon season.

1.4.1 Temperature

Mean maximum and minimum temperature of the district during summer (May-June) is 45°C and 31°C respectively. In case of winter (October-March), mean maximum and minimum temperature remains 22°C and 2°C respectively. During Rainy season (June-Sept), the mean minimum temperature remains 18°C while mean maximum temperature reaches to 29°C.June is the warmest month of the year. The average temperature in June is 35°C. January is the coldest month of the year with average temperature of 8.6°C.

1.4.2 Rainfall

The normal annual rainfall in Mahendragarh is 278.8 mm. On an average rainfall occurs for 26 days in Mahendragarh. Summers are long and arid prohibiting all human activities. With the onset of summer Season temperatures begin to rise rapidly. May and June are the hottest months. The mean

daily maximum temperature in summer is around 40.7°C. The range of temperatures is astonishingly high. On individual days, the day temperature may occasionally exceed 45°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.

Table 2 Block wise average Rain Fall

Sr.No.	Block	Average Rainfall from 2010 to 2019
1	Ateli Nangal	318 mm
2	Kanina	219 mm
3	Mahendragarh	352 mm
4	Nangal Chaudhary	197 mm
5	Narnaul	308 mm

For reference, the past nine years data of annual average rainfall (in mm) that has been presented in the above **table 2**. The rainfall map of Mahendragarh district is shown in **Figure 2**.

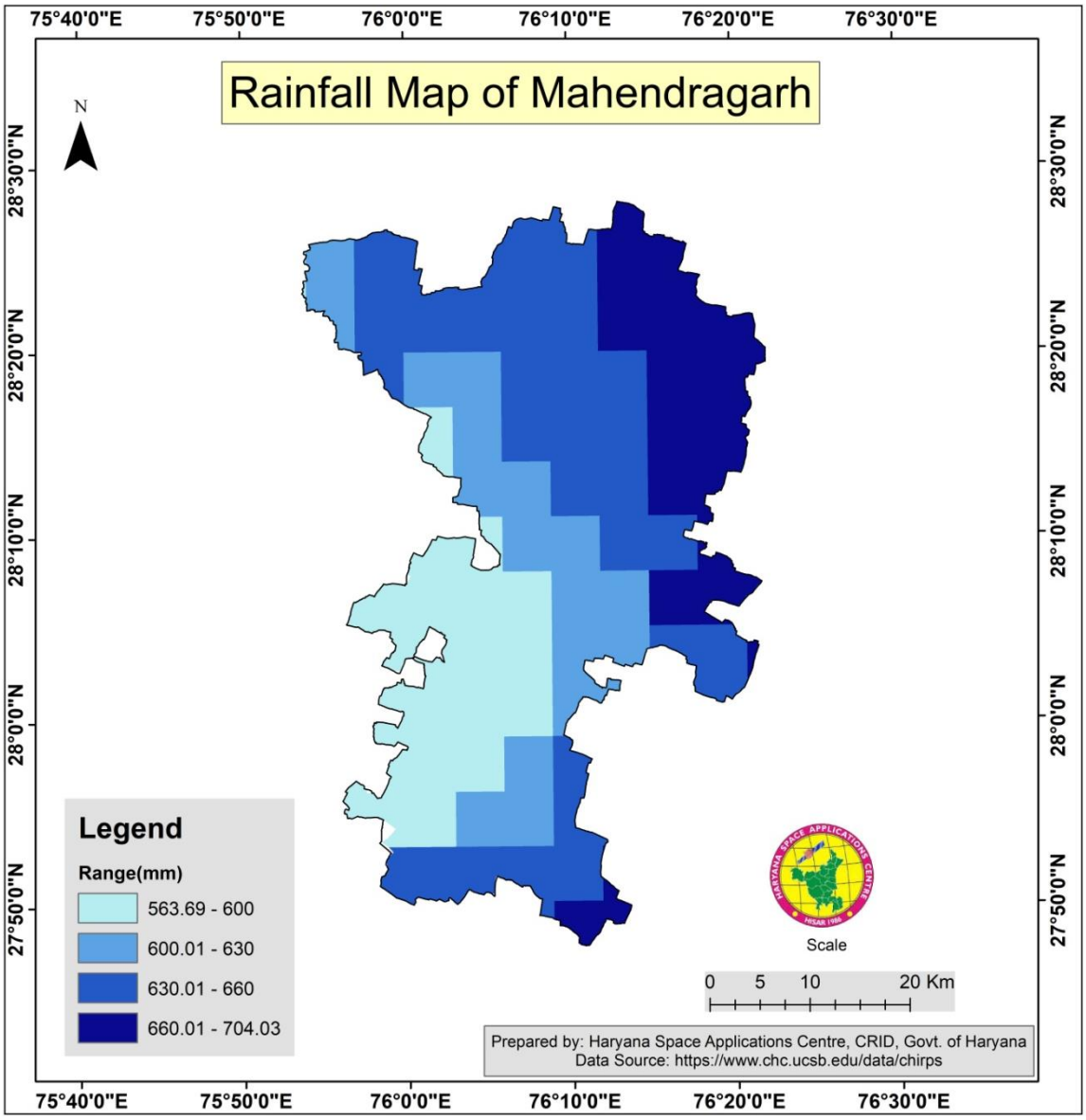


Figure 2 Rainfall Map of Mahendragarh District

1.5 Elevation and Topography

The height above mean sea level of the district ranges from 0 to 594 m (**Figure 3**). The sand dunes attain heights unto 30m but on an average they attain height of about 7m with respect to surrounding. The hill ranges are marked features of the district and are part of great Aravalli chain. The Dhosi hill touches the height of 7090 m amsl. The master slope of the area is north ward. The main streams of the district are Dohan & Krishnawati which flow from south to north. These streams are known to carry copious supply of water to inundate large part of the district during monsoon and remain dry for major part of the year.

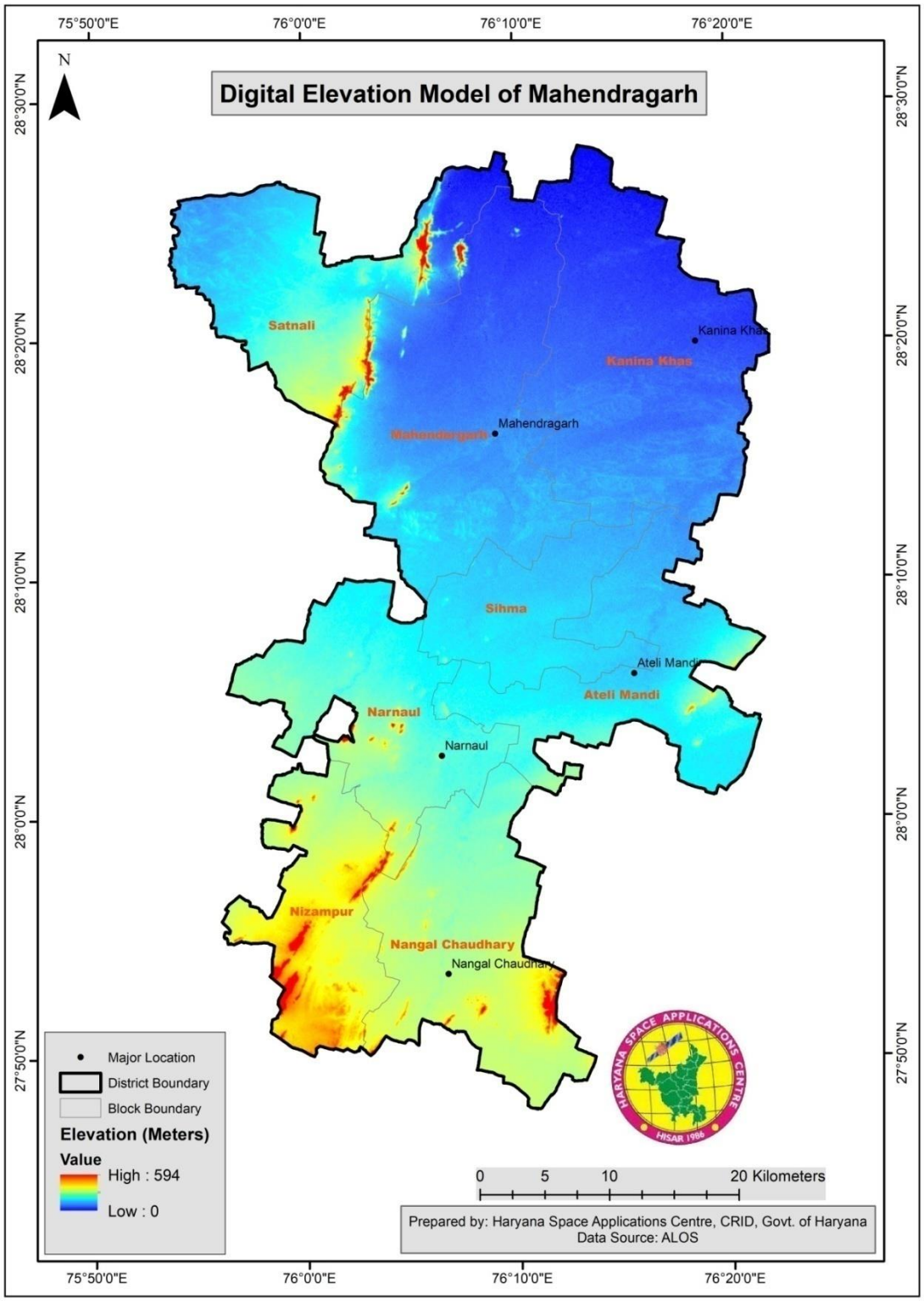


Figure 3 Digital Elevation Model of Mahendragarh District

Slope ranges from flat to >35 degree (**Figure 4**). As per land slope the 54% area classified under 0-3% land slope, 41% area classified under 3-8% land slope and remaining 4% area is classified under

8-25% land slope at places hard rocks are also exposed. Contours of 5 meters interval (**Figure5**) showed similar topography as in digital elevation model.

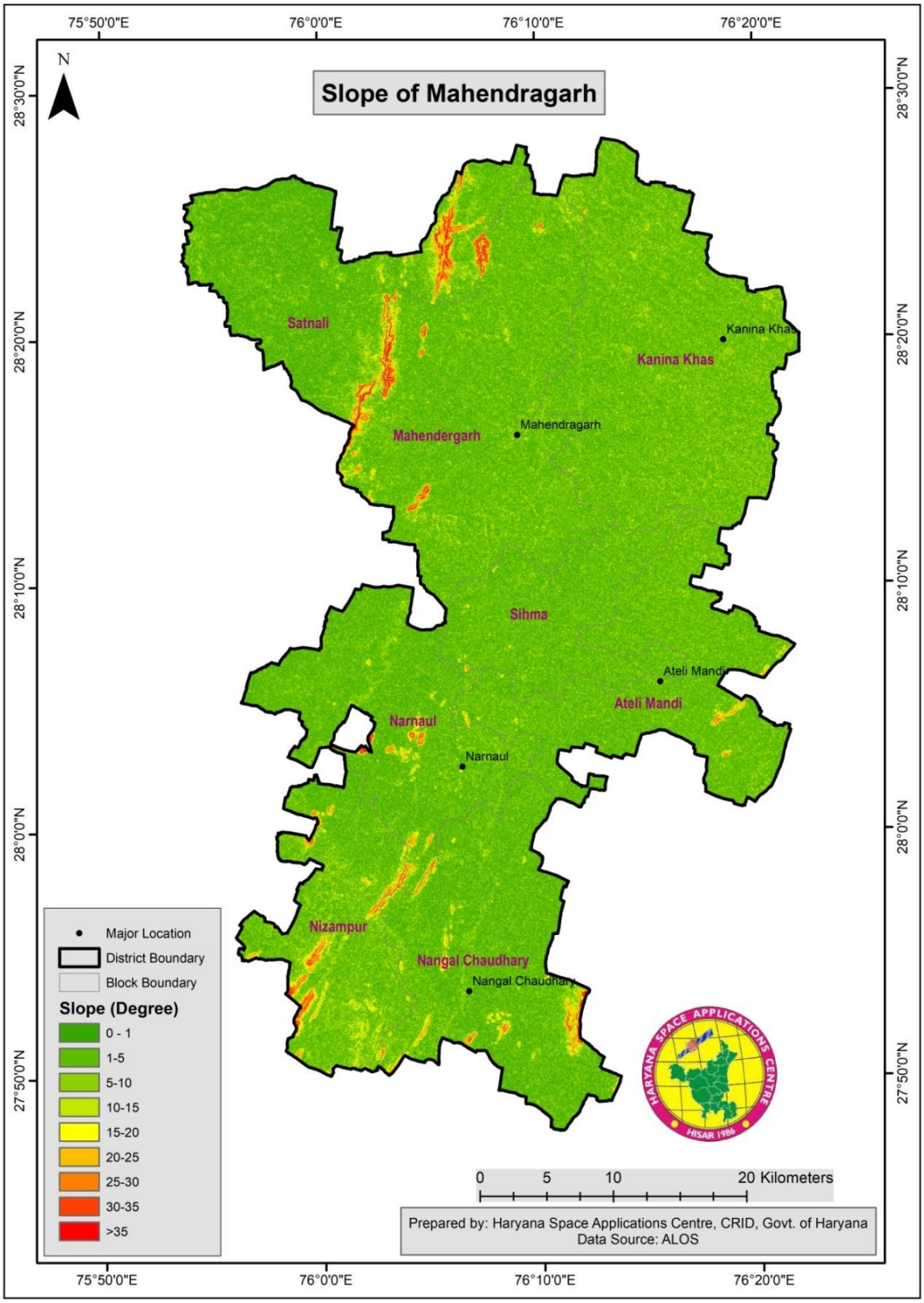


Figure 4 Slope of Mahendragarh District

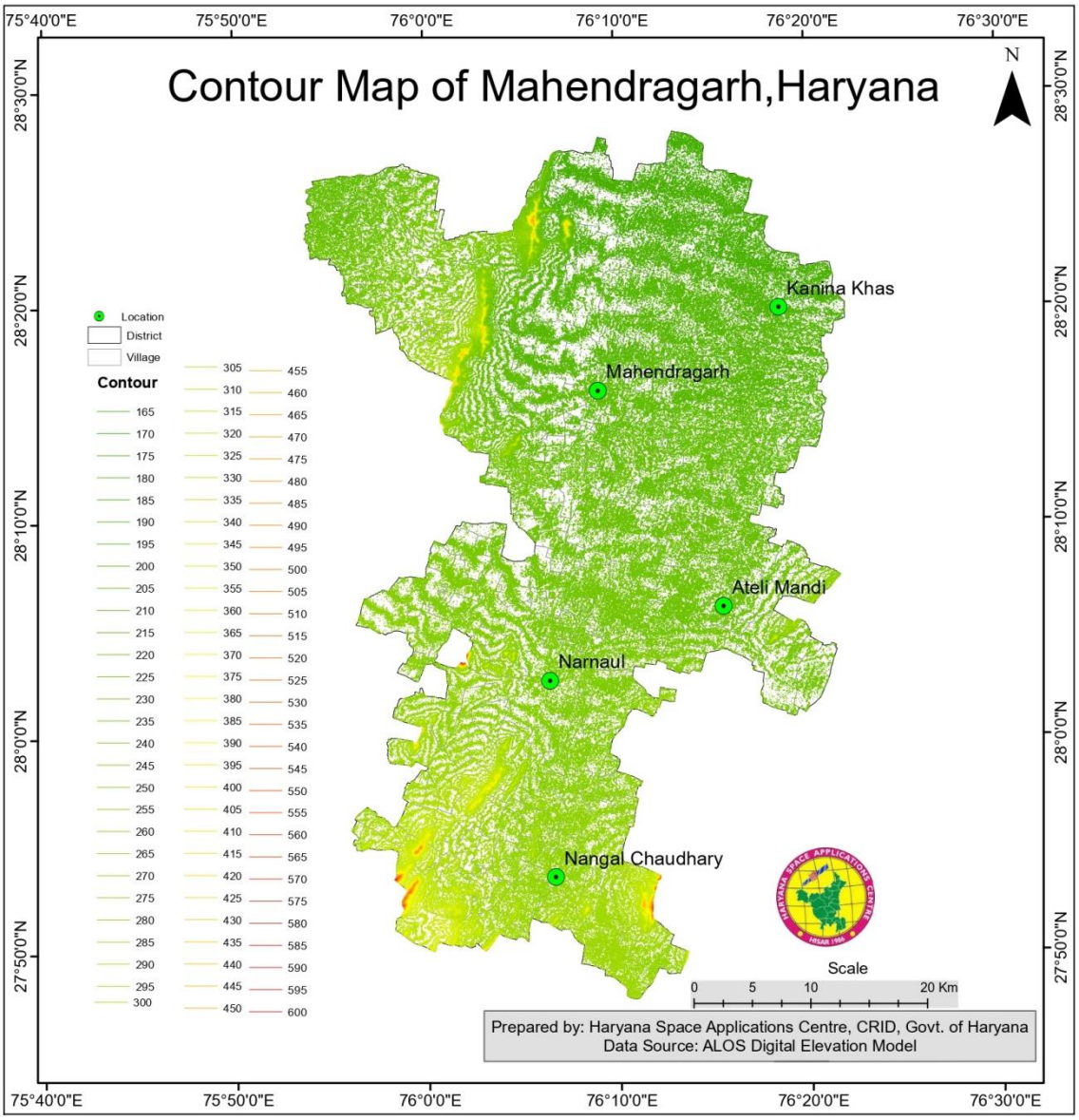


Figure 5 Contour Map of Mahendragarh District

1.5.1 Geology and Lithology

The area forms the part of Indo - Gangetic plains and has vast alluvial and sandy tracts. It is interspersed with strike ridges which are occasionally covered by blown sands. South western part of the district is occupied by blown sand and alluvium. Light colored arid soils are found in the major part of the district (**Figure 6**). These soils are calcareous and have lime nodules in the subsurface horizons. Most of the soils in district are medium textured. Loamy sand is the average texture in all the blocks of the district.

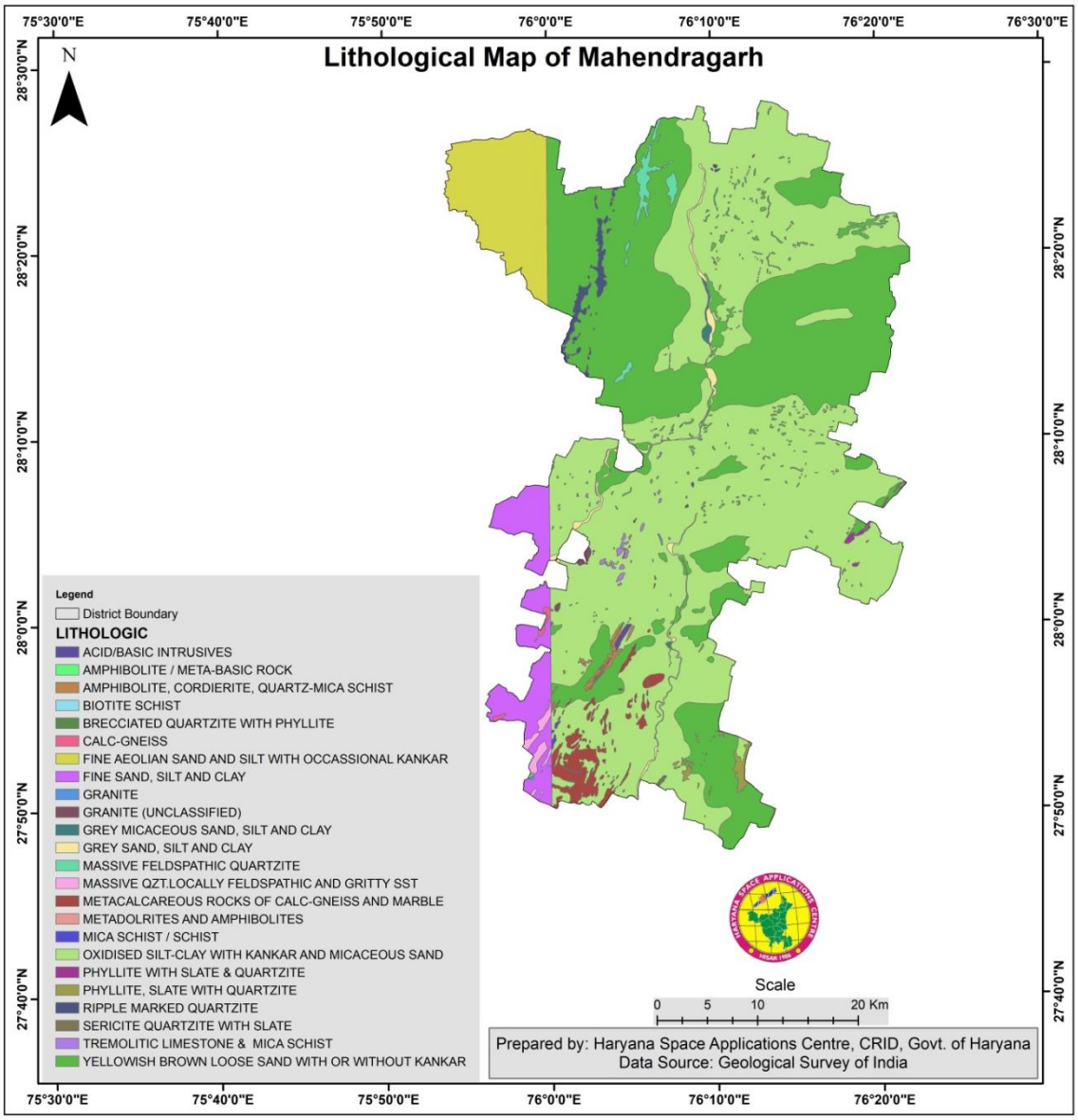


Figure 6 Lithology Map of Mahendragarh District

1.5.2 Soil Profile

The soils of the district are mostly sandy loam and sandy which are highly deficient in organic matter. Wind erosion is the most common feature. At many places, the soil is embedded with lime, kankar and rock. Very light soils are sandy and loamy sand (Bagar) and relatively sandy loam is mostly found in the district. Rocky surfaces are also found here and there. The soils as classified by the National Bureau of Soil survey and Land Use Planning (ICAR), Nagpur, the district has mainly Orthids-fluvents, Psamments and Psamments fluvents types of soils.

In the Mahendragarh district the 57% is classified under loamy sand followed by 41% classified under sandy loam and 2% under sandy soil (**Figure7**). The general profile of soil health of Haryana state is shown in **Figure 8**.

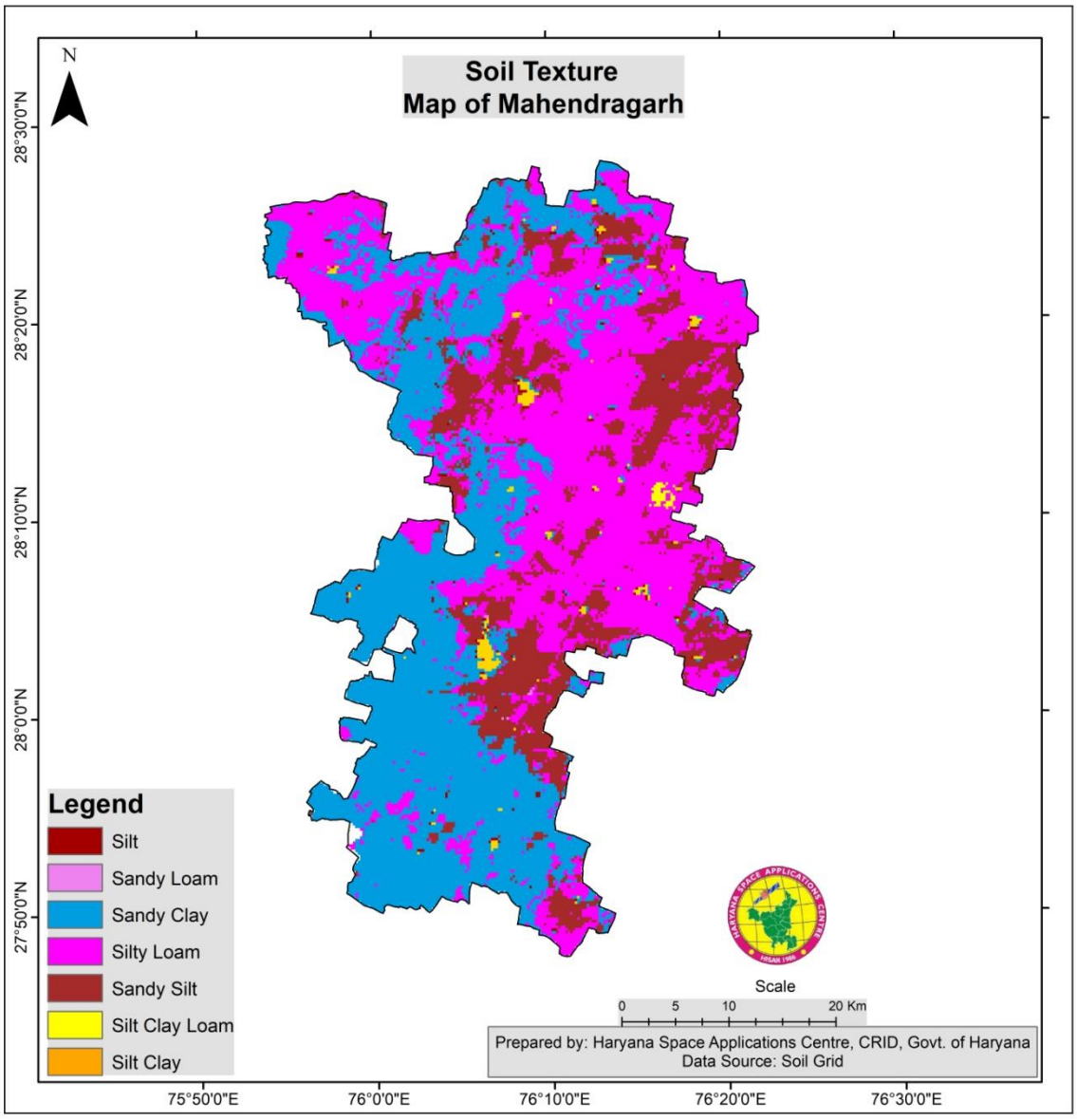


Figure 7 Soil texture Map of Mahendragarh District

Sand Dunes: The sand dunes attain heights unto 30m but on an average they attain height of about 7m with respect to surrounding.

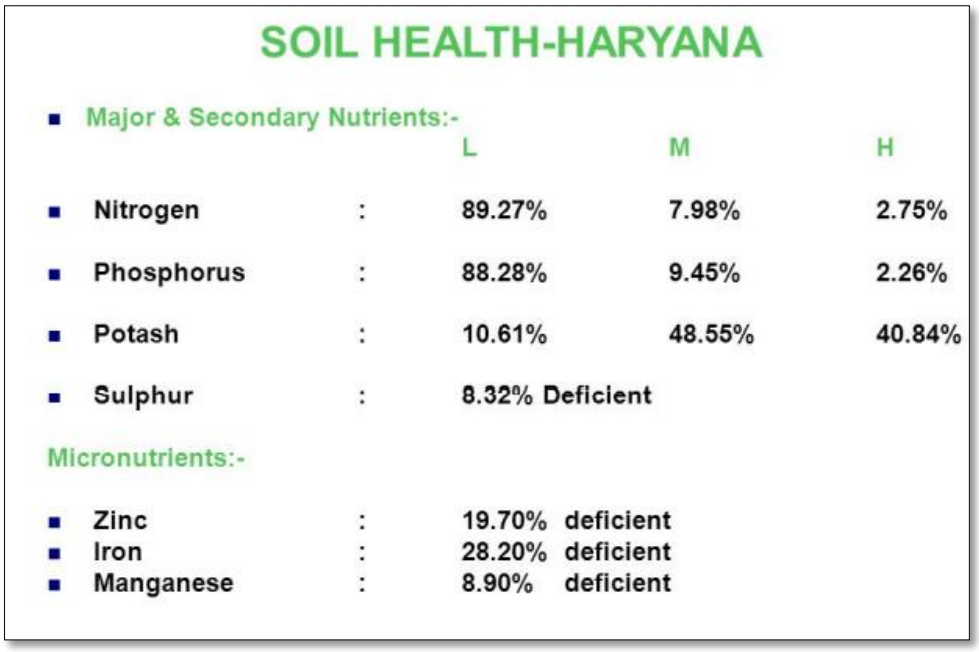


Figure 8 General soil health profile of Haryana

1.6 Land use

The cropping intensity in Ateli Nangal block is 199.35% and ranks second in the district after Kanina block where cropping intensity is 199.38%. In other blocks of Mahendragarh, cropping intensity ranges from 197.77% to 158.48%. Cropping intensity of the district is 189 %. The graph shown in **Figure 9** depict Total Agriculture & Horticulture production in blocks of Mahendragarh. The land use land cover map of Mahendragarh District is shown in **Figure 10**.

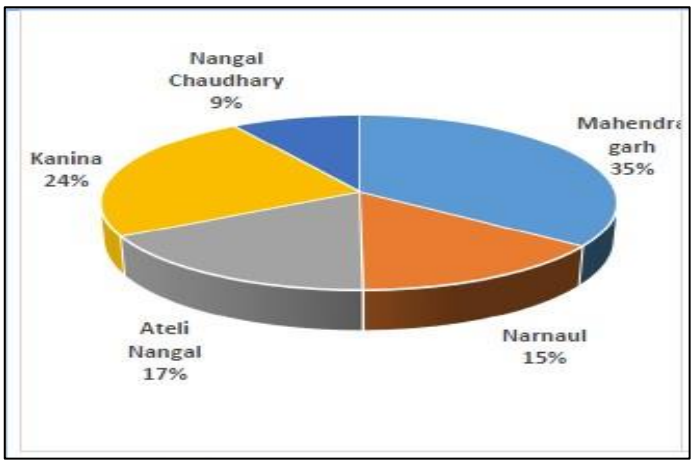


Figure 9 Total Agriculture & Horticulture production in blocks of Mahendragarh

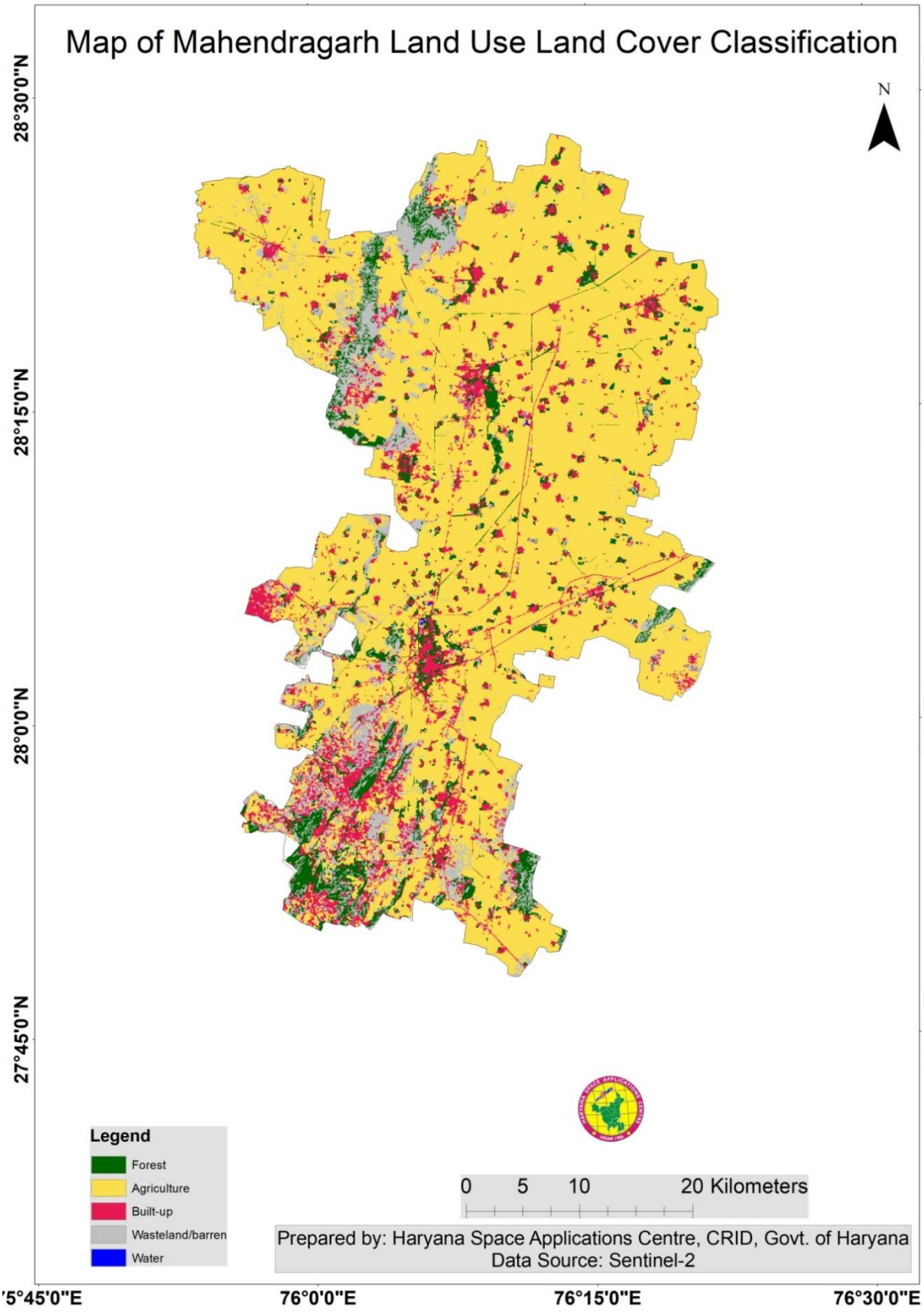


Figure 10 Landuse Landcover of Mahendragarh District

2 District Water Profile

2.1 Source of Water

The total available surface water in the Mahendragarh district is 96.12 MCM. Out of which in the kharif season the availability of surface water is 21.27 MCM and in Rabi season itis 46.84MCM.out of 96.12 MCM the Effluent treated water is 5.94 MCM, which is proposed.It will be available to irrigation additionally when the ETP plants are commissioned. The surface water including rain water harvesting in the district is 58.95 MCM.

2.1.1 Ponds

A **pond** is a body of still water, either natural or man-made, that is usually smaller than a lake. They may arise naturally in floodplains as part of a river system, or they may be somewhat 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 (**Table3**). In Mahendragarh district total 1100 ponds found with the help of satellite data on village level. Some ponds are created specifically for habitat restoration, including water treatment. The map of total water bodies that include ponds, canals are shown in **Figure 11** and **Figure 12** show Monsoonal water-logged area of Mahendragarh district.

Table 3 Block wise number of ponds

Block	No. of Ponds
Ateli Mandi	141
Kanina Khas	245
Mahendergarh	161
Nangal Chaudhary	139
Narnaul	150
Nizampur	106
Satnali	46
Sihma	112

2.1.2 Canals

Irrigation canal is an artificial channel that is the main waterway that brings irrigation water from a water source to the area to be irrigated (**Table 4**). They can be lined with concrete, brick, stone or a flexible membrane to prevent seepage and erosion.

Table 4 Existing Type of Irrigation

Block	Unit	Govt. Canal	Private Tubewells
Ateli Nangal	Number	18	6844
	Command Area (Ha).	17216	-
Kanina	Number	11	8363
	Command Area (Ha).	17863	
Mahendragarh	Number	18	10580
	Command Area (Ha).	44610	-
Nangal Chaudhary	Number	8	Nil
	Command Area (Ha).	18271	-
Narnaul	Number	13	1137
	Command Area (Ha).	17630	-
Total	Number	68	26924
	Command Area (Ha).	115590	-

2.1.3 Rivers

The Dohan river is a rain-fed river that originates at Mandholi village near Neem Ka Thana in Sikar district of Rajasthan and then disappears in Mahendragarh district in Haryana where it use to be a tributary of Sahibi River, which in turn is a still flowing tributary of Yamuna. Its canalized portion in one of its pale channel in Haryana is called the "Outfall Drain No 8".

Several Ochre Colored Pottery culture sites have been found along the banks of Krishnavati river, Sahibi river, Dohan river (tributary of Sahibi river) and Sota River (another tributary of sahibi river that merges with Sahibi at Behror in Alwar district).

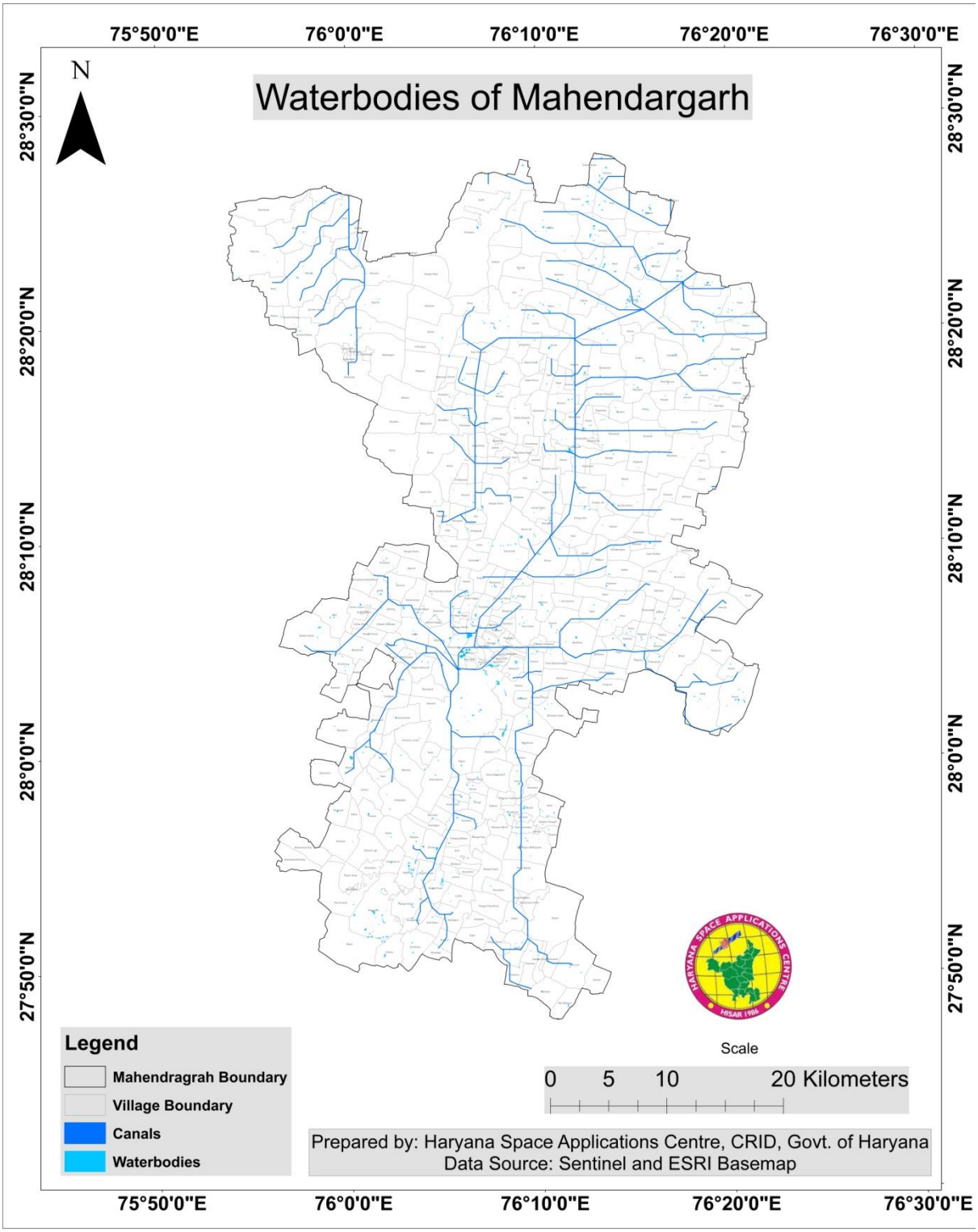


Figure 11 Water bodies of Mahendragarh District

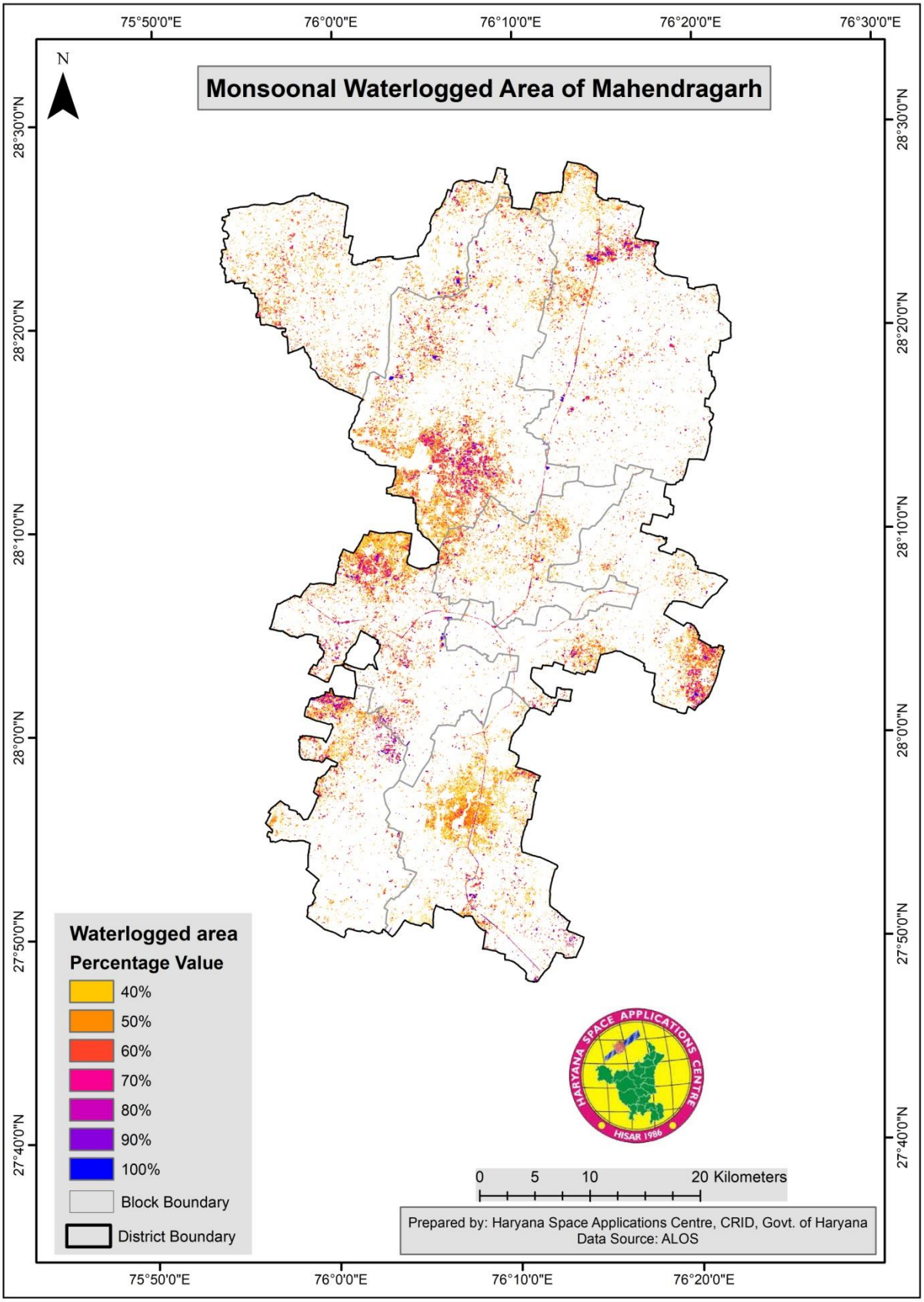


Figure 12 Monsoonal water logged area of Mahendragarh

2.2 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 water body. 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 towards the drain. The drainage map of Mahendragarh District show in **Figure 13** and the statistics of length of drainage in Mahendragarh district are shown in **Table 5**.

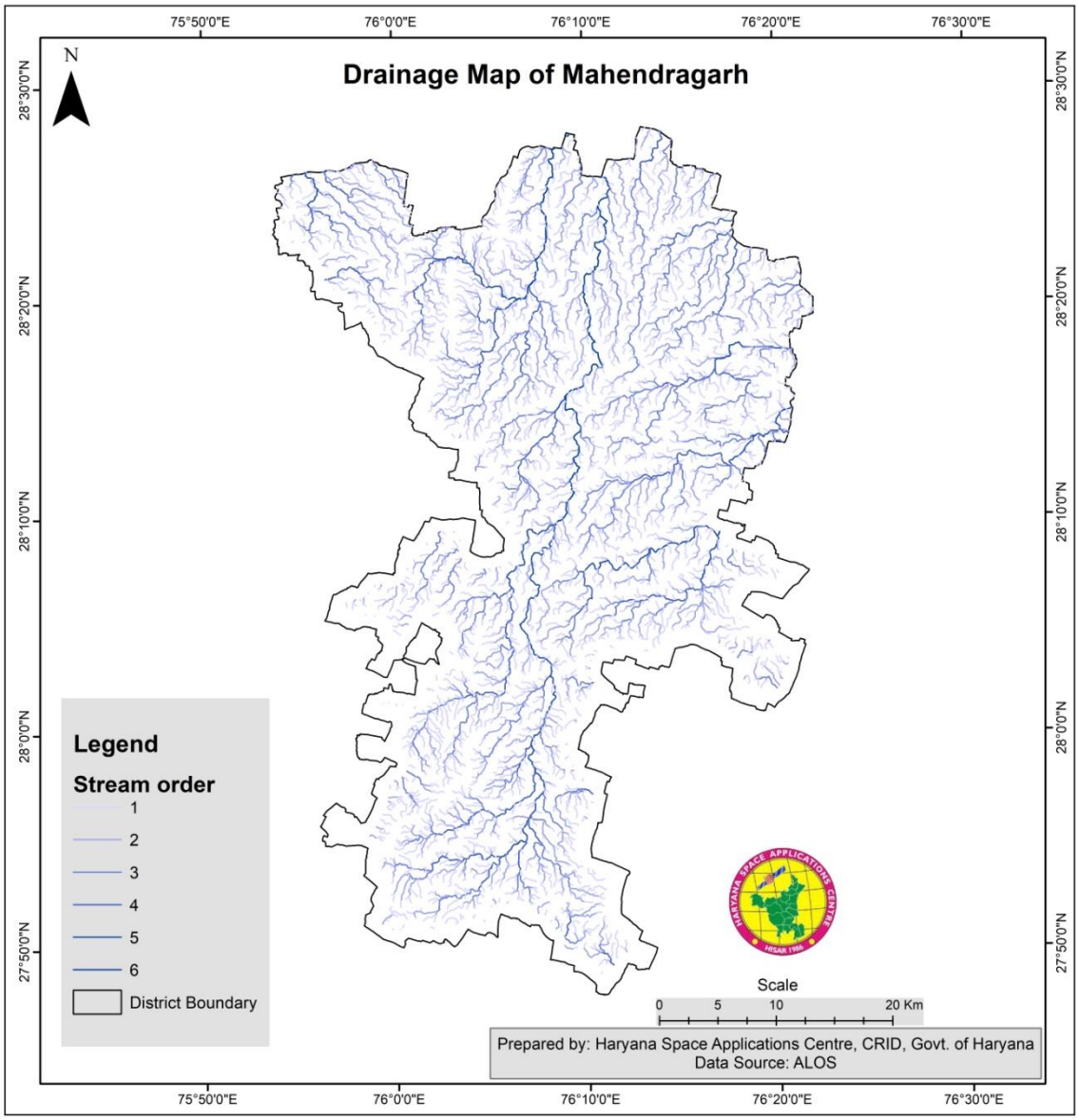


Figure 13 Drainage Map of Mahendragarh

Table 5 Length of Stream order of Mahendragarh District

Sr. no.	Order of Drainage	Total Length (in meters)
1	1st order	1669902.63
2	2nd order	889829.92
3	3rd order	448776.87
4	4th order	175731.88
5	5th order	108611.13
6	6th order	59554.60

2.3 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.

2.3.1 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 6**) 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 dry land, hilly, urban and coastal areas.

Table 6 Water Harvesting System in Mahendragarh District

S.NO.	Activity Name	Works Completed	Works Ongoing	Expenditure (in Lakhs)
Water Conservation and Rain Water Harvesting				
1	Check Dam		1	
2	Pond / Tank		10	
3	Trench	16	8	
4	Rooftop Water Harvesting Structure (Public)	251	0	
5	Rooftop Water Harvesting Structure (Private)	10		
6	Other Rainwater Recharge Structures (Open Well Recharge, Sand Filter for open well recharge)		0	
7	Other Water Conservation Structures (Bench Terracing, Canal)		0	
Total			19	157
Renovation of Traditional and other Water Bodies / Tanks				
1	Traditional Water Bodies Restored	919	23	
Total		919	23	152
Reuse and Recharge Structures				
1	Soak Pit	2507	3	
2	Stabilization Pond	0	0	
3	Other Reuse / Recharge Structure	18	2	
Total		2525	5	1
Watershed Development				
1	Gully Plug	61	0	
2	Percolation Tank		0	
3	Staggered Trenches	5	0	
4	Other Watershed Construction Activities	107	48	
Total			48	441

Intensive Afforestation				
1	Intensive Afforestation-Nurseries	182	0	
2	Intensive Afforestation- Plantation		43	
Total			43	24
Awareness Programs by KVK				
1	Farmers training programs by KVKs on Water Use Efficiency and Appropriate Crops	1386		
2	Distribution of one packet of vegetable seeds and saplings of five nutritious plants to farmers			
3	Awareness Programs/ Kisan Mela on the theme Valuing Water	572		
Total		1958		
Waste Water Treatment				
1	Use of Treated Waste Water	0		
Total		0		

2.3.2 Water Harvesting System 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 Mahendragarh District for rain water harvesting is shown in **Table7** at rural and urban area. The map of water conservation activity in Mahendragarh at rural and urban level is shown in **Figure 14**.

Table 7 Water Harvesting technique in Rural area and Urban Area

In Rural Area		
Sr. No	**Block Name**	**Total No of Activity**
1	Ateli Mandi	0
2	Kanina Khas	0
3	Mahendergarh	0
4	Nangal Chaudhary	0
5	Narnaul	1052
6	Nizampur	877
7	Satnali	774
8	Sihma	406
In Urban Area		
1	Mahendragarh	37

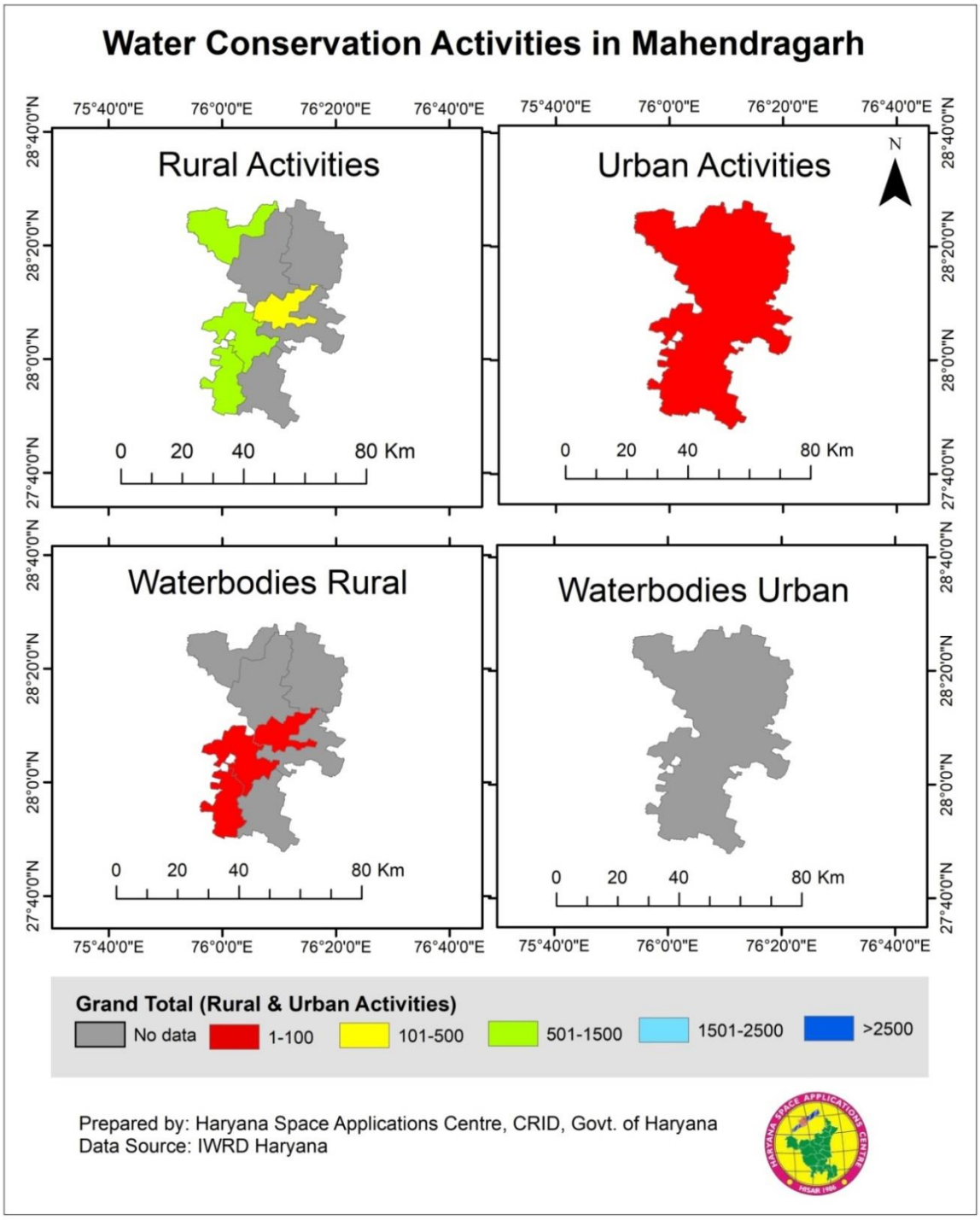


Figure 14 Water Conservation Activities in Mahendragarh

2.3.3 Sewerage Treatment Plant

Sewage treatment plants (STPs) are the main pollution source of micropollutants, including pharmaceuticals and personal care products (PPCPs). Understanding the biotreatment processes of domestic and hospital wastewaters is important for the optimization of micropollutant degradation at the discharge source in order to decrease their concentrations and associated biological effects. It is

known that a large group of compounds comprising aliphatic, aromatic, and halogenated molecules are co-metabolized during nitrification by the enzyme ammonia monooxygenase (AMO). Mahendragarh district has five sewage treatment plants. The sewerage treatment plant map is shown in **Figure 15**. In Mahendragarh District total 5 treatment plants are installed having total capacity of approx. 19 MLD.

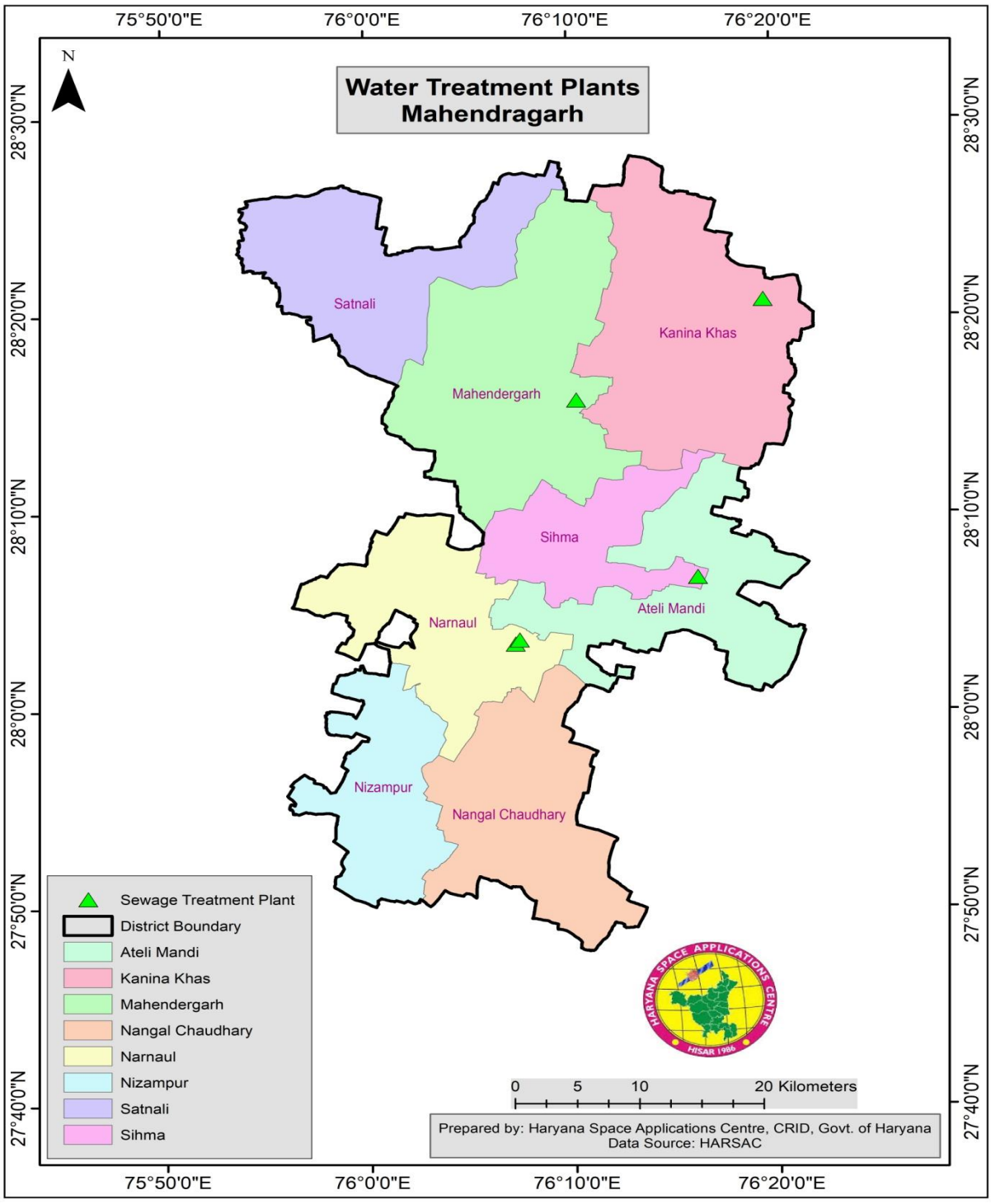


Figure 15 Water Treatment Plant Mahendragarh

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 revegetate 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

4 Water Availability

4.1 Surface Water Availability

In rainy season of 3 Months water released for filling of village pond in Block Ateli Nangal 35 Nos, Block-Nangal Choudhary 40 Nos., Block Narnaul 50 Nos., 18Nos. W.W. Tanks and artificial recharge scheme in Dohan River & Krishnawati River as well as Escape channel of Ateli Disty, In Krishnawati River. **Table 8** shows the status of water availability in Mahendragarh district.

Table 8 Status of water availability in Mahendragarh (MCM)

Sr. No.	Source	Kharif (Area in ha)	Volume of Water (in MCM)	Rabi (Area in ha)	Volume of Water (in MCM)	Summer (Area inha)	Total (Area in ha)	Volume of Water (in MCM)
	Ateli Nangal							
1.	Surface Irrigation	56.00	1.10	213.00	4.37	0.00	269.00	5.51
i.	Various Water Bodies includingRain water Harvesting							6.2
ii.	Treated Effluent received from	0	0.36	0	0.36			0.72

	STP							
	Kanina							
1.	Surface Irrigation							
i.	Canal, Major &Medium Irrigation)	633.00	6.91	1212.00	9.99	0.00	1865.00	16.90
ii.	Treated Effluent received from STP		0.27		0.27			0.54
	Mahendragarh							
1.	Surface Irrigation							
i.	Canal, Major &Medium Irrigation)	615.00	6.421	1184.00	12.299	0.00	1799.00	19.53
ii.	Various Water Bodies includingRain water Harvesting							1.90
iii.	Treated Effluent received from STP		1.35		1.35			2.70
	Nangal Chaudhary							

1.	Surface Irrigation							
i.	Canal, Major &Medium Irrigation)	41.00	1.02	279.00	6.98	0.00	320.00	8.00

4.2 Ground Water Availability

Geologically, the rock formations occupying the district range in age from pre- Cambrian to Quaternary period. The generalized geological succession in the district is given below.

The district is underlain by alluvium and blown sand of Recent to sub recent age which are overlying the rocks of post Delhi and Delhi system. The alluvium in the area belongs to older alluvium stage comprising of sand, silt, clay and calcareous nodules. The alluvium is the fresh water deposit of Indo-Gangetic River system. In alluvium the granular zones exist downto entire thickness, which is negligible near the out crop of Delhi system to about 150m in the northern part of district. The average thickness of the alluvium in the district is more than 50m. Exploratory drilling has been carried out at 19 exploratory sites in alluvial formation and 35 in Hard rock areas. In alluvial formations the successful exploratory tube well tapped aquiferzones down to the depth of 170m & 235 m yielding 220 lpm to 1200 lpm for 6 to 23m drawdown in hard rock area the depth of bore holes ranges between 50 to 135 m and the water bearing zones in weathered fractured quartzite and limestone were tapped. The discharge oftube wells varies between 100 to 1325 lpm with 3 to 15m draw down in lime stone aquifers. The discharge of tube wells constructed in quartzite formation ranges between 22 and 820 lpm for reasonable draw downs. The following map (**Figure 16**) depicts the ground water depth in Mahendragarh district and **Table 9** shows the Ground Water Availability in Mahendragarh District.

Table 9 Ground Water Availability in Mahendragarh

Block	Total Annual Ground Water Recharge in MCM	Provision for Natural Discharge in MCM	Net annual Ground Water availabilityin MCM	Classified
Ateli Nangal	52.92	5.29	47.63	Over Exploited
Kanina	53.16	2.66	50.50	Over Exploited

Mahendragarh	55.99	5.60	50.39	Over Exploited
Nangal Chaudhary	46.22	4.62	41.60	Over Exploited
Narnaul	36.51	1.83	34.68	Over Exploited
Total	**244.80**	**20.00**	**224.80**	

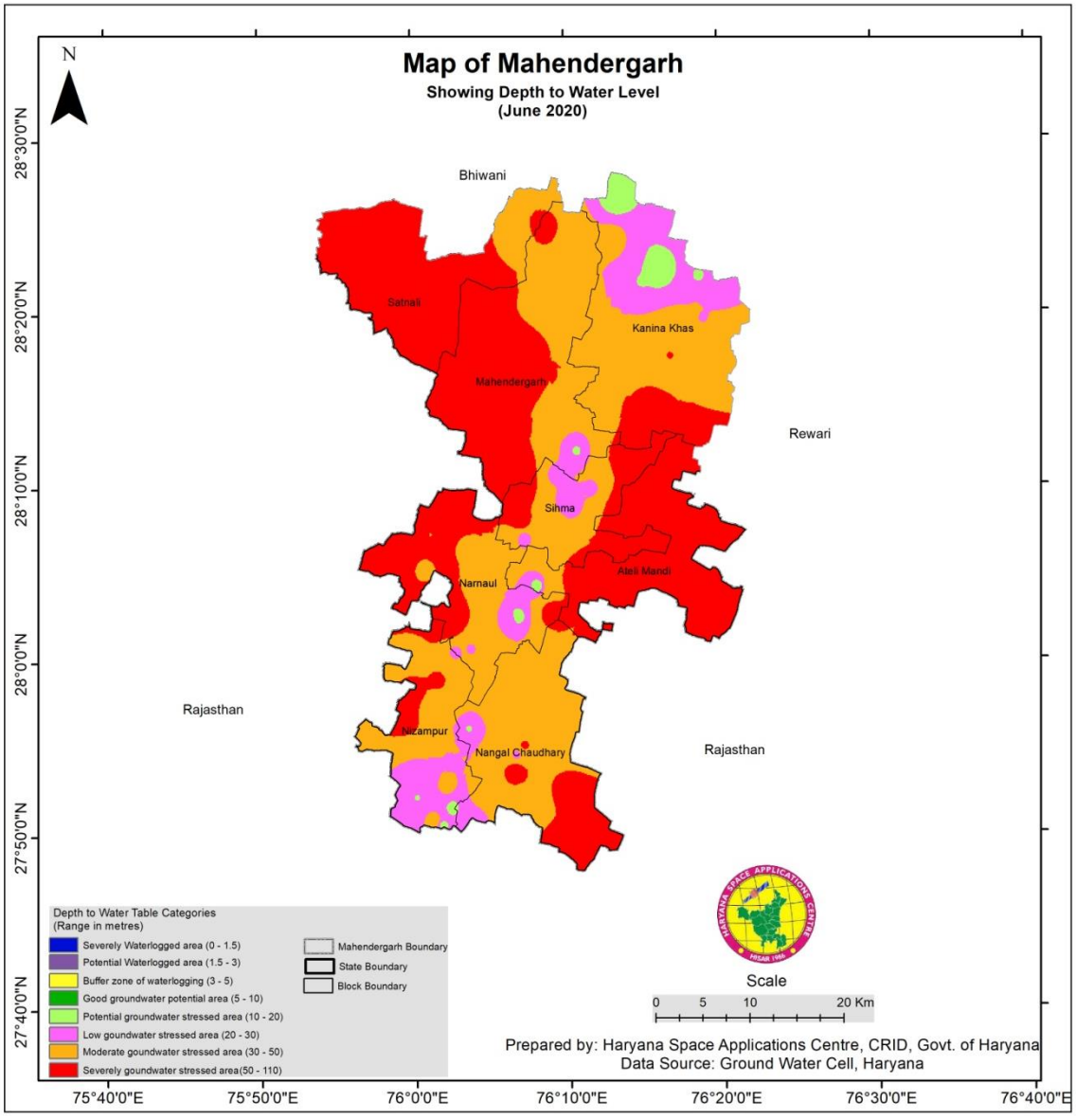


Figure 16 Ground water Availability Map of Mahendragarh District

4.3 Ground Water Quality

The shallow ground water of the district is alkaline in nature (pH 7.46 to 8.40) and is fresh to highly saline. Among anions, bicarbonate as well as chloride dominates in 40%samples and in the remaining samples, none of the anion dominates.

Comparing the concentration values of major ions with the recommended desirable and permissible concentration limits for drinking waters (Bureau of Indian Standards) it is found that ground waters are not suitable for drinking purposes either due to high nitrate or due to high fluoride which exceeds the recommended limit of 45mg/l and 1.5 mg/l, respectively. High nitrate has been found at Buchawas (250mg/l), Kheri (210mg/l) and Narnaul (1270mg/l).

Salinity (EC), Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the parameters for ascertaining the suitability of ground water for irrigational uses. These parameters range from 608 to 6330µS/cm at 250C, 1.78 to 11.18 and – 23.30 to 9.46 mill equivalents respectively. From RSC values it is concluded that groundwater of the district is, byand large, suitable for irrigation. Plot of USSL diagram (based on EC and SAR) used for the classification of irrigation waters indicated that ground waters fall under classes C2S1, C3S2, C3S3, C4S1 and C4S4. Waters belonging to classes C2S1 and C3S2 are suitable for customary irrigation for semi-salt tolerant crops like wheat, rice, maize, gram etc. without any fear of salinity hazards to the crops. However, waters falling under class C3S3 and C4S4 are likely to cause both sodium and salinity hazards and those falling under class C4S1 may cause salinity hazards. It would be better if such waters are used for irrigating salt tolerant crops along with appropriate amount of gypsum on well drained soils. Map 3.2 depicts ground water quality based on the electrical conductivity of ground water. Maximum area of the district is having ECless than 2000 µ mhos/Cm at 250 C. Some areas in red color have water with EC above 6000 µ mhos/Cm at 250 C. Rest parts of the district have EC between 2000-6000 µ mhos/Cm at 250 C. water quality range from 0-45 is good, 45-60 is fair and >60 is very poor quality of water. So, based on that Mahendragarh district's water qualities vary from good to poor (**Figure 17**). Whereas block wise water quality index value is shown in **Table 10**.

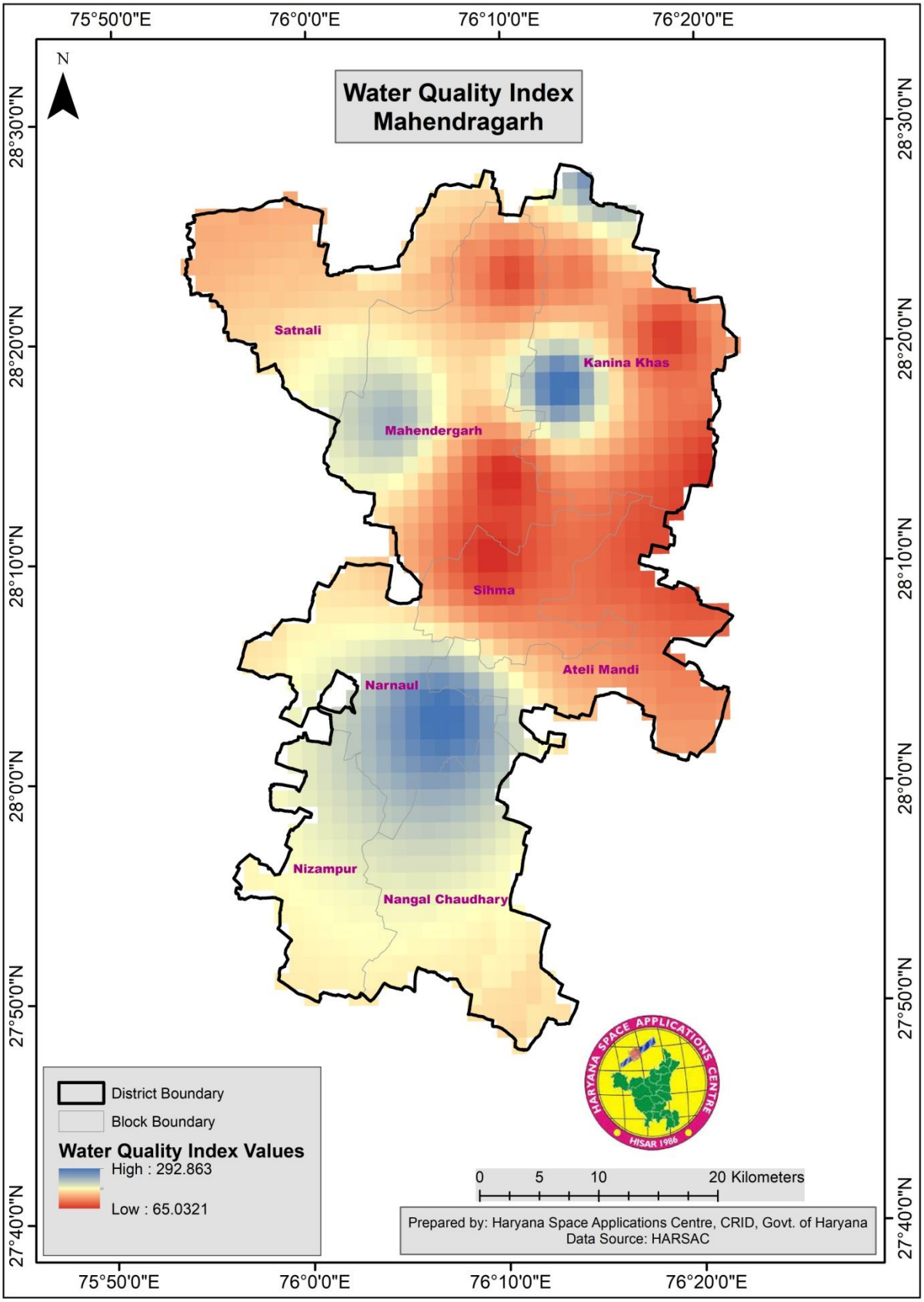


Figure 17 Water quality index of Mahendragarh District

Table 10 Average Water Quality Index Value Block wise

Block Name	Average Water Quality Index Value
Ateli Mandi	126.462753
Kanina Khas	140.109858
Mahendergarh	144.102504
Nangal Chaudhary	185.494998
Narnaul	210.277075
Nizampur	183.423972
Satnali	153.343125
Sihma	109.689801

5 Aquifer System

An aquifer is a body of saturated rock through which water can easily move. Aquifers must be both permeable and porous and include such rock types as sandstone, conglomerate, fractured limestone and unconsolidated sand and gravel. Fractured volcanic rocks such as columnar basalts also make good aquifers. The rubble zones between volcanic flows are generally both porous and permeable and make excellent aquifers. In order for a well to be productive, it must be drilled into an aquifer. Rocks such as granite and schist are generally poor aquifers because they have a very low porosity. However, if these rocks are highly fractured, they make good aquifers. A well is a hole drilled into the ground to penetrate an aquifer. Normally such water must be pumped to the surface. If water is pumped from a well faster than it is replenished, the water table is lowered and the well may go dry. When water is pumped from a well, the water table is generally lowered into a cone of depression at the well. Groundwater normally flows down the slope of the water table towards the well. Some block wise information of Canal command shows in **table 11**.

Table 11 Status of Command Area

Blocks	Information of Canal Command		
	Total Area	Developed Area	Undeveloped Area
Ateli Nangal	17216	269	16947
Kanina	17863	1865	15998
Mahendragarh	44610	1999	42814
Nangal Chaudhary	18271	320	17951
Narnaul	17630	3200	14430
Total	115590	7653	108140

6 Water Requirement/ Demand

Water Requirements

A. Drinking:

(i) Public Health Department= 170 Cs.

Completely met with present demand of 170 Cs discharge and in addition to this there are 600 No. tube wells of PHD augmenting drinking water supply.

(ii) Ponds: 346 No. ponds are connected to canal & 65 No. ponds are to be connected to canal. 1st priority is given to fill W.W. Tank & Ponds by Irrigation Department.

B. Irrigation:

Total demand for existing canal network = 1690 Cs

Present supplies through canal for Irr. Purpose = 500 Cs. (for 16 days) Irrigation Tube wells (Major source) = 31700 No.

There is a wide gap between water availability & demand. Due to this desperate use of underground water has depleted to the level of over exploiting category.

C. Constraints:

(i) Main source of recharging ground water in the district i.e., Krishnawati & Dohan Rivers have been completely dried up since last more than 40 years due to construction of series of bunds by Rajasthan State.

(ii) Deficient rain falls in the area.

D. Challenges:

(i) The farmers installed Diesel Pumping Set on the banks of canal in absence of water courses to irrigate their fields and they lift water as per their own will. Whereas they can take water through water course/ outlet if constructed and use the sprinkling system, if lift is involved.

(ii) Formation of Water User Association (WUA) is mandatory requirement before construction of water courses and Micro irrigation Project. As is observed that there is low interest amongst the farmers for formation of WUA and as such difficulty is being faced for implementation of above works. The basic need of motivation/ participation of farmers is required.

6.1 Water Supply and Gap

While assessing the water being used from Surface sources and through Ground Water extraction, following assumption has been considered. Since, the total water available (consumed) by different sector had to be bifurcated basedon their source of origin (Surface/ Ground), proportion of number of ground water and surface water sources have been taken as the basis for bifurcation of total volume of water (**Table12**).

Table 12 Present and projected water demand in Mahendragarh District

Name ofBlock	**Existing Water availability / Usage (MCM)**		**Total (MCM)**	**Water Demand(MCM)**		**Water Gap (MCM)**	
	Surface Water	**Ground Water**		**Present**	**Projected (2022)**	**Present**	**Projected (2020)**
Ateli Nangal	12.43	47.63	60.06	125.75	127.03	65.69	66.97
Kanina	17.44	50.5	67.94	72.87	74.17	4.93	6.23
Mahendragarh	24.13	50.39	74.52	89.95	91.52	15.43	17.00
Nangal Chaudhary	19.46	41.6	61.06	406.66	408.97	345.6	347.91
Narnaul	22.66	34.68	57.34	115.58	116.84	58.24	59.50
Total	96.12	224.80	320.92	810.81	818.53	489.89	497.61

Table 13 shows water profile in Mahendragarh District. The total available water in the district is 320.92 MCM and the present and projected water demand in Mahendragarh District is 810.81 MCM and 818.53 MCM. The net deficit in the district is 497.61 MCM.

Table 13 Water Profile in Mahendragarh District

Mahendragarh District Water Profile	
Total villages	=381 No.
Total Population	=10.33 Lacs
Total Livestock	=12.13 Lacs
Total Geographical area	=194160 ha
Total cropped area	=285593 (Rabi + Kharif)
G.C.A.	=166167 ha
C.C.A.	=133446 ha
Intensity of irrigation	=62%
No. of canals	=102 No.
Total Length	=792 Km
Total No. of outlets	=737 No.
Total Ponds (Connected with canals)	=346 No.
Ponds to be connected with canals	=30 No.
Public Health Engg. Deptt.Tanks/ Discharge required	=57 No. / 170 Cs.
River (i)Dohan- Distt Mahendragarh/ Haryana, Length (ii)Krishnawati-Distt Mahendragarh/ Haryana, Length	=49 Km =50Km

6.2 Water Budget

1. Domestic Water Demand

Data of Census 2011 and 2001 has been considered to arrive at the growth rate of population ofthe district. As per Census 2011, the district has shown an annual growth rate of 1.348%. Current population (in 2016) has been calculated by assuming a growth rate of 6.74% (1.348% × 5 Years) over a period of four years (from 2011-2016). Projected population has been calculated in similar way by assuming a growth rate of 8.088% (1.348% × 6 Years) over the period of six years (from 2016-2022). **Figure 18** show the graph of Current and projected water demand in the Mahendragarh district under domestic sector and **Table 14** show the Domestic water Demand in The Mahendragarh District.

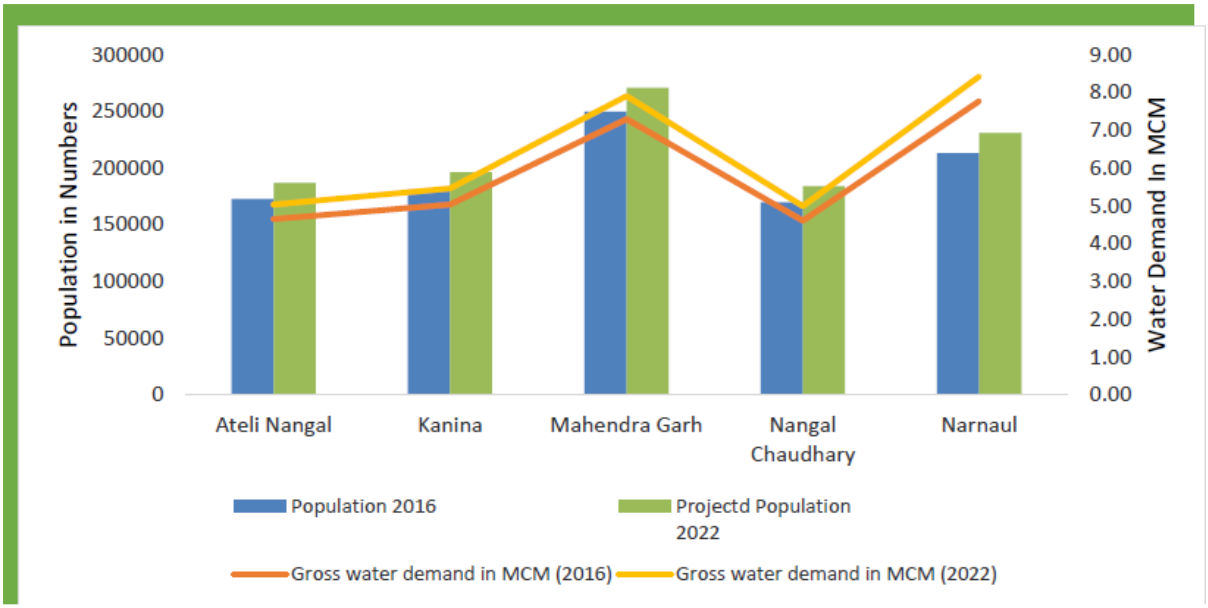


Figure 18 Current and projected water demand in the district under domestic sector

Table 14 Domestic water Demand in The District

Blocks	2011	2016	Gross Water Demand (MCM) in 2016	Projected Population2022	Gross Water Demand (MCM) in 2022
Ateli Nangal R	153623	164260	4.197	178001	4.548
Kanina R	156383	167211	4.272	181199	4.630
Mahendragarh R	204370	218521	4.583	236801	6.050
Narnaul R	124621	133250	3.405	144397	3.689
Ateli Nangal U	7619	8147	0.446	8828	0.483
Kanina U	12989	13888	0.760	15050	0.824
Mahendragarh U	29128	31145	1.705	33750	1.848
Nangal ChaudharyU	8538	9129	0.500	9893	0.542
Narnaul U	74581	79745	4.366	86416	4.731
Total	922088	985935	29.34	1068414	31.79

2. Crop Water Requirement

Crop water requirement for the blocks and district have been calculated based upon the cropping pattern followed in the various blocks of the district. Cropping pattern under irrigated and rainfed system is different in the district. Jawar/Bajra-barley and vegetable based cropping system is followed under unirrigated conditions in all the blocks. Under irrigated conditions, in almost all the blocks vegetable based cropping system is followed. However, under irrigated system, Bajra-wheat, maize-wheat based cropping systems are also being followed. Cereal crops occupy major portion in all the blocks and in district as a whole. Among grain crops, Bajra, wheat and Barley are the most commonly cultivated crops. In some blocks of the district, Barley is also being cultivated. Among pulses grams and Guar are the important crops while mustard is the major oilseed grown in the district. The major vegetables grown in the area are peas, tomato, cabbage, cauliflower, radish, capsicum, lady finger, cucurbits and brinjal.

3. Water Demand for various sectors

In Mahendragarh, water is required for domestic use, crop irrigation and livestock drinking purpose. The district is not having any thermal or nuclear power plant where water may be consumed. Therefore, demand of water for power generation has been taken as nil. Total present annual water demand for Mahendragarh is 812.29 MCM. **Table15** show Sector-wise Water demand in the Mahendragarh district for domestic, crop, livestock and industries.

Table 15 Sector-wise Water demand in the district

Blocks	**Sector-wise Water demand**				**Total**
	Domestic(MCM)	**Crop (MCM)**	**Livestock(MCM)**	**Industries (MCM)**	**(MCM)**
Ateli Nangal	4.64	118.20	2.91	Nil	125.75
Kanina	5.03	64.94	2.90	Nil	72.87
Mahendragarh	7.29	79.11	3.55	Nil	89.95
Nangal Chaudhary	4.60	400.17	1.89	Nil	406.66
Narnaul	7.77	105.26	2.55	1.47	117.05
Total	**29.34**	**767.68**	**13.80**	**1.47**	**812.29**

The projected water demand in the district at the end of year 2022 will be 1260.23 MCMwhich is 8.78 MCM higher than current year water demand in the district. The major sector whichforms the major part of projected water demand in the district is Agriculture where the crop water requirement is projected to be 1153.26 MCM.

4. Livestock Water demand

The requirement of water for livestock of the district has been derived from last two livestock census (2007 & 2012). The table below represents the animal wise water requirement as well as total water requirement of the district for livestock (**Table16**). **Table 17** Showing water budget in Mahendragarh district.

Table 16 Livestock water demand in MCM

Block	**Total number of Livestock(2015)**	**Present water demand in MCM**
Ateli Nangal	536883	2.91
Kanina	229217	2.90
Mahendragarh	555373	3.55
Nangal Chaudhary	457596	1.89
Narnaul	183196	2.55
Total	1962264	13.80

Table 17 Water budget in Mahendragarh

Demand, Supply (Withdrawals) Consumptive Use:										
Government Offices and Campuses: (Liter) Present Water Year : 1st June to 31st May Next Year										
District	Block	Previous Year/ Average Annual Demand	Demand for Present Water Year	Previous Year/Average Annual Supply				Previous Year/ Average Annual Wastewater	Previous Year/ Average Annual Consumptive Use	Remarks
				Rain Water	Surface Water	Ground Water	Total Supply			
Mahendergarh	Mahendergarh	0	0	0	0	0	0	0	0	
	Narnaul	0	0	0	0	0	0	0	0	
	Nangal Chaudhary	0	0	0	0	0	0	0	0	
	Ateli Nangal	4526200	4526200	0	0	4526200	4526200	226310	4,526,200	
	Kanina	657200	657200	0	0	657200	657200	32860	657,200	
	Sihma	371000	371000	0	0	371000	371000	18550	371,000	
	Nizampur	561800	561800	0	0	561800	561800	28090	561,800	
	Satnali	190800	190800	0	0	190800	190800	9540	190,800	

7 Strategies for Water Conservation

Water conservation plan of district revolves around “Each drop of water is precious. District Administration is committed to giving high priority to water security. It will complete the long pending irrigation project as well as water conservation structures on priority and launch the ‘Pradhan Mantri Krishi Sinchayee Yojana’ integrated with “ Jal Shakti Abhiyan” with the motto of ‘Catch the rain, where it falls, when it falls’. There is a need for seriously considering all options of conserving water for ensuring optimal use of our water resources to prevent the recurrence of floods and drought. By harnessing rain water through ‘Jal Sanchay’ and ‘Jal Sinchan’, we will nurture water conservation and ground water recharge. Micro irrigation will be popularized to ensure ‘Per drop-More crop”. The goals of plan can be enumerated as:

- Improving the effectiveness of consumption of water in district
- Ensuring to make this campaign as people’s campaign through Samvadand participation
- Reducing the loss of water.
- Recycle/Reuse of water.
- Recharge of ground water by rain water harvesting methods and afforestation.
- Reviving the traditional infrastructure for water recharge.
- Effective monitoring and sustainability of various structures built under this abhiyan.
- Jal Shakti Kendra has been established in May 2021 at Sinchai Bhawan

7.1 Artificial Recharge

There are few isolated pockets located in the eastern part of the district where water levels are declining very fast. Fresh ground water at deeper level is being exploited by deep tube wells. Limited possibilities of artificial recharge exist in these areas during monsoon season, where excess runoff from upland areas can be utilized. Some of drains which were constructed to drain out excess water can be utilized for artificial recharge by constructing suitable recharge structures, such as injection wells, recharge shafts etc.

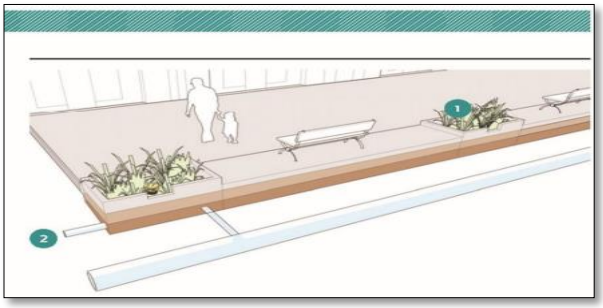
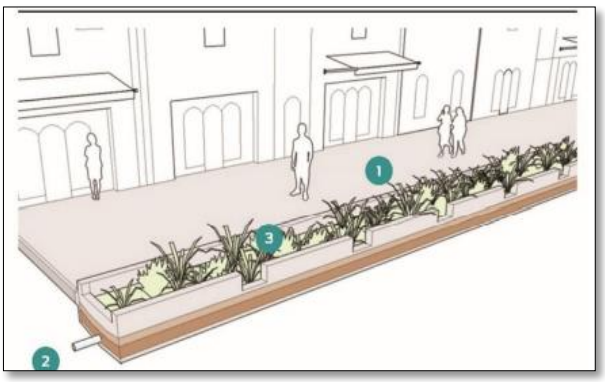
Possibility of Artificial Recharge There is few isolated pockets located in the eastern part of the district where water levels are declining very fast. Fresh ground water at deeper level is being exploited by deep tube wells. Limited possibilities of artificial recharge exist in these areas during monsoon season, where excess runoff from upland areas can be utilized. Some of drains which were

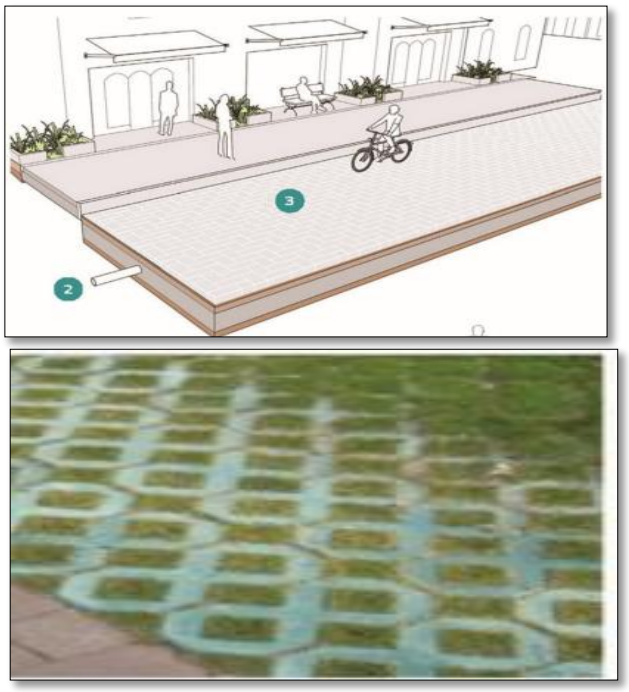
constructed to drain out excess water can be utilized for artificial recharge by constructing suitable recharge structures, such as injection wells, recharge shafts etc.

7.2 Water Sensitive Urban Design

As more and more portions of the district become 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 Mahendragarh. 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 scarcer in terms of frequency. The methods of water table recharge strategies in urban area are shown in **Table 18**.

Table 18 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 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. Wasteland map of Mahendragarh

District is shown in **figure 19** and Table 17. **Table 19** shows the Area under Forest, Wasteland & Other uses in Mahendragarh district. **Table 20** shows Area under Forest, Wasteland & Other uses.

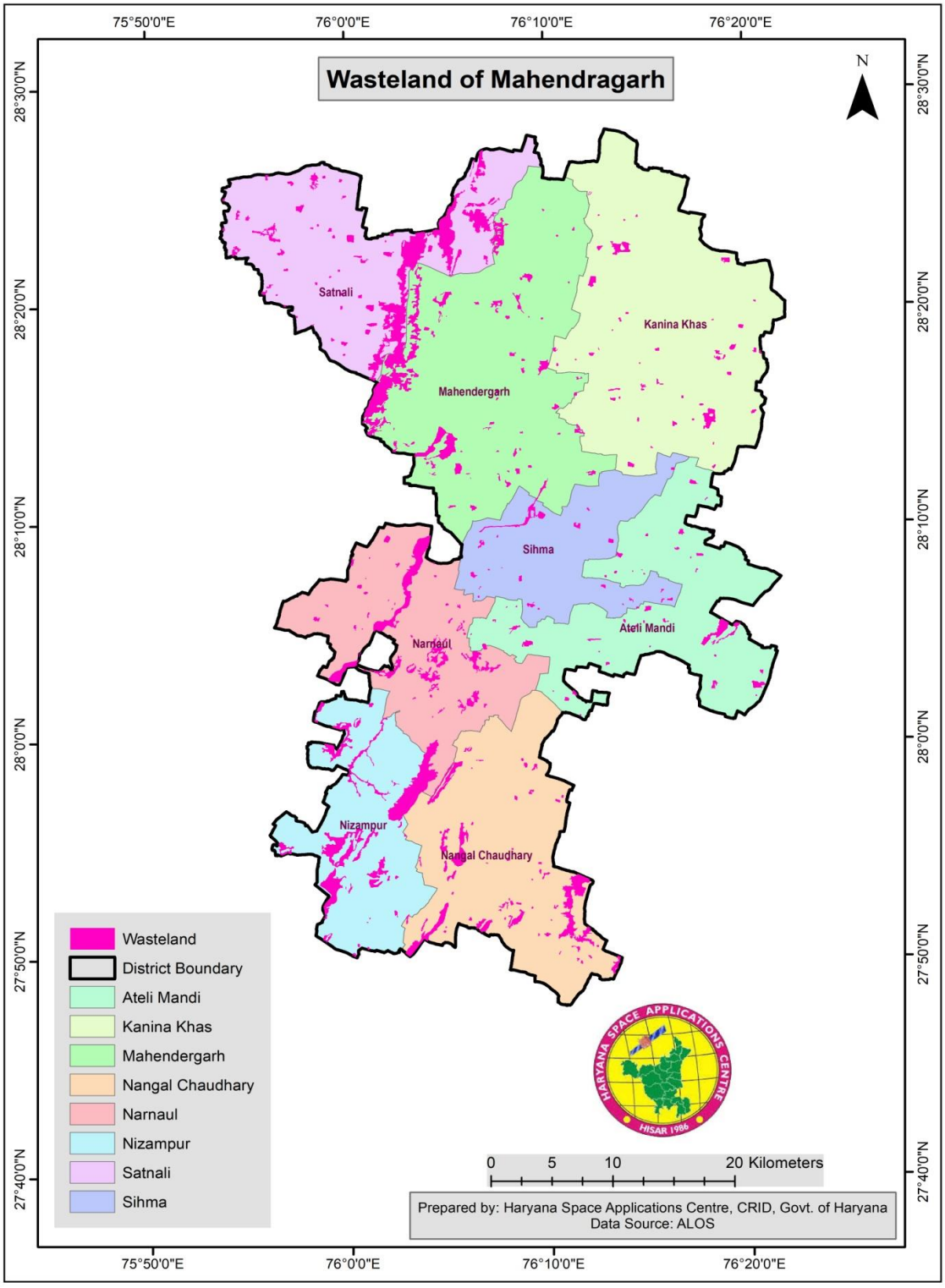


Figure 19 Wasteland Map of Mahendragarh district

Table 19 Plantation targets have been provided in the table below

Block	Wasteland Area (acres)	Plantation at 5 feet spacing
Ateli Nangal	104059.00	906562046
Kanina khas	109915.00	957579530
Mahendragarh	462004.69	4024984922
Nangal Chaudhary	356120.2619	3102519722
Narnaul	373680.102	3255501051
Nizampur	393013.98	3423937857
Satnali	513695.696	4475316907
Sihma	55957.096	487498222

Table 20 Area under Forest, Wasteland & Other uses

District	Area under Forest	Area under wasteland	Area under other uses
Mahendragarh	2035	13643	22996
Total	**2035**	**13643**	**22996**

7.4 Surface water management

7.4.1 Pond restoration and rejuvenation

Priority ponds in Mahendragarh district is 21. 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 m3 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 centers 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 water bodies. 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 Leveling

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 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 exists outside the city center and rural areas where open drainage systems still exist.

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 is a feasible solution that may allow for localized treatment which may eventually be reused for secondary purposes. Like other systems, decentralised systems must be properly designed, maintained, and operated to provide optimum benefits.

7.5 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. The following image shows the various stakeholders involved in IEC Activities (**Figure 20**) and **Table 21** shows the numerous activities and interventions that can be carried out for IEC.

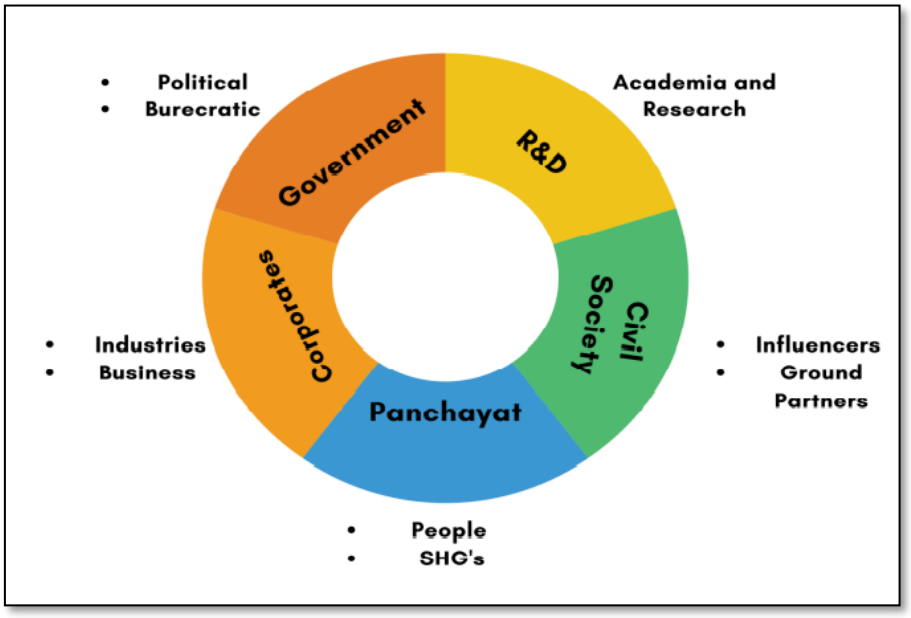


Figure 20 The above figure shows the various stakeholders of IEC Activities

Table 21 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 recognice 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	-To increase the green Cover To increase the water holding Capacity	- Plant List Nursery Database - Distribution Chain Management Posters	Better environment for Future Generations
13	Collaborations	- For IEC	- NYK - District Youth Affairs and Sports -Kalagram -NGO's -Durga Shakthi -Civil Defence -Lion Club	To involve stakeholders to facilitate sessions	- Letter of Collaboration -Google form	- No Overlapping of the work or activities - More effectiveness in Catch the rain Campaign

8 Proposed Activity

8.1 Rainwater harvesting

Roof top rain water harvesting system: A 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 aquifers by adopting artificial recharge techniques or meet the household needs through storage in tanks. These works have to be compulsorily taken up for public/community buildings namely Panchayat Bhawans, schools, Anaganwadis, Public Health Centers and Community halls (if available). Also, households should be convinced to take up roof-top rainwater harvesting structures for their houses.

- Check dams: small engineering structures constructed across a stream/ water course with cement to store water.
- Trenches: Constructed depressions of about 6 feet length, 2 feet width and 1 foot deep (sizes may vary across states) to impound the expected runoff.

The most suitable sites for rainfall water harvesting are shown in map (**Figure 21**). For the process of calculating suitable site a fixed weightage is needed to be applies on the above-mentioned criteria (**Table 22).** For the process of calculating suitable site a fixed weightage is needed to be applies on the above-mentioned criteria (**Table 23).**

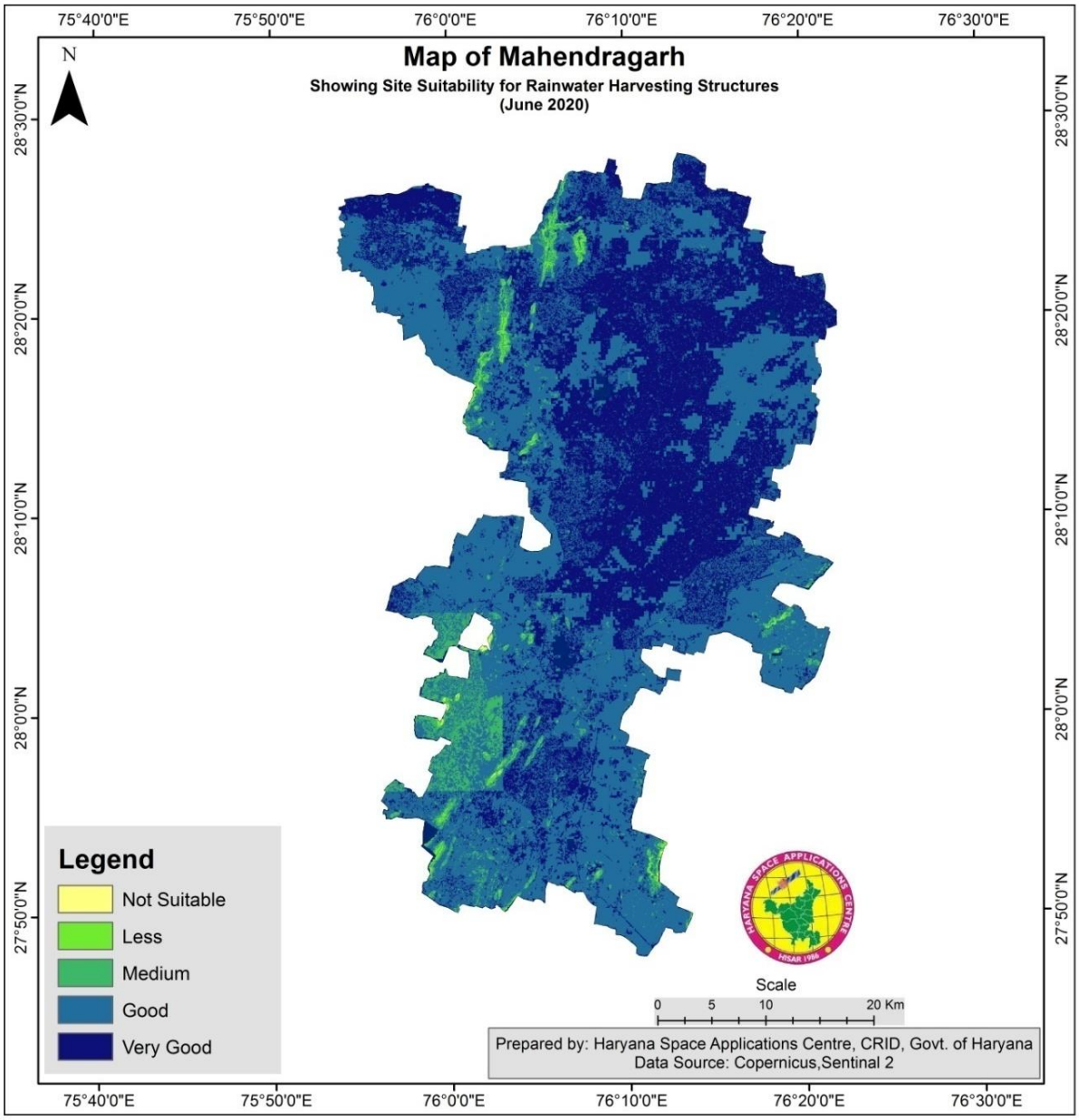


Figure 21 Site Suitability Map for Rainfall Harvesting Structure in the Year 2020

Table 22 Assigned Weight for layer

Parameters	**Weightage**
Rainfall	35
Slope	25
Drainage Density	5
Soil Texture	20
Lulc	15

Table 23 Block wise area under very good suitable site proposed for rain water harvesting

Block Name	Area (Very Good suitability area in Sq meter)
Ateli Mandi	86058735.24
Kanina Khas	212014503.8
Mahendergarh	189352053.6
Nangal Chaudhary	53027147.35
Narnaul	44317523.99
Nizampur	19606733.46
Satnali	82536026.81
Sihma	101447907.4

8.2 Proposed Suitable Site based on Multicriteria

In this section some water harvesting structures are proposed with the suitable sites. These structures are calculated based on different criteria. These criteria are Natural drainage and water occurrence datasets that should exclude the settlement and water bodies on the same place. Stream order system is a simple method of classifying stream segments based on the number of tributaries upstream. Following are the outcomes that show the type of structure on the streams. **Figure 22** shows the proposed suitable site based on multi criteria. Block wise proposed suitable sites based on multi-criteria is shown in **Table 24**.

Following are the harvesting structures proposed based on criteria mentioned as above.

1. 3 Mini percolation Tanks
2. 1 Percolation Tanks
3. 2 Pakka check Dams
4. 2 Annicut
5. 0 Micro Irrigation tanks

Table 24 Block wise proposed suitable sites based on multi-criteria

Sl. No.	Block Name	Mini percolation Tank	Percolation Tank	Pakka Check Dam	Annicut	Micro Irrigation Tank
1	Ateli Mandi	1	0	0	0	0
2	Kanina Khas	0	0	0	0	0
3	Mahendergarh	0	0	0	0	0
4	Nangal Chaudhary	0	0	0	1	0
5	Narnaul	0	0	2	0	0
6	Nizampur	1	0	0	1	0
7	Satnali	1	1	0	0	0
8	Sihma	0	0	0	0	0

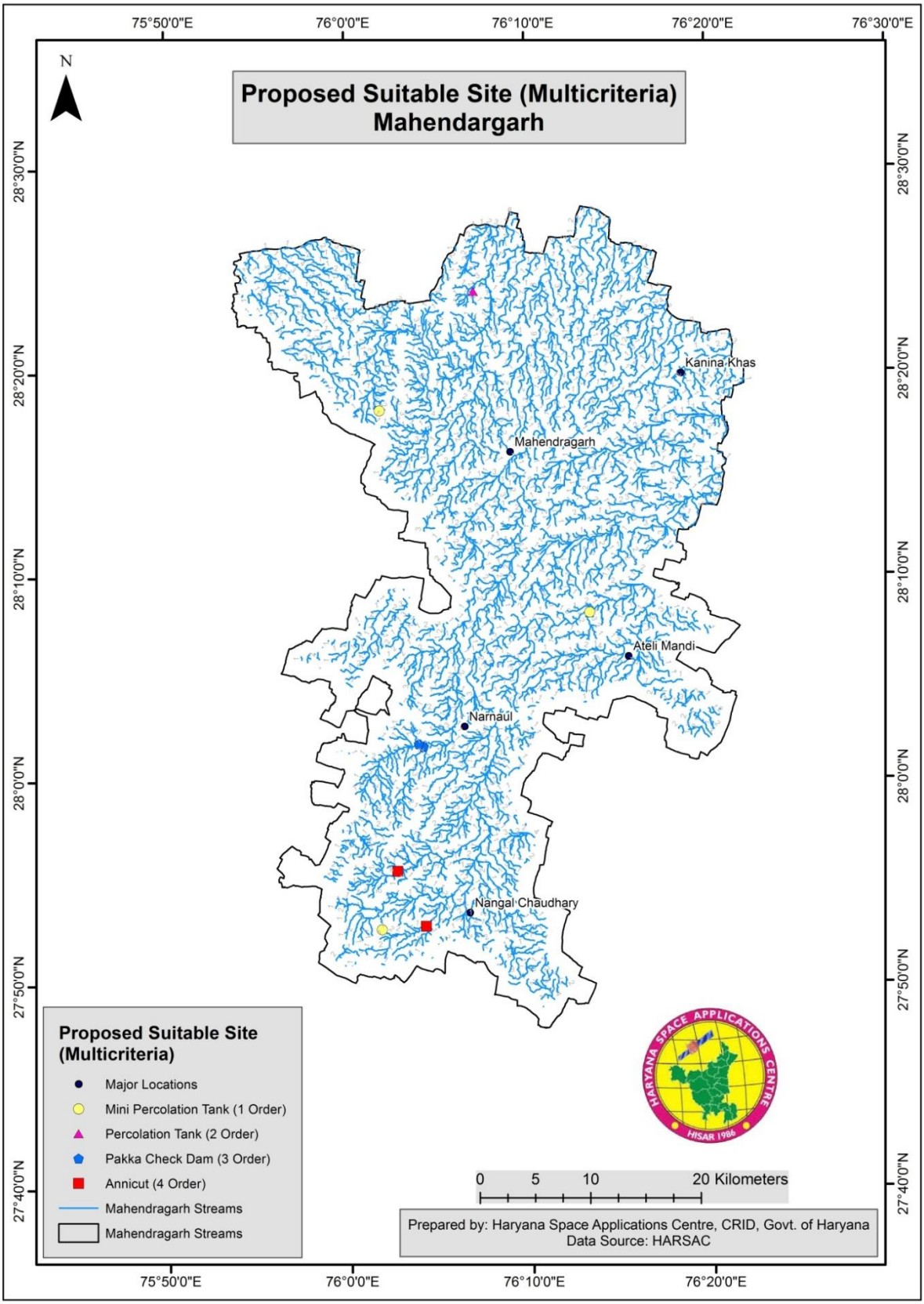


Figure 22 Proposed suitable sites based on multicriteria in Mahendragarh District

8.3 Proposed Suitable Site based on Drainage

The drainages that are created from satellite imagery can be used as base for the water harvesting structure. 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 Ist order Stream, percolation Tanks on 2nd Order Stream, pakka check Dams 3rd Order Stream, Annicut on 4th order, Micro Irrigation tanks 5th Order can be built. **Figure 23** shows the proposed suitable sites based on drainage structure in Charkhi Dadri district. Proposed harvesting structures in Charkhi Dadri based on drainage **Table 25.**

Table 25 Proposed harvesting structures in Charkhi Dadri based on drainage

Sl. No.	Block Name	Mini percolation Tank	Percolation Tank	Pakka Check Dam	Annicut	Micro Irrigation Tank
1	Ateli Mandi	0	1	3	2	7
2	Kanina Khas	12	2	40	26	3
3	Mahendergarh	10	4	28	15	23
4	Nangal Chaudhary	2	1	9	16	14
5	Narnaul	0	0	16	6	2
6	Nizampur	5	2	12	3	0
7	Satnali	5	1	18	7	5
8	Sihma	0	2	2	7	10

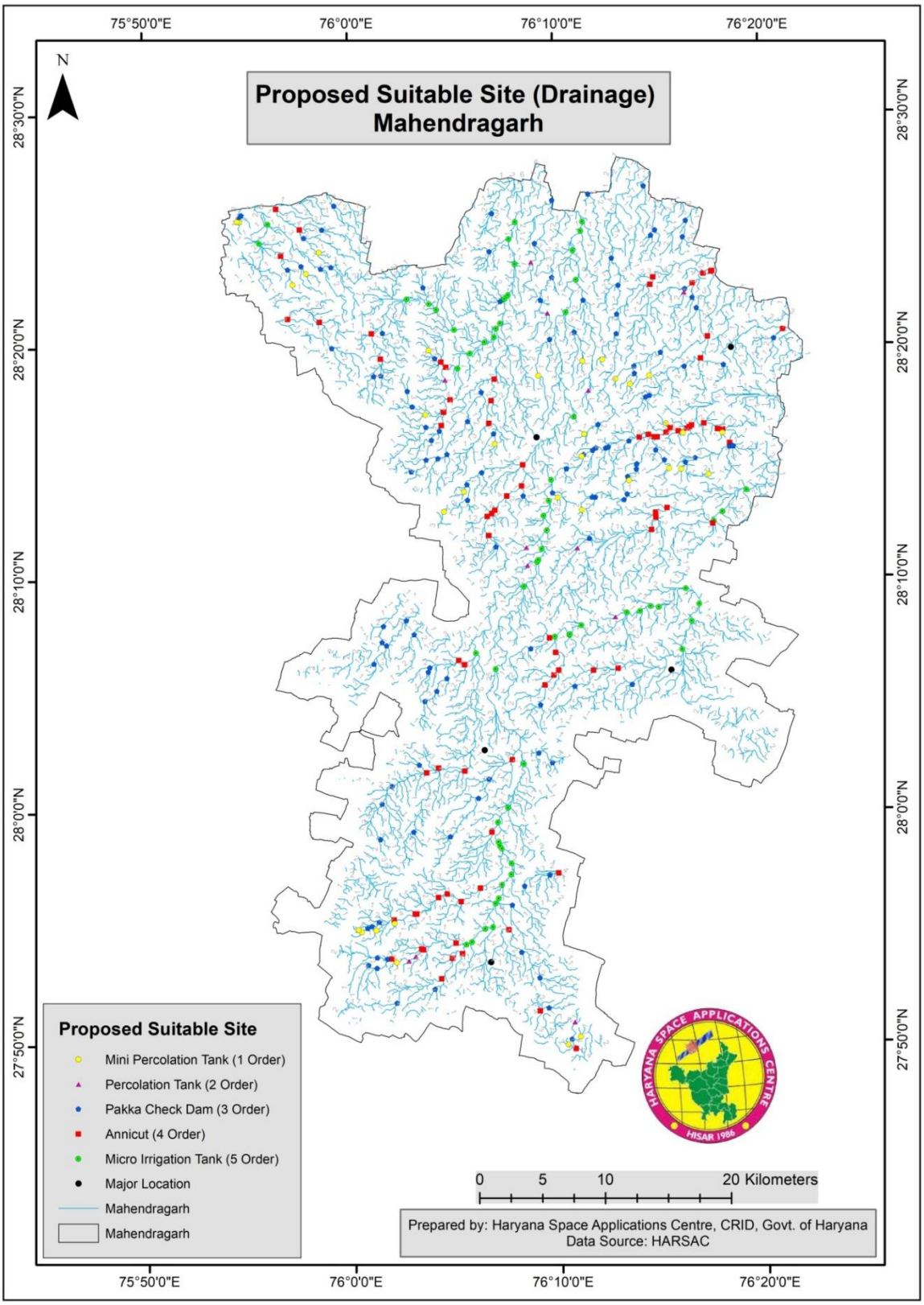


Figure 23 Proposed suitable sites based on drainage in Mahendragarh District

9 Conclusion

Water being an ongoing reliable source around the world, it will not be available forever. When top energy consumers include the United States and China, along with environmental factors affecting these two regions, there is no doubt that this valuable resource will be limited on Earth. Water scarcity is no joke and shouldn't be taken lightly for it has great effects on food production, our farm lands, our health, and our economies. Droughts are common factors of this scarcity of water by drying up land and all the life contained in it. The land for crops is shrinking and are in need of more and more water everyday causing limited amounts of fruits and vegetables to be produced according to the research found by Daryanto and Gilis. When there is low food production, there come high demands which affect the economy.

Environmental concerns are not situated in one side of the world. Water is a broad source extending to different countries along with different advanced technologies. Irrigation has become widespread to improve farming and food production as well. Risks are taken into account because there may be cases in which misuse of conservation technology can affect our health and other resources other than water. Menses illustrates this situation well in his research regarding wastewater in the dairy industry. Through extended research, it is found that these happenings don't just occur once and in one place. The solution to prevent these occurrences exists in such initiatives of the government such as the JAL SHAKTI ABHIYAN. This is where collaboration is important among states and regions. To better and preserve our natural resources, actions and attitudes towards sustainability must stay at a high level throughout nation who is willing to work together towards the same goal.

…… END…….

“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

PIKU