

STUDY OF FLUCTUATIONS IN THE GROUNDWATER LEVEL IN JHALAWAR DISTRICT OF RAJASTHAN USING GIS TECHNIQUES

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Abstract: Groundwater is a major source of freshwater in many parts of the world. Some regions are excessively dependent on it leading to groundwater consumption faster than it can be naturally replenished and causing water tables to decline unremittingly. Rajasthan is the largest state in the country and water resources supporting the human population are very less. Rajasthan has its water problems more-over, it is undergoing an industrial transformation. Present study try to examine trend the groundwater level fluctuation during pre and post monsoon period in last decade of Jhalawar district of Rajasthan. For identify this trend analysis author has used spatial interpolation the Inverse Distance Weightage Method (IDW). For this study author chose 20 village locations of Jhalawar district from each block and distribution has been shown by spatial maps which is prepared through Arc GIS. This study majorly based on Geospatial techniques for evaluating the spatial ground water level fluctuations.

Keywords: Groundwater table, Inverse Distance Weightage, Interpolation, Pre-monsoon, Post-monsoon, Fluctuation.

Introduction: -

Geographical information is an emerging branch of geography which enhances the technological transformation across space. Geographical information system has developed a remarkable step in last few years. This technology has emerged a influencing pace in daily life in modern society. Timely and reliable information on cost effective manner in spatial and temporal domain, which can act as a reliable base line information on natural resources at scale ranging from regional to micro levels, can be generated by geographic information system (GIS), which can help for integrated analysis of natural resources inventory, management and planning the strategy for sustainable development and stand as a power effective administrative and management tool as decision making. Rainfall is a crucial agro climatic factor. It is important to analyse the rainfall for cropping and agriculture. India is a tropical country so water utilization and agricultural planning depends on monsoon rainfall. Mainly the heavy rainfall occurs during the monsoon season. Rainfall during the monsoon season is unequal both in time and space so it is important to analyze the rainfall variation.

Study area: -

Jhalawar district is located in the southeastern part of Rajasthan. It is bounded in the north by Kota and Baran districts, in the south and southwest by state of Madhya Pradesh and in the northeast by Baran district. It stretches between 23° 44' 41.51" to 24° 52' 32.63" North latitude And 75° 27' 34.78" to 76° 57' 30.55" East longitude covering an area of 6,315.2 sq km. Major part of the district have a systematic drainage system, as the whole district is part of 'Chambal River' Basin.

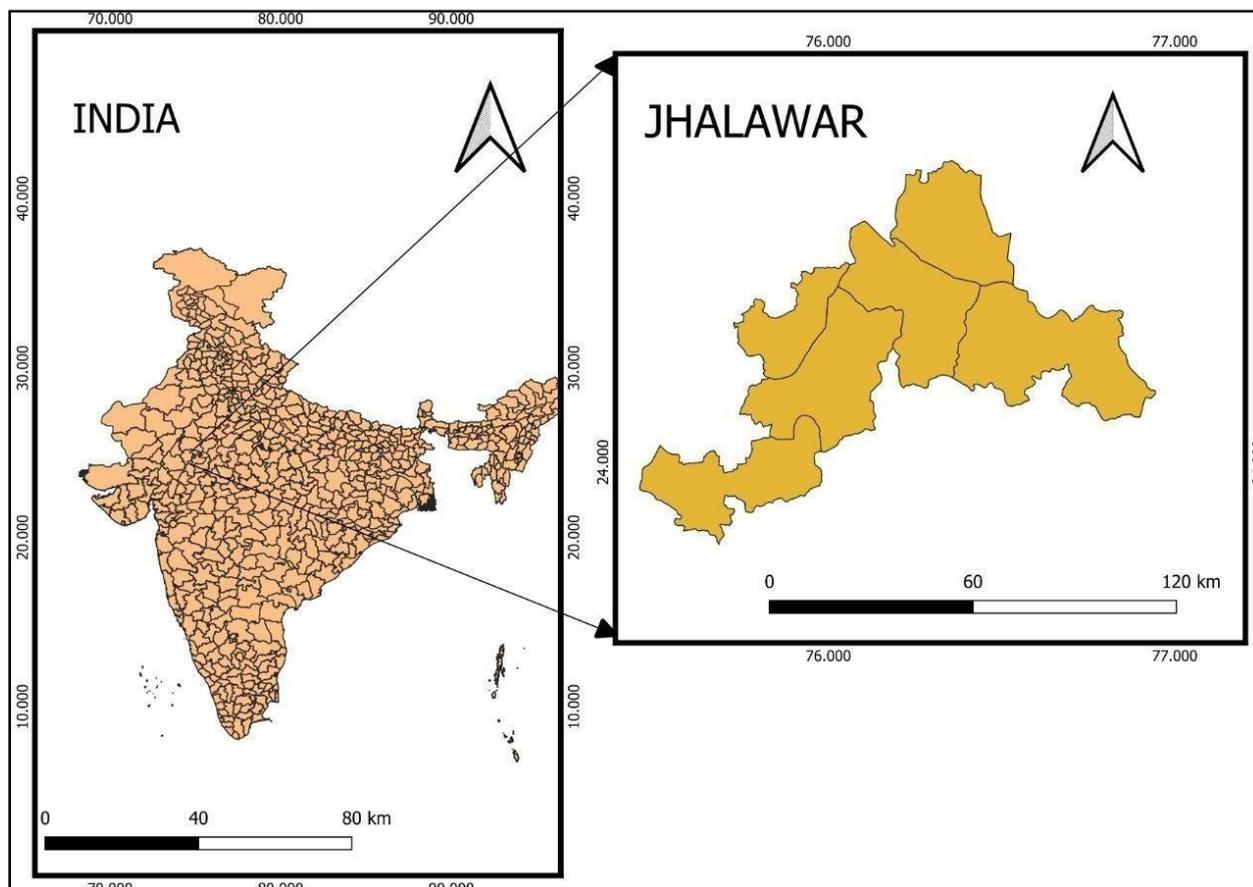


Figure 1: location map of study area Jhalawar district, Rajasthan

Climate: -

The climate of the area is more similar to that of the Indo-Gangetic Plains, with hot summer and delightfully cold winters than to the typical arid parts of Rajasthan. In summer maximum temperature is 47 °C and in winter minimum temperature is 9.5 °C. The monsoon season spread over months of July to September is however, quite unlike and very distinct from the oppressive humid climate of the North Indian Plains. Jhalawar district is known for the highest rainfall in the Rajasthan state. An average of 781.2 mm of rainfall keeps it cool, and gentle breezes ward off the high humidity.

Topography: -

Topographically, the district is an area of rounded hills interspersed by plains in the South and undulating plains in the North. General elevation range is 300-350 m falls under most of the blocks in the district. The entire district belongs to the Chambal river basin. The main rivers of the district are Parwan, Charganga, Kalisindh and Kyasari which are north flowing. The general topographic elevation in the district is between 300-350 m above mean sea level in most of the blocks. Elevation ranges from a minimum of 250.0 m above mean sea level in Khanpur block in the North part of the district and maximum of 523.7 m above mean sea level in Dag in SW part of the district.

Rainfall: -

The rainfall is fairly good in this district. The general distribution of rainfall across can be visualized from isohyets presented in the Plate III. Rainfall ranges from 600-700 mm received in most of the district and 700-800 mm in West and East of the district. The total annual average rainfall is 663.5 mm based on the data of available blocks. Maximum rainfall occurs in Jhalrapatan block (825.4 mm) whereas minimum also in Jhalrapatan block (528.4 mm).

Maximum average annual rain fall is recorded in Pirawa block about 706.9mm.

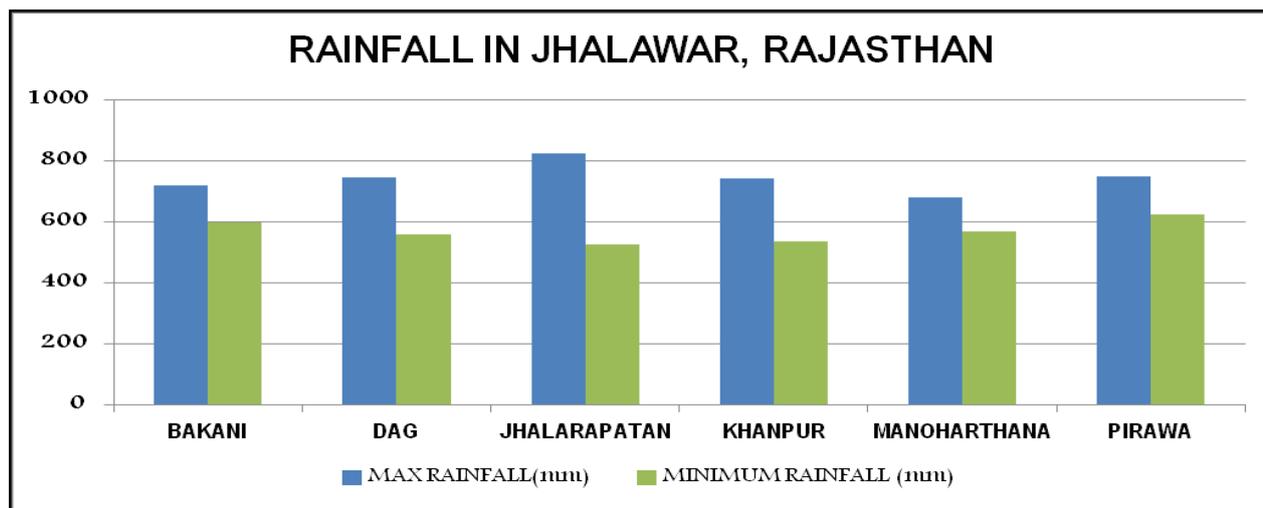


Figure 2 Rainfall in blocks of Jhalawar district Rajasthan

Geology: -

According to Hydro geological Atlas of Rajasthan Jhalawar District (2010), Jhalawar district geologically made from Deccan traps which covers almost 70% area of Jhalawar along with the Vindhyan group rocks. The Vindhyan super group rocks represented by Semri, Kaimur, Rewa, and Bhandar groups which are made from limestone, shale and sandstone. The Vindhyan sandstone and shales from linear hills trending north east to south east. They are exposed around Jhalawar and its north east and north west.

Literature Review: -

(Agarwal, 2007) has noted that increase in population and urbanization leads to groundwater depletion. Thus, groundwater study plays an important role in assessment, monitoring, planning, development and Integrated Water Resources Management in Rajasthan.

(Gopal Rui Das, 2019) has examined that Development of groundwater and scattering inside the aquifer spreads the contaminants over a more extensive territory. Surface water permeate through soil then it gets minerals, salt, furthermore, natural compounds. The water relocates descending thusly centralization of broke down solids are increased. In certain territories minerals focus is sufficient high so that the groundwater is unfit for drinking and water system reason without treatment. At the point when the tainted water saturates the dirt and enters an aquifer it results into ground water contamination.

According to (C. R. Ramakrishnaiah, 2009) GIS is a successful device for groundwater fluctuation mapping and fundamental for checking the natural change recognition. GIS has been utilized in the guide arrangement of groundwater quality, in view of associating all out broke upsolids (TDS) values with some aquifer attributes or land use and land cover.

According to (S. K. Singh, 2018) GIS is generally utilized for site reasonableness investigation, overseeing site stock information, estimation of groundwater helplessness to tainting, groundwater stream demonstrating, displaying solute transport and filtering, and coordinating groundwater quality evaluation models with spatial information to make spatial choice emotionally supportive networks.

(Chinnasamy P, 2015) About 80% of the State areas have witnessed groundwater depletion and many towns and villages have experienced a shortage of drinking water, particularly in summer months.

Research Objectives: -

- 1- To examine the spatial ground water level situation in various villages in Jhalawar district in Rajasthan during (2011-2020)
- 2- To assess the amount of ground water fluctuation across during pre-monsoon and post-monsoon in all the blocks in Jhalawar district Rajasthan.
- 3- To calculate the water level variation block-wise across Jhalawar district pre-monsoon and post-monsoon comparison during (2011-2020).

Research Questions: -

- 1- How ground water fluctuate during pre-monsoon and post-monsoon in Jhalawar district Rajasthan?
- 2- Is ground water availability constant across all the blocks in Jhalawar is there any significant variation in pre and post monsoonal water table?
- 3- What is the trend of ground water fluctuation across all the blocks in Jhalawar district during pre and post monsoon period?

Database: -

This study examines the ground water fluctuation in Jhalawar district in Rajasthan in recent years. The entire study is based on

secondary data sources. Major part of data is taken from government of Rajasthan official website. The ground water level (Pre & Post-monsoon) data has been taken from Ground Water Department, Jodhpur for 20 locations during 2011 to 2020. Rainfall data and water table fluctuation data 2010 have been taken from Hydrological Atlas of Rajasthan. Water level elevation data also taken from Hydrological Atlas of Rajasthan.

Research Methodology: -

Present study focuses more upon water table fluctuations across Jhalawar district. Inverse Distance Weightage method has been applied. For the spatial interpolation the Inverse Distance Weightage Method (IDW). IDW interpolation is some techniques which is largely used in mapping of variables. It is an exact and convex interpolation method that fits only the continuous model of spatial variation. The maps have been prepared from Arc GIS software. Distance Weightage (IDW) was applied for estimating the attribute values of locations that are within the range of available data using known data values. The area of Jhalawar district was clipped from the interpolated data using Model Builder. These values were extracted to MS-Excel for statistical analysis. Two terms has used in this study in many times pre & post monsoon season. Pre-monsoon shows that when monsoon withdraws from peninsular India earlier than the northern parts. June is very much pre-monsoon season for north India. A part from that post monsoon refers to the period of retreating of monsoon during October to November. It also known as autumn season in India.

Discussion: -

The ground water resources are replenished by annually through the monsoon. Therefore, the fluctuations of ground water level were seen calculating difference for pre-monsoon may-June and post-monsoon in November. After analyzing the ground water level fluctuation during pre and post-monsoon period data of Jhalawar, Rajasthan this is observed that depth of water level during pre-monsoon period is high and post monsoon period it decreases that's why The total fluctuation of water table is high in some areas. Sometimes it happens that in pre monsoon period in some areas faces water scarcity. And other areas have sufficient water table. There is adynamic balance of water level between water recharge, storage and discharge if recharge exceeds discharge, the volume of water in storage will increase and water levels will rise; if discharge exceeds recharge, the volume of water in storage will decrease and water levels will drastically fall. It is because recharge and discharge are not uniformly distributed in space and time, ground water tables are continuously rising or falling to adjust the resulting imbalance (Rede, 2012). Following figures illustrates ground water levels and fluctuations for the years 2011, 2014, 2017 and 2020 has been shown through spatial maps comparison during pre- monsoon and post monsoon period in various locations in Jhalawar, Rajasthan.

Year – 2011: -

In 2011 highest water level depth has been found in Golana place in Khanpur block in Jhalawar followed been found locations have sufficient ground water depth viz. Arniya, Dola and Asalpur by Baldeopura and Bagher and lowest ground water level depth has in Motipura followed by Amratkheri and Azampur. Some locations have sufficient ground water depth viz. Arniya, Dola and Asalpur. (Figure-3:)

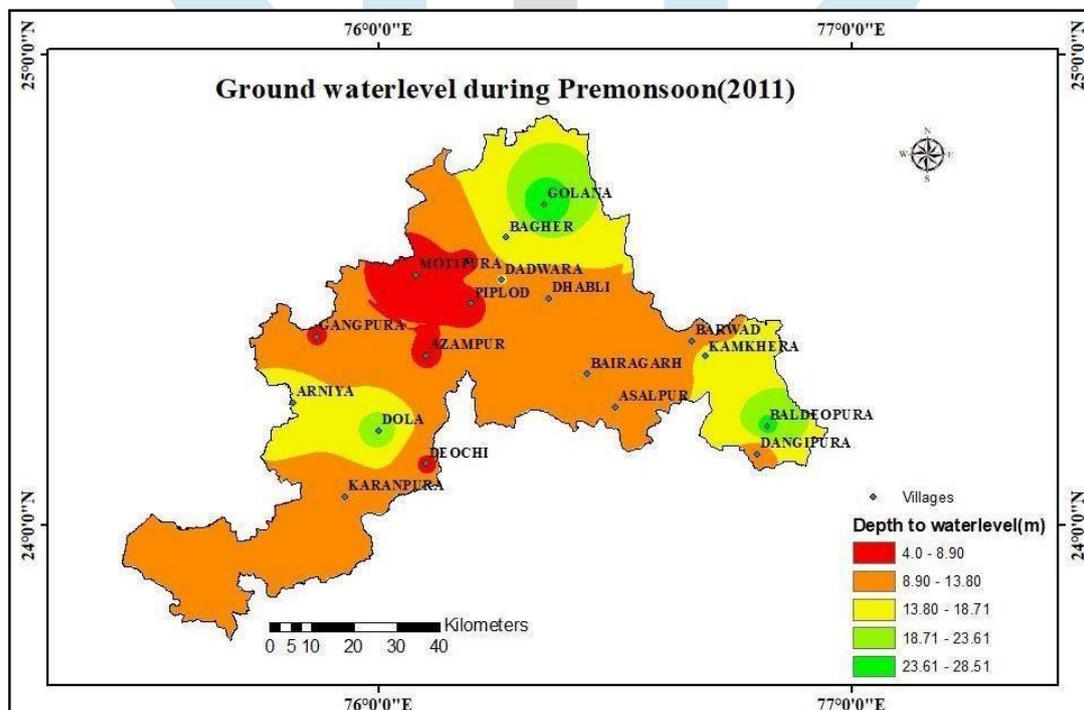


Figure 3 Ground Water level situation map during pre-monsoon season in 2011

In post-monsoon period in 2011 has noticed a average ground water depth in all the locations. Highest ground water depth has seen in Arniya and followed by Dola and Dolana. Lowest depth has been noticed in Deochi followed by Motipura and Dhabli. Good water table indicates a sufficient rainfall in the Jhalawar.

Ground water level Fluctuation in 2011: -

Highest fluctuation has been noticed in Golana followed by Baldeopura and Bagher between all 20 villages across Jhalawar district. Lowest fluctuation has been noticed in Piplod followed by Amratkheri and Dangipura village. Some villages notice a satisfactory ground water table fluctuations viz. Gangpura, Dhabli, Azampur and Dola etc.

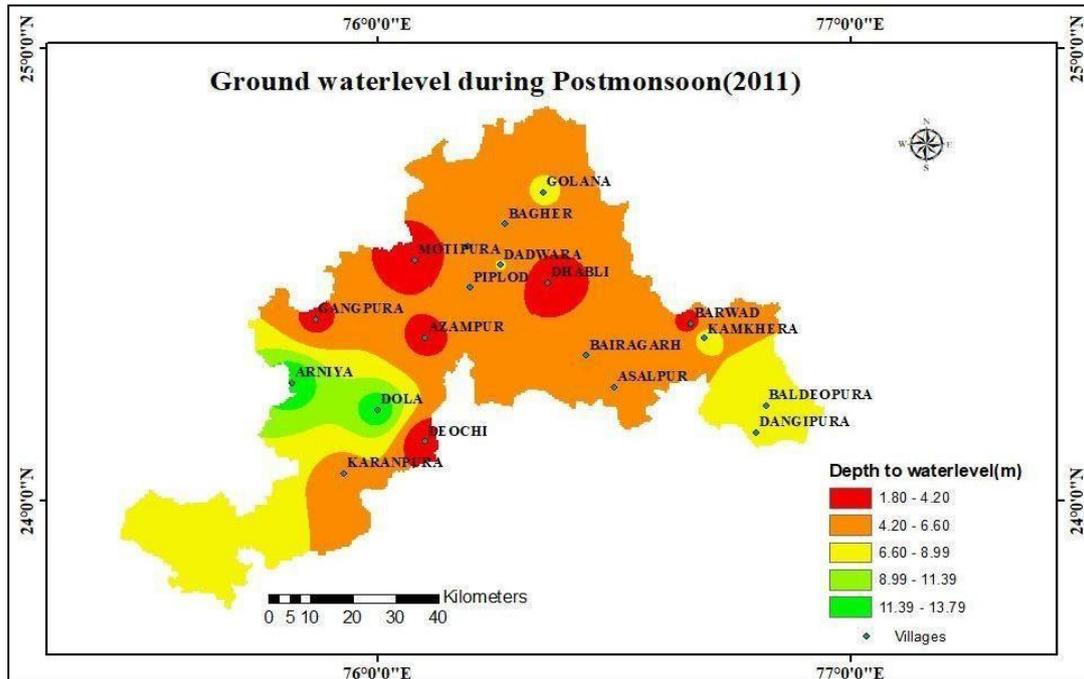


Figure 4 Ground Water level situation map during post-monsoon season in 2011

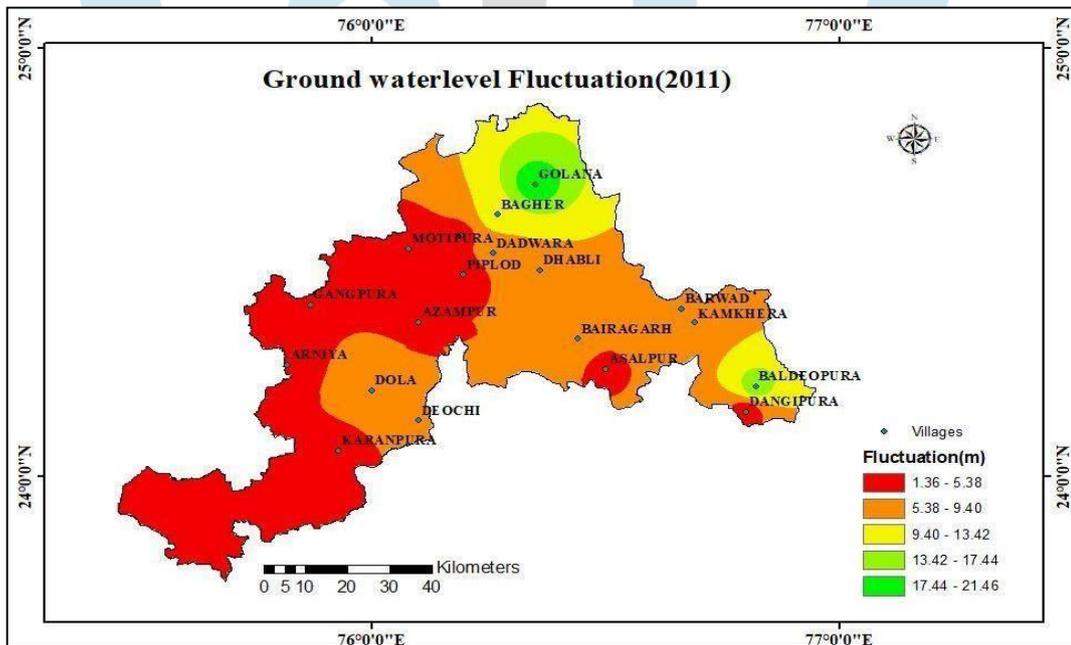


Figure 5 Ground Water level fluctuation map during pre & post-monsoon in 2011

Year – 2014: -

The groundwater levels in pre-monsoon (max) show a decreasing trend in the almost all the locations during 2014 in pre-monsoon period across Jhalawar district. Data has been showing a drastically declining trend across Jhalawar. According to available data Baldeopura depicts high ground water level depth in pre-monsoon season followed by Arniya and Dola villages. A part from that lowest ground water table depth has been noticed in Deochi village. Figure – 6

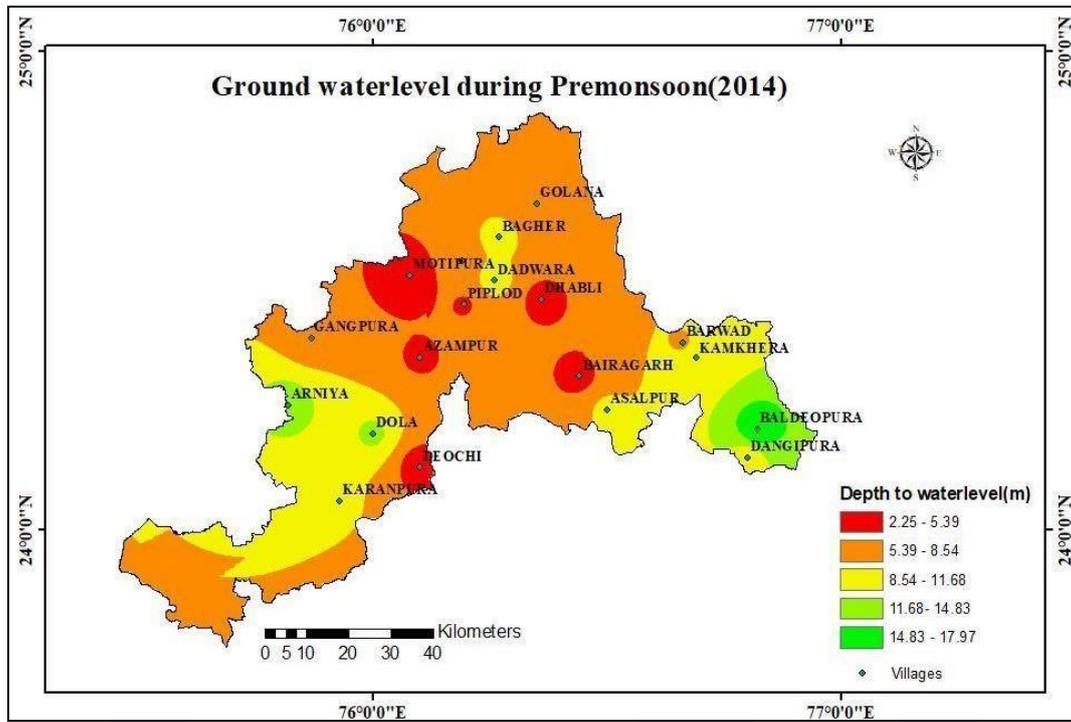
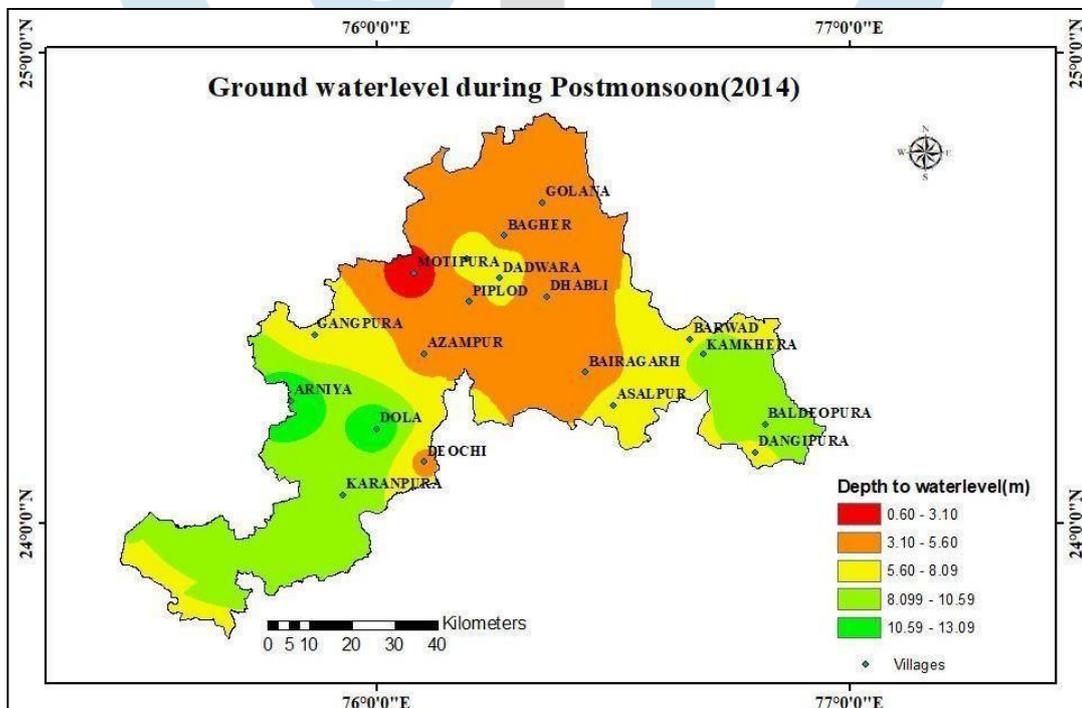


Figure 6: Ground Water level situation map during pre-monsoon season in 2014

During post-monsoon period in 2014. It can be seen in map that a declining performance of ground water depth. The water level increase in 2014. Arniya has noticed lowest ground waterlevel situation across the Jhalawar followed by Baldeopura and Dola. Good water table conditions have seen in Motipura followed by Amratkheri and Bairagarh. Almost All the locations have enough ground water table in 2014. Figure - 7

Figure 7 Ground Water level situation map during post-monsoon season in 2014



Ground water level Fluctuation in 2014: -

In 2014 the Ground water table fluctuation has been more declined in comparison to 2011. In some district viz. Piplod, Dola and Deochi villages have been noticed a negative value fluctuation. The highest fluctuation has been noticed in Baldeopura followed by Bagher and Motipura. This year depicts a significant decline in ground water table fluctuation. Figure 8

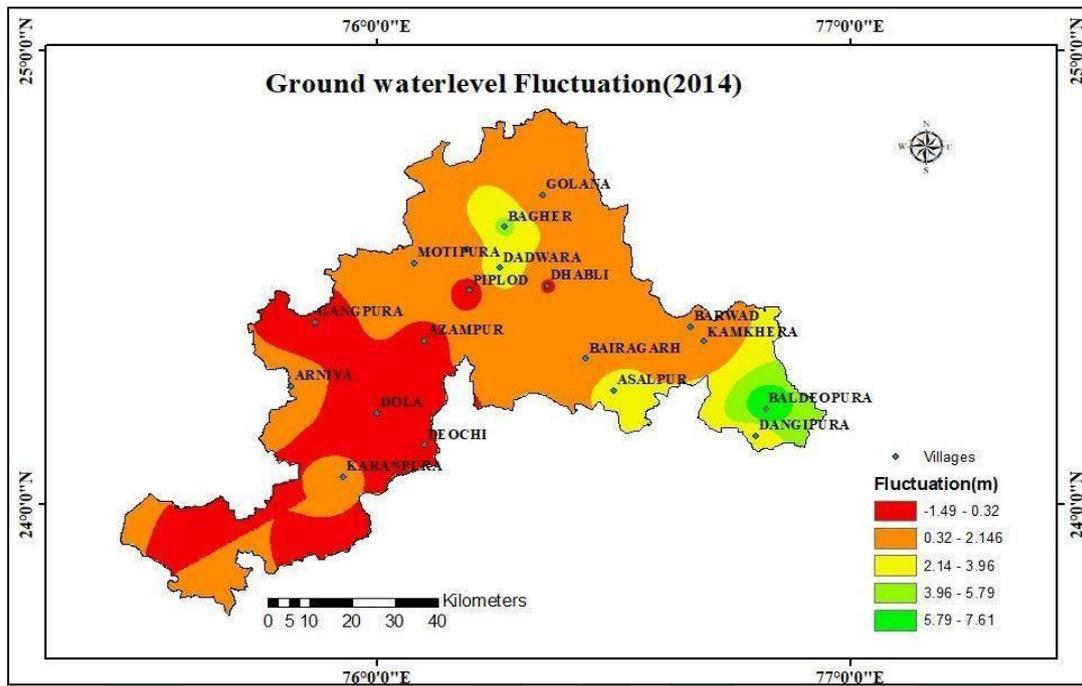


Figure 8: Ground Water level fluctuation map during pre & post-monsoon season in 2014

Year – 2017: -

In 2017 some increasing trend has been happen, in some locations have faced drastic change in ground water depth during pre-monsoon season. In Gangpura village has faced drought like condition and other all locations have noticed a increasing trend in ground water depth. Highest depth has seen in Dola village followed by Arniya and Kamkhera. Figure -9

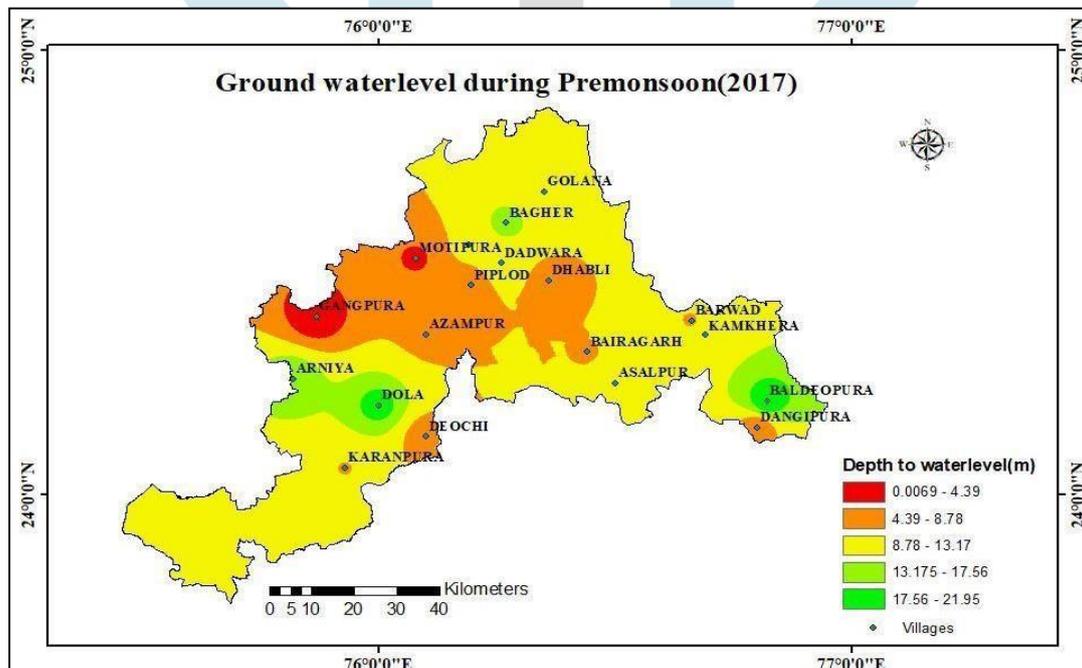


Figure 9: Ground Water level situation map during pre-monsoon season in 2017

In the period of post monsoon during year 2017 it seen can be seen in the spatial map that declining trend is happening in ground water table depth in Jhalawar district Rajasthan. Highest depth of ground water table has noticed in Dola village followed by followed by Arniya. Bagher district has sufficient water table that's why it is well filled up in this period. Lowest depth of ground water table

has seen in Motipura followed by Deochi village. Figure - 10

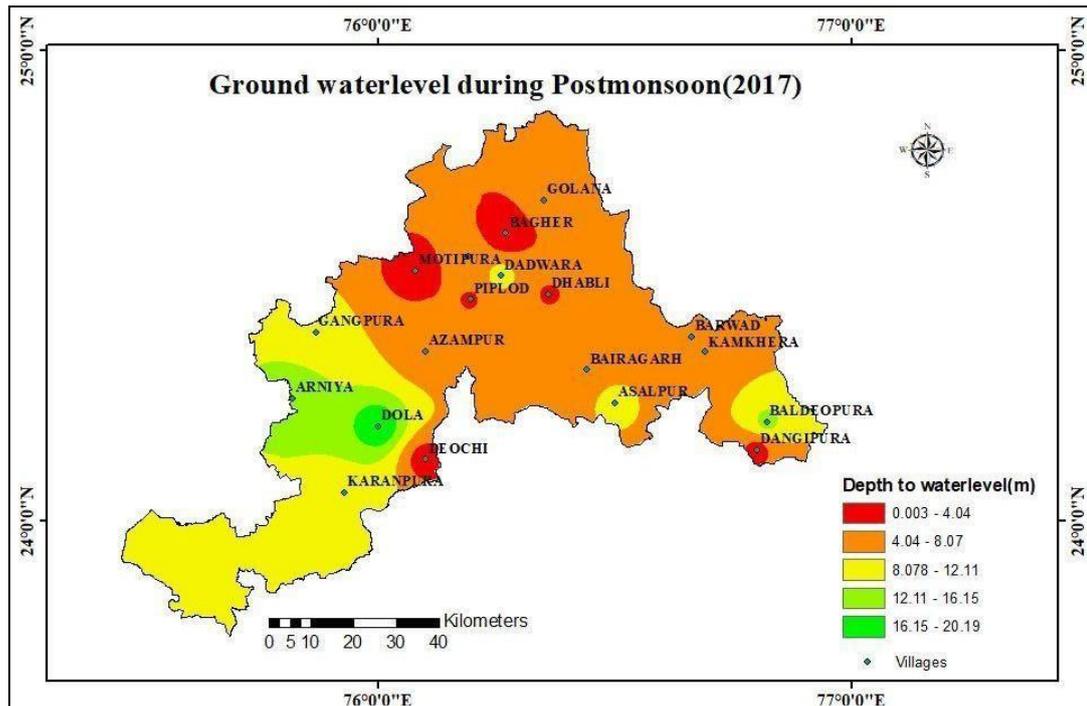


Figure 10 Ground Water level situation map during post-monsoon season in 2017

Ground water level Fluctuation in 2017: -

In 2017 it can be seen that some gradual increase has been happen in ground water table fluctuation. Karanpura district has noticed a significant decline in terms of ground water table fluctuation. Highest value has been noticed in Kamkhera followed by Barwad and Deochi. Fig-11

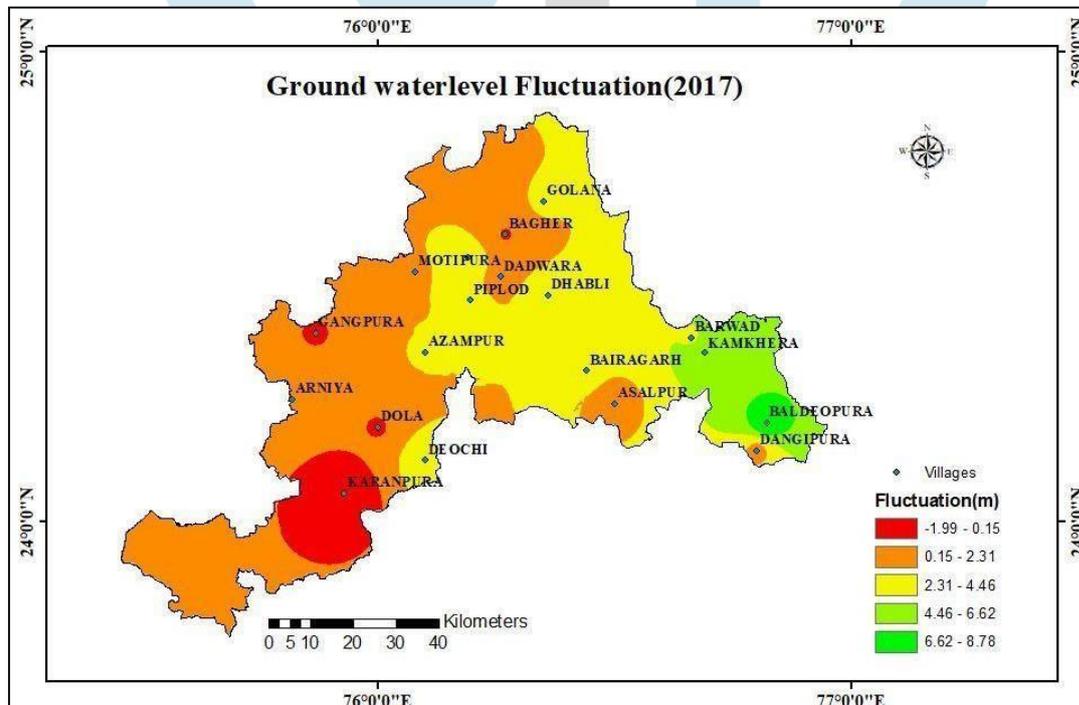


Figure 11: Ground Water level fluctuation map during pre & post-monsoon season in 2017

Year – 2020: -

In 2020 almost same trend has been noticed in pre-monsoon season. The highest ground waterdepth has seen in Arniya village followed by Deochi and Dangipura locations. In other side lowest ground water depth has been noticed in Motipura village followed by Azampur and Dhabli villages. Figure - 12

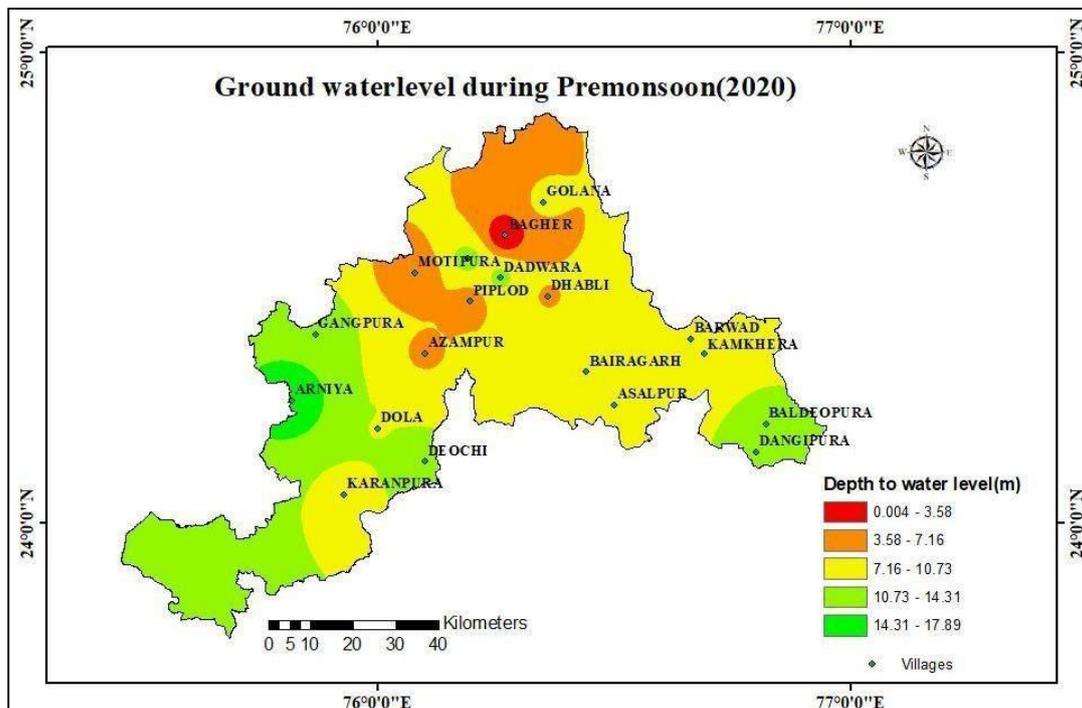
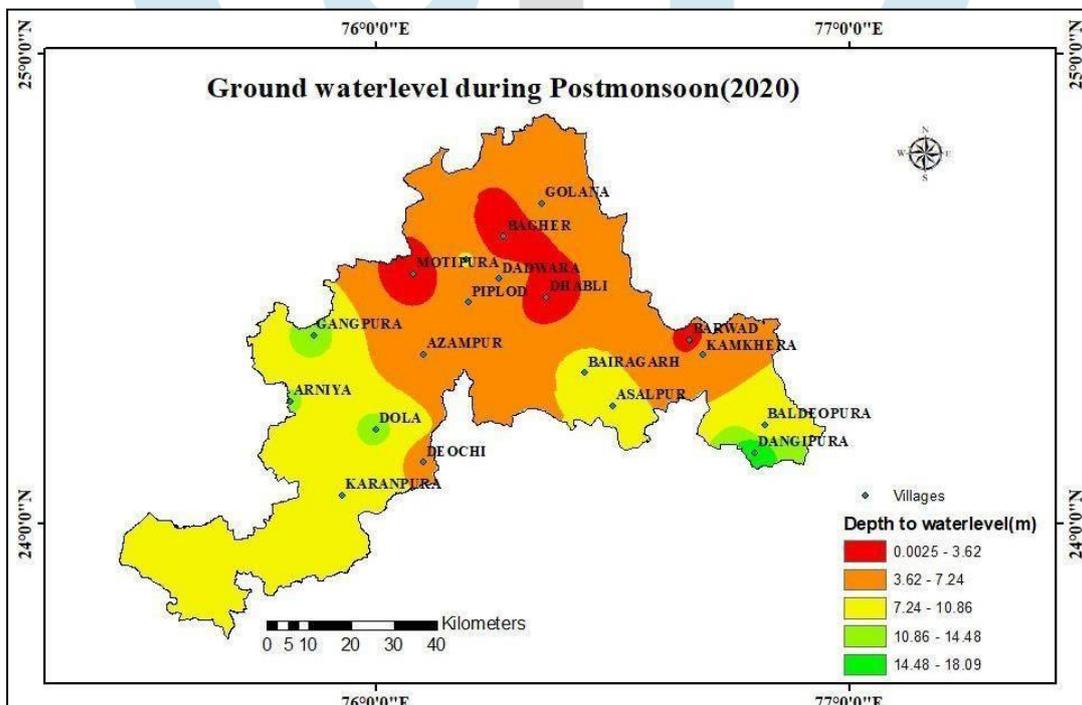


Figure 12: Ground Water level situation map during pre-monsoon season in 2020

In year of 2020 during post monsoon season it can be seen in spatial map that Bagher, Dhabli, Motipura and Barwad has noticed lowest ground water level depth. In other side it also can be seen in the spatial map that Dangipura, Dola and Gangpura has highest ground water level depth in terms of meters. Consequently, in post monsoon, ground water table depth has declining. Fig 13

Figure-13 Ground Water level situation map during post-monsoon season in 2020



Ground water level Fluctuation in 2020: -

In 2020 Dangipura and Dola have been notice a negative value of ground water level fluctuation. In this year some growth has happened in ground water table fluctuation. Highest values have been noticed in Arniya followed by Barwad and Deochi. figure - 14

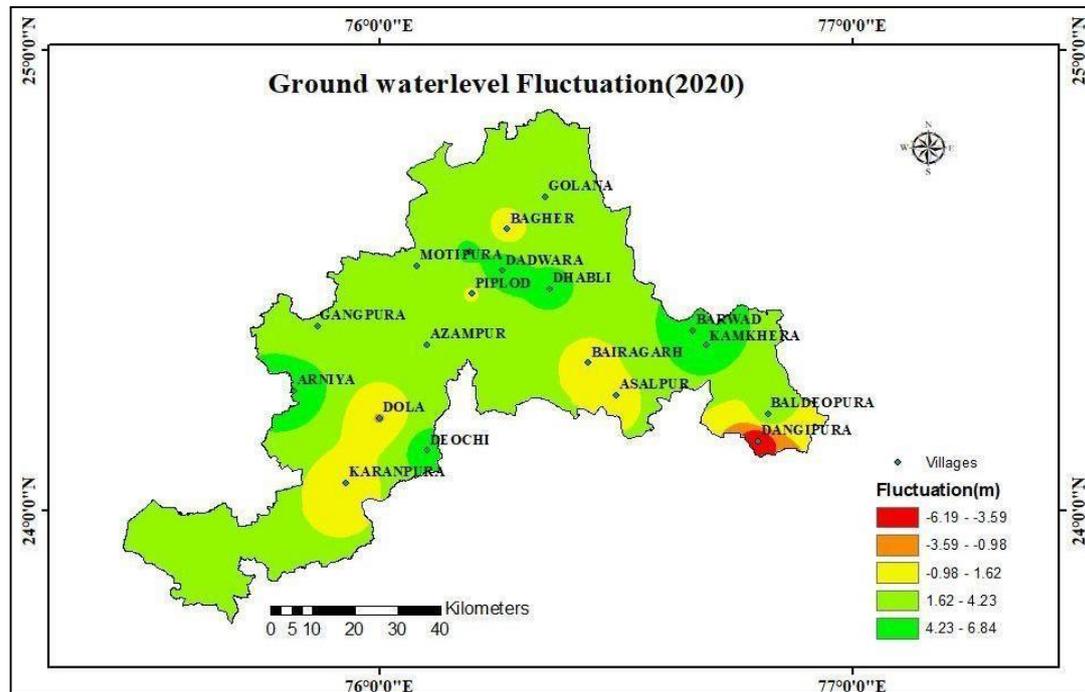


Figure 12: Ground Water level fluctuation map during pre & post-monsoon season in 2020

Results: -

During pre-monsoon period rainfall is less. It is a time before arrival of monsoonal rainfall. So in this particular time ground water level has decreased it means ground water depth has increased because of less rainfall. Sometimes it happens that in some locations faces drought like conditions due to scarce rainfall. Figure-2,3,4 and 5 are depicting the spatial interpretation of ground water situations across Jhalawar during pre-monsoon season.

In post monsoon season declining trend has noticed almost all the locations across Jhalawar district. Some location is also showing an increasing trend in ground water depth viz.

Govindpura, Arniya and Gangpura. Bagher location sufficiently filled up in post monsoon season. Following spatial maps (Figure-6,7,8 and 9) are showing the trend in post-monsoon period across Jhalawar district in Rajasthan.

The ground water fluctuation can be proposed from figure- 10, 11, 12 and 14 spatial maps across Jhalawar district in Rajasthan. In all the 20 locations the fluctuation of ground water level has been shown in spatial maps.

Conclusion: -

Ground water table fluctuations among 20 locations/villages have been determined using Remotesensing and GIS techniques from Jhalawar district Rajasthan. After analyzing the study it has been found that a significant decline in ground water table fluctuation in Jhalawar district Rajasthan. The situation of ground water table in pre-monsoon period became bad and post monsoon period is much better for enough ground water table. In some villages viz. Dola, Dangipura, and Arniya has good water table in all the year. Apart from that Bairagarh, Barwad and Baldeopura are suffering from drought like conditions.

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