Report No.-04

# JSA-CTR

## Scientific Action Plan for Faridabad

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# 1 Introduction

## 1.1 History

Faridabad City by this name, which was established in AD 1707 by Sheikh Farid, the treasurer of Jahangir with the objective of protecting the highway passed through the city. Sheikh Farid built a fort, a tank and a mosque. Later it became the headquarters of a Pargana which was held in Jangir by Ballabgarh ruler. It was confiscated by the government because the ruler took part in the revolt of 1857. The site selected for Faridabad township covers the area of 18.1 square kilometers on the western side of Delhi-Mathura National Highway. The Indian government displaced the North-West Frontier province and Dera Ghazi Khan District (now in Pakistan, in 1947) for rehabilitation of the people. The control of this township was contained in the Faridabad Development Board, which was working under the authority of the Government of India through the Ministry of Rehabilitation. It was not considered desirable that the Central Government should maintain permanent attachment in the State Government and hence the township was handed over to the Punjab Government.

## 1.2 Location

Faridabad Division and District 28 Degrees are between 10’50’N and 28°29’04” latitude and 77 degrees 06’49” E and 77°33’23” Light longitude. It has a geographical area of 742.90 square kilometers. Faridabad District and Division is located on South-Eastern part of the State. Its dense shape located in the south of Delhi is made in the NCR west border of Gurugram district and eastern areas of Uttar Pradesh state. The District Palwal is located in the south. Location map of Faridabad is shown in Figure 1.

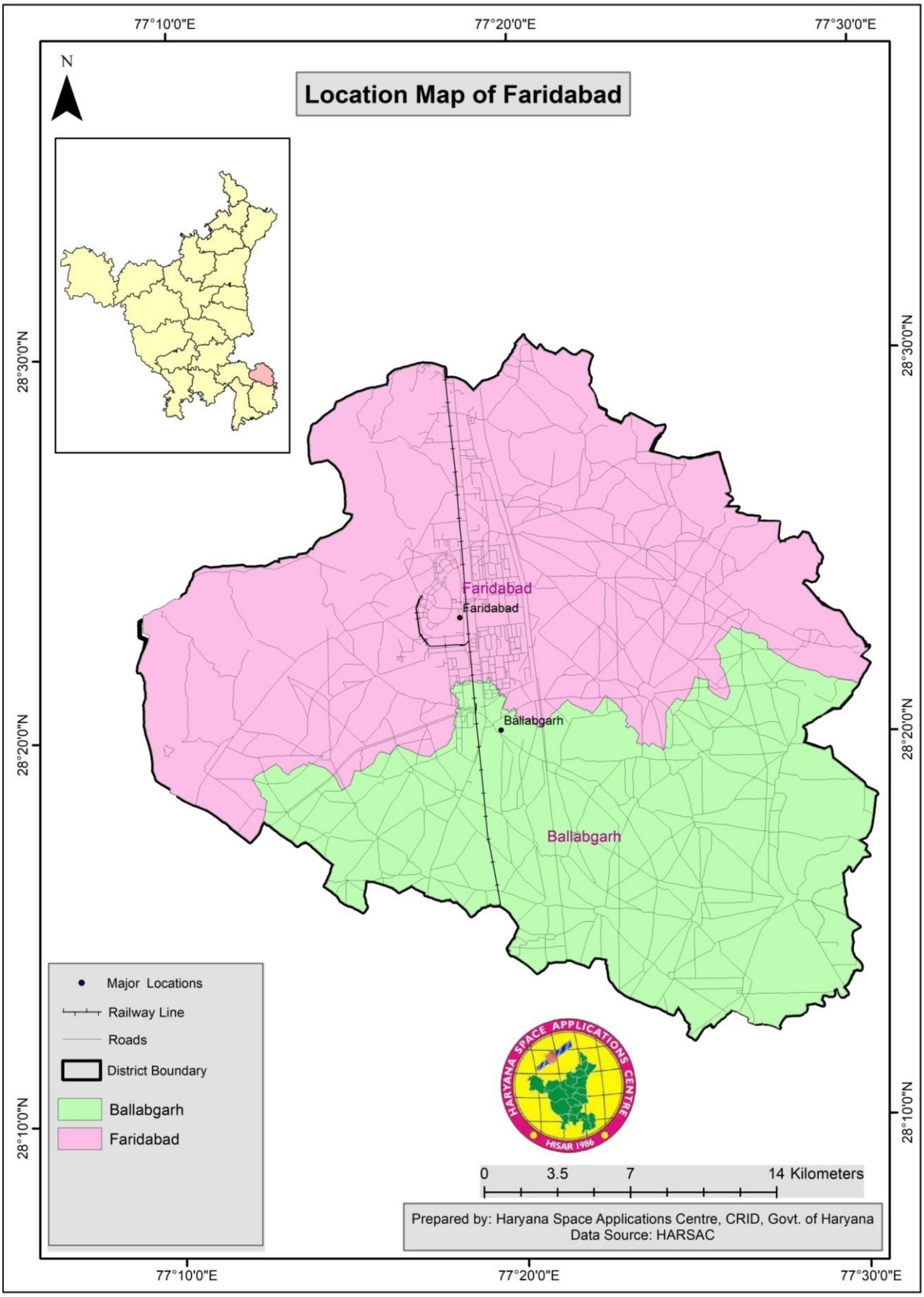



Figure 1 Location Map of Faridabad District

## 1.3 Administrative Setup

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

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

| | |
|---|---|
| **Country** | India |
| **State** | Haryana |
| **Division** | Faridabad |
| **Headquarters** | Faridabad |
| **Tehsil** | 1. Faridabad, 2. Ballabgarh |
| **Area** | 742.90 km2 |
| **Total Population (2011)** | 1,809,733 |
| **Density** | (6,320/sq. mi) |
| **Demographics** | |
| **Literacy rate** | 83% |
| **Vidhan Sabha constituencies** | 1. Prithla, 2. Faridabad NIT, 3. Badkhal, 4. Ballabgarh, 4. Tigaon and 5.Faridabad |
| **Website** | https://faridabad.nic.in/ |
| **Location of Faridabad** | Southern most region of Haryana |
| **Coordinates** | 28.4089° N, 77.3178° E |
| **Elevation** | 198 meter above the sea level |

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

| | |
|---|---|
| **Sub Divisions (2)** | Faridabad and Ballabgarh |
| **Tehsils (2)** | Faridabad and Ballabgarh |
| **Sub-Tehsils (5)** | Mohana, Tigaon, Dhauj, Dayalpur, Gaunchi |
| **Blocks (2)** | Faridabad and Ballabgarh |
| **Municipal Corporation (1)** | Municipal Corporation, Faridabad |
| **Municipal Council** | |
| **Municipal Committees** | |
| | |

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

| | |
|---|---|
| **Total Villages** | 144 |
| **Total Panchayats** | 116 |
| **Village Level** | Panchayat (116) |
| **Block Level** | Panchyat Samiti (60) |
| **District Level** | Zila Parishad (10) |

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

## 1.4 Climate

### 1.4.1 Temperature

Faridabad's climate is a local steppe climate. There is not much rainfall in Faridabad all year long. According to Köppen and Geiger, this climate is classified as BSh. The temperature here averages 24.7 °C | 76.5 °F. The rainfall here is around 700 mm | 27.6 inch per year. Cloud and humidity graph is shown in Figure 2 and temperature graph is shown in Figure 3.


Figure 2 Cloud and Humidity graph

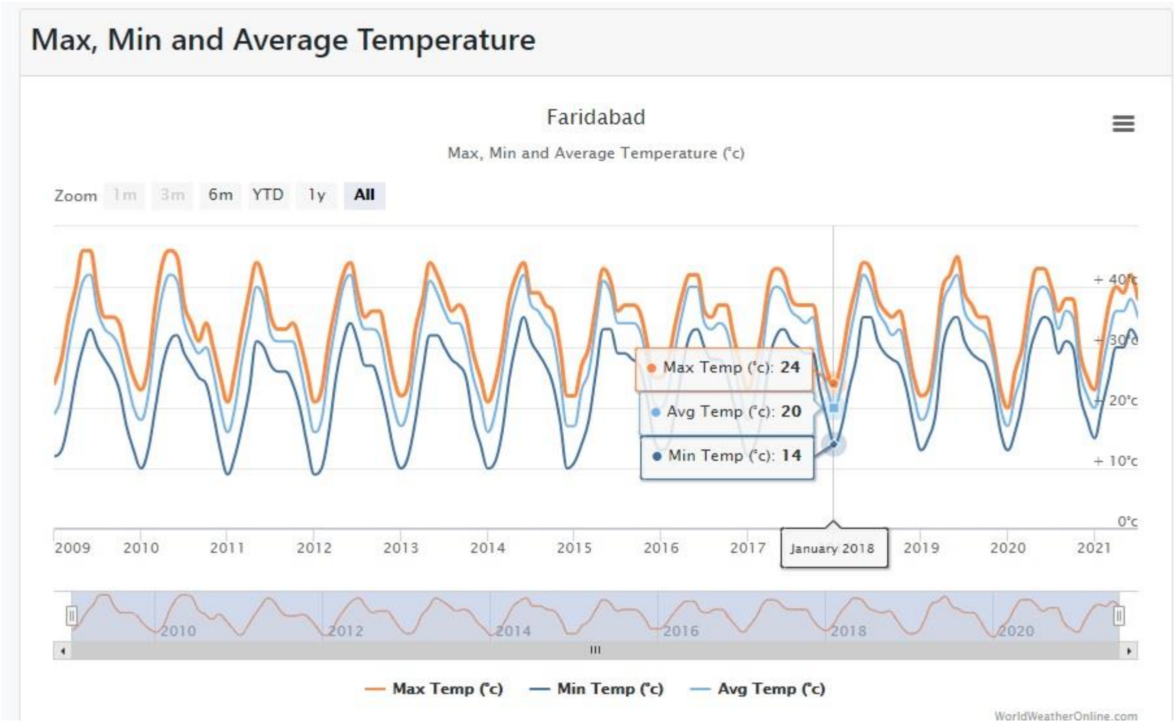



Figure 3 Temperature Graph

### 1.4.2 Rainfall

The district has a sub-tropical continental monsoon climate where we find seasonal rhythm, hot summer, cool winter, unreliable rainfall and great variation in temperature. Rainfall distribution is relatively satisfactory in relation to the western parts of Haryana and it is mainly concentrated during the summer monsoon. Some rain is experienced during the winter season in association with passing western disturbances (cyclone). Air is generally dry during greater part of the year. Dust storms mostly occur during April to June. Sometimes dense fog occurs in winter season. Rainfall distribution of the district is shown in Table 2 and map is illustrated in Figure 4.

**Table 2 Rainfall distribution of Faridabad**

| **Rainfall** | **Average (mm)** | **Normal Onset ( week and month)** | **Normal Cessation (week and month)** |
|---|---|---|---|
| SW monsoon (June-Sep): | 521.0 | 1st week of July | 3rd week of September |
| NE Monsoon (Oct-Dec): | 20.2 | - | - |
| Winter (Jan- March) | 28.0 | | |
| Summer (Apr-May) | 26.4 | | |
| Annual: | 595.6 | | |

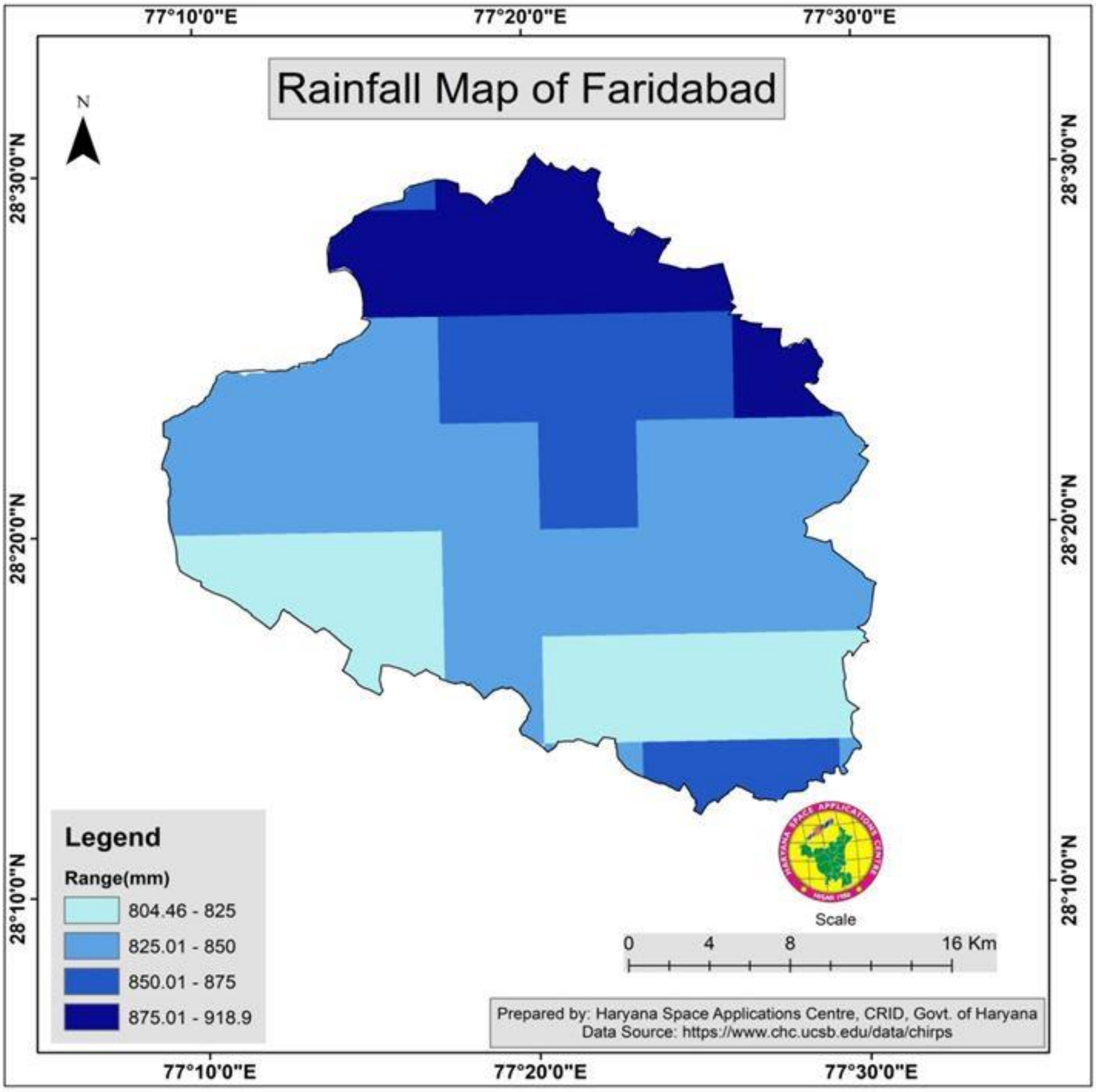



**Figure 4 Rainfall Map of Faridabad District**

## 1.5 Elevation and Topography

The height above mean sea level of the district is 198 meters (650 ft). The district comprises of hills on the one hand and depressions on the other, forming irregular and diverse nature of topography. Slope ranges from flat to >35 degree (**Figure 6**). Most of the area Ballabgarh is flat to less sloppy. Contours of 5 meters interval showed similar topography as in digital elevation model. Digital Elevation Model, slope and contour map of Faridabad district is shown in Figure 5, 6 and 7 respectively.

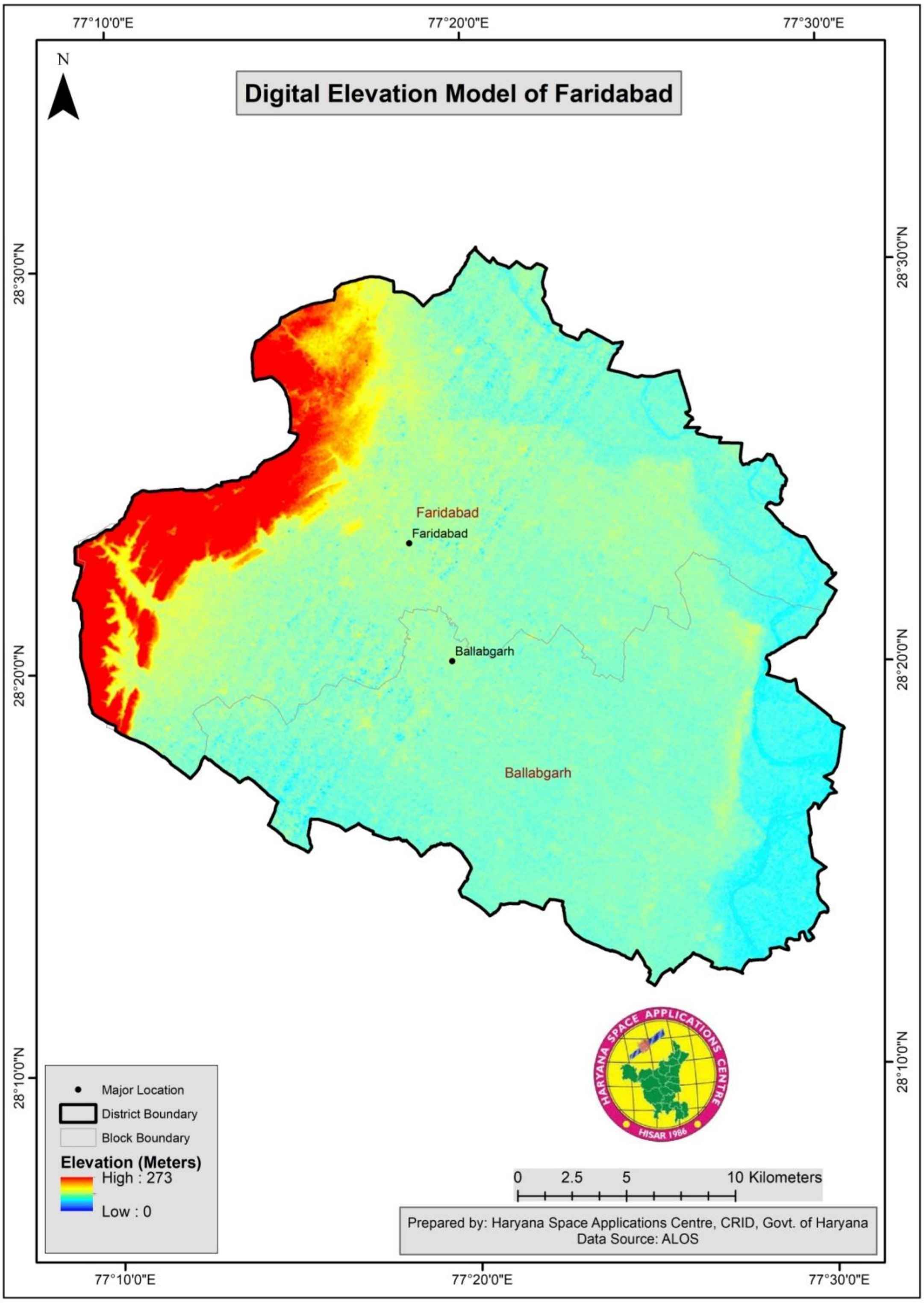



**Figure 5 Digital Elevation Model of Faridabad District**

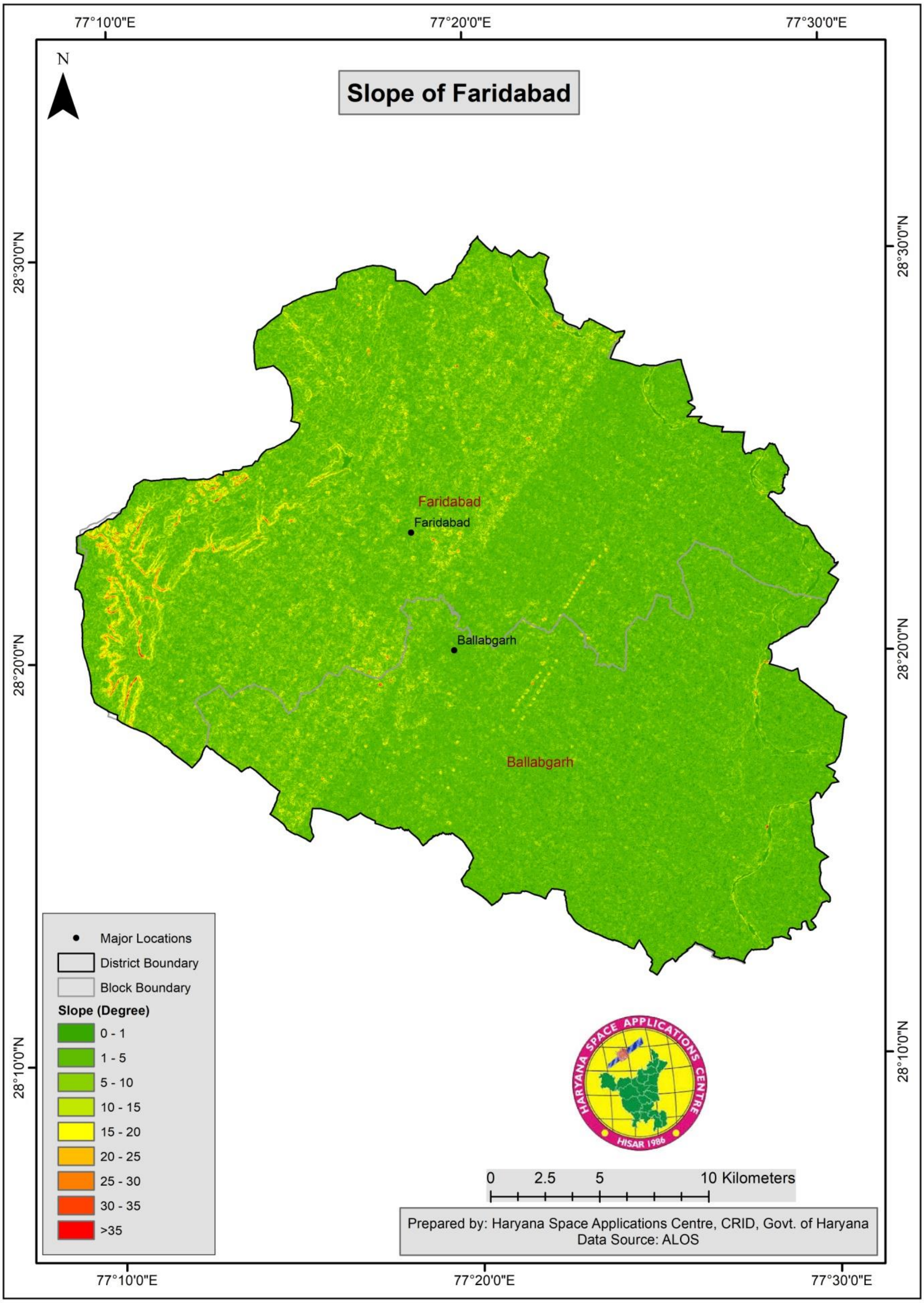



**Figure 6 Slope Map of Faridabad District**

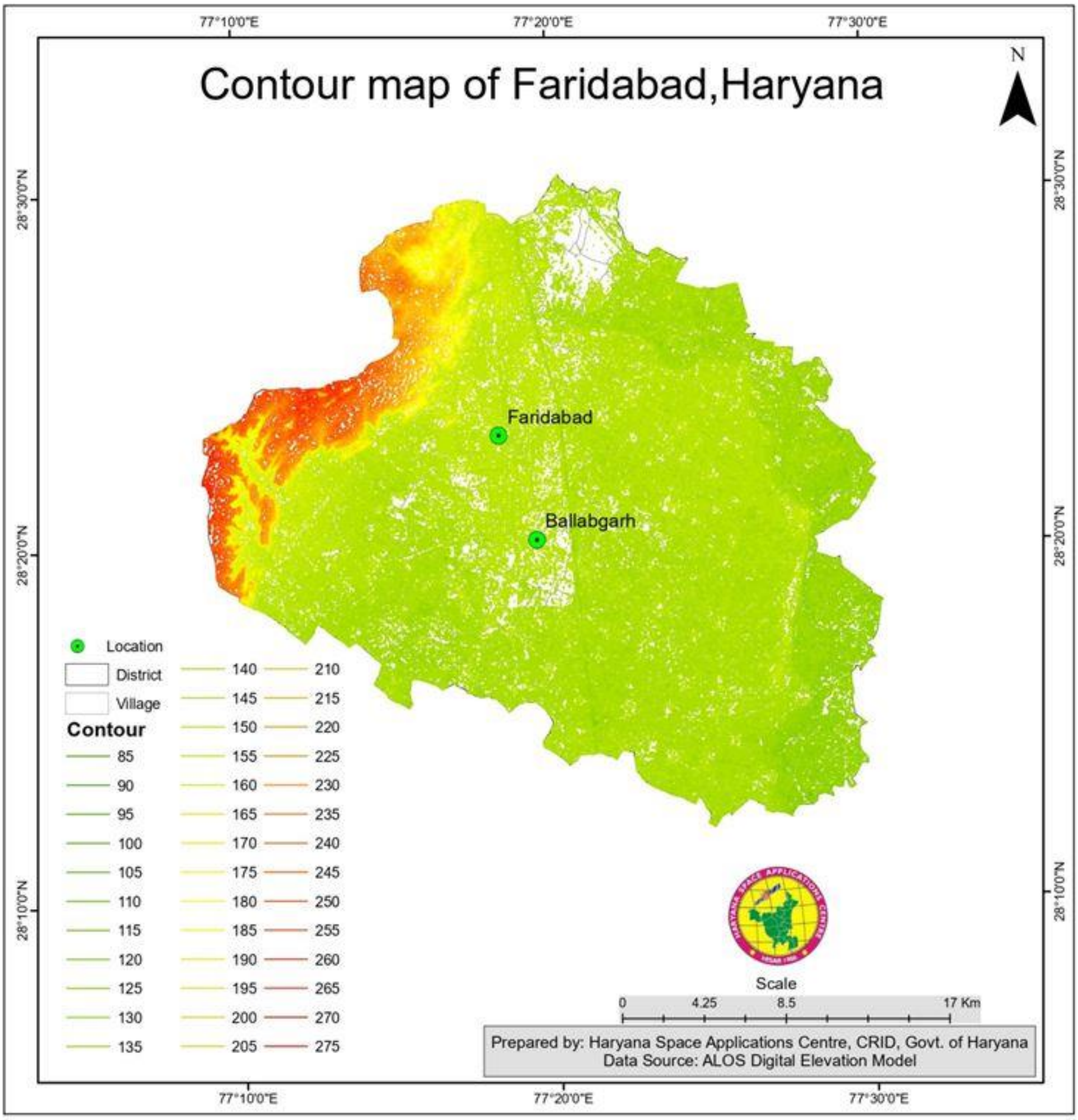



Figure 7 Contour Map of Faridabad District

### 1.5.1 Geology and Lithology

Major parts of the district are occupied by alluvial plains of recent to sub-recent age, which include older (Banger) and newer (Khadar) alluvial and kankar. The kankar occurs mainly in the northern part and is poor in calcareous matter. Lithological map of Faridabad is shown in Figure 8.

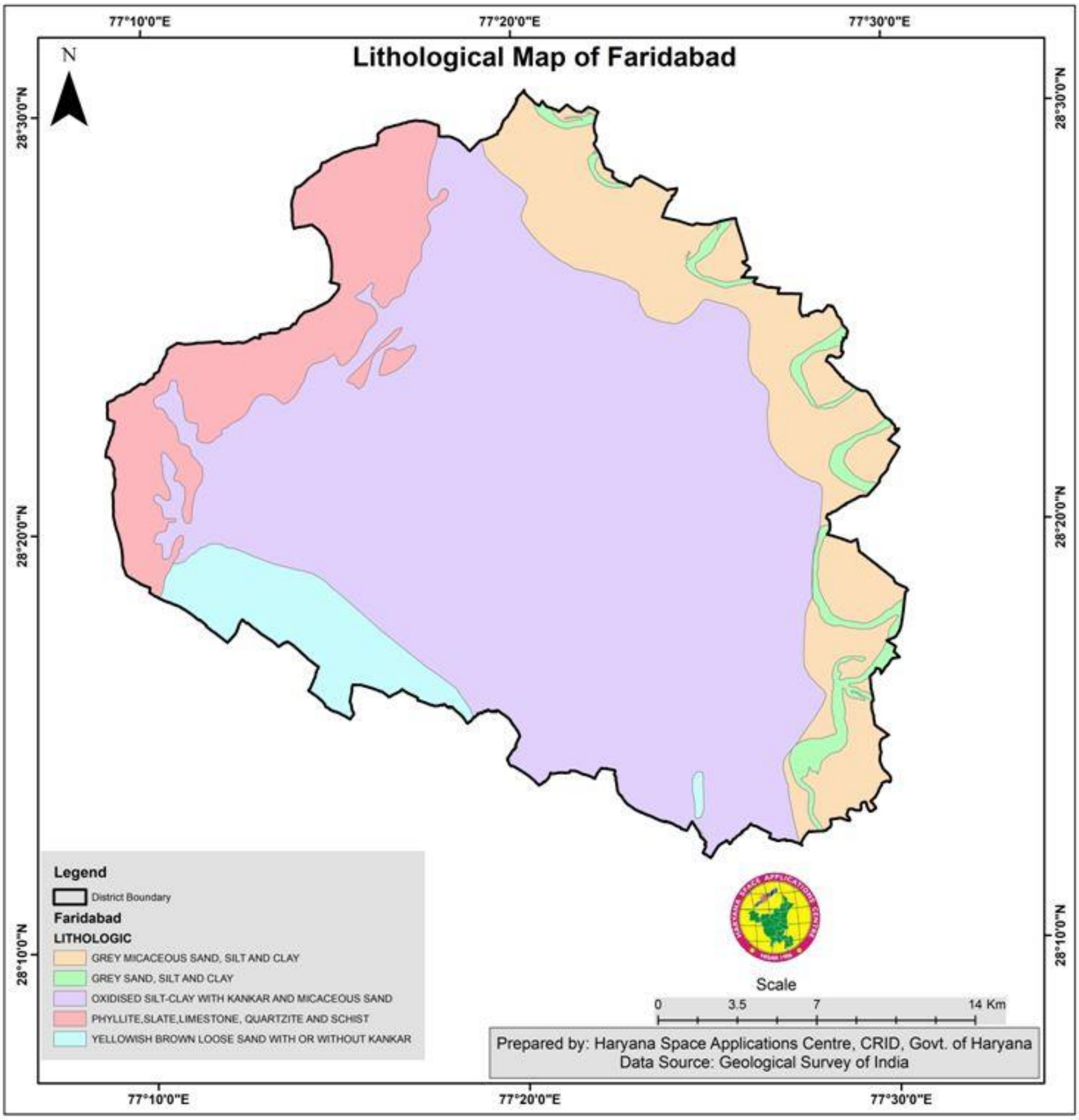



**Figure 8 Lithological Map of Faridabad District**

### 1.5.2 Soil Profile

Soils of Faridabad district are classified as tropical and brown soils, existing in major parts of the district. In Hathin block the organic content of soils ranging from 0.41 to 0.75 percent which is of medium category. In rest of the area organic contents is 0.2 to 0.4 percent and falls in Low category. The average conductivity of the soil is not more than 0.80 µmhos /cm and the average pH of the soil is between 6.5 and 8.7. The area comprises almost flat plains traversed by one ridge running N-S to NNE-SSW direction, divides the alluvium into two parts. The major river is Yamuna which is a perennial river. The soil in the flood plain area, known as khadar, retains adequate moisture even after the rainy season. Mostly the soils are loam (Bhangar and Nardak) and silty loam (Khadar) in the district. Soils as classified by National Bureau of Soil Survey and Land Use Planning (ICAR), Nagpur, the district has mainly Aquents-fluvents and Ochrepts types of soils. Soils in the Palwal Plain area are loam (Bhangar) and relatively sandy loam. Loam is more fertile. Yamuna Khadar area has loam and silty loam soils which have low water holding capacity. Such soils are difficult to work upon when dry. The crops grown in the district are divided into two main categories viz. kharif and rabi, locally called as Sawani and sadhi. The former is the summer season harvest and the latter the winter season harvest. Any crop which does not strictly fall within these two harvests is known as a Zaid crop and its harvest is called the Zaid kharif or Zaid rabi, according to the harvest with which it is assessed. Toria (an oilseed) is cultivated as Zaid kharif and vegetables, melon and green fodder as Zaid rabi. The major kharif crops of the district are Paddy, Bajra, Jowar, kharif pulses and kharif vegetables. The major rabi crops include wheat, barley, rabi oilseeds, vegetables and sugarcane. Soil Texture map of Faridabad is shown in Figure 9.

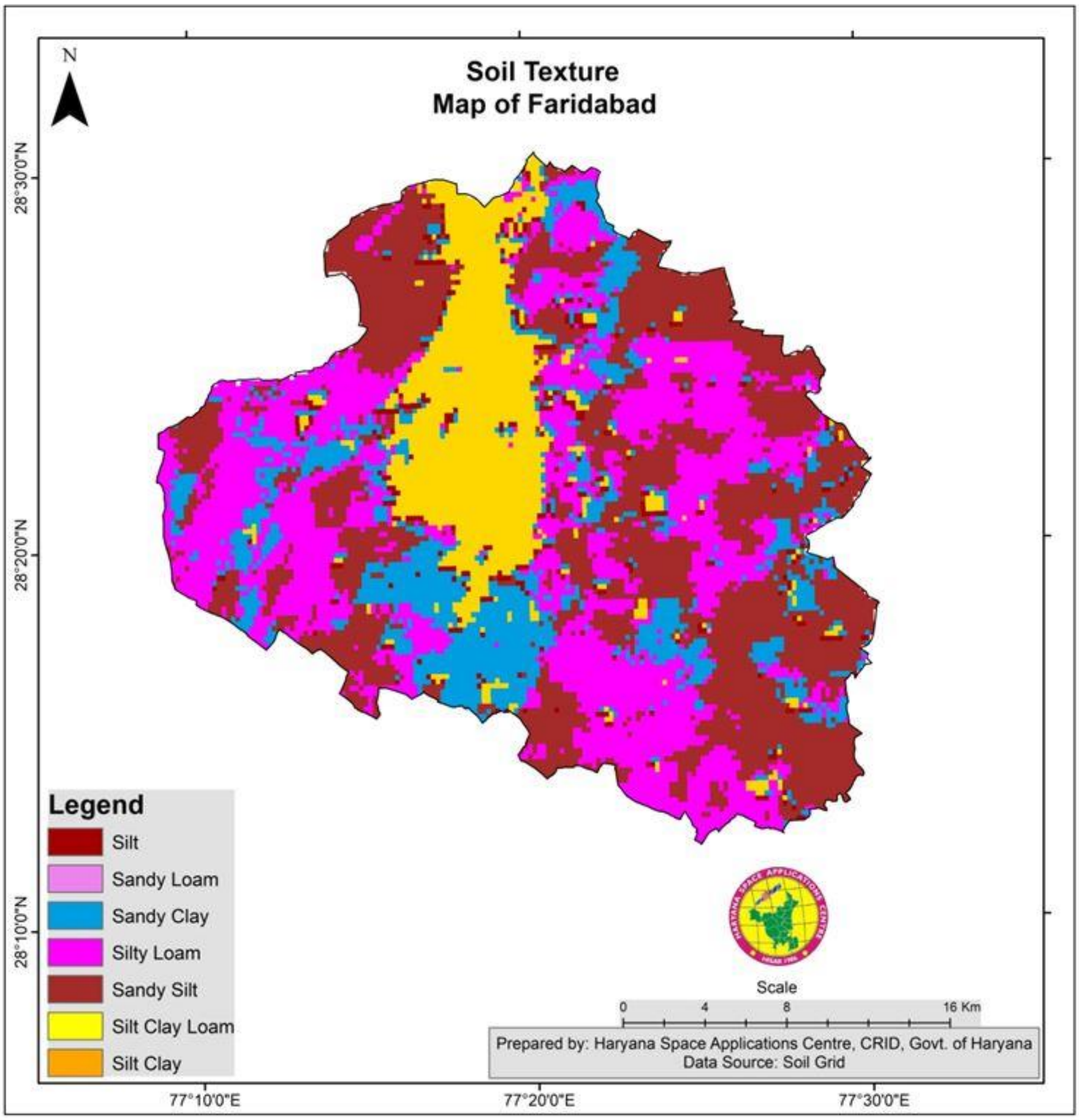



**Figure 9 Soil texture map of Faridabad District**

## Sand Dunes

Strong winds carry sand and silt, forming dunes, from adjacent Rajasthan to this area with the prevailing wind conditions. General soil health profile is shown in Figure 10.

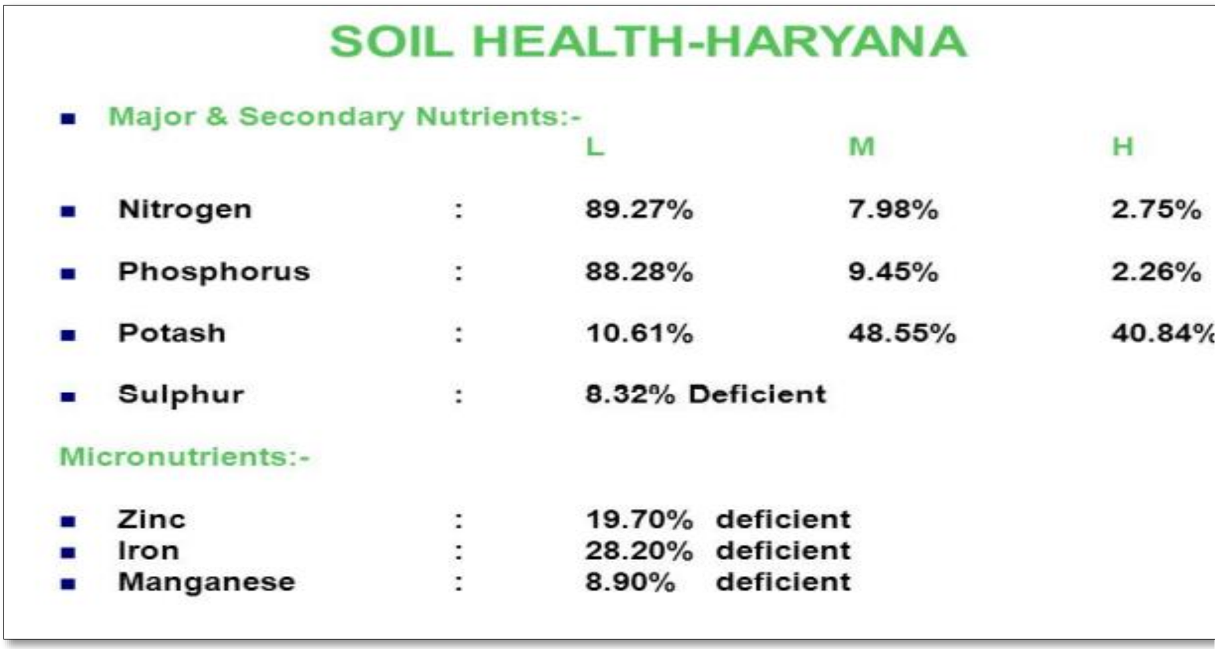



Figure 10 General soil health profile of Haryana

## 1.6 Landuse

Of the total area of 52975 hectares of Faridabad district, 50 hectares under forest; 40689 hectares is net sown area; 659 hectares is culturable waste (including gauchar and groves) and 240 hectares of area is not available for cultivation to which we may call barren and unculturable land. Net area sown in the district is 76.81 percent of total area. Faridabad tahsil has a rural area of 218.79 sq. kms. Whereas 310.96 sq.kms of rural area respectively. Landuse pattern of Faridabad is shown in Figure 11 and pattern is illustrated in Table 3.

### Table 3 Landuse pattern of Faridabad District

| | |
|---|---|
| **Total geographical area** | 172 |
| **Forest area** | 1 |
| **Land under non- agricultural use** | 40 |
| **Permanent pastures** | 2 |
| **Cultivable waste land** | - |
| **Land under Misc. tree crops and groves** | - |
| **Barren and uncultivable land** | 5 |
| Current fallows | 9 |
| Other fallows | - |

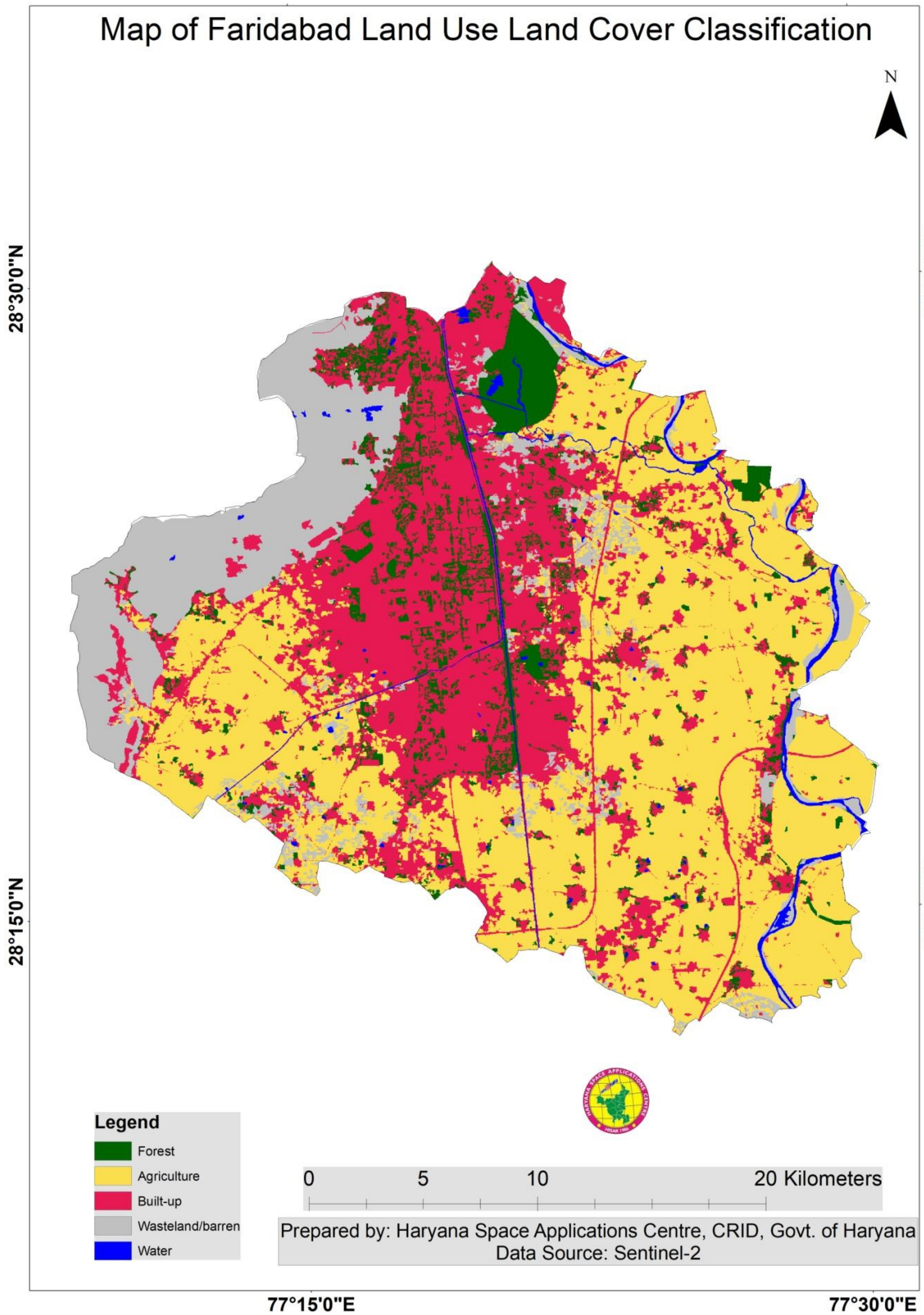



**Figure 11 Landuse Landcover of Faridabad**

## 2 District Water Profile

Water is vital for survival of both plants and animals. It is the central component of the planet Earth controlling the weather, climate, plant and animal kingdom. It supports agriculture, forestry, navigation, industries and hydroelectricity generation and other uses such as for recreation, water sports activities etc. The importance of water has been recognized all over the world. Water resource development and management practices are given top priorities all over the world to avoid the water crisis in future.

### 2.1 Source of Water

Faridabad fulfill its water requirement by natural and manmade modes like canal, ponds, treatment plants, extraction of groundwater by tubewells, water harvesting structures, rainfall water harvested from rooftop and many more. The ground water exploration in Faridabad district has been undertaken at 17 places. Out of these, 17 exploratory wells one slim hole and 2 piezometers were constructed in the district. In general, 6-14 granular zones mainly comprise fine sand, silt, clay and kankar. The discharge of successful exploratory wells varies between 200 and 6629 Ipm with draw down of 2.39-9.12m. To assess the aquifer parameters, aquifer performance tests were conducted. The transmissivity values in the area vary between 125 and 1645m2/ day. The Depth to water level lies between 1.51 to 50.74 mbgl during pre-monsoon and 0.67 to 49.56 mbgl during post-monsoon period. Deeper water level, in the depth range of 10m to 15 m occurs in the southeastern parts of Ballabgarh and Faridabad blocks. Water level elevation range from 220 to 180 m amsl and the general groundwater flow is towards southeast and east. Isolated groundwater mounds and troughs in different parts of the district have been created because of heavy pumping in city area. In general water table has declined all over the district over the past decade. During 1983 to 1993, a decline of water level from 1 to 6m, being more in southern blocks. Besides, drying of tube wells in the eastern parts of Faridabad and Ballabgarh block also proves significant decline of water table in recent past.

#### 2.1.1 Canals

Agra Canal takes out of the Yamuna at Okhla in New Delhi. The Canal passes down straight through Ballabgarh Bhangar area into Palwal Plain area and thence into U.P. and provides irrigation for the areas of the district. Gurgaon Canal project is inter-basin transfer of waters and a flow-cum-lift project. For some distance, it runs parallel to Agra Canal on its western side and then takes a southwest turn to enter Gurgaon 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. Others, like water gardens, water features and koi ponds are designed for aesthetic ornamentation as landscape or architectural features. Around 851 ponds have been recognized in Faridabad according to 2020 satellite image which are plotted on map and shown in Figure no. 12 and monsoonal waterlogged area is shown in Figure 13.

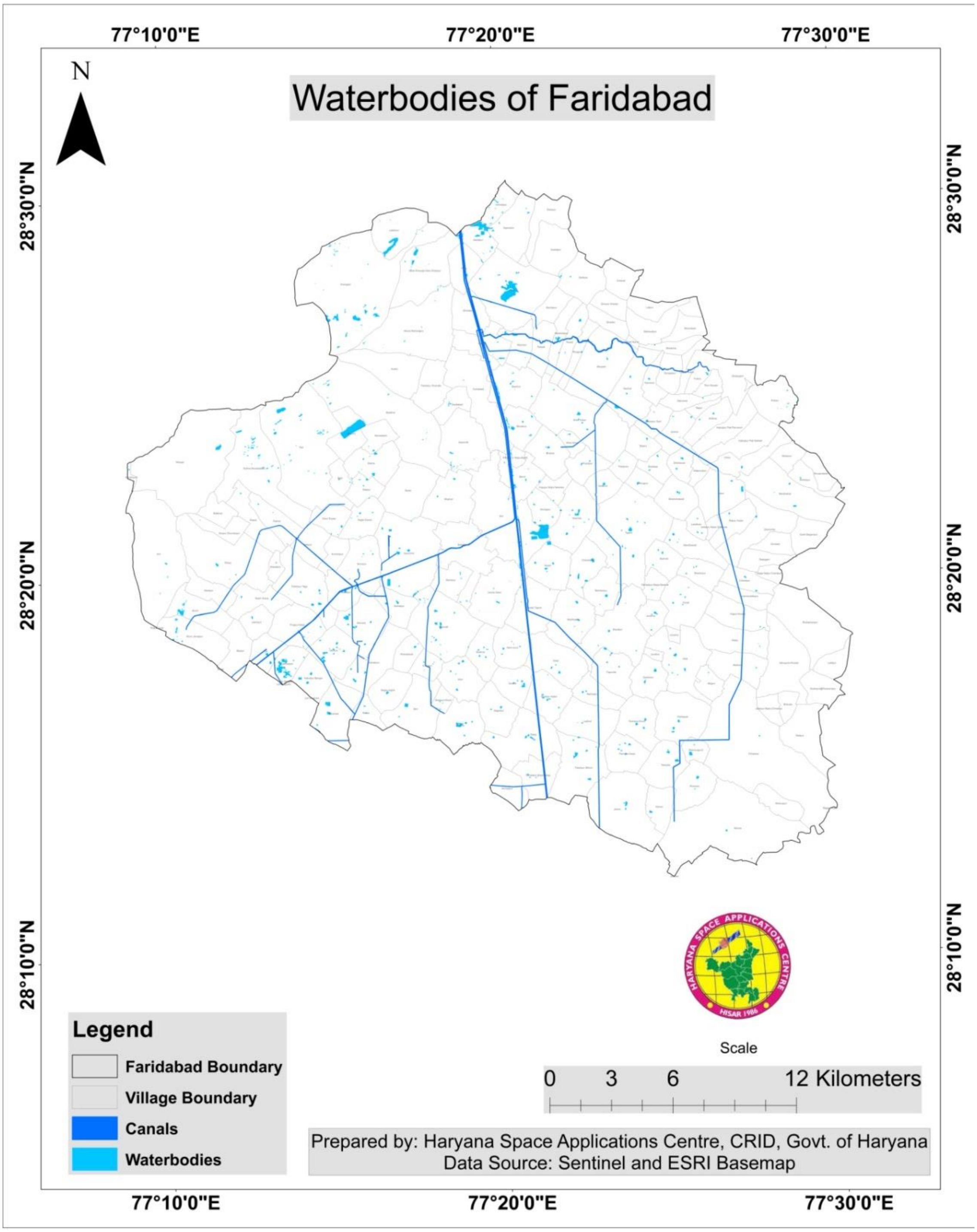



**Figure 12 Water bodies of Faridabad District**

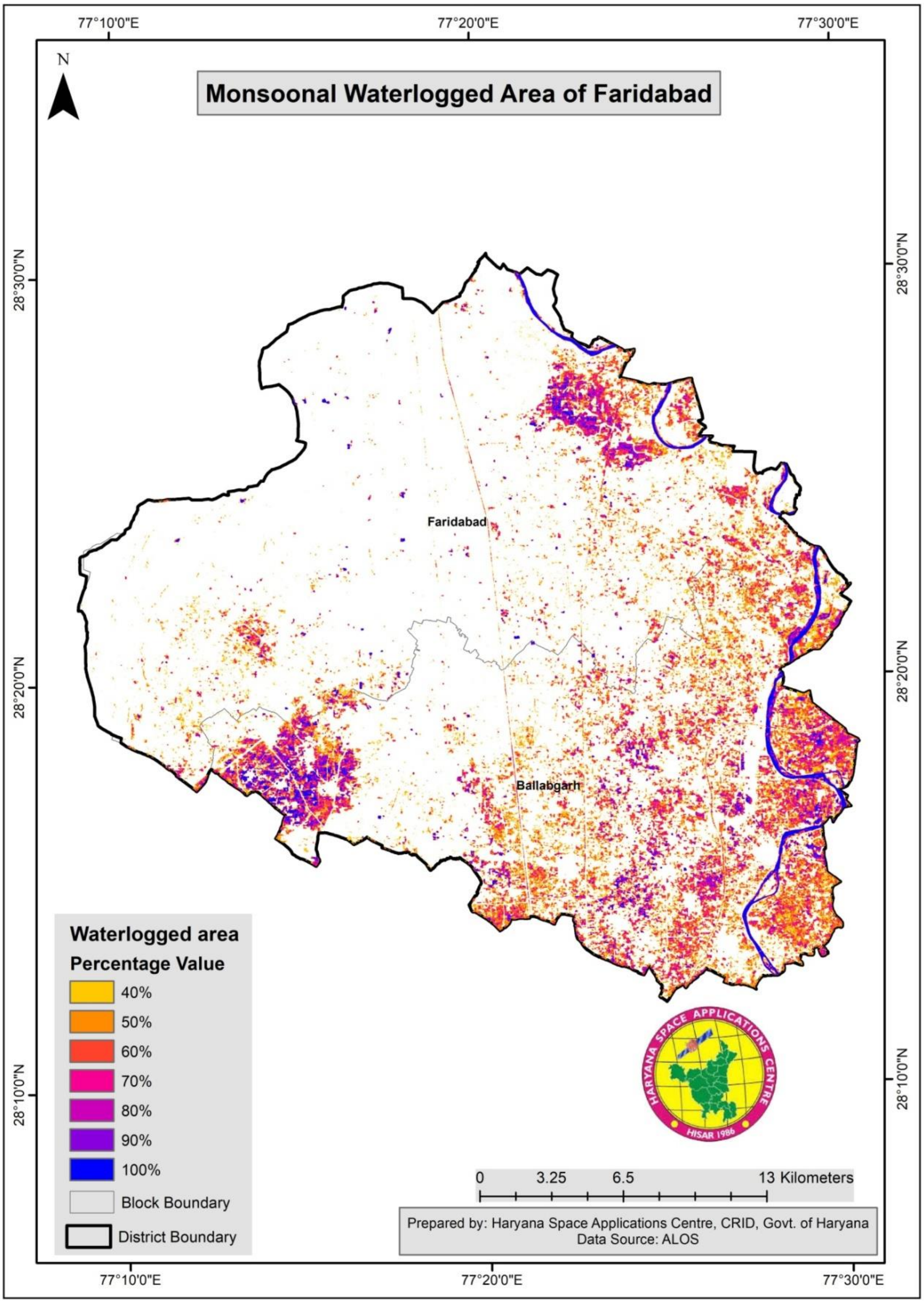



Figure 13 Monsoonal waterlogged area of Faridabad

### 2.1.3 Drain

**N**atural 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 Faridabad District is shown in Figure 14 and the statistics of length of drainage in Faridabad district is shown in Table 4.

**Table 4 Drainage order and total length of the drains in Faridabad district**

| **Sr. No.** | **Order of Drainage** | **Total Length (in meter)** |
|---|---|---|
| 1 | 1st Order | 623399.4943 |
| 2 | 2nd Order | 342274.3721 |
| 3 | 3rd Order | 184851.393 |
| 4 | 4th Order | 73155.1794 |
| 5 | 5th Order | 45220.82316 |
| 6 | 6th Order | 1105.037403 |

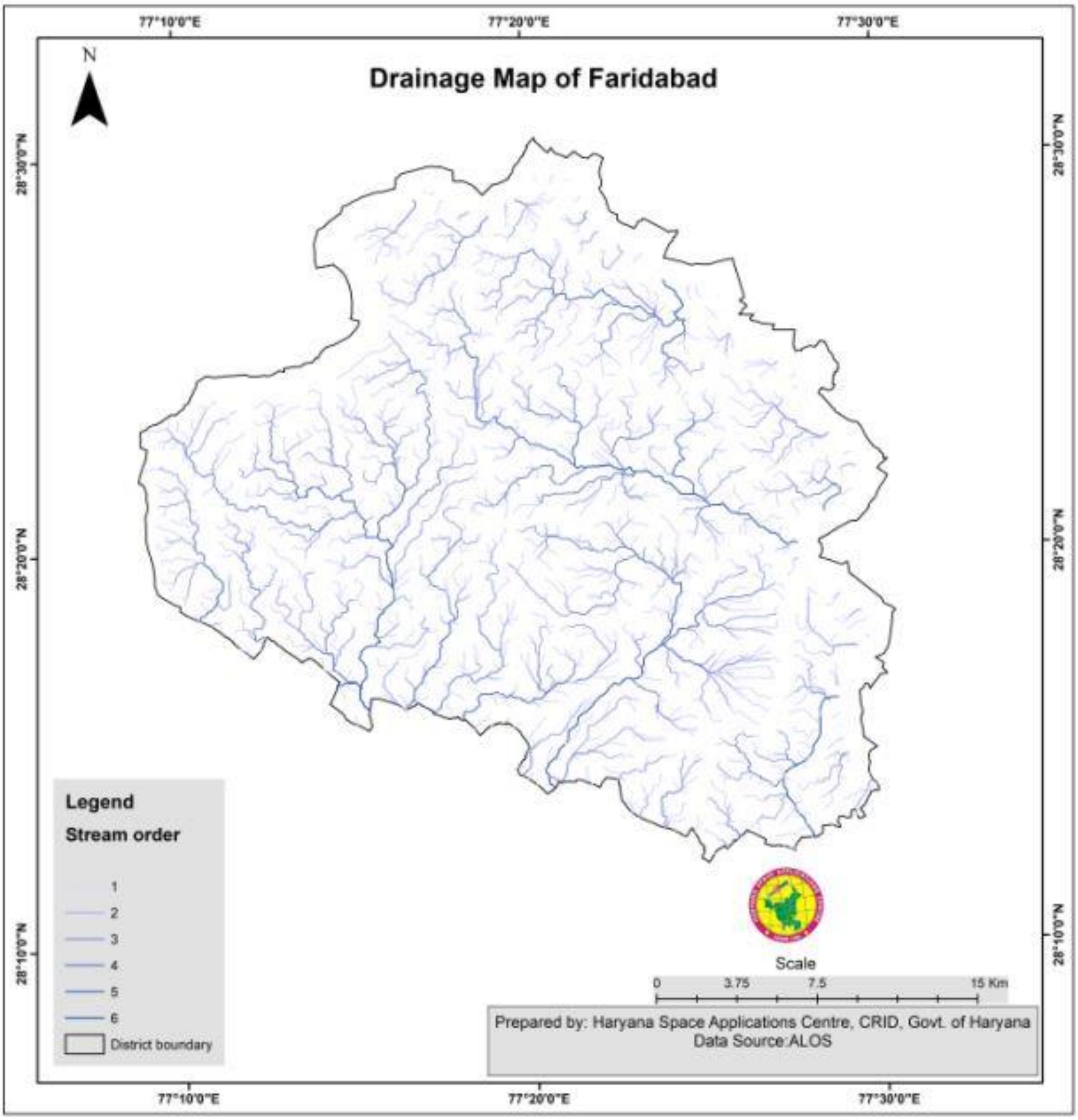



**Figure 14 Drainage Map of Faridabad**

## 2.2 Water Harvesting System

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

### 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 are 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 Faridabad District**

| S.NO. | Activity Name | Works Completed | Works Ongoing | Expenditure (in Lakhs) |
|---|---|---|---|---|
| **Water Conservation and Rain Water Harvesting** | | | | |
| 1 | Check Dam | | 0 | |
| 2 | Pond / Tank | | 1 | |
| 3 | Trench | 0 | 0 | |
| 4 | Rooftop Water Harvesting Structure (Public) | 44 | 0 | |
| 5 | Rooftop Water Harvesting Structure (Private) | 0 | | |

| | | | | |
|---|---|---|---|---|
| 6 | Other Rainwater Recharge Structures (Open Well Recharge, Sand Filter for open well recharge) | | 0 | |
| 7 | Other Water Conservation Structures (Bench Terracing, Canal) | | 0 | |
| | **Total** | | **1** | **10** |
| **Renovation of Traditional and other Water Bodies / Tanks** | | | | |
| 1 | Traditional Water Bodies Restored | 19 | 5 | |
| | **Total** | **19** | **5** | **35** |
| **Reuse and Recharge Structures** | | | | |
| 1 | Soak Pit | 969 | 0 | |
| 2 | Stabilization Pond | 1 | 0 | |
| 3 | Other Reuse / Recharge Structure | 17 | 0 | |
| | **Total** | **987** | **0** | **5** |
| **Watershed Development** | | | | |
| 1 | Gully Plug | 0 | 0 | |
| 2 | Percolation Tank | | 0 | |
| 3 | Staggered Trenches | 0 | 0 | |
| 4 | Other Watershed Construction Activities | 17 | 19 | |
| | **Total** | | **19** | **88** |
| **Intensive Afforestation** | | | | |
| 1 | Intensive Afforestation-Nurseries | 230636 | 1 | |
| 2 | Intensive Afforestation- Plantation | | 0 | |
| | **Total** | | **1** | **37** |
| **Awareness Programs by KVK** | | | | |
| 1 | Farmer’s training programs by KVKs on Water Use Efficiency and Appropriate Crops | 7 | | |
| 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 | 554 | | |
| | **Total** | **561** | | |
| **Waste Water Treatment** | | | | |
| 1 | Use of Treated Waste Water | 0 | | |
| | **Total** | **0** | | |

### 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 Faridabad District for rain water harvesting is shown in **Table 6** at rural and urban area. The map of water conservation activity in Faridabad at rural and urban level is shown in **Figure 15**.

**Table 6 Water Harvesting technique in Rural area and Urban Area**

| **In Rural Area** | | |
|---|---|---|
| **Sr. No** | **Block Name** | **Total No of Activity** |
| **1** | Faridabad | 274 |
| **2** | Ballabgarh | 440 |
| **In Urban Area** | | |
| **1** | Faridabad | 13 |

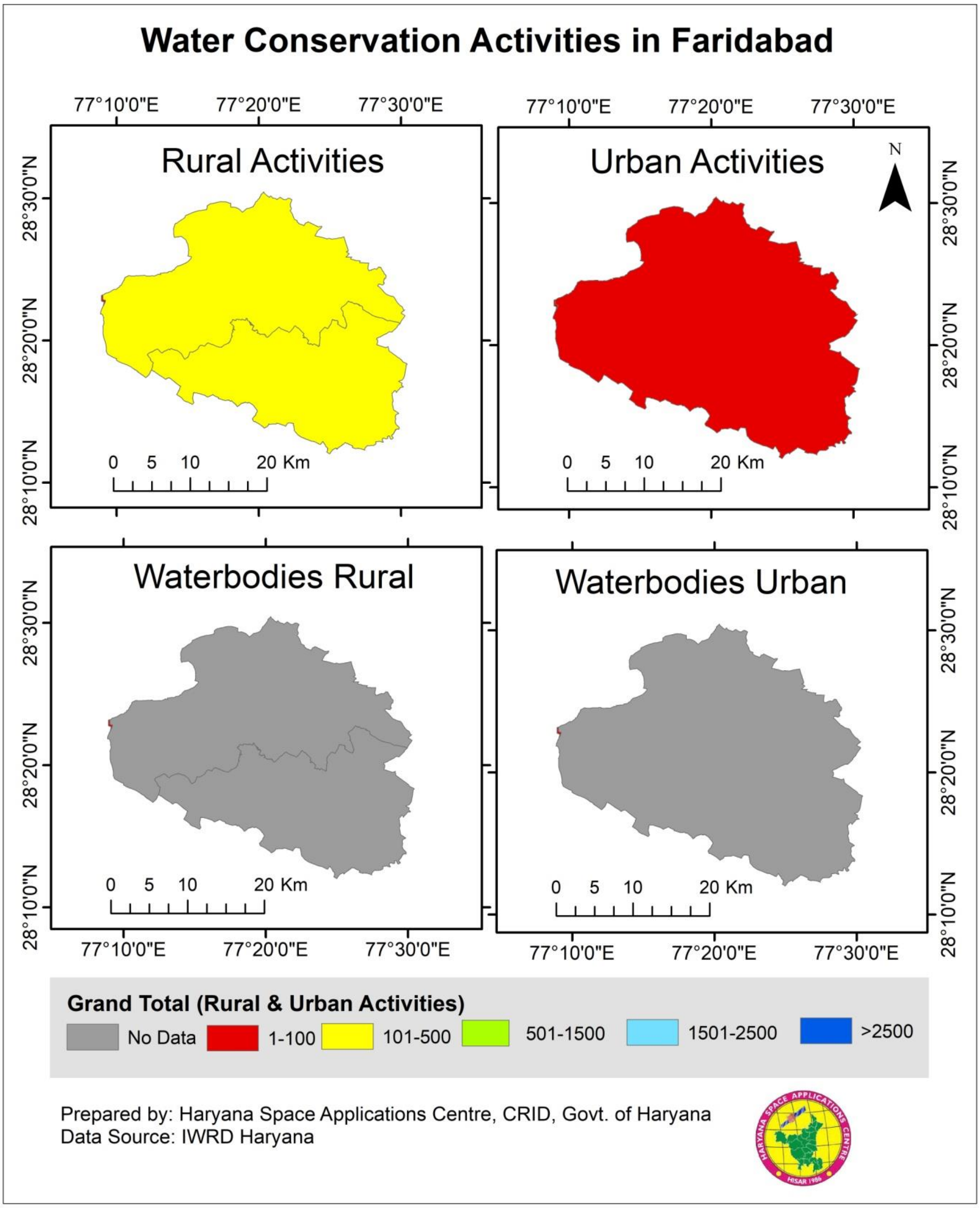



Figure 15 WHS activity map of Faridabad

### 2.2.3 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 No 16**. In Faridabad District a total of 3 treatment plant are installed having total capacity of approx. 100-120 MLD. In Faridabad district there is one major biomedical waste management site in Faridabad Block.

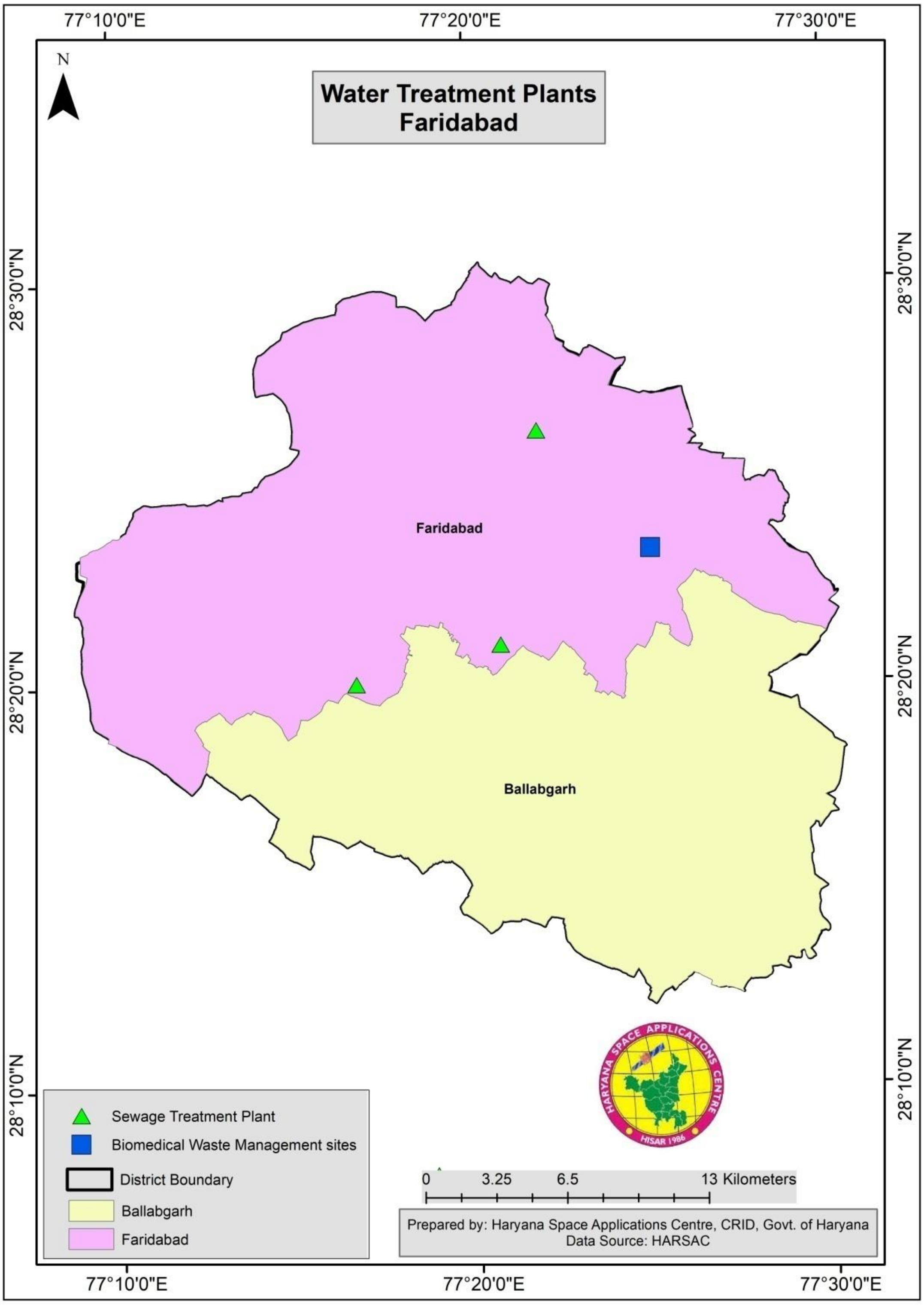



Figure 16 Water treatment plants of Faridabad

## 3 Irrigation Profile

Irrigation is the agricultural process of applying controlled amounts of water to land to assist in the production of crops as well as to grow landscape plants and lawns, where it may be known as watering. Agriculture that does not use irrigation but instead relies only on direct rainfall is referred to as rain-fed. Irrigation helps to grow agricultural crops, maintain landscapes, and create greening over disturbed soils in dry areas and during periods of less than average rainfall. Irrigation also has other uses in crop production, including frost protection, suppressing weed growth in grain fields and preventing soil consolidation. Unmanaged and unplanned irrigation requirements due to various reasons costs water availability and affect the water resources drastically. The district received annual average rainfall of 494.3 mm. during 2005-2009 period. Rainfall in the district is light, scanty and uncertain. Nearly the whole rainfall is concentrated between the months of June and September. Little rainfall in winter benefits the rabi crops. The success of rabi crops depends on adequate showers between mid-December and mid- February. During 2009-10, net irrigated area in the district was 36,000 hectares which was 97.3 percent of the total net sown area. Of this, only 1,000 hectares was irrigated through government canals and 35,000 hectares of area was irrigated by tubewells and pumping sets. Gross irrigated area in the district during this period was 68,000 hectares which was 100 percent of the total cropped area. Only 1.2 percent of gross irrigated area of the State was in Faridabad district. History of the district is full of famines, scarcities and droughts, owing to failure of rains and full dependency on the rains. However, this problem of inadequate and uncertain rains has been solved to some extent by artificial irrigation. Mainly two types of irrigation exist in the district. There were 10,061 tube-wells during 2009-10 in the district. Of these, 7,626 were electric operated and 2,435 diesel operated. Canal irrigation is done through Agra and Gurgaon Canal Systems.

# 4 Water Availability

## 4.1 Surface Water Availability

For creating access to water source either assured or protective to each farmer will require a demand and supply assessment of crop water requirements, effective rainfall and potential source of existing and new water sources considering the geo-hydrological and Agro ecological scenario of the block. The master plan will include information on all sources of available water, distribution network, defunct water bodies, new potential water sources both surface and sub-surface system, application to conveyance provisions, crops and cropping system aligned to available/designed quantity of water and suitability to local Agro ecology. All activities pertaining to water harvesting, water augmentation from surface ad sub surface sources, distribution and application of water including repair, renovation and restoration of water bodies, major, medium and minor irrigation works, command area development etc. are to be taken up within the frame work of this muster plan. Emphasis is to be given for deriving the potential benefit from low hanging fruits like extending the reach/ coverage of water source through effective distribution and application mechanism, reducing the gap between potential created and utilized through more focus on command area development and precision irrigation. Proper integration of creation of diversion head work and water harvesting structures, distribution system like canals and command area development works and precision farming is to be made for best possible use of water resources.

## 4.2 Ground Water Availability

The hydro geological data generated through exploratory drilling has proved a vital information regarding identification of aquifer system, demarcation of their vertical and lateral extent, and delineation of potential aquifer characteristics. These studies also provide information on well design and drilling techniques. A well assembly of 203 mm dia, using about 20 m to 30 m long housing pipe and MS slot pipe with slots of 1.19 mm to 1.59 mm size would be ideal in the district area. “V” wires galvanized Screen having 0.50-1.5 mm slot can also be used as it can provide more open area conventional slotted pipes. Entrance velocity of water in the well has to be kept in mind while designing the well assembly. Reverse /Direct circulation rig is suitable for carrying out the drilling in alluvial parts of district whereas percussion or Down the Hole Hammer (DTH) technique with Odex attachment are suitable for drilling in boulder formation. The block wise ground water resource potential in the district has been assessed as per GEC-97 as on March 2009. The stage of ground water development ranges between 78%(Ballabgarh) to 84% (FARIDABAD). The total replenish able ground water resource in the district is 202.28 MCM of which the total existing ground water draft by all means is 163.50 MCM. The net utilizable ground water resources for future irrigation development are 33.64. Resource and development potential of Faridabad district is shown in Table 7 and water level depth is shown in Figure 17.

**Table 7 Resource and development potential of Faridabad district**

| Block | Net annual groundwater availability | Existing gross ground water draft | Existing gross ground water | Provision for domestic and industrial | Net annual groundwater availability | Stage of ground water develop | Category |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **(ham)** | **for irrigation (ham)** | **draft for all uses (ham)** | **requirement supply to 2025 (ham)** | **for future irrigation development (ham)** | **ment (%)** | |
| Ballabgarh | 10004 | 7493 | 7759 | 453 | 2058 | 78 | Semi critical |
| Faridabad | 10224 | 6625 | 8591 | 2293 | 1306 | 84 | Semi critical |
| **Total** | **20228** | **14118** | **16350** | **2746** | **3365** | **81** | |

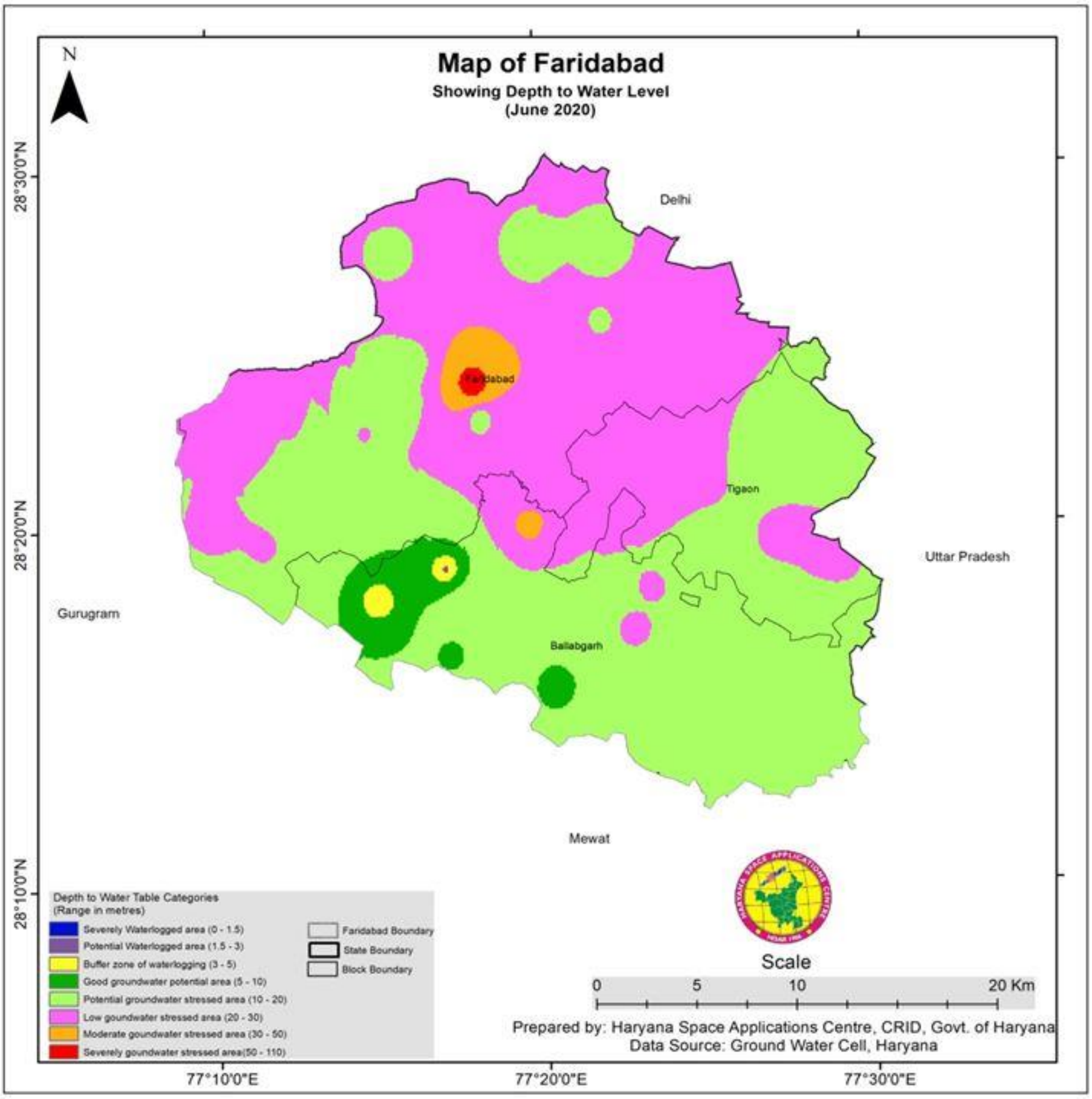



**Figure 17 Ground water Availability Map of Faridabad District**

### 4.2.1 Ground Water Quality

Groundwater is the water found underground in the cracks and spaces in soil, sand and rock. It is stored in and moves slowly through geologic formations of soil, sand and rocks called aquifers. Ground water quality index determines the purity of water. Higher the values on index represent the more turbid water which cannot be used for drinking purpose. In contrast to those lower values on quality index represent the purity of water and are suitable for drinking purpose. According to (http://www.sarasota.wateratlas.usf.edu/library/learn-more/learnmore.aspx?toolsection=lm_wqi) water quality range from 0-45 is good, 45-60 is fair and >60 is very poor quality of water. The shallow ground water of the district is alkaline in nature (pH 7.75 to 8.62) and is moderately to highly saline (EC 693 to 3590qS/cm). Among anions, bicarbonate predominates at some places, whereas at other places either none of the anion dominates or chloride is dominant. Among cat ions, by and large, sodium is the dominant cat ion. At some places mixed cationic character has been observed. Comparing the concentration values of major ions with the recommended desirable and permissible concentration limits for drinking waters (Bureau of Indian Standards) It is found that more than half (75%) of the ground waters are not suitable for drinking purposes mainly due to fluoride content that exceeds the maximum permissible limit of 1.5mg/1. Salinity (EC), Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the parameters for ascertaining the suitability of ground water for irrigational uses. These parameters range from 693 to 3590 micromhos/cm at 250 C, 2.19 to 15.79 and -14.52 to 13.97 milli equivalents respectively. Plot of USSL diagram used for the classification of irrigation waters indicated that ground water samples fall under class C2S1, C3S1, C3C2, C4S2, C4S2, C4S3 and C4S4. These waters are not suitable for customary irrigation as they may cause salinity and sodium hazards. It would be better if such waters are used for semi-salt tolerant to salt tolerant to salt tolerant crops along with appropriate amount of gypsum on well drained soils. Water quality Index of Faridabad is shown in Figure 18 and block wise water quality index value is shown in **Table 8**.

**Table 8 Block wise average water quality index value in Faridabad District**

| **Block Name** | **Average Water Quality Index Value** |
|---|---|
| Faridabad | 178.4 |
| Ballabgarh | 202.1 |

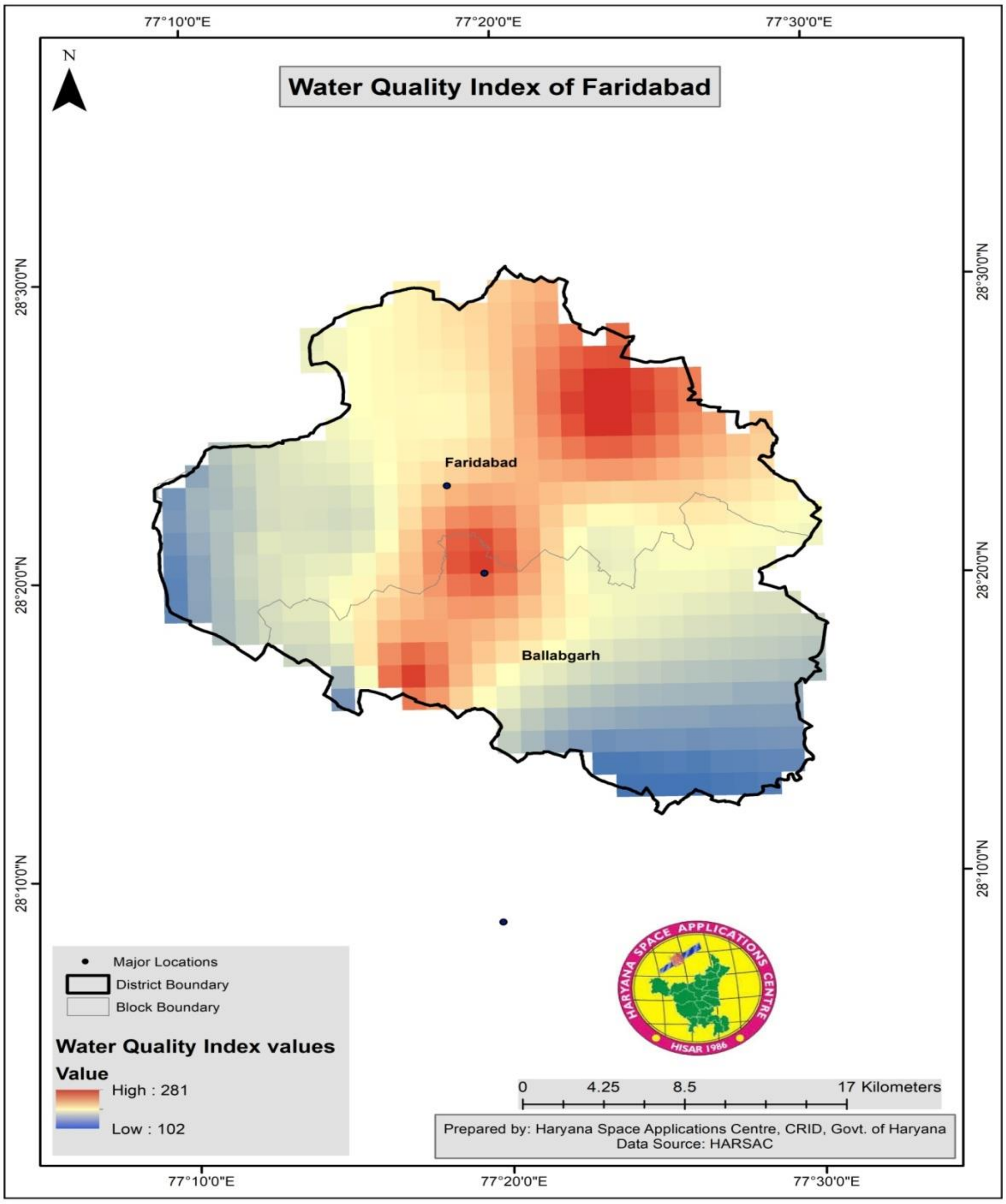



Figure 18 Water Quality Index of Faridabad District

## 5 Water Requirement/ Demand

Whenever an engineer is given the duty to design a water supply scheme for a particular use of the community, it becomes imperative upon him, to first of all, evaluate the amount of water available and the amount of water required/ demanded by the public. In fact, the first study is to consider the demand, and then the second requirement is to find sources to fulfill that demand. Many a times a compromise is sought between the two. It is very difficult to precisely assess the quantity of water demanded by the public since there are many variable factors affecting water consumption. The various type of water demands for a district may be as follows-

## 5.1 Domestic Water Demand

This includes the water requirement in private buildings for drinking, cooking, bathing, lawn sprinkling, gardening, sanitary purposes etc. The amount of domestic water consumption per person shall vary according to the living conditions of the consumers. On an average, this domestic consumption under normal conditions in Indian city is expected to be around 135 liters/ day/ person as per IS: 1172-1971. In a developed and an effluent country like USA, this figure goes as high as 340 liters/ day/ person. This is because more water is consumed in rich living, air cooling/conditioning, automatic household appliances, car washing etc. The total domestic consumption generally amounts to 55% to 60% of the total water consumption. The total domestic water demand shall be equal to the total population multiplied by the per capita domestic consumption i.e., 150 liter/ day in urban areas and 70 liter/day in rural areas. As the last population census was made in 2011, the actual population of the district in 2016 is not readily available. Considering the population of the Faridabad district as per Census, 2011 the projected population in 2022 is worked out assuming the last decadal growth of 32.54 % and annual exponential growth rate of 3.20 % to apply for the period 2011-2022 (11 years). The domestic water demand is given in the table 9 below.

**Table 9 Domestic water demand (MCM)**

| Blocks | Populationas per 2011 census | Population In 2016 | Water demand Current (MCM) | Projected Population in2022 | Gross Water Demand Projected (MCM) |
|---|---|---|---|---|---|
| Ballabgarh (R) | 210603 | 227451.24 | 5.811379182 | 373020 | 9.530661858 |
| Ballabgarh (U) | 4291 | 4698.645 | 0.257250814 | 8270 | 0.452761432 |
| Faridabad (R) | 160275 | 184316.25 | 4.709280188 | 280161 | 7.158105885 |
| Faridabad (U) | 1434564 | 1685612.7 | 43.06740449 | 2865542 | 156.8884021 |
| **Total** | **1809733** | **2102079** | **53.85** | **3526992** | **174.03** |

## 5.2 Crop water demand

Water requirement of a crop means the total quantity and the way in which a crop requires water, from the time it is sown to the time it is harvested (crop period). Different crops will have different water requirements and the same crop may have different water requirements at different places of the same country depending upon the climate, type of soil, method of cultivation and useful rainfall etc. The total quantity of water required by the crop for its full growth may be expressed in Hectare-m or in Million Cubic meter or simply as a depth to which the total supplied irrigation water would stand above the surface without percolation or evaporation. This depth is known as delta for the crop. On the other hand, duty is defined as the area irrigated per cumec of discharge running for the base period. The duty helps us in designing the efficient canal irrigation system. If we know the crops area required to be irrigated and their duties, we can work out the discharge required for designing the canal. Consumptive use for a particular crop may be defined as the total amount of water used by the plant in transpiration (building of plant tissues etc.) and evaporation from adjacent soils or from plant leaves, in any specified time. Therefore, crop water requirements are defined as “the depth of water needed to meet the water loss through evapo-transpiration of a disease-free crop, growing in large fields under non restricting soil conditions including soil water and fertility and achieving full production under the given growing environment. Consumptive use for a particular crop may be defined as the total amount of water used by the plant in transpiration (building of plant tissues etc.) and evaporation from adjacent soils or from plant leaves, in any specified time. Thus, crop water requirement is nothing but the consumptive use itself, but exclusive of effective precipitation, stored soil moisture or ground water. Consumptive use or evapo-transpiration depends upon all those factors on which evaporation and transpiration depend such as, temperature, sunlight, wind movement etc. The crop water requirement of different bocks in the Faridabad district has been worked out and a statement is prepared as shown in table 10 below which outlines the required and available water potential in the district.

**Table 10 Crop water requirement (MCM)**

| Block | Area sown (ha) | Irrigated area(ha) | Crop Water Demand (MCM) | Water potential required (MCM) | Existing Water potential al (MCM) | Water potential to be created (MCM) |
|---|---|---|---|---|---|---|
| **Ballabgarh** | 33613 | 28486 | 341.832 | 341.832 | 133.15 | 208.682 |
| **Faridabad** | 23050 | 18974 | 227.688 | 227.688 | 86.17 | 141.518 |
| **Total** | 56663 | 47460 | 569.52 | 569.52 | 219.32 | 350.2 |

## 5.3 Livestock water demand

The livestock water demand of the district is determined by multiplying the total livestock population in the district by the per capita water requirement (liters/ day/ no.) for each category of the population. As per livestock census of 2003 & 2007, there was 22.89% population growth in four years (Average yearly growth rate being 5.72%). With the existing population recorded for a base year, the total projected livestock population in 2022 may be worked out and accordingly the livestock water demand is worked out.

**Table 11 Livestock water demand (MCM)**

| Block | Totalnumber of livestock | Present Water demand (MCM) | Water demandin 2022 (MCM) | Existing Water potential (MCM) | Water potential to be created (MCM) |
|---|---|---|---|---|---|
| Ballabgarh | 91600 | 1.17 | 1.52 | 1.17 | 0.35 |
| Faridabad | 128036 | 1.64 | 2.13 | 1.64 | 0.49 |
| **Total** | **219636** | **2.81** | **3.65** | **2.81** | **0.84** |

The total water demand of the district for all the sectors described in above tables are given in the are assessed by summing up all the values of water demand for domestic uses, livestock, power and industrial/commercial uses etc. The current water demand has been indicated in Table.12 and the projected water demand has been depicted in Table.13.

**Table 12 Present Water Demand of the district for various sectors**

| BLOCK | Demand from Components (MCM) | | | | | Total MCM |
|---|---|---|---|---|---|---|
| | Domestic | Crop | Livestock | Industrial | Power generation | |
| Ballabgarh | 6.07 | 341.832 | 1.17 | - | - | **349.072** |
| Faridabad | 47.78 | 227.688 | 1.64 | - | - | **277.108** |
| **Total** | 53.85 | 569.52 | 2.81 | - | - | **626.18** |

**Table 13 Total Water Demand of the district for various sectors (Projected for 2022)**

| Block | Demand from Components (MCM) | | | | | Total MCM |
|---|---|---|---|---|---|---|
| | Domestic | Crop | Livestockk | Industrial | Power generation | |
| Ballabgarh | 9.98 | 410.2 | 1.52 | - | - | **421.7** |
| Faridabad | 164.04 | 273.2 | 2.13 | - | - | **439.4** |
| **Total** | 174.03 | 683.4 | 3.65 | - | - | **861.1** |

### 5.4 Water Budget

The water budget of the district for the base year 2015-16 and 2021-22 as per water availability and demand is given in the table 14. The present water availability/demand and also for 2022 are worked out as explained above and the water gap is found out.

**Table 14 Water Budget (Volume in MCM)**

| **District** | **Existing Water Availability (MCM)** | | **Total (MCM)** | **Water Demand (MCM)** | | **Water Gap (MCM)** | |
|---|---|---|---|---|---|---|---|
| | Surface water | Ground water | | Present | Projected (2022) | Present | Projected (2022) |
| Faridabad | 23.68 | 195.64 | 219.3 | 626.18 | 861.103 | 406.86 | 641.783 |

## 6 Strategies for Water Conservation

Water is the most important element for the preservation of life. Water is a finite commodity which, if not managed properly, will result in shortages in the near future. Water conservation can go a long way to help alleviate these impending shortages.

**1. Check your toilet for leaks.**

Put a few drops of food coloring in your toilet tank. If, without flushing, the coloring begins to appear in the bowl., you have a leak that may be wasting more than 100 gallons of water a day.

**2. Stop using your toilet as an ashtray or wastebasket**

Every cigarette butt or tissue you flush away also flushes away five to seven gallons of water.

**3. Put a plastic bottle in your toilet tank**

Put an inch or two of sand or pebbles in the bottom of a one-liter bottle to weigh it down. Fill the rest of the bottle with water and put it in your toilet tank, safely away from the operating mechanism. In an average home, the bottle may save five gallons or more of water every day without harming the efficiency of the toilet. If your tank is big enough, you may even be able to put in two bottles.

**4. Take shorter showers**

A typical shower uses five to ten gallons of water a minute. Limit your showers to the time it takes to soap up, wash down and rise off.

**5. Install water-saving shower heads or flow restrictors**

Your hardware or plumbing supply store stocks inexpensive shower heads or flow restrictors that will cut your shower flow to about three gallons a minute instead of five to ten. They are easy to install, and your showers will still be cleansing and refreshing.

**6. Take baths**

A partially filled tub uses less water than all but the shortest showers.

**7. Turn off the water while brushing your teeth**

Before brushing, wet your brush and fill a glass for rinsing your mouth.

**8. Turn off the water while shaving**

Fill the bottom of the sink with a few inches of warm water in which to rinse your razor.

**9. Check faucets and pipes for leaks**

Even a small drip can waste 50 or more gallons of water a day.

**10. Use your automatic dishwasher for full loads only**

Every time you run your dishwasher; you use about 25 gallons of water.

**11. Use your automatic washing machine only for full loads only**

Your automatic washer uses 30 to 35 gallons per cycle.

**12. Don't let the faucet run while you clean vegetables**

Rinse your vegetables instead in a bowl or sink full of clean water.

**13. Keep a bottle of drinking water in the refrigerator**

This puts a stop to the wasteful practice of running tap water to cool it for drinking.

**14. If you wash dishes by hand, don't leave the water running for rinsing**

If you have two sinks, fill one with rinse water. If you have only one sink, first gather all your washed dishes in a dish rack, then rinse them quickly with a spray device or a pan of water.

**15. Check faucets and pipes for leaks**

Leaks waste water 24 hours a day, seven days a week. An inexpensive washer is usually enough to stop them.

**16. Water your lawn only when it needs it**

Watering on a regular schedule doesn't allow for cool spells or rainfall which reduce the need for watering. Step on some grass. If it springs back up when you move your foot, it doesn't need water.

**17. Deep-soak your lawn**

When you do water your lawn, water it long enough for water to seep down to the roots where it is needed. A light sprinkling that sits on the surface will simply evaporate and be wasted.

**18. Water during the cool parts of the day**

Early morning is better than dusk since it helps prevent the growth of fungus.

**19. Don't water the gutter**

Position your sprinklers so that water lands on your lawn or garden, not in areas where it does no good. Also, avoid watering on windy days when much of your water may be carried off to the streets and sidewalks.

**20. Plant drought-resistant trees and plants**

Many beautiful trees and plants thrive without irrigation.

**21. Put a layer of mulch around trees and plants.**

Mulch slows the evaporation of moisture.

**22. Use a broom to clean driveways, sidewalks and steps**

Using a hose wastes hundreds and hundreds of gallons of water.

**23. Don't run the hose while washing your car**

Soap down your car from a pail of soapy water. Use a hose only to rinse it off.

**24. Tell your children not to play with the hose and sprinklers**

Children love to play under a hose or sprinkler on a hot day. Unfortunately, this practice is extremely wasteful of precious water and should be discouraged.

**25. Check for leaks in pipes, hoses faucets and couplings**

Leaks outside the house are easier to ignore since they since they don't mess up the floor or keep you awake at night. However, they can be even more wasteful than inside water leaks especially when they occur on your main water line.

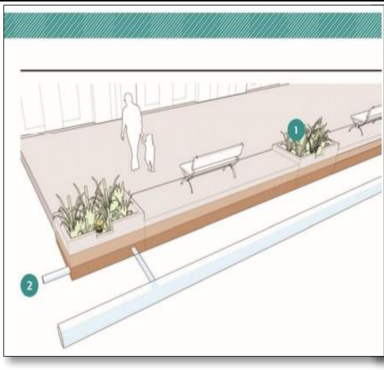
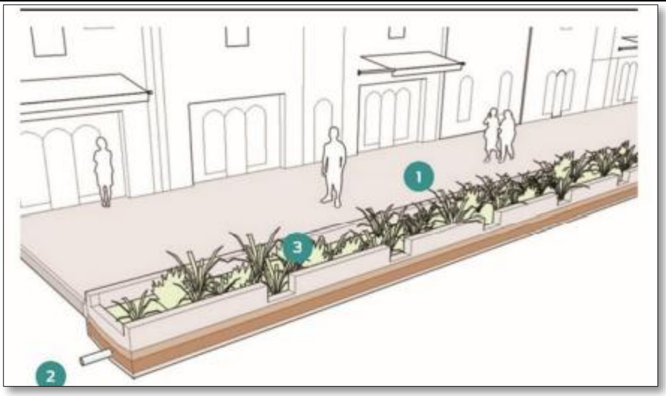
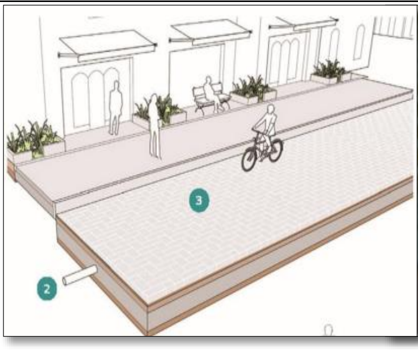
## 6.1 Artificial Recharge

An experimental study for artificial recharge to ground water was taken up by NWR in the premises of D.C. office/ complex during the year 1999-2000. Mass awareness programme to raise awareness on water conservation and artificial recharge to ground water was organized by central ground water Board on 22nd December 2001. A lecture on ground water condition in Faridabad area was delivered by Shri A.K. Bhatia, Sc 'D' of NWR, CGWB, Chandigarh. An exhibition depicting various facets of hydrogeology and Geophysics was also organized during mass awareness programme.

## 6.2 Water Sensitive Urban Design

As more and more portions of the district become urbanised, 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 Faridabad. 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 15**.

**Table 15 The methods of water table recharge strategies in urban area**

| Sr. No. | Method | Image |
|---|---|---|
| 1 | Flow Through Planters |   |
| 2 | Pervious Strips |  |
| 3 | Pervious Pavement |   |
| 4 | Stormwater Tree |  |

## 6.3 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 Faridabad 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 large amount of land is in wasteland form that could be used for plantation. The wasteland that could be used for plantation for conservation of water in Faridabad district is shown in **Figure 19** and **Table 16** shows the proposed no of plantation targets in Faridabad District.

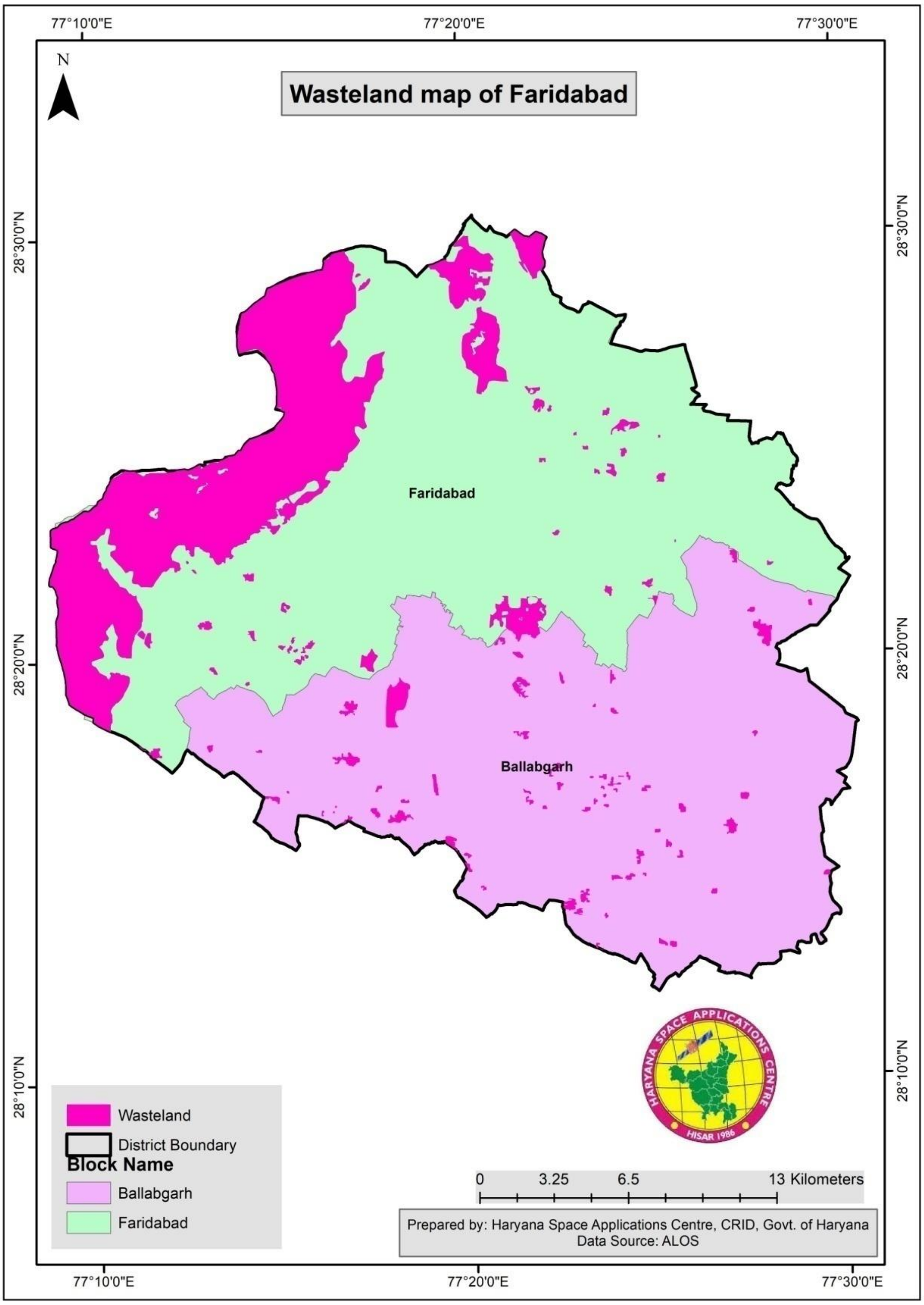



**Figure 19 Wasteland Map of Faridabad District**

**Table 16 The proposed targets for plantation in Faridabad District**

| Block Name | Wasteland Area (acre) | Plantation at 5 feet spacing |
|---|---|---|
| **Faridabad** | 26117.5 | 22,75,35,660 |
| **Ballabgarh** | 1960.5 | 1,70,79,876 |
| **Total** | **28,078** | **24,46,15,536** |

## 6.4 Public Education & Awareness

Public water conservation campaigns raise awareness in all levels of society about the importance of saving water to cope with its scarcity and ensure sustainability. The aim is to change citizen attitudes and behavior to improve water use efficiency. This is done through education and awareness campaigns on the socioeconomic and environmental benefits of water conservation and different conservation methods. Communication means include traditional and social media, as well as direct communication such as workshops, presentations, stakeholder dialogues, etc. Other means such as economic incentives can also be employed, for example, free installation of water meters. Raising water conservation awareness is important as the combined impact of even small improvements in individual household use can amount to significant savings at a municipality or regional level.

## 6.5 Public water conservation campaigns implementation

Preparation and execution of public awareness campaigns requires a multidisciplinary team, including water experts, building and construction experts, and social marketing, communication and outreach and education professionals. A thorough analysis of local public water systems and consumer habits is typically undertaken (often using household surveys) to identify potential water savings and primary targets for consumer behavior patterns. This includes identification of main target groups for awareness campaigns, for example local water utility companies, households, workplaces, large businesses, etc. Campaigns can also establish water conservation goals to facilitate tracking of progress and achievement of objectives. Critical components of planning and executing a campaign include communication protocols and materials organization and production, and establishment of partnerships with media, schools, local NGOs, etc. for effective dissemination. Some action plans and strategies are shown in Table 17.

**Table 17 Department wise Action plan/Strategy**

| SN | Name of task | Name Of Department | Activities | Target (In Nos.) |
|---|---|---|---|---|
| 1 | **Water conservation and rainwater harvesting** | **1.I& WRD** | 1. De-silting /Removal of obstruction in Channel | 10 |
| | | | 2. Internal clearances of Drains | 5 |
| | | **2.Rural Development & Panchayat** | 1.Roof top water harvesting on public buildings (In Nos.) | 5 |
| | | | 2.Roof top water harvesting on private buildings (In Nos.) | 0 |
| | | **3.Agriculture** | | 2 |
| | | **4. PWD Building & Roads** | | 10 |
| | | **5.PHED** | | |
| | | **6.Urban Local Bodies** | | |
| | | **7.HSVP** | | |
| | | **8.DTP** | 1.Roof top water harvesting on public buildings (In Nos.) | |
| | | | 2.Roof top water harvesting on private buildings (In Nos.) | 63 |
| | | **9.Forest Department** | | |
| | | **Total** | | **95** |
| | | **1.Rural Development & Panchayat** | **Soak Pits (In Nos.)** | |
| | | | 1.Soak Pits in Rural Area (In Nos) | 800 |
| | | | 2.Soak Pits in Rural Urban (In Nos) | |
| | | **Total** | | **895** |
| 2 | **Renovation of traditional and other water bodies/tanks {In Nos)** | **1.I&WRD** | 1. GIS Mapping of pond/water bodies | 16 |
| | | **2.Rural Development & Panchayats** | 1. Rural | 19 |
| | | | 2. Urban | 25 |
| | | **3.MGNREGA** | | |
| | | **4.PHED** | | |
| | | **Total** | | **60** |
| 3 | **Reuse, borewell recharge structures (In Nos.)** | **1.I&WRD** | | |
| | | **2.MCF** | | 10 |
| | | **2.Rural Development & Panchayat** | 1.Borewells/wells to be used for water recharge (in Nos.) | |
| | | **Total** | | **10** |
| 4 | **Watershed** | **1.Agriculture** | | 2 |

| | | | | |
|---|---|---|---|---|
| | **Development (In Nos.)** | **2.Rural Development & Panchayat** | 1. Check dams and Trenches | 0 |
| | | **2.Forest Department** | | |
| | | **Total** | | **2** |
| 5 | **Intensive afforestation (In Nos.)** | **1.Forest Department** | 1. Plantation of trees | 400000 |
| | | **2.I& WRD** | | 1000 |
| | | **Total** | | **401000** |
| 6 | **Krishi Vigyan Kendra (KVK) Melas** | **1.Agriculture** | | 500 |
| | | **2.Rural Development & Panchayat** | | |
| | | **Total** | | **500** |

## 6.6 Surface water management

### 6.6.1Pond 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 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. 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 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 preceding and after as well.

### 6.6.2 Decentralize Treatment Plant

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

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

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

However, planning for sewage infrastructure and pipelines are a long-term investment, with the advent of exponential population increase also has been a challenge. Instead, decentralized wastewater management approach can be considered as a sustainable and cost-effective alternative as it treats discharges or reuses the effluent in the relative vicinity of its source of generation. Therefore, decentralization of wastewater treatment facilities 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. Table 18 shows the activities being undertaken by the District for Surface water management.

**Table 18 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 | 66 |

### 6.7 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.

## 7 Proposed Activity

### 7.1 Rainwater harvesting

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

There are some factors that affect the rainfall water harvesting which needs to be focused for the development of suitable sites of water harvesting. These factors include rainfall, slope, soil texture, drainage, topography and land use / land cover and integration of these factors using weighted overlay analysis that results in suitable sites for rainwater harvesting. These sites are then classified into various suitability levels, namely, not suitable, less, medium, good and very good. The most suitable sites for rainfall water harvesting are shown in map (**Figure 20**). The block wise area proposed for rainwater harvesting under most suitable sites is shown in **Table 19.** For the process of calculating suitable site a fixed weightage is needed to be applied on the above-mentioned criteria (**Table 20).**

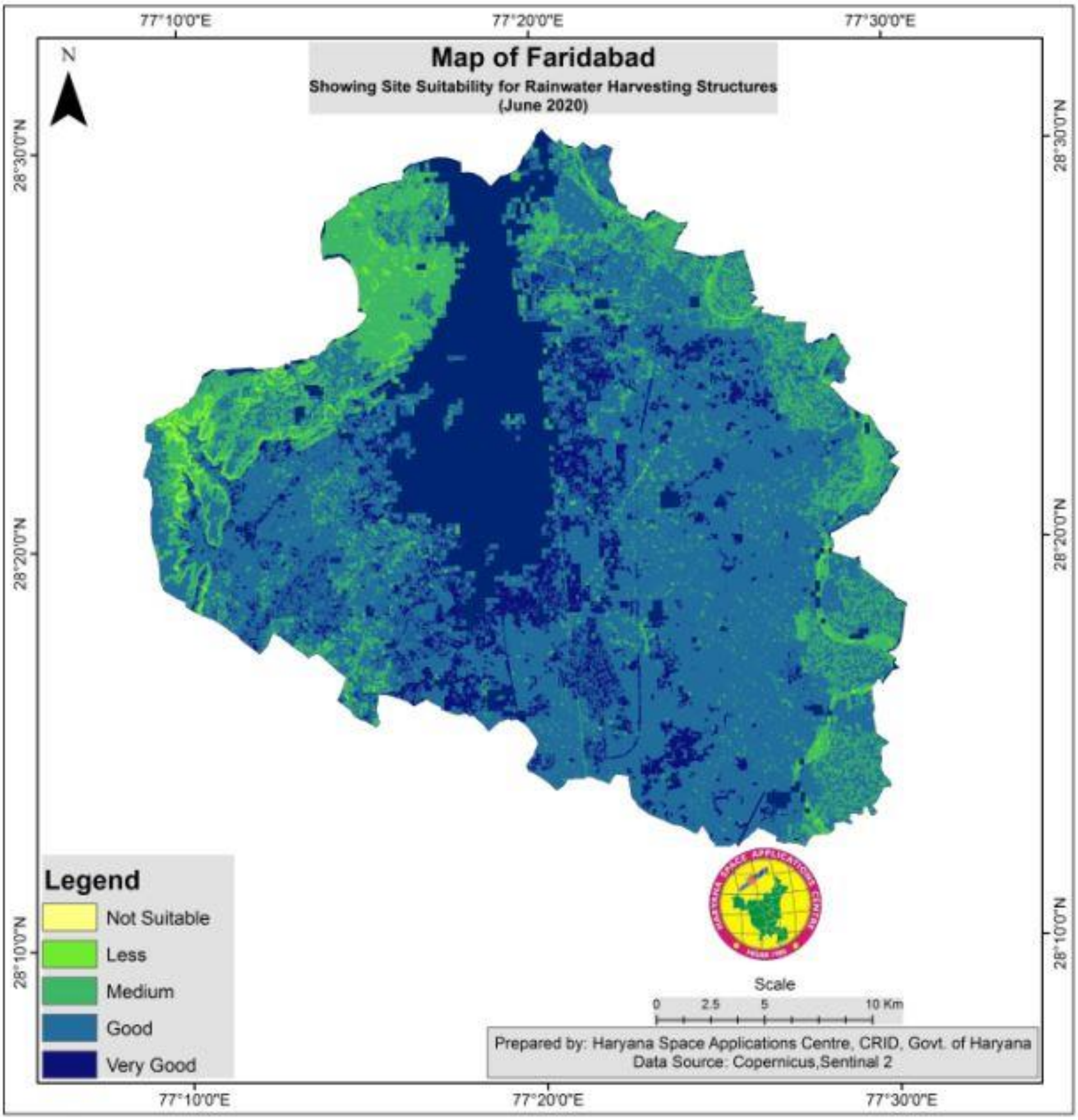



Figure 20 Proposed Site Suitable Map for rain water harvesting

Table 19 Block wise area under very good suitable site proposed for rain water harvesting

| Block Name | Area (Very Good suitability area in Sq meter) |
|---|---|
| **Faridabad** | 118230592.9 |
| **Ballabgarh** | 58227447.33 |

### Table 20 Assigned Weight for Criteria Parameters

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

## 7.2 Proposed Suitable Site based on 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 21** shows the proposed suitable site based on multi criteria. Block wise proposed suitable sites based on multi-criteria is shown in **Table 21**.

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

1. 13 Mini percolation Tanks
2. 9 Percolation Tanks
3. 12 Pakka check Dams
4. 1 Micro Irrigation tanks

### Table 21 Block wise proposed suitable sites based on multi-criteria

| Sl. No. | Block Name | Mini percolation Tank | Percolation Tank | Pakka Check Dam | Annicut | Micro Irrigation Tank |
|---|---|---|---|---|---|---|
| 1 | Faridabad | 11 | 7 | 11 | | 1 |
| 2 | Ballabgarh | 2 | 2 | 1 | | |

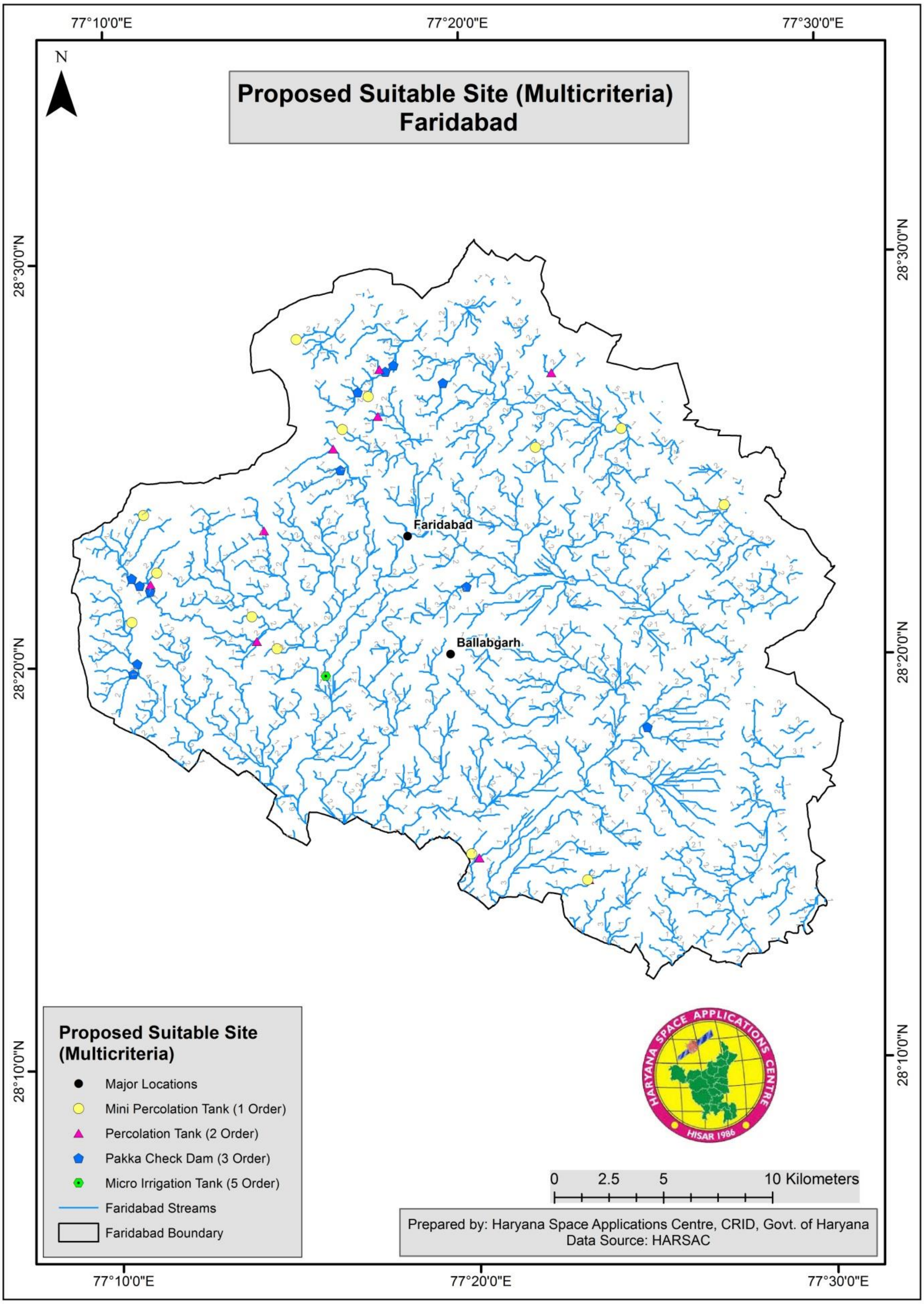



**Figure 21 Proposed suitable sites based on multicriteria in Faridabad District**

## 7.3 Proposed Suitable Site based on Drainage

The drainages that are created from satellite imagery can be used as base for plotting the water harvesting structure **(Figure 22).**

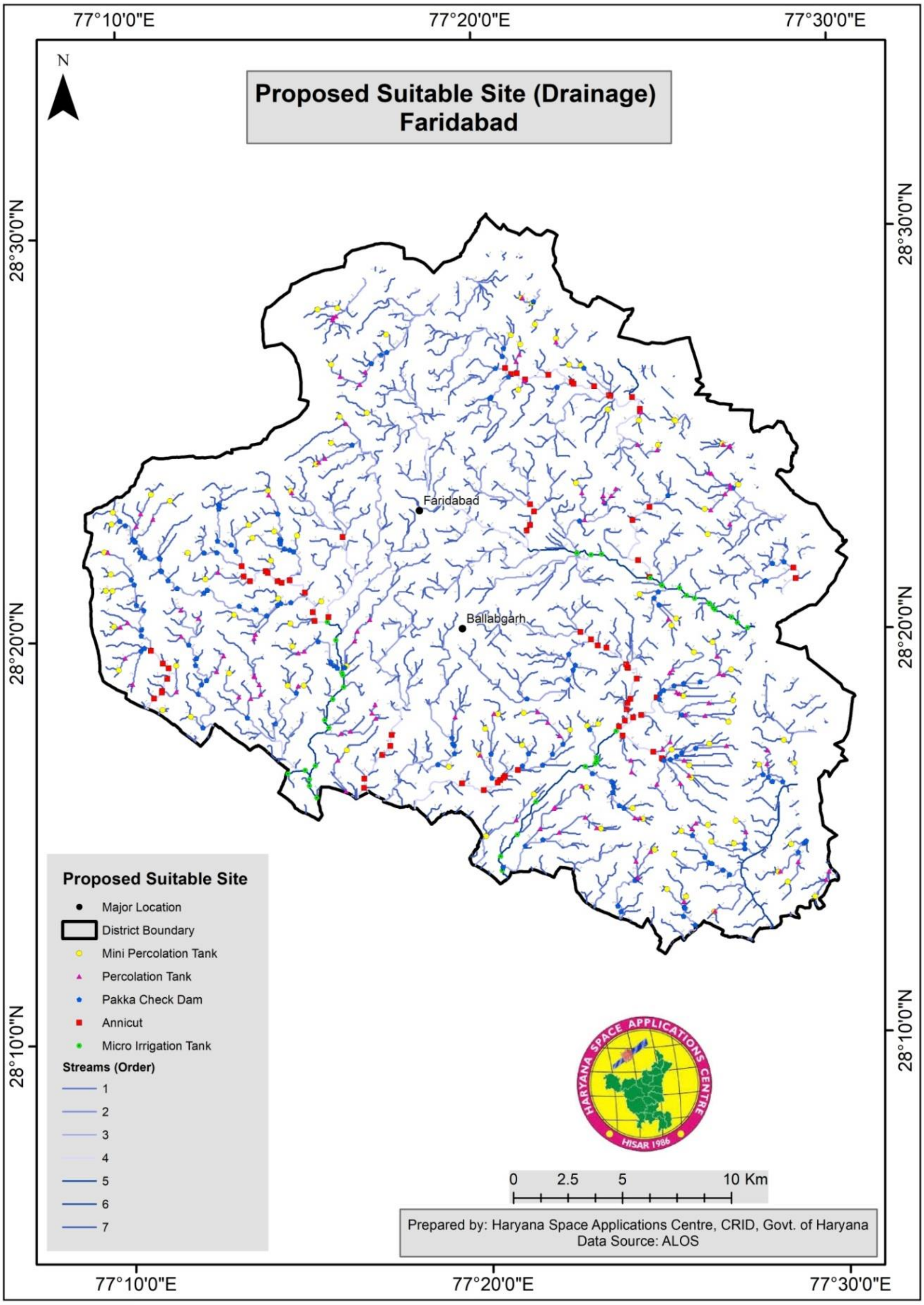



**Figure 22 Proposed suitable sites based on drainage in Faridabad District**

Stream order system is a simple method of classifying stream segments based on the number of tributaries upstream. So, based on the order of streams we can propose the suitable sites for water harvesting structures. A general idea says that Mini percolation Tanks on Ist order Stream, percolation Tanks on $2^{nd}$ Order Stream, pakka check Dams $3^{rd}$ Order Stream, Annicut on $4^{th}$ order, Micro Irrigation tanks $5^{th}$ Order can be built. **Figure 22** shows the proposed suitable sites based on drainage structure in Faridabad district. Proposed harvesting structures in Faridabad based on drainage are mentioned in Table **22.**

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

| **Sr. No.** | **Block Name** | **Mini percolation Tank** | **Percolation Tank** | **Pakka Check Dam** | **Annicut** | **Micro Irrigation Tank** |
|---|---|---|---|---|---|---|
| 1 | Faridabad | 55 | 57 | 71 | 42 | 7 |
| 2 | Ballabgarh | 49 | 64 | 76 | 33 | 34 |
| | **Total** | **104** | **121** | **147** | **75** | **41** |

## 8 Conclusion

Due to rapid urbanization, the Faridabad 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.

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.

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# “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