Report No.-02

JSA-CTR

Scientific Action Plan for Bhiwani

Prepared By-

Haryana Space Applications Centre (HARSAC),

Citizen Resource Information Department (CRID)

Government of Haryana

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1 Introduction

1.1 History

Bhiwani is a corrupted form of Bhani. The town was founded by a Rajput chief called Neem Singh. His wife named Bhani once saved his life from treachery. In 1803, Bhiwani was annexed by the British raj from the Maratha Empire. In 1817, William Frazer built a mandi (grain and goods market) here, resulting in the emergence of town as the regional hub of trade. Consequently, he named the town after her. The corrupted name of the town from Bhani to Bhiani (natives still use this pronunciation) eventually came to be known as Bhawani-Indus Valley Civilization mine, smelt and houses have been found at Khanak hills of Tosham Hill range. Excavations (1968–73 and 1980–86) in the village of Mitathal in Bhiwani have unearthed evidence of pre-Harappan and Harappan (Indus Valley Civilization) culture in the area. Near the village of Naurangabad, about 10 kilometres (6.2 mi) east of Bhiwani city, preliminary diggings in 2001 revealed artifacts including coins, tools, sieves, toys, statues and pots up to 2,500 years old. According to archaeologists the presence of coins, coin moulds, statues and design of the houses, suggests that a town existed here sometimes in the Kushan, Gupta and the Youdheya period till 300 BCE. Bhiwani city is mentioned in the Ain-i-Akbari and has been a prominent centre of commerce since the time of the Mughals

1.2 Location

Bhiwani district lies in south-western part of Haryana state covering an area of 4778 sq.km. There is no perennial river passing through the district. Physio graphically, the district consists of flat level plain interrupted from place to place by clusters of sand dunes, isolated hillocks and rocky ridges. A few isolated rocky ridges elevated sharply from the plain occur in the south-central portion of the district. Dohan river is the only ephemeral stream in the area and flows with the onset of precipitation. The district is located between 28°19’ to 29°05’ North latitude and 75°26’ to 76°28’ East longitude. It is surrounded by Hissar district on its north, some area of Jhunjhunu and Churu District of Rajasthan on its west, Mahender Garh, Jhunjhunu district on its south and district Rohtak on east. It is 124 Kilometre from Delhi & 285 Kilometre from Chandigarh. The Location Map of Bhiwani district is shown in **Figure 1**.

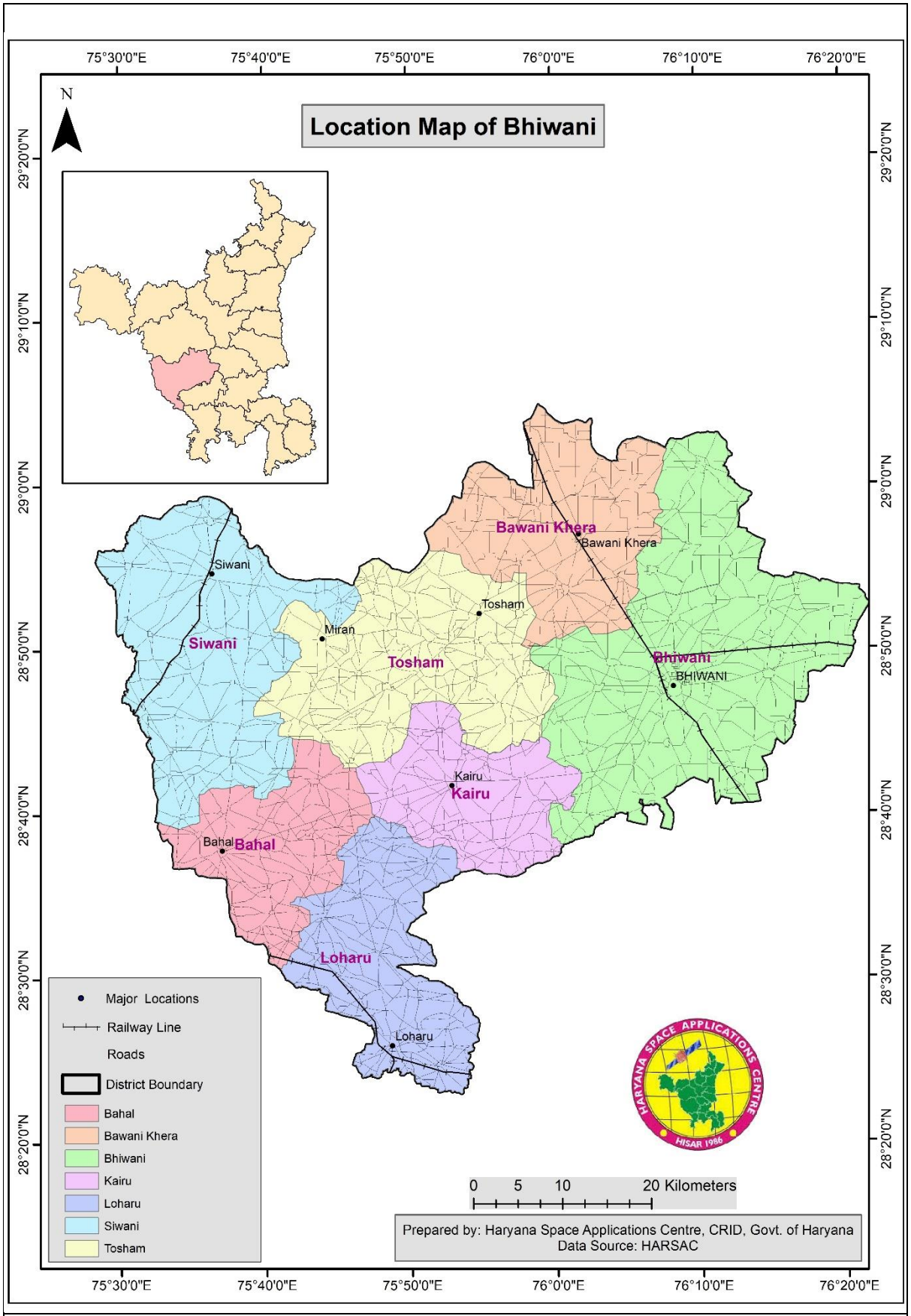


Figure 1Location Map of Bhiwani District

1.3Administrative Setup

Bhiwani district is one of the 22 districts of the northern Indian state of Haryana. Created on 22 December 1972, the district was the largest district of the state by area, before the creation of Charkhi Dadri as a separate district, as it occupied an area of 4,778 square kilometres (1,845 sq. mi) and administered 442 villages with a population of 1,634,445. Sirsa is now the largest district of the state. The detailed administrative setup is shown in **Table 1**.

Table 1 Major Administrative Jurisdictional Setup of Bhiwani District.

Country	India
State	Haryana
Division	Hisar
Headquarters	Bhiwani
Tehsils	1. Bhiwani, 2. Bawani Khera, 3. Tosham, 4. Siwani, 5. Loharu
Area	3,432 km2 (1,325 sq. mi)
Total Population (2011)	1,132,169
Density	330/km2 (850/sq. mi)
Lok Sabha constituencies	1. Bhiwani-Mahendragarh (shared with Charkhi Dadri and Mahendragarh districts), 2. Hisar (shared with Hisar and Jind districts)
Literacy	
Vidhan Sabha constituencies	1. Bhiwani, 2. Loharu, 3. Tosham, 4. Bawani Khera
Website	https://en.wikipedia.org/wiki/Bhiwani_district
Location of Bhiwani	
Coordinates	28.19 degree and 29.05-degree north latitudes and 75.26 degree and 76.28-degree east longitudes.

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

Sub Divisions (4)	Bhiwani, Loharu, Tosham, Siwani
Tehsils (5)	Bhiwani, Bawani Khera, Loharu, Tosham. Siwani
Sub-Tehsils (4)	Behal
Blocks (4)	
Municipal Corporation ()	Municipal Corporation, Gurugram Municipal Corporation, Manesar
Municipal Council (1)	Sohna
Municipal Committees (4)	Bhiwani, Loharu, Tosham, Siwani
Population (Census 2011)	196,057

Source: https://bhiwani.gov.in/about-district/administrative-setup/

Local Institutions: -

Total Villages	272
Village Level	Panchayat
Block Level	Panchyat Samiti
District Level	Zila Parishad

Source: https://bhiwani.gov.in/about-district/administrative-setup/

1.4Climate

1.4.1 Temperature

Temperature in the Bhiwani District varies from 2° C to 45°C. In May the highest number of daily hours of sunshine is measured in Bhiwani on average. In May there is an average of 12.15 hours of sunshine a day and a total of 376.67 hours of sunshine throughout May. In January, the lowest number of daily hours of sunshine is measured in Bhiwani on average. In January there are an average of 8.86 hours of sunshine per day and a total of 274.63 hours of sunshine. Around 3711.47 hours of sunshine are counted in Bhiwani throughout the year. On average there are 122.02 hours of sunshine per month.

1.4.2 Rainfall

The principal precipitation is by South-Western Monsoon during the period from June to September. Most of the rainfall (about 85%) of annual precipitation occurs during this period. The winter rains are rare & scanty. The annual rainfall recorded at 7 Rain gauge stations in Bhiwani District for last 40 years (1975-2015). Minimum average annual rainfall is recorded in 2002 which is 73.33 mm and maximum in 1975 &2008 which is 624.75 & 606.67 mm and the average annual rainfall for the district comes to 340.8 mm. During a period of 25 years' area faced two severe droughts viz. during year 2002 and 2012, when only 75.14 mm and 68 mm rainfall occurred, respectively. There were 10 years when was below average (317.27) mm, which was not sufficient to harvest good crops. Although, during the year 1995 and 2008, annual rainfall was around 600 mm, which could be declared as good rainfall years and district got a bumper crop production. Good rainfall; around 350 mm; occurred during the remaining 11 years. Rainfall amount also varied among different blocks. Average rainfall occurred highest in Bhiwani (408.8 mm), Badhra (377 mm), Loharu (365.09 mm), Tosham (248.34 mm), Siwani (222.89 mm) and least in Bawani Khera (199.18 mm). Amount of rainfall varied depending on location of the block. It is quite interesting analysis that farmers of block Bawani Khera are getting good profit from farming in comparison to block Loharu and Badhra, although, block received least average rainfall during the 25years. It might be due to type of soil, technologies adopted by the inhabitants and availability of subsurface water resources. Block Bawani Kheda had good quality soils and water.

Whereas, block Loharu has been notified by Central Ground Waterboard under dark zone. The rainfall map Mewat district is shown in **Figure 3**

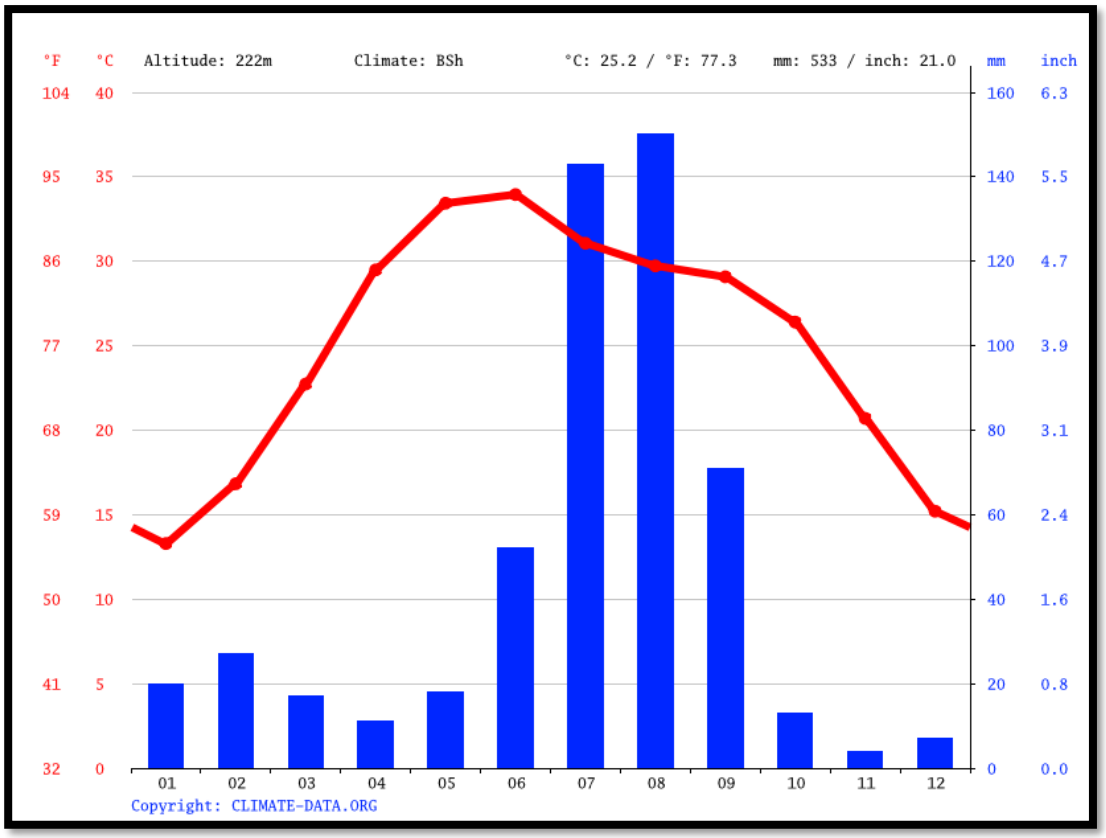


Figure 2Climate graph/ Weather by month of Bhiwani

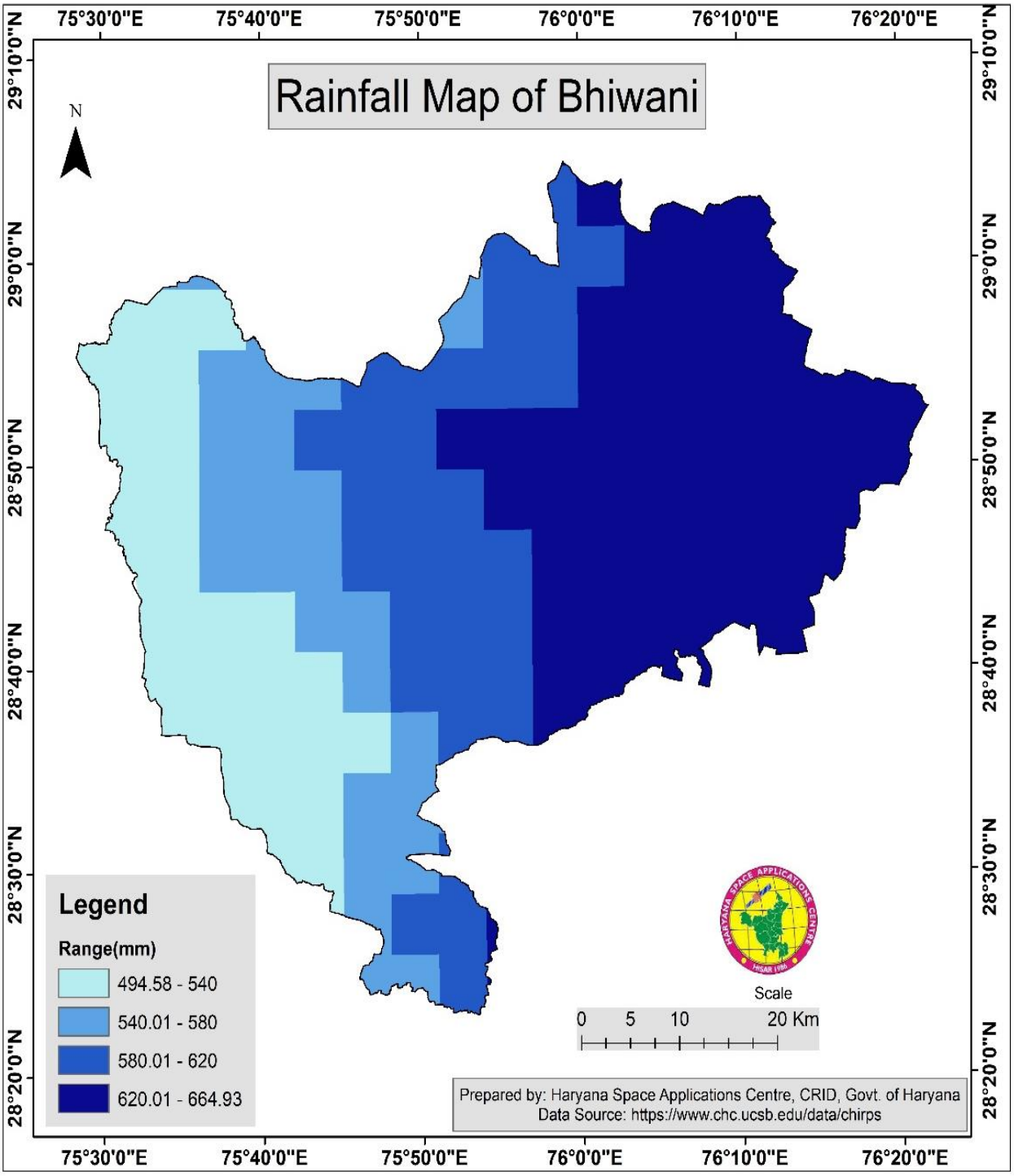


Figure 3 Rainfall Map of Bhiwani District

1.5Elevation and Topography

Bhiwani lies 225 meters above the mean sea level. The district consists of flat and level plain interrupted from place to place by clusters of sand dunes, isolated hillocks and rocky ridges. A few isolated rocky ridges elevated sharply from the plain occur in the south-central portion or the district. Dohan river is the only ephemeral stream in the area and flows in direct response to precipitation. Only the tail of this ephemeral stream falls in the south-central corner of the district and ultimately dies out in sands around village. **Figure 4** shows the digital elevation map of Bhiwani district where red colour shows the highest value up to 399 meters and the lowest value has been presented in deep blue.

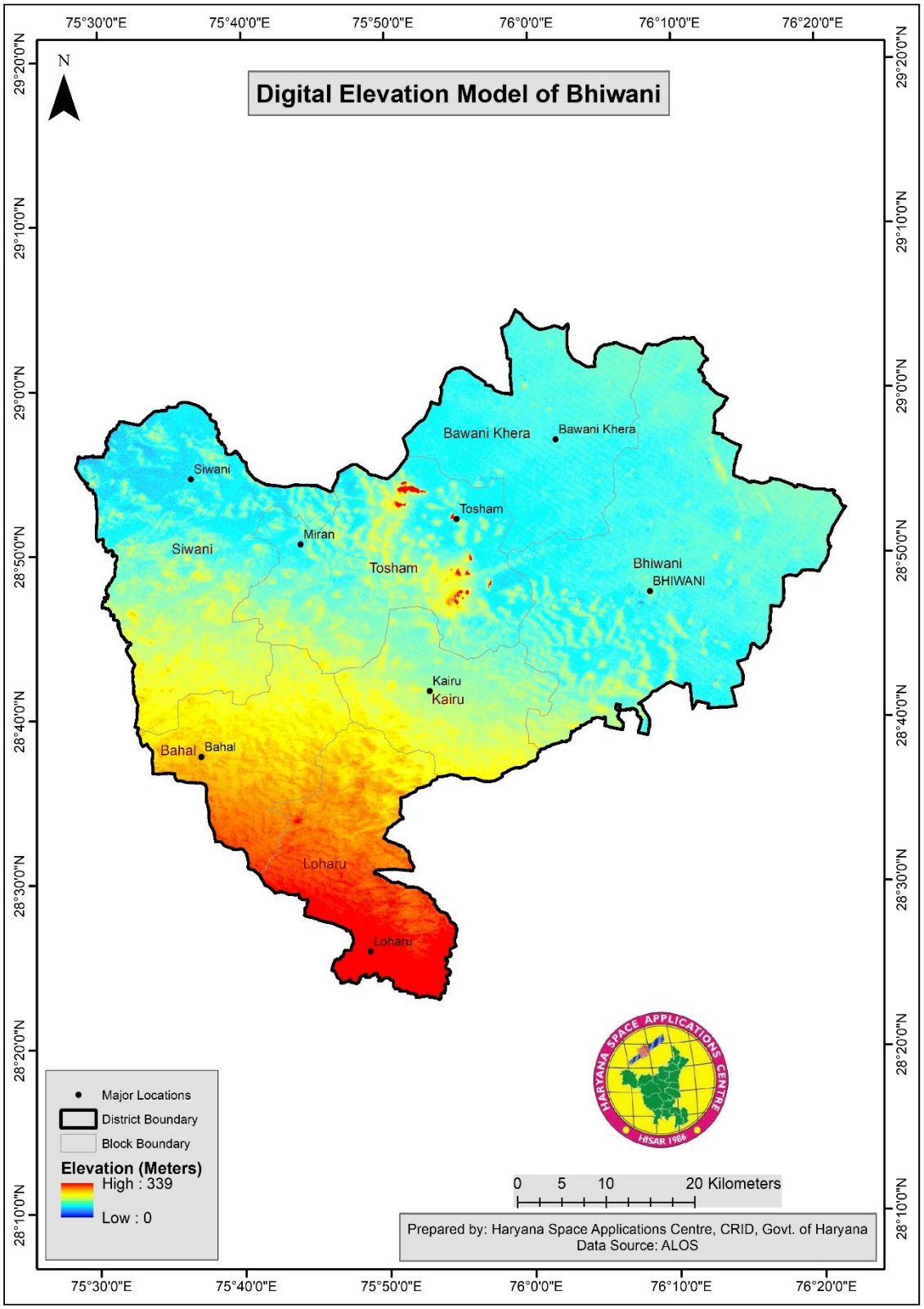


Figure 4 Digital Elevation Model of Bhiwani District

Slope map (**Figure5)** and contour map (**Figure6)** have been presented below for Bhiwani district. Slope ranges from flat to more than 35 degrees. Colour red has been used to indicate slope and green colour shows flat surface. So, from the figure it is very clear that this district mostly falls under flat zone.

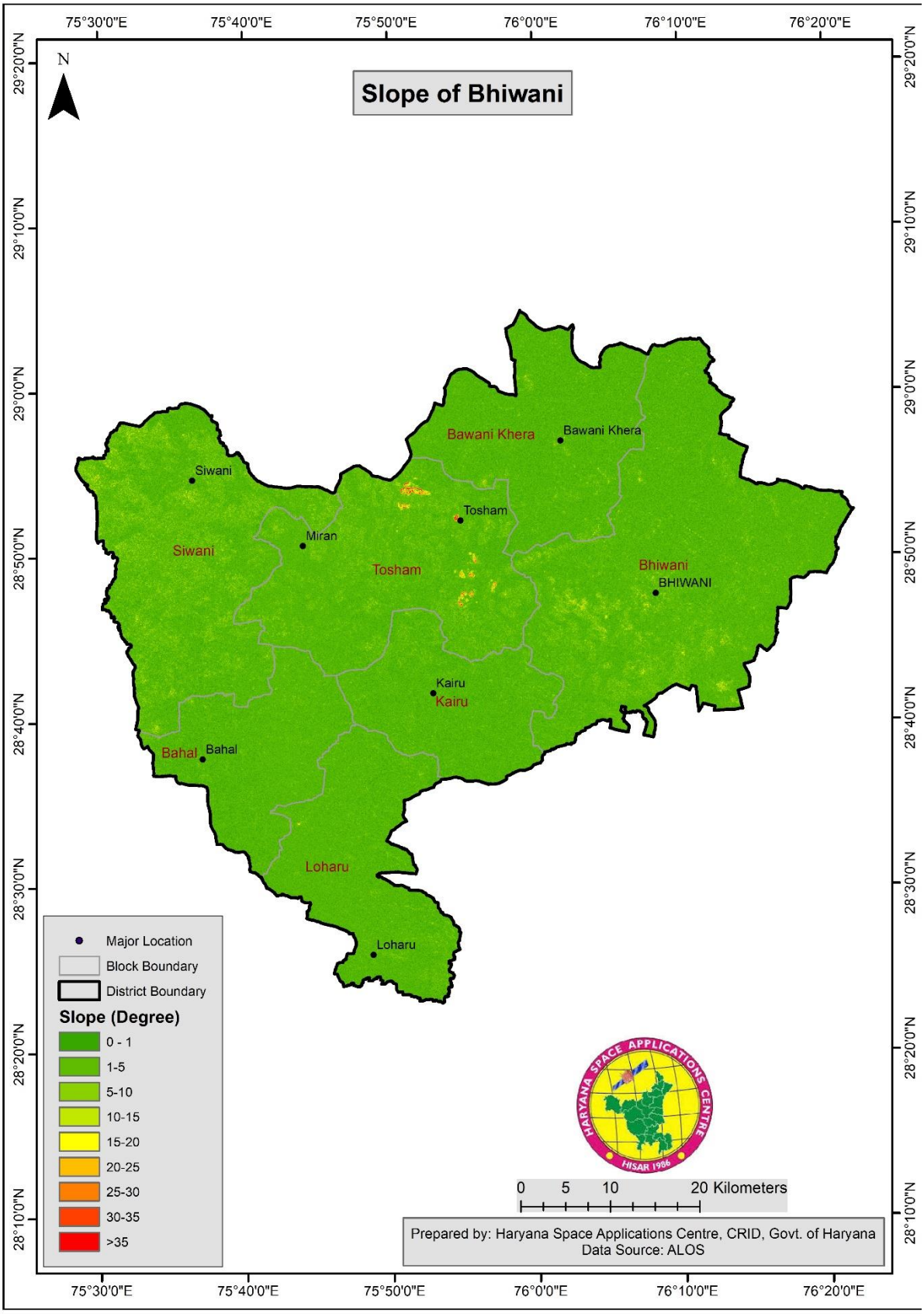


Figure 5 Slope Map of Bhiwani District

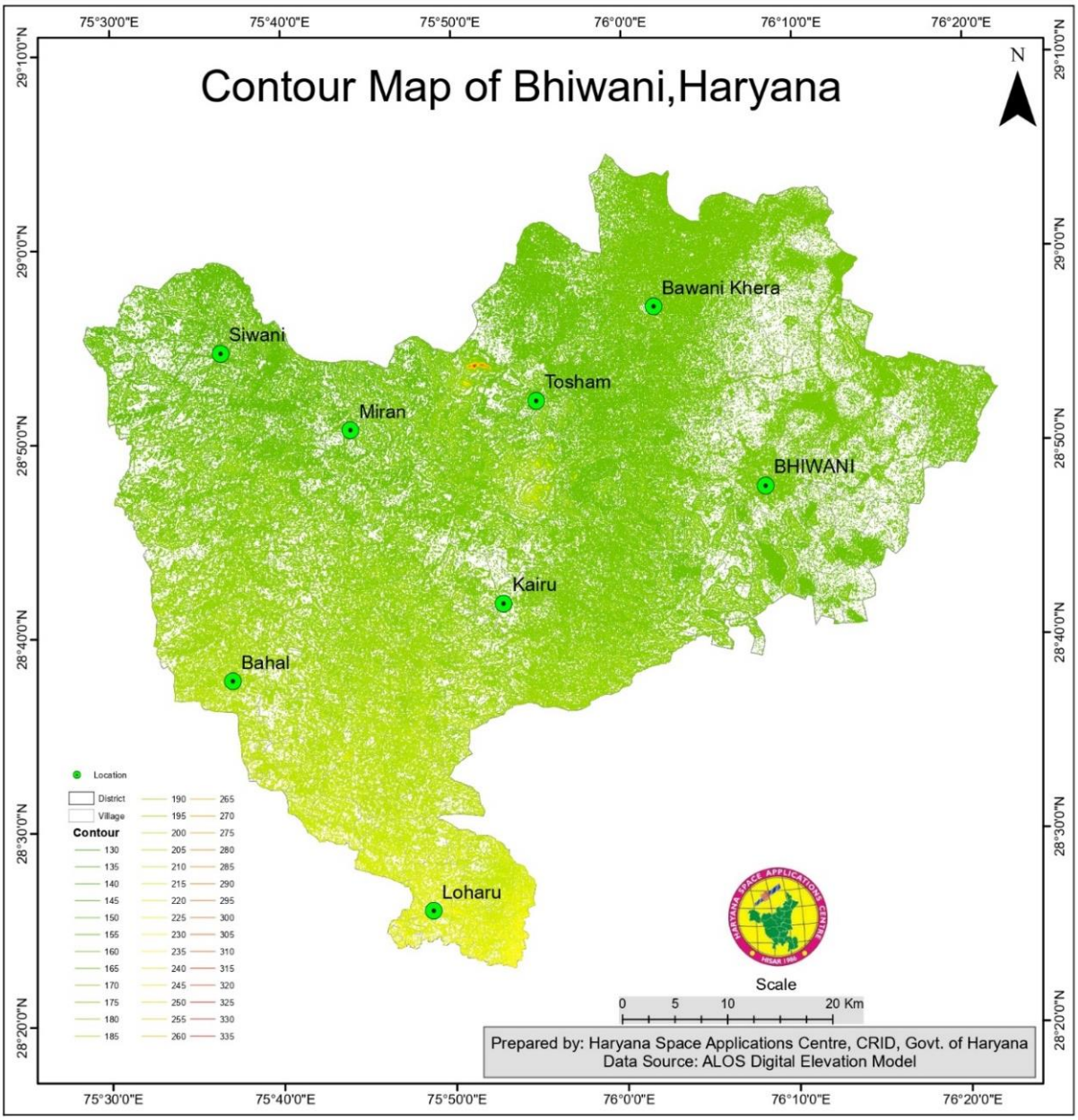


Figure 6 Contour Map of Bhiwani District

1.5.1 Geology and Lithology

The geological formation met within the district are ferruginous chiastolite schist associated argillaceous rocks of Aravalli group, Alwar quartzite of Delhi system, Malani suite of volcanics of lower Vindhyan age, Older alluvial deposits of Quaternary age and Aeolian sands of recent age the out crops are, however, limited to small parts of the district, Older alluvium occurs extensively in the area consisting of inter bedded , lenticular, interfingering deposits of gravel sand ,silt, clay and Kankar mixed in various proportions **(Figure7).** The youngest formations are aeolian deposits, which are unconsolidated surface sands covering large area in the western part of the district, these deposits occur as sand dunes at the surface and consist of sands. Ground water occurs in alluvium and aeolian sands and underlying jointed and fractured hard rocks formations also form the aquifers, in alluvium, sands, silt, kankar and gravel form the water bearing zones. In-shallow aquifers zones, ground water occurs under water table conditions where as in the deeper zones, confined/semiconfined condition exist, hard rocks comprising of Aravalli group of rocks, Malani suite of volcanics and Alwar Quartzites of Delhi system are water bearing but have yet not been explored thoroughly. Drilling was conducted at 21 locations in the district, with the depth. Out of these 2 were constructed and remaining had to be abandoned due to poor quality of ground water or inadequate thickness of granular zones. In alluvium granular zones exist down to its entire thickness which is of negligible thickness near the out crops as revealed by the lithology of boreholes. An exploratory tubewell at Budhera taps aquifer zones in the depth range of 52 to 100m and yields 946 LPM for 8.4 m. of drawdown with transmissivity of 1130 m2/day. Another exploratory tubewell located at Jhojukalan taps aquifer zones in the depth range of 52 to 100m yields 632 LPM for 6.5 m. of drawdown with transmissivity of 265 m2/day, 14 Piezometers also been constructed in the district by CGWB for water level monitoring. During the post monsoon period depth to water in the district varies from 0.84 m bgl at Dhanana, Bhawani Khera block (Northern, North-eastern and Eastern part) to 64.19 mbgl at Singhari, Loharu block (Western). In the pre-monsoon period depth to water table ranged between less than 1.87m.bgl at Dhanana, Bhawani Khera block to 65.97 m bgl at Singhari, Loharu block the depth to water level is shallow and range between 0.84 m to 10 m in the Northern, North-eastern and Eastern (Tosham Bhiwani Khera Dadri-l and Bhiwani blocks) and 10 to 20 mbgl in the Southern and North-western parts of the district (Badra, Dadri-ll and Siwani). Ground water levels are deeper in the Western and some patches in the Central part ranging from 40 to more than 60 m (Loharu and Siwani blocks). Water level fluctuation for 10 years shows rising water level trend in the Northern blocks and declining water level trend in southern blocks. During pre-monsoon water level rise fluctuates between 0.35 to 4.44 m, while in post monsoon it varies from 1.12 to 3.35 m. The decline varies from 0.71 m to 7.68 m.

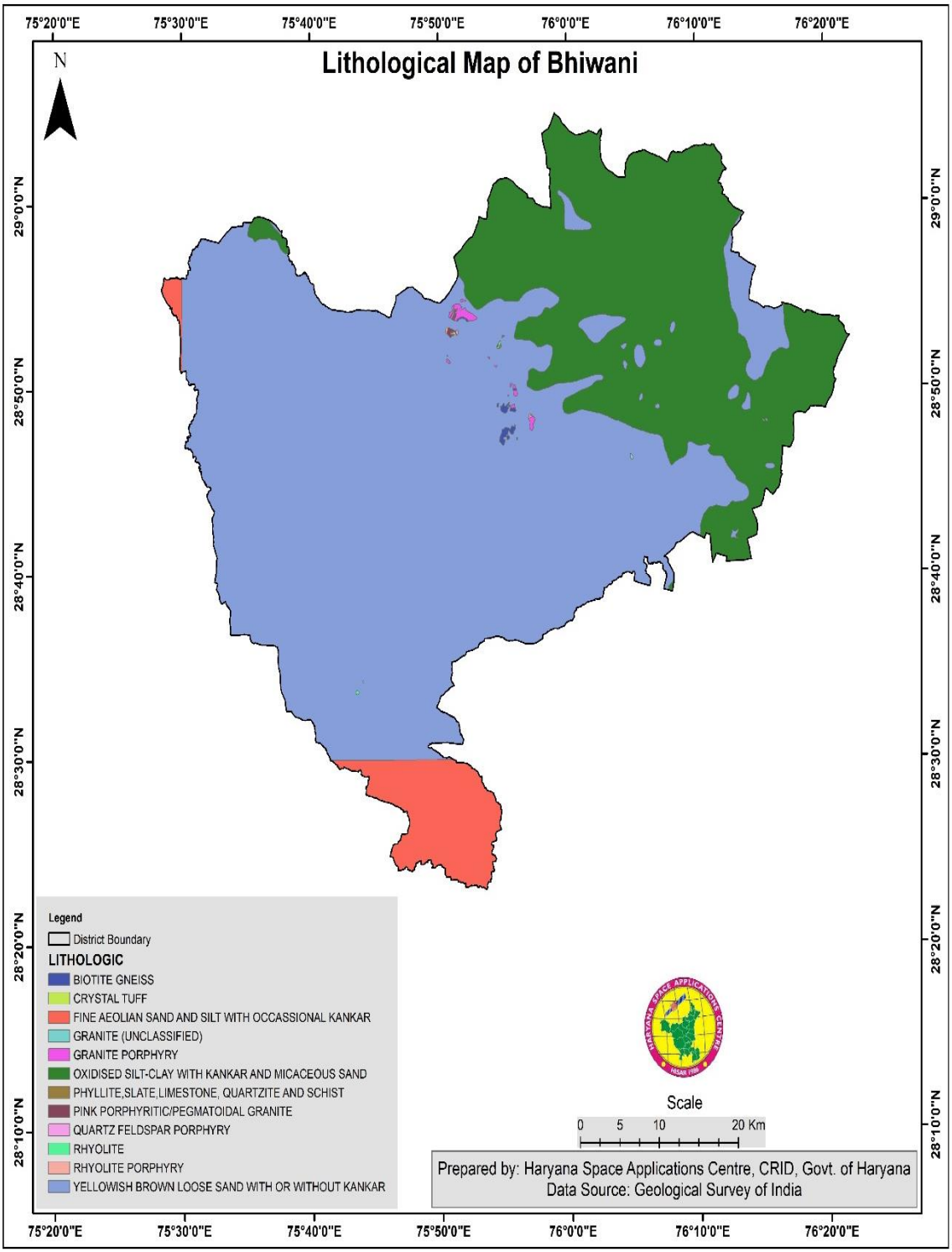


Figure 7 Lithological Map of Bhiwani District

1.5.3 Soil Profile

The type of soil is an important factor for the growth of plants and crops in any area. The soil system has various criteria to classify the soils of a region such as geology, humidity, rainfall pattern, soil texture, soil salinity etc **(Figure8).** The district has two types of soils viz Sierozem and Desert soils. The sierozem soils are found in major parts of the district and desert soils are comparatively found in smaller part of the district especially in southern part of the district. Sierozem Soil are found in the areas where the normal annual rainfall varies from 300 to 500 mm. These soils vary from sandy loam to loamy sands in texture and are marginally fertile. Degree of salinity and alkali hazards is highly variable, though salinity is majorhazaed. These soils occur mainly in northern parts of the district

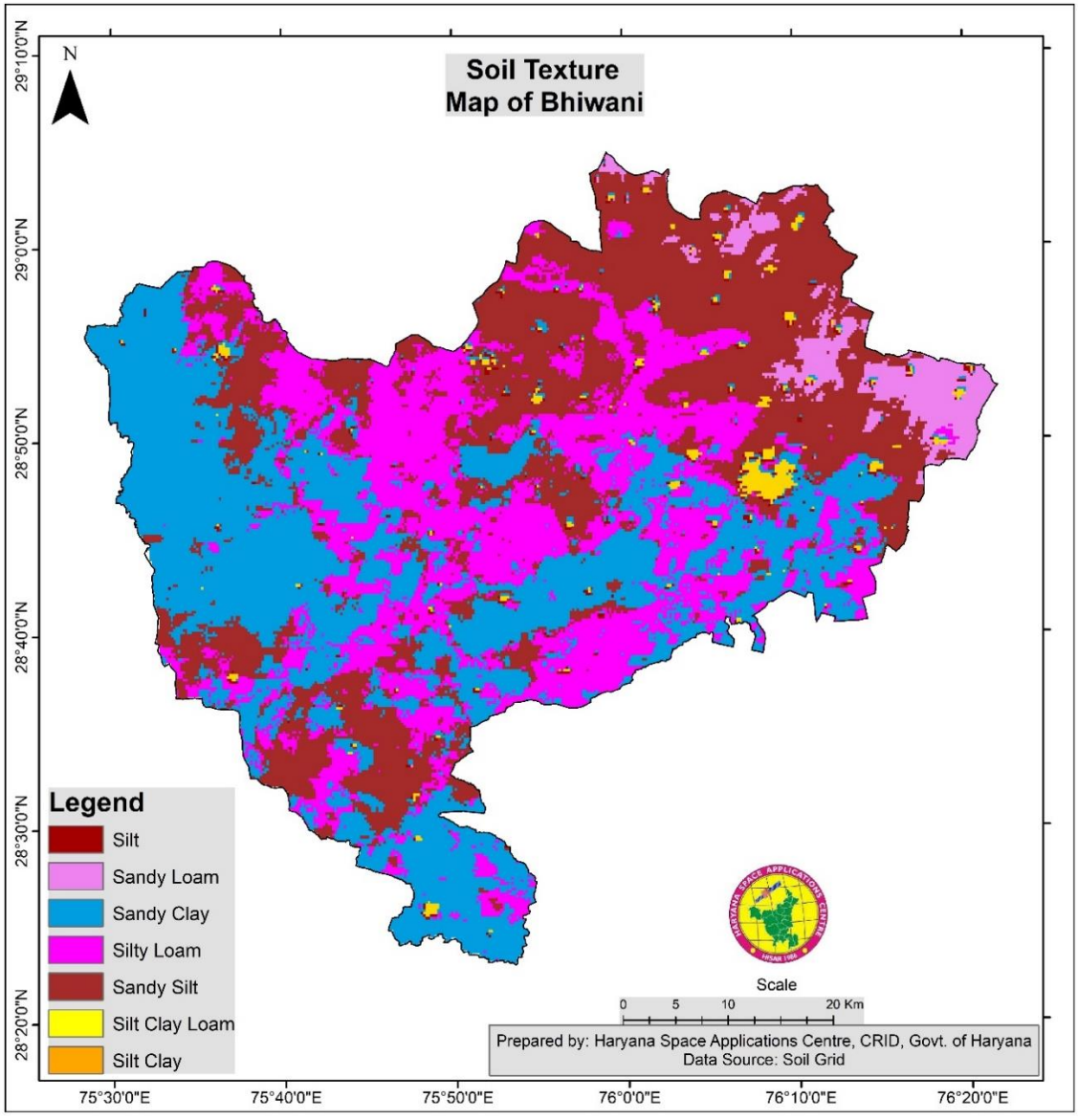


Figure 8 Soil texture map of Bhiwani District

The general profile of soil health of Haryana state is shown in **Figure 9.**

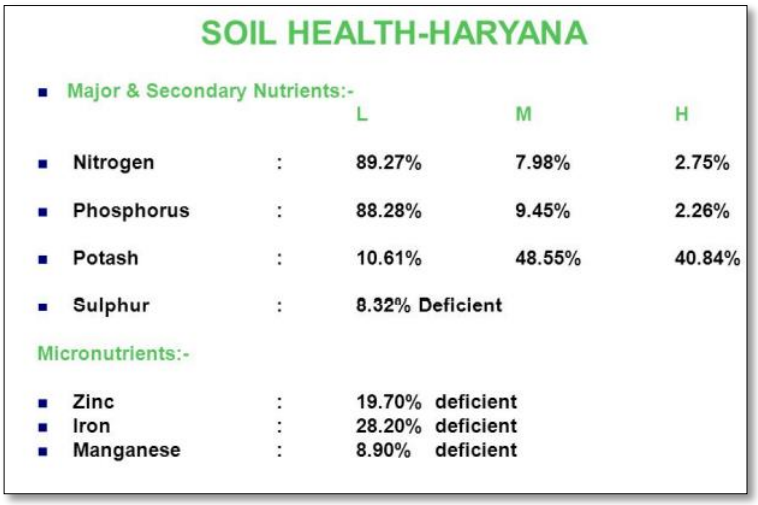


Figure 9 General soil health profile of Haryana

1.6 Landuse

The population of the Bhiwani town as per 1991 census is 121499 persons. As per Population Projection the total population by 2025 A.D. will be 3.6 lacs persons therefore, land is required to adjust additional 2,38,500 persons. Keeping in view the social and economic characteristics of town an overall town density has been assumed to be 40 persons per acre. At the rate of this density an area of about 3570 areas is required to adjust the additional population by 2025 AD. Landuse is shown in **figure 10** The extent of various land uses within Municipal Limits.

Table 2 Landuse in Bhiwani district.

Land use	**Approximate within Municipal limits**
Residential	3543 Acres
Commercial	320 Acres
Industrial	430 Acres
Transport and Communication	310 Acres
Public Utilities	425 Acres
Public and Semi-Public Buildings	547 Acres
Major Public Open Spaces	525 Acres
Total	**6100 Acres**

Residential Zone

To provide for the projected population a residential area of 4083 acres has been proposed keeping in view the general topography and proximity to the existing abides has been changed into residential purposes for Government residential colony as mostly in this area residential construction has been completed.

Commercials

Major commercial uses provided in the plan are as under: - (A) City Centre: - This zone has been proposed in sector 15 near the existing town at Hansi Road. Keeping in view the existing town and proposed development. This area has most venerable location. (B) Commercial Belt: - A hundred-metre-wide commercial belt for important commercial establishment and professional institutions has been provided on the part of main arterial road (the Bhiwani City railway station to bus stand of the town in sector-13) (C) Wholesale Market: - The Marketing Board HSAMB has set up a new grain market on loharu road and the improvement trust has provided a truck stand nearby and vegetable market on Rohtak Road. Area in sector-2 A and near city railway station along railway line has also been provided for whole sale market. All the existing whole sale market and warehousing area shall exist, as has been earmarked as such in the Development Plan. (D) Commercial Belt on circular roads: The circular road around the old walled city of Bhiwani is now an important Boulevard and a commercial belt around this road is proposed in the development plan. (E) Sector-32 falling on northern side of Bhiwani-Rohtak Road as well as along the outer ring road has been reserved for commercial purposes as the area for this purpose is not sufficient in near future. The above major areas along with the existing commercial Bazaars have been earmarked for commercial use.

Industrial

This zone has been provided in continuity with the existing industrial area and provided on Rohtak-Bhiwani Road. This is the most suitable site from the point of view of prevailing wind direction the convenient transport facilities. Besides this, other small industrial zones have been proposed near the existing major units of T.I.T. and B.T.M. in the municipal limits as shown in the plan.

Public and Semi-Public Buildings

The existing educational institutions and public buildings are well located. The sites for major public buildings of Government College, Haryana Education Board, Hafed establishment, Mills Plants, Jersy Cross, Panchayat Bhawan, Tourist Hotel (Public sector"), Bal Bhawan, Red Cross Bhawan have been located on Bhiwani Hansi and Bhiwani city Railway station road. These areas have been zoned for public and semi-public buildings.

Agriculture Zone

A sizeable area has been reserved as agricultural zone. This zone will however, not eliminate the essential building development within this area, such as the extension of existing village taken under project approved or sponsored by Government for such ancillary and allied facilities necessary for maintenance and improvement of the area as an agricultural area. A forestry and orchard belt of approximately 100 M wide have been provided around the urbanised area of the town to act wind and dust breakers for the town. The remaining area in the controlled area outside this orchards belt will continue to be used for agricultural and allied purposes.

The land use land cover map of Bhiwani District is shown in **Figure 10**

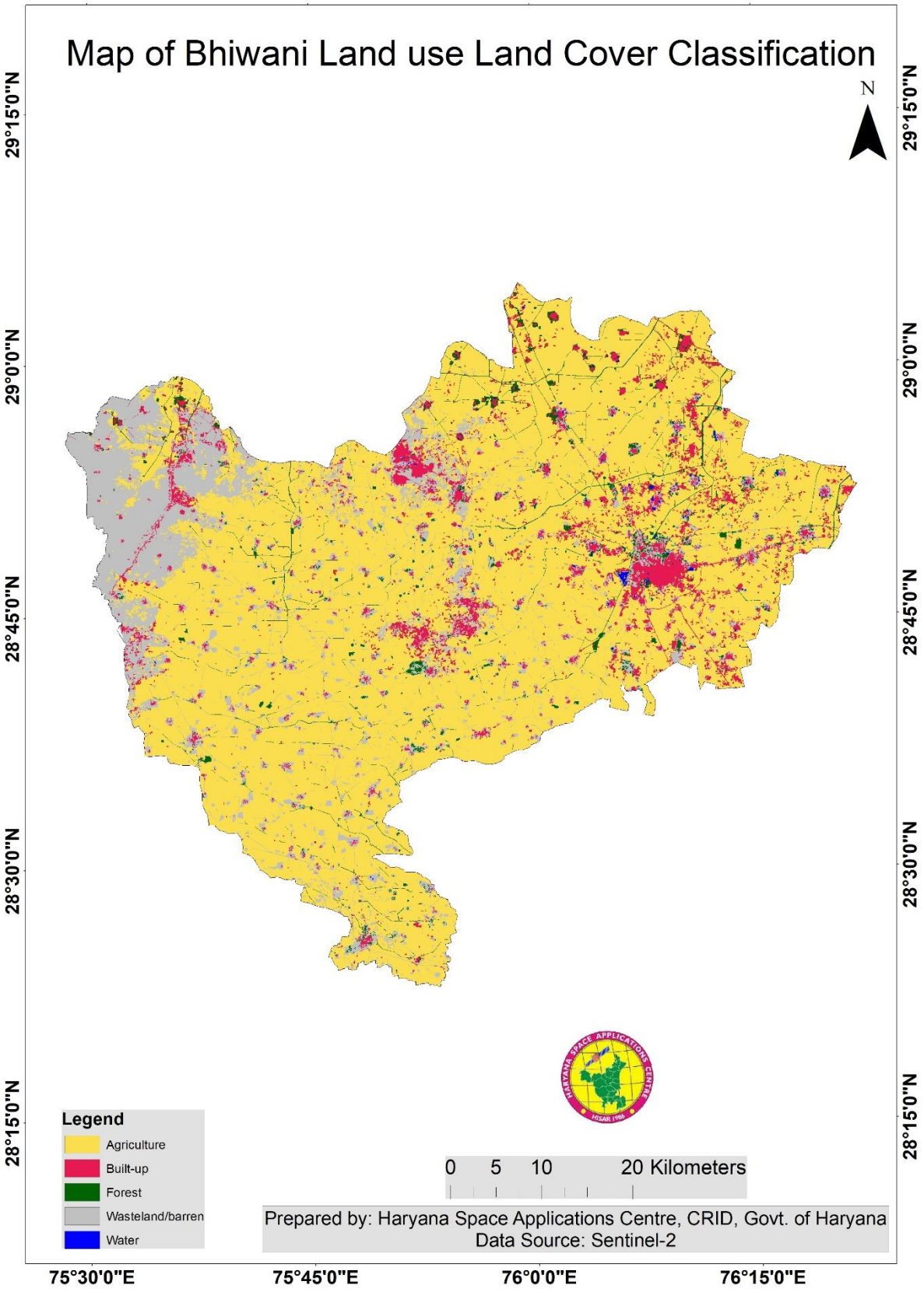


Figure 10 Landuse and Landcover of Bhiwani District

2 District Water Profile

2.1 Source of Water

The sub-soil water level in the district is 100 ft to 250 ft; therefore, the Main Source of water is through existing canal system i.e., from Mohla Head at RD 121000Sunder Sub Branch 1600 Cs to Bhiwani district out of 1750 Cs; Kharakhara Head at RD 107200 of Bhiwani Sub Branch 460 Cs to district Bhiwani out of 560 Cs; Bakra Head at RD 0 of Loharu Feeder 450 Cs and Siwani canal 200 Cs to Bhiwani district out of 300 Cs. In addition to above, tube wells have also been installed by the Public Health Engineering Department and by Agriculture Department.

2.1.1 Canals

The canals irrigate vast tracts of land in the region in Ambala district, Karnal district, Sonepat district, Rohtak district, Jind district, Hisar district and **Bhiwani district.** The Bhiwani Branch, built in 1985, is a sub-branch of Western Yamuna Canal that meanders through Bhiwani district.

2.1.2 Ponds

A pond is a body of standing 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. Some ponds are created specifically for habitat restoration, including water treatment. In Bhiwani district total 878 ponds found with the help of satellite data on village level. **Table 3** shows Bhiwani block wise no. of ponds. The map of total ponds/waterbodies that include ponds, canals are shown in **Figure 11** and **Figure 12** show Monsoonal water-logged area of Bhiwani**.**

Table 3 Bhiwani block wise no. of ponds

Blocks	Ponds
Bawani Khera	304
Bhiwani	780
Kairu	158
Tosham	304
Siwani	195
Bahal	152
Loharu	200

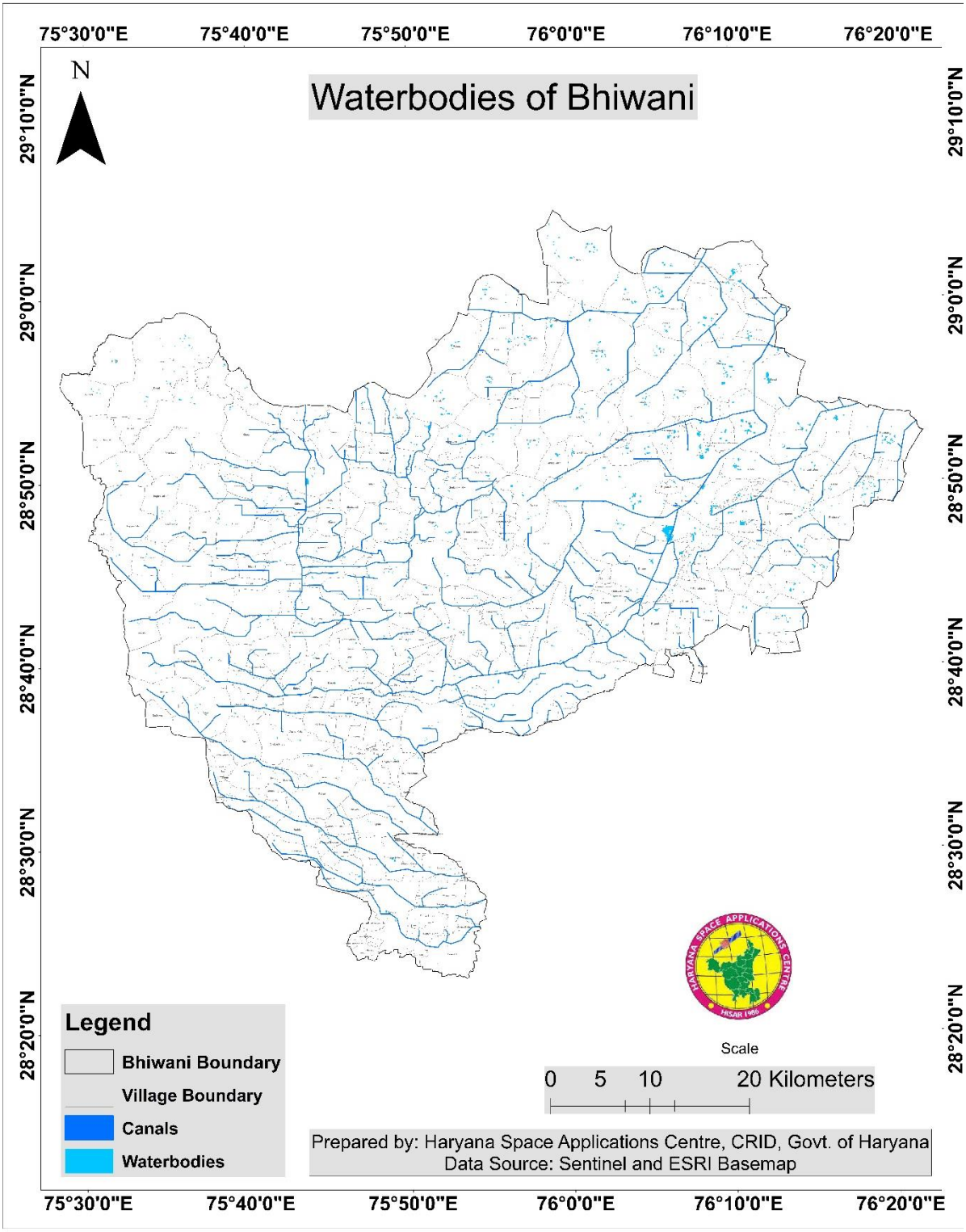


Figure 11Water Bodies of Bhiwani district

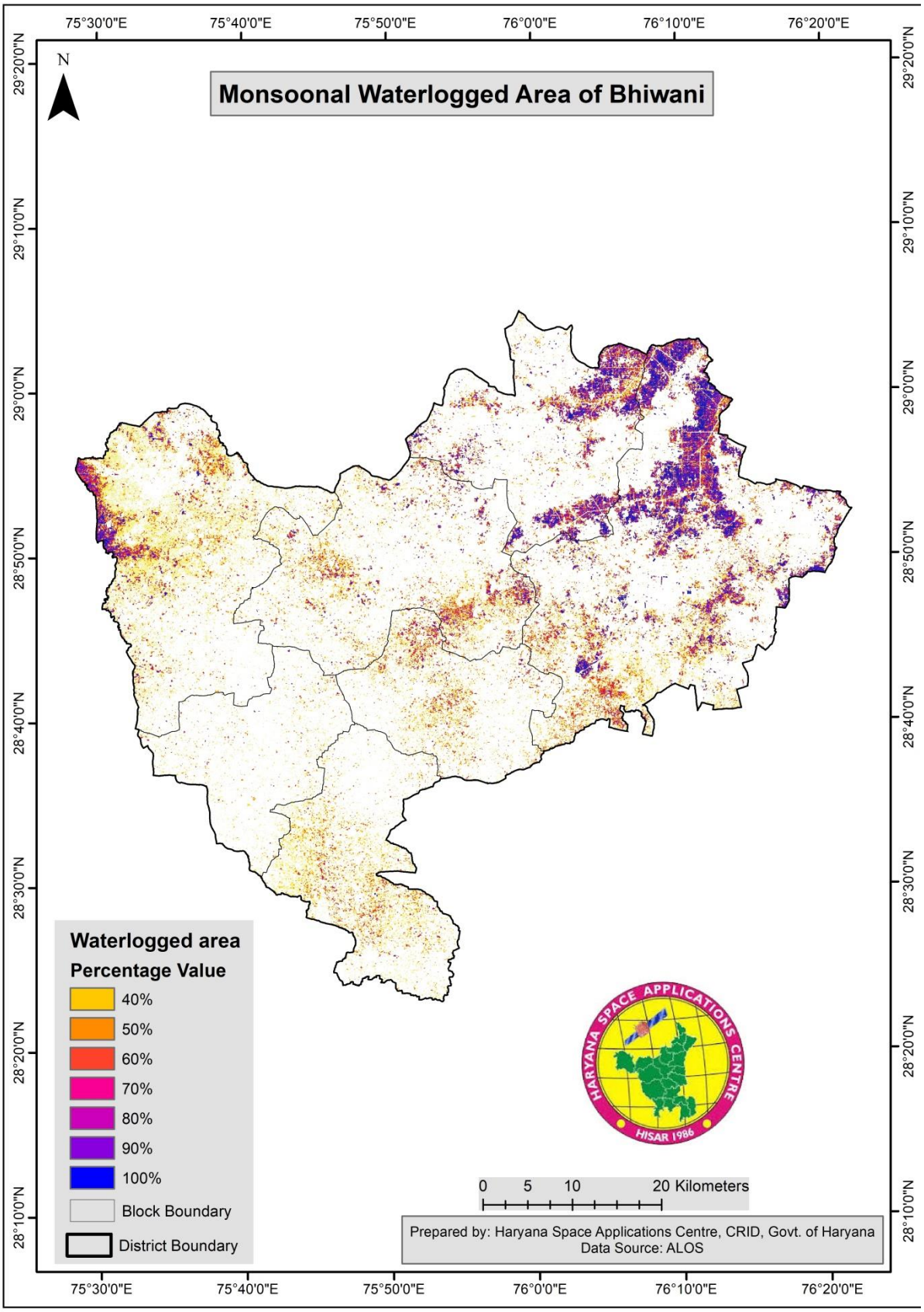


Figure 12 Monsoonal water-logged area of Bhiwani

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 toward the drains DEM is very important. The drainage map of Bhiwani District is shown in **Figure 13.** The statistics of length of drainages under each order are shown in **Table 4**.

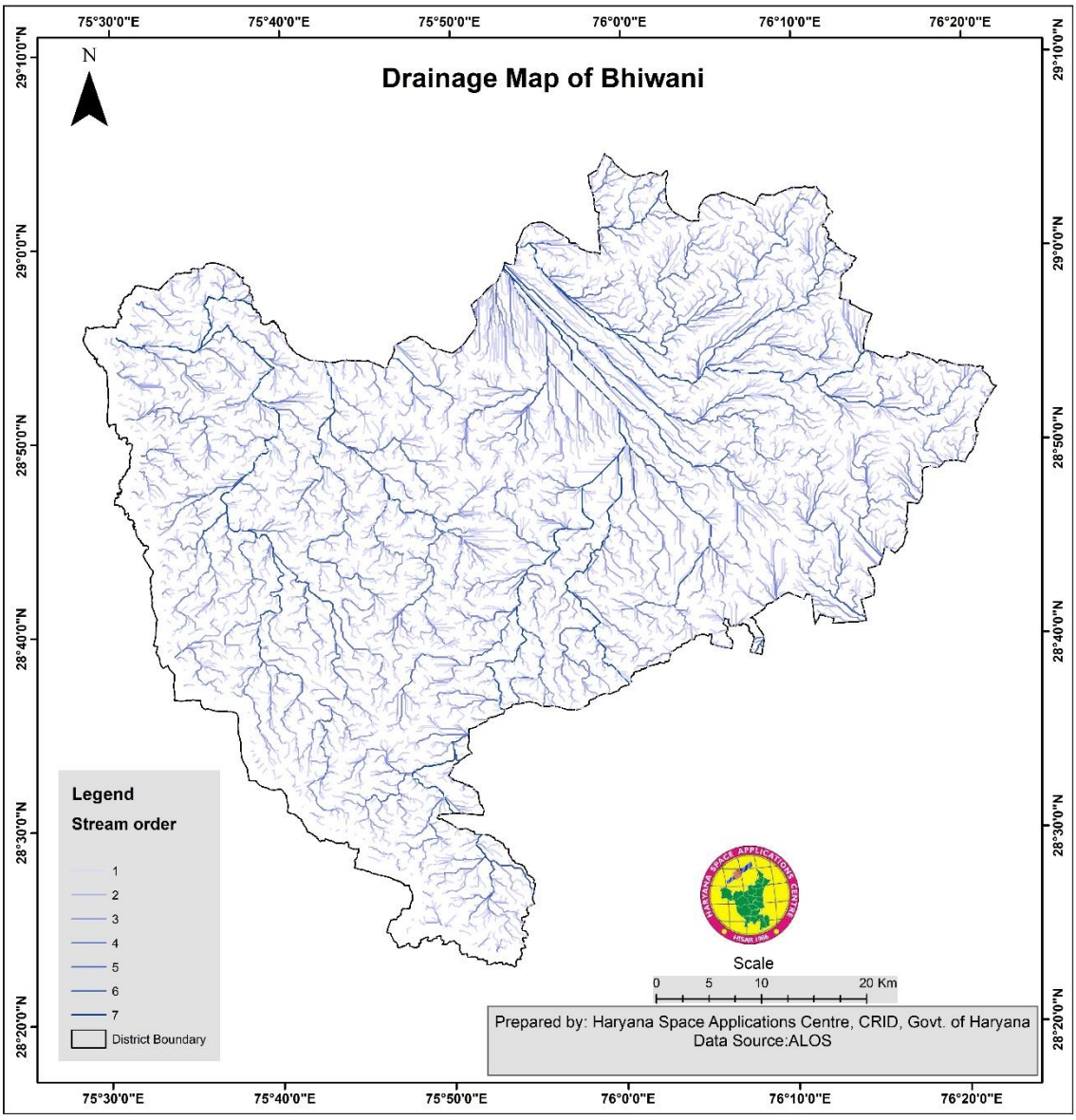


Figure 13 Drainage Map of Bhiwani District

Table 4 Drainage order and total length of the drains in Bhiwani District

Sr.No.	Stream Order	Length in meters
1	1st order	3275353.14432
2	2nd order	1606768.25129
3	3rd order	736868.046915
4	4th order	402236.499406
5	5th order	210364.521241
6	6th order	181028.883783
7	7th order	44397.885279

2.3 Water Harvesting System

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 ‘Har Khet Ko Pani’ and “Snchay Jal Behtar Kal”. 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.

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 5**) 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 5 Water Harvesting System in Bhiwani District

Sr.No.	Activity Name	Works Completed	Works Ongoing	Expenditure (in Lakhs)
Water Conservation and Rain Water Harvesting				
1	Check Dam		0	
2	Pond / Tank		5	
3	Trench	2623	1	
4	Rooftop Water Harvesting Structure (Public)	167	0	
5	Rooftop Water Harvesting Structure (Private)	7		
6	Other Rainwater Recharge Structures (Open Well Recharge, Sand Filter for open well recharge)		0	
7	Other Water Conservation Structures (Bench Terracing, Canal)		19	
	Total		**25**	**213**
Renovation of Traditional and other Water Bodies / Tanks				
1	Traditional Water Bodies Restored	1529	48	
	Total	**1529**	**48**	**649**
Reuse and Recharge Structures				
1	Soak Pit	1388	55	
2	Stabilization Pond	3	0	
3	Other Reuse / Recharge Structure	930	1	
	Total	**2321**	**56**	**11**
Watershed Development				
1	Gully Plug	0	0	
2	Percolation Tank		2	
3	Staggered Trenches	1882	0	
4	Other Watershed Construction Activities	136	39	
	Total		**41**	**605**
Intensive Afforestation				

1	Intensive Afforestation-Nurseries	#####	0	
2	Intensive Afforestation- Plantation		39	
Total			**39**	**27**
Awareness Programs by KVK				
1	Farmer's training programs by KVKs on Water Use Efficiency and Appropriate Crops	368		
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	1118		
Total		**1486**		
Waste Water Treatment				
1	Use of Treated Waste Water	60680		
Total		**60680**		

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 Mewat District for rain water harvesting is shown in **Table 6** at rural and urban area. The map of water conservation activity in Mewat at rural and urban level is shown in **Figure 14**

Table 6 Water Harvesting activities in Rural area and Urban Area

In Rural Area		
Sr. No	**Block Name**	**Total No of Activity (no.)**
1	Bawani Khera	499
2	Bhiwani	1434
3	Kairu	1432
4	Tosham	1126
5	Siwani	3667
6	Bahal	0
7	Loharu	754
In Urban Area		
1	Bhiwani	52

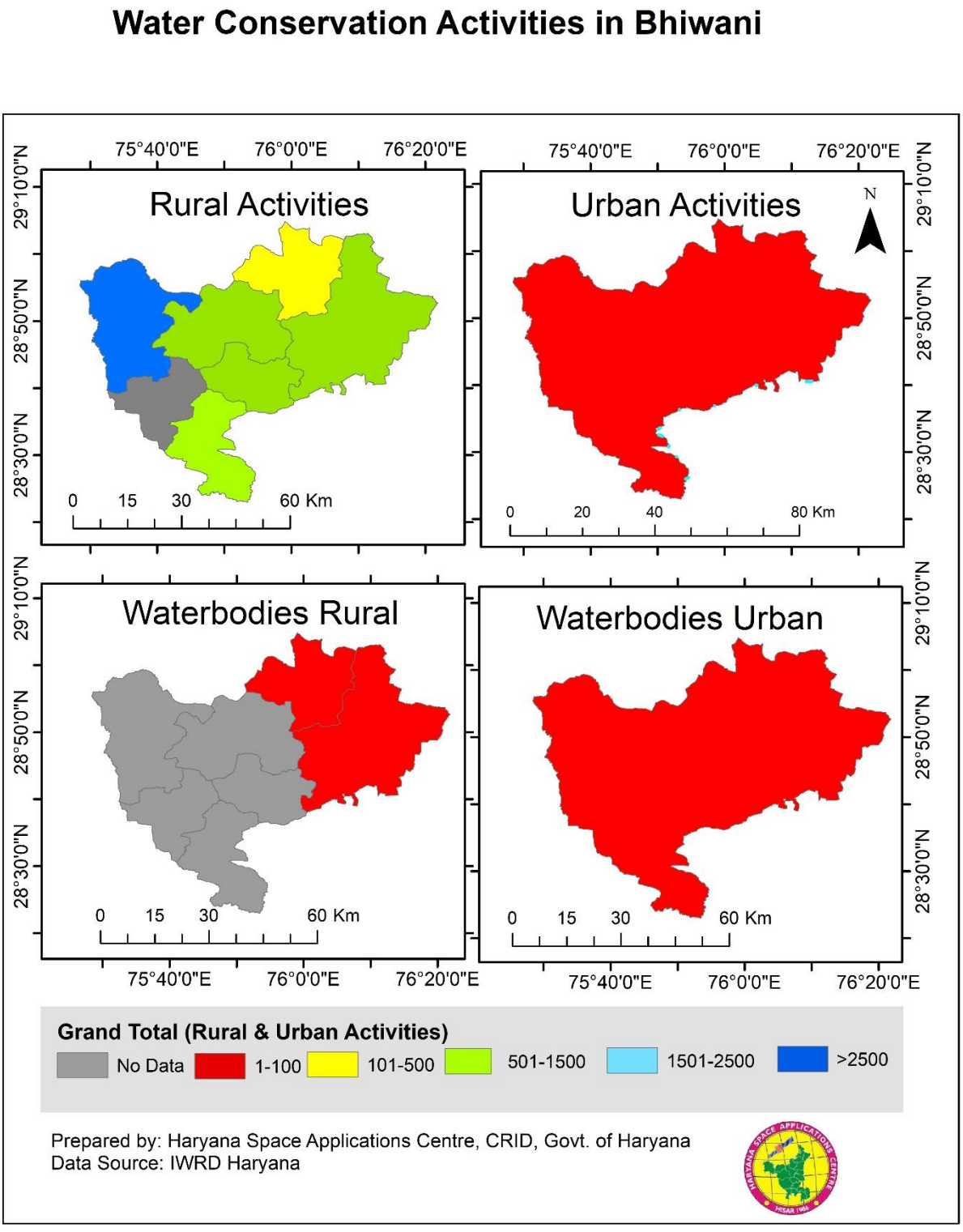


Figure 14 Water Conservation Activity in Bhiwani District

2.3.3 Sewerage Treatment Plant

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 15.** In Bhiwani 7 treatment plants have been installed.

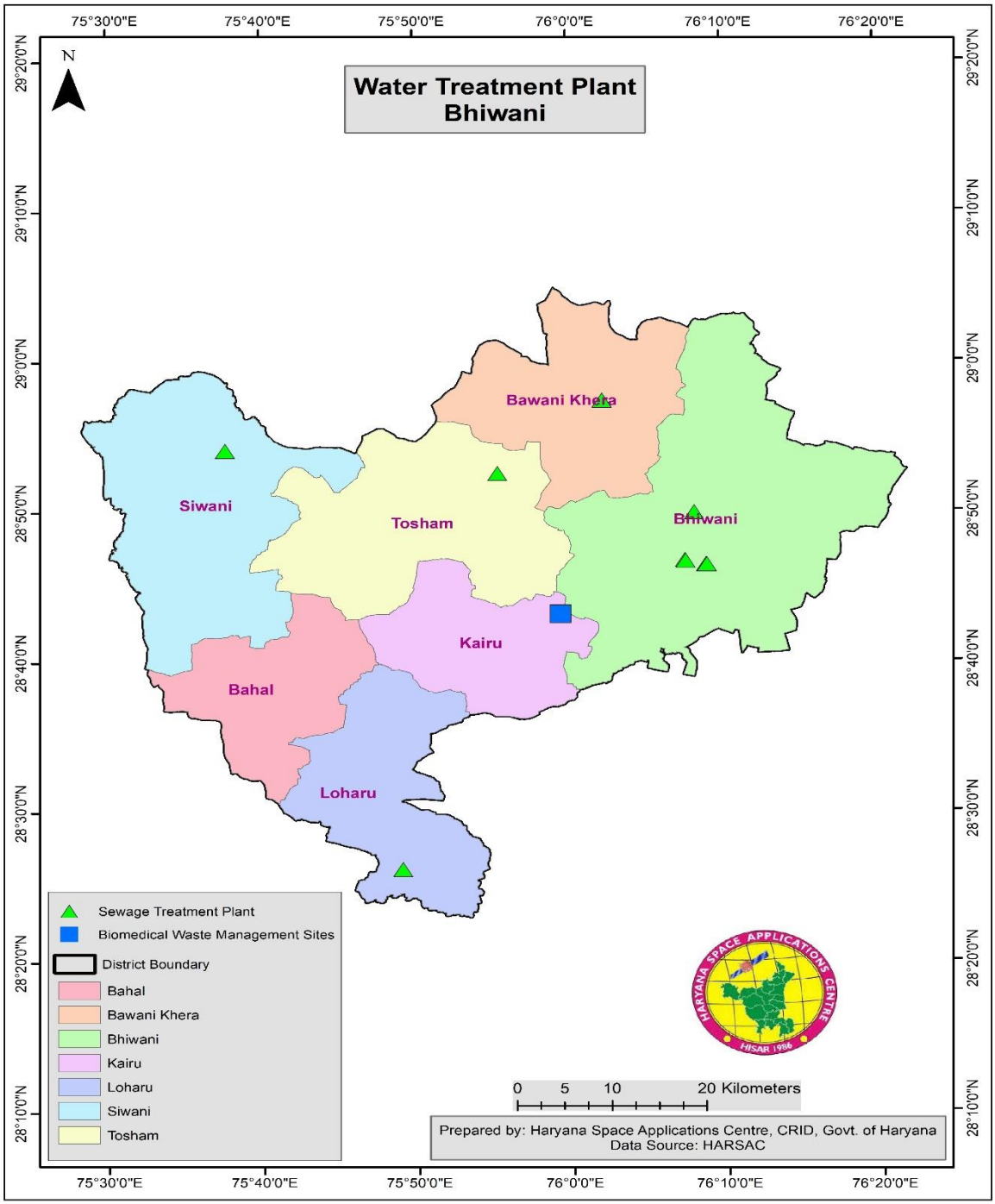


Figure 15Water Treatment Plant Map of Bhiwani District

3 Irrigation Profile

Gross command area is 418843 ha out of which 412913 is cultural command area. The total numbers of canals in the district are 315; with total length 2351 km. Irrigation in the district is done mainly by gravitational flow canal and irrigation system through the following canal networks.

Table 7 Major Canals in districts Bhiwani

Sr.no.	Name of the canal	Length(km)	Discharge (Cs)	GA (ha)	CCA (ha)	Major Crops	
						Rabi	Kharif
Sundar System (Mohla Head) RD 121361 Sundar Sub Branch						**Wheat, Barley, Gram, Oilseed, Sugarcane, Groundnut, Vegetables**	**Paddy, Cotton, Sugarcane, Bajra, Maize, Pulses, Vegetables**
1.	Sundar Sub-branch/Sundar Disty	50.41	599	39458	38865		
	Mithathal Feeder	26.82	299	27552	23140		
Jui Canal System (Mohla Head)							
1.	Jui Feeder	80.10	864	59158	44054		
2	Nigana Feeder	41.44	298	37429	32012		
Siwani Canal System (Bhakhra System)							
1.	Siwani Feeder	45.34	658	77653	58129		
Loharu System (JLN Feeder RD 236070)							
1.	Loharu Feeder	31.85	1329	218605	187348		
Bhiwani Sub Branch System (RD 107200)							
1.	Dadri Feeder	13.02	507	5029	4105		
Total				**418843**	**412913**		

3.2 Gravitational Irrigation

The canals falling under Sunder Systems viz. Sunder Sub Branch, Sunder Distributary, Mithathal Feeder and the off taking channels get fed from W J C as well. Major canals under this system are Dadri Feeder and Bhiwani distributary.

3.3 Lift Irrigation

Lift irrigation is done where the area falling in the tail portion and higher elevation where the gravity flow is not possible. The irrigation under the Jui, Nigana, Siwani and Loharu canal system is being done by lift system through89 pump houses installed on the various canals. In addition to irrigation, water is also supplied to 237 number of W.W. Tanks and 387 number of village ponds. Water is made available for the village ponds as and when required by the villagers

4 Water Availability

4.1 Surface Water Availability

4.2 Ground Water Availability

The water supply to the district is mainly based on groundwater through tubewells. The urban population is covered under drinking water supply scheme. The water supply to the villages is met out with the installation of hand pumps by the villagers as spot and convenient source of water. The shallow tubewells in the district range from 20 to 90m. deep, tapping the aquifer from 15m to 90 m. with a discharge of 400 to 900 Ipm. Most of the shallow tube wells are either run by diesel engines or electric motors. There are 32790 motors working in the district. The major part of the district is being irrigated through ground water.

The hydrogeological data generated through exploratory test drilling has provided vital information regarding identification of aquifer systems, demarcation of their vertical and lateral extent, delineation of potential aquifer characteristics. These studies also provide information on well design and drilling techniques. A well assembly of 305/203mm dia. Combination, using about 40m to 50m housing length having slot size of 1.19mm would be ideal for the district area. The "V" wire galvanized Screen having 1.O mm slot width may also be used against granular zones, as it has more open area for the entrance of water. The shallow tube wells up to 40m depth should have 203mm single dia. pipe assembly with a suitable screen length. Direct Rotary rig can carry out the drilling in the district area.

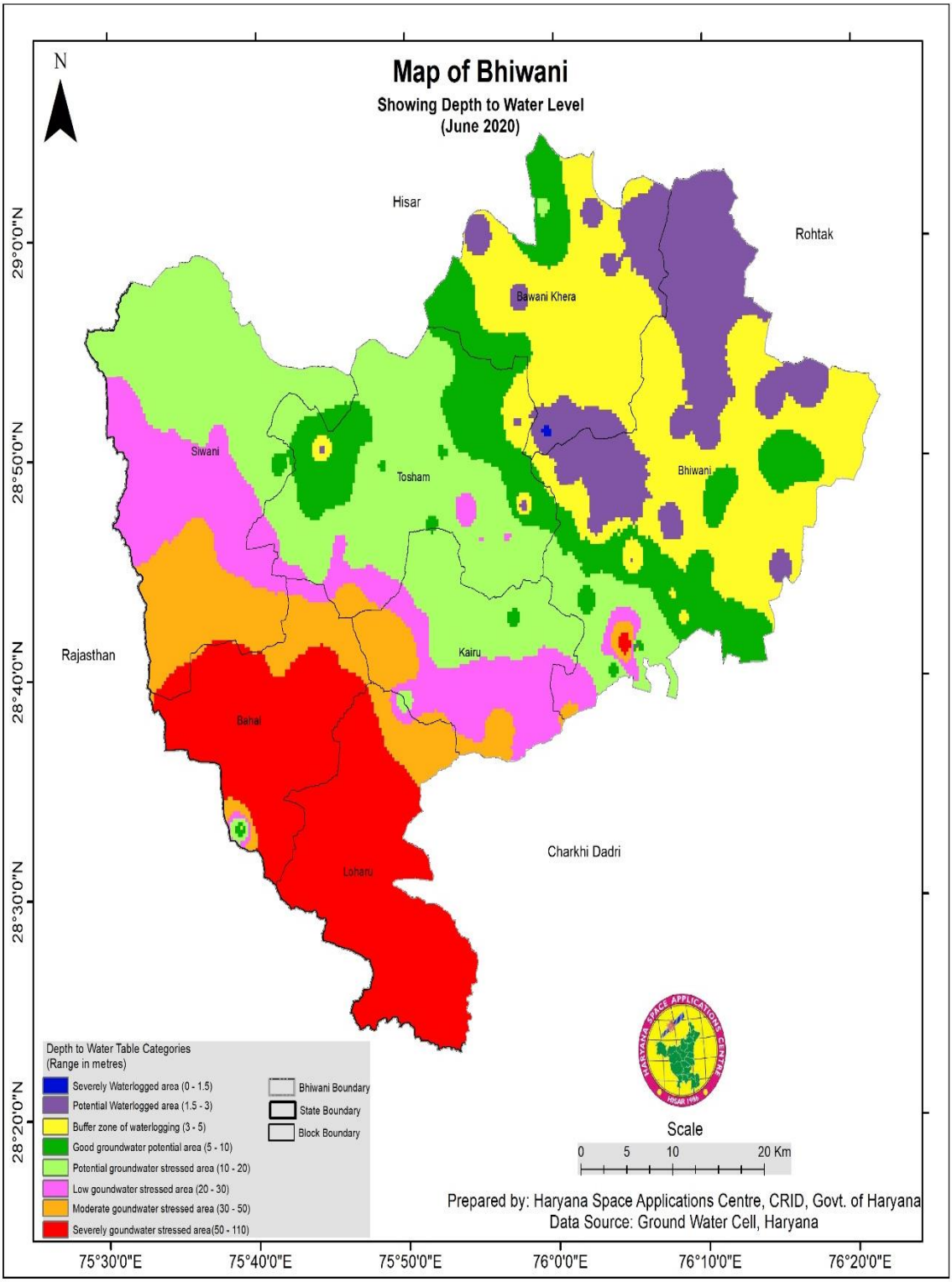


Figure 16 Ground water Availability Map of Bhiwani District

4.3 Ground Water Quality

Chemical quality data of shallow aquifers reveals that ground water is alkaline in nature and significant number of samples have conductivity values more than 3000µS/cm. Concentration of vital chemical constituents such as fluoride and nitrate in about 50 % of the water samples is within permissible limit assigned by BIS 1991. Among trace metals, arsenic and iron are found in excess at Sui (0.02 mg/l) and Tosham (10.83 mg/l) against the maximum permissible limit of 0.01 mg/l and 1.0 mg/l respectively. Among anions, bicarbonates dominate in some wells having low to moderate salinity, chloride dominates in wells with high salinity and in remaining no single anion dominates. It means that the water is of mixed anion type. Among cations sodium dominates in more than 50% wells whereas no individual cation dominates in the remaining water samples.

Table 8 Water Quality Parameters of Bhiwani Districts

S. No.	**Characteristic**	**Requirement (Acceptable**	**Permissible Limit in Absence of Alternate**	**Remarks**
General Parameters and Major Ions (mg/l)				
i)	pH value	6.5-8.5	No	-
ii)	EC(µScm-1)	-	-	Not noted in IS
iii)	Total dissolved solids (mg/l)	500	2000	-
iv)	Turbidity (NTU)	1	5	-
v)	Total Hardness as CaCO3	200	600	-
vi)	Alkalinity as CaCO3 (mg/l)	200	600	-
vii)	Fluoride (as F) mg/l	1.0	1.5	-
viii)	Chloride (as Cl), mg/l	200	1000	-
x)	Carbonate, mg/l	-	-	Not noted in IS
	Sulphate (as SO4) mg/l	200	400	Maybe extended to 400 provided
xi)	Nitrate (as NO3) mg/l	45	No relaxation	-
xii)	Calcium (as Ca) mg/l	75	200	-
xiii)	Magnesium (as Mg) mg/l	30	100	-
xiv)	Sodium (as Na) mg/l	-	-	Not noted in IS
xv)	Potassium (as K) mg/l	-	--	Not noted in IS
xvi)	Iron (as Fe) mg/l	0.3	No relaxation	Total concentration of manganese
xxiii	Total Arsenic (as as) mg/l	0.01	0.05	-

Suitability for Drinking Purposes

Based on the concentration of anions and cations in shallow ground water samples, it is found that in some parts of the district the quality of ground water is not suitable for drinking uses, whereas in others it is of permissible quality.

Suitability for Irrigation Purposes

Plot of USSL diagram used for the classification of Irrigation waters indicates that Ground water fall under C2S, C3S1, C3S2, C3S3, C4S1, C4S2 and C4S4 classes. More than 50% ground water are likely to cause medium salinity hazards when used for customary irrigation and the remaining water falling under C3S4.

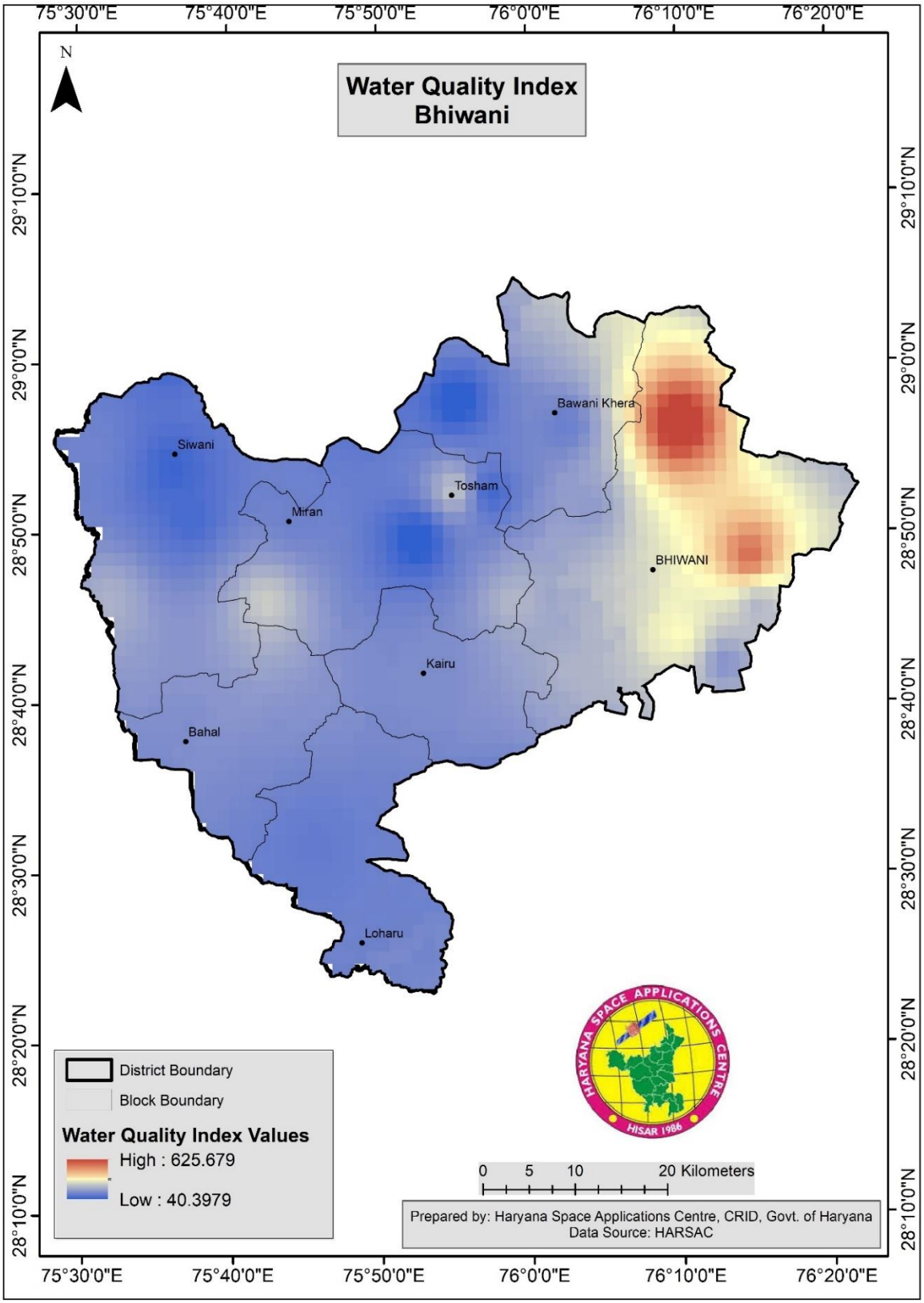


Figure 17 -Water quality index of Bhiwani District

5 Aquifer System

5.1 Aquifer Geometry & Disposition

To understand the sub surface lithology and its disposition, the lithological data of the optimized wells drilled by CGWB, PHED and Private Agencies is plotted using the RockWorks15 software and a lithological model has been prepared. The 3D lithological fence diagram has been prepared using the lithology model.

The aquifer material and non-aquifer material in the district is highly variable. The major aquifer material is sand, kankar and gravel and the non-aquifer material is majorly clay, sandstone, chert and granite. The sandstone, chert and granite are found at deeper depth starting from 230m bgl.

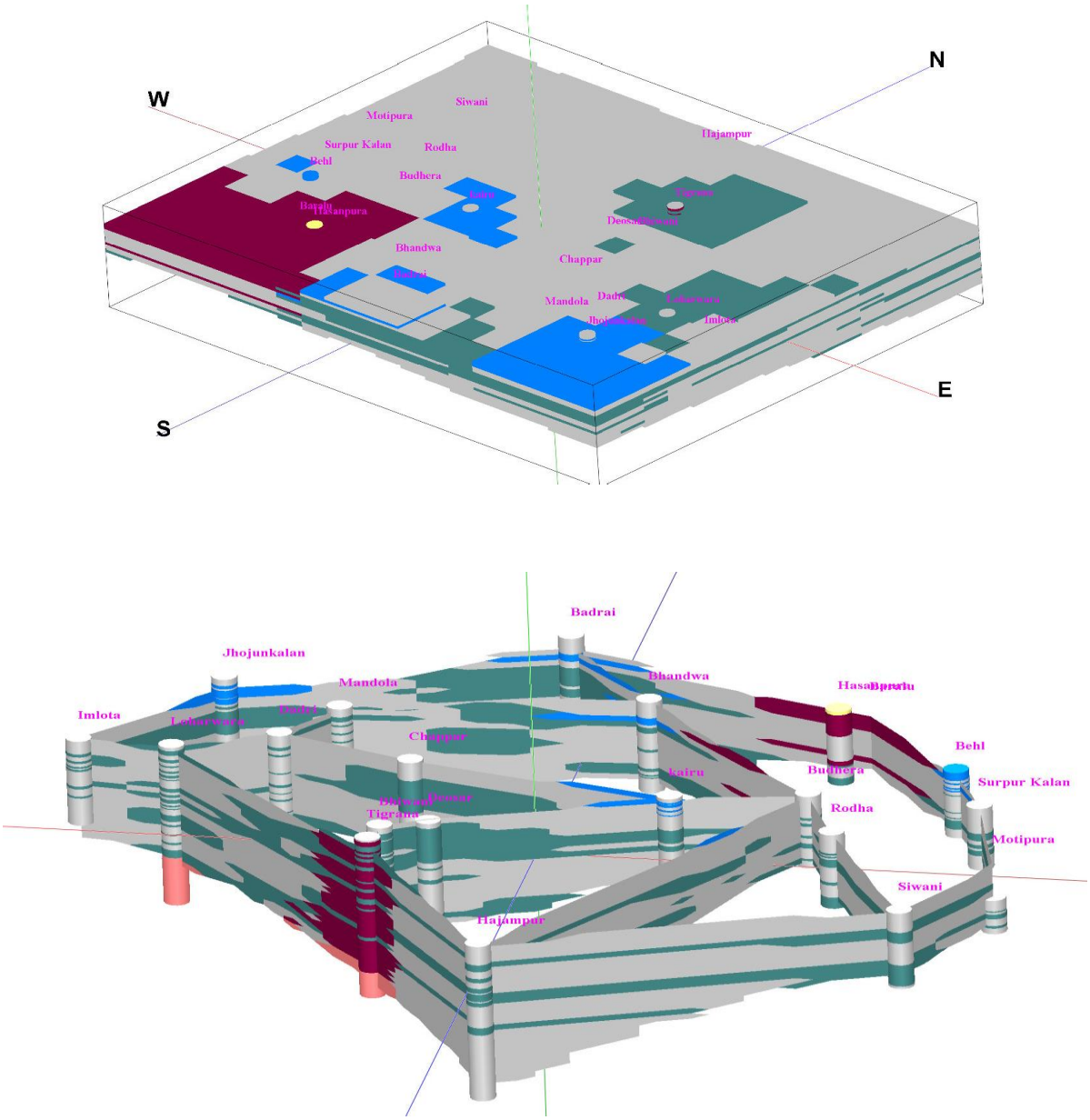


Figure 19 3-Dimension Lithological Model of Bhiwani

5.2 Ground Water Resources of Multiple Aquifer up to 300 m Depth

Ground water resource estimation of the area have been carried out by taking Dynamic and Static/In-storage resources of unconfined aquifer and confined aquifers present up to 300m depth. The assessment of dynamic ground water Resources of the study area has been carried out jointly by CGWB and Ground Water Cell, Department of Agriculture, Haryana on the basis of Ground Water Estimation Committee (1997) methodology based on data available and as per the revised methodology for the year as on 31st March 2013.

The occurrence of potential aquifers (productive granular zones) up to 300 m depth has been demarcated on basis of aquifer wise subsurface mapping. The total saturated thickness of granular zones was derived from the exploratory borehole data of a particular block. The granular zones occurring below the zone of water level fluctuation up to the first confining layer has been considered as static unconfined zone. The specific yield value for the unconfined aquifer has been taken as 60% of 0.12 which comes as 0.072 whereas for the confined aquifer, the storativity value has been considered. Since the specific yield is likely to reduce with increase in depth due to compaction of overlying sediments.

Hence, the major data elements considered in this estimation are thickness of granular zones, specific yield/storativity, and area of both fresh water and saline/brackish water. It has been observed that in some of the blocks sufficient data on probable occurrence of granular zones was not available. In those cases, the existing exploratory data of adjoining block/district has been either extrapolated or interpolated to derive such parameters required for estimation. This assessment of total groundwater resources has been computed based on the available data with CGWB & Ground Water Cell, Department of Agriculture, Haryana.

Table 9 -Block Wise in storage Ground Water Resources Below Fresh-Saline Interface (Up To 300m Depth)

Name of Assessment Unit	Type of rock formation	Areal extent (sq km) Total Area below Fresh Saline Interface	Fresh-Saline Interface (m bgl)	Average Explored Depth (m bgl)	Total Thickness of formation below Fresh-Saline Interface (m) (5-6)	Thickness of the Granular Zone below Fresh Saline Interface (Saline) (m)	Average Specific Yield	In-Storage GroundWater Resources [(7) *(11) *(12) *] BRAKISH / SALINE (mcm)
Badra	Alluvium	446.67	53	183	130	84	0.072	2701.46
Bawani Khera	Alluvium	557.32	6.4	193	186.6	94	0.072	3771.94
Behal	Alluvium	303.8	50	136	86	30	0.072	656.208
Bhiwani	Alluvium	684.74	3	252	249	67	0.072	3303.19
Dadri-I	Alluvium	368.87	8	210	202	92	0.072	2443.39
Dadri-II	Alluvium	516.56	6	180	174	46	0.072	1710.85
Kairu	Alluvium	418.58	16	166	150	35	0.072	1054.82
Loharu	Alluvium	368.73	70	140	70	25	0.072	663.714
Siwani	Alluvium	698.53	13	143	130	60	0.072	3017.65
Tosham	Alluvium	387.13	6.5	140	133.5	45	0.072	1254.3
Dist. Total		8552.01						**26370**

Table 10 Block Wise Total Available Ground Water Resources in Aquifer up to 300 m Depth

Assessment Unit/Block	Dynamic Ground water Resources (2013)	In-storage Ground water Resources UPTO FRESH WATER ZONE	Total Groundwater Resources up to Avg. Depth of Fresh Water zone [(2)+(3)]	Total Saline Groundwater Resources up to the depth of wells available in each block	Total Availability of Fresh and Saline Ground water Resources [(4)+(5)]	Volume of Unsaturated Granular Zones (above Water Level) for Natural Recharge (Considered below 3m bgl to WL)	UnsaturatedZone (in m)
1	2	3	4	5	6	7	8
Badra	45.07	351.976	397.046	2701.46	2735.41	418.083	13
Bawani Khera	90.03	0	90.03	3771.94	3771.94	0	0
Behal	122.02	196.862	318.882	656.208	682.633	174.989	8
Bhiwani	72.79	0	72.79	3303.19	3303.19	0	0
Dadri-I	63.46	0	63.46	2443.39	2443.39	0	0
Dadri-II	44.45	0	44.45	1710.85	1710.85	0	0
Kairu	34.04	0	34.04	1054.82	1054.82	452.066	15
Loharu	20.9	0	20.9	663.71	663.71	0	0
Siwani	59.92	0	59.92	3017.65	3017.65	0	0
Tosham	68.54	0	68.54	1254.301	1254.301	0	0
Total	621.21	548.8387	1170.05	26370.3	26440.67	1045.138	

6 Water Requirement/ Demand

In Bhiwani, water is required for domestic use, crop irrigation, and livestock drinking purpose, industrial use, and power generation. Total present annual water demand for districtBhiwani is 1792.95 MCM. Maximum water is required for irrigation use (1699.38 MCM), followed by domestic use (66.70 MCM), livestock (19.01 MCM), industry (7.83 MCM) and least for power generation.

Table 11Block wise Water Demand targeted under JSA

Block	Sector-wise water demand					Total (MCM)
	Domestic (MCM)	Crop (MCM)	Livestock (MCM)	Industries (MCM)	Power (MCM)	
Behal	1.8	146.35	0.29	NA	0.0365	148.477
Bhiwani	20.08	237.94	0.97	0.7	0	259.69
Kairu	2.17	121.4	0.28	1	0	124.85
Loharu	3.03	163.93	0.38	1.9	0.0007	169.241
Tosham	4.4	178.02	0.52	0.4	0	183.34
Total	**31.48**	**847.6**	**2.44**	**4**	**0.037**	**885.6**

7 Strategies for Water Conservation

- Improving the effectiveness of consumption of water in district
- 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.
- Convergence of existing and new schemes for water conservation with Local
- Bodies funds under 14th Finance Commission
- Effective monitoring and sustainability of various structures built under this abhiyan

Table 12 Plan under various interventions of Jal Shakti Abhiyan

Intervention	**Planned Target year 2019 (July-September)**
Water conservation and rainwater harvesting	210
Renovation of traditional and other water bodies/tanks	548
Reuse, borewell recharge structures	5150
Watershed development	0
Intensive Afforestation	156260

7.1 Artificial Recharge

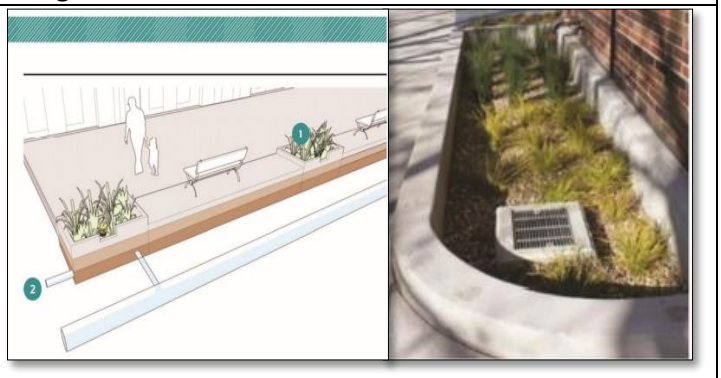
There are few isolated pockets located in the eastern part of the district where water levels are declining very fast. Fresh ground water at deeper level is being exploited by deep tube wells. Limited possibilities of artificial recharge exist in these areas during monsoon season, where excess runoff 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.

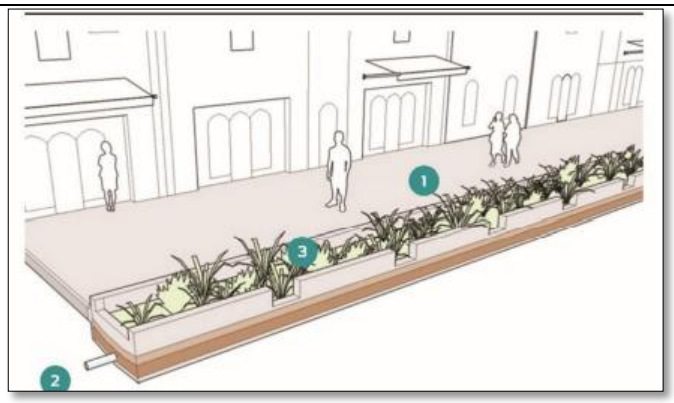
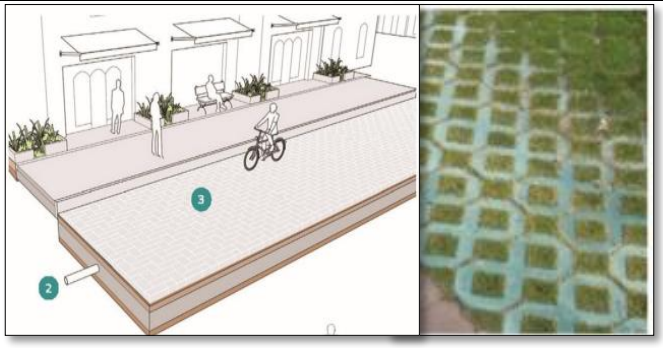
Possibility of Artificial Recharge There is few isolated pockets located in the eastern part of the district where water levels are declining very fast. Fresh ground water at deeper level is being exploited by deep tube wells. Limited possibilities of artificial recharge exist in these areas during monsoon 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 Bhiwani. 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 no 13**.

Table 13 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. The wasteland that could be used for plantation for conservation of water in Bhiwani district is shown in **Figure 20** and **Table 14** shows the proposed no of plantation targets in Bhiwani District.

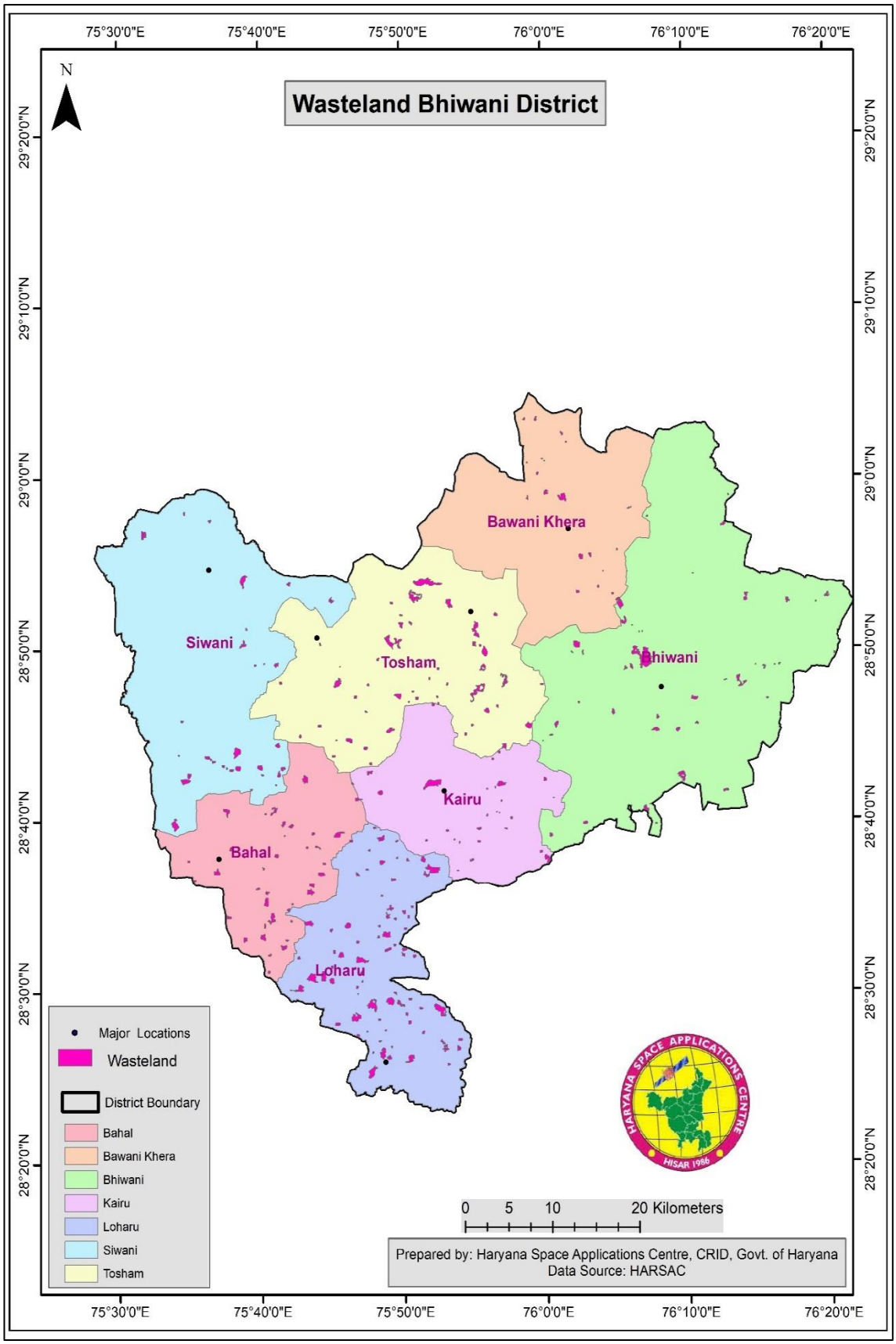


Figure 20 Wasteland Map of Bhiwani district

Table 14 The Plantation targets have been provided in the table below.

Block	Wasteland Area (acres)	Plantation at 5 feet spacing
Bahal	1294.224175	11275281.01
Bawani Khera	381.152052	3320596.677
Bhiwani	1756.183183	15299867.89
Kairu	749.412494	6528881.648
Loharu	3370.155088	29360791.13
Siwani	1183.857224	10313764.14
Tosham	2396.348118	20876984.8

7.4 Surface water management

7.4.1 Pond restoration and rejuvenation

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 civilisation.

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 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 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 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 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 centre 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

Making it a people's Campaign IEC plan has been prepared to generate awareness amongst the stakeholders for achieving the objectives of the Jal Shakti Abhiyan it is essential to use all type of communication mediums such as Inter Personnel Communication (IPC), Print media, electronic media, outdoor media and folk media. Extensive publicity and designing and printing of IEC material will be undertaken to disseminate the designated communication issues. IEC activities taken up in the action plan are telecast and broadcast of issues through electronic media, publication of public appeals in print and extensive use of social media. In addition to this orientation workshops, trainings, designing and printing of IEC material like posters, banners, flex, booklets, leaflets, flip chart and other material will be undertaken. The major focus has been given to the grass root level interpersonal activities. The interpersonal communication will help in clearing the doubts of audience and take instant action. The advantage of this medium is that the messages can be communicated to the target audience who are not adequately educated. The details are follows: - 1) School student's mobilization through Eco-clubs (15th July) a. Nodal Office: DEO b. ESSAY and DRAWING COMPETITION i. Objectives of the activities: - 1. To sensitize the community on sustainability and rain water harvesting. 2. To generate awareness among children for water conservation. 3. To orient the community about the judicious use of water and not to waste water. ii. Expected outcomes: - 1. Community made aware, sensitized and oriented about above issues. 2. Participants: -Students of the schools at village level. 3. Responsibility: -DEO will be responsible for organizing the event. iii. The Oath of Jal Sanchay will be conducted as follows: - 1. Water is limited, do not waste it and use it judiciously. 2. Grow less water consuming Crops like Makka, Bajara, Mustard etc 3. Use drip and sprinkler for save water. 4. Harvest rainwater and use it for drinking purpose. 5. Maintain cleanliness around the water sources so that water quality of the source is not adversely affected. iv. Essay competition and Painting competition 1. The topics for the Essay and painting competitions are as follows: - a. Importance of water conservation in present scenario. b. Rain water harvesting structures. c. Methods of judicious use of water and ground water recharge. d. Do not waste water; water is finite therefore precious.

2) College Campus Day (22nd July) i. Nodal Office: CEO ZILA Parishad and Principal Higher Education ii. Brainstorming session on 16th July on activities that can conducted on 22nd July (College Campus Day) iii. Recommended Activities 1. Election Of College Water Representative 2. Wall Paintings in College 3. Nukkad Nataks 4. Pledge on Jal Sanchay 5. Debate Completion.

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 Centres 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.

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 21**). The block wise area proposed for rainwater harvesting under most suitable sites is shown in **Table 15.**

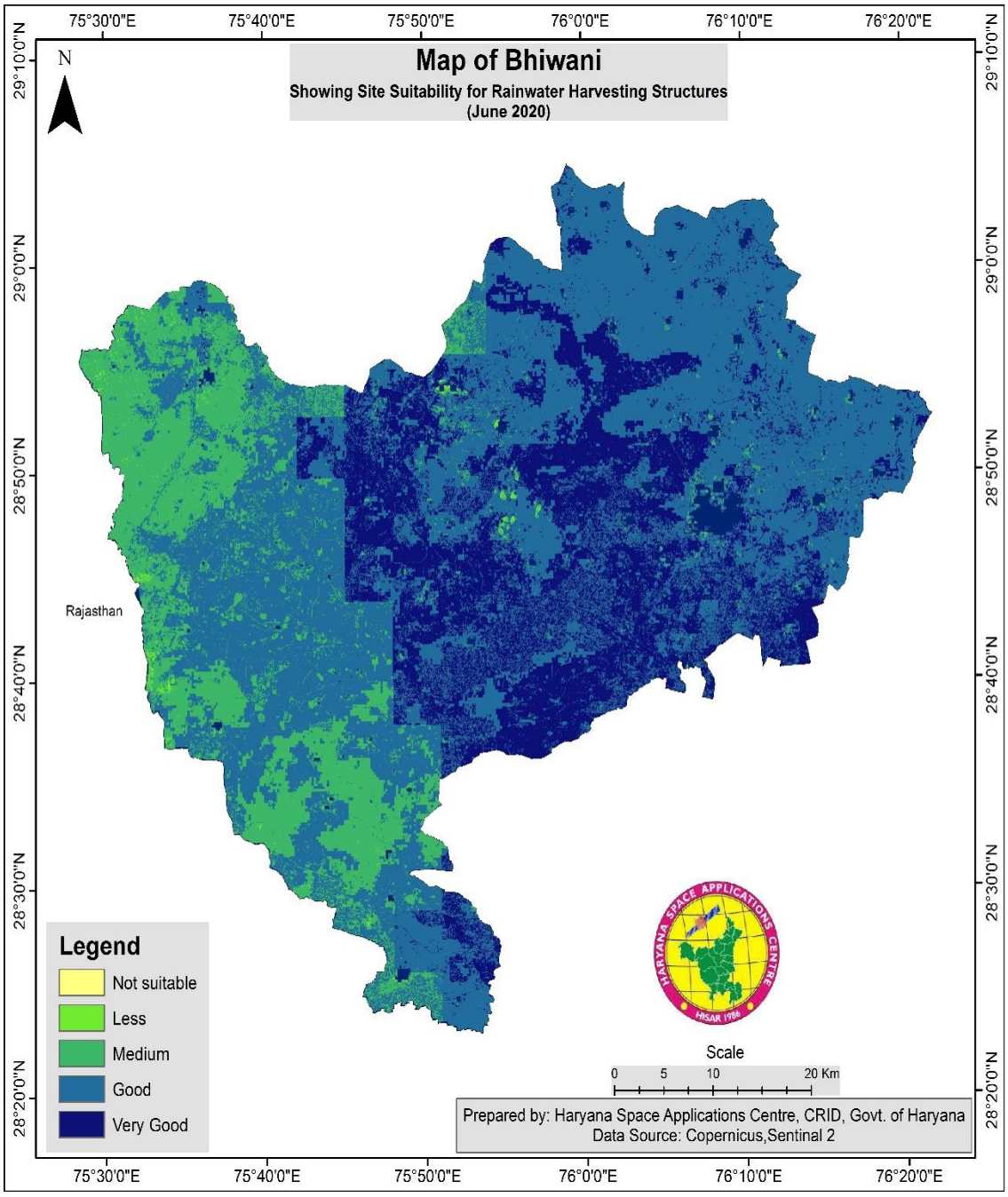


Figure 21 Site Suitability Map for Rainfall Harvesting Structure in the Year 2020

Table 15 Block wise area under very good suitable site proposed for rain water harvesting

Block Name	Area (Very Good suitability area in Sq. meter)
Bahal	2590757.191
Bawani Khera	99530627.47
Bhiwani	301770980.1
Kairu	180152201.2
Loharu	40823315.89
Siwani	13275823.71
Tosham	206425225.5

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 16**.

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

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

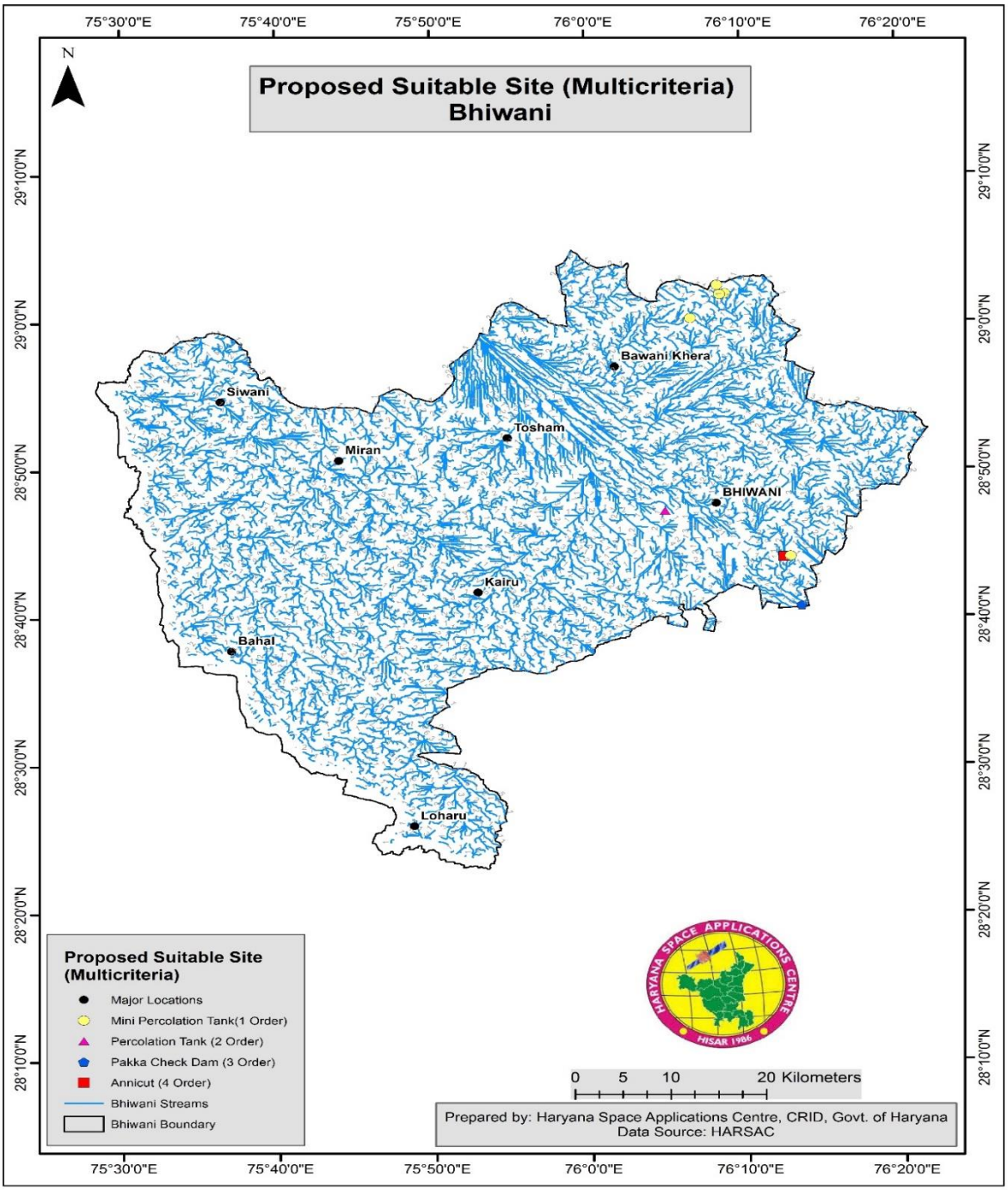


Figure 22 Proposed suitable sites based on multicriteria in Bhiwani District

Table 16 Block wise proposed suitable sites based on multi-criteria.

Sr. No.	Block Name	Mini percolation Tank	Percolation Tank	Pakka Check Dam	Annicut	Micro Irrigation Tank
1	Bawani Khera	1	0	0	0	0
2	Bhiwani	4	1	1	1	0
3	Kairu	0	0	0	0	0
4	Tosham	0	0	0	0	0
5	Siwani	0	0	0	0	0
6	Bahal	0	0	0	0	0
7	Loharu	0	0	0	0	0

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 Bhiwani district. Proposed harvesting structures in Bhiwani based on drainage **Table 17.**

Table 17 Proposed harvesting structures in Bhiwani based on drainage

Sr. No.	Block Name	Mini percolation Tank	Percolation Tank	Pakka Check Dam	Annicut	Micro Irrigation Tank
1	Bawani Khera	48	77	89	58	112
2	Bhiwani	162	172	294	105	104
3	Kairu	49	68	78	77	60
4	Tosham	87	90	102	92	70
5	Siwani	94	132	154	71	132
6	Bahal	27	41	77	59	12
7	Loharu	58	74	67	32	56

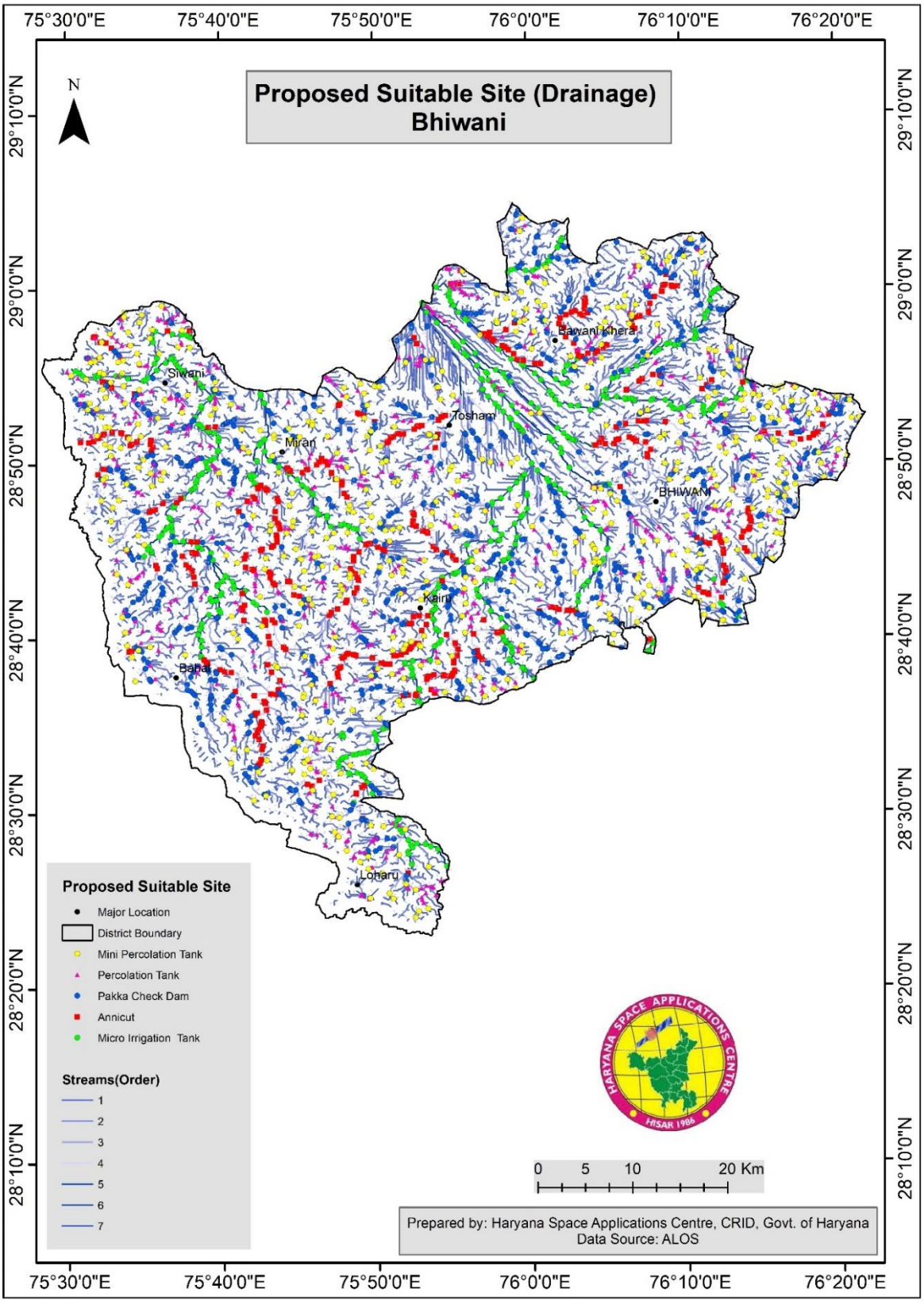


Figure 23 Proposed suitable sites based on drainage in Panipat District

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

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