



JSA-CTR

Scientific Action Plan for Panipat



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1. Introduction

1.1. History

The first record of the district is found in Ain-i-Akbari. It was part of Suba Delhi. When the British took over the area in 1803, it was a part of Delhi territory. In 1819 reorganization, Panipat, Karnal and Sonapat areas formed part of Panipat district. In 1851 Panipat district was divided into Panipat and Karnal tahsils with headquarters at Panipat and Gharaunda respectively. Panipat was one of the five cities (prasthas) founded by the Pandava brothers during the times of the Mahabharata; its historic name being Panduprastha. Panipat was the scene of three pivotal battles in Indian history. The First Battle of Panipat was fought on 21 April 1526 between Ibrahim Lodhi, Sultan of Delhi, and the Timurid warlord Zaheer Uddin Babur. Babur's force defeated Ibrahim's much larger force of over one lakh (one hundred thousand) soldiers. This First battle of Panipat thus ended the 'Lodi Rule' established by Bahlul Lodhi in India.

The Second Battle of Panipat was fought on 5 November 1556 between the forces of Akbar and Samrat Hem Chandra Vikram Aditya, a King of North India, who belonged to Rewari in Haryana and had captured the large states of Agra and Delhi defeating Akbar's forces. This king, also known as Vikram Aditya had won 22 battles against the Afghan rebels from 1553–1556 from Punjab to Bengal, and had his coronation at PuranaQuila in Delhi on 7 October 1556 and had established 'Hindu Raj' in North India, before the 2nd battle of Panipat. Hem Chandra had a large army, and initially his forces were winning, but suddenly Hemu was struck by an arrow in the eye and he lost his senses. On not seeing him in his howdah on the back of an elephant, his army fled. He was later captured and beheaded by the Mughals. His head was sent to Kabul to be hanged outside Delhi Darwaza and torso was hanged outside PuranaQuila in Delhi. This Second battle of Panipat thus ended the 'Hindu Raj' established by Hemu in north India, albeit for a short period.

The Third Battle of Panipat was fought in 1761 between the Afghan invader Ahmad Shah Abdali and the Marathas under Sadashiv Rao Bhau Peshwa of Pune. Ahmad Shah won but with a very heavy casualty rate on both sides. It resulted in the worst defeat of Marathas in their history. The war led to a power vacuum which later led to the British conquest of India. The famous Urdu Shaya Maulana Hali was born in Panipat.

1.2. Location

Panipat is a historic city in Haryana, India. It is 90 km north of Delhi and 169 km south of Chandigarh on National Highway. It lies in between the 29.398928 and 29° 23' 56.1408" N Latitude, and 76.977081 and 76° 58' 37.4916" E longitude & elevation. of 219 meters (718 feet). The historical

town of Panipat is the administrative headquarters of the district. The district occupies an area of 1,268 km² (490 sq mi), making it the nineteenth largest in the state with Gurugram and Panchkula following it. Panipat is situated on Sher shah Suri Marg (now known as G.T. road or NH-1), 90 KM north of Delhi. On three sides, Panipat district boundaries touch other districts of Haryana –Karnal in the north, Jind in the west and Sonipat in the south. The Location Map of Panipat district is shown in **Figure 1**.

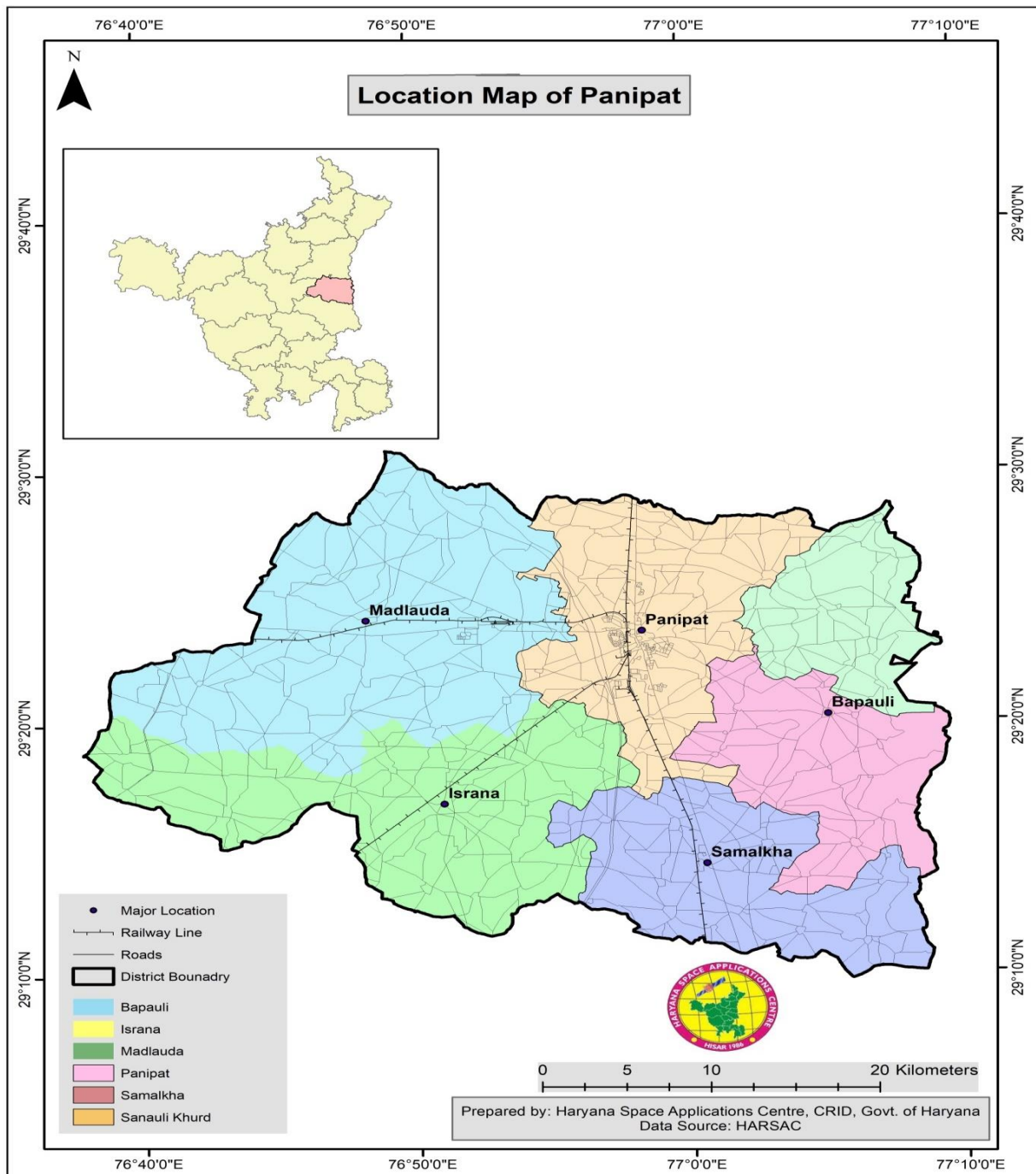


Figure 1- Location Map of Panipat District

1.3. Administrative setup

The administrative setup of the District of Panipat 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 Gurugram District.

| | |
|-------------------------------------|--|
| Country | India |
| State | Haryana |
| Division | Panipat |
| Headquarters | Panipat |
| Tehsil | 1. Panipat, 2. Samalkha, 3. Israna, 4. Madlauda, 5. Bapoli |
| Total Area | 1,268 km ² (490 sq. mi) |
| Total Population (2011) | 1,205,437 |
| Density | 950/km ² (2,500/sq. mi) |
| Demographics | 75.94% |
| Literacy | Male = 83.71% |
| Sex ratio | Female = 67.00% |
| Sex ratio | 864 |
| Vidhana Sabha constituencies | 1. Panipat Rural, 2. Panipat City, 3. Israna, 4. Samalkha |
| Website | http://Panipat.gov.in |
| Location of Gurugram | South East region of Haryana |
| Coordinates | 29.398928 And 29° 23' 56.1408" N Latitude, and 76.977081 and 76° 58' 37.4916" E Longitude. |
| Total Area | 490 sq. mi |
| Elevation | 219 meters (718 ft) above the sea level. |

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

| | |
|---------------------------------|--|
| Sub Divisions (2) | Panipat Samalkha |
| sub-divisions (3) | Panipat, Samalkha, Israna |
| Tehsils (6) | 1. Panipat, 2. Samalkha, 3. Israna, 4. Madlauda 5. Bapoli 6. Sanauli Khurd |
| Blocks (4) | Panipat, Bapoli, Samalkha, Madlauda, Sanoli Khurd and Israna. |
| Municipal Corporation | Municipal Corporation Panipat |
| Municipal Committees | Panipat |
| Population (Census 2011) | 1,205,437 |

Source: <https://panipat.gov.in/administrative-setup/>

| | |
|-------------------------|----------------------|
| Total Villages | 200 |
| Total Panchayats | 175 |
| Village Level | Panchayat (175) |
| Block Level | Panchayat Samiti (4) |
| District Level | Zila Parishad (1) |

| Tehsil | Blocks | Area of blocks (Sq. Km) |
|---------------|---------------|--------------------------------|
| Panipat | Panipat | 1268 sq.km |
| Samalkha | Samalkha | 452 sq.km |
| Bapoli | Bapoli | 1296 ha |
| Madlauda | Madlauda | 1244 ha |
| Israna | Israna | 280 sq km |
| | Sanoli | - |

1.4. Climate

The climate of the district is characterized by the dryness of the air with an intensely hot summer and a cold winter. The year may be divided in to four seasons. The cold season starts by late November and extends to the middle of March. It is followed by hot season which continues to the end of June when the southwest monsoon arrives over the district. July to September is the southwest monsoon season. The post monsoon season period is from October to December.

1.4.1. Temperature

Temperatures reach a maximum of forty-five degrees (45°C) and a minimum of thirty-five degrees (35°C) during this time. Late March, April and May are the summer months.

1.4.2 Rainfall

Panipat experiences moderate rainfall due to the influence of the South West monsoon. The rainfall map of Gurugram district is shown in (Figure 2). The rainfall is normally mild during the months of July and August and recedes through the month of September. In a year, the rainfall is 781 mm (30.7 inch). Average rainfalls in various blocks of district Panipat shown in (Table 2), from 2010 to 2019 is as follows:

Table 2 -Average Rainfall

| Sr. No | Block | Average Rainfall from 2010 to 2019 |
|---------------|--------------|---|
| 1 | Panipat | 680 mm |
| 2 | Samalkha | 680 mm |
| 3 | Bapoli | 680 mm |
| 4 | Madlauda | 680 mm |
| 5 | Israna | 680 mm |
| 6 | Sanoli | 680 mm |

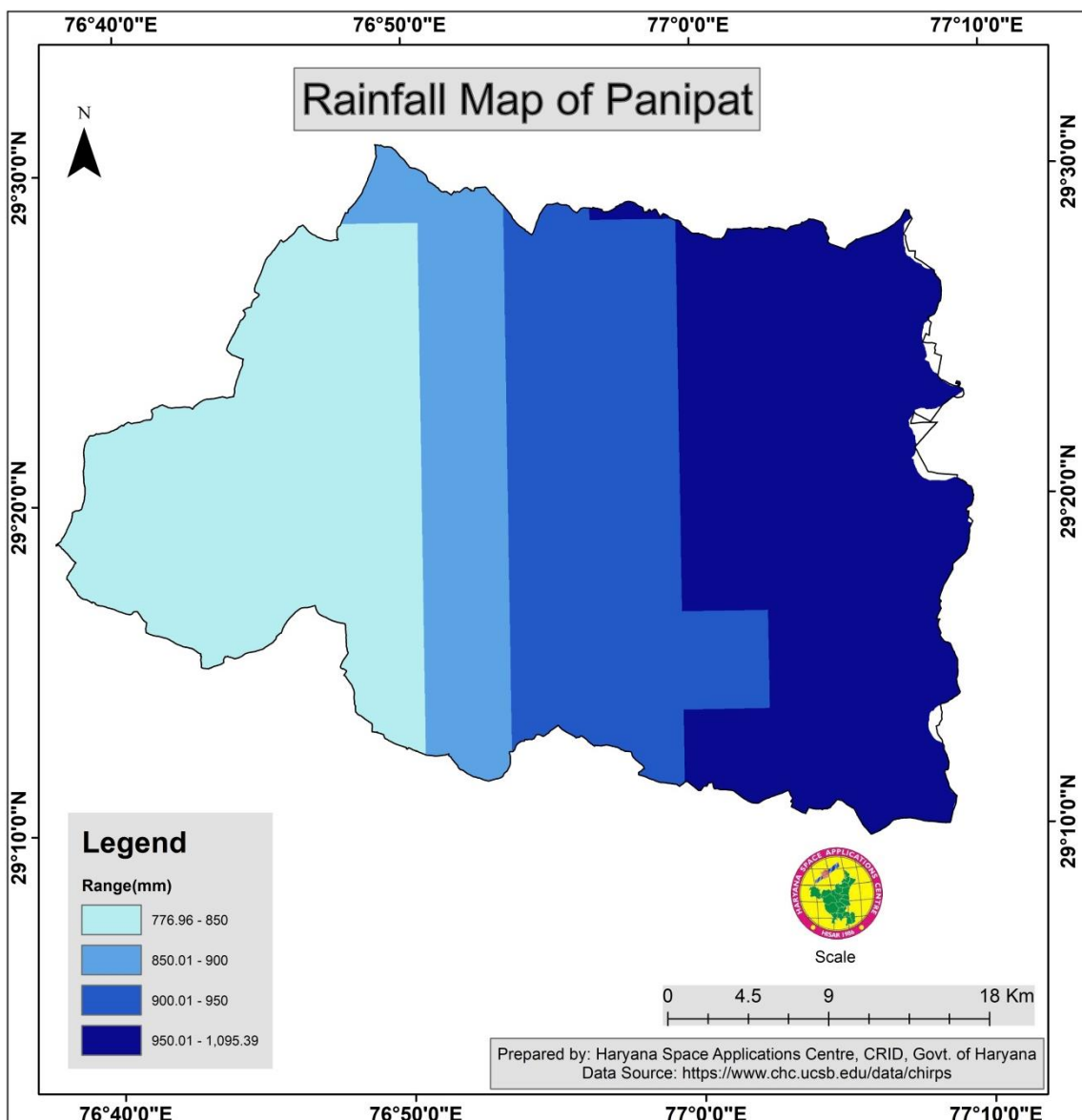


Figure 2 -Rainfall Map of Panipat District

1.5. Elevation and Topography

Panipat is at elevation of 244 m above sea level (**Figure 3**), Panipat touches the districts like Jind in the west, Karnal in the north, and Sonipat o the south.

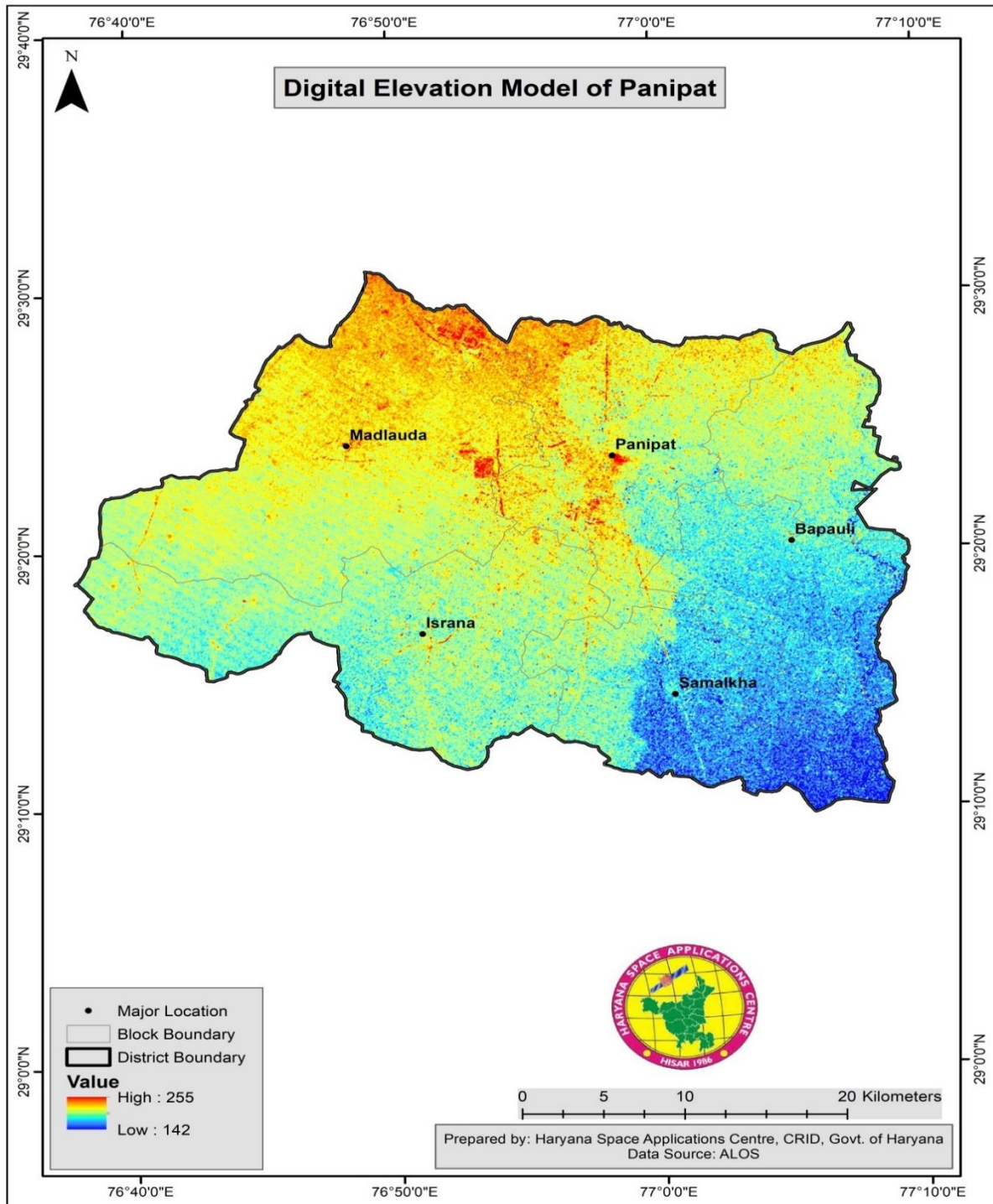


Figure 3- Digital Elevation Model of Panipat District

Slope ranges from flat to >35 degree (**Figure 4**). Most of the area of Madlauda is flat to less sloppy. Contours of 5 meters interval showed similar topography as in digital elevation model. Southern and South Eastern part of Bapauli and Samalkha block is also flat and slope is meeting in Yamuna River shown in (**Figure 5**).

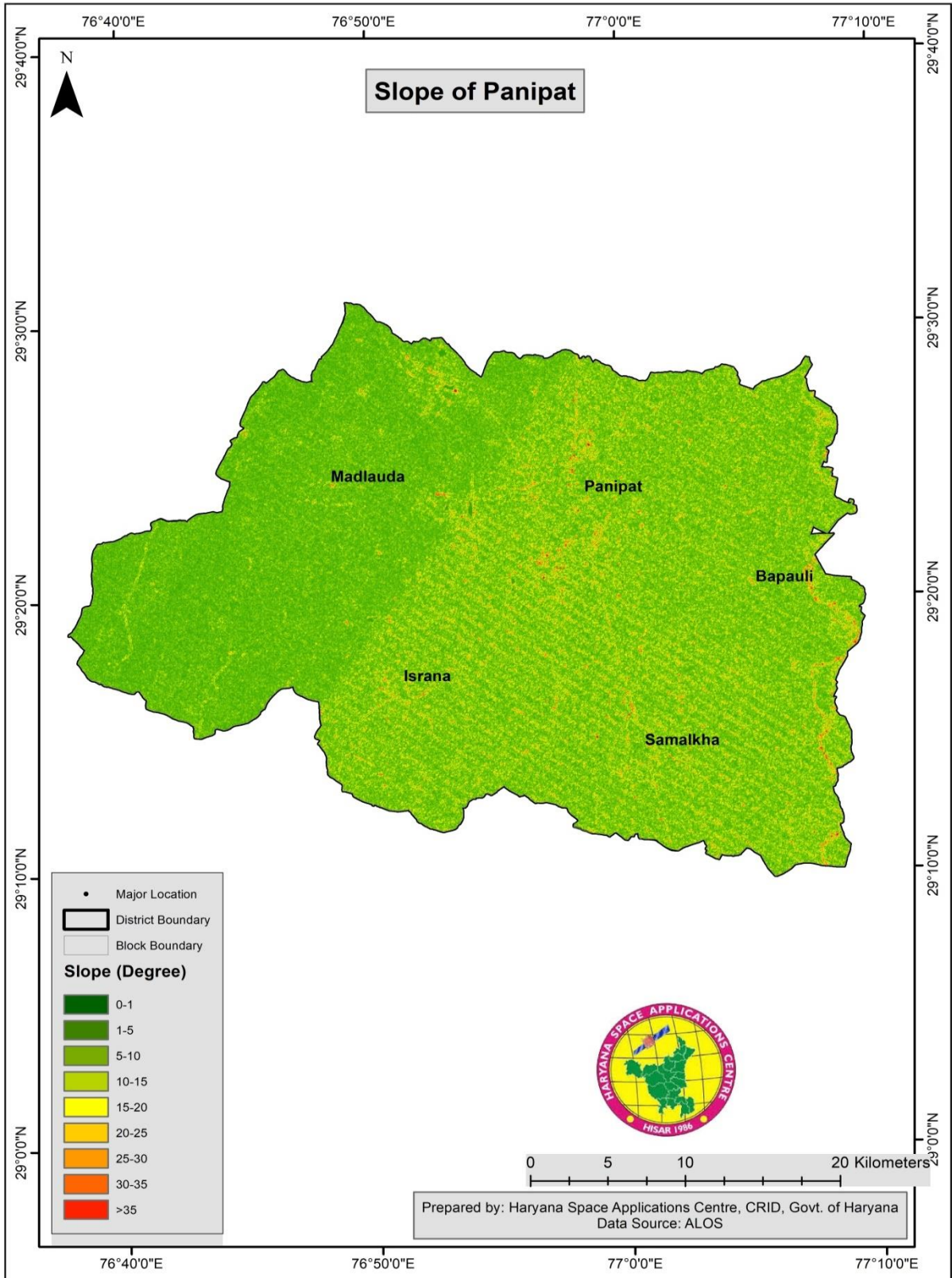


Figure 4- Slope Map of Panipat District

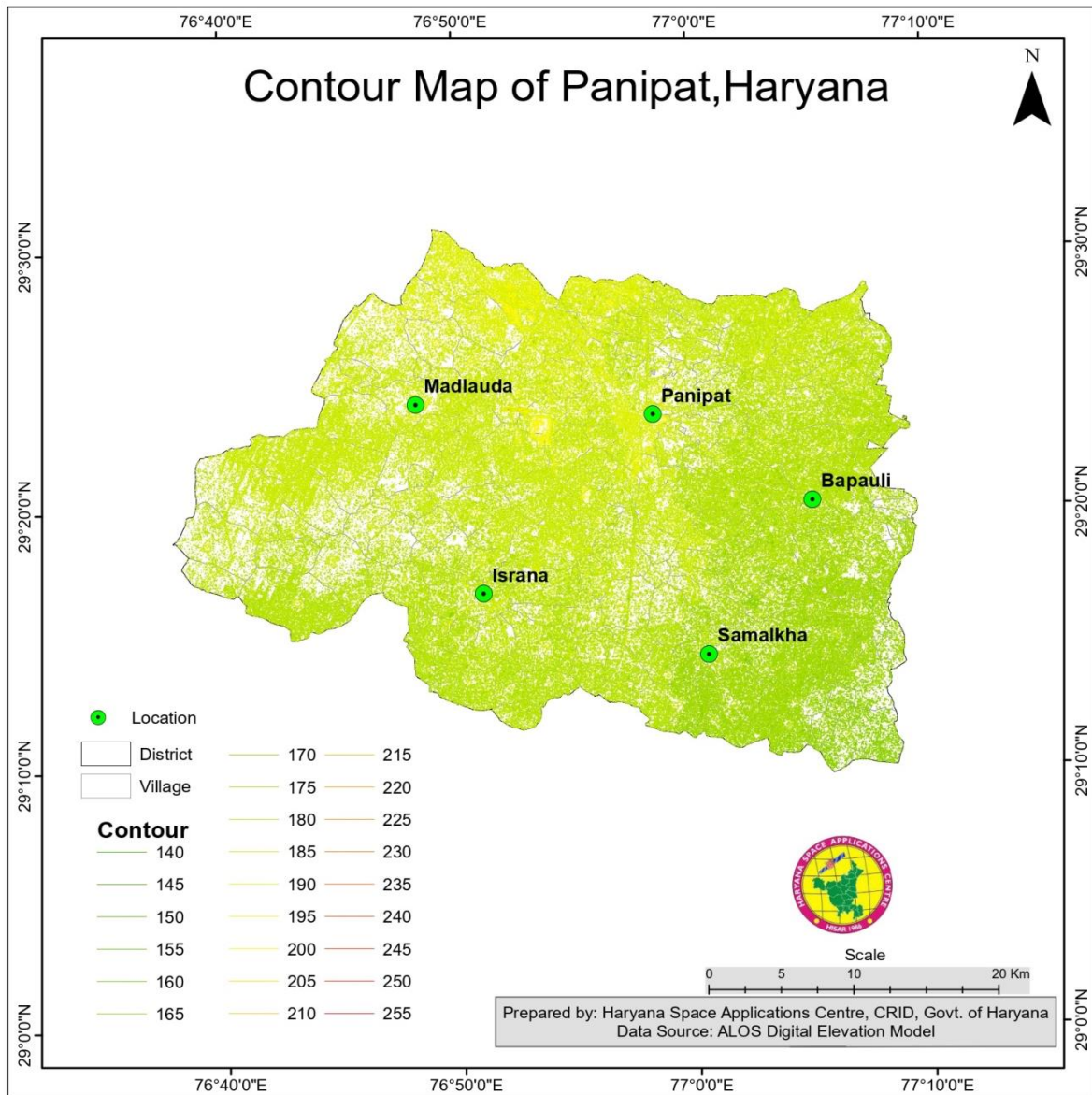


Figure 5- Contour Map of Panipat District

1.5.1. Geology and Lithology

The area constitutes almost alluvial plain without any conspicuous topographical features and forms a part of the vast Indo-Gangetic plain. The elevation of the area above mean sea level ranges from 244 m, above Mean Sea Level (AMSL). The general slope of the area is southwards. In the north western part of the district the land slopes south west wards shown in (Figure 6).

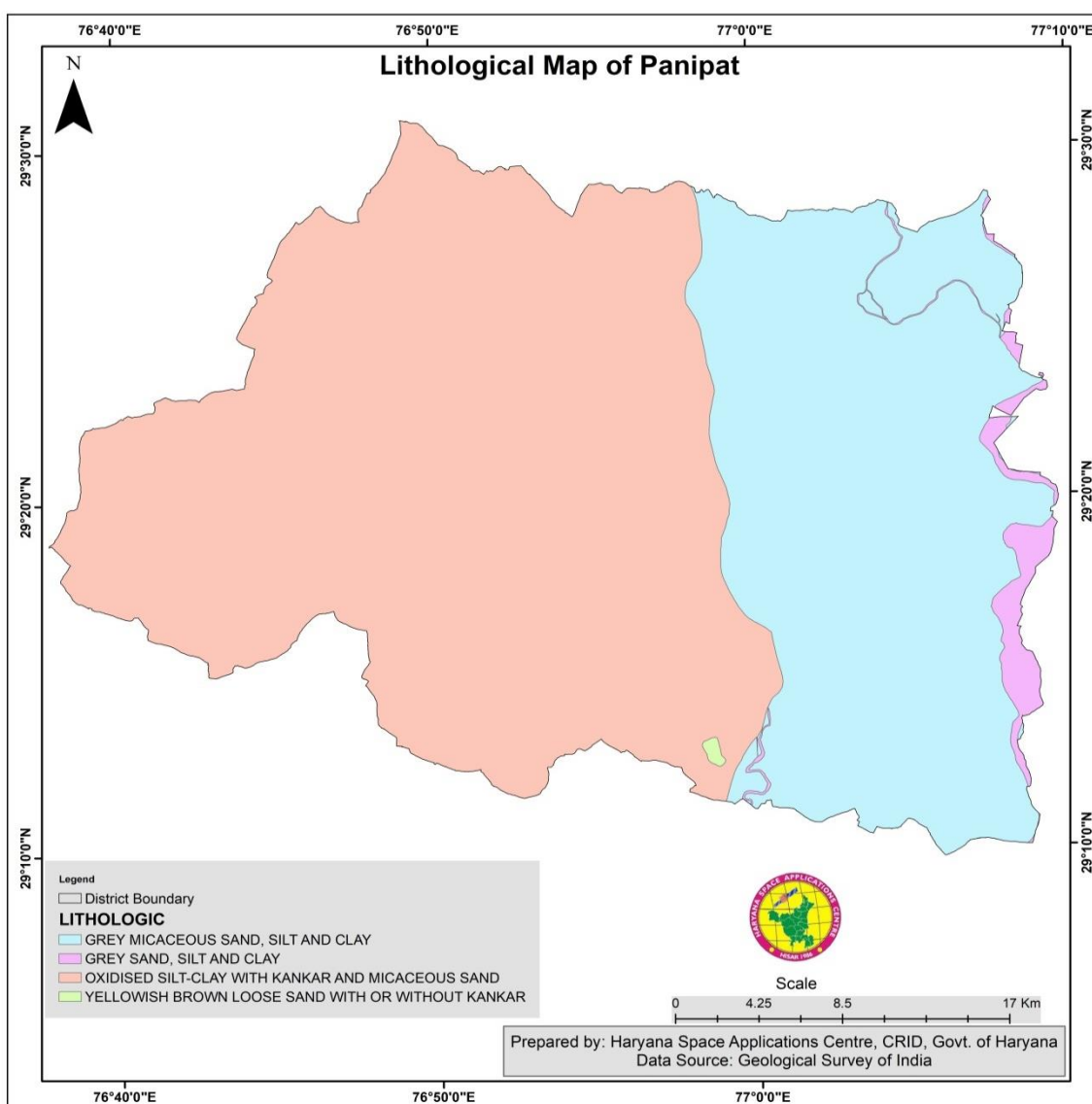


Figure 6- Lithological Map of Panipat District

1.5.2. Soil Profile

The district has two types of soils viz-tropical arid brown and arid brown soils (solemnized. The arid brown soils are found in major parts of the district whereas tropical arid brown soils are found in north eastern part of the district especially in parts of Bapoli and Panipat blocks.), shown in (Figure 8)

The district has two types of soils - tropical arid brown and arid brown soils (solemnized) (Gupta, 2007). The arid brown soils are found in major parts of the district whereas tropical arid brown soils

are found in north eastern part of the district especially in parts of Bapoli and Panipat blocks. The soil generally varies from sandy loam to loam with alkaline patches of variable ph. The area along the river Yamuna contains light soils and water table lies close to the surface. These soils are deep and grade varies from sandy loam near surface to clay loam in the sub-surface horizons. The general profile of soil health of Haryana state is shown in (Figure 7).

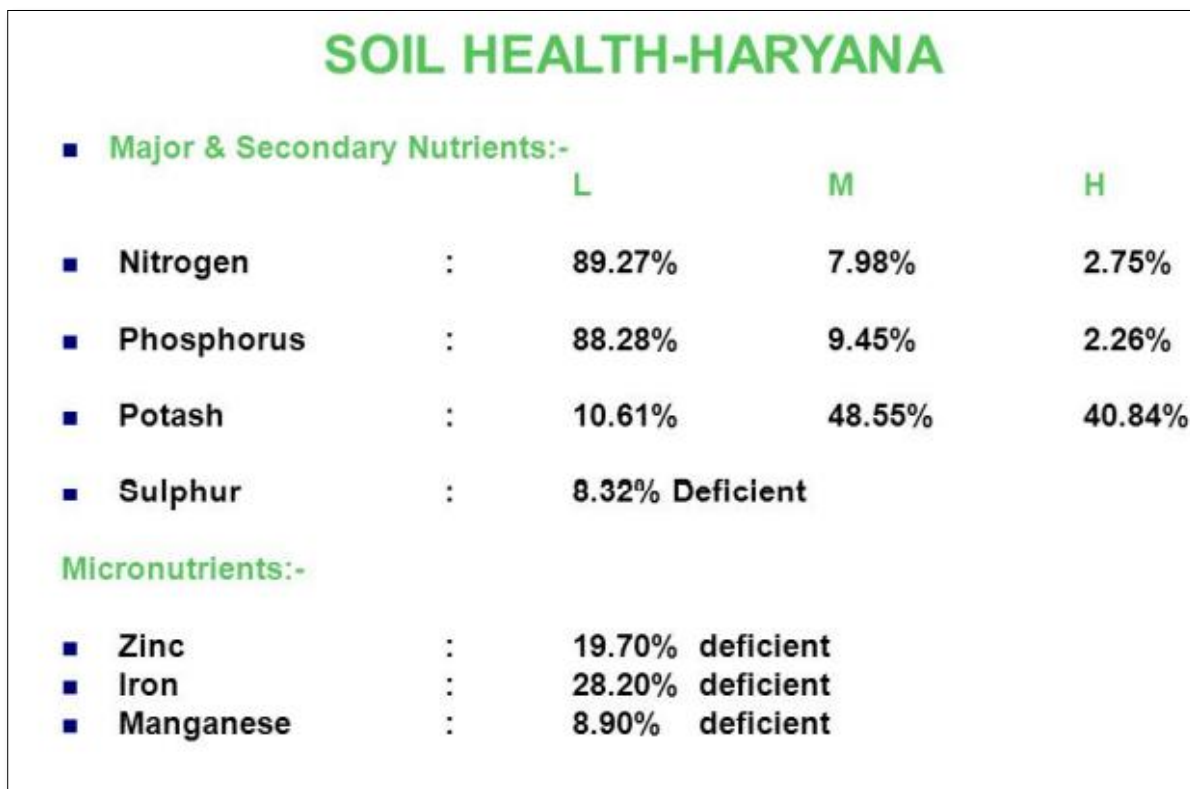


Figure 7- General Soil health profile of Haryana

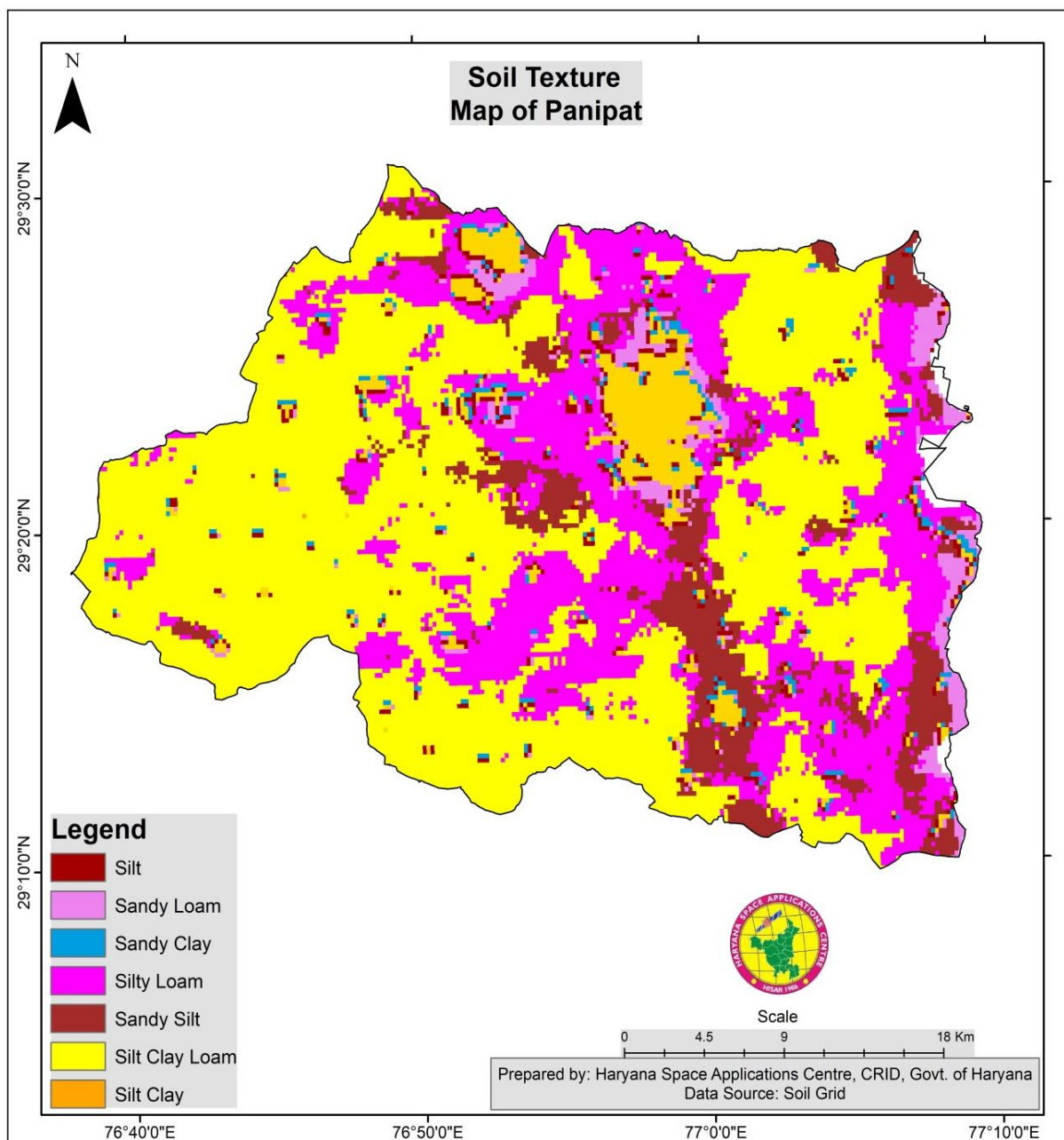


Figure 8 -Soil texture map of Panipat District

1.6. Land use

The terms land use and land cover are often used interchangeably, but each term has its own unique meaning. Land cover refers to the surface cover on the ground like vegetation, urban infrastructure, water, bare soil etc. Main land use in the district is for agriculture with 191Hect. of the land being used for agriculture. Land put to various uses in the district is given in the table land use pattern of Panipat district, Haryana. Panipat is lies in the medium fertility zone of the Sub region. There are Number of Textile and Food processing industries in the Panipat District. The major portion of Land is covered under Agriculture which is 4.08% more than the NCR Agricultural land use average. The

forest cover is 3.29% which is less than NCR average i.e., 4.02% but it ranked 2nd among the districts under most forest cover in Sub Region. The land use land cover map of Panipat District is shown in (Figure 9). Land use and Land Cover distribution of Panipat shown in Table 3.

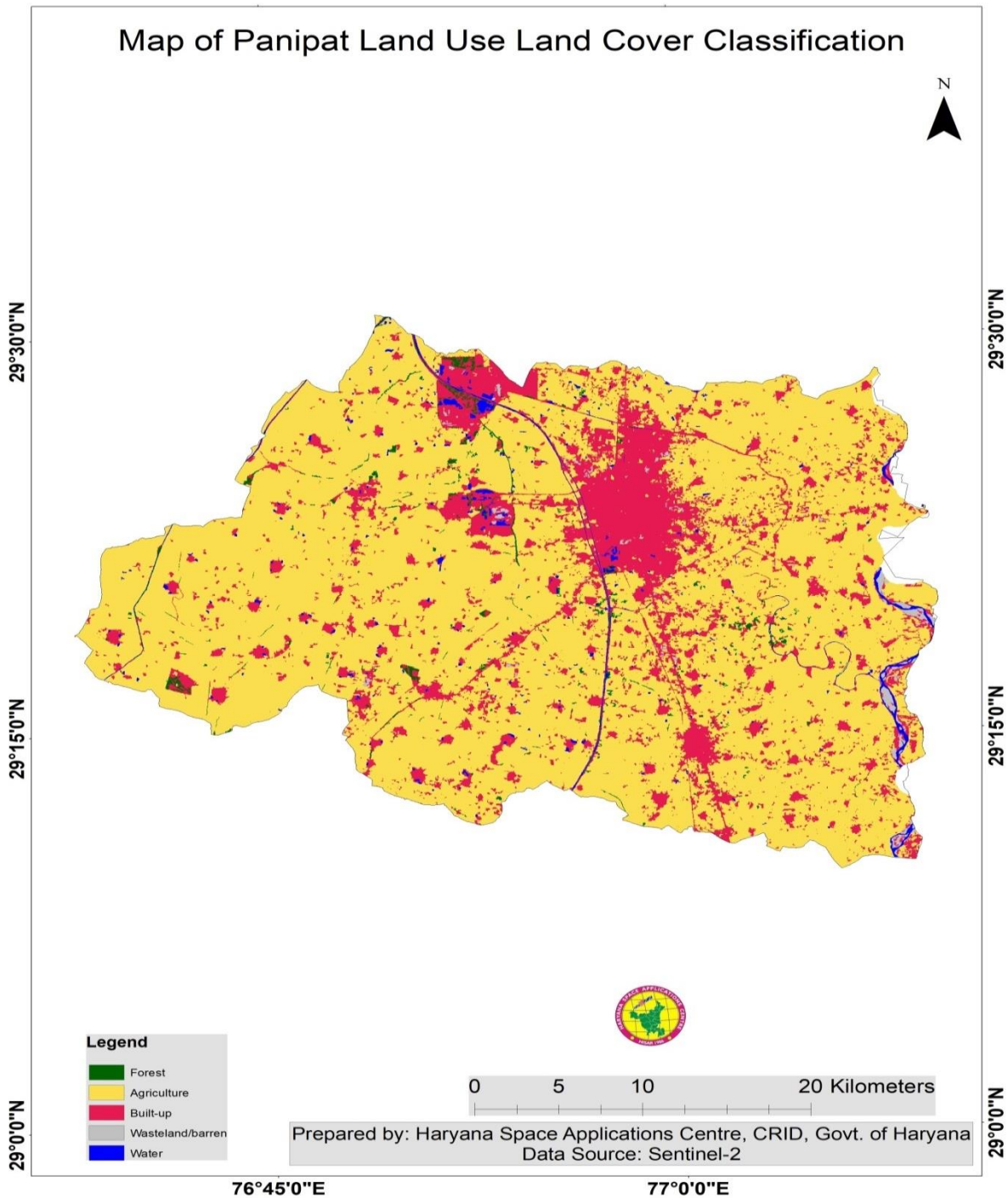


Figure 9- Land use and Land cover of Panipat District

Table 3 -Land use and Land Cover distribution of Panipat

2. District Water Profile

| Sr. No. | Type of Land use | Area (thousand hectares) |
|---------|---|--------------------------|
| 1. | Total area | 1268 sq.km |
| 2. | Forest | 30 sq.km |
| 3. | Land put to non-agricultural use | 308 sq. km |
| 4. | Barren and unculturable land | - |
| 5. | Permanent pastures and other grazing lands | - |
| 6. | Land under misc. tree crops and grooves not included in net area sown | - |
| 7. | Current fallows | - |
| 8. | Net area sown | 960 sq. km |
| 9. | Culturable area | 140 sq. km |
| 10. | Area sown more than once | 950 sq. km |
| 11. | Total cropped area | 1910 sq.km |

2.1. Source of Water

The district forms a part of Indo gangetic plain and lies in Yamuna Sub basin of main Ganga basin. Physiographically, the district is characterized by two distinct features i.e. vast upland plain and Yamuna flood plain. The width of the flood plain varies according to the amount of shift experienced by the river. It is narrow in the Northern part and widens downstream. The district is mainly drained by the river Yamuna and its tributaries. The river Yamuna is major Perennial River which flows all along the eastern margin of the district from northern to southern direction. The district is also drained by the artificial drain named as 'Naurah Drain' which originate in southern eastern part of Madlauda block and flows through south western part of Panipat and all along eastern boundary of Israna block in southerly direction. Status of water availability shown in **Table 4**

Table 4 -Status of water availability

| Sr. No. | Source | Kharif (in Cusecs) | Rabi (in Cusecs) | Total (in Cusecs) | Remarks |
|----------------|------------------------------------|---------------------------|-------------------------|--------------------------|--|
| I. | Surface Irrigation | | | | |
| (i) | Canal, Major & Medium Irrigation | 335.59 | 335.59 | 671.18 | |
| (ii) | Minor Irrigation Tank (FIS) | | | | |
| (iii) | Lift Irrigation/ Diversion | | | | |
| (iv) | Various Water Bodies including RWH | | | | |
| (v) | Treated Effluent received from STP | | | 90 | |
| (vi) | Un treated Effluent | | | | |
| (vii) | Perennial sources of water | | | | The PD Branch is perennial sources of water through River Yamuna |
| II. | Ground Water | | | | |
| (i) | Open well | | | | |
| (ii) | Deep Tubewell | | | | |
| (iii) | Medium Tubewell | | | | |
| (iv) | Shallow Tubewell | | | | |

2.1.1. Rivers

River Yamuna is the only river flowing along the entire eastern boundary of Panipat district. Total length of river Yamuna in the district is 45 Km. District is equipped with good drainage system in the shape of Main Drain No. 2, Try. Drain No. 1, Try. Drain No. 2, Try. Drain No. 3, Try. Drain No. 4, Nohra Drain & Panipat Drain etc. which is sufficient to discharge excessive rain/flood water in the area.

2.1.2. Canals

Panipat district borders the state of Uttar Pradesh across the Yamuna River in the east. Panipat falls in the Upper Yamuna Basin and the principal ground water reservoir in the area is unconsolidated alluvial deposits of Quaternary age. Ground water in near surface zone occurs under water table conditions and occurs under semi confined to confined conditions in deeper aquifers. Rainfall and seepage from the river Yamuna, canal networks and irrigation are the principal source of ground water recharge in the area.

2.1.3. 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. Others, like water gardens, water features and koi ponds are designed for aesthetic ornamentation as landscape or architectural features. The map of total waterbodies that include ponds, canals are shown in **Figure 10 (a)** and map of Monsoon waterlogged area in Panipat district **Figure 10 (b)**. Block wise No. of Ponds in Panipat District shown in **Table 5**.

Table 5- Block wise No. of Ponds in Panipat District

| Sr. No | Block Name | No. of Ponds |
|--------|---------------|--------------|
| 1 | Bapauli | 144 |
| 2 | Israna | 250 |
| 3 | Madlauda | 344 |
| 4 | Panipat | 146 |
| 5 | Samalkha | 129 |
| 6 | Sanauli Khurd | 92 |

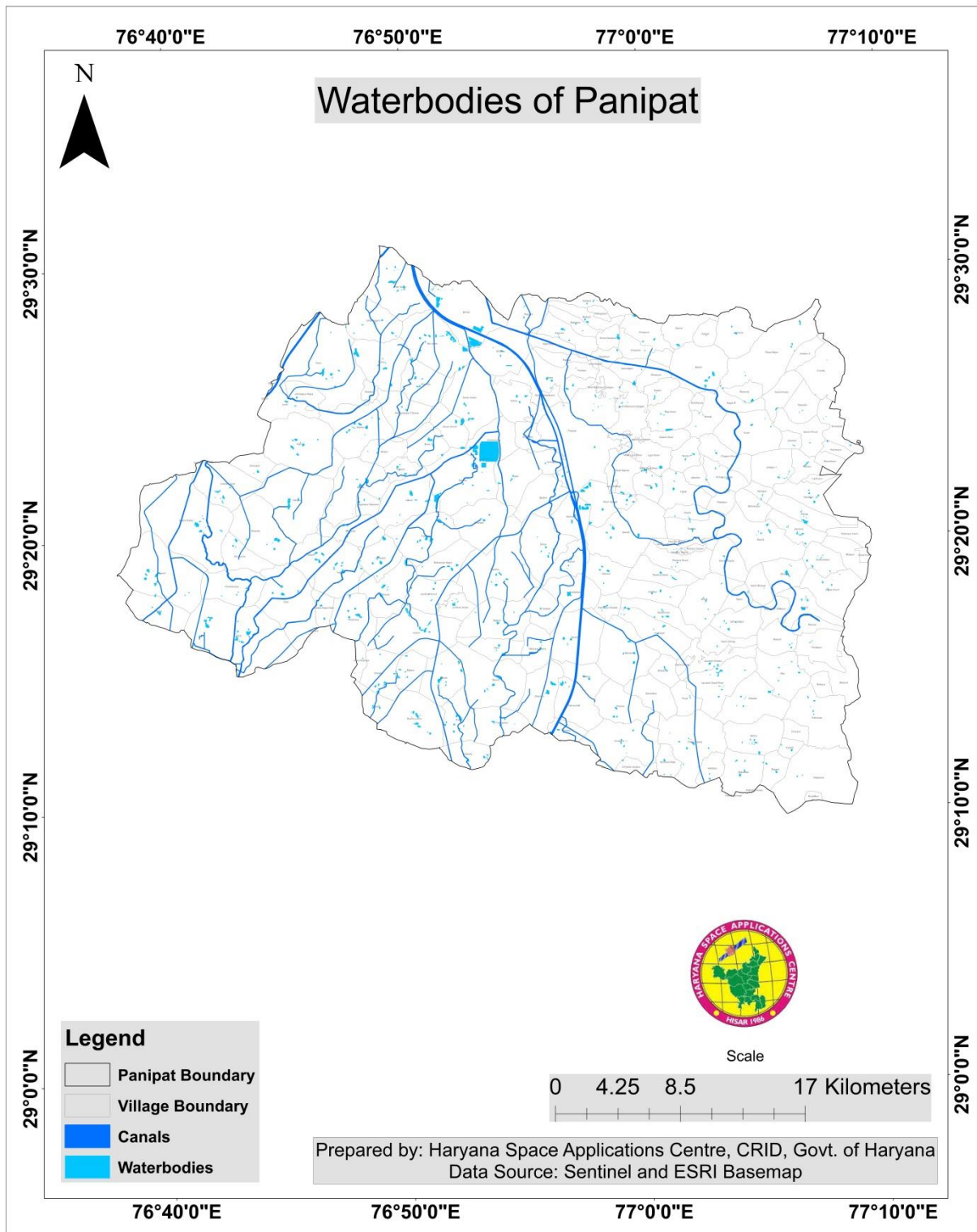


Figure 10 (a) Water bodies of Panipat District

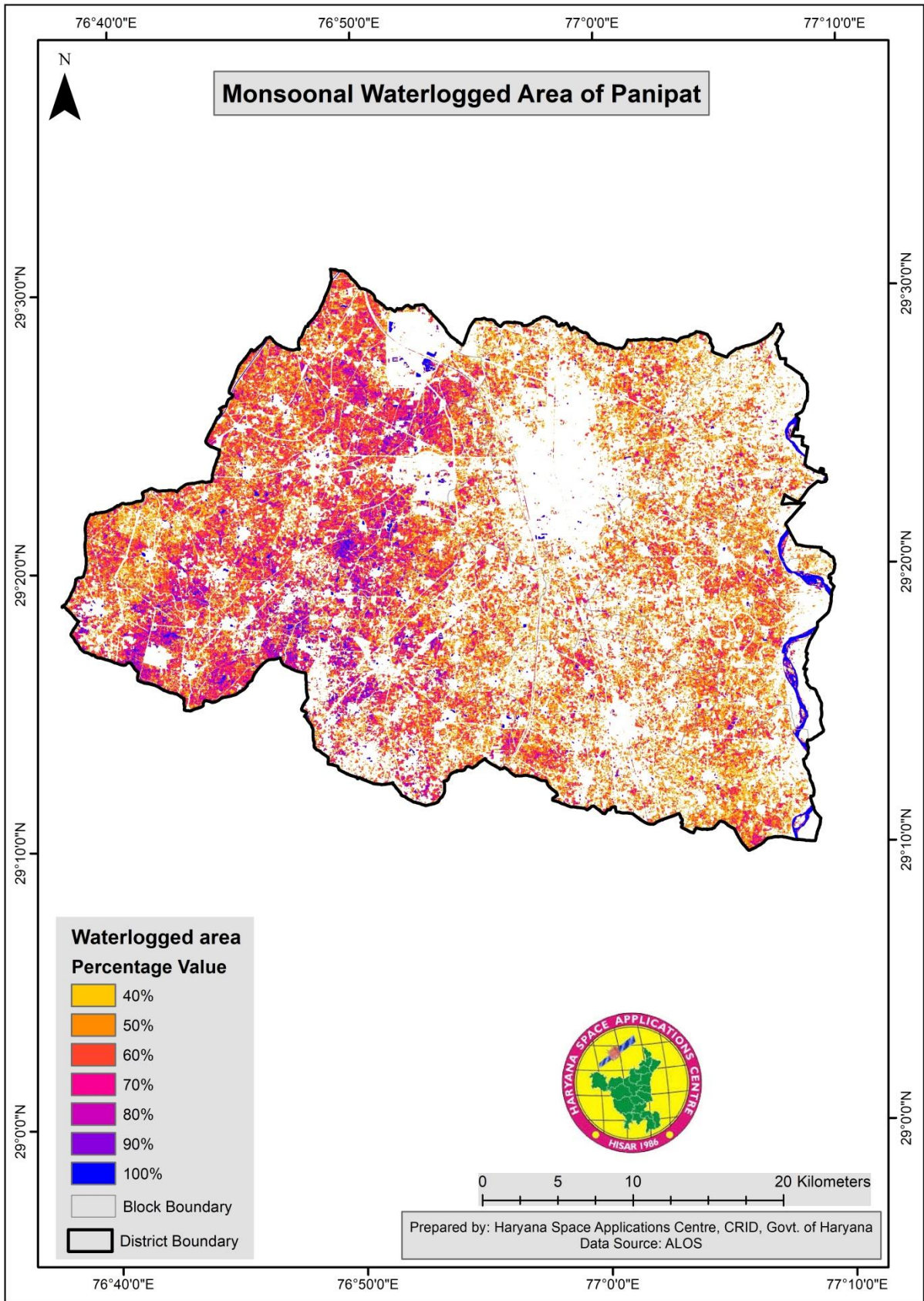


Figure 11 (b) Water Persistence's of Panipat District

2.1.4. Drain

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

Table 6 Length of Stream order of Panipat District

| Sr. No. | Stream Order | Total Length (in meters) |
|---------|-----------------------|--------------------------|
| 1 | 1 st order | 1148376.45 |
| 2 | 2 nd order | 615883.58 |
| 3 | 3 rd order | 369155.46 |
| 4 | 4 th order | 176217.58 |
| 5 | 5 th order | 125332.82 |

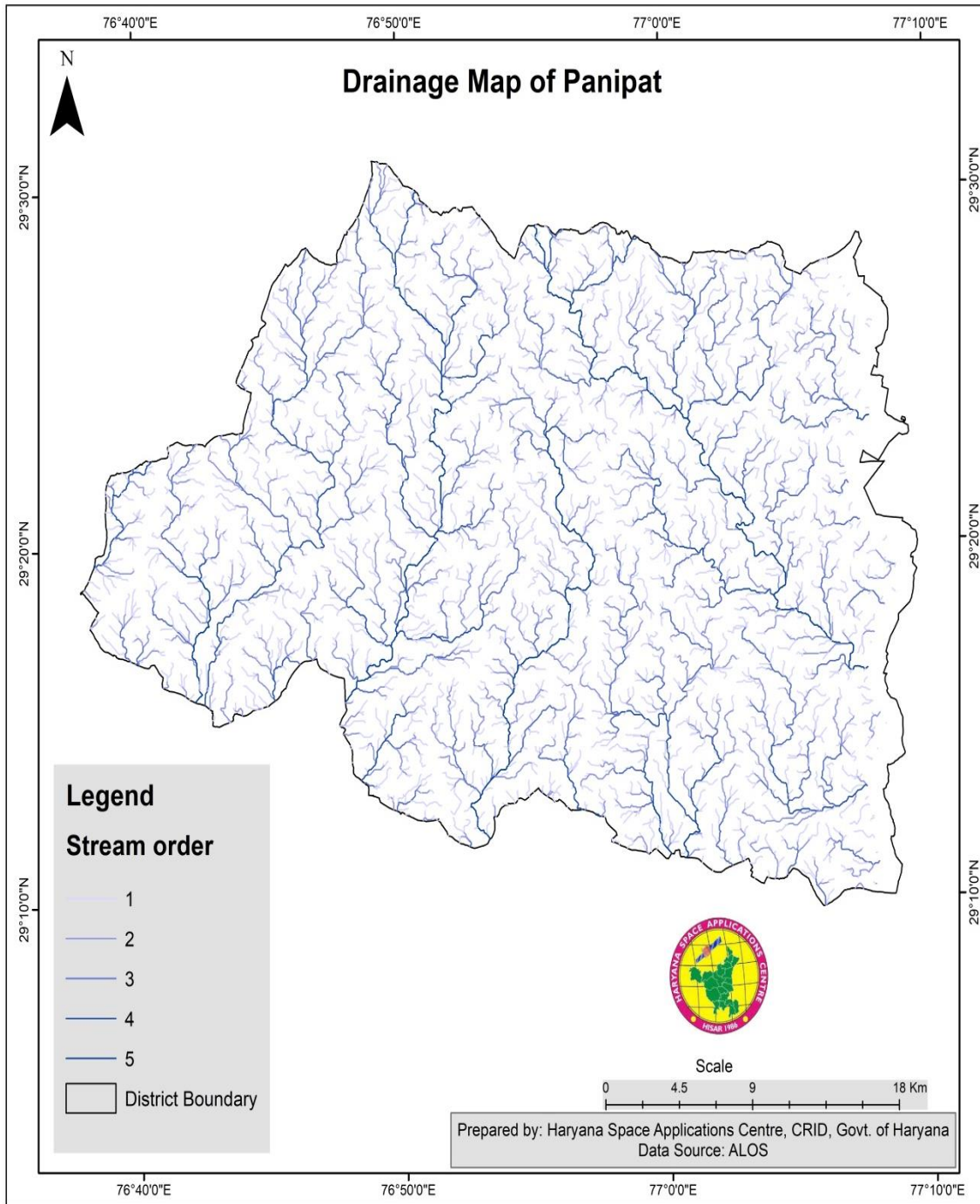


Figure 12- Drainage Map of Panipat District

2.2. Water Harvesting System

A rainwater harvesting system comprises components of various stages - transporting rainwater through pipes or drains, filtration, and storage in tanks for reuse or recharge. As per assessment of the Central Ground Water Board for preparation of Master Plan on Artificial Recharge, blocks namely

Panipat, Samalkha, Bapoli and parts of Israna and Madlauda blocks are found to be feasible for Artificial Recharge. The major source of water for recharge is rainfall. The type of recharge structures suitable are recharge shafts, trenches, injection wells, gabion structures in river bed. As per 'Master Plan on Artificial recharge 2013' an area of 1268 sq.km has been identified for artificial recharge in the district which has a subsurface storage potential of 14 0 2 MCM. A volume of 1865 MCM of water would be required to attain this recharge. A total of 1140 Nos of recharge structure have been proposed. Besides this roof top rain water harvesting should also be taken up in the district. Water Harvesting System in Panipat District shown in **Table 7**.

Table 7 Water Harvesting System in Panipat District

| Sr.No. | Activity Name | Works Completed | Works Ongoing | Expenditure (in Lakhs) |
|--------|--|-----------------|---------------|------------------------|
| 1 | Check Dam | | 0 | |
| 2 | Pond / Tank | | 4 | |
| 3 | Trench | 49 | 0 | |
| 4 | Rooftop Water Harvesting Structure (Public) | 4 | 0 | |
| 5 | Rooftop Water Harvesting Structure (Private) | 2 | | |
| 6 | Other Rainwater Recharge Structures (Open Well Recharge, Sand Filter for open well recharge) | | 2 | |
| 7 | Other Water Conservation Structures (Bench Terracing, Canal) | | 4 | |
| | | | | |
| 1 | Traditional Water Bodies Restored | 61 | 55 | |
| | | | | |
| 1 | Soak Pit | 117 | 58 | |
| 2 | Stabilization Pond | 0 | 0 | |
| 3 | Other Reuse / Recharge | 9 | 0 | |

| | | | | |
|---|---|-----|----|--|
| | Structure | | | |
| | | | | |
| 1 | Gully Plug | 0 | 0 | |
| 2 | Percolation Tank | | 1 | |
| 3 | Staggered Trenches | 0 | 0 | |
| 4 | Other Watershed Construction Activities | 75 | 58 | |
| | | | | |
| 1 | Intensive Afforestation-Nurseries | 6 | 5 | |
| 2 | Intensive Afforestation-Plantation | | 40 | |
| | | | | |
| 1 | Farmer's training programs by KVKs on Water Use Efficiency and Appropriate Crops | 42 | | |
| 2 | Distribution of one packet of vegetable seeds and saplings of five nutritious plants to farmers | | | |
| 3 | Awareness Programs/ KisanMela on the theme Valuing Water | 314 | | |
| | | | | |
| 1 | Use of Treated Waste Water | 0 | | |

2.2.1. Roof Top Harvesting

There are a number of different ways to harvest rain water. But the one most essential thing that is common in all of the available water conservation techniques is to utilize natural rainwater to supplement the daily life's water consumption. People in the city are becoming all the more conscious day by day in implementing the best possible water conservation techniques. The major benefits of

harvesting natural rainfall is 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 8**) 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 8 Water Harvesting System in Panipat District

| Sr.No. | Activity Name | Works Completed | Works Ongoing | Expenditure (in Lakhs) |
|--------|--|-----------------|---------------|------------------------|
| 1 | Check Dam | | 0 | |
| 2 | Pond / Tank | | 0 | |
| 3 | Trench | 0 | 0 | |
| 4 | Rooftop Water Harvesting Structure (Public) | 218 | 0 | |
| 5 | Rooftop Water Harvesting Structure (Private) | 0 | | |
| 6 | Other Rainwater Recharge Structures (Open Well Recharge, Sand Filter for open well recharge) | | 36 | |
| 7 | Other Water Conservation Structures (Bench Terracing, Canal) | | 0 | |
| | | | | |

| | | | | |
|---|---|--------|----|--|
| 1 | Traditional Water Bodies Restored | 22 | 5 | |
| | | | | |
| 1 | Soak Pit | 716 | 0 | |
| 2 | Stabilization Pond | 1 | 0 | |
| 3 | Other Reuse / Recharge Structure | 8 | 0 | |
| | | | | |
| 1 | Gully Plug | 1 | 0 | |
| 2 | Percolation Tank | | 0 | |
| 3 | Staggered Trenches | 0 | 0 | |
| 4 | Other Watershed Construction Activities | 33 | 16 | |
| | | | | |
| 1 | Intensive Afforestation-Nurseries | 214500 | 0 | |
| 2 | Intensive Afforestation- Plantation | | 10 | |
| | | | | |
| 1 | Farmer's training programs by KVKs on Water Use Efficiency and Appropriate Crops | 183 | | |
| 2 | Distribution of one packet of vegetable seeds and saplings of five nutritious plants to farmers | | | |
| 3 | Awareness Programs/ KisanMela on the theme Valuing Water | 141 | | |
| | | | | |
| 1 | Use of Treated Waste Water | 53505 | | |
| | | | | |

2.2.2. Water Harvesting system other than roof top

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be a terrace, courtyard, or paved or unpaved open ground. The terrace may be a flat RCC/stone roof or sloping roof. Therefore, the catchment is the area, which actually contributes rainwater to the harvesting system. Rainwater from the rooftop should be carried through down to take water pipes or drains to the storage/harvesting system. Water pipes should be UV resistant (ISI HDPE/PVC pipes) of the required capacity. The total no of activities achieved in Gurugram District for rain water harvesting is shown in **Table 9** at rural and urban area. The map of water conservation activity in Gurugram at rural and urban level is shown in **Figure 12**.

Table 9 -Water Harvesting technique in Rural area and Urban Area

| In Rural Area | | |
|----------------------|-------------------|-----------------------------|
| Sr. No | Block Name | Total No of Activity |
| 1 | Bapauli | 0 |
| 2 | Israna | 8 |
| 3 | Madlauda | 9 |
| 4 | Panipat | 17 |
| 5 | Samalkha | 5 |
| 6 | Sanauli Khurd | 7 |
| In Urban Area | | |
| 1 | Panipat | 14 |

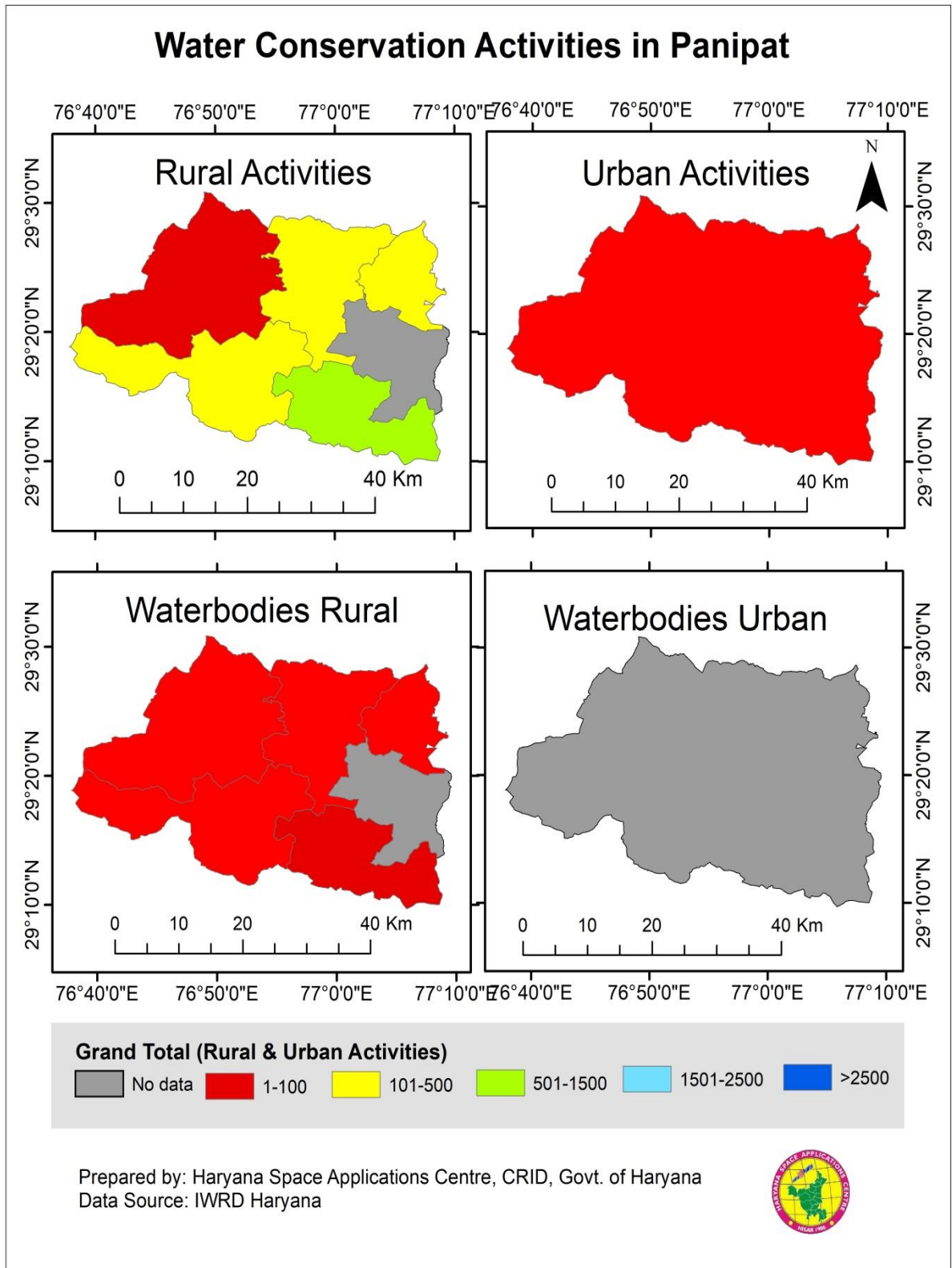


Figure 13 -Water Conservation Activities in Panipat District

2.2.3. Sewerage Treatment Plant

STP are very similar to the way the normal septic tanks work but mechanical components provide additional processes to help break down the solids so as to produce a cleaner and environment friendly effluent. Waste water and sewage from large number of properties are fed in primary settlement tank where solid and liquids separate and the liquor flows into the bio zone or aeration chamber where a aerator diffuses air or oxygen into the waste thereby encouraging the good bacteria to digest the organic matter thus breaking the organic matter down and purifying it. As the water leaves the final chamber also known as settling chamber, the effluent is 95% clean and ready for discharge into local water courses, ditches or land drainage systems. In Sonipat District total 6 treatment plant are installed having total capacity of approx. 90-100 MLD. The purpose of a sewage treatment plant is to thoroughly treat wastewater. The sewerage treatment plant map is shown in **Figure 13**. There are 5 number of sewage treatment plants present in the district Panipat.

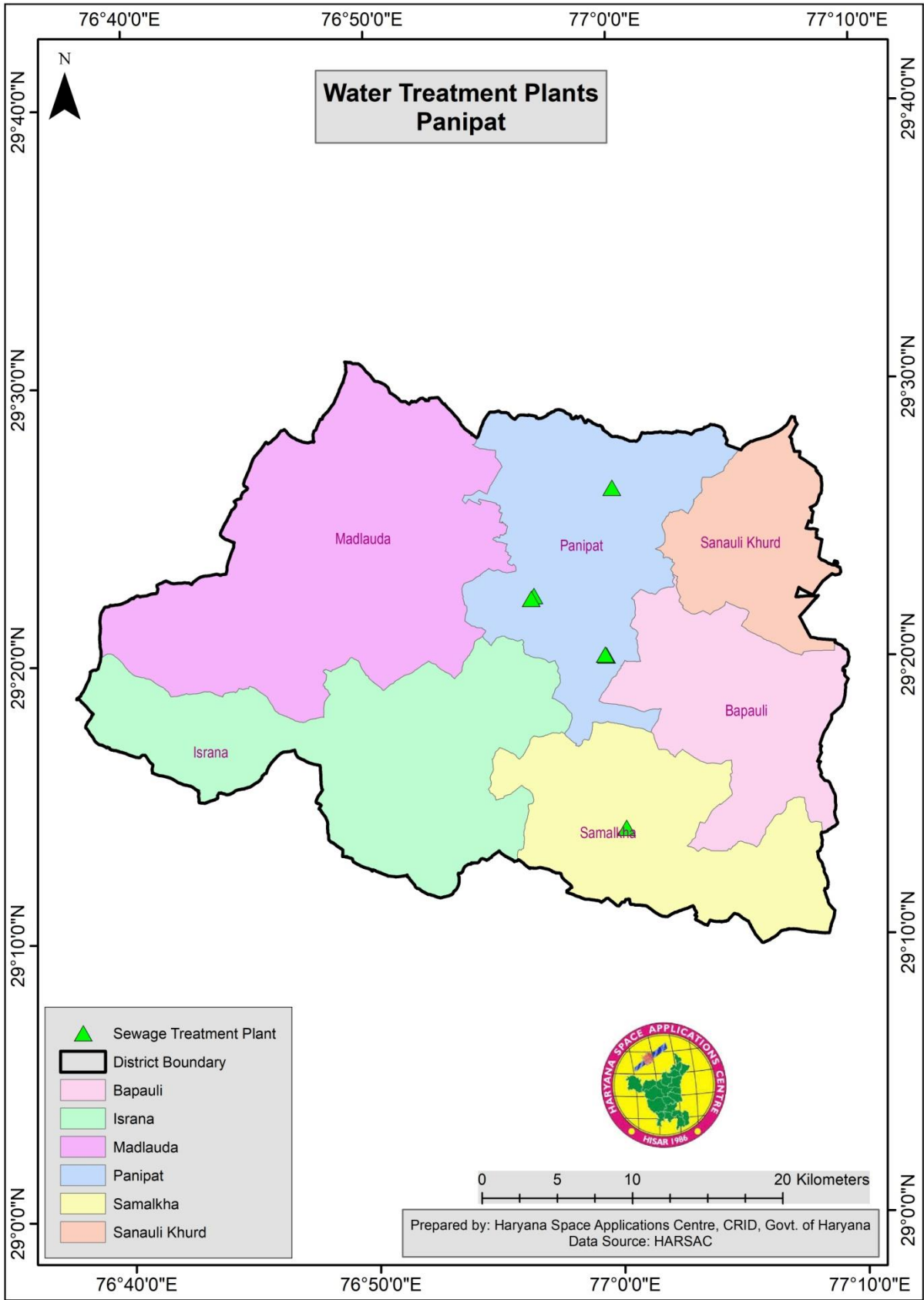


Figure 14- Water Treatment Plant Map of Panipat District

3. Irrigation profile

The Western Yamuna Canal (WJC) is the major source of canal irrigation. The WJC passes through the central part of the district covering part of Madlauda, Panipat and Samalkha blocks. Out of 96,000 ha net irrigated area, 28,000 ha is irrigated by canal and 68,000 ha is irrigated by ground water. About 70.83% of the irrigation is based on ground water resources. The gross irrigated area has been worked out as 1, 90,000 ha, which is 3.49% to the State total. Percentage of Gross Area Irrigated to Total Cropped Area has been worked out as 99.5% with the irrigation intensity of 197.9.

Status of drinking water supply

Drinking water supply to rural as well as urban area of the district is both tube well and canal based and maintained by State Public Health Department and Sewerage Department along with Municipal Council of Panipat. Western part of the district the ground water is saline to marginally saline. Therefore, the canal water constitutes the major source of water supply to the villages and towns especially western part of the district. Whereas most of water works in northern part of the district are tube well based. At some places water works are using canal water in conjunction with tube well water, wherever either water is not available or quality of water is fit for drinking purpose. Water supply in the district is maintained by public health department.

Source: YWS Circle, Irrigation Department, Karnal

It is evident from the above table that there are two major sources of irrigation in the district. Canal irrigation is available throughout the district and it is available during Kharif and Rabi season. In case of ground water irrigation, shallow tube wells are used mostly. The other source of water in the district is Treated Effluent received from STP which is under Public Health Department.

4. Water Availability

Block-wise ground water resource potential of the district has been assessed as per GEC-97 as on 31st March 2009. The ground water development in all the blocks has exceeded the available recharge, thus all the blocks have been categorized as over exploited, Stage of ground water development, ranges from 127% (block-Madlauda) to 210% (block-Samalkha). Net annual replenishes able ground water availability in the district have been assessed as 308.65 MCM. The total ground water draft for all uses in the district is 514.56 MCM, thus leaving shot-fall (over draft) of 205.91 M C M. Stage of ground water development in the Panipat district has been assessed to be 167%.

4.1. Surface Water Availability

River Yamuna is the only river flowing along the entire eastern boundary of Panipat district. Total length of river Yamuna in the district is 45 Km. District is equipped with good drainage system in the shape of Main Drain No. 2, Try. Drain No. 1, Try. Drain No. 2, Try. Drain No. 3, Try. Drain No. 4, Nohra Drain & Panipat Drain etc. which is sufficient to discharge excessive rain/flood water in the area. **Table 10** shows the type of water resources available in Panipat District.

Net area sown in the district is 96,000 ha, which is 100% of the total cultivable area of the district. Area sown more than once is 95,000 ha bringing the total cropped area to 1, 91, 000 ha. The entire net area sown is irrigated through tube wells and canals. Shallow tube wells are the most important ground water development structures in the district and have shown a tremendous growth in the past years. There are 83,855 tube wells in the district which irrigates an area of 68,000 ha. Most of these tube wells are cavity type. Filter type tube wells are found in the eastern part of the district especially along the river Yamuna. The average depth of tube wells in the district is 60m, varying between 12 to 80m tapping aquifer between 10 to 80m. The discharge varies from 8 to 14 lps. Canals of the area are irrigating approximately 28,000 ha. Tube wells support 70.83% irrigation in the district.

Table 10- Status of water availability of Panipat District

| Sr. No. | Source | Kharif (in Cusecs) | Rabi (in Cusecs) | Total (in Cusecs) | Remarks |
|-----------|------------------------------------|--------------------|------------------|-------------------|--|
| I. | Surface Irrigation | | | | |
| (i) | Canal, Major & Medium Irrigation | 335.59 | 335.59 | 671.18 | |
| (ii) | Minor Irrigation Tank (FIS) | | | | |
| (iii) | Lift Irrigation/ Diversion | | | | |
| (iv) | Various Water Bodies including RWH | | | | |
| (v) | Treated Effluent received from STP | | | 90 | |
| (vi) | Untreated Effluent | | | | |
| (vii) | Perennial sources of water | | | | The PD Branch is perennial sources of water through River Yamuna |

| | | | | | |
|------------|---------------------|--|--|--|--|
| II. | Ground Water | | | | |
| (i) | Open well | | | | |
| (ii) | Deep Tubewell | | | | |
| (iii) | Medium Tubewell | | | | |
| (iv) | Shallow Tubewell | | | | |

Source: YWS Circle, Irrigation Department, Karnal

4.2. Ground Water Availability

Panipat falls in the Upper Yamuna Basin and the principal ground water reservoir in the area is unconsolidated alluvial deposits of Quaternary age. Ground water in near surface zone occurs under water table conditions and occurs under semi confined to confined conditions in deeper aquifers. Rainfall and seepage from the river Yamuna, canal networks and irrigation are the principal source of ground water recharge in the area.

Ground water irrigation scenario

As per the data available from minor irrigation census 2006-07 the detailed number of shallow, deep, tube wells, lined, unlined water distribution system, land holdings of wells are given below for reference Total Distribution of Tube wells According to Owner's Holding Size. The following map (**Figure 14**) depicts the ground water depth in Panipat district and the **Table 11** gives the description of ground water resource and development potential of Panipat District.

Ground water level monitoring and behavior

The hydro-geological scenario and ground water behavior has been assessed by the water level data of the ground water monitoring stations established during the pre-monsoon and post- monsoon period of the year 2016. Depth to water level data in the district varies from 4 m Below Ground Level (bgl) to >30.0 mbgl. Western parts and along river Yamuna of the district are having relatively shallower water level, whereas in the central parts of the district have deeper water levels. Areas close to Yamuna also have relatively shallower water levels, in areas close to river water level even becomes shallower locally.

Table 11- Block wise Ground water Resources of Panipat District

| Block | Net Annual Ground Water Availability (Ha m) | Existing Gross Ground Water Draft For Irrigation (Ha m) | Existing Gross Ground Water Draft For All Uses (Ha m) | Allocation Domestic Industrial Up-to next 25years (Ha m) | Net Ground Water Availability For Future Irrigation Development (Ha m) | Stage Ground Water Development (%) | Category Of Block |
|--------------|--|--|--|---|---|---|--------------------------|
| Panipat | 5891 | 9723 | 10051 | 328 | -4160 | 171 | Over Exploited |
| Samalkha | 4373 | 9098 | 9172 | 74 | -4799 | 210 | Over Exploited |
| Madlauda | 7810 | 9874 | 9902 | 28 | -2092 | 127 | Over Exploited |
| Israna | 6774 | 11314 | 11332 | 18 | -4558 | 167 | Over Exploited |
| Bapoli | 6017 | 10952 | 10999 | 47 | -4982 | 183 | Over Exploited |
| TOTAL | 30865 | 50961 | 51456 | 495 | -20591 | 167 | Over Exploited |

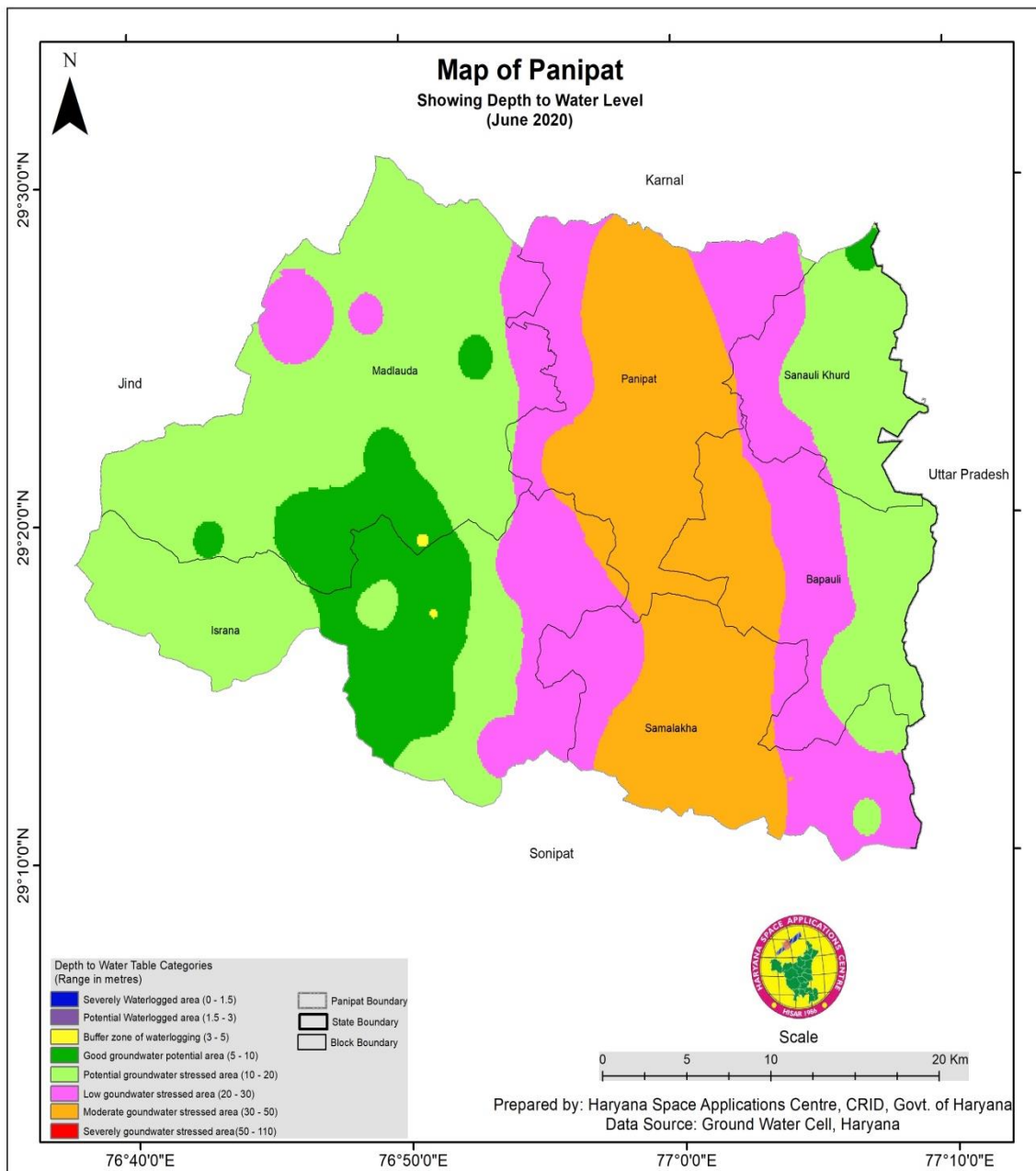


Figure 15- Ground water Availability Map of Panipat District

4.2.1. Ground Water Quality

Groundwater of the Panipat district is alkaline in nature and of low to medium salinity category. The spatial differences between the EC and TDS values reflect the wide variation in the activities and processes prevailing in the region. HCO₃, SO₄ and Cl are the dominant anions both in shallow and deep aquifers. The cation chemistry indicates that majority of the samples falls in the Na + K type water zone. The values of Total Dissolved Solids (TDS) exceed the desirable level in some 93% and total hardness values in 52% of the samples, indicating higher dissolved ionic concentrations.

Concentration of exceeds the permissible limit of 1.5 mg/l in about 24% of the groundwater samples. Concentrations of Cland SO4 2- also exceed the desirable levels in some groundwater samples of the area. In general, drinking water quality is beyond the acceptable standards in many water samples in respect of TDS, SO4, F, Ca, Mg, alkalinity and hardness. Heavy metals analysis shows that concentrations of some heavy metals (Fe, Mn and Pb) are present well above the prescribed permissible levels recommended for the drinking water in few groundwater samples. Concentrations of Cr, As, Se and Cd are found well within the threshold values.

The study on Ground Water quality and pollution aspects have been carried out in the industrial town of Panipat City. The studies indicate that ground water in the city is polluted by nitrate and fluoride in some parts and is also polluted by heavy metals like Mn, Pb, Fe at many placed. Heavy metals like Cd, Ni, Zn, Cu, Co, Sr are also found in low concentrations. Heavy metals are found even at deeper levels also. Ground Water is hard in a large area. Ground Water in some parts of the city is unsuitable for drinking purpose. Deeper ground water is by and large is potable. So, based on that Panipat district's water quality varies from good to poor (**Figure 15**) and Whereas block wise water quality index value is shown in **Table 12**.

Table 12 -Block wise average water quality index value in Panipat District.

| Sr.No. | Block Name | Average Water Quality Index value |
|--------|---------------|-----------------------------------|
| 1 | Bapauli | 74.88434 |
| 2 | Israna | 159.867221 |
| 3 | Madlauda | 130.482497 |
| 4 | Panipat | 68.064203 |
| 5 | Samalkha | 90.5448 |
| 6 | Sanauli Khurd | 68.527415 |

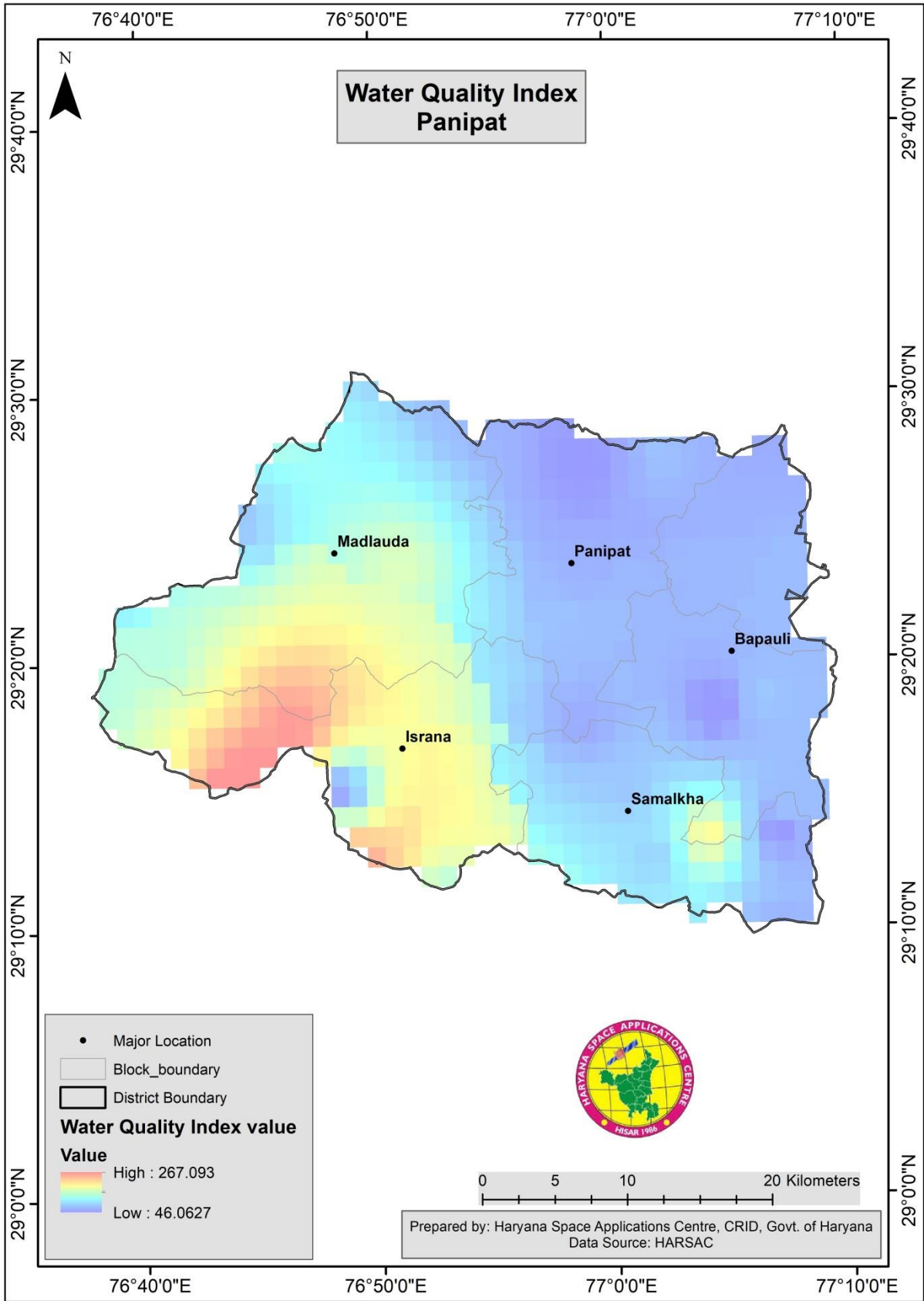


Figure 16 - Water quality index of Panipat District

5. Aquifer System

Twelve Exploratory wells were drilled in Panipat district during 2013 wherein water samples were collected following the standard sampling procedure as per APHA (1998). Data available reveals that four aquifer systems exist in Panipat district. The perusal of depth-wise chemical data as tabulated in Annexure indicates that the ground water samples of the 1st aquifer system are fit for human consumption as all the parameters determined are within BIS permissible limits for drinking water. Similarly, well waters from 2nd aquifer system have all the parameters well within BIS permissible limits for drinking water. The pH values of samples collected from 3rd aquifer system of the district range up to 9.0 making the water highly alkaline. The water is suitable for drinking purposes with respect to other parameters such as EC, TDS, F and NO₃ which are within the BIS desirable limits of drinking water. Similarly, the pH values of samples collected from the 4th aquifer system of the district range up to 9.01 making the water highly alkaline. Salinity, SAR (Sodium Absorption Ratio) and RSC (Residual Sodium Carbonate) values ascertain suitability of water for irrigation purposes (Table 17). The overall salinity at all depths is within permissible guideline of 3000 $\mu\text{mhos/cm}$. The alkalinity hazard ratios computed indicate that SAR values in 1st aquifer zone are below 10 and RSC is below 1.25 meq/l making the water suitable for irrigation purposes.

The water of 2nd aquifer has the calculated SAR of 13.61 and RSC of 4.17 meq/l. This water is suitable for irrigation purposes on well-drained soil or after blending with water of low RSC. Though the waters of 3rd and 4th aquifers have low salinity and medium SAR values with respect to irrigation, it is unsuitable for irrigation purposes due to high RSC values that vary from 3.21 to 4.2 meq/l. It is observed that there is a decrease in EC, TDS, SO₄, Ca, Mg, Na and K concentrations as depth increases with exception at Mahayudinpur Thirana (3rd aquifer) 64 wherein the sulphate concentration is also found to be high (739 mg/l). Nitrate concentrations in all aquifers, in general, are low while no particular trend of fluoride is observed aquifer-wise. There is an increase in SAR and RSC values with depth.

6. Water Requirement/ Demand

6.1. Water Supply and Gap

The stage of ground water development for the district as a whole is 167% and all the five blocks have shown high development of ground water resources and making the blocks overexploited. It indicates that the ground water is under stress and ground water level is declining. Based on the ground water exploration carried out in the district a well assembly of 305 / 203 mm with about 80 m of housing length and 1.19 mm slot size and shrouded with 1.6 – 8 mm gravel would be suitable in the district. Shallow tube wells can have a single diameter pipe assembly of 203 mm screening the granular zones.

Since the whole area of the district is alluvium and neither basement nor any cobble, pebble bed has been encountered, hence appropriate method of drilling in the area would be direct or reverse rotary. There is a need to take up the measures to enhance water use efficiency by adopting practices of water conservation techniques. Besides, there is need to arrest the depleting ground water resources by implementing the projects of rain water harvesting and artificial recharge to ground water. Domestic Water Requirement (MCM/Per Year) is shown in **Table 13**, Crop Water Requirement (MCM/Per Year) shown in **Table 14** and Livestock Water Requirement (MCM) shown in **Table 15**.

Table 13 Domestic Water Requirement (MCM/Per Year)

| Block | Population | Existing Population in 2016 | Present Water Requirement | Projected Population in 2022 | Annual Water Requirement in 2022 |
|--------------|----------------|-----------------------------|---------------------------|------------------------------|----------------------------------|
| Panipat | 650322 | 692593 | 2.68 | 829160 | 2.74 |
| Samalkha | 139049 | 156430 | 3.35 | 177287 | 3.41 |
| Bapoli | 66205 | 74480 | 1.59 | 84411 | 1.62 |
| Madlauda | 102596 | 115420 | 1.56 | 130810 | 1.73 |
| Israna | 110204 | 123980 | 2.61 | 140510 | 2.86 |
| Sanoli | 69428 | 78160 | 1.67 | 88521 | 1.70 |
| Total | 1137804 | 1241063 | 13.46 | 1450699 | 14.06 |

Table 14 Crop Water Requirement (MCM/Year)

| Block | Area sown(Ha) | Irrigated area (ha) | Crop Water Demand |
|--------------|---------------|---------------------|-------------------|
| Panipat | ----- | 8295 | 10.10 |
| Samalkha | ----- | 9139 | 11.11 |
| Bapoli | ----- | ----- | ----- |
| Madlauda | ----- | 22188 | 27.02 |
| Israna | ----- | 16989 | 20.69 |
| Sanoli | ----- | ----- | ----- |
| Total | ----- | 56611 | 68.92 |

Table 15 Livestock Water Requirement (MCM)

| Block | Total number of livestock | Present water Demand | Water Demand in (2022) | Existing Water Potential | Water Potential to be created |
|--------------|---------------------------|----------------------|------------------------|--------------------------|-------------------------------|
| Panipat | 60851 | 82543100 lts | 83554600 lts | optimum | ----- |
| Samalkha | 57847 | 82543100 lts | 83554600 lts | optimum | ----- |
| Bapoli | 18767 | 82543100 lts | 83554600 lts | optimum | ----- |
| Madlauda | 49526 | 82543100 lts | 83554600 lts | optimum | ----- |
| Israna | 43951 | 82543100 lts | 83554600 lts | optimum | ----- |
| Sanoli | 22585 | 82543100 lts | 83554600 lts | optimum | ----- |
| Total | 253527 | ----- | ----- | ----- | ----- |

Industrial Water Requirement

Panipat district consists of two sub divisions viz. Panipat & Samalkha comprising of six development blocks. The district is basically an agricultural producing area and the major dependence of the people is on land. Prior to the formation of Haryana State, the industrial development in the district was negligible and with the provision of infrastructure viz. Roads and Power etc. by the Haryana Govt. three number main industries units i.e., IOCL, PNCP & NFL have come up in the district. In addition to this, 6 No. units of PTPS has been set up in the Distt. Industrial Water Requirement (in Census) shown in **Table 16** below.

Table 16 Industrial Water Requirement (in Census)

| Blocks | Current Water Demand | Water Demand in 2022 | Existing Water Potential | Water Potential to becreated |
|-----------------|----------------------|----------------------|--------------------------|------------------------------|
| Panipat | 50 | 80 | 80 | 0 |
| Samalkha | --- | --- | --- | --- |
| Bapoli | --- | --- | --- | --- |
| Madlauda | 10 | 10 | 10 | 0 |
| Israna | --- | --- | --- | --- |
| Sanoli | --- | --- | --- | --- |
| Total | 60 | 90 | 90 | 0 |

Total Water Demand of the district for various sectors

This section presents the total water demand of the district and has been calculated by summing up all major sectors consuming water. The current water demand has been indicated in **Table 17** and the projected water demand has been depicted in **Table 18**.

Table 17- Sector wise present water requirement (2016)

| Blocks | Demand from components (in Cusecs) | | | | | |
|-----------------|------------------------------------|---------------|-----------|------------|------------------|-------|
| | Domestic | Crop | Livestock | Industrial | Power Generation | Total |
| Panipat | --- | 49.17 | --- | 50 | 0 | |
| Samalkha | --- | 54.18 | --- | --- | 0 | |
| Bapoli | --- | ----- | --- | --- | 0 | |
| Madlauda | 7.60 | 131.53 | --- | 10 | 0 | |
| Israna | 12.71 | 100.71 | --- | --- | 0 | |
| Sanoli | --- | ----- | --- | --- | 0 | |
| Total | 20.31 | 335.59 | --- | 60 | 0 | |

Table 18 -Sector wise present water requirement (2022)

| Blocks | Demand from components (Cusecs) | | | | | |
|-----------------|---------------------------------|--------------|-----------|------------|------------------|-------|
| | Domestic | Crop | Livestock | Industrial | Power Generation | Total |
| Panipat | --- | 54.09 | --- | 80 | 0 | |
| Samalkha | --- | 59.59 | --- | --- | 0 | |
| Bapoli | --- | ----- --- | --- | --- | 0 | |
| Madlauda | 8.35 | 144.6 8 | --- | 10 | 0 | |
| Israna | 13.71 | 110.7 8 | --- | --- | 0 | |
| Sanoli | --- | ----- --- | --- | --- | 0 | |
| Total | 22.06 | 369.1 5 | --- | 90 | 0 | |

6.2. Water Budget

To arrive at the future water demand for the HSR the consultants have prepared a statement taking into consideration the drinking water demand, firefighting demand, industrial demand and the losses in transmission and distribution. The agricultural demand has been kept separate. Data has been compiled for all the towns / rural areas and authenticated by the consultants. The methodology adopted to arrive at each demand figure is as the norms and standards for water supply as fixed by the Engineer-in-Chief, Haryana with a slight modification for Class III, IV, V towns, where the water demand has been taken as 120 lpcd for class III and 100 lpcd for class IV & V. Detailed calculations on above and the water demand figures of the HSR region are enclosed herewith where the settlement-wise water demands are shown in **Table 19** below:

Table 19 Water budgeting Panipat district

| 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 Waster Water | Previous Year/ Average Annual Consumptive Use | Remarks |
| | | | | Rain Water | Surface Water | Ground Water | Total Supply | | | |
| Panipat | Panipat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Samalkha | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Israna | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Bapouli | 4526200 | 4526200 | 0 | 0 | 4526200 | 4526200 | 226310 | 4,526,200 | |
| | Madlauda | 657200 | 657200 | 0 | 0 | 657200 | 657200 | 32860 | 657,200 | |
| | Sanoli Khurd | 371000 | 371000 | 0 | 0 | 371000 | 371000 | 18550 | 371,000 | |

7. Strategies for Water Conservation

The following remedial measures are recommended to minimize the declining ground water trend in parts of the Panipat district as safeguard against environmental degradation.

1. The directives of CGWA notification for the notified block Samalkha should be implemented.
2. Artificial recharge to ground water should be taken up in the urban and rural area to avert the further lowering of ground water level since natural recharge to the aquifer system is not adequate to support such heavy ground water withdrawal.
3. Subsurface drainage system may be laid down in Israna and Madlauda blocks to combat water logging.
4. The study of Flood plains of river Yamuna may be taken up for safe ground water exploitation as flood plains have more prolific fresh water aquifers due to perennial nature of river Yamuna.
5. Geophysical study is required for the delineation of fresh water zones in Israna and Madlauda blocks.

6. Revival of water bodies like pond in the village could be recommended under scheme of drinking water mission for the sustainability of shallow tube wells and crops of the area.
7. Water use efficiency should be enhanced by practicing modern methods of irrigation like Laser levelling, zero tillage, mulching, Sprinkler irrigation, drip Irrigation etc.
8. Local populace to be educated regarding consequences of mining of ground water and need for its effective/economic use.
9. Local populace should also be educated regarding fluoride problem of the district specifically prevalent in Madlauda and Israna blocks. Safe drinking water should be provided to the populace after ascertaining the concentration of Fluoride for Safe limit.

7.1. Artificial Recharge

There are 344 tanks and ponds in the district which act as both water conservation and recharge structures. Their block wise distribution and recharge to ground water is as follows:

Artificial Recharge is feasible in Panipat, Samalkha, and Bapoli blocks and also in parts of Israna and Madlauda blocks. The major source of water for recharge is rainfall. The type of recharge structures suitable in the terrain are recharge shafts, trenches, injection wells, gabion structures in river bed. As a first approximation and area of 695 sq.km has been identified for artificial recharge in the district which has a subsurface storage potential of 242 MCM. A volume of 321 MCM of water would be required to attain this recharge. Besides this roof top rain water harvesting should also be taken up in the district.

Recommendations: The following remedial measures are recommended to minimize the declining ground water trend in parts of the Panipat district as safeguard against environmental degradation.

* It is necessary to notify the district for regulation of all ground water abstraction structures and for the construction of any Tubewell prior permission should be sought from the Central Ground Water Authority.

* Artificial recharge to ground water should be taken up in the urban and rural area to avert the further lowering of ground water level since natural recharge to the aquifer system is not adequate to support such heavy ground water withdrawal.

The Lakes & ponds in Panipat District are shown in **Table 20** below:


Table 20 Lakes & ponds in Panipat District

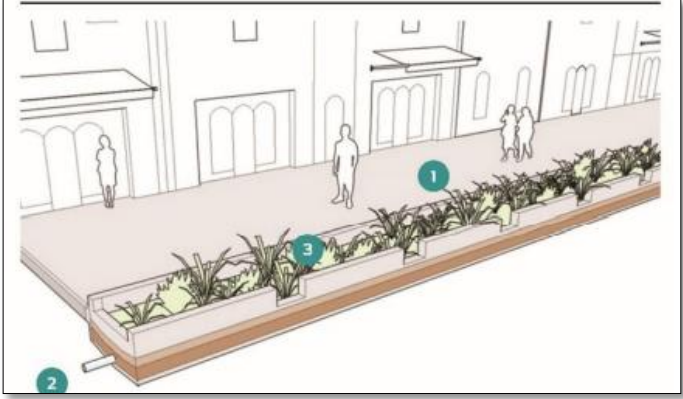
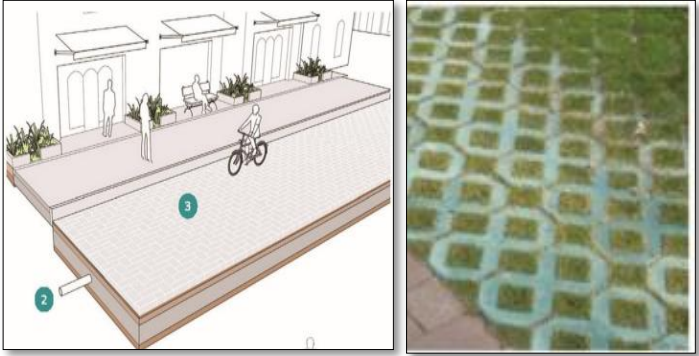

| No. of Tank/Pond | Average water spread area(ha) | | No of days water is available | | Recharge in Ha m during | |
|------------------|-------------------------------|--------------|-------------------------------|--------------|-------------------------|--------------|
| | monsoon | Non- monsoon | monsoon | Non- monsoon | monsoon | Non- monsoon |
| 377 | 750 | 375 | 450 | 1050 | 97.2 | 113.4 |

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 Panipat 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 below **Table 21**.

Table 21 The methods of water table recharge strategies in urban area

| Sr. No. | Method | Image |
|---------|-----------------------|---|
| 1 | Flow Through Planters |  <p>The image shows two parts: a cross-sectional diagram on the left and a photograph on the right. The diagram illustrates a planter box with plants, a drainage layer, and a collection pipe (labeled '2') that allows water to infiltrate the ground. The photograph shows a real-world example of a planter box with a drainage grate (labeled '1') and a collection pipe (labeled '2') installed in a concrete curb.</p> |

| | | |
|---|--------------------------|--|
| 2 | Pervious Strips |  |
| 3 | Pervious Pavement |  |
| 4 | Stormwater Tree |  |

7.3. Plantation

A major portion of WSUD that is popular within the Government Departments is plantation of various species of plants, both in public and private spaces, to encourage community participation and increase green cover. While increasing the aesthetic value of a location, plants are heavily influential to change microclimates and in fact playing a factor to rainfall patterns. Along with benefits of carbon sequestration, they contribute to increasing the local biodiversity of the region by attracting several types of fauna as well. Currently a multi-departmental approach within Gurugram 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 Panipat district is shown in **Figure 16** and **Table 22** shows the plantation target in Panipat District.

Table 22 -The plantation targets have been provided in the table below.

| Block | Wasteland Area (Sq. ft.) | Plantation at 5 feet spacing |
|----------------|---------------------------------|-------------------------------------|
| Panipat | 80532047.87 | 16106409 |
| Samalkha Khurd | 3983327.47 | 796665 |
| Israna | 43916761.44 | 8783352 |
| Madlauda | 55700786.72 | 11140157 |
| Bapauli | 25840426.40 | 5168085 |
| Sanauli | 17345294.32 | 3469058 |

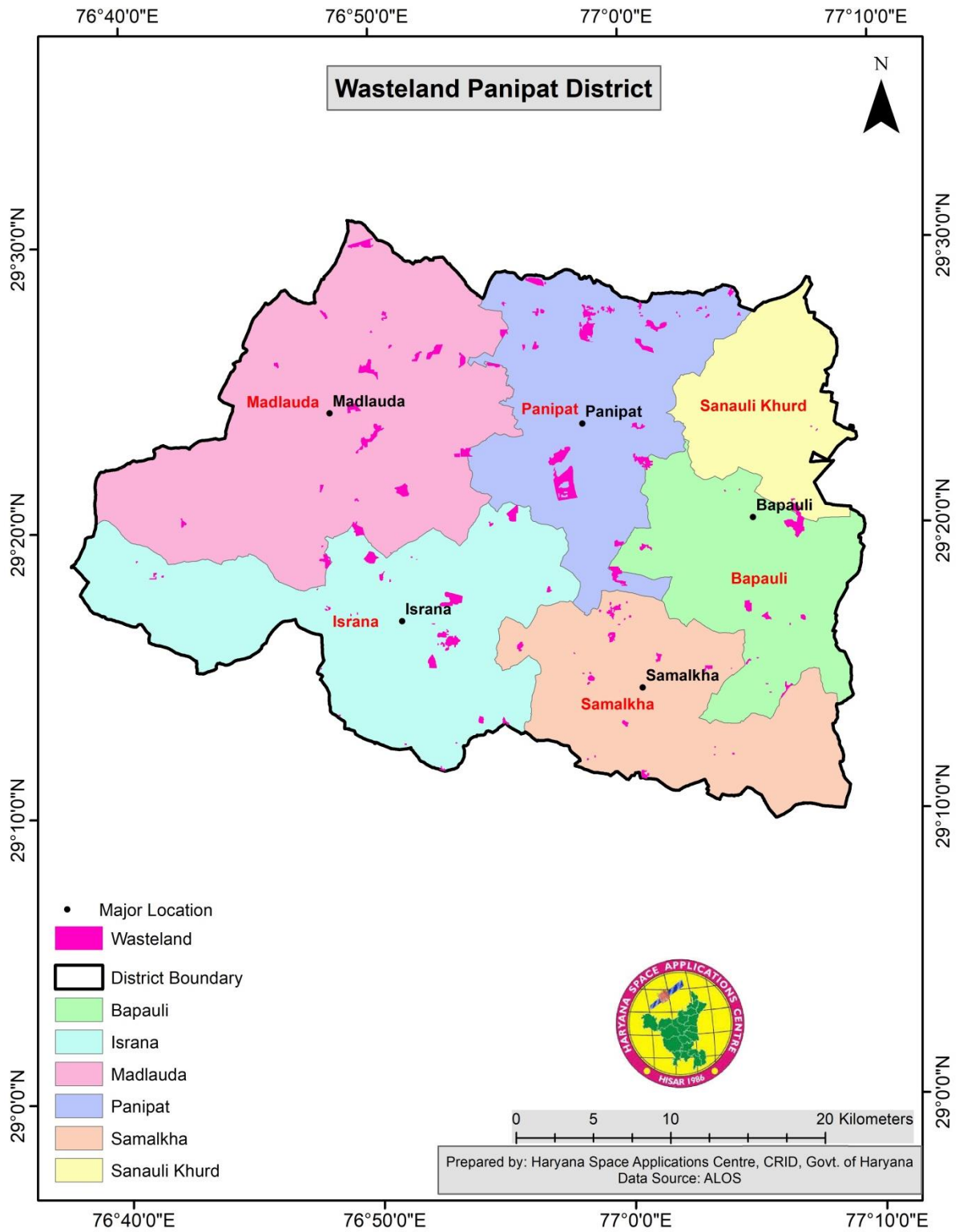


Figure 17- Wasteland of Panipat District

7.4. Surface water management

7.4.1. Pond restoration and rejuvenation

Priority ponds in Panipat district are 109. 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. Currently Gurugram

has a gap of 32 MLD of untreated wastewater, according the National Green Tribunal Status Report of February 2020 on Yamuna Action Plan that is being discharged directly into the Najafgarh Drain that directly drains into the Yamuna River. However, the ground reality suggests that there are a lot of unmapped points of discharge of wastewater that pollute the local waterbodies. These localized incidents of pollution of water bodies contribute to the loss of biodiversity and pose a threat to water security. In the recent years, it has been realized that wastewater may be an essential commodity and tool that may be used to close the demand supply gap and augment freshwater supply.

In order for pond restoration and rejuvenation to be done in a scientific and methodical manner, following a 11-step procedure that is accommodative of each individual pond site requirements are 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 exist 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, decentralized systems must be properly designed, maintained, and operated to provide optimum benefits.

The following table (**Table 23**) shows a list of generic conditions that are most often found in Panipat according to the type of treatment considerations and other main constraints such as land availability and population, given that finances are a constant.

Table 23 -Indicators and factors to decide the type of decentralised treatment required

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

| | | | |
|--------------------|-----|--------------|-------------------------------|
| Black Water | Yes | <5000 people | Hybrid |
| Black Water | No | >5000 people | Mechanized FSTP for a cluster |

Currently, the District has the following target for activities related to Pond Restoration and Rejuvenation (**Table 24**).

Table 24 The activities being undertaken by the District for Surface water management

| Pond Restoration Activity | Structure | Target |
|--|---------------------------|---------------|
| Restoration and Rejuvenation of Water Bodies | Water Bodies/TANKS | 21 |
| 3D Village Contour Mapping | Village Covered | 320 |
| Urban Wastewater Reuse | In Million Litres per Day | 370 |

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 (**Figure 17**) and **Table 25** shows the numerous activities and interventions that can be carried out for IEC

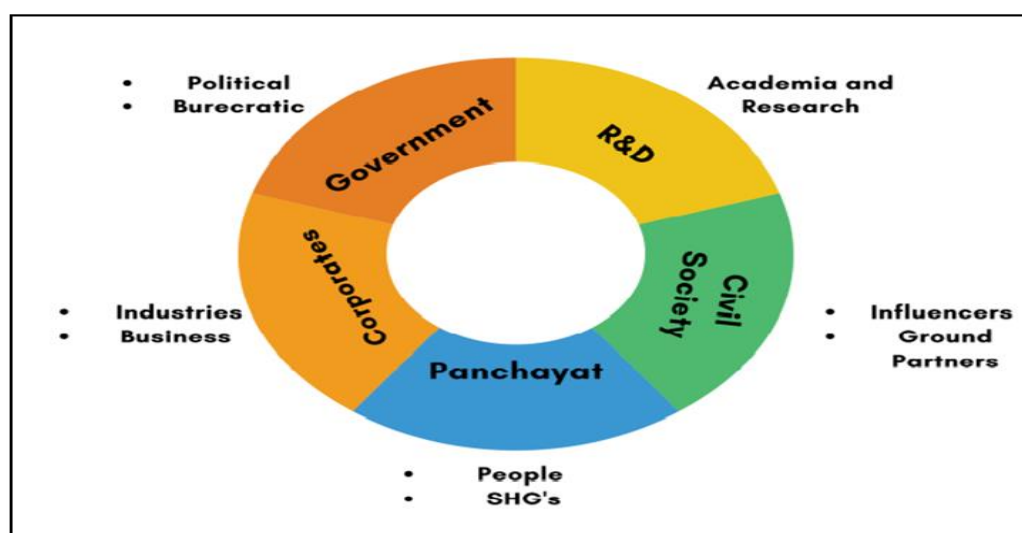


Figure 18 The various stakeholders of IEC Activities

Table 25- 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 Management 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 Example |
| 4 | Formation of Clubs | -how do we know about good vendor? - how do we identify places for RWH - How do we build RWH? | RWA | To make water representative from every RWA | Check list of water auditing for the water representative | 1. do the meetings with respective water representative from every RWA. -Team building for the Society |
| 5 | Guidelines | - Guidelines for All the drops of the Society | - RWA - govt institutions - Schools - Corporates | Information Flow | - guidelines and poster | - Information and Awareness on Water |

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

| | | | | | | |
|----|-------------------|----------------------------------|--|--|--|---|
| 12 | Plantation Drives | - Awareness on Plantation drives | - Urban (RWA, MCG, MC) - Rural (Pond Sites) - Schools -NGO's - NYK - District Youth Affairs and Sports | -To increase the green Cover To increase the water holding Capacity | - Plant List Nursery Database - Distribution Chain Management Posters | Better environment for Future Generations |
| 13 | Collaborations | - For IEC | -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

8.4. Rainwater harvesting

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

There are some factors that affect the rainfall water harvesting which needs to be focused for the development of suitable sites of water harvesting. These factors include rainfall, slope, soil texture, drainage, topography and land use / land cover and integration of these factors using weighted overlay analysis that results in suitable sites for rainwater harvesting. These sites are then classified into various suitability levels, namely, not suitable, less, medium, good and very good. The most suitable sites for rainfall water harvesting are shown in map (**Figure 27**). For the process of calculating suitable site a fixed weightage is needed to be applies on the above-mentioned criteria (Table 19) and the block wise area proposed for rainwater harvesting under most suitable sites is shown in **Table 26**.

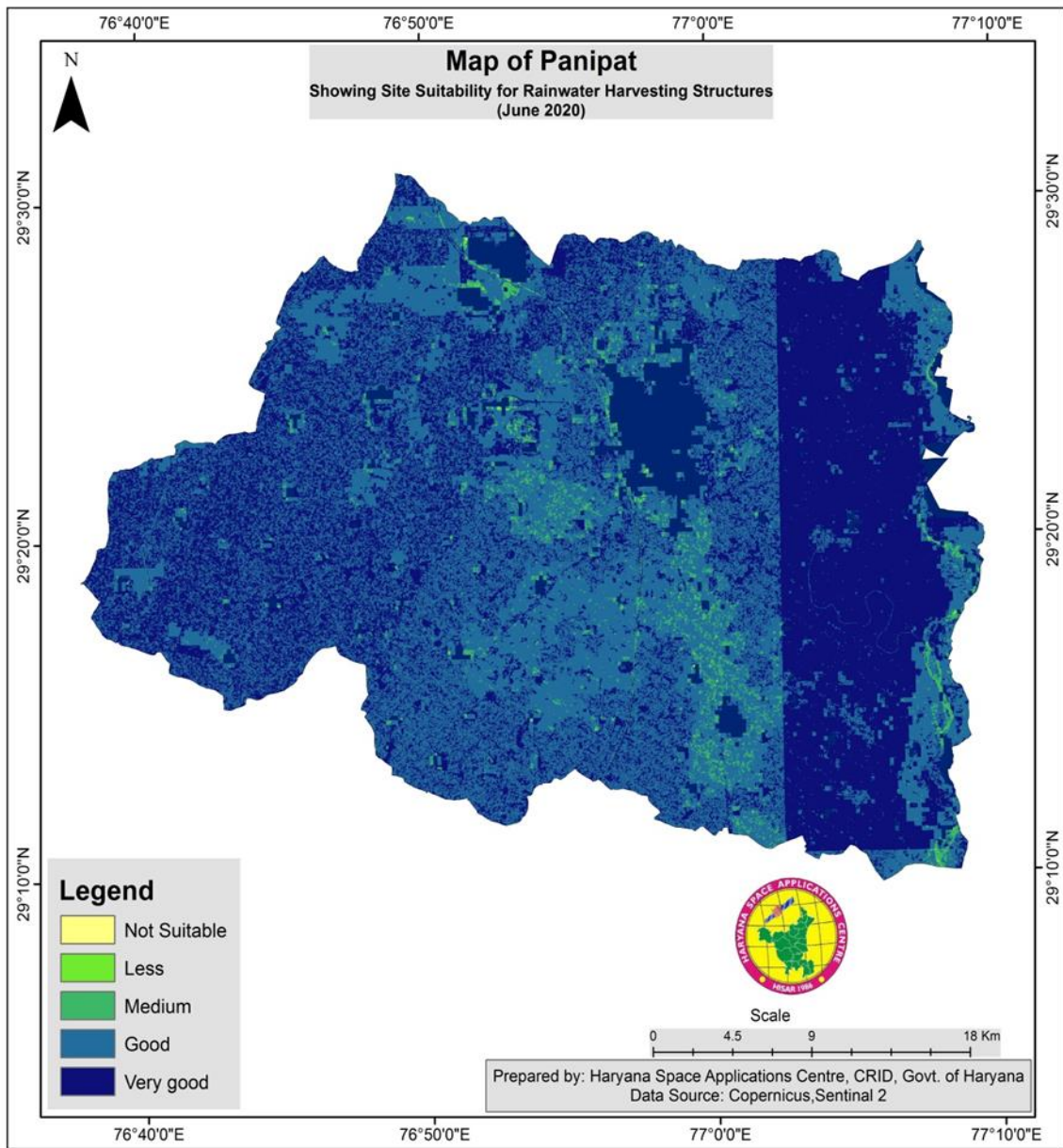


Figure 19 Site Suitability Map for Rainfall Harvesting Structure in the Year 2020

Table 26 Block wise area under very good suitable site proposed for rain water harvesting

| Sr.No. | Block Name | Area (Very Good suitability area in Sq. meter) |
|--------|---------------|--|
| 1 | Bapauli | 113351408.08 |
| 2 | Israna | 100341828.81 |
| 3 | Madlauda | 158246064.99 |
| 4 | Panipat | 95442731.51 |
| 5 | Samalkha | 78634587.35 |
| 6 | Sanauli Khurd | 85524404.89 |

Table 27 Assigned Weight for layer

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

8.5. Multi-criteria

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 19** shows the proposed suitable site based on multi criteria. Block wise proposed suitable sites based on multi- criteria is shown in **Table 28**.

Identify the suitable sites on Streams order.

- 0 Mini percolation Tanks, on Ist order Stream
- 0 Percolation Tanks, 2nd Order Stream
- 1 Pakka check Dams 3rd Order Stream
- 5 Micro Irrigation tanks 5th Order

- 1 Anicuts 4th order

Table 28 -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 | Panipat | 0 | 0 | 0 | 0 | 0 |
| 2 | Samalkha Khurd | 0 | 0 | 0 | 0 | 0 |
| 3 | Israna | 0 | 0 | 0 | 0 | 1 |
| 4 | Madlauda | 0 | 0 | 1 | 1 | 3 |
| 5 | Bapauli | 0 | 0 | 0 | 0 | 0 |
| 6 | Sanauli | 0 | 0 | 0 | 0 | 0 |

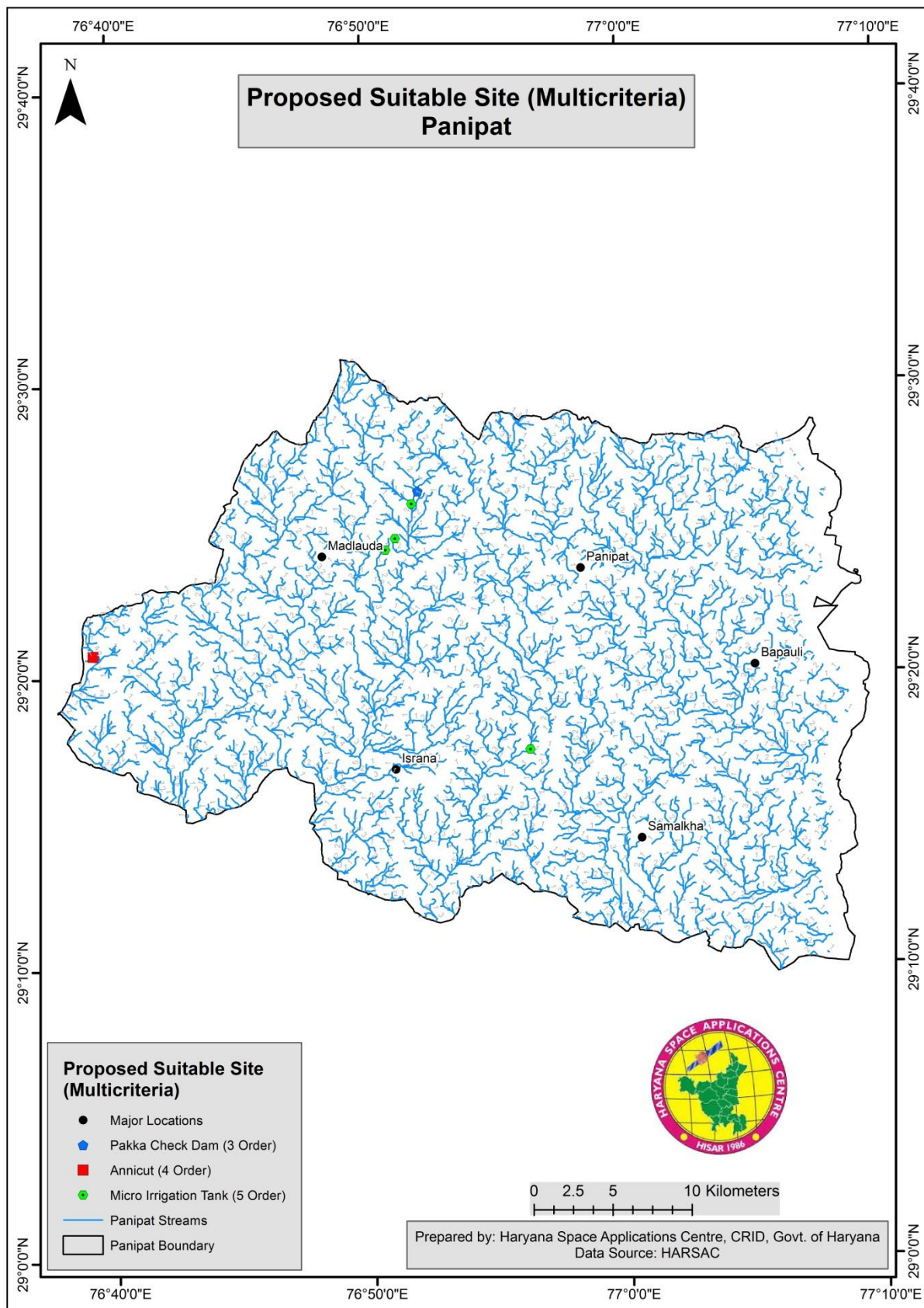


Figure 20 Proposed suitable sites based on multi-criteria in Panipat District

8.6. 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 1st order Stream, percolation Tanks, 2nd Order Stream, Pakka check Dams 3rd Order Stream, Micro Irrigation tanks 4th Order can be built. **Figure 20** shows the proposed suitable sites based on drainage structure in Panipat district. Proposed harvesting structures in Gurugram based on drainage **Table 29**.

Table 29 Proposed harvesting structures in Panipat based on drainage

| Sr. No. | Block Name | Mini percolation Tank | Percolation Tank | Pakka Check Dam | Annicut | Micro Irrigation Tank |
|---------|---------------|-----------------------|------------------|-----------------|---------|-----------------------|
| 1 | Panipat | 3 | 4 | 51 | 37 | 26 |
| 2 | Sanauli Khurd | 6 | 2 | 27 | 8 | 0 |
| 3 | Israna | 44 | 65 | 80 | 44 | 58 |
| 4 | Madlauda | 64 | 89 | 116 | 91 | 33 |
| 5 | Bapauli | 0 | 0 | 43 | 18 | 23 |
| 6 | Samalkha | 0 | 0 | 61 | 27 | 0 |

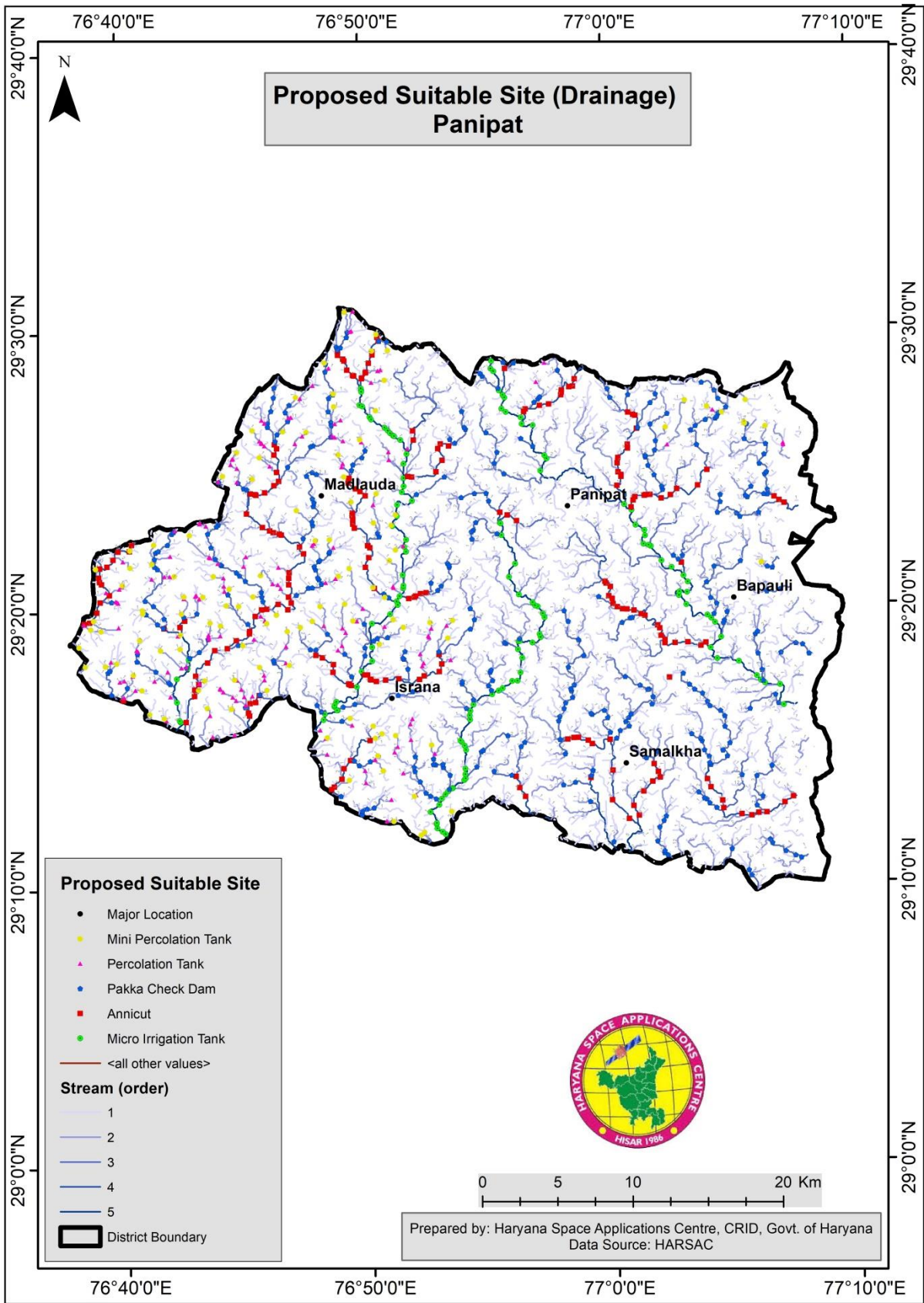


Figure 21 Proposed suitable sites based on drainage in Panipat District

9. Conclusion

Due to rapid urbanization, Panipat has seen problems related to water resources. There is water scarcity in lean season and waterlogging in monsoon season. Water logging over roads due to insufficient/unmanaged drains is the major problem. Current scientific report includes required information for the water harvesting where it is excess especially during monsoon/rainy season. The current water infrastructure information related to ponds/waterbodies, canals, natural drains, and drains based on slope is helpful in taking decisions on the construction of new structures for water harvesting. Block-wise estimates are given in the report while village level information is available at <https://onemapggm.gmda.gov.in/portal/apps/webappviewer/index.html?id=dba1be50c558408cb6b06c27d337bdb4>.

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

