Report No.-16

जल शक्ति अभियान

संचय जल, बेहतर कल

# JSA-CTR

## Scientific Action Plan for Panchkula

हर बूंद संचय, हर खेत पानी

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GOVT. OF HARYANA

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# 1 Introduction

## 1.1 History

Panchkula is a well-planned city of state of Haryana. Panchkula city, was established in the year of 1995 as district. It is a satellite city of the Union Territory of Chandigarh.

The Prestigious Chandi mandir Cantonment Headquarters of the Indian Western Command, is also located in Panchkula city. There are five towns in the district named Panchkula, Barwala, Pinjore, Kalka, and Raipur Rani. The only Hill station in Haryana called Morni is also in this District. In 2011, Panchkula had a population of 561,293 of which male and female were 299,679 and 261,614 respectively. Panchkula and Mohali (in Punjab) are two satellite cities of Chandigarh. These three cities are collectively known as Chandigarh Tricity. The word panchkula is derived from combination of two words Panch (local) + Kul (Sanskrit: कुला) (canal) which mean the city of five canals. Possibly referring to five irrigation canals which distribute water of Ghaggar river from nada sahib to Mata Mansa Devi. The Nada canal has now been eroded by the river and most of the Kul's pass through the cantonment of Chandimandir towards Mansa Devi. The canals are a beautiful example of community property and are maintained by the villagers along the way, with distribution days decided. The canals were made by a ruler in the past, and follow the contours to take water to levels much higher than the river at the same spot. Though the district came into existence in the mid of last decade of 20th century, yet its antiquity is beyond any doubt. The earliest inhabitants of the district were a primitive people using stone tools of the lower palaeolithic age such as choppers, hand-axes, etc. These have been discovered from Mansa Devi area (Bilaspur), Pinjore and Suketri. In the ancient time Aryans traversed the region emotionally. The district is also associated with Pandavas who enroute to Himalayas during their exile stayed here for some times. The place was known as Panchpura later corrupted to Pinjore. Panchkula tehsil was created by transferring 77 villages of Kalka tehsil and 19 villages of Naraingarh tehsil in October, 1989. Out of these 96 villages, four villages were fully merged in Panchkula Urban estate. The full-fledged Panchkula district came into existence with effect from 15-8-1995. Now it has three tehsils Kalka, Panchkula and Raipur Rani.

## 1.2 Location

Panchkula district of Haryana is located in Northern part of Haryana State and lies between 30° 41' 42.7272" N latitudes and 76° 51' 15.0192" E longitudes. Himachal Pradesh bound the district, in North and east, in west Punjab and Union Territory of Chandigarh and in south by Ambala district. Total geographical area of the district is 898 sq. km. It is a satellite city of the Union Territory of Chandigarh. Location Map of Panchkula District is given in **Figure 1.**

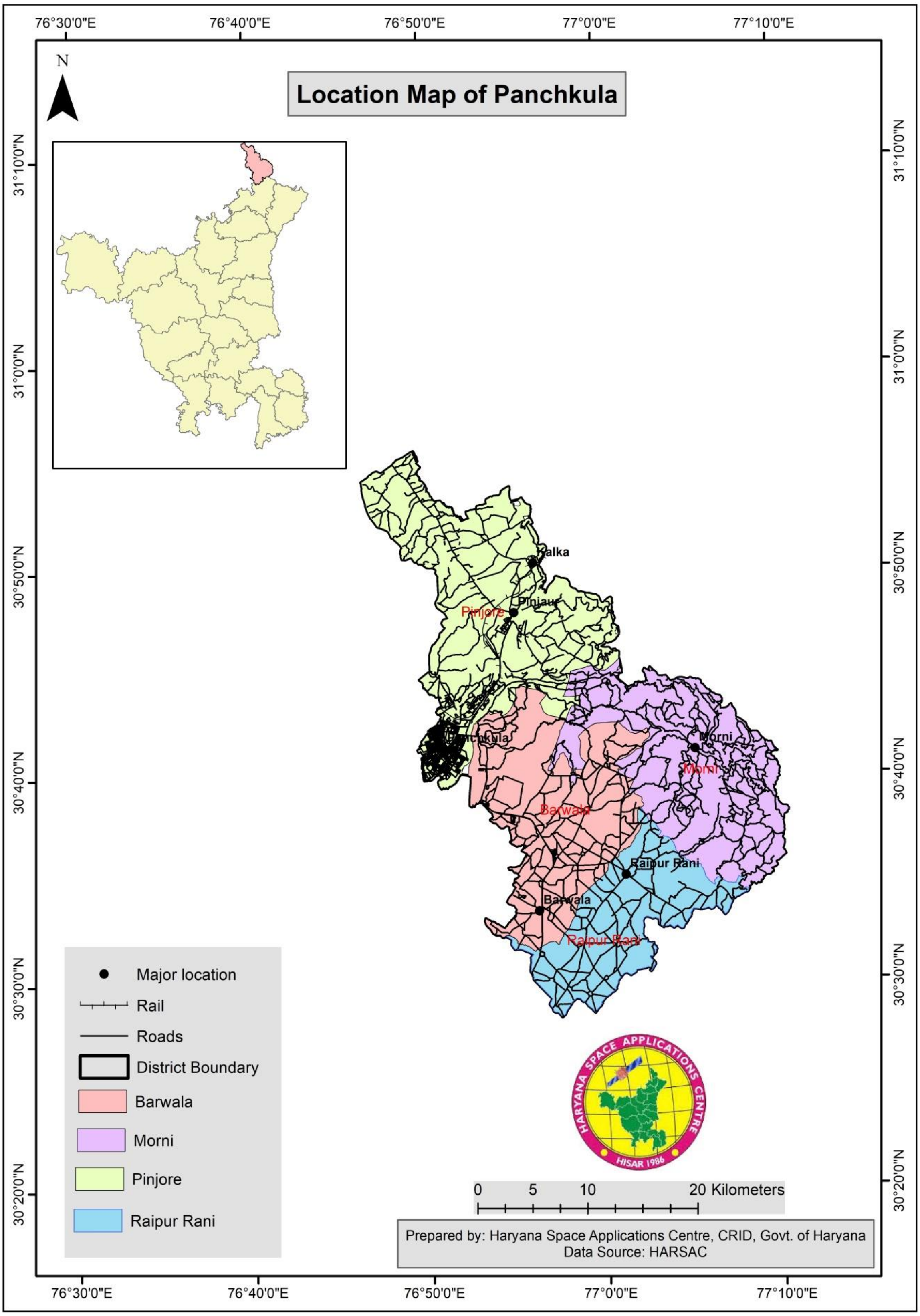


**Figure 1 Location Map of Panchkula District**

## 1.3 Administrative Setup

The administrative setup of the District of Panchkula 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 Panchkula District

| | |
|---|---|
| **Country** | India |
| **State** | Haryana |
| **Division** | Panchkula |
| **Headquarters** | Panchkula |
| **Tehsil** | 1. Panchkula 2. Kalka 3. Raipur Rani |
| **Total Area** | 1258 km2 (486 sq. mi) |
| **Total Population (2011)** | 561,293 |
| **Density** | 630/km2 (1,600/sq. mi) |
| **Demographics** | (Tehsil Panchkula MC- Panchkula, Chandimandir CT, Bir Ghaggar CT, Ramgarh CT, Raipur Rani CT, Tehsil Kalka – Kalka MC, Pinjore MC and HMT Pinjore CT) |
| **Literacy** | Panchkula (Lok Sabha constituency) |
| **Vidhan Sabha constituencies** | 1. Kalka, 2. Panchkula, |
| **Website** | https://panchkula.nic.in/ |
| **Location of Panchkula** | Northern most region of Haryana |
| **Coordinates** | 30° 41' 42.7272" N latitudes and 76° 51' 15.0192" E longitudes. |
| **Total Area** | 176.5 sq. mi |
| **Elevation** | 711.9 ft above the sea level |

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

| | |
|---|---|
| **Sub Divisions (2)** | Panchkula, Kalka |
| **Tehsils (5)** | Panchkula, Kalka, Raipur Rani |
| **Sub-Tehsils (2)** | Barwala, Morni Hills |
| **Blocks (4)** | Barwala, Pinjore, Morni, Raipur Rani |
| **Municipal Corporation (2)** | |
| **Municipal Council (1)** | |
| **Municipal Committees (3)** | |
| **Population (Census 2011)** | 561293 |

Source: https://panchkula.nic.in/village-panchayats

| | |
|---|---|
| **Total Villages** | 236 |
| **Total Panchayats** | 128 |
| **Village Level** | Panchayat (162) |
| **Block Level** | Panchyat Samiti (4) |
| **District Level** | Zila Parishad (1) |

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

## 1.4 Climate

### 1.4.1 Temperature

The climate of Panchkula can be classified as subtropical monsoon, mild &dry winter, hot summer and sub-humid which is mainly dry with hot summer and cold winter except during monsoon season when moist air of oceanic origin penetrates into the district. There are four seasons in a year. The hot weather season starts from mid-March to last week of the June followed by the southwest monsoon, which lasts up to September. The transition period from September to November forms the post monsoon season. The winter season starts late in November and remains up to first week of March.

Mean maximum and minimum temperature of the district during summer (May-June) is 39°C and14°C respectively. In case of winter (October-March), mean maximum and minimum temperature remains °C and 6.1 °C respectively. During Rainy season (June-Sept), the mean minimum temperature remains 18°C while mean maximum temperature reaches to 29°C.June is the warmest month of the year. The average temperature in June is 39.1°C. January is the coldest month of the year with average temperature of 6.1°C.

### 1.4.2 Rainfall

The normal annual rainfall of the district is 1057 mm, which is unevenly distributed over the area in 49 days. The southwest monsoon sets in from last week of June and withdraws in end of September, contributed about 86% of annual rainfall. July and August are the wettest months. Normal monsoon rainfall is 911 mm. Rest 14% rainfall is received during non-monsoon period in the wake of western disturbances and thunderstorms. During monsoon months the humidity is about 80 percent. For rest of the year humidity is moderate and is around 70 percent except for the month of May &June. The humidity in April to June is around 50 percent and are the driest months. Humidity is higher in the mornings. Rainfall Map of Panchkula District is given in **Figure 2**. Rain falls ranges from 1139.7 to 1735.57.

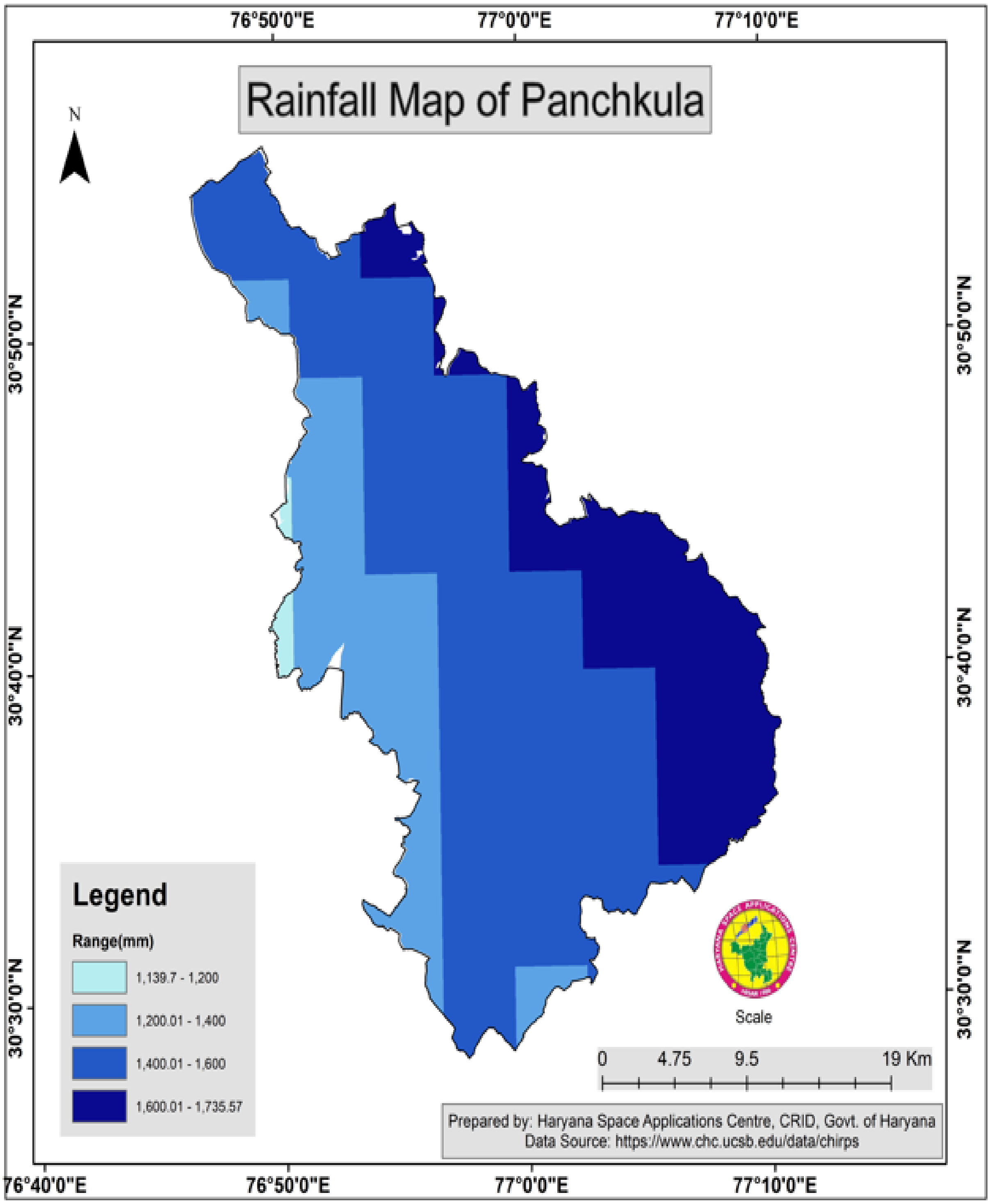


**Figure 2 Rainfall Map of Panchkula District**

## 1.5 Elevation and Topography

Generally, the slope of the district is from north east to south west and in this direction, most of the rivers/streams rain-fed torrents flow down and spread much gravel and pebbles in their beds. Only the Sirsa river, in Kalka Tehsil flows towards the north-west. The soils in the district are mainly light loam. The height above mean sea level of the district ranges from 1000 to 1454 m as given in (**Figure 3)**.

Slope ranges from flat to >35 degree (**Figure 4**). Contours of 5 meters interval showed (**Figure 5**). similar to topography as in digital elevation model.

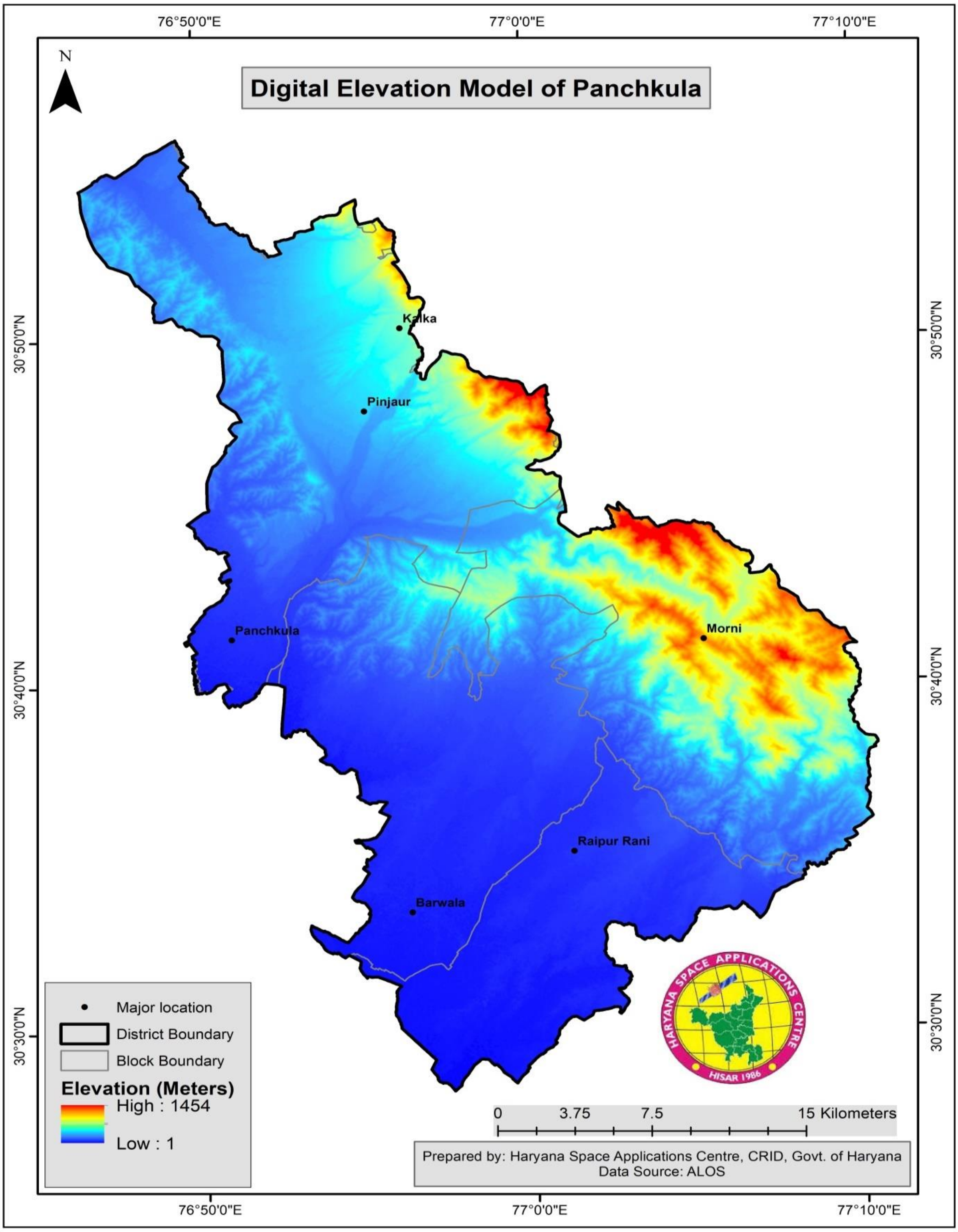


**Figure 3- Digital elevation model of Panchkula District**

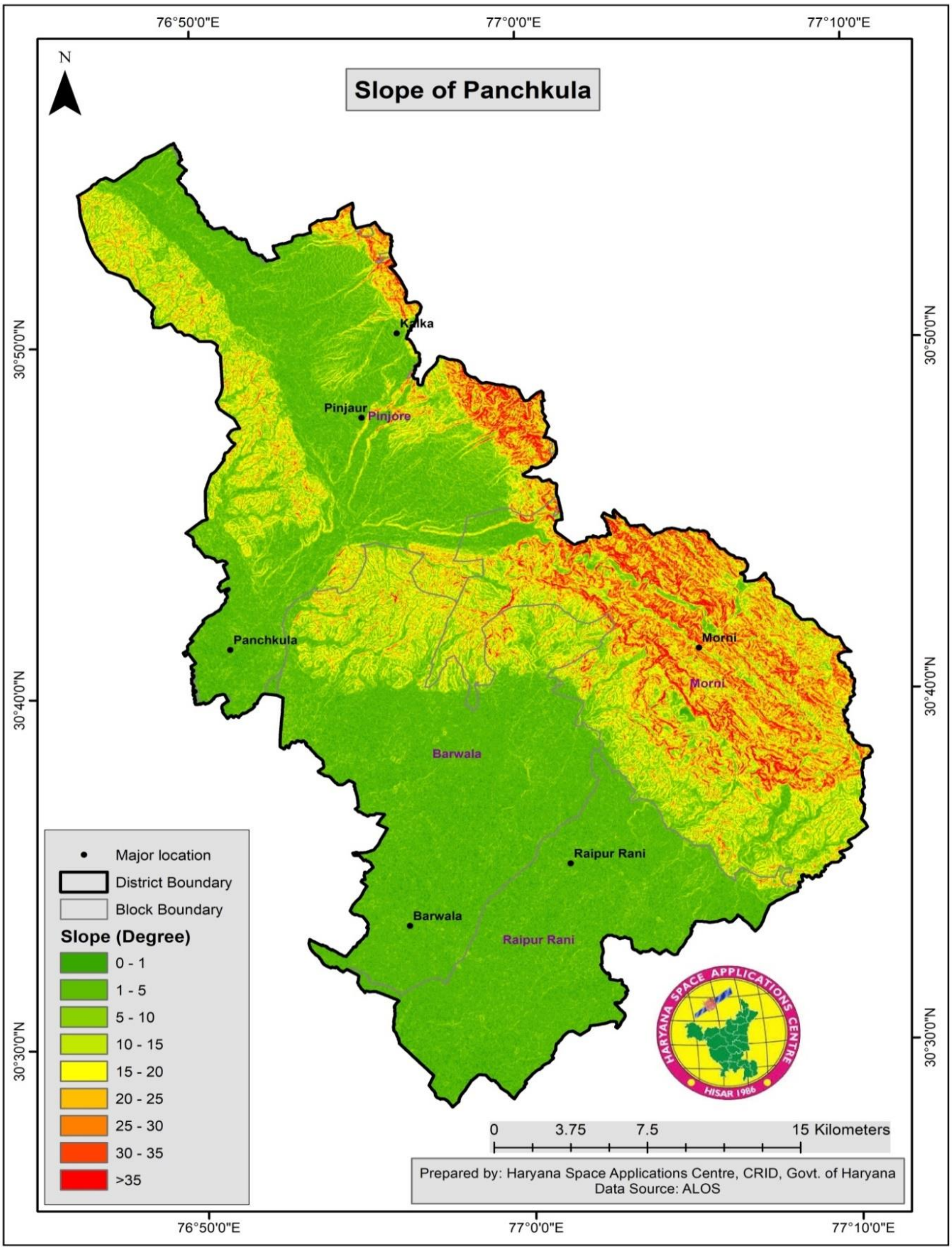


**Figure 4- Slope Map of Panchkula District**

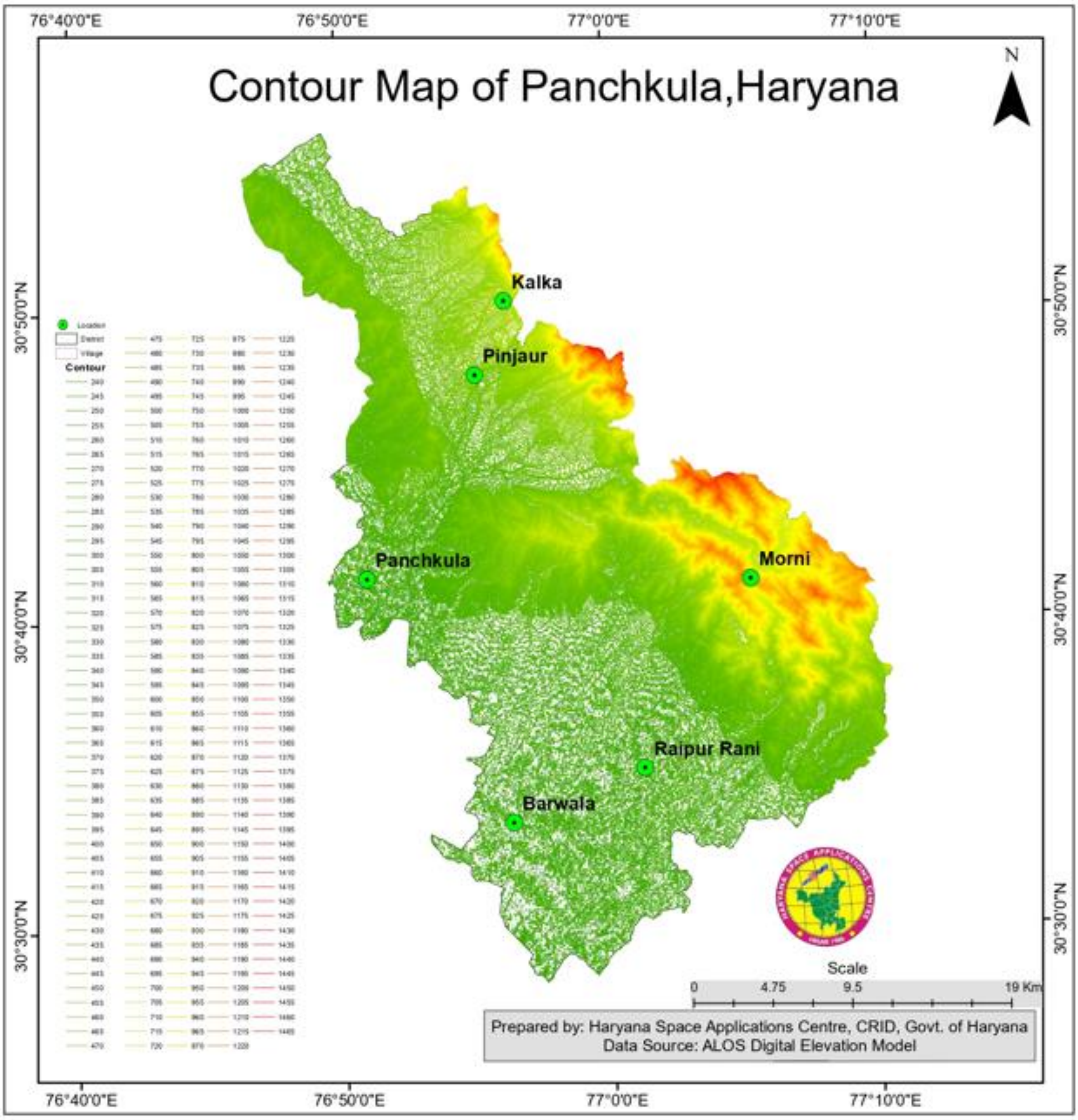


**Figure 5- Contour Map of Panchkula District**

### 1.5.1 Geology and Lithology

The district is divided into four Physiographic units Siwaliks Dissected Rolling Plains (Kandi) Alluvial Plains

**Siwaliks hills:** Siwalik hill ranges occupy the Northern and North-Eastern fringe of Panchkula district and attain the height up to 950m AMSL. The hills are about 500m high with respect to the adjacent alluvial plains. These are characterized by the broad tableland topography that has been carved into quite sharp slopes by numerous ephemeral streams come down to the outer slopes of the Siwaliks and spread much of gravels boulders, pebbles in the beds of these streams.

**Kandi Belt:** A dissected rolling plain in the Northern parts of district is a transitional tract between Siwaliks hills and alluvial plains. It is about 3-8 km wide and elevation varies between 250 and 375 m AMSL.

**Alluvial plains**: This tract is part of higher ground between Ghaggar and Chautang and includes high mounds and valleys. In general, the slope is from northeast to southwest.

Eurtrochrepts / Udorthents soils are shallow and loamy sands to fine sandy loams are found in the Siwalik range. Udipsamments/ udorthents type soils are loamy sand to sandy loam deep, well-drained, non-saline, non-alkali found in transitional tract between Siwaliks hills and alluvial plains. **Figure 6** shows the Lithological Map of Panchkula district.

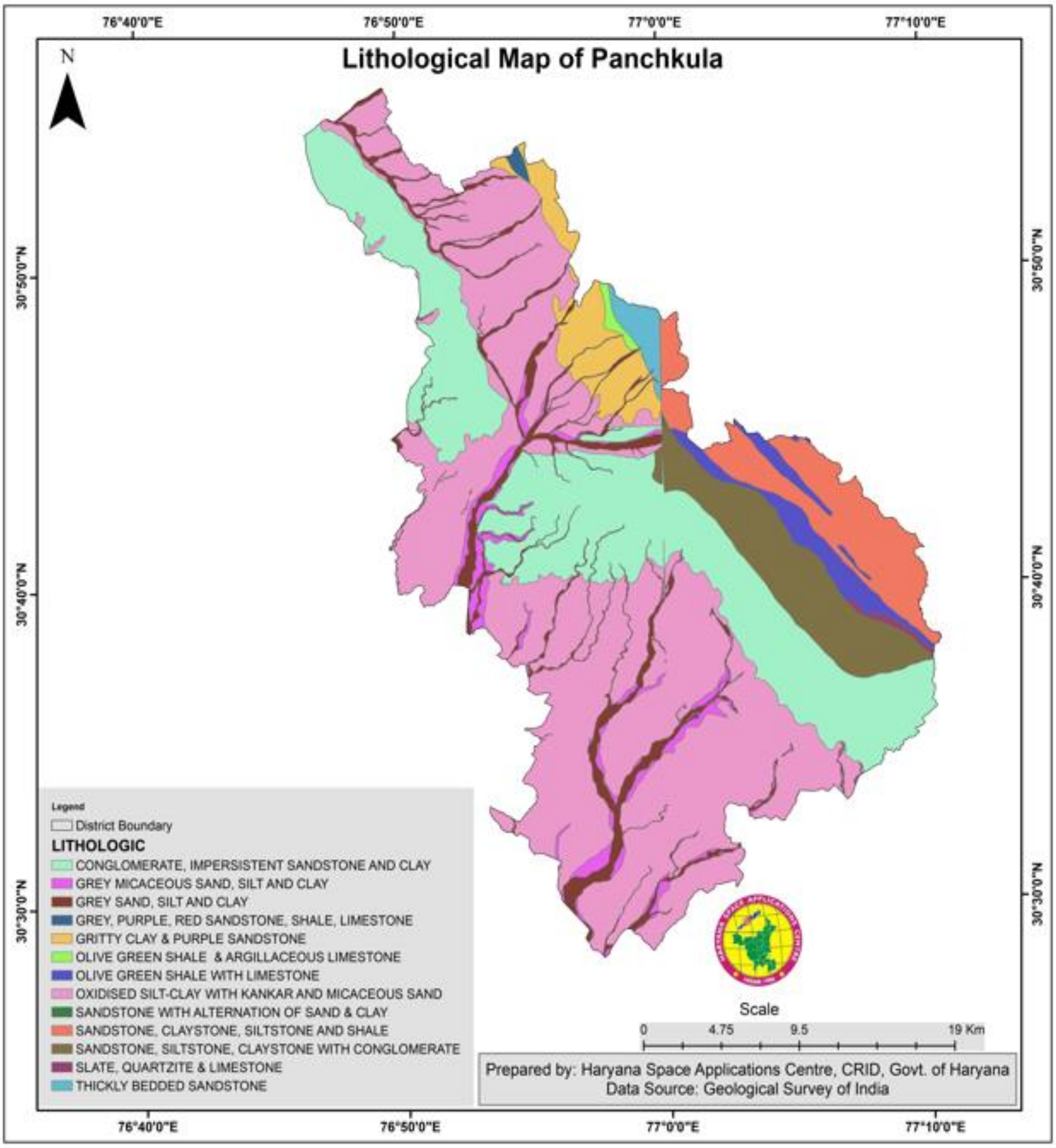


**Figure 6 Lithological Map of Panchkula District**

### 1.5.2 Soil Profile

In the district, most of the soil is shallow and loamy sands to fine sandy loams, except in depressions, well-drained, non-saline, non-alkali, non-calcareous, mostly base saturated and are classified as loamy skeletal typic, lithyhic, eurtrochrepts / udorthents. These soils are found in the Shivalik range.

**Udipsamments/ udorthents** - These are loamy sand to sandy loam deep, excessively or well-drained, non-saline, non-alkali. These are placed under the associations of transitional tract between Shivalik hills and alluvial plains.

**Psammaquents and Haplaquepts** –These soils are found in Yamuna Plains

**Haplaquept-** These soils are non-saline, alkalinity hazards are classified as typic ustochrepts but water-logged soils with loam to clay loam texture showing the effect of glazing, are classified as aeric /typic Haplaquepts. Areas as aeridic soil moisture have soils classified as camborthics and torropsamments.

Soils are rich in nutrients and thus are fertile. In total, 70 percent of the soil of the district comes under Sandy class followed by clay soil which contributes 22% and remaining 8% in Silty soil. The proportion of sandy soil to total soil of the block is maximum (94 percent) in followed by Raipur Rani and Barwala where the extent of sandy soil is to the tune of 81% and 61 percent.

As the district has plain areas, the soil profile varies from neutral to slightly acidic. Also, the soil texture varies from sandy loam to clay loam. The soil depth is generally shallow except in areas having vegetation coverage. The organic matter is medium to high. Available phosphorus is low to medium and potassium is generally in medium category. According to soil taxonomy, the soils classify as loamy skeletal typic, lithyhic, eurtrochrepts or udorthents. Most of the area is falling under sin various land slope. 45% area under 3-8% land slope, 38% area under 0-3% land slope, 14% area under 8-25% land slope and remaining 3% area under > 25% land slope.

### Table 2 -The soil profile of the district

| Block | Major soil Cluster (Soil type) | Area (Ha) | 0-3% | 3-8% | 8-25% | >25% |
|---|---|---|---|---|---|---|
| Barwala | Sandy Soil | 9670 | 9250 | 4650 | 1888 | |
| | Clay Soil | 5100 | | | | |
| | Silty Soil | 1018 | | | | |
| Morni | Sandy Soil | 1406 | | 160 | 345 | 997 |
| | Clay Soil | 96 | | | | |
| | Silty Soil | | | | | |
| Pinjore | Sandy Soil | 3090 | 650 | 5580 | 1684 | |
| | Clay Soil | 1894 | | | | |
| | Silty Soil | 206 | | | | |
| Raipur Rani | sandy Soil | 10850 | 4950 | 7100 | 1343 | |
| | Clay Soil | 780 | | | | |
| | Silty Soil | 1763 | | | | |

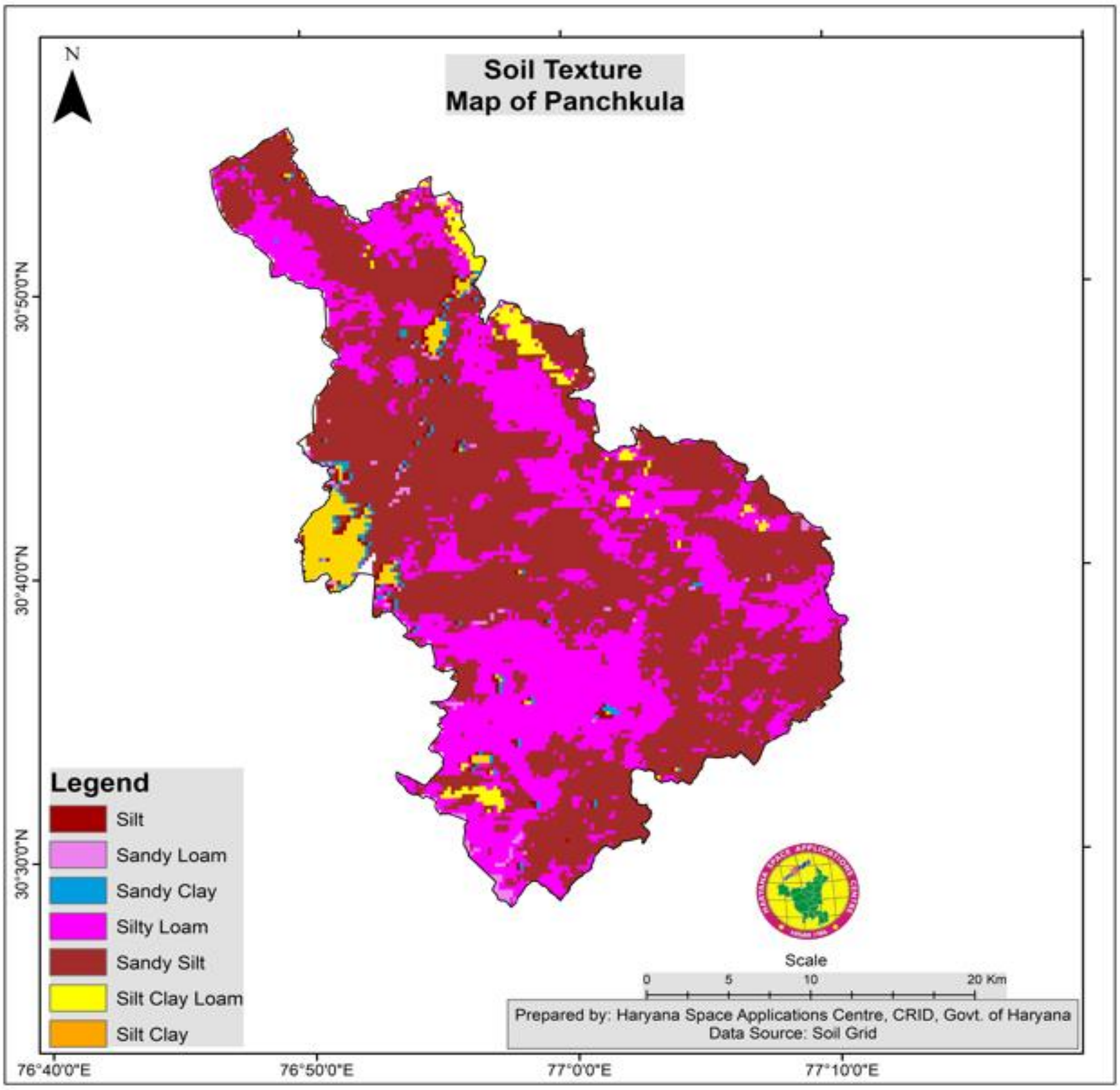


**Figure 7- Soil texture map of Panchkula District**

As seen from **Table 2** area under 0-3% in the Barwala block has 59% followed by29% area under 3-8% land slope, remaining 12% area has under 8-25% land slope. In the Morni block 66% area has under >25% land slope, under 8-25% land slope 23% area. In the Pinjore block the 71% area has under 8-25% land slope. In the Raipur Rani the 53% area under 3-8% land slopes.

### Sand Dunes

**SOIL HEALTH-HARYANA**

- Major & Secondary Nutrients:-

| | | L | M | H |
|---|---|---|---|---|
| Nitrogen | : | 89.27% | 7.98% | 2.75% |
| Phosphorus | : | 88.28% | 9.45% | 2.26% |
| Potash | : | 10.61% | 48.55% | 40.84% |
| Sulphur | : | 8.32% Deficient | | |

Micronutrients:-

| | | |
|---|---|---|
| Zinc | : | 19.70% deficient |
| Iron | : | 28.20% deficient |
| Manganese | : | 8.90% deficient |

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

As per the soil survey conducted by NBSS & LUP (1997), more than 75 percent of the geographical area of the State is suffering from one or the other soil degradation problem. The major degradation problems are water erosion including top soil loss and terrain deformation, flooding and acidity. Therefore, major challenge is to reduce these problems up to the tolerance limits for the sustainable agricultural development. This calls for scientific land use planning on water shed basis and its proper implementation with the active involvement of all the stakeholders. Figure shows the General soil health profile of Haryana.

## 1.6 Land use

The total geographical area (TGA) of Panchkula is 56,732 hectares. In the district the block wise information is not available so we have considered the Tehsil wise data the largest Tehsil of the district is Panchkula which is comprises TGA of 41,313 hectares i.e., about 73% of the TGA of the district. The Gross Cropped Area of the district is 41,518 hectares out of which 25,255 hectares i.e.,61% of the area falls in Panchkula Tehsil, followed by Kalka Tehsil having TGA of 16,623ha i.e., 39% of the district. Panchkula Tehsil records for maximum nets own area of 11,415 hectare i.e.,59% of the net sown area of the district. **Table 3** shows according to the Patwari record area under agriculture.

**Table 3 -According to the Patwari record area under agriculture.**

| Tehsil | TGA | GCA | NSA | AST | Cropping Intensity (%) |
|---|---|---|---|---|---|
| Panchkula | 41313 | 25255 | 11415 | 13840 | 221% |
| Kalka | 15419 | 16262 | 7868 | 8395 | 207% |
| Total | 56732 | 41518 | 19283 | 22235 | 214% |

**TGA-**Total Geographical Area, **GCA-**Gross Cropped Area**, NSA-**Net Sown Area, **AST-**Area Sown more than once

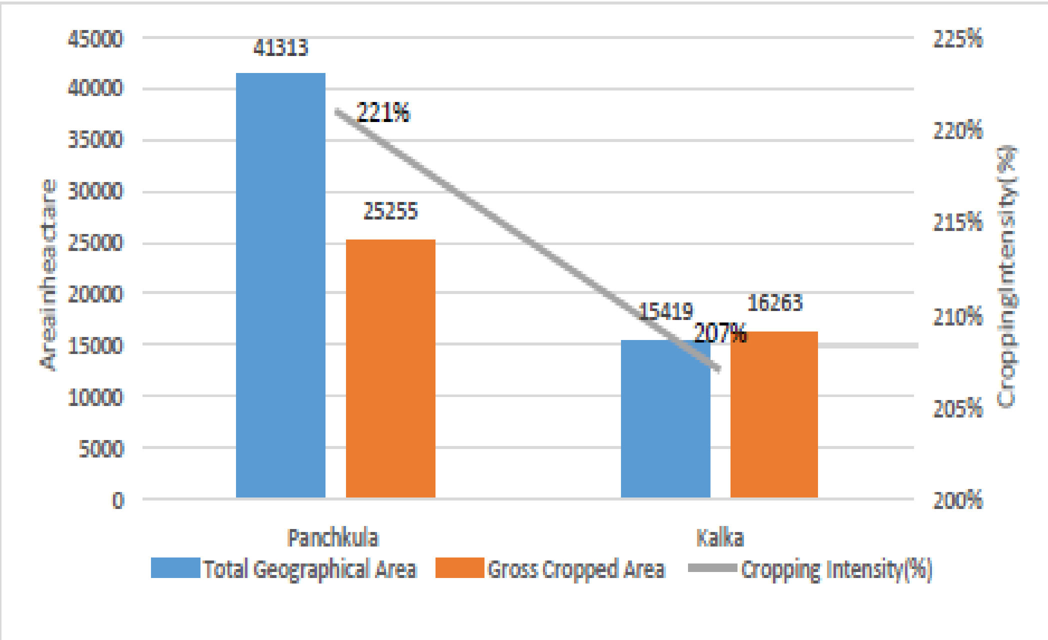


**Figure 9- TGA, GCA and Cropping Intensities of the blocks**

The cropping intensity in Panchkula Tehsil is 221% and ranks 1st in the district second Kalka Tehsil where cropping intensity is 207. Cropping intensity of the district is 214%.

### Table 4 Area under forest, waste land and other uses

| Tehsil | Area Under Forest | Area Under Wasteland | |
|---|---|---|---|
| Panchkula | 880 | 2522 | 8418 |
| Kalka | 470 | 4588 | 5232 |
| Total | 1350 | 7110 | 13650 |

National Forest Policy, 1988 meant for hills and mountainous regions, envisages two third of the area under tree cover in order to prevent erosion and land degradation and to ensure the stability of the ecosystem. The district with a total geographical area of 56,732 hectare has an area of only 1350 hectare (**Table 4).** Figure 10 shows the land use land cover classification of Panchkula **area** under forest, waste land and other uses.

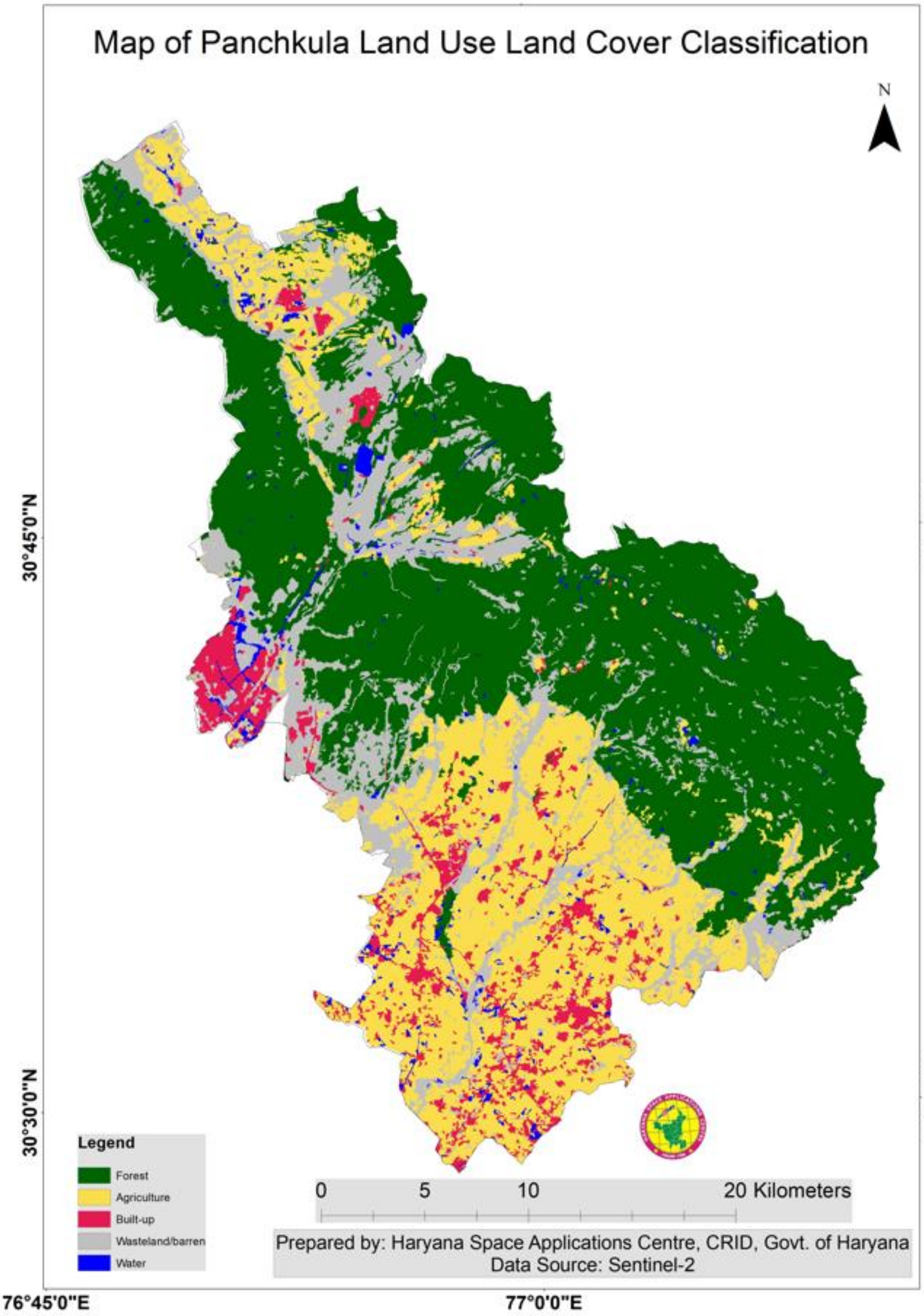


**Figure 10 -Landuse and Landcover of Panchkula District**

# 2 District Water Profile

## 2.1 Sources of Water

Water is a prime need of life. Adequate availability of required quality of water is needed for human life and animals. Only 3% of fresh water is available for human beings for their various activities on this earth out of which about 2% is available as glaciers and ground water and only 1% is available in rivers and ponds. Surface water bodies such as lakes, ponds, reservoirs, river and tanks were used as sources. **Figure 11** shows the waterbodies and Figure 12 shows the Monsoonal waterlogged area of Panchkula district.

The city gets its water from three sources including Kaushalya dam, Kajauli waterworks and tube wells installed in the city. While Kaushalya dam provides about 18 cusecs of water and Kajauli waterworks supplies about 10 cusecs, about 190 Tube wells installed across the city has remained as the main water source.  Even though the city is not receiving water from Kaushalya dam for the past one year, as the pipeline that supplied water from the dam had got damaged in 2018, the city has not recorded water scarcity.

### 2.1.1 Canals

The name of the city Panchkula in Haryana, came from the place where five irrigation canals meet. 'Panch' is five and 'Kuls' means canal, hence the name Panchkula. The canals take water from the Ghaggar and distribute it from Nada Sahib to Mansa Devi.

### 2.1.2 Ponds

The definition of the pond as per act as “a tank or lake or any other inland water body having an area of 0.5 acre or more, whether it contains water or not, and mentioned in revenue records as talab, johar, tank or by any other name and includes green belt and the peripheral catchments areas, main feeder inlet and other inlets, bunds, weirs, sluices etc but does not include wet lands as notified by the Government time to time. The ponds have a vital role in conservation, storage, recharging of ground water and also being used for religious purposes in the country. The water sources are such as ponds, wells and rivers are worshiped as gods, but the situation of the ponds in the State are deteriorated with the passage of time resulting in the deterioration of the water quality in the ponds, reduction in the percolation of Ground Water causing the depletion of the ground water level. Less water is available for agriculture, industrial and domestic use. There is total 631 ponds in a Panchkula district.

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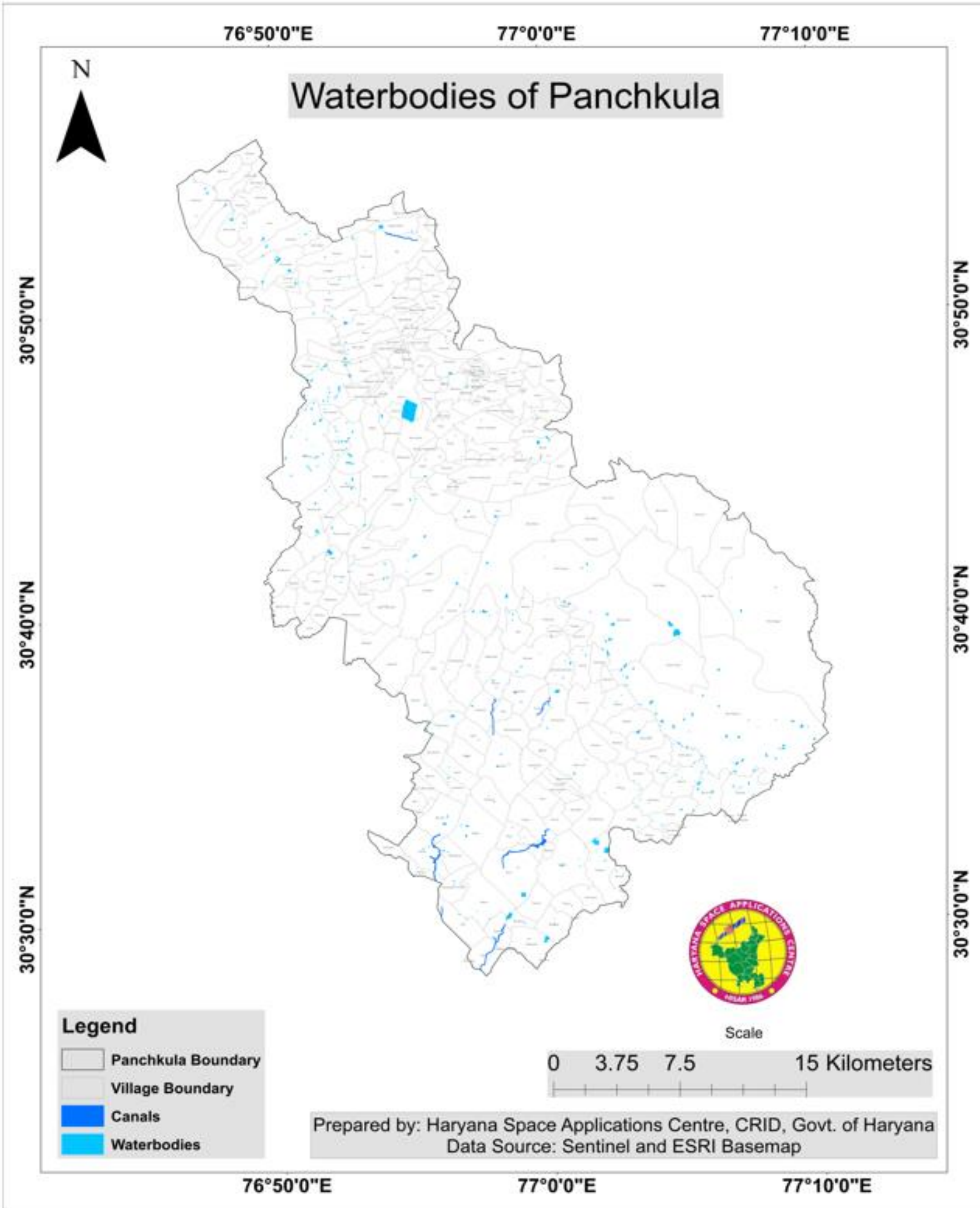


**Figure 11 Water bodies of Panchkula District**

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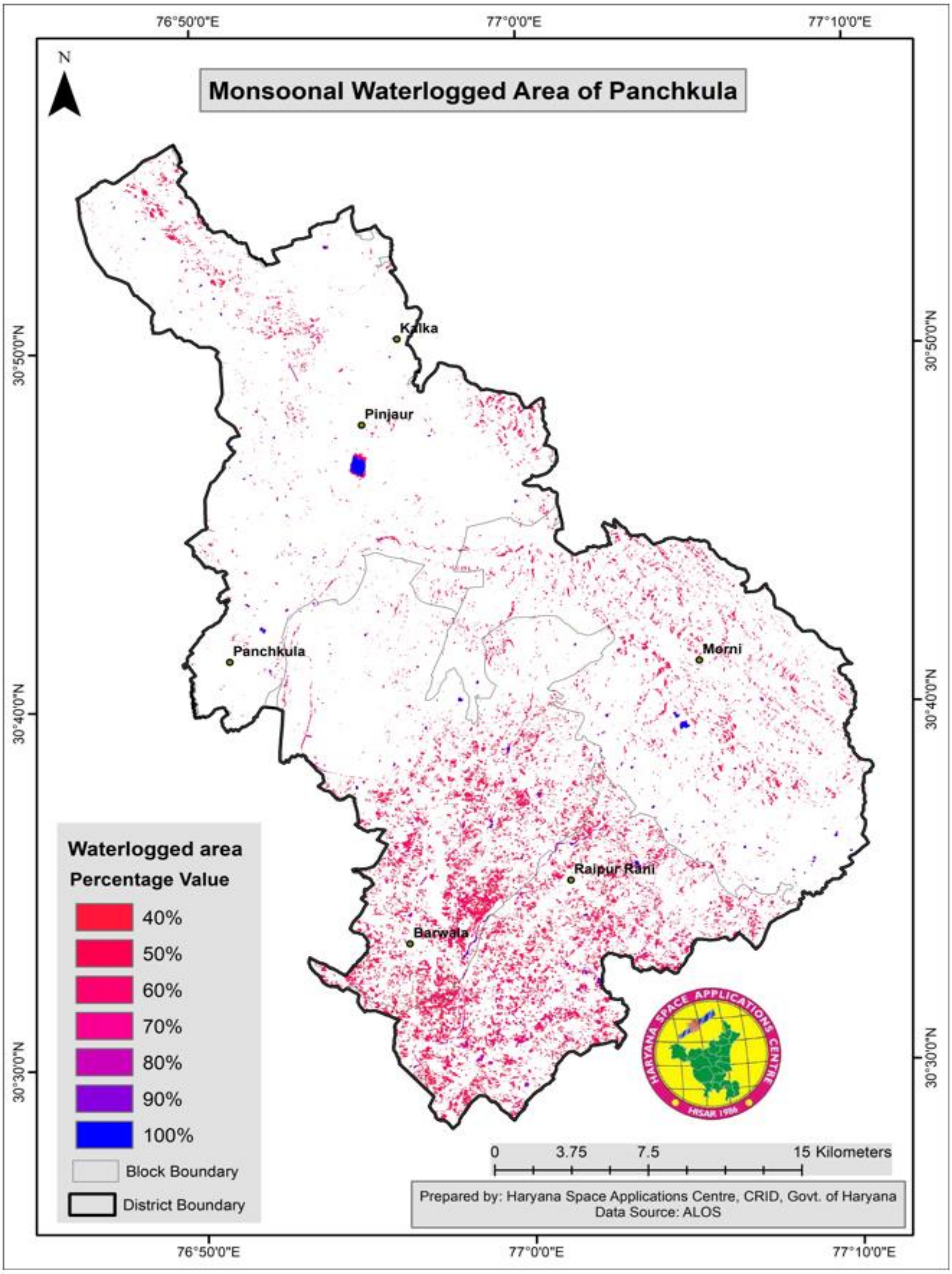



**Figure 12 Monsoonal Waterlogged Area of Panchkula**

### 2.1.3 Drain

Natural drainage means a drainage consisting of native soils such as a natural swale or topographic depression, which gathers or conveys run-off to a permanent or intermittent watercourse or waterbody. During rain or irrigation, the fields become wet. The water infiltrates into the soil and is stored in its pores. When all the pores are filled with water, the soil is said to be saturated and no more water can be absorbed; when rain or irrigation continues, pools may form on the soil surface. Surface drainage is the removal of excess water from the surface of the land. Shallow ditches, also called open drains, normally accomplish this. The shallow ditches discharge into larger and deeper collector drains. In order to facilitate the flow of excess water toward the drains DEM is very important. The drainage map of Panchkula District is shown in **Figure 13**. The statistics of length of drainages under each order are shown in **Table 5.**

**Table 5 shows the length of Different Stream Order**

| Sr.No. | Stream Order | Length (metres) |
|---|---|---|
| 1 | 1st | 717902.878 |
| 2 | 2nd | 393720.621 |
| 3 | 3rd | 189422.518 |
| 4 | 4th | 82675.81 |
| 5 | 5th | 29904.992 |

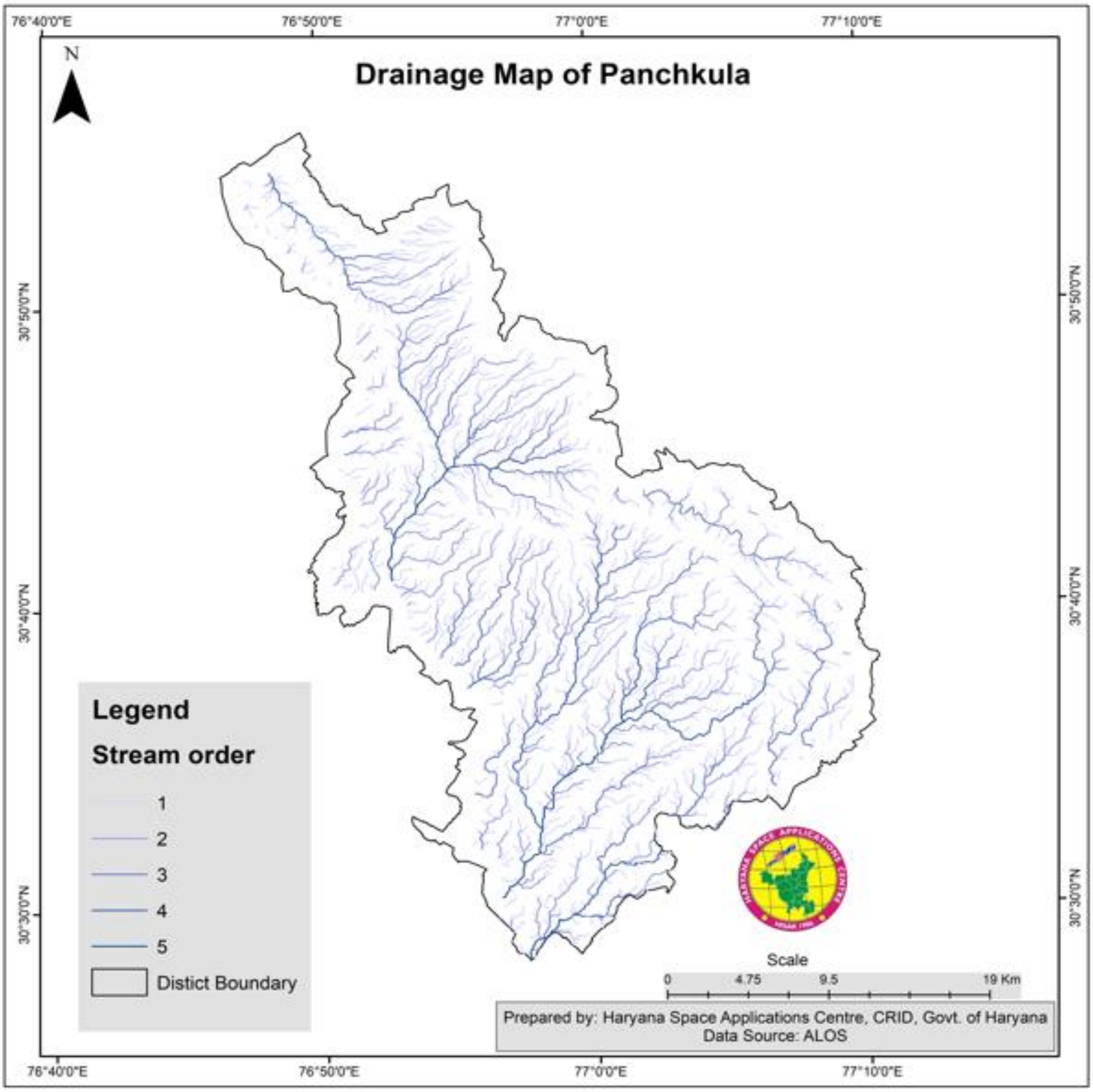



Figure 13 Drainage Map of Panchkula District

## 2.2 Water Harvesting System

Rainwater harvesting essentially means collecting rainwater on the roofs of building and storing it underground for later use. Not only does this recharging arrest groundwater depletion, it also raises the declining water table and can help augment water supply. Rainwater harvesting and artificial recharging are becoming very important issues. It is essential to stop the decline in groundwater levels, arrest seawater ingress, i.e., prevent seawater from moving landward, and conserve surface water run-off during the rainy season. **Table 8** shows the water harvesting System in Panchkula District.

### 2.2.1 Roof Top Harvesting

The roof catchments and stored in reservoirs. Technique through which rain water is captured from 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. In Panchkula district method like rooftop rain water harvesting is very common.

### Table 6 Water Harvesting System in Panchkula District

| Sr.No. | Activity Name | Works Completed | Works Ongoing | Expenditure (in Lakhs) |
|---|---|---|---|---|
| **Water Conservation and Rain Water Harvesting** | | | | |
| 1 | Check Dam | | 0 | |
| 2 | Pond / Tank | | 1 | |
| 3 | Trench | 4 | 0 | |
| 4 | Rooftop Water Harvesting Structure (Public) | 598 | 0 | |
| 5 | Rooftop Water Harvesting Structure (Private) | 633 | | |
| 6 | Other Rainwater Recharge Structures (Open Well Recharge, Sand Filter for open well recharge) | | 0 | |
| 7 | Other Water Conservation Structures (Bench Terracing, Canal) | | 1 | |
| **Total** | | | **2** | **15** |
| **Renovation of Traditional and other Water Bodies / Tanks** | | | | |
| 1 | Traditional Water Bodies Restored | 59 | 11 | |

| | | | | |
|---|---|---|---|---|
| **Total** | | **59** | **11** | **47** |
| **Reuse and Recharge Structures** | | | | |
| 1 | Soak Pit | 1334 | 20 | |
| 2 | Stabilization Pond | 1 | 0 | |
| 3 | Other Reuse / Recharge Structure | 4 | 0 | |
| **Total** | | **1339** | **20** | **1** |
| **Watershed Development** | | | | |
| 1 | Gully Plug | 0 | 0 | |
| 2 | Percolation Tank | | 0 | |
| 3 | Staggered Trenches | 0 | 0 | |
| 4 | Other Watershed Construction Activities | 222 | 12 | |
| **Total** | | | **12** | **195** |
| **Intensive Afforestation** | | | | |
| 1 | Intensive Afforestation-Nurseries | 2 | 0 | |
| 2 | Intensive Afforestation- Plantation | | 0 | |
| **Total** | | | **0** | **11** |
| **Awareness Programs by KVK** | | | | |
| 1 | Farmer's training programs by KVKs on Water Use Efficiency and Appropriate Crops | | | |
| 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 | | | |
| **Total** | | | | |
| **Waste Water Treatment** | | | | |
| 1 | Use of Treated Waste Water | 6372159 | | |
| **Total** | | **6372159** | | 22932464.55 |

### 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 Panchkula**.** District for rain water harvesting is shown in **Table 8** at rural and urban area. The map of water conservation activity in Panchkula at rural and urban level is shown in **Figure 14**.

**Table 7 Water Harvesting activities in rural and urban area**

| **In Rural Area** | | |
|---|---|---|
| **Sr. No** | **Block Name** | **Total No of Activity (no.)** |
| **1** | Morni | 322 |
| **2** | Pinjore | 529 |
| **3** | Raipur Rani | 590 |
| **4** | Barwala | 588 |
| **In Urban Area** | | |
| **1** | Panchkula | 1083 |

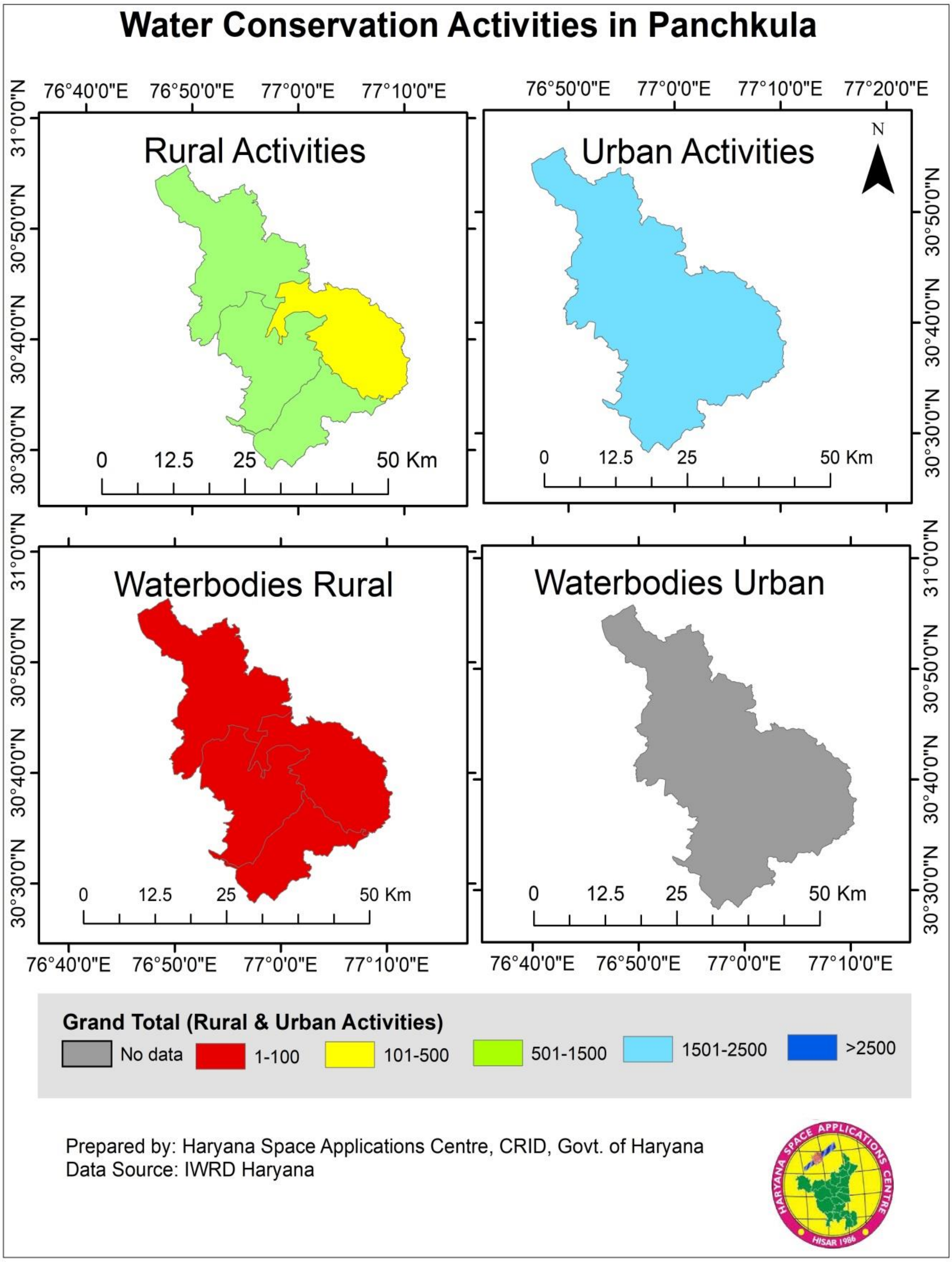



**Figure 14 -Water Conservation Activity in Panchkula**

### 2.2.4 Sewerage Treatment Plant

As sewage enters a plant for treatment, it flows through a screen, which removes large floating objects such as rags and sticks that might clog pipes or damage equipment. After sewage has been screened, it passes into a grit chamber, where cinders, sand, and small stones settle to the bottomThe sewerage treatment plant map is shown in **Figure No 13**. In Panchkula district a total of 4 sewage treatment plant, and 1 Common effluent Treatment Plant are installed sites are installed.

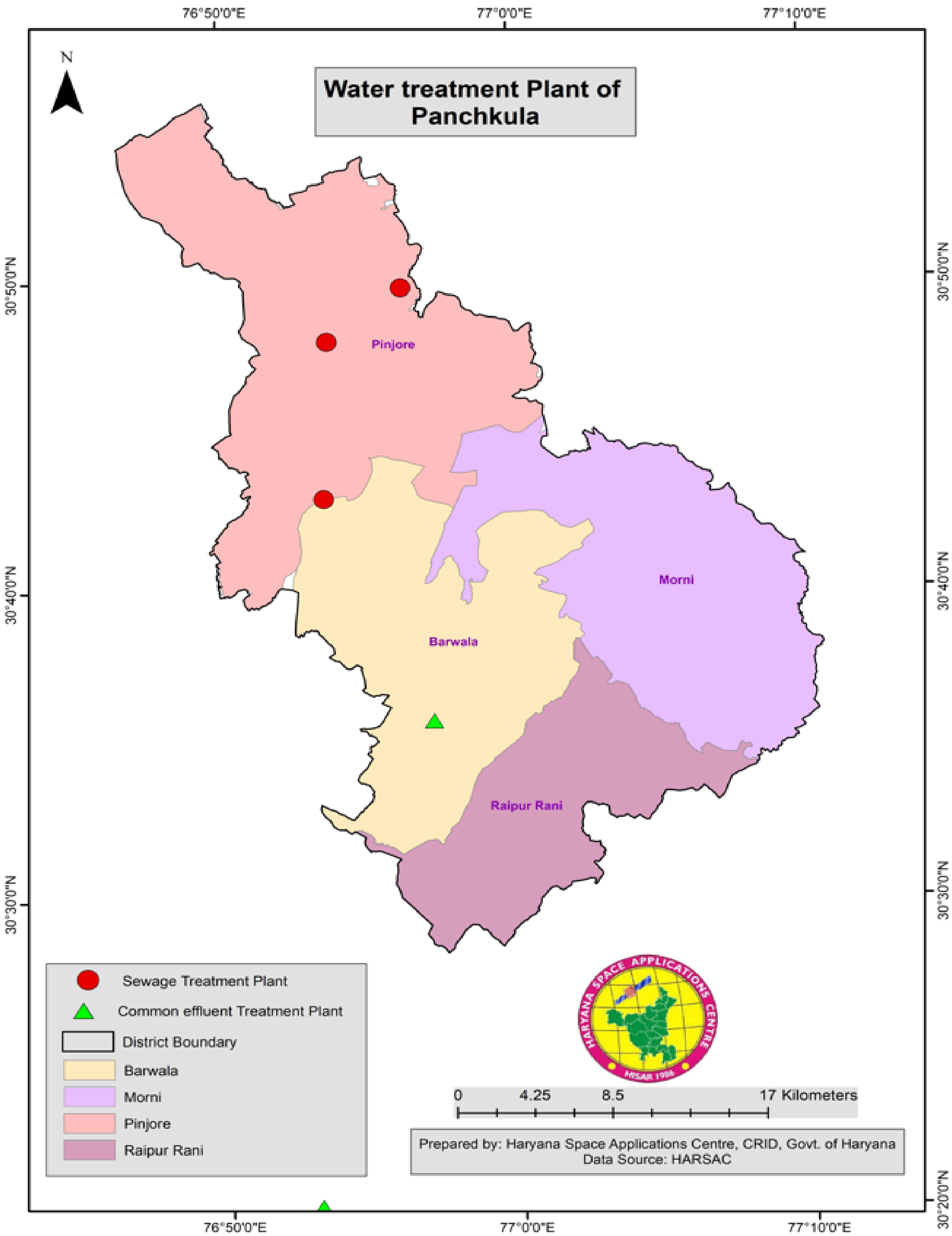



Figure 15 Water Treatment Plant Map of Panchkula District

## 3 Irrigation Profile

Irrigation Cropping pattern in Panchkula is mostly Paddy -wheat; maize-barley and vegetable based under irrigated conditions. The system is mostly uniform in all the blocks. It has also been observed that in some of the blocks, paddy-wheat cropping is also followed. Under irrigated conditions, vegetable based cropping system is highly followed in all the blocks. However, paddy-wheat, maize-wheat was also followed in irrigated areas. **Table 9** shows the area wise, crop wise irrigation status.

The ground water is major sources of irrigation in the district. Net irrigated area is 80Km2 whereas, gross irrigated area 180 Km2. Percentage of gross area irrigated to total cropped area is 91.6%. Area Wise, Crop Wise Irrigation Status The gross irrigated area in the district is 25,559 hectare which is around 72% of 35429 hectare of gross cropped area. The extent of irrigation is 66% during Kharif is 23% while the same in Rabi is 77%. The gross cropped area in Kharif is 15% less than the gross cropped area in Rabi. In Kharif, the gross cropped area is 9731 hectares while during Rabi, the gross cropped area is15,574 hectare. In case of Horticultural and Plantation crops, the irrigated area is to the extent of 54%of the total area covered under this category of crops.

**Table 9 Area Wise, Crop Wise irrigation Status**

| **Block** | **Kharif (Area in ha)** | | | **Rabi (Area in ha)** | | | **Horticulture& Crops (Area in ha)** | | |
|---|---|---|---|---|---|---|---|---|---|
| | Irrigated | Rainfed | Total | Irrigated | Rainfed | Total | Irrigated | Rainfed | Total |
| Barwala | 3916 | 904 | 4820 | 5575 | 1122 | 6697 | 97 | 52 | 149 |
| Morni | 0 | 550 | 550 | 930 | 1084 | 2014 | 0 | 46 | 46 |
| Pinjore | 1300 | 2600 | 3900 | 3419 | 1164 | 4583 | 69 | 62 | 131 |
| Raipur Rani | 4515 | 1005 | 5520 | 5750 | 1231 | 6881 | 88 | 50 | 138 |
| Total | 9713 | 5059 | 14790 | 4601 | 4601 | 20175 | 254 | 210 | 464 |

## 3.1 Gravitational Irrigation

Gravity or flow irrigation is the type of irrigation in which water is available at a higher level as to enable supply to the land by gravity flow. Gravity Irrigation: Gravity or flow irrigation is the type of irrigation in which water is available at a higher level as to enable supply to the land by gravity flow

## 3.2 Lift Irrigation

Lift irrigation is a method of irrigation in which water instead of being transported by natural flow (as in gravity-fed canal systems) requires external energy through animal, fuel based or electric power using pumps or other mechanical means.

## 4 Water Availability

### 4.1 Surface Water Availability

The district is mainly drained by the river Ghaggar and its tributaries. A small patch of northwest part of the district is drained by north westerly flowing Sirsa nadi, as its tributaries east west direction before joining Sirsa nadi, which is tributary of Sutlej River. **Table 8** shows the block wise Water Availability System in Panchkula District.

**Table 8 Water Availability System in Panchkula District**

| **Sr. No.** | **Source** | **Volume of water in Monsoon (in MCM** | **Volume of water in Monsoon (in MCM** | **Total Volume of Water (in MCM)** |
|---|---|---|---|---|
| **Block Barwala** | | | | |
| I | Surface Irrigation | | | |
| (i) | Canal, Major& Medium Irrigation | NIL | NIL | NIL |
| II | Ground Water | 42.59 | 22.70 | 95.29 |
| **Total** | | 42.59 | 22.70 | 95.29 |
| **Block Pinjore** | | | | |
| I | Surface Irrigation | | | |
| (i) | Canal, Major& Medium Irrigation | NIL | NIL | NIL |
| II | Ground Water | 35.90 | 11.15 | 47.05 |
| | Total | **35.90** | **11.15** | **47.05** |
| **Block Pinjore** | | | | |
| I | Surface Irrigation | | | |
| (i) | Canal, Major& Medium Irrigation | NIL | NIL | NIL |
| II | Ground Water | 26.88 | 9.76 | 36.64 |
| **District Total Total** | | 105.37 | 43.61 | 148.98 |

## 4.2 Ground Water Availability

The ground water exploration in the district reveals that clay group of formations dominates over the sand group in the district area. Groundwater in the district occurs in the alluvium underwater table and semi-confined to confined conditions. These aquifers consist of sand, silt, gravel sand kankar associated with clay and form highly potential aquifers. In alluvium, the permeable granular zones comprising fine to medium grained sand and occasionally coarse sand and gravel. Their lateral and as well as vertical extent is extensive. In Kandi belt, which has not been explored fully boulders cobbles and pebbles, constitutes the major aquifer horizon. Siwalik Hills occupy marginal areas in the north eastern parts of the district constitute a low potential zone.

**Occurrence of groundwater**

The ground water occurs in pore-spaces of alluvial formation including Kandi belt stretching range Siwalik foothills. In alluvium, sands, silts, kankar and gravels form potential aquifer zones in the district. The Kandi belt yet to be explored constitute of boulders, pebbles and cobbles forming major aquifer horizon.

**Nature and depth of ground water aquifers**

In Kandi areas, the shallow aquifers are isolated lenses embedded in clay beds whereas aquifers in alluvial areas occur in regional scale and have pinching and swelling disposition and are quite extensive in nature. These aquifers generally consist sands (fine to coarse grained) and gravel sand are often intercepted by clay and kankar horizons. These aquifers are under unconfined to semi-confined conditions and support a large no. of shallow tube wells within the depth of 50monly.The discharge of these tube wells varies between 100lpm and 500lpm for moderate draw down values. Underground water exploration programme fourteen exploratory wells were drilled in the district. On average 4-6 No Of granular zones have been deciphered in the depth range down to 355m bgl. Exploratory wells were drilled in depth range of 132 and 355 mbgl, yield range between 205 to 3000 lpm.

**Depth to water level**

The depth to water level during pre-monsoon period in the district ranges between 8.11 mbgl and 29.44 mbgl. The Depth to water level during post-monsoon period in the district ranges between 6.78 mbgl and 29.00 mbgl. However, in major part of district water level 30 ranges between 10.0mbgl and 20.0m bgl. During last ten years, majority of observation points in the district have shown declining trends ranging from 0.00013 m/yr. to 0.389m/yr. Groundwater Resource Estimation Rainfall is the major source of recharge to the groundwater body, apart from the influent see page from the rivers, irrigated fields and inflow from upland areas. The discharge from ground water, mainly takes place from wells and tube wells; effluent see pages of ground water in the form of springs and base flow in streams. Ground water resources and irrigation potential for block wise area of the district have been computed as per the GEC-97 methodology and the resources for the year 2011 are presented below. **Table 9** shows the Status of ground water availability and development as on 31March 2011.The stage of ground water development ranges between 94 % (block-Raipur Rani) to 57% (block-Pinjore). All the blocks are in 'Critical" category. The total net replenishable ground water resource in the district is 139.18 mcm. The net ground water draft is 112.54 mcm. The stage of ground water development in the district is 81%.

**Table 9 Status of ground water availability and development as on 31 March 2011**

| **Block** | **Net annual ground water availability (ha m)** | **Existing gross ground water draft or irrigation (ha m)** | **Existing gross ground water draft for all uses(ha m)** | **Provision for domestic & industrial requirements supply to 2025(ha m)** | **Net annual ground water availability for future irrigation development** | **Stage of ground water development** | **Category of the block** |
|---|---|---|---|---|---|---|---|
| Barwala | 6203 | 4987 | 5572 | 976 | 240 | 90 | Critical |
| Pinjore | 4234 | 963 | 2403 | 2376 | 895 | 57 | Critical |
| RaipurRani | 3481 | 2514 | 3279 | 967 | 0 | 94 | Critical |
| Total | 13918 | 8464 | 11254 | 4319 | 1135 | 81 | 997 |

This suggests, that groundwater recharge is required in the districts.

Ground Water Quality Chemical quality of ground water from shallow as well as deep aquifers in the district indicates that ground water is generally alkaline in nature and suitable for both domestic and irrigation use. All the parameters analysed are well within the permissible limits of safe drinking water, as per Bureau of Indian Standard (BIS). The range of chemical parameters, as per samples collected from hydrograph network stations of CGWB in the district are summarized below **Table 10**. Quality of ground water in shallow aquifer is thus good for domestic and irrigation purpose in the district except the groundwater around the village Barwala has exceptionally high concentration of Iron (10.84mg/L). Similarly, the trace element arsenic is found below the permissible limit in the entire district. Thus, the ground water in these areas is unfit for human consumption.

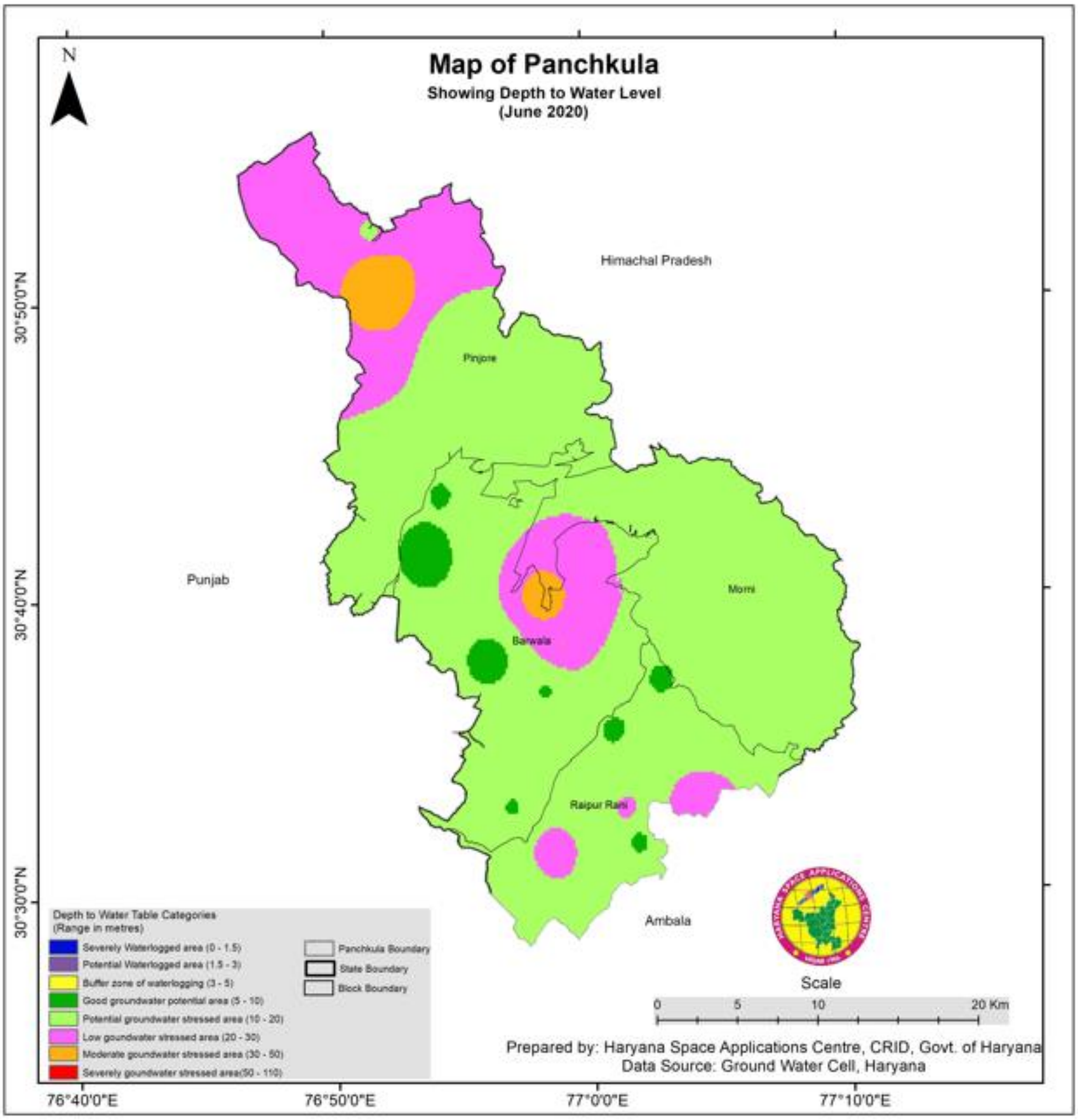



**Figure 16 Ground water Availability Map of Panchkula District**

### 4.2.1 Ground Water Quality

Chemical quality of ground water from shallow as well as deep aquifers in the district indicates that ground water is generally alkaline in nature and suitable for both domestic and irrigation use. All the parameters analysed are well within the permissible limits of safe drinking water, as per Bureau of Indian Standard (BIS). The range of chemical parameters, as per samples collected from hydrograph network stations of CGWB in the district are summarized below. Quality of ground water in shallow aquifer is thus good for domestic and irrigation purpose in the district except the groundwater around the village Barwala has exceptionally high concentration of Iron (10.84mg/L). Similarly, the trace element arsenic is found below the permissible limit in the entire district. Thus, the ground water in these areas is unfit for human consumption. **Table 11** shows the block wise water quality index value in Panchkula district.

**Table 10 Chemical quality of ground water in Panchkula District**

| Range | pH | EC uS/cm | CO3 | HCO3 | CL | NO3 | F | Ca | Mg | Na | K | THasCaCO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Min | 7.9 | 220 | 0 | 88 | 7 | O | 0.12 | 11415 | 13840 | 221% | 1 | 81 |
| Max | 8.47 | 1030 | 25 | 228 | 175 | 98 | 0.31 | 7868 | 8395 | 207% | 4 | 345 |

**Table 11 block wise water quality index value in Panchkula district**

| Block Name | Average Water Quality Index Value |
|---|---|
| Morni | 57.35206 |
| Pinjore | 44.51959 |
| Raipur Rani | 56.74827 |
| Barwala | 51.85143 |

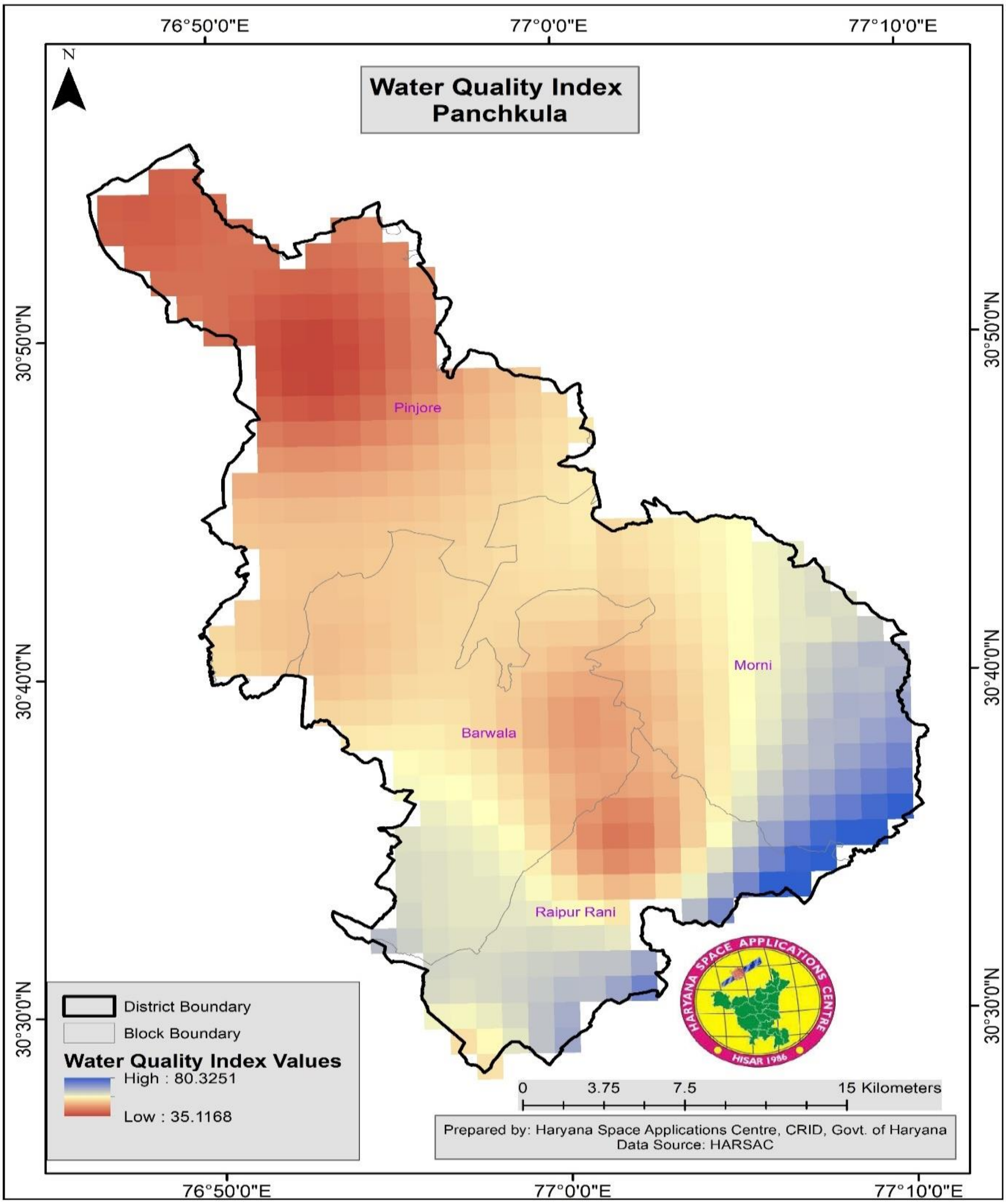


**Figure 17 Water quality index of Panchkula District**

## 5 Aquifer System

In Kandi areas, the shallow aquifers are isolated lenses embedded in clay beds whereas aquifers in alluvial areas occur in regional scale and have pinching and swelling disposition and are quite extensive in nature. These aquifers generally consist sands (fine to coarse grained) and gravel sand are often intercepted by clay and kankar horizons. These aquifers are under unconfined to semi-confined conditions and support a large no. of shallow tube wells within the depth of 50comonly. **Figure 19** shows the water seasonal level fluctuations map. The discharge of these tube wells varies between 100lpm and 500lpm for moderate draw down values. Underground water exploration programme fourteen exploratory wells were drilled in the district. On average 4-6 No Of granular zones have been deciphered in the depth range down to 355m bgl. **Figure 18** shows the Depth to water level in Panchkula district. Exploratory wells were drilled in depth range of 132 and 355 mbgl, yield range between 205 to 3000 lpm. for Draw down up to of 3.2 and 21.9m and Transmissivity of aquifers range between 2493 and 4928 m2 /day. Storativity of formation is 1.3*10-2.

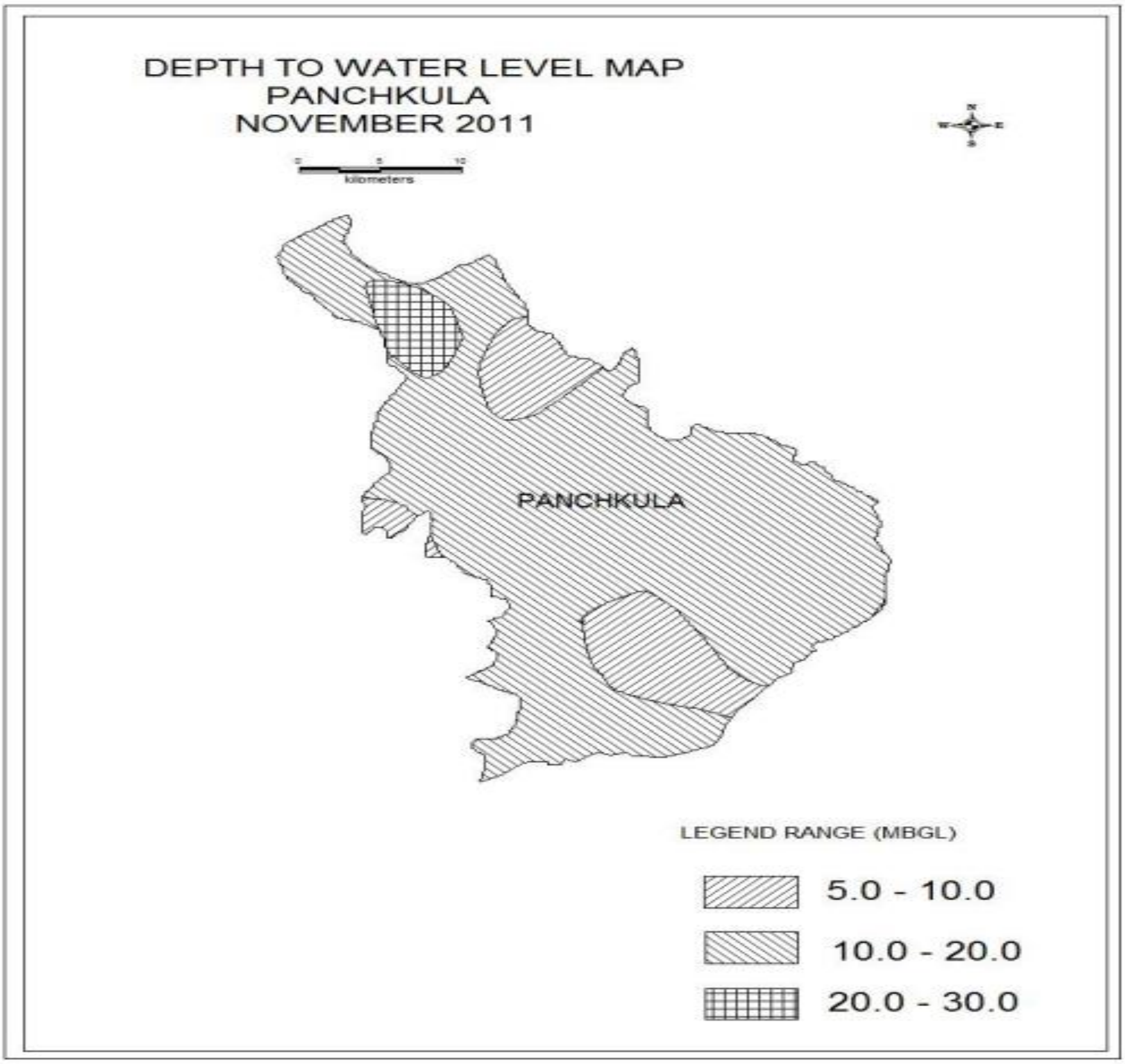



Figure 18 Depth to water level Map of Panchkula

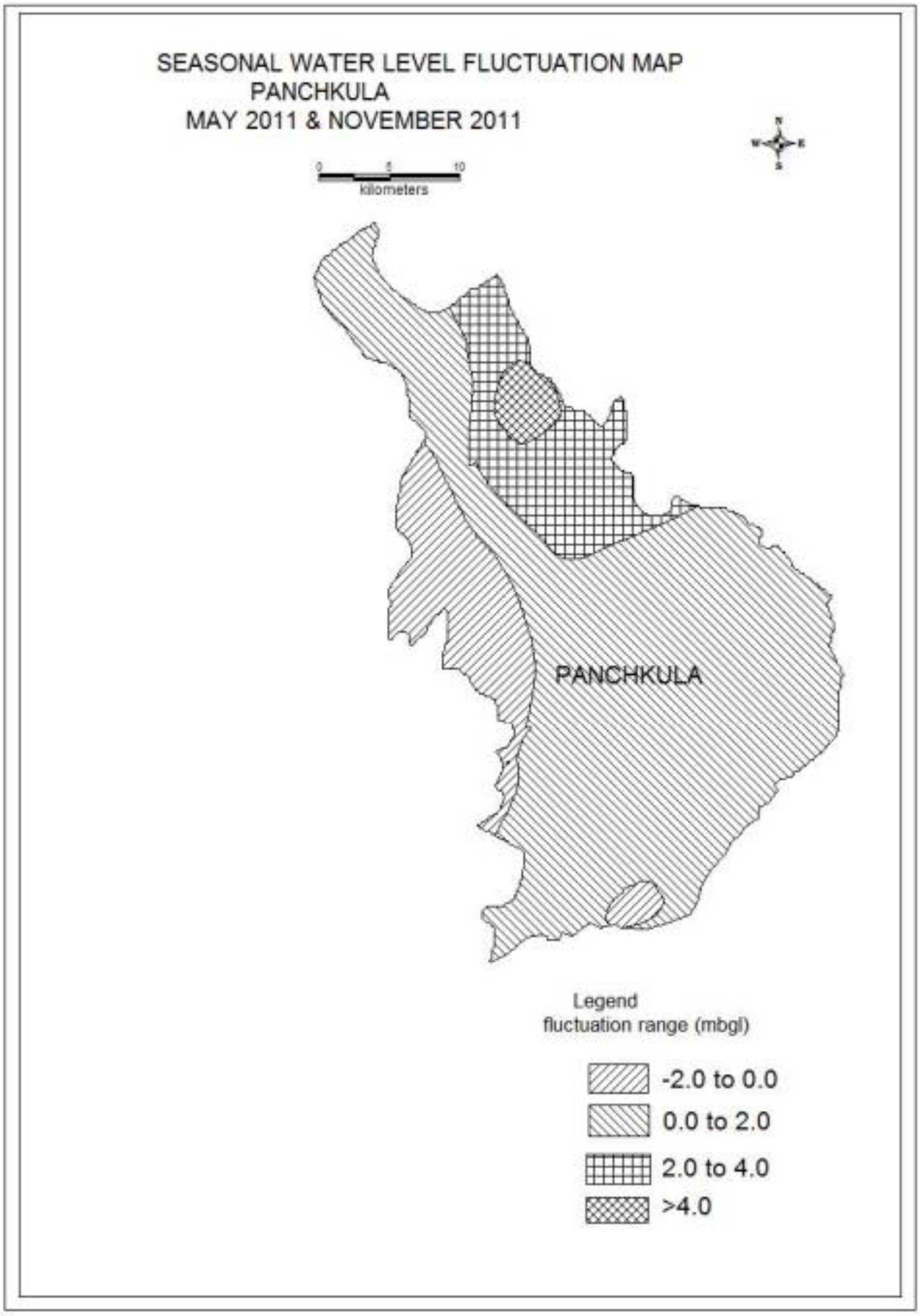



Figure 19 Water Seasonal water level Fluctuation Map of Panchkula

## Ground Water

The block wise ground water resource potential in the district has been assessed in **Table 12**. The stage of ground water development ranges between 85% (block-Raipur Rani) to 103% (block Barwala). The total replenishable ground water resource in the district is 138.76 mcm. The net ground water draft is 118.62 mcm. The stage of ground water development in the district is 85%.

**Table 12 Ground Water Resource and Development Potential of Panchkula District, Haryana as on 31st March, 2011 in ha m**

| Block | Net annual ground water availability(ham) | Existing gross ground water draft or irrigation (ham) | Existing gross ground water draft for all uses(ham) | Provision for domestic & industrial requirement supply to 2025(ham) | Net annual ground water availability for future irrigation development | Stage of ground water development (%) | Category of the block |
|---|---|---|---|---|---|---|---|
| Barwala | 5823 | 5430 | 6015 | 585 | -192 | 103 | OVER EXPLOITED |
| Pinjore | 3950 | 905 | 2345 | 2442 | 603 | 59 | SAFE |
| RaipurRani | 4103 | 2737 | 3502 | 1352 | 14 | 85 | SEMI-CRITICAL |
| Total | 13876 | 9072 | 11862 | 4379 | 425 | 85 | |

The ground water in the district is alkaline in nature with low to medium salinity. The chemical quality data from the shallow and deep aquifers indicate that all major cations (Ca, Mg, Na, K) and anions (CO3, HCO3, Cl, SO4) are within the permissible limits set by BIS, 1991. Electrical conductivity is below 650 µs/cm in almost the entire district. Ground water around village Kakar Majra, in the southern part of the district, has slightly higher EC of 1030 µs/cm. ground water in the district has no particular cation as dominant, while HCO3 is the dominant anion in 56% of the samples, hence, the **Table 13** shows the ground water can be described as of mixed character.

**Table 13 Ground water can be described as of mixed character.**

| Constituents | Concentration | |
|---|---|---|
| | **Minimum** | **Maximum** |
| pH | 7.9 | 8.47 |
| EC Micromhos/cm at 25°**C** | 220 | 1030 |
| CO3 (mg/l) | 0 | 25 |
| HCO3(mg/l) | 88 | 288 |
| CI (mg/l) | 7 | 175 |
| SO4(mg/l) | 0 | 130 |

| | | |
|---|---|---|
| NO3(mg/l) | 0 | 98 |
| F(mg/l) | 0.12 | 0.31 |
| Ca(mg/l) | 12 | 61 |
| Mg(mg/l) | 2 | 62 |
| Na(mg/l) | 24 | 102 |
| K(mg/l) | 1 | 4 |
| TH (Total Hardness as CaCO3) | 81 | 345 |

**Type Of Water**

The shallow groundwater is of mixed type in the district.

**Suitability Of Water Domestic**

All the physical and chemical parameters are within the permissible limit prescribed by BIS. Hence, the ground water in the area is suitable for drinking purposes.

**Irrigation**

Suitability of groundwater for irrigation purpose is calculated by SAR and RSC values which are below 10 and 2.0 respectively in the entire district. As per USSL diagram, most of well waters fall in C2S1 class. Only two well waters fall in C1S1 and C3S1 class. These waters will cause neither salinity nor sodium hazards when used for customary irrigation. The minor constituents such as iron, nitrate and fluoride, which are essential for plant and animal growth, are found below the permissible limit in almost the entire district. The ground water around the village Barwala has exceptionally high concentration of Iron (10.84mg/L). Similarly, the trace element arsenic is found below the permissible limit in the entire district. Thus, the ground water in these areas is unfit for human consumption.

**Status of Ground Water Development**

The Ghaggar is the Perennial River and descending from Himalayas in Himachal Pradesh and carries a small quantity of water in Panchkula district, only 10 Km2 area is irrigated by the canal system, gross area irrigated in the district is 180 $Km^2$, whereas net area irrigated is 80 $Km^2$. Percentage of gross area irrigated to total cropped area is 38.3%. Nearly about 70 $Km^2$ of area is irrigated through 4502 shallow tube wells and pump sets, besides this there are many deep public tube wells. The discharge of shallow tube wells varies between 200 lpm and 480 lpm, whereas the discharge of deep tube wells varies between 2000 lpm and 3500 lpm. The depth of shallow tube wells ranges between 40-80m, whereas deep tube wells range up to 270 m depth. Of the shallow tube wells 2070 are diesel engine operated and remaining 2432 are run by electric motors. The drinking water supply is mainly ground water based in the district, besides piped water supply, the public health department as well as public hand pump as the most convenient water source to meet water shortage in villages and towns.

Panchkula district has registered of 50.90% increase in population during last one decade mainly because urbanization around Panchkula town which has put a lot of stress on water resources.

# 6 Water Requirement/ Demand

## 6.1 Water Supply and Gap

Data of Census 2011 and 2001 has been considered to arrive at the growth rate of population of the district. As per Census 2011, the district has shown an annual growth rate of 1.983%. Current population (in 2016) has been calculated by assuming a growth rate of 9.915% (1.983% × 5Years) over a period of four years (from 2012-2016). Projected population has been calculated in similar way by assuming a growth rate of 11.898% (1.983% × 6 Years) over the period of Six years (from 2016-2022). It has been assumed that per capita daily water requirement of people residing in urban areas of the district is 150 litters and for population in rural areas, the daily per capita daily water requirement is 70 litters. Using the same norms, **Table 14** shows the block-wise domestic water supply demand has been worked out and is given in below

### Table 14 block-wise domestic water supply demand

| Block | 2011CP | Population in 2016 | Present Water Requirement (2016) | Projected population in 2022 | Annual Water Requirement in 2022 |
|---|---|---|---|---|---|
| Barwala R | 72373 | 79839 | 2.040 | 89822 | 2.295 |
| Morni R | 21330 | 23530 | 0.601 | 26473 | 0.676 |
| Pinjore and Kalka R | 104275 | 115032 | 2.939 | 129415 | 3.307 |
| RaipurRani R | 50085 | 55252 | 1.412 | 62160 | 1.588 |
| Barwala U | 4934 | 5443 | 0.298 | 6124 | 0.335 |
| Morni U | 0 | 0 | 0.000 | 0 | 0.000 |
| Pinjore and Kalka U | 87913 | 96982 | 5.310 | 109109 | 5.974 |
| Raipur Rani U | 9028 | 9959 | 0.545 | 11205 | 0.613 |
| Panchkula urban | 211355 | 233159 | 12.765 | 262312 | 14.362 |
| Total | 561293 | 619197 | 25.91 | 696619 | 29.15 |

**R-Rural U-Urban**

It can be inferred from the table that considering the growth rate of population of the district, the quantity of water required in 2020 for domestic consumption shall be Population in 34 approximately 29.15 MCM which is 3.24 MCM more than the present water requirements

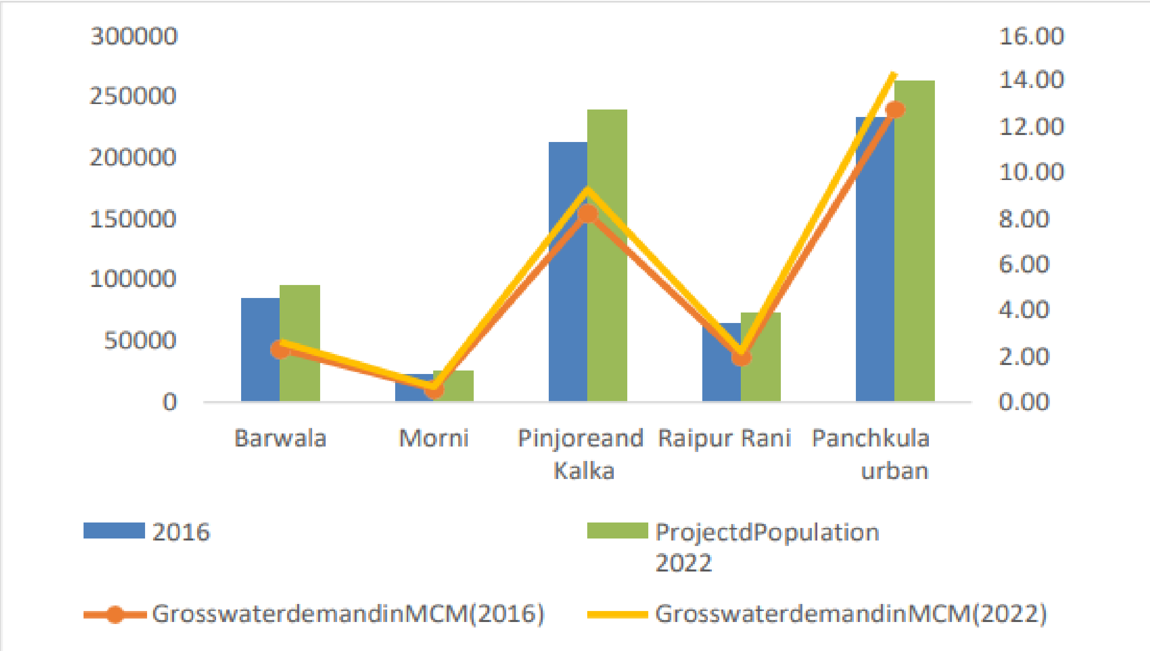



**Figure 20 Present and Projected population and water requirement**

**Figure 20** above depicts the population and water requirement of blocks comprising of both rural and urban areas.

**Crop Water Requirement**

Crop water requirement for the blocks and district have been calculated based upon the cropping pattern followed in the various blocks of the district. Cropping pattern under irrigated and rain fed system is different in the district. Maize-barley and vegetable based cropping system is followed under unirrigated conditions in all the blocks. Under irrigated conditions, in almost all the blocks vegetable based cropping system is followed. However, under irrigated system, paddy-wheat, maize-wheat based cropping system are also being followed. Cereal crops occupy major portion in all the blocks and in district as a whole. Maize, wheat and paddy are the most commonly cultivated crops. In some blocks of the district, Barley is also being cultivated. Among pulses, grams are the important crops while mustard is the major oilseed grown in the district.

**Table 15 Crop Water Requirement in Million Cubic Meter**

| Blocks | Area sown Potential (Ha) | Irrigated to be created | Crop Water area (ha) | Water Demand Required | Existing potential | Water |
|---|---|---|---|---|---|---|
| **Barwala** | 11518 | 9493.00 | 56.15 | 5.93 | 50.22 | 5.93 |
| **Morni** | 2493 | 930.00 | 8.19 | 4.86 | 3.33 | 4.86 |
| **Pinjore** | 8443 | 4719.00 | 34.61 | 11.74 | 22.87 | 11.74 |
| **Raipur Rani** | 19431 | 9765.00 | 85.82 | 33.36 | 52.46 | 33.36 |
| **Total** | **41885** | **24907** | **184.77** | **55.89** | **128.88** | **55.89** |

It can be concluded from the **Table 15** that in all the 4 blocks, a total water potential of 55.89 MCM is to be created in the district to fulfil the requirement of crops.

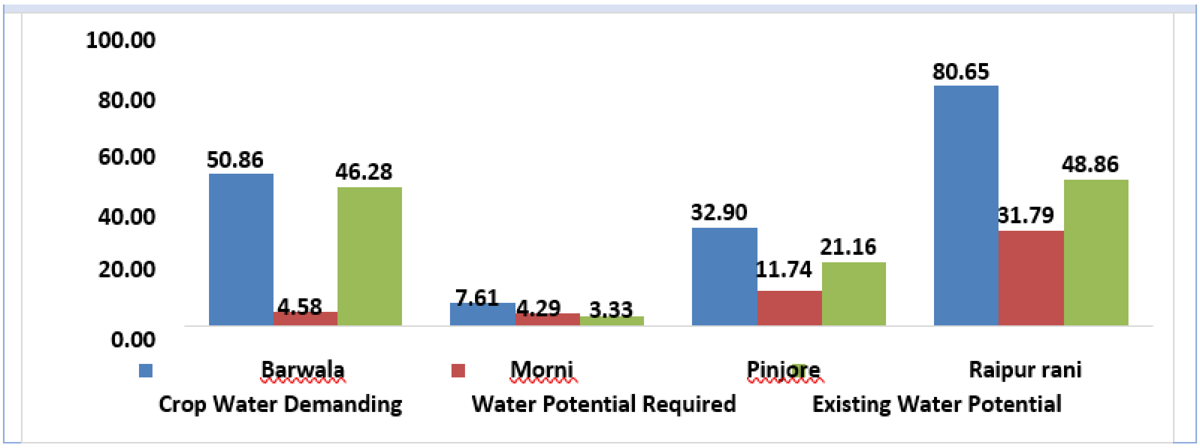



**Figure 21 Water potential required block wise**

**Figure 21** shows the water potential required blockwise, and **Table 16** shows the crop wise water requirement has been taken based upon discussion with Agronomists of Agriculture University as per practices prevailing in the State.

**Table 16 The crop wise water requirement has been taken based upon discussion with Agronomists of Agriculture University as per practices prevailing in the district**

| Crop | Depth of each irrigation | No. of watering | Total water requirement |
|---|---|---|---|
| Paddy | 75 | 10 | 750 |
| Maize | 60 | 5 | 300 |
| Bajra | 75 | 1 | 75 |
| Cotton | 60 | 5 | 300 |
| Jowar | 60 | 5 | 300 |
| Wheat | 60 | 6 | 360 |
| Gram | 60 | 2 | 120 |
| Rabi Oil seeds | 75 | 2 | 150 |
| Sugarcane | 75 | 10 | 750 |

Livestock Growth in livestock of the district has been derived from last two livestock census (2007 &2012). The **Table 17** below represents the animal wise water requirement as well as total water requirement of the district for livestock. Livestock population in 2022 has been projected taking into account the growth rate. Where growth rate is negative 2016 (E) population has been considered in the year 2022 also. **Table 18** Shows the block wise water estimation for livestock

**Table 17 Livestock Water Requirement**

| Animal | | | Population | | | Water requirement | |
|---|---|---|---|---|---|---|---|
| | 2007 | 2012 | YoYGrowth (2007 | 2,016(E) | 2022(P) | 2,016(E) | 2022(P) |
| | | | to 2012) | | | | |
| Poultry | 5496470 | 18838 | -20% | 18838 | 18838 | 0.0014 | 0.0014 |
| Pigs | 957 | 3036 | 43% | 8312 | 13,589 | 0.18 | 0.3 |
| Goats | 8858 | 6204 | -6% | 6204 | 6204 | 0.03 | 0.03 |
| Sheep's | 2363 | 4417 | 17% | 7489 | 10,560 | 0.04 | 0.06 |
| Hybrid Cow | 27933 | 21726 | -4% | 21726 | 21726 | 0.56 | 0.56 |
| Hybrid Buffalo | 68492 | 57719 | -3% | 57719 | 57719 | 2.11 | 2.11 |
| Total Water requirement | | | | | | 2.91 | 3.05 |
| In cases where growth rate is negative, the number of animals in different years has been kept constant. | | | | | | | |

**Table 18 Livestock Water Requirement in demand**

| Block | Total number of livestock (2015) | Present water demand (MCM) | Water Demand in2020(MCM) | Existing water potential (MCM)* | Water potential to be created (MCM) | Water potential to be created (Cubic Meter) |
|---|---|---|---|---|---|---|
| Barwala | 42252 | 0.66 | 0.69 | 0.66 | 0.03 | 33605.46 |
| Morni | 8362 | 0.23 | 0.23 | 0.23 | 0 | 1294.06 |
| Pinjore | 32028 | 0.97 | 1.03 | 0.97 | 0.06 | 64162.72 |
| Raipur Rani | 37644 | 1.06 | 1.09 | 1.06 | 0.03 | 33306.61 |
| Total | 120287 | 2.91 | 3.05 | 2.91 | 0.13 | 132368.9 |
| * It is assumed that present water requirement of animal is met from existing water usage and hence existing potential is equal to existing demand. | | | | | | |

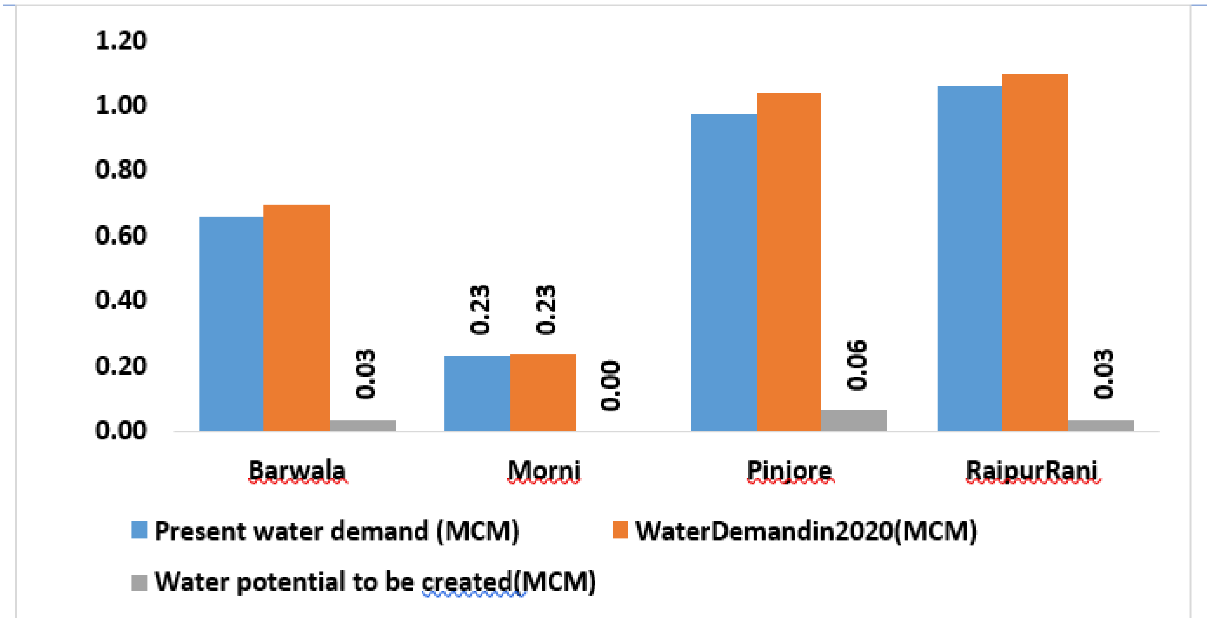



Figure 22Water demand for livestock (in MCM)

Based on the projected water requirement for livestock in 2020, the gap has been assessed. The total potential which has to be created for livestock in 2020 is 3.05 MCM. **Figure 23** shows the water demand for livestock.

For projecting the water demand of livestock, growth rate as deduced from census has-been considered during calculations. In case of livestock with decreasing growth rate of population, the present population has been considered. It is assumed that present water requirement of livestock is met from existing water usage and hence existing potential is equal to existing demand.

**Industrial Water Requirement**

Small & Medium Enterprises have been setup in the district as on 31/12/2014.

**Table 19 Industries in panchkula**

| Sr. No. | Particulars | Numbers |
|---|---|---|
| 1 | Registered (MSEs)Industrial Units | 1862 |
| 2 | Registered Medium and Large-Scale Units | 10 |
| 3 | No. of Industrial area | 5 |
| | Total | 2430 |

The major groups of industries which saw boom after implementation of special package of incentives to the state which has been partially withdrawn now are the pharmaceutical group and corrugated box enterprises. After the implementation of Special Industrial Package of incentives, many large & medium scale industries have also come up in the district. As on 31/12/2014 total number of large & medium scale units are functioning in the district is 7. **Table 19** shows the number of Industries in Panchkula

While assessing the ground water requirement of the district by Central Ground Water Board and Ground Water Cell they have already taken industrial water requirement for next 25 years in the ground water report therefore to avoid double counting Industrial demand has been taken as nil. **Table 20** shows the Industrial Water Demand.

**Table 20 Industrial Water Demand in (MCM)**

| Block | Current Water Demand | Water Demanding 2022 | Existing Water Potential | Water Potential to be created |
|---|---|---|---|---|
| Barwala | NIL | NIL | NIL | NIL |
| Morni | NIL | NIL | NIL | NIL |
| Pinjore | NIL | NIL | NIL | NIL |
| RaipurRani | NIL | NIL | NIL | NIL |
| Total | NIL | NIL | NIL | NIL |

**Water Demand for Power Generation**

The district is not having any thermal or nuclear power plant where water may be consumed. Therefore, demand of water for power generation has been taken as nil.

**Total Water Demand for Power Generation**

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 4.8andthe projected water demand. **Table 21** shows the present water demand of the district for various sectors in 2016. **Figure 24** shows the water requirement of various sectors in 2016.

Table 21  Present Water Demand of the district for various sectors (2016)

| **Blocks** | **Demand from components (MCM)** | | | | | **Total** |
|---|---|---|---|---|---|---|
| | **Domestic** | **Crop** | **Livestock** | **Industrial** | **Power Generation** | |
| | | | | ***** | **on** | |
| **Barwala** | 2.34 | 50.85 | 0.66 | NIL | NIL | 53.85 |
| **Morni** | 0.6 | 7.61 | 0.23 | NIL | NIL | 8.45 |
| **Pinjore** | 8.25 | 32.9 | 0.97 | NIL | NIL | 42.12 |
| **RaipurRani** | 1.96 | 80.65 | 1.06 | NIL | NIL | 83.66 |
| **Panchkula urban** | 13.06 | NA | NA | NIL | NIL | 13.06 |
| **Total** | **26.21** | **172.02** | **2.91** | NIL | NIL | **201.14** |

***Already considered in ground water assessment**

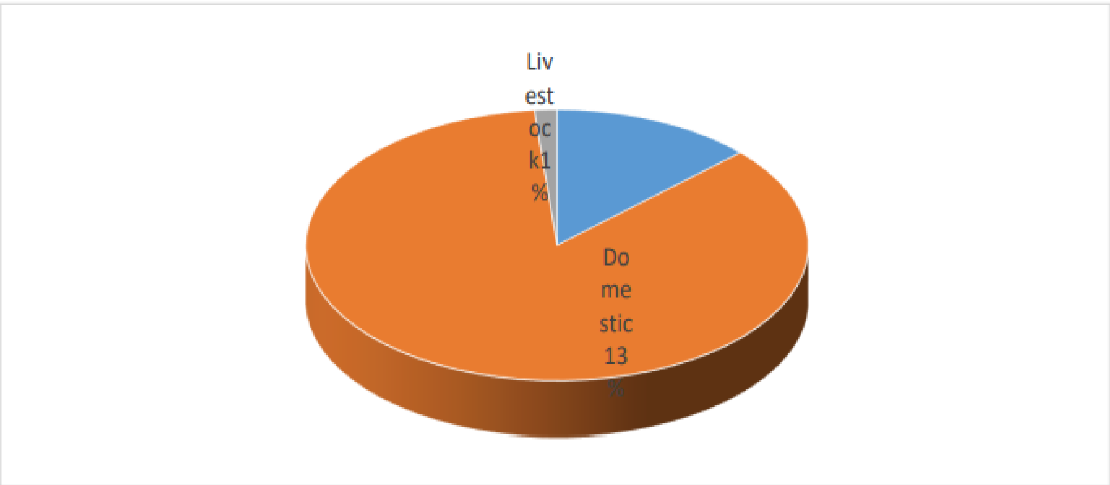



Figure 23 Water requirement of various sectors in 2016

The present water demand of the district has been assessed at 201.14MCM annually, with Raipur-Rani the block with maximum water requirement (83.66 MCM) and Barwala blocks stand at 2nd position.

**Table 22 Total Water Demand of the district for various sectors (Projected for 2022)**

| **Blocks Demand from components (MCM) Total** | | | | | | |
|---|---|---|---|---|---|---|
| | **Domestic** | **Crop** | **Livestock** | **Industrial*** | **Power Generation** | **Total** |
| **Barwala** | 2.53 | 50.86 | 0.69 | NIL | 0 | 54.08 |
| **Morni** | 0.65 | 7.61 | 0.23 | NIL | 0 | 8.5 |
| **Pinjore** | 8.92 | 32.9 | 1.03 | NIL | 0 | 42.86 |
| **RaipurRani** | 2.12 | 80.65 | 1.09 | NIL | 0 | 83.85 |
| **Panchkula urban** | 14.13 | NA | NA | NIL | 0 | 14.13 |
| **Total** | 28.35 | 172.02 | 3.05 | NIL | 0 | 203.41 |

***Already considered in ground water assessment**

During 2022, the **Table 22** shows the total water requirement of the district has been assessed at 203.41 MCM. The **Figure 26** projected requirement of the blocks is almost in the similar proportion to present requirement.

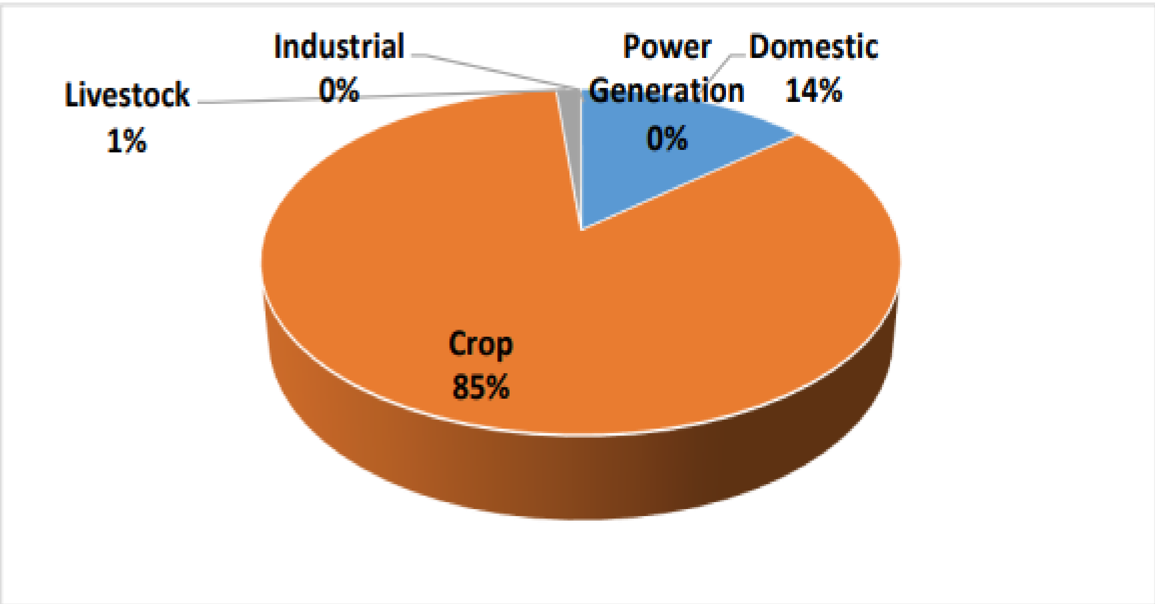



**Figure 24 Projected water requirement for various sectors**

## 6.2 Water Budget

### Table 23 water budget (volume in MCM)

| Name of Blocks | Existing water availability /Usage (MCM) | | Total (MCM) | Water Demand (MCM) | | Water Gap (MCM) | |
|---|---|---|---|---|---|---|---|
| | Surface Water | Ground Water | | Present | Projected (2022) | Present | Projected (2022) |
| Barwala | NIL | 55.72 | 55.72 | 53.85 | 54.08 | 1.87 | 1.64 |
| Morni | NIL | 0 | 0 | 8.45 | 8.5 | -8.45 | -8.5 |
| Pinjore | NIL | 24.03 | 24.03 | 42.12 | 42.86 | -18.09 | -18.83 |
| Raipur Rani | NIL | 32.79 | 32.79 | 96.72 | 97.98 | -63.93 | -65.19 |
| Total | NIL | 112.54 | 112.54 | 201.14 | 203.41 | -88.6 | -90.87 |

**The Table 23 the total water gap for the district has been estimated at 90.87 MCM during 2022. Figure 25 shows the demand vs water avaibility in Panchkula district.**

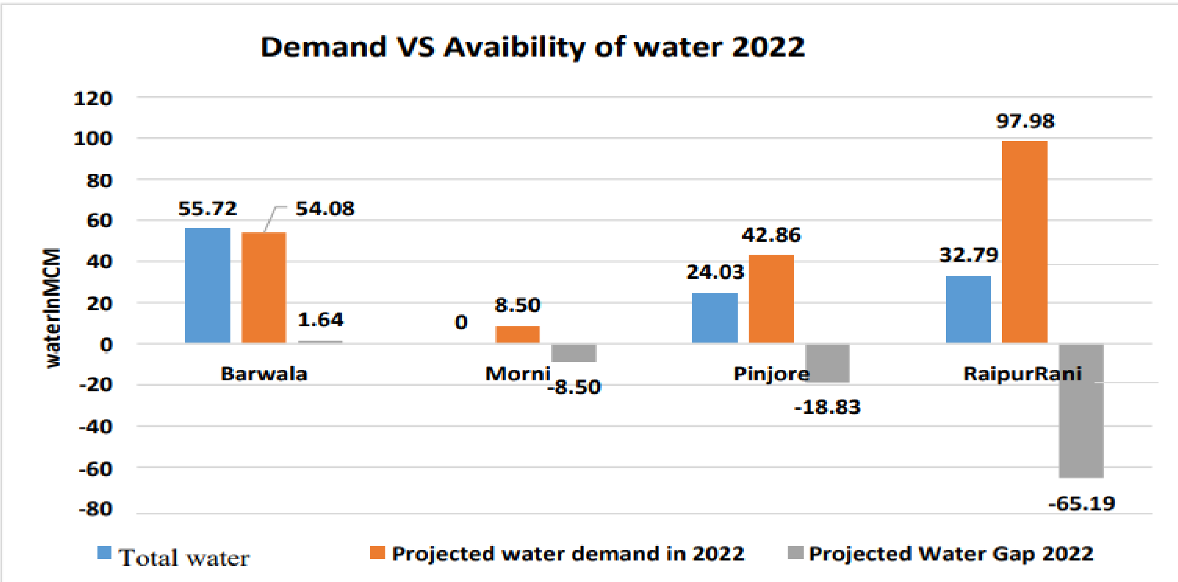



Figure 25 demand vs water availability in Panchkula District

## 7 Strategies for Water Conservation

**MEASURES OF WATER CONSERVATION**

Water conservation measures in industries should include: (i) review of alternate production processes and technologies from water consumption point of view; (ii) ensuring sound plant maintenance practices and good housekeeping, minimizing spills and leaks; and (iii) optimization of treatment to achieve maximum recycling. Another established technique for maximum water recovery is the water pinch analysis technique. However, this technique only focuses on maximizing freshwater and wastewater reduction via reuse and regeneration.

**WHAT WE CAN DO TO CONSERVE WATER**

Use only as much water as you require. Close the taps well after use. While brushing or other use, do not leave the tap running, and open it only when you require it. See that there are no leaking taps.

➢ Use a washing machine that does not consume too much water. Do not leave the taps running while washing dishes and clothes.

➢ Install small showerheads to reduce the flow of the water. Water in which the vegetables & fruits have been washed - use to water the flowers & plants.

➢ At the end of the day if you have water left in your water bottle do not throw it away, pour it over some plants.

➢ Re-use water as much as possible

➢ Change in attitude & habits for water conservation ➢ Every drop counts

**IMPROVE WATER MANAGEMENT**

➢ The close link between forests and water, and the traditional relationship between agriculture and water, need to be recognized and protected to ensure sustained productivity.

➢ National water management policies should take account of the impact of trade in water-intensive goods on water availability and ecosystems integrity.
water scarce regions, people should grow crops with low water requirements, or of high value compared to the water used. Options for improving the water balance by importing water intensive goods from water-rich regions should be explored, where appropriate and cost-effective.

➢ The potential of rainwater harvesting for augmenting rural and urban water supply is increasingly becoming recognized. This alternative should be further explored and utilized.

➢ Proper water pricing must be an integral part of water policies. However, care must be taken to ensure that the poor and socially disadvantaged are not denied access. Moreover, there must be adequate monitoring and control of market mechanisms.

**PUBLIC EDUCATION AND AWARENESS**

➢ Public awareness and education on the importance of protection of the coastal and ocean environment helps to meet social and economic needs and aspirations of the country in the long run.

➢ Awareness campaigns on existing regulations for management of coastal areas need to be conducted. Education and communication material on the need for conservation and protection of rare and endangered species need to be developed.

➢ Research findings on marine resources, their development and management have to be demystified. The educational and communication material targeted at the public has to be developed in local languages.

➢ Opportunities for interactions between communities, policy makers, regulating agencies, NGOs, scientists, etc. need to be increased.

➢ Appropriate strategies and decision-making tools that would enhance the capabilities of professionals, Government, and non-government organizations to take up local and community level action programmes need to be developed.

**Suggestions**

For successful implementation of District Water Conservation plan it is suggested that:

All the stake holders should convene meeting of Panchayat Samities and then finalize the village plan and prepare DPR.

• There should not be duplicity of project.

• The Department should supplement each other's or that the maximum irrigation efficiency is achieved.

• Agriculture and Horticulture Department should take micro irrigation projects in the command of minor irrigation projects completed or likely to be completed in near future.

• All the irrigation projects should have a component of water conveyance so that the each drop of water is judiciously utilized.

• Where ever feasible solar pump sets should be installed.

• All the structures planned should be geo tagged and marked on map, so that social monitoring of the projects can be conducted. This will also avoid the duplicity.

• Priority should be given to projects minimize the gap in potential created and potential utilized.

• Execution of the scheme should be expeditiously completed.

• There should be smooth fund flow to timely complete the project

By water conservation we mean any beneficial deduction in water loss, use, or waste, a reduction in water use accomplished by implementation of water conservation or water efficiency measures or Improved water management practices that reduce or enhance the beneficial use of water. A water conservation measure is an action, behavioural change, device, technology, or improved design or process implemented to reduce water loss, waste and use. Water efficiency is a tool of water conservation. That results in more efficient water use and thus reduces water demand. The value and cost-effectiveness of a water efficiency measure must be evaluated in relation to its effects on the use and cost of other natural resources (e.g., energy or chemicals). In Panchkula district they are using multiple method like rooftop rain water harvesting system, irrigation tank for farmers, soak pit, remodelling local ponds, check dams etc and all other methods.

## 7.1 Artificial Recharge

In the District of Panchkula, Agriculture University, Engineering Collages, Academic and Research Institution, NGO have taken up the pilot or demonstrative projects in the blocks suitable to them to plan at local level as per local conditions. The given Table below Shows the Artificial recharge plan for urban areas **Table 24 in** rural areas, **Table 25** Artificial recharge in rural areas and through recharge pits in farm.

**Table 24 Artificial recharge in Urban Area**

| Name of Blocks | Total Households | No of Houses taken for Artificial Recharge (10% of total households | Total No of AR Structures (one structure for 10 households) | Annual Rainfall runoff Available for recharge (MCM) (No of households *avg rooftop area (200sqm) *runoff coefficient (80%) *rainfall,960 mm) |
|---|---|---|---|---|
| Pinjore | 68218 | 6822 | 6822 | 1.048 |
| Barwala | 942 | 94.2 | | |
| Raipur Rani | 1793 | 179 | 179 | 0.014 |
| Total | | | 7095 | 1.101 |

**Table 25 Artificial Recharge in rural Area**

| Name of Blocks | Total Households | No of Houses taken for Artificial Recharge (10% of total households | Total No of AR Structures (one structure for 10 households) | Annual Rainfall runoff Available for recharge (MCM) (No of households *avg rooftop area (200sqm) *runoff coefficient (80%) *rainfall,960 mm) |
|---|---|---|---|---|
| Pinjore | 20133 | 2013 | 2013 | 0.232 |
| Barwala | 13104 | 1310 | 1310 | 0.122 |
| Raipur Rani | 8978 | 898 | 898 | 0.153 |
| Total | | | 4222 | 0.507 |

**Table 26 Following table shows the methods of water table recharge strategies in urban area**

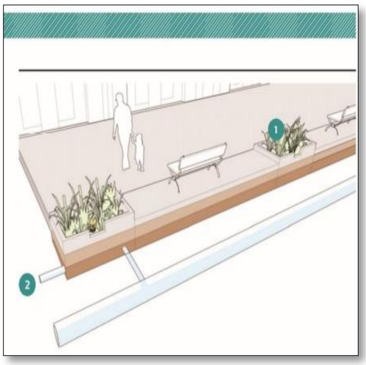
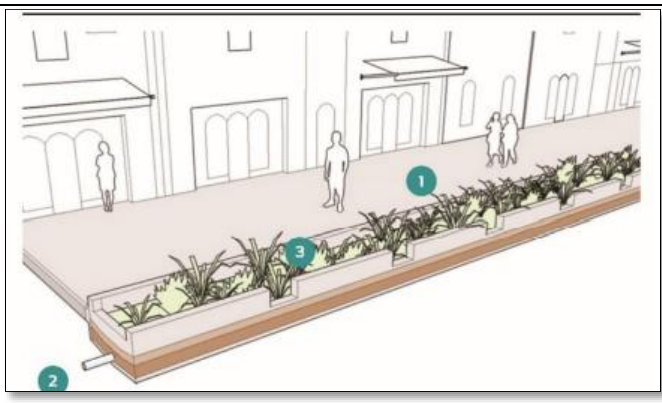
| Name of Blocks | Total Geographical areas in hectares | 10% of village area taken for farm recharge (sq. m) | Total No of Recharge pits (1 recharge pit/hector) for 10% area | Annual recharge 9 (MCM) = (Area*Runoff 15%Rainfall 777 mm/100000 |
|---|---|---|---|---|
| Pinjore | 17024 | 17024000 | 1702 | 2.45 |
| Barwala | 17368 | 17368000 | 1737 | 2.02 |
| Raipur Rani | 12813 | 12813000 | 1281 | 2.73 |
| Total | | | 4721 | 7.21 |

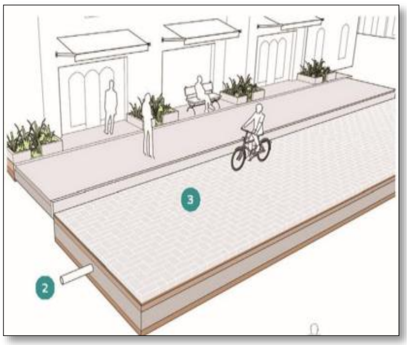
In fact, in order to encourage WSUD element design, major building certification and by laws, including the Haryana Building Code of 2016, has made it mandatory for the construction and presence of rainwater harvesting structures in any property of above 500 $m^2$ and has recommended it for any property above 100 m2 to have a recharge structure on the premises.

## 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 Panchkula. Water Sensitive Urban Design (WSUD) is a familiar concept for engineers and architects practicing and designing in the face of overwhelming environmental changes brought in by climate change. A major part of WSUD also allows us as a society to grow more resilient towards more intensive changes in rainfall patterns, as they grow more intensive, however more care in terms of frequency. The methods of water table recharge strategies in urban area are shown in below **Table 21.**

**Table 27 Following table shows 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** |  |

## 7.3 Plantation (wasteland map)

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 Panchkula is being undertaken both within and outside of government with the engagement of several active citizen stakeholders and non-governmental organisations. 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 Panchkula district is shown in **Figure 26** and **Table 28 shows** the Wasteland Stats in Panchkula District.

**Table 28 Wasteland Stats of Panchkula District**

| **Block Name** | **Wasteland Area (sq feet)** | **Plantation at 5 feet spacing** |
|---|---|---|
| Barwala | 267315833.9 | 44152676.16 |
| Pinjore | 28267419.86 | 85275619.83 |
| Morni | 23423488.17 | 296457390.7 |
| Raipur Rani | 109334449.1 | 330100778.6 |
| **Total** | 428341191 | 592914781.5 |

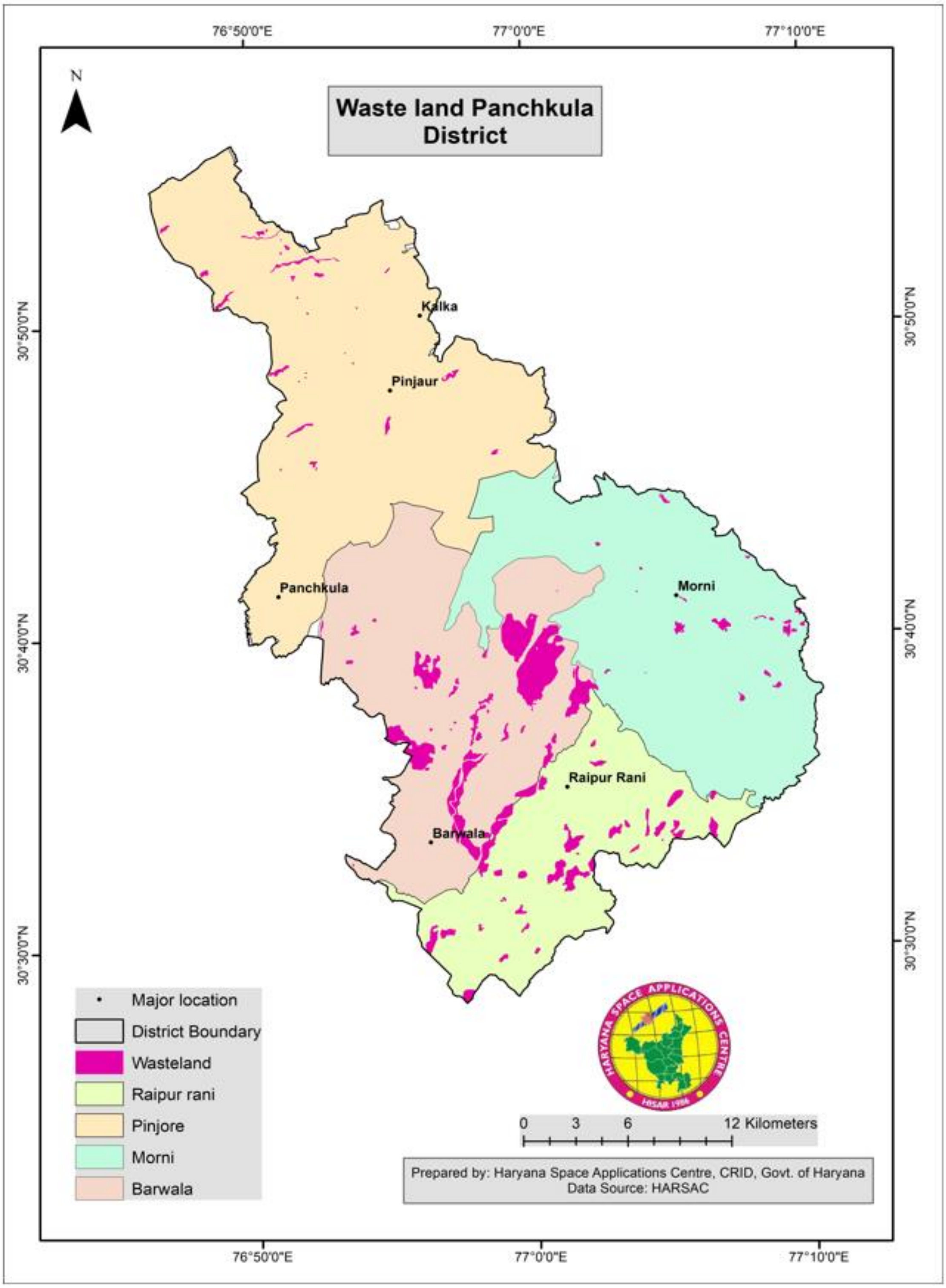



**Figure 26 Wasteland Map of Panchkula District**

## 7.4 Surface water management

### 7.4.1 Pond restoration and rejuvenation

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

Research also shows that that storage of water within a single pond structure contributed to a range of 26,000 to 62,000 m3 to groundwater recharge over a year, that was equivalent to 1.3 to 3.6% of the total water recharge volumes in the study carried out in Ramganga Basin, India, which would serve to irrigate lands of 8 to 18 hectares of land cropped in the rabi season. As such ponds demonstratively serve as an essential structure for water security. Although it serves to only hold a relatively small volume of water, the stored water becomes vital for food security and economic stability within a small community.

Ponds are also essential structures that provide water security in areas where groundwater has grown extremely saline and cannot be used for irrigation purposes. Irrigation channels have been built in such areas during the Green Revolution in these areas in order to meet irrigation demands in this region. However, in order to supply to the increasing demands of high yield production, a lot of pressure has been put on the agriculture industry, as a result of which freshwater demand has increased. The original channels are therefore not sufficient to meet the current water demands. Without accesses to enough water, structures such as ponds become an 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 revolutionised and reinstated the importance of having water storage and wise utilisation for increasing crop yield have served as models for reviving these traditional lifelines within the rural eco-system, while setting important benchmarks for its urban counterparts. Culturally, due to its life-sustaining properties, ponds have also been the centres or natural hubs for monthly or annual fairs to be held, and have been biodiversity hotspots that encourage the link between human and wildlife.

Therefore, ponds form a fundamental part of the hydrological cycle in the environment and has allowed a rich cultural, agricultural and societal practices to flourish in India Since ponds can be formed in a much broader range of environments and landscapes, they demonstrate a wide range of physiochemical activities that allows a wide range of flora and fauna to flourish. Currently Panchkula 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 preceding and after as well.

## 7.5 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 centre and rural areas where open drainage systems still exist. Over the past three decades, the city limits of Panchkula 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.

The following **Table 29** shows a list of generic conditions that are most often found according to the type of treatment considerations and other main constraints such as land availability and population, given that finances are a constant.

**Table 29 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 30**)

**Table 30 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 |

## 7.6 Information Education and Communication

Through open exchange of information, education and communication established between the community and the implementing agency, ownership of the projects and interventions is reinstated; from inception to implementation and beyond. Selected committee members that form groups such as self-help groups, youth groups are in fact chosen to carry out regular capacity building of the community at large, with special attention paid to children, women and those belonging most vulnerable groups are carried out. Knowledge exchange and capacity building are at the core of IEC activities. The following image shows the various stakeholders involved in IEC Activities. The following image shows the various stakeholders involved in IEC Activities (**Figure 27**) and **Table 31** shows the numerous activities and intervention that can be carried out in for IEC.

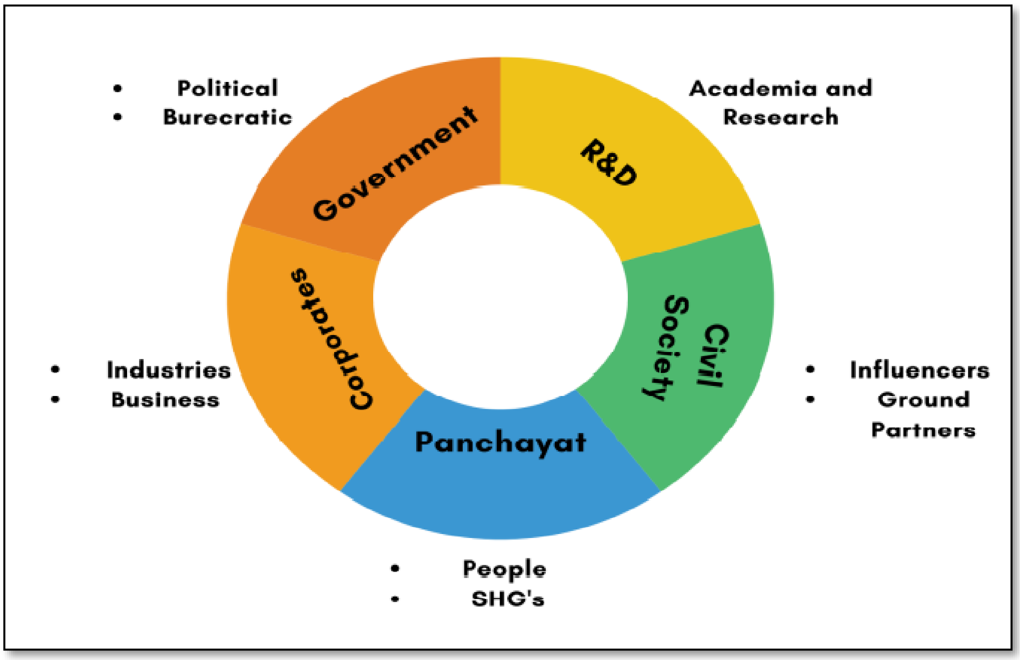



Figure 27 The above figure shows the various stakeholders of IEC Activities.

**Table 31 The numerous activities and interventions that can be carried out for IEC**

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

| | | | | | | |
|---|---|---|---|---|---|---|
| | | regarding Rain water harvesting and its maintenance | - Rural Public buildings | | | conservation and Rules |
| 6 | Information Boards | - Water awareness (Ponds, RWH, Plantation) | - Schools<br>- Public Institutes<br>Open Spaces<br>Roads<br>- | - To change the perspective of people | Location, Capacity, Design OF RWH, information board | Awareness , mobilise citizens<br>- 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<br>- Awareness | FAQ TYPES<br>Best Practices<br>Video clips of Officers and celebrities | Awareness , mobilise citizens |
| 9 | Recognitions/Awards | - Rain water Harvesting<br>- Best Practises<br>- Best RWA in Water management | - RWA<br>- In Panchayats<br>- NGO<br>- Schools<br>- Corporates<br>- Active Citizens | to recognice best practices | -Parameters list for best practices | To encourage more practices and people<br>- Increase interest and motivation for the end users |
| 10 | Video Clips and Interviews | - Individual water Conservation steps<br>- Best Water Management Practices | - RWA<br>- In Panchayats<br>- NGO<br>- Schools<br>- Corporates<br>- Celebs | Digital marketing<br>- Awareness - virtual presence | - letters for the celebs, script. | To recognise people, encourage more |
| 11 | Working Models | - Rain water Harvesting Models<br>- 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 )<br>- Rural (Pond Sites)<br>- Schools<br>-NGO's | -To increase the green Cover<br>To increase the water holding Capacity | - Plant List Nursery Database<br>- Distribution Chain Management Posters | Better environment for Future Generations |
| 13 | Collaborations | - For IEC | - NYK<br>- District Youth Affairs and Sports<br>-Kalagram<br>-NGO's<br>-Durga Shakthi<br>-Civil Defence<br>-Lion Club | To involve stakeholders to facilitate sessions | - Letter of Collaboration<br>-Google form | - No Overlapping of the work or activities<br>- More effectiveness in Catch the rain Campaign |

# 8 Proposed Activity

## 8.1 Rainwater harvesting

Rainwater harvesting is the simple process or technology used to conserve Rainwater by collecting, storing, conveying and purifying of Rainwater that runs off from rooftops, parks, roads, open grounds, etc. for later use

The rainwater harvesting system is one of the best methods practised and followed to support the conservation of water. Today, scarcity of good quality water has become a significant cause of concern. However, Rainwater, which is pure and of good quality, can be used for irrigation, washing, cleaning, bathing, cooking and also for other livestock requirements.

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 28**). For the process of calculating suitable site a fixed weightage is needed to be applies on the above-mentioned criteria **Table 33** and **table 32** shows the Block wise area under very good suitable site proposed for rain water harvesting.

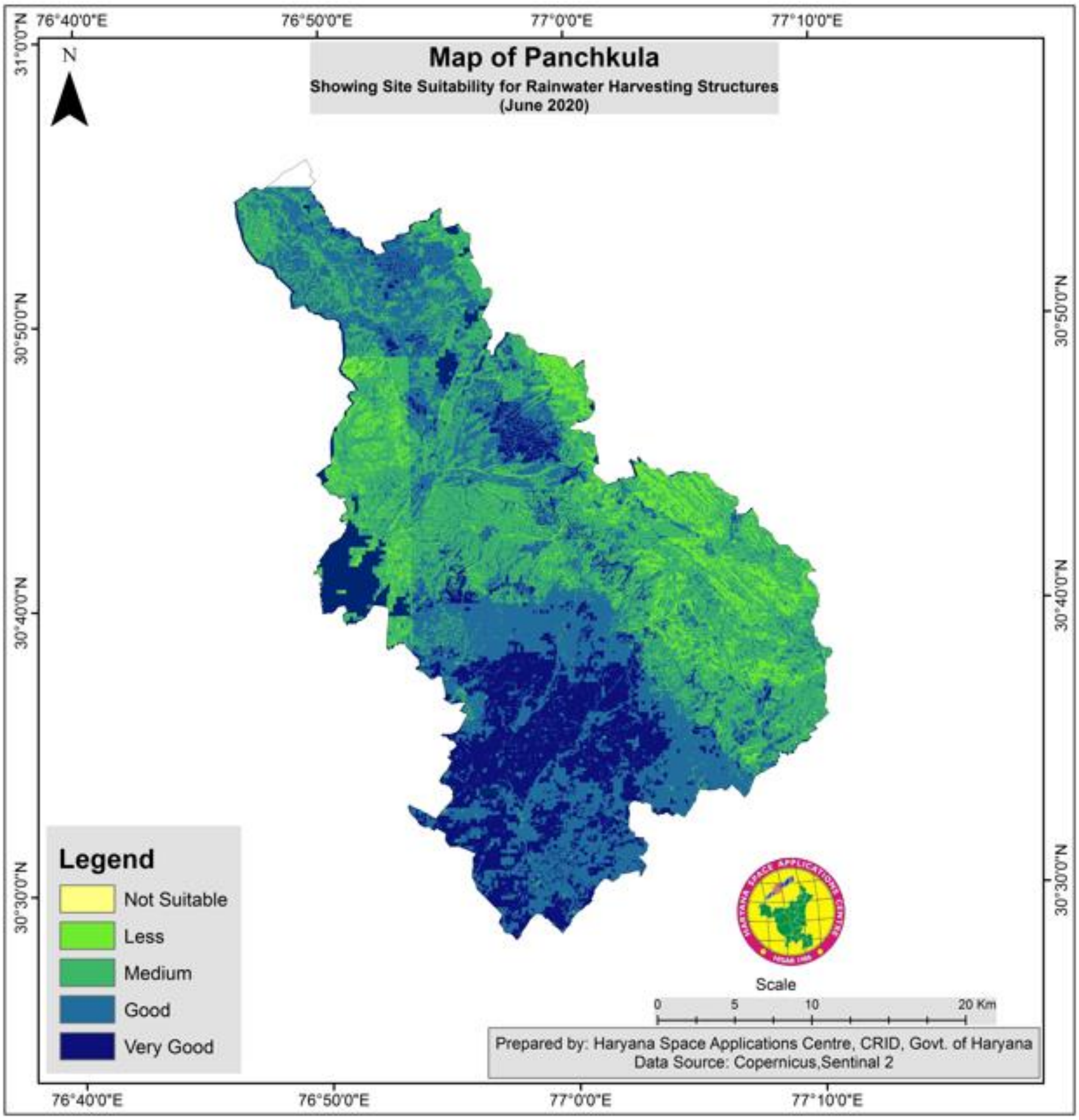



**Figure 28 Site suitability for Rainwater Harvesting Structure in Panchkula District**

**Table 32  Block wise area under very good suitable site proposed for rain water harvesting**

| Block Name | Area (Very Good suitability area in Sq meter) |
|---|---|
| Morni | 53246763.33 |
| Pinjore | 148088641 |
| Raipur Rani | 136237328.8 |
| Barwala | 164913511.8 |

**Table 33  Assigned Weight for layer**

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

## 8.2 Proposed Suitable Site based on Multicriteria

In this section some water harvesting structures are proposed with the suitable sites. These structures are calculated based on different criteria. These criteria are Natural drainage and water occurrence datasets that should exclude the settlement and water bodies on the same place. Stream order system is a simple method of classifying stream segments based on the number of tributaries upstream. A general idea says that in Table 34 a given Mini percolation Tanks, on Ist order Stream, percolation Tanks, on $2^{nd}$ Order Stream, pakka check Dams on $3^{rd}$ Order Stream, Annicut on $4^{th}$ Order, Micro Irrigation tank on $5^{th}$ Order can be build. Following are the outcomes that show the type of structure on the streams. **Figure 29** shows the proposed suitable site based on multi criteria. And **Table 35** shows the blockwise proposed suitable sites based on multi-criteria.

**Table 34 Total number of Proposed sites on Multicriteria based on different Stream order in Panchkula district**

| SR.NO | Stream Order | Total no of Proposed Sites |
|---|---|---|
| 1 | Mini percolation Tanks, on Ist order Stream | 16 |
| 2 | 2nd Order, Percolation tank | 7 |
| 3 | 3rd Order, Pakka check Dam | 2 |

**Table 35 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 | Pinjore | 3 | 1 | 0 | 0 | 0 |
| 2 | Barwala | 7 | 3 | 1 | 0 | 0 |
| 3 | Raipur Rani | 3 | 1 | 0 | 0 | 0 |
| 4 | Morni | 3 | 2 | 1 | 0 | 0 |

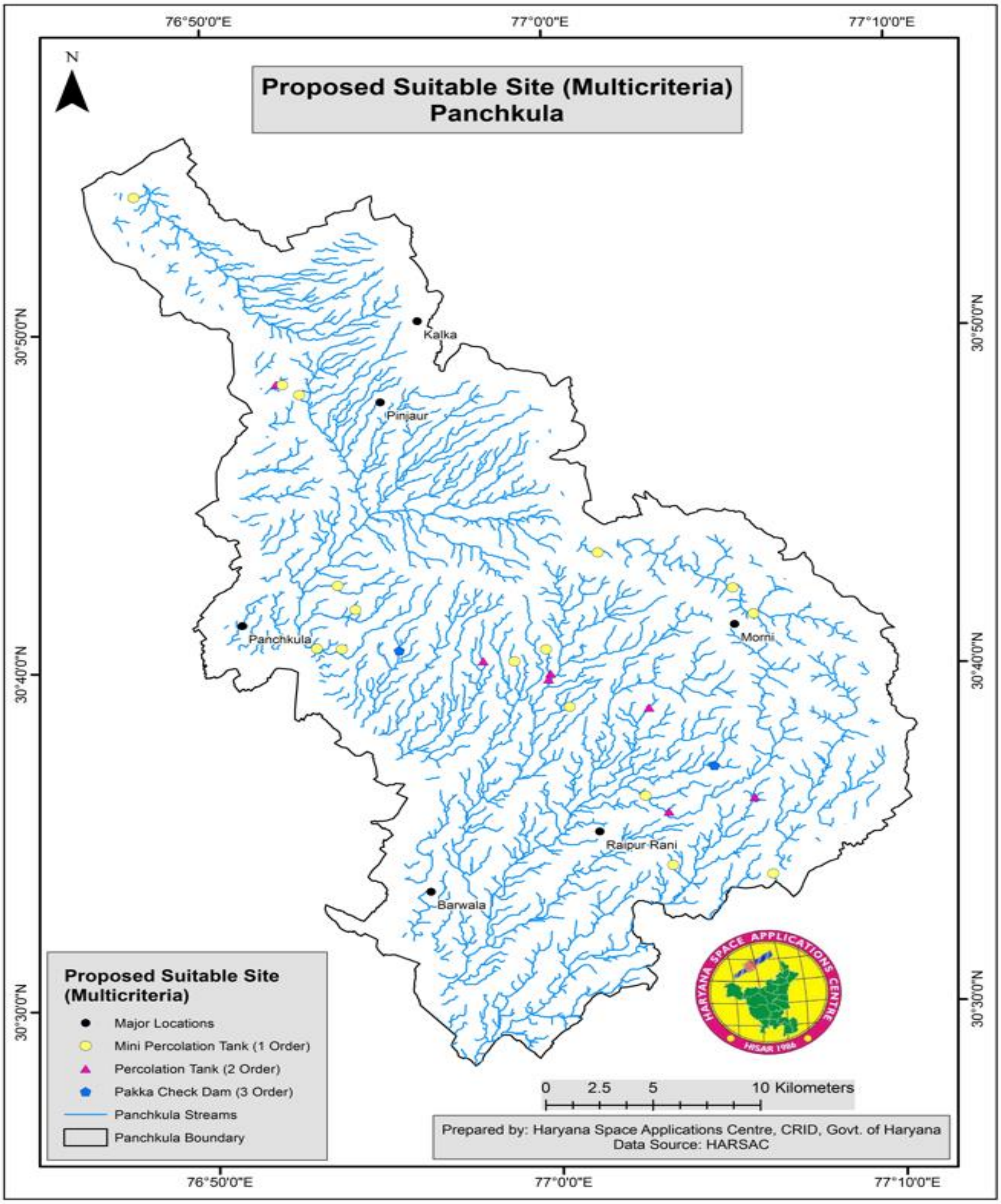



**Figure 29 Proposed suitable sites based on multicriteria in Panchkula District**

## 8.2 Proposed Suitable Site based on Drainage

From satellite imagery the drainages that are created 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 on **Table 37** that Mini percolation Tanks, on Ist order Stream, percolation Tanks, 2$^{nd}$ Order Stream, pakka check Dams 3$^{rd}$ Order Stream, 4th Order, Annicut Micro Irrigation tanks 5$^{th}$ Order can be built, **Figure** shows the proposed suitable sites based on drainage structure in Panchkula district. **Table 38** below shows Proposed harvesting structures in Panchkula based on drainage.

**Table 36 Total number of Proposed sites based on different Stream order in Panchkula district**

| SR.NO | Stream Order | Total no of Proposed Sites |
|---|---|---|
| 1 | 1st Order mini percolation tank | 147 |
| 2 | 2nd Order, Percolation tank | 143 |
| 3 | 3rd Order, Pakka check Dam | 219 |
| 4 | 4th Order, Annicut | 79 |
| *5* | 5th Order Micro irrigation Tank | 19 |

**Table 37 Proposed harvesting structures in Panchkula based on drainage**

| Sl. No. | Block Name | Mini percolation Tank | Percolation Tank | Pakka Check Dam | Annicut | Micro Irrigation Tank |
|---|---|---|---|---|---|---|
| 1 | Pinjore | 31 | 30 | 47 | 24 | 8 |
| 2 | Barwala | 35 | 37 | 57 | 24 | 3 |
| 3 | Raipur Rani | 27 | 36 | 41 | 23 | 8 |
| 4 | Morni | 54 | 40 | 74 | 8 | 0 |

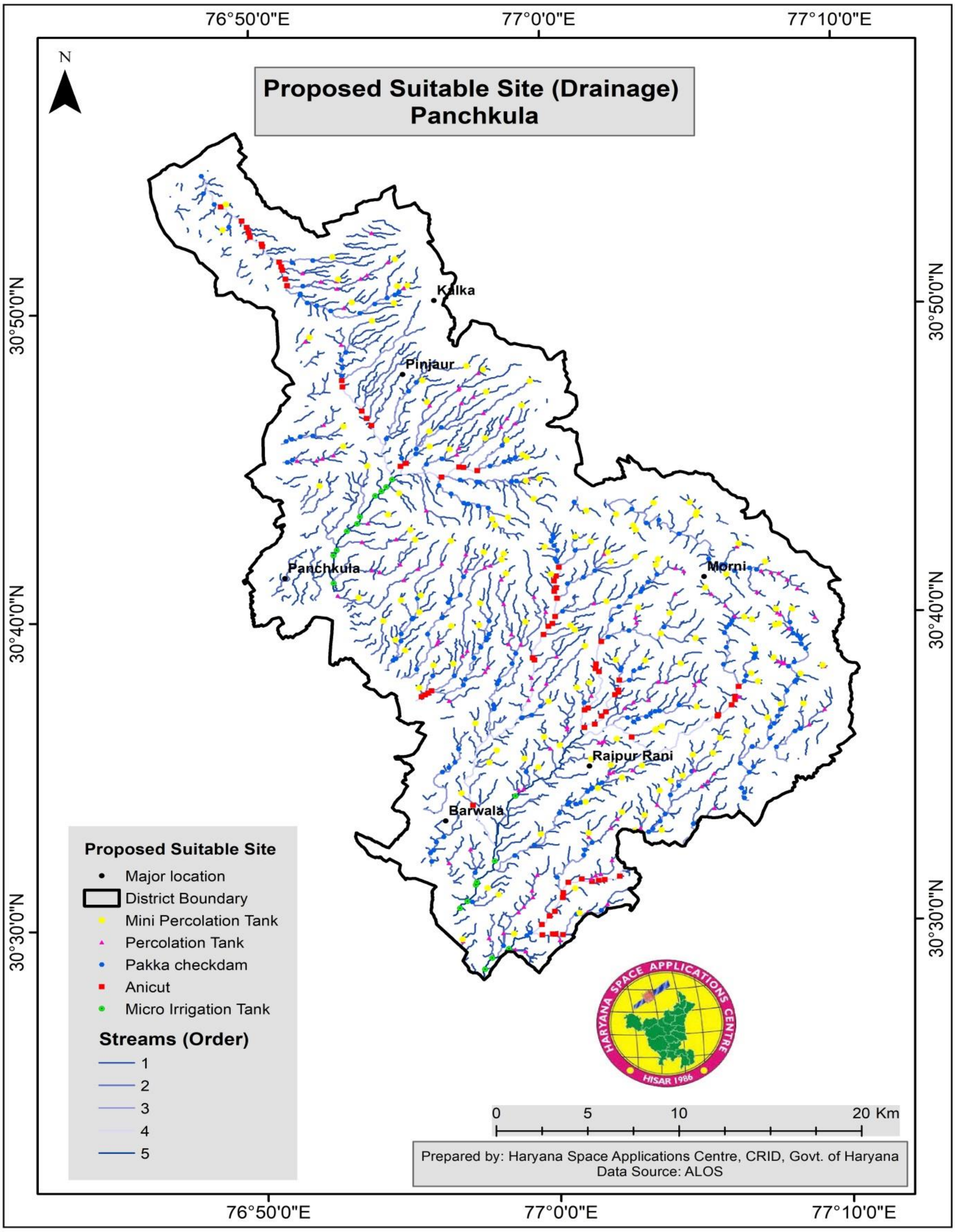



Figure 30 Proposed suitable sites based on drainage in Panchkula District

## Conclusion

Water problems will not go away by themselves. On the contrary, they will worsen unless we, as a global community, respond and use water responsibly. So, before it is too late, let us all, as individuals, families, communities, companies & institutions, pledge towards using water wisely. Intelligence is not in lavishness but in conservation, so that our future generations can continue to enjoy the blissful feeling and touch of water.

Due to rapid urbanization, the Panchkula 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.

……………………………………….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