CHAPTER 7 CONCLUSION AND RECOMMENDATIONS

7.1 CONCLUSION

Summering the conclusion, this can be drawn:

- Having regard to the conditions of rainfall, the nature of the soils and the geological formations, which prevail in Kutch, reliance cannot be placed upon the surface storage for an adequate or satisfactory water supply for the town of Gandhidham.
- Storage reservoirs should however be constructed as a measure of conservation of the water resources of Kutch. These reservoirs will impound run-off from the surface, which would otherwise flow, to the sea or the Rann. Water so impounded will be put to maximum use in such a manner that evaporation losses would be kept to a minimum while percolation water will replenish supplies available in the underground water.
- Ground resources of study area have not been intensively developed for other purposes like agriculture with the result that adequate quantities of water will be regularly available from the source to maintain population. Though good amount of water is being used for the drinking purpose from the dug wells.

- There is depletion in the water level within the study area even when there is a normal rainfall or a surplus rainfall for few years. The reason for this can be understood by the daily rainfall patterns studies. From the data collected it was observed that the most of the rain in study area occurs only with in few days of

the total monsoon seasons. Hence there are more chances of rainfall runoff rather than a recharge if this rain water is not properly managed. The requirement for the groundwater recharge can be clearly understood from the analysis.

- The SCS-model analysis in the study area based on Hydro-Geological parameters supports in proving that urban development has also contributed to increase in the runoff while acting as a barrier between the surface and the subsurface aquifers lowering the groundwater tables.
    - In the last few decades, Anjar, Bhuj and Gandhidham Taluka have experienced an increase in urban area while reducing the overall agriculture land. Due to this rapid expansion and ignorance of Humans to tackle the future groundwater problems has affected the local water environment. Increased pollution in Water is another problem that can be considered as a by-product of this urbanization process.
    - It can be predicted that if proper recharge structures are implemented along with well thought-out water management plans for the current usages, there are high chances of revival of the water level in catchment area of Sakar and Sang river basin (study area). According to the model considered for coming 20 years, around 25-40 mtr rise in the water level can be expected. The major positive impacts are mostly in the Taluka of Anjar followed by Bhuj and lastly Gandhidham. Owing to the proximity to the coast, no major changes visible near the coastal part of Gandhidham taluka.
    - The DRASTIC analysis shows higher risk areas mostly in the southern part of the study area with some dispersed moderate to high risk areas throughout

the study area. Few of the area in the southern portion of the Gandhidham Taluka are in the high risk as shown in the map in red colour where there are agriculture fields. This area is also adjacent to the major water body of Anjar Taluka. A little portion on North and some region of the south of Anjar Taluka fall in moderate risk, whereas the upper areas near Bhuj and few portion towards the north in the Anjar Taluka area at comparatively lower to moderate risk.

- In this particular application it is to be noted that the area is a coastal zone and hence sea water ingression cannot be avoided due to the presence of various industries at the coast as well as Kandla port and also due to over exploitation of the groundwater resources due to the rising demand. Sea water ingression is also to be considered here as an additional factor.
- The study and analysis of the integrated data facilitates evaluation of the unit in terms of the potential of the aquifer material for the occurrence and movement of groundwater, amount of the water available for recharge and the actual recharge taken place. The main sources of recharge to the aquifer/hydro-geomorphic unit are rainfall, water bodies, return flow from the irrigation, etc. The amount of water available has been taken in to account for assessing the recharge condition from all these sources. However, the total available water may not percolate in to the ground. It depends on the infiltration capacity of the soil and the hydrogeological properties of the underlying rock formations. Hence, the actual recharge is assessed not only based on the water available from different sources but also the hydro-geological properties of geological material. Overall, the locations for

recharge structures are identified on upstream of the problematic area. They are located mainly on 1st to 3rd order streams and at the most up to the initial stages of 4th order stream. No recharge structure is located on major streams / rivers occupying large area.

7.2 RECOMMEDATIONS

Since rain is concentrated in a few months and unevenly distributed across the country, it is imperative for India to develop the capacity to store and transport water. Although water can be stored either above or below ground, there are limits to how much can be stored through groundwater recharge and water harvesting. The first step is to increase local storage and recharge through watershed development. However, in the long run, dams are inevitable. Even with full groundwater recharge, water harvesting, and recycling, there will still be a need to store water in reservoirs; otherwise, this water will drain into the sea during monsoon floods.

The following recommendations address the most important issues of water crisis.

India's twelfth five-year plan (2012–17) has focused attention on issues of water management. The plan puts great importance on aquifer mapping, watershed development, involvement of NGOs, and efficiency in developing irrigation capacity. Because water is a state subject in the federal constitution, state governments are expected to play a large role in these efforts. At the same time, many active NGOs are now able to enforce compliance with environmental obligations through the right to information act, active and competitive media, and growing awareness on water issues.

First, the central and state governments should permit local groups with knowledge, understanding, and real-time information on the status of groundwater so as to manage extraction in a cooperative way. Since groundwater is an open resource, farmers extract as much as they can. But when everyone does this, it leads to extraction above a sustainable level. This problem can be managed by a cooperative agreement among the users of the aquifer, who should know how much can be extracted without depleting the resource. The state can monitor and provide this information. Efforts at cooperative management of groundwater can work.

Second, India needs to promote and emphasis on watershed development. This involves leveling land and tapping rainwater in small ponds created by building small dams in the streams (called check dams). This water increases soil moisture, recharges groundwater, and permits a second crop to be planted.

Moreover, it can be undertaken at the local level all over the country and can be accomplished in a relatively short time.

Third, people must be educated about the need to store water.

Fourth, the government should strengthen pollution control boards to enforce effluent standards. The technical and human resources currently available to the boards are inadequate to effectively monitor activities, enforce regulations, and convict violators.

Fifth, in addition, adequate sewage treatment facilities must be constructed. Many cities treat only a part and some no more than half, of the effluent.

Sixth, Cities need to charge a proper price for water so that local sewage work operators have the income and resources to sufficiently maintain treatment plants. If

necessary, associate and work with private firms to modernize urban water-distribution systems.

Seventh, In Urban areas, conservation of the roof top rainwater must be made mandatory for recharge of ground water. Such approach requires connecting the outlet pipe from rooftop to divert the water to existing wells / tubewells or custom designed wells; this can be made affordable under various government schemes. The urban housing complexes, commercial buildings, institutional buildings and industries have large roof areas, there is an urgent need for utilizing them for harvesting roof top rainwater to recharge aquifer in urban and semi-urban areas. It will be a major step toward addressing this most critical issues causing water crisis by adopting and implementing roof top harvesting at all levels like local, state and federal.

Water touches every aspect of life, and in India uncertainty over access to and the availability of this basic resource may be reaching calamity levels. India experiences dramatic changes caused by a growing economy and population, competing demands for this limited resource coming from households, industry, and agriculture have wide-ranging implications for the country's future. If no action is taken, there could be grim consequences.