Research Paper Engineering

# A Study of Groundwater Balance in Command Area of Machchhu-1 Dam, Morbi.

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**ABSTRACT**

The revised ground water resource estimation methodology is adopted for ground water resource estimation considering distinctions such as hard rock area sand alluvial areas, canal command areas and non- command areas and recharge in monsoon season and non-monsoon season, are kept in view. Recharge due to rainfall in the monsoon season is estimated by groundwater level fluctuation method. Results obtained from analysis of various components of recharge and ground water balance shows that there is a continuous increase in draft although available recharge is varying and not exactly following direct correlation with the average rainfall during the analysis period.

**KEYWORDS**

## INTRODUCTION

Water resources are becoming scarce, due to growing population and changing lifestyles, increase in demands from industry, contamination of available water resources, resulting from human activities, etc. This thins out the allotment of water available for irrigation. Dam projects generate a vast array of economic impacts—both in the area where they are located and at inter-regional, national and even global levels. These impacts are evaluated in terms of additional output of agricultural commodities, hydropower, navigation, fishing,

tourism, recreation, prevention of droughts and reduced in flood damages, and arereferred to as direct impacts. The direct impacts, in turn, create a number ofin-direct and induced impacts as a consequence of:

• Inter-industry linkage impacts, including both backward and forward linkages, which lead to increase in the demand for and outputs of other sectors.Ingestion-induced impacts arising as a result of increase in incomes and wages generated by the direct outputs of the dam[ ].

Dams are not just significant in economic growth, but also in overall economical and moral growth. In many developed countries, dams have performed a central function in the evolution of the developing nations.[1] Objective of the study is to Estimate Groundwater Recharge and Balance using GWRE method in command area of machchu-1.

## STUDY AREA

Location of Machchu-1 dam is on river Machchu near a Jalsika villagein Wakaner of Rajkot District, the distance is 57 km from the source of the river. The Wankaner town lies 22km down-stream of Machhu I dam. The Completion of Machchu-I damwas in the year 1958, the dam site catchment area is up to 735 km2. The projected gross and live storage capacities of the dam are 72.7 Mm3 and 70.8Mm3 respectively with FRL at 135.35 m.

TheMachchu-I dam has been designed as a reservoir impounding water for the purpose of irrigation.The command area of the task rests on the left bank of River Machhu in Wankaner and Morbi talks of Rajkot district. The cultivable command area is 104.09 Mm2 and the gross command area of this project is 182.18 Mm2.The whole of the catchment area gradually rises towards the source in the north eastern direction, i.e., Mandva hills from where the river holds its source.Away of the 735 km2 of the catchment area at the dam site, 36.3 km2 have already been intercepted by a tank at area, 35.4 km upstream of the dam site.The reservoir is preconceived to provide irrigation water all the year round.Hence, a preparation for the evaporation and absorption losses that take place in the reservoir throughout the year has been caused. The spillway of the damwas designed to pass a flood of 2,595 cumecs with HFL at 137.46 m[ ].

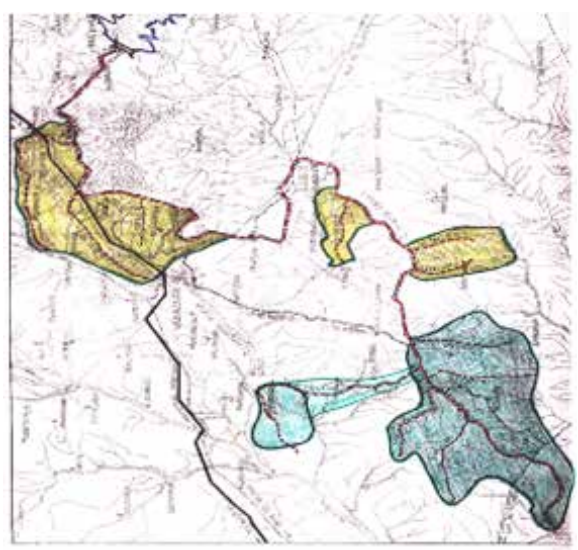

**Fig.1 -Study area map of machchhu1 reservoir Source: GWSSB (irrigation dept.) - Morbi.**
Data Collection ofMachchhu1 reservoirs.

Machchu-I reservoir Basin Map & data of the village were collected from GWSSB-Gandhinagar and GWRDC- Rajkot, GWSSB(irrigation)-Morbi. The data are Monthly rainfall of Machchhu-I reservoir, Ground water levels, Well location (latitude & longitude), Irrigation area, Canal running Period, Numbers of check dam and Percolation tanks, Seepage factor of canal, wetted perimeter of canal, hard rock, soft rock and alluvial rock area, numbers of pump set with unit draft in area.

## METHODOLOGY

Evaluation of Ground Water Recharge By "Ground Water Resources Estimation Methodology" Source: Report of The

Ground Water Resource Estimation Committee GWRE Mehodology-2009

The revised ground water resource estimation methodology proposed by the committee is presented in this Para. The methodology may be adopted for ground water resource estimation. In this methodology, distinctions such as hard rock areas and alluvial areas, canal command areas and non- command areas and recharge in monsoon season and non-monsoon season, are kept in view. It is recommended to estimate recharge due to rainfall in the monsoon season by ground water level fluctuation method, unless adequate data is not available, for which case rainfall infiltration factor method may be used. The ground water recharge assessment is essentially for unconfined aquifers.

**RESULT AND DISCUSSION**

Results obtained from analysis of various components of recharge and ground water balance by Ground Water Resources Estimation Methodology is tabulated in Table 1. Calculations done by this method requires variety of information and data in form of inputs. These data are GWL, Population, Irrigation, number of pumps, wells, dams, lakes, ponds, check-dams, canals types, rainfall, specific yield, normalization factor, etc., The analysis shows that there is a continuous increase in draft although available recharge is varyin-

**Table 1 Results obtained by GWRE Method**

| YEAR | Monsoon Recharge (in Mcm/year) | Recharge from rainfall | Recharge from other sources | Non Monsoon Recharge (in mcm/year) | Ground Water Return flow | TOTAL (GROSS) RECHARGE in mcm/year | AVAILABLE RECHARGE (Mcm/year) | DRAFT in Mcm/year | BALANCE in Mcm/year |
|---|---|---|---|---|---|---|---|---|---|
| 1981-85 | 28.210 | 7.881 | 10.328 | 19.116 | 0.719 | 37.325 | 35.46 | 13.93 | 23.53 |
| 1986-90 | 30.239 | 22.407 | 7.891 | 17.132 | 0.725 | 47.430 | 45.06 | 12.44 | 32.62 |
| 1991-95 | 36.035 | 29.595 | 6.440 | 21.282 | 0.805 | 57.217 | 54.36 | 13.60 | 40.76 |
| 1996-2000 | 37.859 | 30.578 | 7.315 | 12.172 | 1.305 | 50.265 | 47.75 | 15.81 | 31.94 |
| 2001-05 | 40.952 | 35.021 | 5.929 | 9.595 | 1.194 | 50.546 | 48.02 | 16.62 | 31.40 |
| 2006-10 | 21.290 | 21.900 | 1.394 | 10.190 | 1.440 | 33.480 | 31.81 | 20.59 | 11.22 |
| 2011-13 | 31.600 | 30.180 | 1.420 | 10.470 | 1.450 | 42.370 | 39.97 | 21.25 | 18.72 |

-g and not exactly following direct correlation with the average rainfall during the analysis period. For example, during 1991-95 and 1995-2000 rainfall was considerably lesser than the average rainfall of 2006-10 and 2011-13, still there observed considerable rise in available recharge. During 2006-10 and 2011-13, there is significant increase in annual draft because of increased population, which caused significant lowering of ground water table. In addition, irrigation was done only in one season that is rabbi; so, Ground Water Balance reduced.

The analysis need to divide data into some group of years, in present study area data has divide into 7 stages of five years group. The graph is then prepared from parameters like ground water balance, available recharge and gross draft. In which, available recharge and ground water balance shows similar path but gross draft is continuously in increment mode; at one stage it intersect the groundwater balance and increased than ground water balance value. Pi-charts shows in figure-2 below stage-wise percentage distribution of available recharge into Draft and Balance. It can be observed that Draft was in range of 13 to 17 % of available recharge so consequently Balance was in range of 33 to 37 % for first five stages. In last two stages Draft has increased significantly which caused noticeable decline in available groundwater balance.

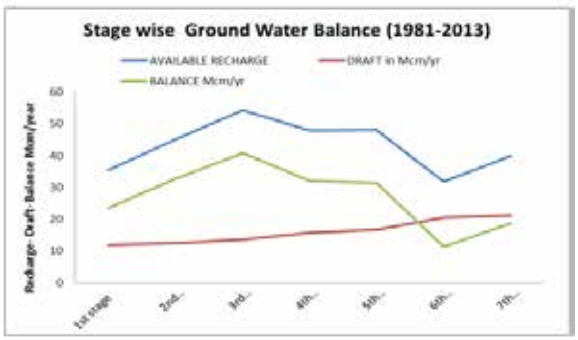


**Figure 2 Stages of Ground Water balance**

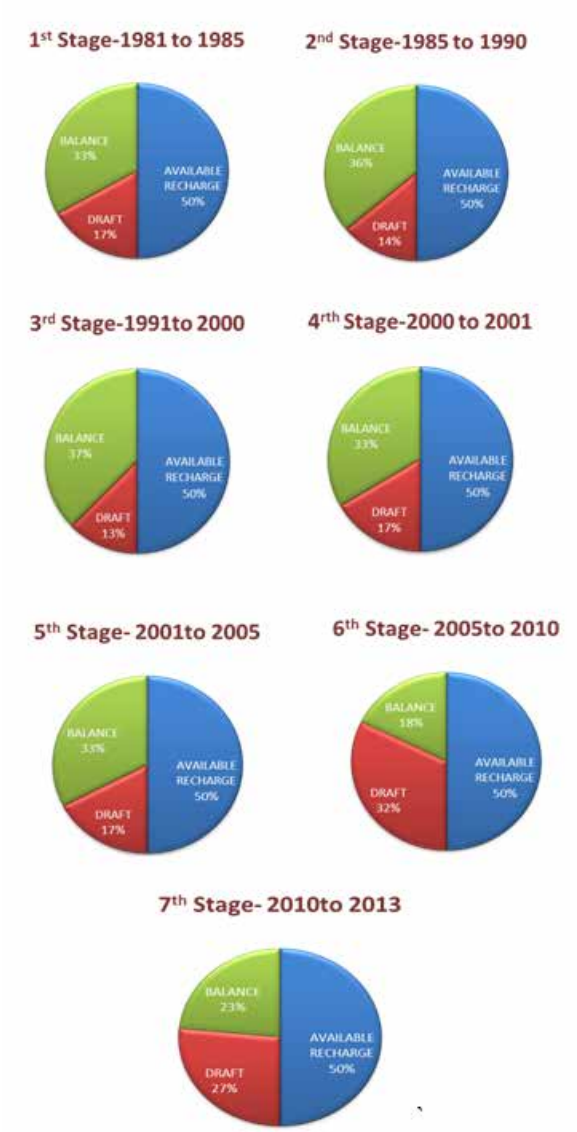


**Figure-3 Stage-wise percentage distri-bution of available recharge into Draft and Balance**

**CONCLUSION**

Results obtained from analysis of various components of recharge and ground water balance by Ground Water Resources Estimation Methodology shows that there is a continuous increase in draft although available recharge is varying and not exactly following direct correlation with the average rainfall dugring the analysis period.

The significant increase in annual draft may be because of increased population, which caused significant lowering of ground water table. Further irrigation was done only in one season that is rabbi; so, Ground Water Balance reduced.

Pi-charts shows that Draft was in range of 13 to 17 % of available recharge so consequently balance was in range of 33 to 37 % for first five stages and it is increased significantly which caused noticeable decline in available groundwater balance.

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