EXECUTIVE SUMMARY

Water, having social, economic and environmental value, plays an important role for human beings. Despite accelerated economic growth in India, still 65% people directly depend on agriculture and allied activities. Water, available through surface and ground water sources, is a primary factor for crop development. The main input for surface and ground water resources is rainfall as determined by amount, intensity and duration. For developing surface water resources, storage structures like dams, barrages and weirs are required. However, as the surface water resources are beset with the problems of evaporation, sedimentation, efficiency and quality, land acquisition their performances are compromised. These problems are avoided in case of ground water storage, making the ground water resource to be more assured for water supply and crop productive, which accounts for almost 70% irrigation and domestic water supplies.

The study area for the present thesis covered the semi-arid Rajkot District in Saurashtra region of Gujarat State which is frequented by water scarcity, causing drought every alternate year and severe drought in three years out of ten years. Government provides drinking water to thousands of villages by tankers in summer. The average rainfall for last 40 years is 567mm in Rajkot District ranging from 1370mm (1970) highest to 166.8mm (1985) minimum with 27% coefficient of variation. While the number of rainy days per year is 27, 80% of rain water is received during July to August months. Thus, the rainfall pattern in Rajkot district is erratic. Due to over withdrawal of ground water in Saurashtra, seawater intrusion has advanced from 0.8 km to 8 km in last two decades. Many dug wells have become dead due to lowering of ground water.

Rajkot district has a geographical area of 11043 km^2 covering 14 talukas & 857 villages. The population of the district as per 2001 census is 31,69,881. Geologically, 90% area of the district comprises of Daccan trap basalt and remaining 10% area is covered by sandstone, limestone and recent marine alluvial deposits. The basalt is highly fractured and confined to a depth of about 30 to 40 m only, and below it, the solid rock is encountered which hardly has any scope of ground water accumulation. Thus,

the fractured basaltic rock up to 30-40 m depth forms good aquifer. In the Rajkot district, the number of wells in the year 2006 was 90356 through which the irrigation potential of 179300 ha has been created and by surface water it is 50000 ha. Moreover, the water utilization of the farmer is more efficient since the average ground water irrigation duty is 245 ha/Mm^3, while the surface water irrigation duty is 175ha/Mm^3. Due to erratic rainfall pattern, the ground water recharge is less and the consequential reduced ground water availability for irrigation causes the production loss of Kharif crops (groundnut and cotton), which is so common due to inability of the farmers for provide the last watering which is most critical to crop production.

Per capita availability of water in Rajkot district (700 m^3/year) is less than the minimum requirement of 1000 m^3/year. The Bhadar Irrigation Project was commissioned in the year 1965 to bridge the water availability gap in the 49 villages of the 2500 km^2 catchment as also in the downstream villages of the 17000 ha command area. But the large share of the water is availed by the Bhadar-I downstream villages, while the catchment 188 villages are deprived of their legitimate supply. They exclusively suffer the water deprivation by the fact that the live storage capacity of the reservoir has decreased over years because actual sedimentation rate far exceeds the design rate (3.37ham/100sq.km/year), rendering the reservoir life span much shorter. Despite the dwindling live storage, the reservoir surface water area exposed for evaporation remaining the same, relatively greater proportion of reservoir water is lost through it, which is approximately 28% of the average water yield. But the apathy is that only the catchment area villages, which are having agriculture land as much as in the command area villages, are made to suffer the water deprivation of their catchment water which is utilized in downstream areas in total disregard of equity principle.

The redeeming strategy of constructing 905 check dams in the Bhadar–I catchment area for building ground water storage through artificial recharging has been a most welcome state government intervention towards rectifying the aberration of inequity. The participation of the people in the construction of the check dams, has substantially enhanced the ground water resource potential which is a vital resource for protective irrigation of Kharif crops. This attests people's emotional integration with the

governmental development initiative which by itself is a significantly positive gain. While the water availability has improved through enhanced ground water storage in the catchment villages, there has not been adverse impact on the reservoir water storage, which is rather positively influenced because of extensive entrapping of silts by the check dams in the catchment area resulting in reduced sediment loading into the reservoir associated with protection of live storage.

The impact of check dams on the Bhadar-I dam has been analyzed in consideration of sediment entrapment by the check dams constructed in the catchment area ($0.45Mm^3$/year) and the consequential reduction in sediment loading into the reservoir. Moreover, the underground stored water escaped the evaporation and the conveyance losses that were likely, had the check dam stored water moved to the reservoir.

Similarly the impact of 4670 check dams constructed in 6 years in Rajkot district on ground water regime also indicate positive results. The ground water estimates for year 1997, year 2002 and year 2006 give ground water recharge of 1150 Mm^3, 1190 Mm^3 and 1930 Mm^3, respectively. The additional amount of water, being available to the farmers of the entire Rajkot district, resulted in assured Kharif crops with larger area coverage and greater crop yields, coupled with increased Rabi irrigation.

These too different aspects have been comprehensively studied and the findings have been incorporated in the thesis which is a unique endeavor.

An integrated river basin project, having water harvesting structures and dams of all sizes, (small, medium and large) as essential components, qualifies to be an optimal water management system. It is to be aptly recognized that a judicious combination of all sizes is required and the surface water harvesting structures such as check dams have a definite role to play in such a scheme of things. The research findings incorporated in the present thesis authenticate the articulation of an optimal water resource management system taking shape in entire Rajkot district as well as Bhadar-I catchment through the intervention of check dams construction in the catchment area.