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A study on hydrogeological investigation in Manasa area Neemuch district, Madhya Pradesh, India

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Abstract
In the view of water resource, it is considered desirable to carry out investigation in manasa area located in the Neemuch district of Madhya Pradesh, to prepare a plan for the exploration and management of Ground-water resource to provide a remedial solution to cater the demand of sustained water supply for different human applications.
Ground water condition of area depends on Geology, hydrology, soil, recharge and discharge aquifer.
The variation range of ground water static water level is found to be Pre-monsoon 6.50 to 30 m and post-monsoon 0.50 to 4.10 m. On observing 36 dug well Ground-water level fluctuation varies from 4.00 to 30.50 m. The maximum depth of fluctuation i.e. 30.50m is found at Atri village and maximum depth of fluctuation i.e. 4.00m is found at Semli village. In 2.77% of wells the fluctuations of water levels arrange less than 3 to 4 m, in 94.4% of wells range of 4 to 16 m and only in 2.77% of well range of 29 to 30 m is noted.
The level of ground water can be increased by development of artificial recharge structures such as pit, trench, stop dam, pond, gully plug, percolation tank, and dyke and rain water harvesting system. The development of crops also depends on the soil and geographical status.

Keywords: fluctuation, hydrology, and artificial recharge, Madhya Pradesh

Introduction
Water is one of the most valuable natural resource for the development of mankind and society. The economic prosperity of a country is controlled by it's water resources. Earth contains abundant water resource, which constitutes about 71% of the world. However, the good quality fresh water is available in limited quantity. It has been estimated that 97% ($1.25x10^{18}m^3$) of water is contained in the oceans and remaining 3% as fresh water distributed as polar ice and glaciers 75%, ground-water 14% with depth range of 800 to 4000 m and 11% at depth of less than 800m, in lakes0.3%, soil moisture 0.6%, in atmosphere 0.35% and in rivers 0.03% (Chow, 1964) [1].
The water resource is of vital importance for the optimum development of agriculture and acts as an only potential substitute of surface water demand of populace. The Ground-water resource is of immense importance due to its characteristic nature of availability at the point of use for varied applications.
The optimum development of agriculture and surface water demand of populace, the water resource is very important. To prepare a plan for the exploration and management of ground water resource, to provide a remedial solution to cater the demand of sustained water supply for different human applications, it is considered to carryout investigation in Manasa area of Neemuch District in Madhya Pradesh.

The study area Location
At present the study area is located in manasa block of neemuch district, of the malwa plateau in Madhya Pradesh, within latitudes from 24^0 18' to 24^0 30' N and longitudes from 75^0 5' to 75^0 15' E (Survey of India toposheet no. 45 P/3, Figure 1). The study area covers 371 km^2 in vicinity of manasa and is located on the mhow- Neemuch road at a distance of 22 km. from Neemuch city. The area is accessible throughout the year by motorable road, field tracks and nearest railway station of Neemuch.

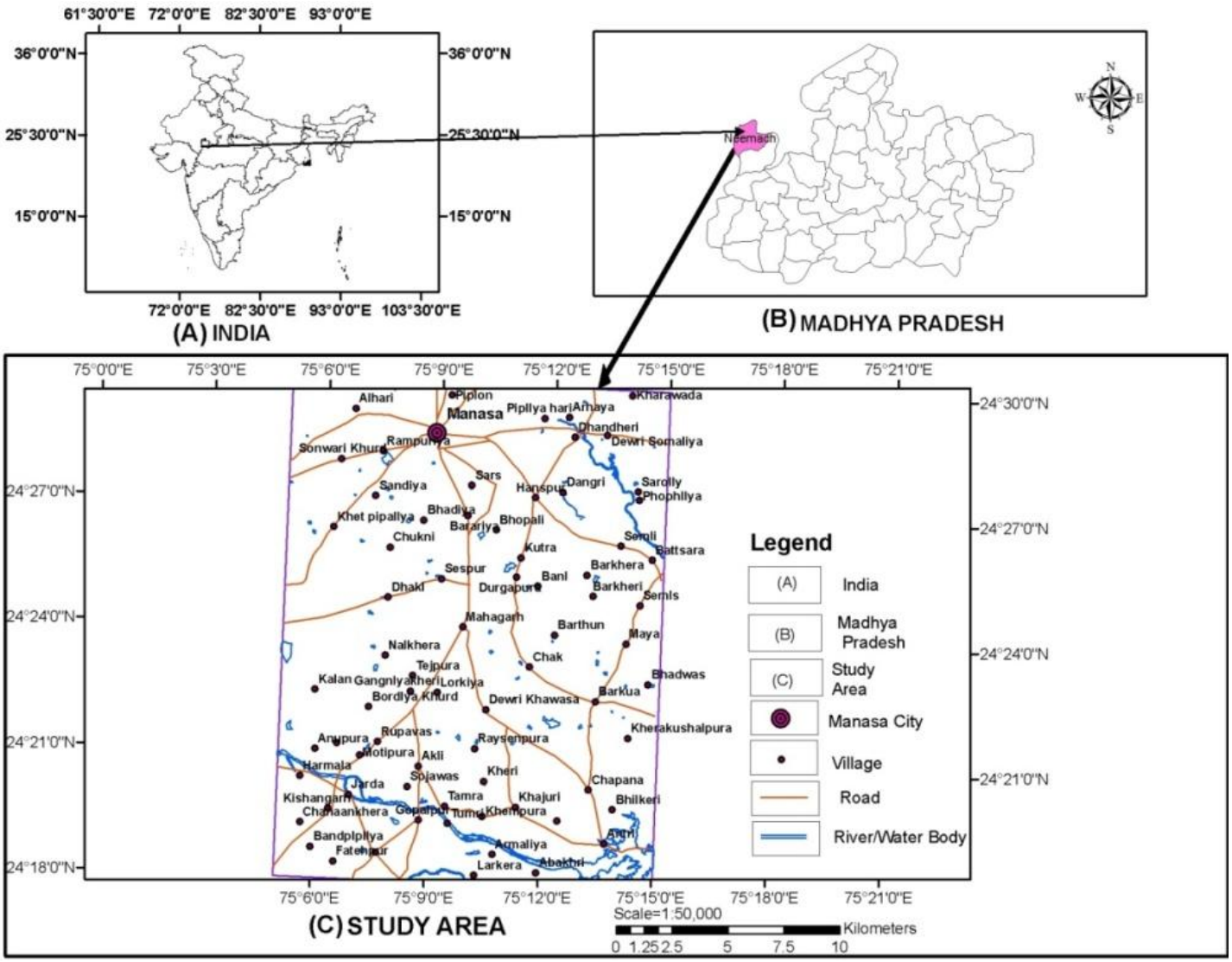

Fig 1: Location map of Manasa study area, Neemuch district, M.P.

Environmental Impact of Ground-Water Rainfall-

The rainy season is recorded during June to September period. The maximum amount is rainfall recorded during monsoon season. The range of annual rainfall is 457 mm. to 1599.7 mm. with average of 862.352 mm. Maximum rainfall has been recorded during the year of 2006.

Soil

The soil of Manasa area has been classified as black cotton soil, also known as 'shasya shyamal'. In some parts red and yellow soils are found, soils are suitable for the cultivation of poppy, though all kinds of crops are developed in Neemuch district. The total grass cropped area 75% was devoted to the production of Kharif crops and 25% to rabi crops. The various crops predominate with 68% and 32% was non food crops. Jowar 25.8%, wheat 11.5%, maize 8.6%, urad 8.7%, gram 7.6%, oilseed, groundnut 10.5%, cotton 3.6% and the opium.

Geology

The present study has been carried out in Manasa area located in Neemuch district of Malwa region Madhya Pradesh, The occupied by rocks are Vindhyan Super Group (Pre-Cambrian) and the Deccan Traps (Upper Creteceous to Lower Eocene) (Table 1, Fig 2).

Table 1: Stratigraphic succession of Manasa area, Neemuch district, M.P.

Age	Super Group	Group	Member
Recent	-	-	Alluvium, Leterite
Lower Eocene to Upper Creataceous	Deccan Traps	-	Basaltic lava flow
Pre-Cambrian	Lower Vindhyan	Semri Group	Limestone and conglomerate
Base not exposed			

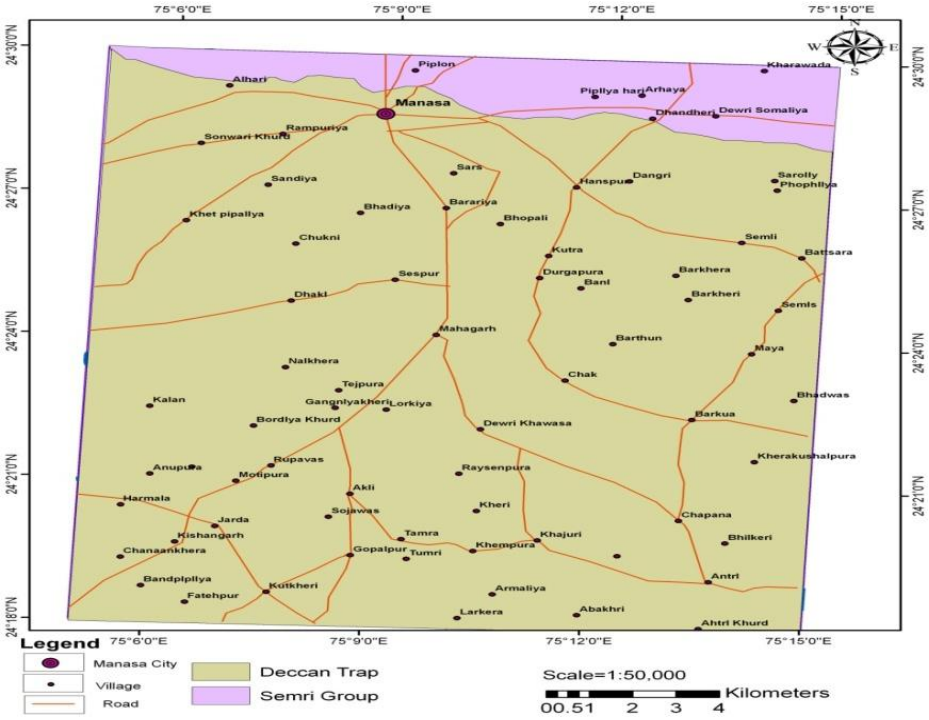

Fig 2: The geological map of Manasa area

Prospect Map Groundwater

The false colour composite (FCC) and TM 4 band data examination reflects identification of the geomorphic features reflect suitable sites of groundwater in the study area (Figure 3).

Ground-water potential is observed of the ranging from very high, high, medium, low and very low. The zones along the water body in indicate the ground-water potential zone is fairly high to very high. The near Kishangrah, Moya, Semli, Bhadwas, Saroly and Khet Piplliya area yields medium Ground-water potential prospects. The plateau is indicative of the low to very low Ground-water potential zone. The geomorphic unit such as the linear ridge indicates that the Ground-water potential is very low (Figure 3).

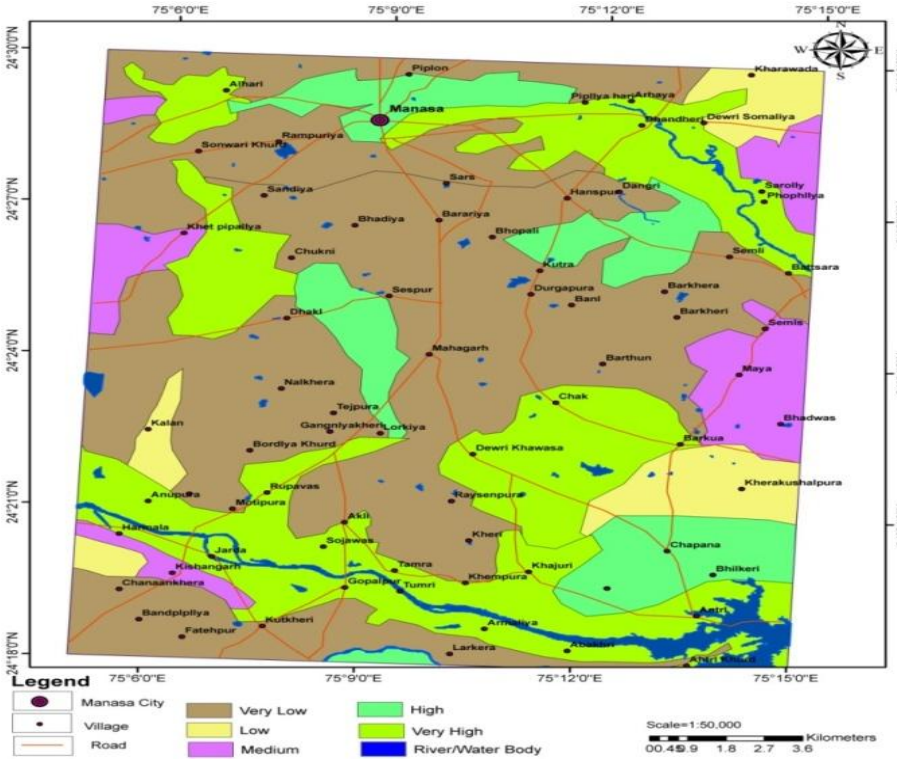

Fig 3: Ground-water prospect map of Manasa study area, Neemuch M.P

Result and Discussion

In the Present investigation is dealing with the shallow Ground-water system in Manasa area of Neemuch district in Madhya Pradesh. The characteristic of the occurrence, movement and potential of Ground-water have been examined on the basis of recording relevant well data. The hydro geological survey of the present area has been conducted by the well inventory of existing dug wells. The relevant hydro geological data in respect of 56 open dug wells have been examined and data such as the location, owner of the well, mode of lifting, type of well, use of water, bench mark, static water level, depth of well during post monsoon period etc. have been recorded. Based on the seasonal variation of Ground-water 36 open dug wells has been demarked as observation wells to records fluctuation from post-monsoon to pre-monsoon.

Ground-Water Movement

The movement of Ground-water has been through the pore space and voids. The well data collected during October 2010 and June 2011, 36 observation wells have been analyzed to determine the reduced water levels from, bench mark (Table 2). The help of reduced water levels, the water level contour maps have been prepared to post-monsoon and pre-monsoon periods. With the direction of Ground-water flow, has been determined by dropping a perpendicular from a higher value water level contour of lower value water level contours which indicates the flow directions of the ground-water movement and favorable site in the area.

Table 2: Measurement of observed wells in the Manasa area.

S. No	Location	Bench Mark	Post Monsoon		Pre-Monsoon		Fluctuation
			Static water level (m)	Reduced water level (m)	Static water level (m)	Reduced water level (m)	
1	Antri Khurd	410	1	409	6	404	5
2	Antri	412	1	411	30	381	30
3	Khajuri	448	3	445	11	437	9
4	Dewri	481	2	479	8.5	472.5	6.5
5	Chaplana	419	2.1	416.9	12	407	9.9
6	Kheri	462	3	459	12	450	9
7	Kempura	425	1	424	16	409	15
8	Kesharpura	447	1.35	445.6	12.5	434.5	11.1
9	Mahagarh	449	4	445	12	437	8
10	Barthun	482	0.5	481.5	14	467	14.2
11	Moya	421	2	419	18	403	16
12	Buni	473	1.4	471.6	12.3	460.7	10.9
13	Semi	421	2.5	418.5	6.5	414.5	4
14	Kotrao	471	2.7	468.3	15.8	455.2	13.1
15	Sors	462	2.8	459.2	13.7	448.03	10.9
16	Dangri	436	2.3	432.7	11.9	423.1	9.6
17	Manasa	450	2.5	447.5	14.5	435.5	12
18	Kharwada	429	3	426	11	418	8
19	Alher	470	2.5	467.5	14.2	455.8	11.7
20	Rampuriya	476	1	475	9.9	466.1	8.9
21	Koliner	467	1	466	11.1	455.9	10.1
22	Dhakni	454	2.8	451.2	11.1	442.9	8.3
23	Chakhi	470	1.8	468.2	17.9	458.1	10.1
24	Sespur	454	2.2	451.8	15.4	438.6	13.2
25	Nalkera	457	1.2	445.8	12.1	434.9	10.9
26	Lorikiya	434	3.3	430.7	8.3	425.7	5
27	Lorikiya	441	2.9	438.1	9.9	431.1	7
28	Motipura	429	2	427	11.2	417.8	9.2
29	Rupavas	436	4.1	431.9	15	421	10.9
30	Akli	427	1.5	425.5	13.5	413.5	12
31	Tumra	421	2.5	418.5	11	410	8.5
32	Jarda	417	1.9	415.1	15.4	401.6	13.5
33	Gopalpura	423	1.1	421.9	12	411	10.9
34	Kishangarh	430	2.5	427.5	12	418	9.5
35	Bordiya	449	1.3	447.7	11.9	437.1	10.6
36	Dandheri	440	2.7	437.3	12.5	427.5	10.2

Post-Monsoon Ground-Water Level Contour Map

The contour map of ground-water level in the study area is prepared on basis of the collected data of wells during post-monsoon period (October 2010). The Ground-water level movement flow directions have been marked, with the help of arrow on the water level contour map (figure 4). It has been observed that Ground-water level is rather widely spaced almost throughout the area of investigation, except in at Antri, Chaplana, Kheri, Dewri, Keshapura, Barthun, Moya, Semli and Kotrao villages. In the location Jarda, Dewri, Barthun, Buni and Rampuriya village of Ground-water mound is observed and its presence is suitable zone for Ground-water extraction. In the part of the North-West-South at Mahasa, Alher, Sors, Chakni, Joliner, Dhakhi, Sespur, Mahagarh, Nalkhera, Lorkiya, Bordiya, Rupavas, Motipura, Akli, Jarda, Tumra, Gopalpura and Kishangarh villages are nature of Ground-water contours indicates the existence of a favourable recharge zone. The movement of Ground-water is Ratam River.

Pre-Monsoon Ground-Water Level Contour Map

The contour map of ground-water level in the study area is prepared on basis of the collected data of wells during pre-monsoon period (June 2011) reveals a drastic change in the nature of contour levels from post-monsoon period (Figure 5) particularly in at Antri, Chaplana, Kishapura, Khajuri, Kheri, Dewri, Chakhi, Dangri, Dhanderi, Sors, Manasa, Jhakni, Jarda and Tumra villages. It has been observed that pre-monsoon is affected by depletion of water level in the existing well as compared to that observed post-monsoon. The occurrence of mounds at some places in post-monsoon period provides the indication of availability of Ground-water as examined by the author. The Ground-water movement is Ratam river revealing no noticeable change as compared to Post-monsoon period.

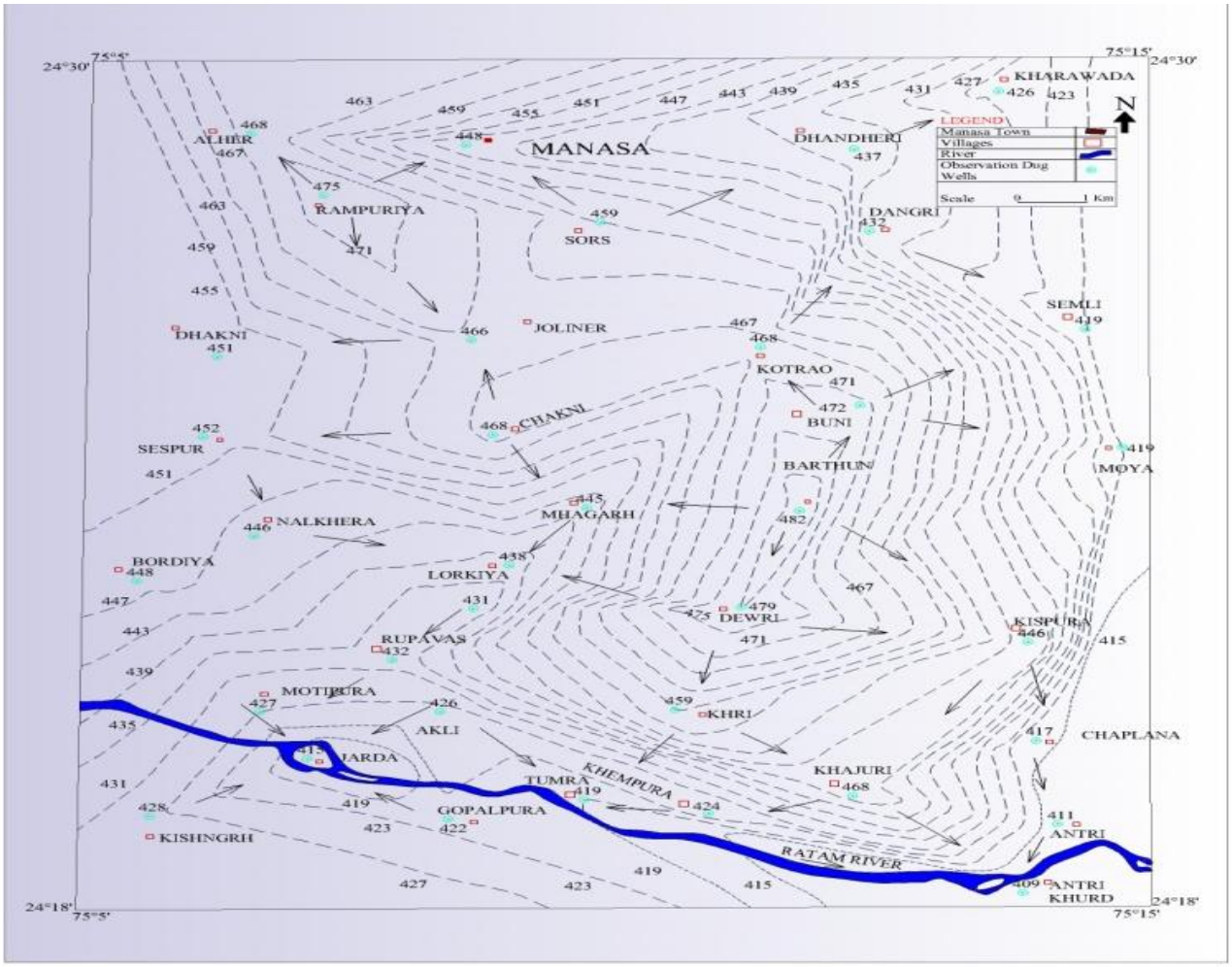

Fig 4: Post-monsoon groundwater level contour of Manasa area

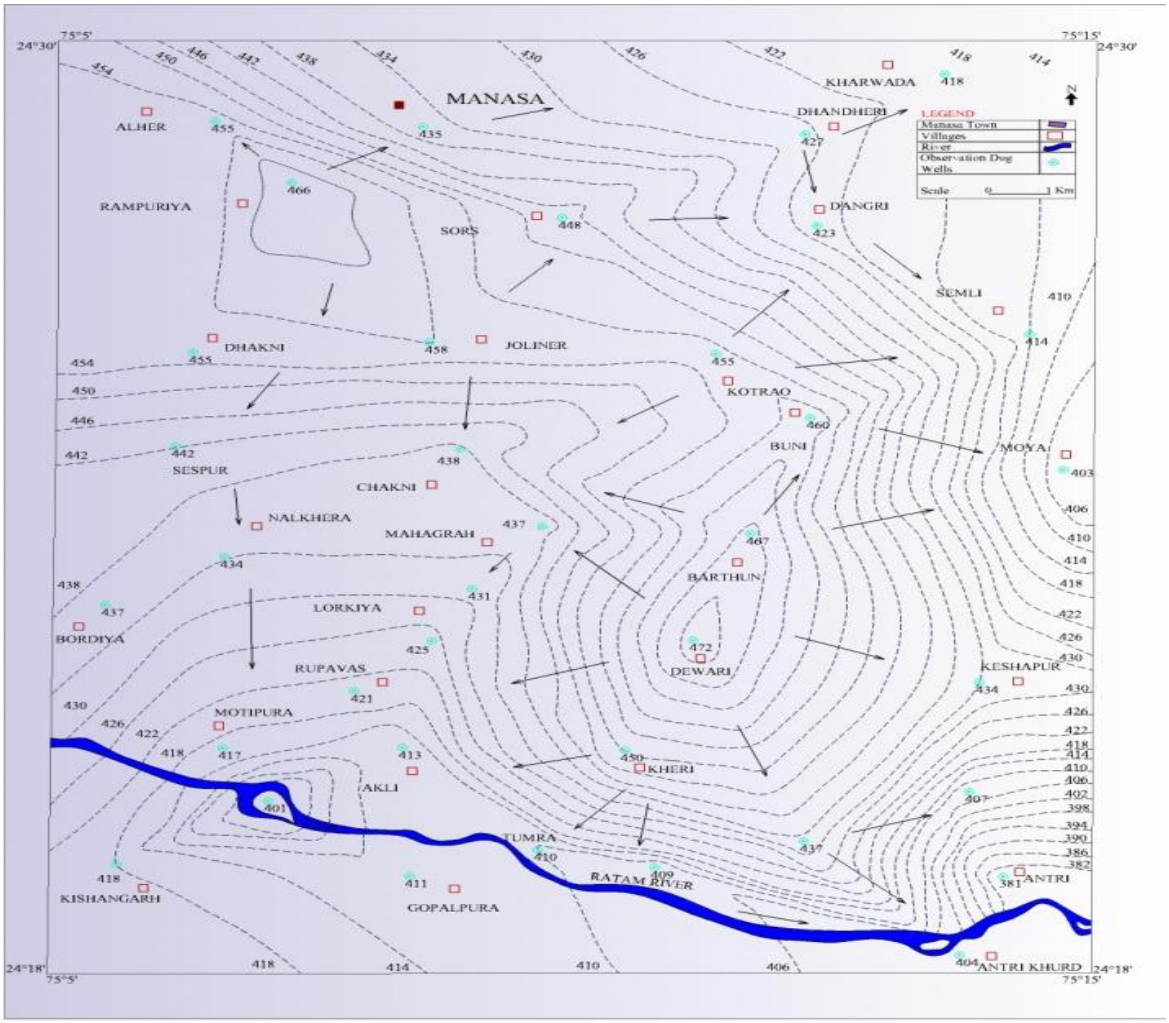

Fig 5: Pre-monsoon groundwater level contour of Manasa area

Groundwater Level Seasonal Fluctuation

The fluctuation of groundwater level calculated on basis of the data collected the dug wells during post-monsoon and pre-monsoon period. Main recharge source of ground-water recharge is the rainfall; the intensity and amount of rainfall affect the levels of Ground-water storage. Another factor is the topography and temperature which is effecting the water table fluctuation. The water levels are directly related to nature of the topography and temperature features.

Table 3: Fluctuation range of Ground-water levels of the study area

S. No	Fluctuation range (m)	Number of wells	Percentage (%)
1	4-Mar	1	2.77
2	5-Apr	2	5.55
3	6-May	-	-
4	7-Jun	2	5.55
5	8-Jul	2	5.55
6	9-Aug	5	13.88
7	10-Sep	4	11.11
8	11-Oct	9	25
9	12-Nov	4	11.11
10	13-Dec	-	-
11	13-14	3	8.33
12	14-15	2	5.55
13	15-16	1	2.77
14	16-29	-	-
15	29-30	1	2.77
	Total	**36**	**99.94%**

Fig 6: Seasonal fluctuation of groundwater level of Manasa area

Conclusion

Pre-monsoon range of groundwater static level in Manasa area is found to be 6.50 to 30 m and post-monsoon 0.50 to 4.10 m. However, the study area of Ground-water level fluctuation of 36 observed dug well indicates a various fluctuation from 4.00 m. to 30.50 m., the maximum depth of fluctuation 30.50 m. at Antri village and minimum depth of fluctuation 4.00 m. at Semli village.

The fluctuations of water levels within the range of the less than 3 to 4 m. have been noted in 2.77% of wells and a range of 4 to 16 m. was observed in 94.4% of wells. Only 2.77% of the wells have a fluctuation of water levels with the range of 29-30 m.

It has been visualized that the Ground-water reserves in Manasa area can be increased by the implementation of a scheme for ground water development. The concept of artificial recharge has been discussed. The construction of artificial recharge structures such as pit, trench, stop dam, pond, gully plug, percolation tank, sub surface dyke, injection well, and roof-top rain water harvesting system, have been favored for augmentation of Ground-water reservoir.

The optimum management of Ground-water involves estimation of both the quantity and quality of Ground-water, which can be achieved by suitable implementation of a plan of Ground-water increase and utilization by controlled water supply. The environmental impacts caused by the construction of artificial recharge structures can be controlled by adopting appropriate remedial measures with a view to allow pollution free water for recharging the Ground-water system through artificial recharge structures in the study area.

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