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GROUNDWATER AND HYDROLOGICAL STUDIES IN AJJAMPUR SUBWATERSHED

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Abstract

The water table fluctuation in the bore wells which were selected for study purpose revealed the minimum and maximum watertable levels as 5.32m and 36.26m and the average depth to water table was 18.61m during pre-monsoon season. During the *Kharif* 2016 the maximum depth to the water table was about 45.86% of the sub-watershed and was covered with a water table in the range of 20 to 25m below ground level whereas during rabi it was 66.63% of the sub-watershed. Similarly, during 2017, the water table fluctuation in the study area revealed that water table was more than the 35 m bgl which account for 75.65% of total sub-watershed during Karif season whereas during rabi the water table was between 25 to 30m bgl it was 49.88%

The long term average annual rainfall (1980-2017) was found 874 mm. Maximum rainfall is observed during 2014 whereas minimum rainfall during 2012. The high temporal variation found between yearly annual rainfall. During the years of 2016 (38 %) and 2017 (24.16 %) were found deficient years between 2010-2017. High variability was found between annual *Kharif* rainfall. Years of 2011 (21 %), 2012 (62 %), 2016 (19%) and 2017 (44 %) received deficient rainfall. The average Rabi rainfall (Sep-Dec) is about 33 % of the average annual rainfall. Years 2012 (43%), 2013 (16%), 2013 (39%) and 2016 (64%) received deficient rainfall. Years 2010 and 2014 received highest Rabi rainfall. During lower rainfall years (2011, 2012 and 2017) it was found that there were at least 4 events per year except in 2016 (extremely lower rainfall year), which produced just one event. The maximum discharge of borewells was observed during post-monsoon due to recharge, whereas 30 to 40 per cent of the discharge was decreased during pre-monsoon period due to over-exploitation of groundwater, as the majority of the farmers dependent on groundwater for irrigation. The discharge has got reduced in January, May and August of 2017 due to late monsoon.

Key words : Watertable, Water level fluctuation, Ground water, Hydrologic study.

Introduction

The details of hydrological and water resources are necessary for the sustainable use of water resources and also for higher productivity. In addition, the goals are to assess the links between groundwater conditions in the watersheds and design of soil and water conservation measures, groundwater level changes and water yields in hard rock aquifers and impacts of water stress on crop productivity, land management changes and impacts on groundwater recharge and runoff. The availability of such data will enhance the accuracy of the hydrological analysis, which provides the information on which design and operation concepts may be done to aid the decision support system for water planning and management of watersheds/subwatershed.

Availability of groundwater is of limited in hard rock terrains as the groundwater is a dynamic and replenishable natural resource. The occurrence of groundwater in such rocks is mainly confined to different fractured and weathered horizons. In hard rock terrains poor knowledge about this resource, its occurrence in complex subsurface formations is considered to be a big obstacle to the efficient management of this important resource.

In India, hard rock formations with low porosity (less than 5 per cent) are about 65 per cent of the total

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geographical area and very low (10^{-1} to 10^{-5} m/day) permeability (Saraf and Choudary, 1998 and Sahu, 2001). Therefore, effective management and planning of groundwater in these areas is of the utmost importance. An extensive hydrogeological investigation is required for a thorough understanding of the groundwater conditions.

Recent research shows that groundwater irrigation has overtaken surface water irrigation as the main supplier of water for India's crops. Groundwater presently sustains almost 60 per cent of the country's irrigated area (IWMI, 2001). In the last two decades, the groundwater irrigated areas in India increased by 105 per cent compared to only 28 per cent increase in the surface-water irrigated areas. Because of these unique advantages, throughout the world, regions that have sustainable groundwater balance are shrinking by the day. Yet, groundwater depletion and the host of associated problems pose one of the most daunting challenges that the world faces in the water sector. In most of the low rainfall areas of the country, the availability of utilizable surface water is very low that people have to depend largely on groundwater for agriculture and domestic purpose. Excessive pumping of groundwater in areas of different states revealed that groundwater levels are decreasing. The problem has been compounded due to large-scale urbanization and growth of megacities, which has drastically reduced open lands for natural recharge. To improve the groundwater levels, it is necessary to recharge the depleted groundwater aquifers artificially

Materials and Methods

Study area

Ajjampur Subwatershed comes under Tarikere taluk in Chikkamagaluru district of Karnataka state. It is between 13⁰46'11.52" and 13⁰44'49.55'' N latitude and 75⁰58'27.66" and 76⁰ 03'18.22'' E longitude with a geographical area of about 4068.72 ha and 751m above mean sea level (Fig. 1). Tarikere taluk lies in agro-climatic Southern transition zone, and it comprises of red soils developed from quartzite and small patches of black soil differing in their morphological physical and chemical characteristics.

Results and Discussion

Rainfall distribution

The rainfall data of Ajjampura Hobli station (KSNDMC) is considered for study as it is nearer to sub-watershed. The long term average annual rainfall (1980-2017) was found 874 mm. Years of 2011 (7.68 per cent deficit with respect to average annual), 2012 (41.31 per cent), 2016 (38 per cent) and 2017 (24.16 per cent

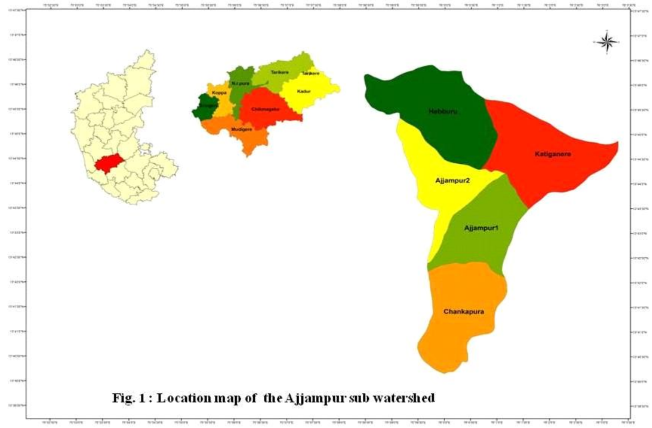

Fig. 1 : Location map of the Ajjampur sub watershed

) were found deficient years between 2010-2017. The Year 2014 received 42 per cent excess rainfall (Fig.2).

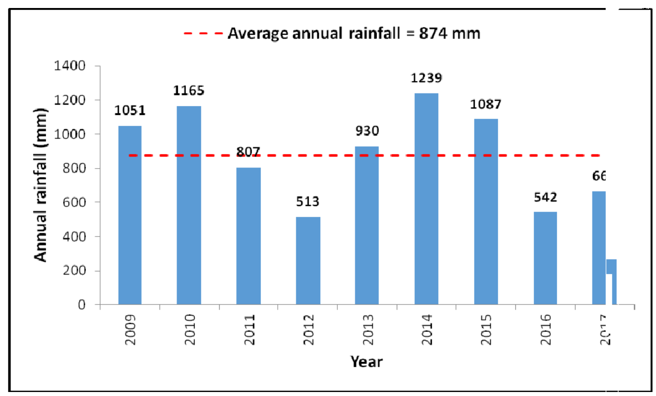

Fig. 2: Temporal variation of annual rainfall between 2009-2017.

The *Kharif* rainfall (May-August) is about 60 per cent of the average annual rainfall, and it typically follows the annual rainfall patterns. High variability was found between annual *Kharif* rainfall. Years of 2011 (21 per cent), 2012 (62 per cent), 2016 (19 per cent) and 2017 (44 per cent) received deficient rainfall (Fig. 3).

The average rainfall during *rabi* (September-December) is about 33 per cent of the average annual rainfall. The maximum (556 mm) and minimum (106 mm)

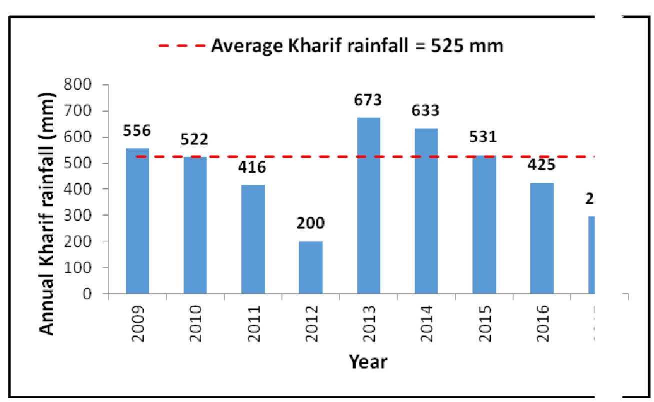

Fig. 3: Temporal variation of *Kharif* rainfall between 2009-2017.

rainfall during rabi season were observed during the year 2010 and 2016 respectively. Years 2012 (43 per cent), 2013 (16 per cent) and 2016 (64 per cent) received deficient rainfall (Fig. 4).

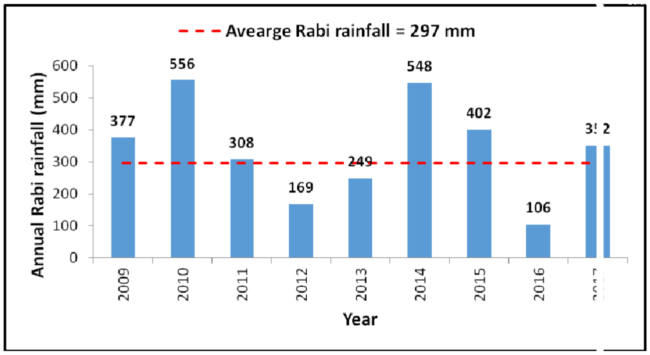

Fig. 4: Temporal variation of Rabi rainfall between 2009-2017.

The average summer rainfall (January-April) is about 6 per cent of the average annual rainfall. Most of the summer rainfall occurred during April, which will be useful for land preparation. Between 2009-2017, most of the years received above long term average rainfall (Fig.5).

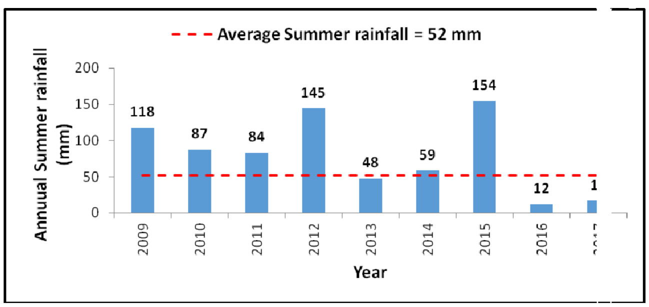

Fig. 5: Temporal variation of Summer rainfall between 2009-2017.

Groundwater level measurements

The groundwater level data is an important variable in the hydrological budget (e.g. estimation of recharge from rainfall or other sources) in subwatersheds. Time series data of groundwater level is also useful in understanding the usage patterns of groundwater for irrigation. The data is also useful in assessing the role of managed aquifer recharge or watershed practices in the catchments.

To study the hydrological characteristics like fluctuation of water table depth 150 borewells were selected. The water table was measured from the 150 representatives bore wells, monthly from January 2016 to November 2018 by water level sensing probe with a graduated tape was used for measurement of depth to the water table. There was an increasing trend of depth to the water table in the watershed during 2016 and 2017, as these years were lower rainfall years and indicate utilization of groundwater to buffer the lower rainfall years. Moreover, the groundwater use is relatively higher, and there is scope to reduce the use by utilizing the marginally under-utilized runoff through harvesting and conservation practices. The water table isobaths maps were prepared. The water table fluctuation in the study area during 2016 reveals that maximum area of 1808 ha was in the water table range of 20-25 m bgl accounting 45.86 per cent of total subwatershed during *Kharif* 2016 (Fig. 6), and during rabi the maxi (Fig. 7). It may be due to rainfall occurred during rabi season.

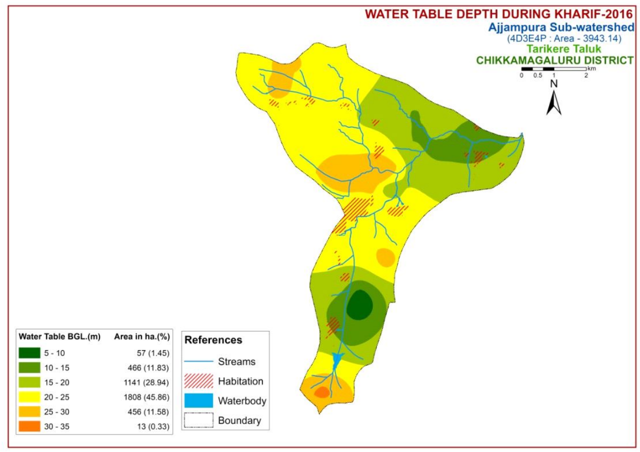

Fig. 6: Spatial variation of groundwater levels during *Kharif*, 2016 in Ajjampur subwatershed.

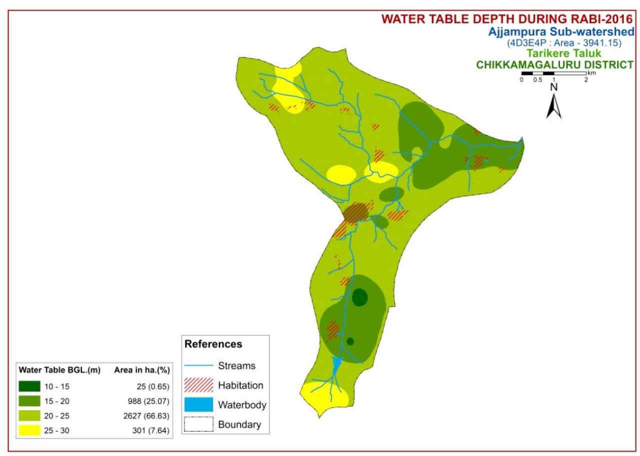

Fig.7: Spatial variation of groundwater levels during rabi 2016 in Ajjampur subwatershed.

Similarly, During 2017, The water table fluctuation in the study area reveals that the highest area of 2983 ha was observed in the watertable range more than the 35 m bgl accounting 75.65 per cent of total subwatershed during *Kharif* (Fig. 8) and during rabi 2017, the maximum area of 1967 ha was observed in the watertable range of 25-30 m bgl accounting 49.88 per cent. But during summer 2017 the maximum area of 2331 ha (55.13%) was in the water table range more than 35 m bgl (Fig. 9).

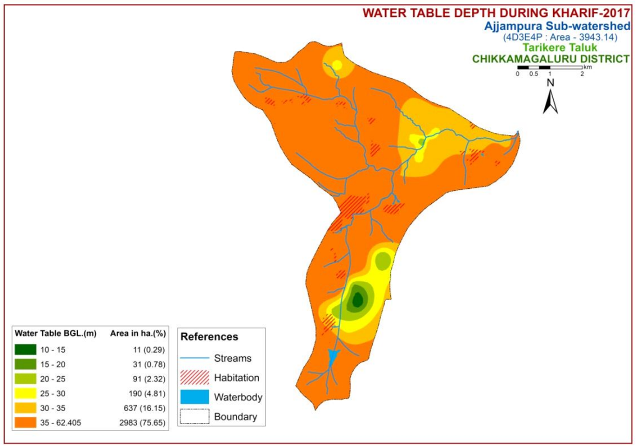

Fig. 8: Spatial variation of groundwater levels during *Kharif* 2017 in Ajjampur subwatershed.

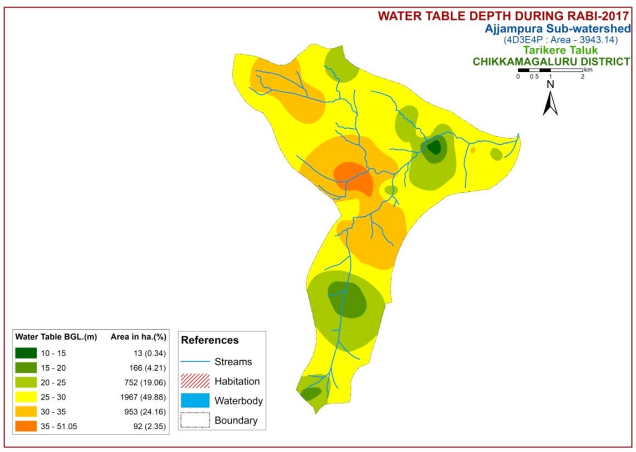

Fig. 9: Spatial variation of groundwater levels during rabi 2017 in Ajjampur subwatershed.

Conclusion

On an average 60 per cent of annual average rainfall is received during *Kharif* and 33 per cent of annual average is received in Rabi season. In a seven-year window, three years received low rainfall. There was an increasing trend of depth to the water table in the watershed during 2016 and 2017, as these years were lower rainfall years and indicated utilization of groundwater to buffer the lower rainfall years. Moreover, the groundwater use is relatively higher, and there is scope to reduce the use by utilizing the marginally under-utilized runoff through harvesting and conservation practices.

The water resource is one of the important natural resources available on Earth. Being an essential natural resource for the sustenance of life on Earth is a principal raw material for agriculture and industrial development. Though it is most widely available on Earth, the amount useful for human requirements is only 0.03%. This tiny amount is available in the form of inland water bodies (lakes, tanks, rivers, streams, etc.) and groundwater. If judiciously used, the available water is sufficient to cater to the needs of the human and animal population. Due to ever-growing demand, overexploitation, pollution, continuous drought, unplanned developments in the catchment area, unscientific agricultural practices and other human activities, the shortage of water is being felt. Hence, sustainable use and improvement/ development of water resource is prime requisite in the present-day context.

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