

Challenged Ground Water Foot Prints, “A Pressure Indicator” For Upcoming Ujjain Ground Water Crisis, An Analysis In Simhastha 2016 Context

Dr. Kalpana Virendra Singh¹, Anil Prajapati² Sumanshu Sharma³

¹P.G. Department of Chemistry and Pharmaceutical Chemistry, Govt. Madhav Science P.G. College Ujjain [M.P.]

²Department of Computer Science, Govt. Madhav Science P.G. College Ujjain [M.P.]

³Department of Computer application, Govt. Madhav Science P.G. College Ujjain [M.P.]

Abstract: Civilizations have developed around Water all over the world. Water is the median for development and plays vital role in socio-economic development. Nation's principal reserve of fresh water is ground water; it is also the most preferred resource to meet various requirements. More than 90% of rural and 50% of urban population is dependent on ground water sources in M.P. Ground water is also major source of irrigation in Madhya Pradesh and about 6,714,300 hectare of land is irrigated through ground water according to ground water report submitted in 2013. As per the well census of 2013, there are around 4369672 ground water abstraction structures with an estimated annual ground water draft of about 18 Billion Cubic Meter and the number is still swelling. There are reports from all over the state about drying up of a large number of dug wells/ bore wells in some areas due to declining ground water levels and this has jeopardized irrigation, industrial and domestic needs in Madhya Pradesh. Demands for safe drinking water are increasing and there are growing concerns about the scientific chemical parameters of water. Water quality issues related to geogenic contamination such as fluoride, anthropogenic contamination such as nitrate and inland salinity are the matter of concern. Ujjain also had disturbed and varied rainy season during past decade. City saw a major decline in the green cover owing to the cropping up of housing infrastructures and business endeavors. This year from April 22nd to June 21st Ujjain will witness The Simhastha Mahaparva. This Simhastha Mahaparva will welcome 5 crore pilgrims across the Globe. Govt. has left no stone unturned, but are we really prepared in terms of ground water, the present paper will look into the scientific issues related to ground water scenario of Ujjain in pre Simhastha and Post Simhastha clock.

Keywords: Ground Water, Geogenic contamination, anthropogenic contamination, Simhastha.

I. Introduction

Ground water is a fundamentally important resource, necessary for socio economic development of a country. It is crucial for mitigating ever expanding needs of drinking water as well as Industrial water requirements. Madhya Pradesh is a land-locked state with an area of 3,08,252 km² situated in the central region of India, sharing boundaries with Chhattisgarh in the east, Gujrat in the west Rajasthan in the northwest, Uttar Pradesh on the northeast and Maharashtra on the southern border. It is situated between north latitudes 21° 04' and 26° 54' and east longitudes 74° 00' and 82° 50'. As per census of 2011 state has population of 7,25,97,565. Population density distribution is 236 persons per Km² area. 75% of the total population lives in villages, agriculture being the main occupation. More than 90% of the rural and 50% of Urban population is dependent on ground water sources in M.P. Ground water being the major source of irrigation. According to ground water report submitted in 2013 about 6,714,300 hectare of land is irrigated through ground water. There are reports about declining Ground water levels throughout the state. Ground water has also proved to be an important resource to meet the rapidly expanding demand of drinking water. Ujjain is a city of religious importance belonging to Malwa plateauregion of M.P. The plateau is located in the northwest of the State and north of the Vindhya Range. Ujjain is witnessing one of the largest conglomerations of religious pilgrims stated as Simhastha 2016 from 22nd of April to 21st of May 2016. Till 09th of May 2016 as per officially shared data city has already welcomed 60 Lakh pilgrims and still there are 12 days to go. Subjected to realization most probably more than 100 Lakh pilgrims will take dip in Holy Shipra river by the end date i.e. 21st of May 2016. Ujjain has experienced varied rainy season during the past decade and owing to depletion of green cover, cropping up of housing infrastructure and big business endeavors, city once popular for its pleasant nights, cool mornings and not so hot days is scorching under heat in summer afternoons with temperature rising up to even 42°C. Reports about receding water tables are there and there are growing concerns about the scientific chemical parameters of water. Water quality issues related to geogenic contamination such as fluoride, anthropogenic contamination such as nitrate and inland salinity are the matter of concern. Tracking of changes

in the ground water regime and its periodic monitoring is an essential prerequisite for effective planning , management and sustenance of quantity as well quality of this precious resource.

II. Hydrogeology of Madhya Pradesh

Madhya Pradesh has diverse hydrogeological characteristics resulting into varied water potential at different places. More than 80% of the total land area of the state is covered by variety of hard rocks varying in geological structures, geomorphological set up and hydro meteorological conditions. State has following hydrogeological units:

1. Archeans: comprising of old metamorphic rocks, granites, gneisses and schists. They have very low primary permeability and form poor aquifers
2. Vindhyaans: Comprised of sand stone, shale and limestone. Sand Stone and Shale are hard and compact forming poor aquifers, Limestone has secondary permeability
3. Gondwans: Sedimentary formations rich in granular zones and form good aquifers
4. InfraTrappeans: Sedimentary formations but have a limited extent and poor to moderate permeability
5. Deccan Traps: The weathered, fractured , jointed and vesicular units of Basalts form moderate to good aquifers, this type of units form the most important aquifers in the region. They occupy the Malwa Plateau
6. Alluvium: comprises of unconsolidated gravel, sand , silt clay in various proportions, has primary intergranular porosity and permeability. They form very good aquifers

Table1. Hydrogeological group belonging to Malwa Plateau

Geological Age	Hydrogeological Group	Rock Formation	Surface Exposure Area	Occurrence
Cretaceous	Deccan Trap	Basalts	1,43,300	Malwa plateau covering Nimuch, Mandsaur, Indore, Ujjain, Ratlam, Shajapur, Sagar, Rajgarh, Sehore, Badwani, Khargon, Burhanpur districts and parts of Jabua, Raisen, Guna, Ashok Nagar, Bhopal, Sehore, Betul, Jabalpur, Katni, Hoshangabad, Chhindwara, Seoni, Dindori, Mandla, Shahdol and Anuppur

III. Ground Water Quantity, an analysis

3.1 Monsoon rainfall distribution during the year 2014

Ground water levels are maintained through regular discharge and recharge phenomenon .Rainfall during monsoon period is the sole source of natural recharge to ground water and rainfall pattern has an impact on ground water levels. Madhya Pradesh experiences most rainfall during south- west mon soon season i.e. from mid June to September. The rainfall data for 2014 for Ujjain is given in Table II.

TableII: Rainfall in Ujjain - 2014

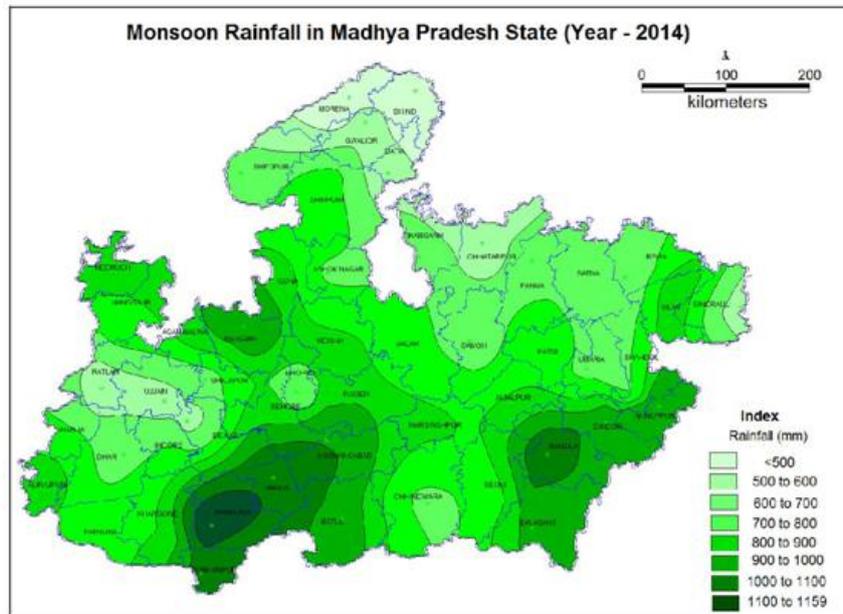
Sr. No.	Name of Station	Normal rainfall Monsoon (1 st June- 30 th Sept)	Actual rainfall (01.06.2014 to 30.09.2014)	%Departure wrt Normal Monsoon Rainfall-2014
48	Ujjain	833.7	573.7	-31

Source:www.imd.gov.in

The isohyetal map of monsoon rainfall 2014 for whole Madhya Pradesh is given in Fig 1. Where

- Monsoon rainfall within $\pm 19\%$ of the normal monsoon rainfall is considered as normal rainfall
- Monsoon rainfall less than -19% and more than -59% of the normal monsoon rainfall is considered deficit
- lesser than -59% of the normal monsoon rainfall, it is considered scanty rainfall.

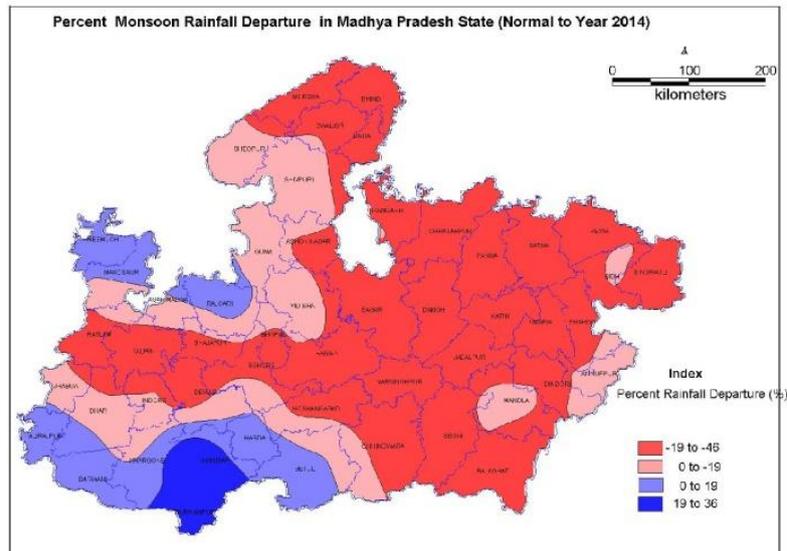
Figure: 1



Acknowledgement: Ground Water Year Book - Madhya Pradesh (2014-15)

As clear from the figure state has received 20.00 % less rainfall with respect to the normal rainfall. The percent monsoon rainfall departure from normal rainfall map of Madhya Pradesh for the year 2014 is presented in Fig.II

Figure: II



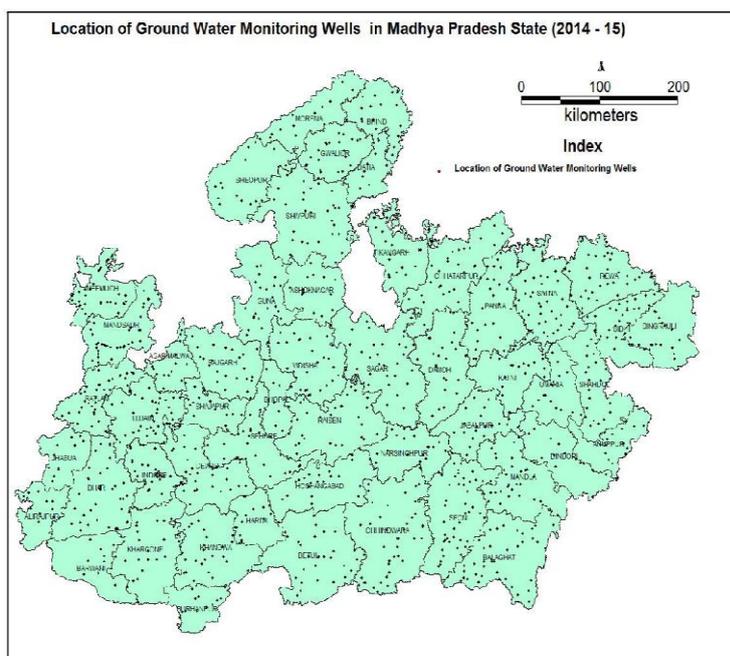
Acknowledgement: Ground Water Year Book - Madhya Pradesh (2014-15)

As per figure I and Figure II it is evident that Ujjain received deficit rainfall during Summer monsoon period in 2014.

3.2 Analyses of ground water levels

Planning, management, sustenance of quantity as well as quality of ground water resource depends upon the periodic monitoring of the ground water regime. Central Ground Water Board monitors ground water level four times in a year, i.e. during May, August, November and January, through a network of Ground Water monitoring Wells

Figure III: Location of ground water monitoring wells in Madhya Pradesh (2014-15)



Acknowledgement: Ground Water Year Book - Madhya Pradesh (2014-15)

Table III: Number of monitoring stations at Ujjain as per reports by Central Ground Water Board

S No.	District	No of monitoring stations			No of monitoring stations		
		DW	PZ	Total	DW	PZ	Total
1	Ujjain	26	26	52	26	26	52

3.2.1 Depth to water level May 2014

May is the pre monsoon month and as per reports of central ground water Board depth of water level ranges from 0.83 to 49.40 m bgl in whole state. 0.71% of wells in sporadic patches recorded very shallow water level up to 2 m bgl. Very deep ground water level of 20-40 m bgl are found in about 3.53% of the wells and occur mainly in Burhanpur, Indore, Ujjain, Mandsaur, Chhindwara, Gwalior, Narsinghpur, morena and Bhind districts.

3.2.2 Depth to water level August 2014

August is the monsoon month and depth of ground water level range from 0.8 to 49.00 m bgl in the whole state. very shallow water levels up to 2m bgl are seen in almost entire state. 28.33% of monitoring wells recorded very shallow water level less than 2m bgl. Deeper ground water level of more than 20m are found in 1.58% of wells. Extremely deeper ground water levels of more than 40 m bgl are found in Bhind district only. Ujjain also recorded shallow water levels in the records taken for the month of August

3.2.3. Depth to water level November 2014

November is the post monsoon month. Depth of water levels ranges from 0.21 bgl to 49.00 m bgl in Madhya Pradesh. 7.68% of monitoring wells recorded water level less than 2 m bgl. About 36.84% of wells spreading over the state recorded a water level in the depth range of 2-5 m bgl. 37.88% of wells recorded deeper ground water level in the range of 10-20 m bgl.

3.2.4 Depth to water level January 2015

January is a post monsoon winter month when environment is comparatively cooler with temperature not soaring high. Depth of water levels range from 0.21 m bgl to 49.00 m bgl in Madhya Pradesh. Very shallow water levels are seen in some pockets. 28.18% of monitoring wells has recorded water level in the depth of 2-5 m bgl. 44.16% of wells have water level ranging between 5-10 m bgl. 19.44% of wells have deeper ground water level ranging 10-20 m bgl. 3.39% of wells have water level at more than 20 m which is considered as an alarming situation Ujjain falls in this category with other districts like Indore, Dhar, Mandsaur and Ratlam

Figure IV: Water level Fluctuation Map of Madhya Pradesh (May 2014-August 2014)

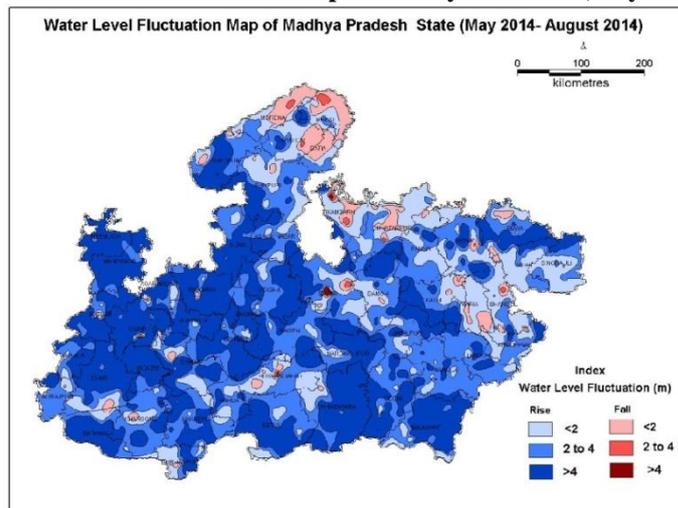
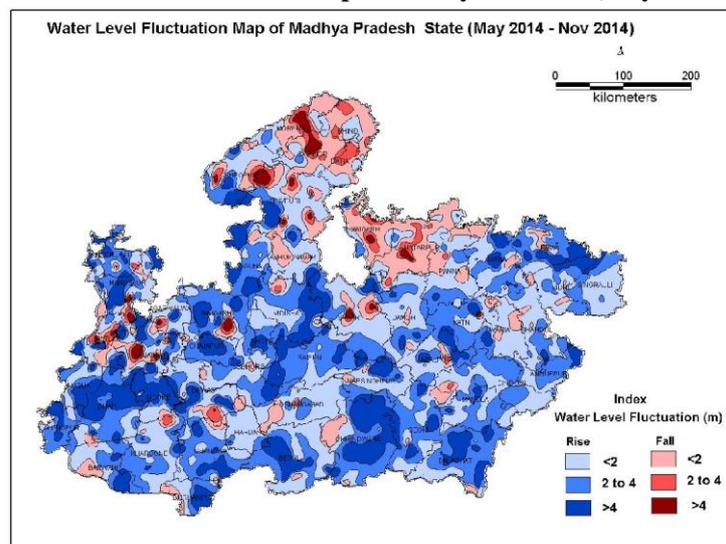
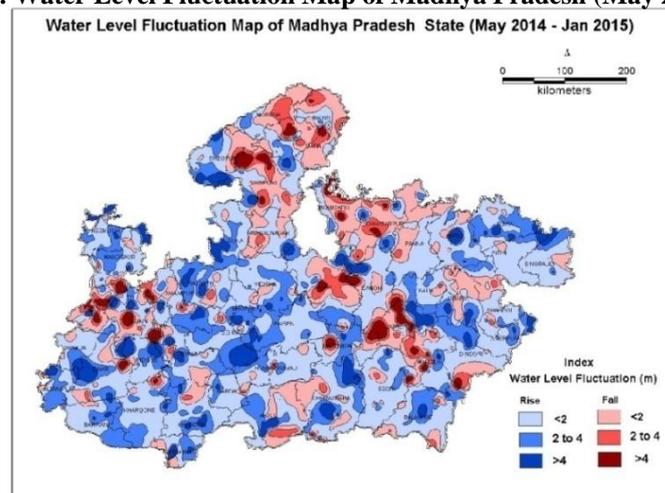


Figure V: Water Level Fluctuation Map of Madhya Pradesh (May 2014-Nov.2014)



Acknowledgement Figure IV and V: Ground Water Year Book - Madhya Pradesh (2014-15)

Figure VI: Water Level Fluctuation Map of Madhya Pradesh (May 2014-Jan 2015)



Acknowledgement: Ground Water Year Book - Madhya Pradesh (2014-15)

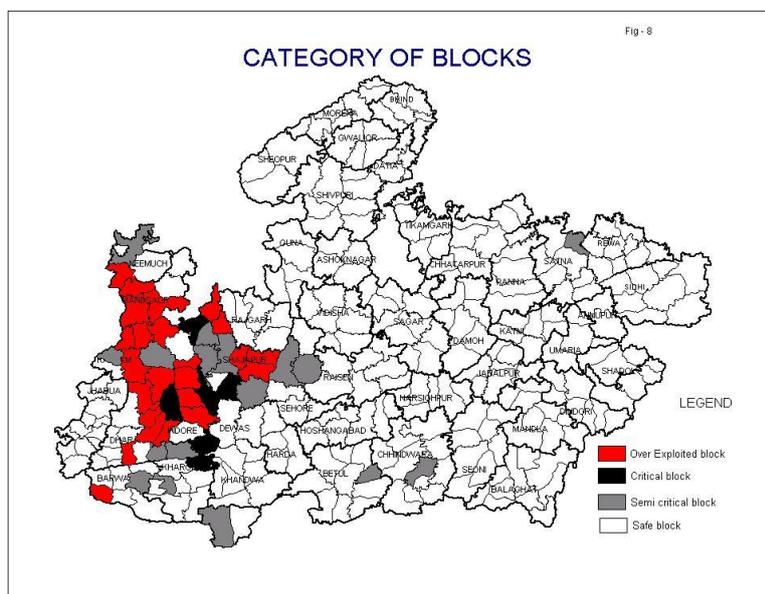
3.2.5 Decadal water level fluctuations

As per reports of central ground water board decadal water level fluctuations are calculated by comparing ground water level of a particular monitoring season with its 10 years of mean data.

3.2.6 Water level fluctuation mean (January 2005-2014) to January 2015

50.08% of wells experienced rise in water levels and 49.92% experienced fall in water levels. 35.05% of wells experienced decline up to 2 m, about 8.64% of the wells showed decline in the order of 2-4 meters and 6.23% showed decline in the order of more than 4 m. The worst effected districts are Ujjain, Ratlam, Shajapur, Jabalpur ,Bhind, Gwalior , Morena and Chhindwara.

Figure VII Category of Blocks as per Exploitation of Ground Water



Acknowledgement: http://www.mpwrd.gov.in/image/image_gallery

IV. Groundwater Issues And Assessment Of Sustainability Present And Future

The major issue is declining surface and ground water resources. The net annual ground water expense for drinking and irrigated agriculture exceeds the recharge potential. Kshipra is the main river , but the river itself and its tributaries are polluted with untreated waste water leading in to elevated Nitrate and Fluoride values. Kshipra has become ephemeral and paucity of water limits other beneficial uses.

Expanding ground water extractions and indiscriminate use of ground water resources have put up significant stress on entire Kshipra Basin including Ujjain. Ujjain district has ground water development stage (GDS) of 109%, with Ujjain block having a GDS of 144% [1-3].

The other important issue about Kshipra basin is that ground water is derived from weathered Deccan trap basalts, which have high porosity but shows relatively low storage, which ultimately emphasizes the need for sustainable ground water management and artificial recharge opportunities[4]

V. Quality of Ground water

5.1 Hydrochemistry of Ground water (2013-14)

5.1.1 Salinity

Electrical conductivity is the measure of salinity, depending upon the total concentration of the ionized substances dissolved in water. High salinity imparts bad taste to water and makes it not usable also for irrigation purpose. Water with electrical conductivity upto $1000\mu\text{S}/\text{cm}$ is considered as safe and fit for drinking. The chemical quality of ground water of M.P. is generally good as 65.27% wells have electrical conductivity less than $1000\mu\text{S}/\text{cm}$. Only 0.91% wells have electrical conductivity more than $3000\mu\text{S}/\text{cm}$ at 25°C . Very high electrical conductivity of $3500\mu\text{S}/\text{cm}$ at 25°C is reported from Mahidpur road district Ujjain

5.1.2 Fluoride

Natural water contains fluoride in low concentration and it is very important from health point of view for human consumption. High concentration of fluoride above the permissible limit of 1.5 mg/l in

drinking water is harmful for human consumption. Fluoride rich water occurs in shallow aquifers in Ujjain district. According to a pilot study by govt. of India and Ayush Department Ujjain is marked for further studies related to fluoride contamination and identification of cases related to Fluorosis.

5.1.3 Nitrate

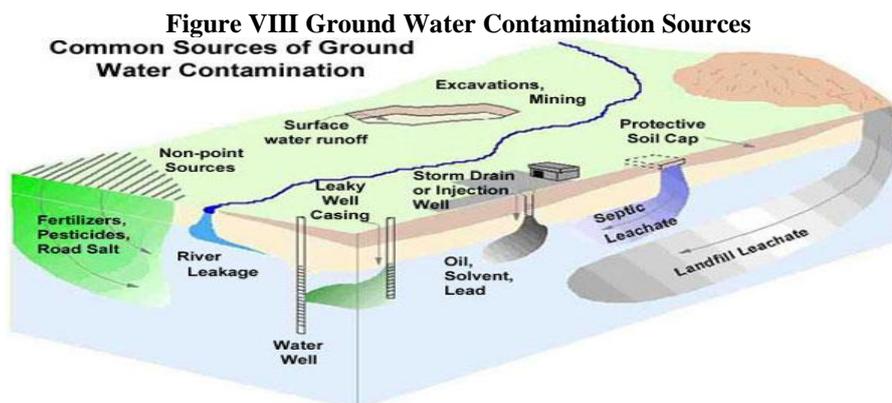
Nitrate naturally occurs in ground water in very low concentration as contribution of Nitrate through geo genic impurities in ground water is almost negligible. Anthropogenic activities are the major contributors for elevated Nitrate concentrations. Sewage and animal waste contain considerable amount of Nitrate and after discharge on land it gets leached out by rainfall causing enrichment of Nitrate in ground water. Faulty Agricultural practices like excessive use of fertilizers, irrigation with waste waters, legumes and farm yard wastes contribute Nitrate to ground water. Concentration of Nitrate in excess of 45 mg/l in water is harmful for human consumption, particularly in infants it causes blue baby disease.

In Madhya Pradesh, nitrate concentration in shallow aquifer occurs in Anuppur, Balaghat, Barwani, Betul, Bhind, Bhopal, Chhatarpur, Chhindwara, Damoh, Datia, Dewas, Dhar, Guna, Gwalior, Harda, Hoshangabad, Indore, Jabalpur, Jhabua, Katni, Khandwa, Kargone, Mandla, Mandsaur, Morena, Narsinghpur, Nimuch, Panna, Raisen, Rajgarh, Ratlam, Rewa, Sagar, Satna, Sehore, Seoni, Shahdol, Shajapur, Sheopur, Shivpuri, Sidhi, Tikamgarh, Ujjain, Umaria and Vidisha districts.

The locations having more than 45 mg/l nitrate in ground water of Ujjain district are shown in Table IV.

Table IV Locations showing nitrate more than 45 mg/l in ground water

S.No.	Districts	Block	Location	NO ₃ (mg/l)
367	Ujjain	BADNAGAR	Dablahardu	190
368	Ujjain	GHATIA	Bachhukhera	52
369	Ujjain	MAHIDPUR	Bajjnath	118
370	Ujjain	MAHIDPUR	Delchibuzurg	205
371	Ujjain	MAHIDPUR	Mahidpurroad	136
372	Ujjain	MAHIDPUR	Mahidpurtown	48
373	Ujjain	TARANA	Rupakhedi	114
374	Ujjain	UJJAIN	Chandukhedi	101
375	Ujjain	UJJAIN	Palkhanda	87
376	Ujjain	UJJAIN	Patpala	220
377	Ujjain		Tajpur	60



5.1.4 Total Hardness

Calcium and Magnesium Bicarbonate, sulphate and Chloride ions are responsible for imparting hardness to water. Highest desirable limit of total hardness in water is 200 mg/l and highest permissible limit is 600 mg/l. Shallow aquifers of Ujjain with total hardness .exceeding permissible limits is given table V

Table V Frequency distribution of Total Hardness in shallow aquifer

S.No.	Districts	Block	Location	Total Hardness (mg/l)
86	Ujjain	BADNAGAR	Dablahardu	955
87	Ujjain	MAHIDPUR	Mahidpurroad	1215
88	Ujjain	MAHIDPUR	Raghvi	875

VI. Conclusion

Ujjain is a part of Malwa Plateau lying in Deccan Trap hydrogeological unit. Rock formation is Basaltic forming moderate to good aquifers. This type of rock formation imparts good permeability to surface. As per data collected by central Ground Water Board, Ground water scenario in Ujjain is quite critical. Ground water

scenario pre and post monsoon for 2014 and January 2015. As well as decadal ground water fluctuations suggest that ground water level is alarmingly low in Ujjain, despite of the fact that Ujjain enjoys Basaltic underground rock formation. The other problem confronted is that in Ujjain the equilibrium between Recharge and discharge of water from aquifer is also disturbed. The main source of recharge of aquifers is natural rainfall and as per data collected from CGWB in 2014 Ujjain received 20.00% less rainfall with respect to normal. High quantities of radicals like F and NO_3 also point towards unwanted and malafied anthropological activities. Increase in CO_2 concentration in the atmosphere suppresses precipitation resulting in to drier season and less rainfall. Routine activities like turning the lights on, cooking food or use of traditional energy sources add up to carbon footprints by the emission of CO_2 and other heat trapping gases. As per official data around 150 Lakh people have taken dip in the holy Kshipra river. Power was supplied in the fair through high tension center and 33/11 KV subcenter. 45 generators and 23 mobile towers have been installed. Power load of Simhastha area was 100 MV, while the consumption of whole city is only 110 MV. SimhasthaMela area had more than 100 food zones catering to the dietary needs of 150 Lakh pilgrims. All these factors add up to accumulation of CO_2 in the environment. Simhastha fair could have harnessed solar energy for combating energy needs in the form of Solar furnaces, Solar lights etc., but unfortunately not much was done in this field resulting in the increase of carbon foot prints and worsening the ground water scenario further.

References

- [1]. CGWB Northern Central Region Dewas District groundwater information booklet, (2007) Bhopal.
- [2]. CGWB Northern Central Region Indore District groundwater information booklet, (2009) Bhopal.
- [3]. CGWB Northern Central Region Ujjain District groundwater information booklet, (2008) Bhopal.
- [4]. World Bank Deep Wells and Prudence: Towards Pragmatic Action for Addressing Groundwater Overexploitation in India. World Bank, (2010) Washington.