

8. CONCLUSIONS, DISCUSSIONS & RECOMMENDATIONS

8.1 CONCLUSIONS & DISCUSSIONS

8.1.1 Conclusions & Discussions for Rainfall Analysis

1. The average annual rainfall for Kutch district ranges between 300 to 400 mm. The average rainfall value for 130 year span is 356 mm but the rainfall ranging between 351 to 400 mm has occurred 18 times (13.85%) in a span of 130 years. The probability analysis clearly indicates that the variation in the annual rainfall values is very high.
2. The average annual rainfall is maximum at Mandvi i.e. 414 mm while it is minimum at Lakhpat i.e. 322 mm. The analysis clearly indicates that the rainfall values increase from north to south and west to east.
3. It has been observed that one in every 3-4 years is either a drought year or a rainfall deficit year. There are 19 drought years, 39 rainfall deficit years, 29 normal rainfall years, 18 above average rainfall years and 25 surplus rainfall years in a span of 130 years. Thus a total of 58 years in a span of 130 years have rainfall below 300 mm. Lakhpat taluka, which is very near to the Rann of Kutch has the maximum number of years with less than 300 mm rainfall.
4. The maximum daily rainfall for Mandvi of 335mm was observed on 16th July, 1989 while that for Lakhpat of 314 mm was observed on 26th July, 2003.
5. The maximum rainfall occurs in the month of July and on an average there are 14 to 19 rainy days in a year.

8.1.2 Conclusions & Discussions for Surface Water Analysis

1. All the rivers in the region originate from the central hilly range and flow towards the sea in the south and the Rann in the north. All the rivers are seasonal having length ranging from 25 to 40 km. The gradient is very high and therefore rivers have flashy floods.
2. The runoff for all the talukas ranges from 15 to 35 % of the rainfall values. The values of runoff are found to be higher for the south flowing rivers as compared to the values for the north flowing rivers.
3. The runoff has been calculated and values found for annual and monthly periods shows a maximum annual runoff of 610.79 mm at Mandvi. The minimum annual runoff of 0 mm was observed for maximum number of years at Lakhpat.

8.1.3 Conclusions & Discussions for Groundwater Potential Analysis

1. The conventional method of estimation of draft is based on the number of wells and the capacity of the pumps. However, the actual quantity of draft depends upon the rainfall pattern, the number of wells, the agricultural area and the total area of the region. Therefore, it was needed to develop a separate equation for calculation of draft for the Kutch region. Based on the equation developed, the groundwater draft has been calculated which clearly shows that the maximum average annual draft is at Mandvi being 55.96 mm and minimum average annual draft is at Lakhpat being 20.01 mm.
2. The recharge due to rainfall has been calculated using the values of annual groundwater table fluctuations, specific yield and ratio of the area suitable for recharge to the total areas of each taluka.
3. The recharge due to surface storage has been calculated using the equation developed by Sharda et al (2006) along with the rainfall values and the catchment areas of the medium and minor irrigation schemes and check dams.
4. The total recharge is obtained by summation of the recharge due to rainfall and the recharge due to surface storage.
5. The groundwater recharge due to rainfall ranges from 5 to 35 % of the rainfall values.
6. The groundwater recharge due to surface storage ranges from 5 to 15%.
7. The rainfall pattern of the preceding two years plays a very important role in the extraction pattern of the groundwater. A dry spell of more than two years results in extraction of groundwater more than the quantity of recharge due to surface storage as well as the recharge due to rainfall.
8. The groundwater recharge shows negative values for the year 2002, which shows declination of the groundwater table. This is due to a major earthquake in the region due to which most of the surface storage structures were damaged and therefore under repair.
9. The groundwater recharge shows negative values for the years 1991 and 1996 which also indicates declination in the groundwater table. It can be justified as the rainfall pattern for the previous two years shows that the values of rainfall were much less than the average annual values.

8.1.4 Conclusions & Discussions for Inter Relationships

1. The rainfall - runoff equations developed for each taluka will be the most important tool to determine the runoff most accurately.

2. The rainfall – groundwater recharge equations developed for each taluka can be very effectively used for determination of the quantity of groundwater recharge for each taluka.

8.2 RECOMMENDATIONS

1. For accurate calculation of runoff, equations for rainfall-runoff should be determined for other regions too instead of calculating runoff by taking approximate percentages.
2. The parameters calculated using the developed equations for inter relations have 95 % confidence level and can be utilized by Government, Semi-government and other departments related to water resources.

8.3 SCOPE FOR FUTURE STUDY

1. Physically based modeling like Soil and Water Assessment Tool (SWAT); Kineros 2 can be used to characterize different hydrological components for all talukas on individual watershed basis.
2. Several Salinity Ingress Prevention (SIP) structures have been constructed on the coastal boundary of Kutch after 2007. The study for behavior, characteristics and efficacy of individual SIP structures can be done.
3. Study for use of Groundwater Modeling System (GMS) for characterizing groundwater can also be done.
4. Similar studies can be carried out for other regions.