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Assessment of Physico – Chemical Characteristics of Ground Water Quality in Different Villages of Majhgawan Block in Satna District, Madhya Pradesh, India

Sapna Mishra[1], Neelam Rechhariya[2]
[1]*Department of Chemistry, SRKCI, Satna Madhya Pradesh, India*
[2]*Department of Chemistry, Govt.Girls P.G College, Satna Madhya Pradesh, India*

***Abstract*- Groundwater is the backbone of India's agriculture and drinking water security in rural and urban areas, meeting nearly 80% of the country's drinking water and two-thirds of its irrigation needs. Hence, Groundwater is pivotal to India's water security. The entry of nutrients into water through leaching and surface runoff from agriculture fields helps to access the impact of Agrochemical. Hence the present study has been carried out to assess the impact of chemical fertilizers application in relation to nutrients contamination in ground water resources .Water samples collected during the March- April of 2023 from the study area/region and the samples were analyzed for various physical and chemical properties. During the study it was found that Total Dissolved Solids varies from 140 mg/L to 930 mg/Land compared with permissible limits. The concentration of calcium and magnesium in all water samples is very high. Therefore, the best accepted option is to avoid the possibility of polluting the ground water resources.**

***Keywords*- Ground Water Quality, Physico-chemical properties, Majhgawan block, Water Quality.**

I. Introduction

Groundwater is a natural resource for drinking water In addition to the population growth, urbanization and industrialization also extend the demand of water. Providing safe drinking water supply to the ever growing urban and sub- urban population is going to be a challenge to the civil authorities, city planners, policy makers and environmentalists. Groundwater is a major source of drinking water in both urban and rural areas of Majhgawan Block at Satna. Satna district is rapidly raising population, changing lifestyle and intense competition among users-agriculture, industry and domestic sectors is driving the groundwater table lower.

Besides, use of chemical fertilizers also contaminate groundwater, thereby accumulation of nitrate content in ground water. The present work is aimed at assessing the impact of agrochemicals on the ground water samples of Majhgawan Block, Satna District. The groundwater samples of about 15 samples were collected and subjected for a comprehensive physicochemical analysis. The purposes of this investigation are to provide an overview of present ground water quality for the following 15 parameters such as Urea Residue ,DAP Residue ,pH, conductivity, Alkalinity, TDS, total hardness, calcium, magnesium, chloride, nitrate, Nitrite, Sodium, Potassium, Phosphate are to be considered for calculating the Water quality parameters. The results are analyzed with WHO Standards desirable limits for predicting contamination in ground water. The ,main objective of the present study is to assess the level of pollution in ground water resources around the agriculture area of Majhgawan Block and to study the effect of application of the chemical fertilizers on nutrients contamination in ground water resources.

II. Material And Methods

2.1 Description of the Study Area:

The fifteen major Villages of Majhgawan Block of Satna district were selected for the study of underground water quality in the agriculture land vicinity of different villages of Majhgawan block Satna district.

These Agricultural land sites are from Jhari, Majhagwan, Semra, Malmau, Hinauta, Berahna, Bandhi, Kawar, Mahkhed, Sahpur, Naugawn, Chandai, Pindra, Pagarkhurd and Panghati.

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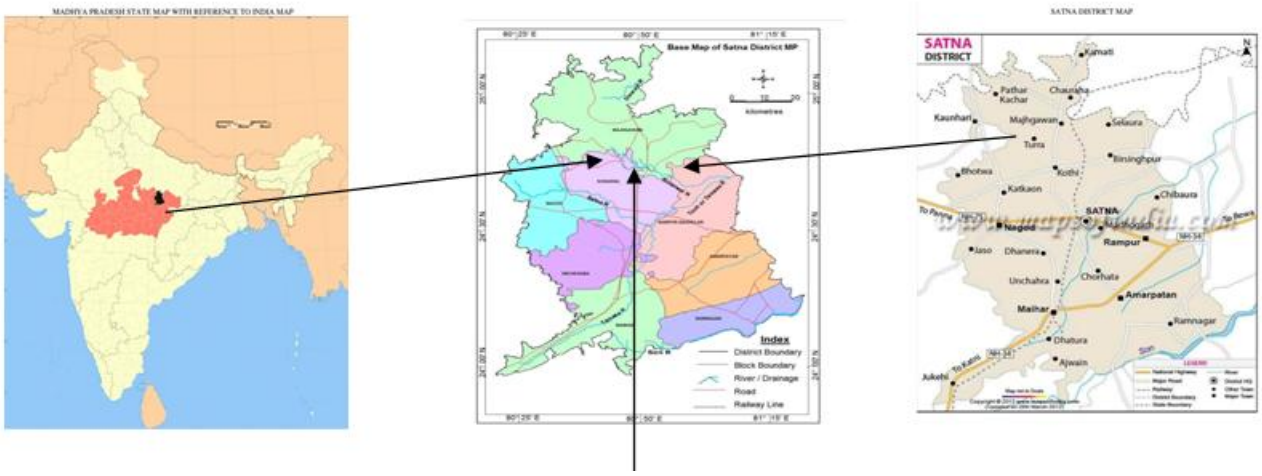


Figure 1: Map of Study

2.2 Sampling and Analysis:

Survey was conducted during the months of March-April of year 2023 of the fifteen different sampling sites around Majhgawan Block, Satna District. Sampling was done in accordance with grab sampling methods in 1litre plastic containers and prior to collection all the bottles were washed with non-ionic detergent and rinsed with de-ionized water prior to usage. Before the final water sampling was done,the bottles were rinsed three times with well water at the pointof collection. During sampling from hand pumps and bore wells, the water pumped to waste for about five minutes and sample was collected directly .Each bottle was labeled according to sampling location whileall the samples were preserved at 4ºC and transported to the laboratory.

2.3 Physico-Chemical Analysis:

Table 1 :Methods Used for Groundwater analysis (Laboratory analytical methods)

Sr No	Physo - Chemical Paramenters	Methods
1	pH	Potentiometry (pH mete)
2	Condutivity	Conductivity probe
3	Alkalinity	Argentometry (Titration)
4	Chloride	Argentometry (Titration)
5	Total Hardness	Complexometry by EDTA Titration
6	Calcium	Argentometry (Titration)
7	Magnesium	Argentometry (Titration)
8	Total Dissolved Solid	TDS Probe
9	Sodium	Flame Photometric Method
10	Potassium	Flame Photometric Method
11	Nitrate	Phenoldisulphonic Method
12	Chloride	Argentometry (Titration)

2.4 Analysis of water Samples:

The urea residues were quantified by diacetyl monoxime method and diammonium phosthate residue where calculated by using amount of phosphate present in the water samples considering molecular weight of DAP and atomic weight of Phosphate in DAP fertilizers. Rest of the Physico- Chemical Analysis is done as per the Table 1.

III. Result And Discussion

3.1 Urea Residue: During the present study, the urea residues ranged from 0.67-2.2ppm. The minimum and Maximum concentration of Urea residue was recorded in bore well water samples TW (5) TW(6),TW(8),and TW(12) in rest of the samples either the urea residue was not found or in some samples the results are minimum range. This implies that the quantity of urea residues entered to the water resources may completely hydrolyzed.

3.2 DAP Residue: During the present study, the urea residues ranged from 1.25-4.75ppm. The minimum and Maximum concentration of DAP residue was recorded in bore well water samples TW (15) and TW (7)in TW(1),(3),(5),(6),(9),(10),(11),(13),(14)the urea residue was not found. The concentration of DAP residue indicates that the quantity of fertilizers applied to the soil has not been completely utilized by the crops . Due to the leaching through the soil profile the DAP residues where recorded in water samples.

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Results of chemical fertilizers residues and physico-chemical characteristics of water samples of selected Villages of Majhgawan Block

Sr No	Name of Village	Test Site	Urea Residue	DAP Residue	pH	EC	Alkalinity	Chloride	Total Hardness	Calcium	Magnesium	Total Dissolved Solid	Total Dissolved oxygen	Nitrate	Nitrite	Sodium	Potasium	Phosphate
	SV		0.6-2.8ppm	2.50-5.42ppm	6.5-8.5	300	200-600	250-1000	300-600	100-200	150	1000	6.5-8.5	45-100	1	200	55	0.1
1	Jhari	TW1	NIL	NIL	7.25	750	140	240	480	196	36	930	3.76	70	2.66	100	35	1.25
2	Majhgawan	TW2	NIL	2.97	7.55	813	156	80	320	232	88	833	4.60	60	5.52	220	25	3.21
3	Semra	TW3	NIL	NIL	7.66	652	550	90	390	165	78	390	2.75	74	1.32	240	15	0.20
4	Malmau	TW4	0.67	1.75	7.87	856	760	140	420	179	52	380	3.76	50	2.76	180	20	2.60
5	Hinautha	TW5	2.20	NIL	7.83	672	148	77	267	267	92	687	4.70	94	3.69	150	15	1.22
6	Berahna	TW6	1.35	NIL	6.80	500	245	85	250	220	38	140	1.97	65	1.23	660	24	3.27
7	Bandhi	TW7	NIL	4.75	8.32	280	567	260	750	250	40	750	8.99	76	2.34	140	45	5.21
8	Kawar	TW8	1.90	2.23	6.53	600	245	130	220	124	74	620	3.77	80	2.43	480	40	4.27
9	Mahkhed	TW9	NIL	NIL	7.86	870	170	147	180	86	26	220	2.20	26	1.34	550	30	0.34
10	Sahpur	TW10	NIL	NIL	6.50	550	630	540	560	75	42	180	1.35	48	2.11	350	17	0.56
11	Naugawan	TW11	NIL	NIL	8.30	540	197	125	190	95	28	750	5.53	56	1.45	190	25	2.21
12	Chandai	TW12	1.32	2.54	7.96	650	156	180	240	210	89	920	7.96	65	2.56	120	10	3.45
13	Pindra	TW13	NIL	NIL	8.01	765	440	990	530	167	45	880	6.76	54	2.33	350	25	1.70
14	Pagarkhurd	TW14	NIL	NIL	6.75	320	350	773	620	193	95	460	4.65	47	1.55	170	20	1.3
15	Panghati	TW15	NIL	1.25	7.80	350	167	650	475	247	93	350	3.89	32	1.67	230	15	2.56
	Min		0.67	1.25	6.50	280	140	77.00	180	75	26	140	1.35	26.00	1	100	10.00	0.20
	Max		2.20	4.75	8.32	870	760	990	750	267	95	930	8.99	94	5.52	660	45	5.21

	Urea	DAP	pH	EC	Alkalinity	Chloride	Total Hardn	Calcium	Magnesiu	TDS	TDO	Nitrate	Nitrite	Sodium	Potasium	Phosphate
Urea Residue	1															
DAP Residue	0.065	1														
pH	-0.212	0.276	1													
EC	0.085	-0.2	0.149	1												
Alkalinity	-0.262	0.127	-0.02	-0.054	1											
Chloride	-0.424	-0.22	-0.11	-0.316	0.1967	1										
Total Hardness	-0.51	0.235	-0.03	-0.494	0.5645	0.617	1									
Calcium	0.256	0.397	0.242	-0.268	-0.201	-0.037	0.2497	1								
Magnesium	0.316	0.188	-0.12	-0.193	-0.218	0.088	0.0007	0.53	1							
Total Dissolved Solid	0.044	0.358	0.419	0.156	-0.32	0.009	0.0423	0.308	0.145	1						
Total Dissolved oxygen	0.006	0.611	0.618	-0.245	-0.039	0.155	0.286	0.423	0.14	0.755	1					
Nitrate	0.604	0.222	-0.03	-0.04	-0.048	-0.437	-0.0677	0.391	0.209	0.455	0.2892	1				
Nitrite	0.185	0.437	0.089	0.4	-0.17	-0.227	-0.0482	0.414	0.369	0.524	0.2285	0.345	1			
Sodium	0.194	-0.27	-0.43	0.117	-0.071	-0.063	-0.3872	-0.398	-0.367	-0.6	-0.5517	-0.239	-0.36	1		
Potasium	-0.101	0.402	-0.03	-0.086	0.0011	-0.132	0.1928	-0.099	-0.497	0.227	0.199	0.191	0.0279	0.187	1	
Phosphate	0.304	0.837	0.124	-0.346	-0.043	-0.199	0.0651	0.41	0.077	0.326	0.5717	0.306	0.2505	-0.027	0.463	1

Table -3 Correlation matrix between the chemical fertilizer residue and selected water quality parameters

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3.3 pH: During the present study, the pH is ranged from 0.67-2.2ppm .pH is the measure of acidity or alkalinity of the water . pH in the present study ranged from minimum of 6.50 to a maximum of 8.32.All the Water Samples were found to be the permissible limits of the WHO Standards. The result also show that the alkaline pH is due to the presence of calcium ,Magnesium and Sodium .

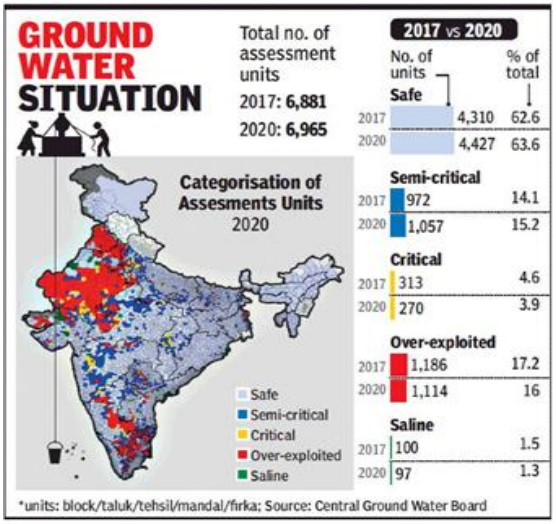
3.4 Electric Conductivity: During the present study, the Electric conductivity is ranged from minimum of 280dS/m to maximum of 870 dS/m. Electric conductivity is the measure capacity of water to carry the electric current . It signifies the amount of the total dissolved salt in the water. All the Water Samples were found to be the permissible limits of the WHO Standards.

3.5 Total Dissolved Soilds: TDS indicate the nature of water quality. During the present study, the TDS is ranged from minimum of 140 mg/l to maximum of 930 mg/l. All the Water Samples were found to be the permissible limits of the WHO Standards. So it can be concluded that the water of Majhgawan block can be used for drinking and agriculture purpose.

3.6 Alkalinity: Alkalinity indicate the capacity to neutralize a strong acid in a solution nature of water quality. During the present study, the *Alkalinty* is ranged from minimum of 140 mg/l to maximum of 760 mg/l. Some of the Water Samples were found to be the higher side of permissible limits of the WHO Standards which is normally due to the presence of carbonates ,bicarbonates and hydroxides of calcium and magnesium.

3.7 Total Hardness: Total Hardness indicate the presence of calcium and magnesium present in the water. During the present study, the Total Hardness is ranged from minimum of 180 mg/l to maximum of 750 mg/l. Some of the Water Samples were found to be the higher side of permissible limits of the WHO Standards which is normally due to the presence of calcium and magnesium.

3.8 Calcium and magnesium: calcium and magnesium. indicate the hardness of the water. During the present study, the calcium and magnesium. is ranged from minimum of 75 mg/l and 26mg/l to maximum of 267 mg/l and 95 mg/l. All of the Water Samples were found to be within the permissible limits of the WHO Standards.



3.9 Chloride: Chloride occurs naturally in all types of water sample. Chloride in natural water results from agriculture activities, some times it could be due to chloride from chloride containing rocks During the present study, the calcium and magnesium. is ranged from minimum of 77 mg/l to maximum of 990 mg/l. All of the Water Samples were found to be within the permissible limits of the WHO Standards .

3.10 Dissolved oxygen: If Dissolved Oxygen is in higher side that indicates that indicates the high oxygen contents in water. During the present study, the Dissolved oxygen is ranged from minimum of 1.35 mg/l to maximum of 8.99 mg/l. All of the Water Samples were found to be within the permissible limits of the WHO Standards.

3.11 Sodium and potassium: The Sodium and potassium ranged from minimum of 100 mg/l to maximum of 660 mg/l. and Potassium ranged minimum from 10mg/l to maximum of 45 mg/l. Some of the Water Samples were found to be within the permissible limits of the WHO Standards and some are higher the permissible limits. The potassium contamination is due to application of the potassium fertilizer greater than the required concentration.

3.12 Nitrate and Nitrite: The Nitrate and Nitrite ranged from minimum of 26 mg/l to maximum of 94 mg/l. and Nitrite ranged minimum from 1mg/l to maximum of 5.52 mg/l.

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Some of the Water Samples were found to be within the permissible limits of the WHO Standards and some are higher the permissible limits. During irrigation ,urea is generally used as source of nitrogen for paddy and other crops . In the soil when urea is applied, it gets transformed to ammonia ions by soil enzymes ,which tends to stronger absorbed on soil particles. This adsorption inhibits the movement of ammonium ions through the soil. Ammonium ions is energy rich and certain soil bacteria can utilize this energy rich and certain soil bacteria can utilize this energy by decomposing the ammonium ions, nitrate ions is not absorbed on soil particles and therefore moves readily with water in the soil.

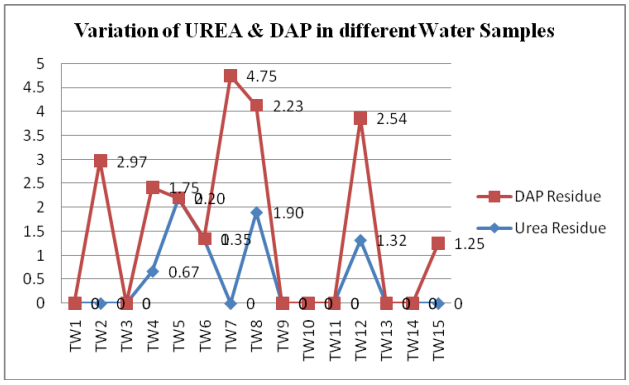
3.12 Potassium and Phosphate: Potassium and Phosphate is strongly absorbed by soil colloids which greatly retards its downward movement. Usually the surface and ground water contains of native phosphate minerals and also due to the high retention capacity of soils to retain phosphate. In the present study, the potassium is ranged from minimum of 10 mg/l to maximum of 45 mg/l. and Phosphate ranged minimum from 0.20mg/l to higher 5.21 mg/l. Water Samples were found to be within the permissible limits of the WHO Standards.

IV. Statistical Analysis

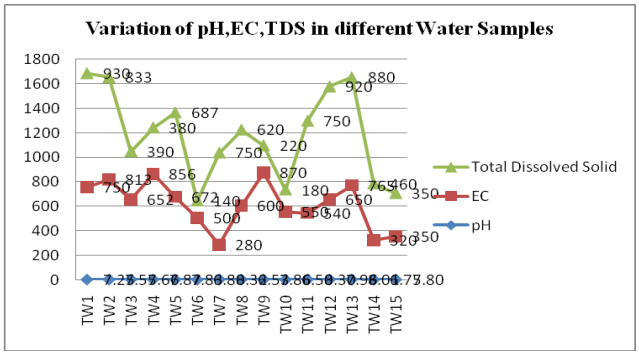
In the present study, correlation analysis between various attributes of physical and chemical parameters of water along with Urea and DAP residues were done and presented in correlation matrix. A Correlation analysis is a bivariant method applied to describe the relation between two different parameters. Interrelationship between two parameters was carried out using Pearson correlation. A high correlation co-efficient (near +1 or -1) means a good relation between two variables, and its concentration around zero means no relationship between them.

A correlation study between chemical fertilizer residues, chemical characteristics with selected water quality parameters shows that, there is impact of chemical fertilizers in under ground water.

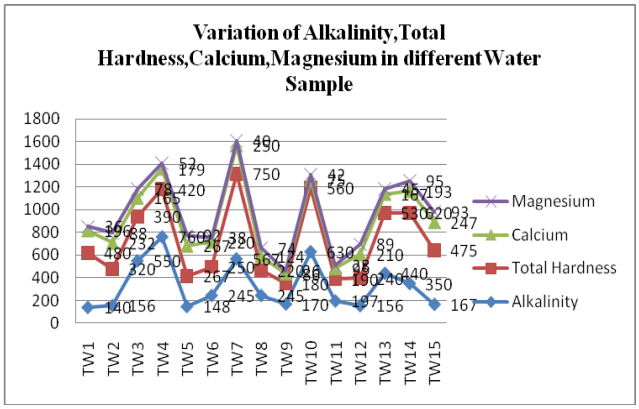
V. Graphical Representation Of Variations In Chemical Fertilizers Residue And Physico – Chemical Characteristics Of Water Samples.



Graph 1 Variation of Urea and DAP in different water samples.

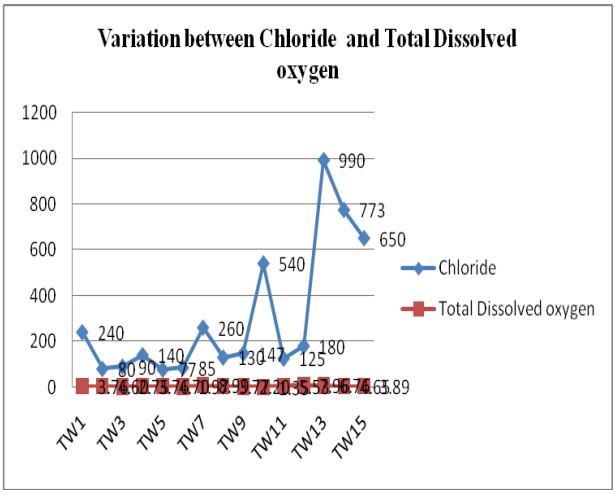


Graph 2 Variation of pH,EC and TDS in different water samples.

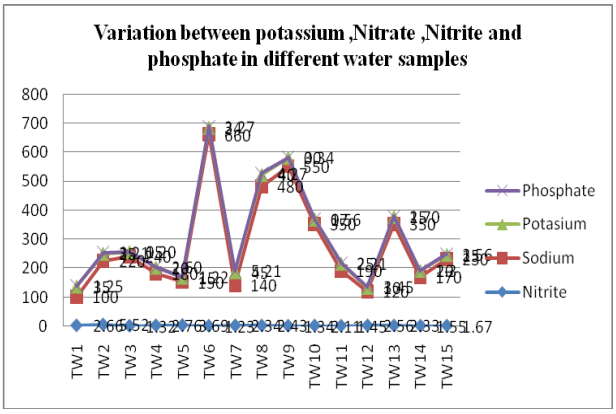


Graph 3 Variation of Alkalinity, Total hardness calcium ,magnesium in different water samples.

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Graph 4 Variation of Chloride and Total Dissolved oxygen in different water samples.



Graph 5 Variation of Potassium, Nitrate, Nitrite and Phosphate in different water samples.

VI. CONCLUSION

The study focused on the impact of chemical fertilizers on physic-chemical characteristics of water samples collected around agricultural area o Majhgawan Block .From the present study it can be concluded that there is influence of use of chemical fertilizes on underground water quality. Traces of calcium, magnesium, sodium and potassium where found to be reduced.

So from the present study it can be concluded that the appropriate advice should be given to the farmers for the proportionate use of chemical fertilizers with respect to the application of the chemical fertilizer dose at required concentration to reduce the pollution of surface and underground water.

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