

Analysis of Groundwater Quality Using Physicochemical Parameters in Kahalgaon Town of Bhagalpur District, Bihar, India

Abstract

The majority of people living on earth rely on groundwater as their day to day needs of water. However, anthropogenic activities continuously **threat this valuable natural resource**.

People on globe are under tremendous threat due to changes in the physical, chemical and biological characteristics of water. With increased human populations, industrialization, use of

fertilizer and man-made activities water is becoming highly polluted with different harmful contaminants. It is necessary that the quality of drinking water should be examined thoroughly at regular interval of time, because due to use of contaminated drinking water not only human populations but also other living organism of whole biosphere suffer from various type of water borne diseases. **The study was conducted in Khalgaon town of Bhagalpur District of Bihar.**

Physicochemical parameters analysed are: pH, TDS, EC, Sulphate, Nitrates, Bacteriological, Total Hardness, Ca, Mg, Fe, As, Cl, F, Turbidity, and Alkalinity were also analysed using standard process and procedures. The present paper is a modest attempt to analyse the Physicochemical Parameters of Groundwater of all 17-wards of Kahalgaon Town, (Bhagalpur District, Bihar) and as well as to suggest suitable measures for the redressal of problems identified.

Key Words: *Physicochemical Parameter, Arsenic, Iron, Fluoride, Groundwater, Black Plum Wood, Water Purifier.*

Introduction:

Groundwater is used a lot in our daily life, it is like a precious boon for all of us, but due to excessive interference with nature by humans, our underground water has become polluted. Groundwater source is the major source of drinking water in most of the suburban areas of India⁽¹⁾. This resource is threatened by the potential presence of faecal bacteria coming from a variety of sources and pollution paths, the former including septic tanks, landfills, and crop irrigation with untreated, or insufficiently treated, sewage effluent⁽²⁾. Accurately assessing the microbiological safety of water resources is essential to reduce diseases caused by waterborne faecal exposure⁽²⁾. Continuous indiscriminate waste dumping and unruly human behaviour towards environmental management and strategies require a holistic approach to guarantee environmental security⁽⁷⁾. Groundwater being usually of good quality and easy availability is the most viable source of water supply for many communities since decades⁽⁸⁾. In the rapidly transforming world, where there are innumerable groundwater issues, the effects of urban environment on groundwater resources have created a worldwide concern⁽⁸⁾. Therefore, it has become necessary to pay ample attention toward this issue⁽⁸⁾. Due to daily use of polluted water, people are falling victim to serious diseases. In this research paper, we tried to find out the real condition of Kahalgaon Town which is located in Bhagalpur district of Bihar state, India by investigating various physicochemical parameters (i.e. pH, TDS, EC, Sulphate, Nitrates, Bacteriological, Total Hardness, Ca, Mg, Fe, As, Cl, F, Turbidity, and Alkalinity) through different methods and we all have tried to provide some safety measures as well. It is

also a matter of concern that heavy metals like arsenic have been found in the underground water of some wards of Kahalgaon Town. The underground water of this city contains elements like iron, fluoride, chloride in abundant quantities which are fatal for people and are also the cause of various types of dangerous diseases (Das et al, 2020). The problems can be solved to some extent by putting Black Plum wood in the water tanks of houses. **Placing Black Plum wood in the water tank keeps the water fresh and helps prevent stomachache, diabetes, arthritis, dysentery, and other serious digestive diseases.** The problem can be solved to some extent by drinking, the water after cleaning it with the Black Plumwood and then purifying it with a simple water purifier.

Materials and Methods:

The Study Area and Origin of Research:

Kahalgaon is a town and a municipality in Bhagalpur district in Bihar, India and it is situated at elevation 16 meters above the sea level. The Geographical Coordinates of this town is 25°15'37"N and 87°14'10"E. It is located close to Vikramshila that was once a famous Centre of Buddhist learning across the world, along with the Nalanda during the Pala dynasty. The Kahalgaon NTPC located near the town is very useful to the people. It is also a city of historical importance on the southern banks of the holy river Ganga. Kahalgaon is my native place.



Figure 1: Map of Kahalgaon Town in Bhagalpur District, Bihar

Significance of Research in this Area:

Kahalgaon is a developing town and there is a number of educational institutions and hospitals are situated in and around the town. About 50 villages are entirely depending upon this town. Everyday around thousands of students and people travels through the town. There are number of mango pulp and smallscale industries in and around the city. Therefore, it was very essential to do assessment of environment with respect to water as it is a daily consumption and essential for humans. Now a days, awareness has been increased on environmental issues and trace elements play a vital role, either helpful or harmful to human

health. In this regards, the complete study and assessment of water quality around Bhagalpur district was required. It would be helpful to the public as well as administration about the status of the rural areas water quality, public health, environmental conditions and issues of the country.

Objectives:

- To analyse the ward wise concentration of aforesaid physicochemical parameter in groundwater of Kahalgaon Town, Bhagalpur District, Bihar.
- To Suggest the suitable measures for the problem identified.

Hypotheses:

To achieve above objectives following hypotheses have been formulated.

- Due to daily use of polluted groundwater, people in this area are falling victim to serious water born diseases.
- Black Plum or Jawa Plum wood can purify groundwater and can be considered an effective solution for purifying groundwater.

Method of Analysis:

In this research paper, we analysed the physicochemical parameters by different suitable methods which are shown in Table 1.

Sl. No.	Name of Physicochemical Parameter	Methods of Analysis
01.	pH	Through pH Meter
02.	Turbidity	Turbidity Meter
03.	Electrical Conductivity	Conductivity Meter
04.	TDS	Gravimetric Filtration Method

Table 1: Analytical Method used for this Paper.

05.	Total Hardness				EDTA Titration Method				
06.	Calcium				EDTA Titration Method				
07.	Place	Source	Magnesium	Turbidity	EC in	EDTA Titration Method	Mg	Cl	
08.			Chloride	in NTU	µs/cm	Titration with AgNO ₃ Solution Method			
09.			Alkalinity			Titration with H ₂ SO ₄ Method			
01	Ward	GW	Iron	7.50	2.62	212.0	109.0	60.6	14.5
10.			Nitrates				Phenanthroline Method	5.8	19.3
11.	No. 1						UV- Spectrophotometer		
02	Ward	GW	Sulphate	7.34	2.65	678.0	351.0	177.7	43.6
12.			Fluoride				Turbidity Meter with Barium Chloride solution	16.6	109.7
13.	No. 2						SPANDS Method and Selective Ions Electrode Method	10.4	14.7
03.	Ward	GW		7.25	1.63	686.0	343.0	162.0	40.4
14.	No. 3		Arsenic				SDDC Method Through UV- Spectrophotometer		
15.	Bacteriological				Through H ₂ S Strip Method				

Result And Discussion:

After checking all the physicochemical parameters we found that the pH value of ground water is correct but the turbidity level is very high, especially in ward number 9, 14, 16 and 17 it has crossed the maximum limit. Electrical conductivity is also higher in some wards. Except ward number 01, 02, 03, 04, 06 and ward number 08, the amount of TDS in all other wards is quite high. Total hardness is fine for almost all the wards. Some wards have high levels of calcium and magnesium. The chloride content is also correct in almost all the wards, and the alkalinity level is also manageable. The amount of iron is also near the maximum limit and nitrate is also correct in all wards. Due to the presence of arsenic in ward number 01, 02, 04, 10 and 16, people living there may face problems in the future.

After analysis of all physicochemical parameters the data are listed in Table 2 and Table 3.

04.	Ward No. 4	GW	7.41	2.99	845.0	423.0	218.1	59.7	16.6	95.8	
05.	Ward No. 5	GW	7.15	4.60	1041.0	506.0	262.6	63.0	25.5	28.9	
Sl. No.	Place	Source	Alkalinity mg/L	Fe mg/L	NO ₃ mg/L	SO ₄ mg/L	F mg/L	As mg/L	Bacteriological		
06.	Ward No. 6	GW	7.29	3.89	204.0	105.0	60.6	12.9	6.8	13.2	
07.	Ward No. 7	GW	7.36	3.65	117.5	59.0	303.07	74.001	28.4	83.8	Negative
08.	Ward No. 8	GW	7.67	2.40	371.5	186.0	96.91	25.805	7.8	18.4	Negative
09.	Ward No. 9	GW	7.57	23.0	182.6	89.0	416.45	106.800	34.3	59.8	Negative
10.	Ward No. 10	GW	7.28	4.10	118.0	58.0	290.38	71.001	27.4	43.7	Negative
11.	Ward No. 11	GW	7.46	3.60	153.2	75.0	367.61	106.000	25.5	58.1	Negative
12.	Ward No. 12	GW	7.58	3.58	1124.0	564.0	282.8	75.9	22.5	89.8	
13.	Ward No. 13	GW	7.62	4.56	1766.0	883.0	420.2	117.9	30.4	90.5	
14.	Ward No. 14	GW	7.25	5.65	1504.0	752.0	363.6	96.9	29.4	45	
15.	Ward No. 15	GW	7.43	4.68	1252.0	625.0	303.0	79.1	25.5	51.8	
16.	Ward No. 16	GW	7.25	8.16	1311.0	657.0	319.1	82.4	27.40	71.8	
17.	Ward No. 17	GW	7.34	7.13	1095.0	545.0	262.6	67.8	22.50	39.9	
Desirable Limit.			6.5-8.5	1.0	-	500	300	75	30	250	
Permissible limit in absence of alternate source.			NR	5.0	-	2000	600	200	100	1000	

Table 2: Ward Wise Analytical Result of Physicochemical Parameter.

06.	Ward No. 6	GW	48.4	0.40	1.4	3.0	0.72	0.000	Negative
07.	Ward No. 7	GW	282.8	0.18	4.2	10.0	0.30	0.000	Negative
08.	Ward No. 8	GW	76.7	0.05	1.6	3.0	0.52	0.000	Negative
09.	Ward No. 9	GW	92.9	0.17	6.1	10.0	0.34	0.000	Negative
10.	Ward No. 10	GW	274.7	0.25	3.5	6.0	0.49	0.003	Negative
11.	Ward No. 11	GW	343.4	0.30	5.4	10.0	0.23	0.000	Negative
12.	Ward No. 12	GW	266.6	0.35	3.4	6.0	0.48	0.000	Negative
13.	Ward No. 13	GW	395.9	0.60	5.0	8.0	0.34	0.000	Negative
14.	Ward No. 14	GW	339.3	0.55	4.4	7.0	0.82	0.000	Negative
15.	Ward No. 15	GW	278.7	0.04	4.5	5.0	0.85	0.000	Negative
16.	Ward No. 16	GW	290.8	0.26	4.6	8.0	0.98	0.001	Negative
17.	Ward No. 17	GW	246.4	0.24	4.0	4.0	0.66	0.000	Negative
Desirable Limit.			200	1.0	45	200	1.0	0.01	-
Permissible limit in absence of alternate source.			600	NR	NR	400	1.5	NR	-

Table 3: Ward Wise Analytical Result of Physicochemical Parameter (Continued)

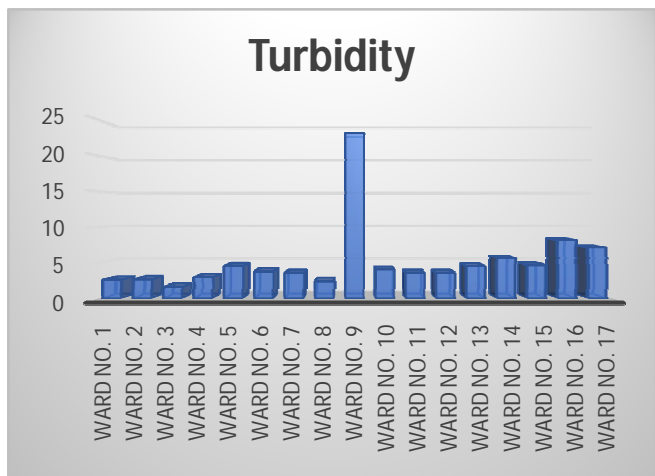
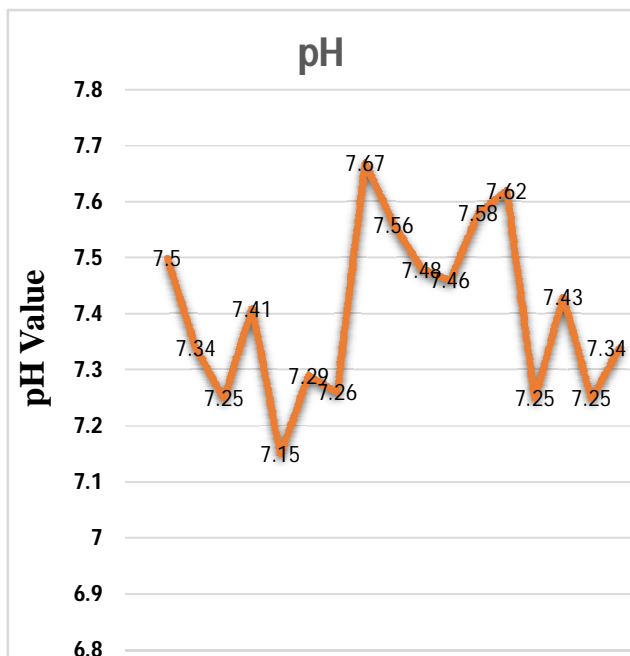
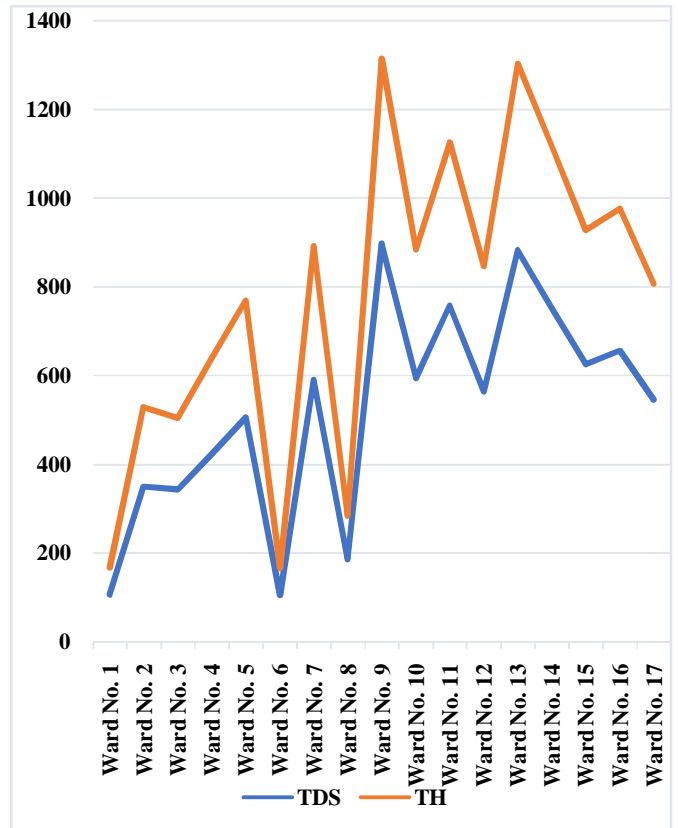
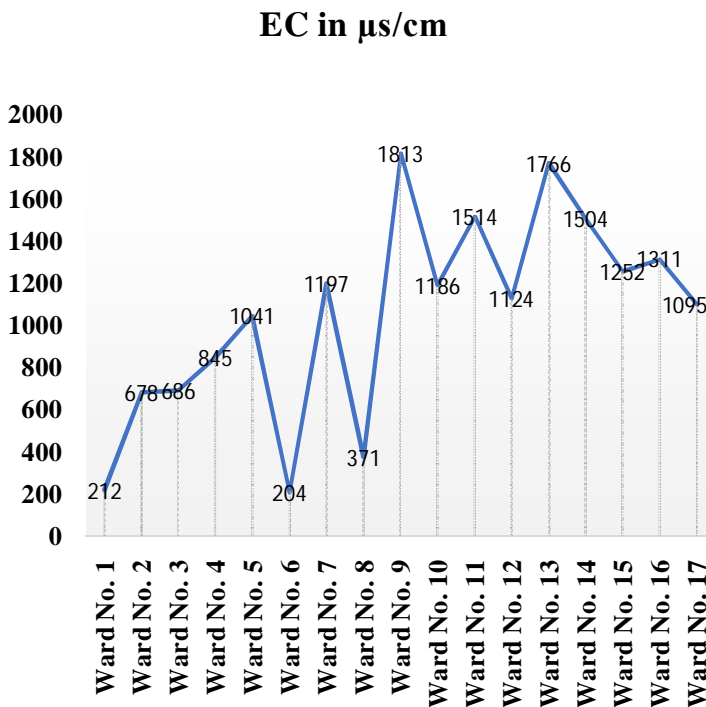
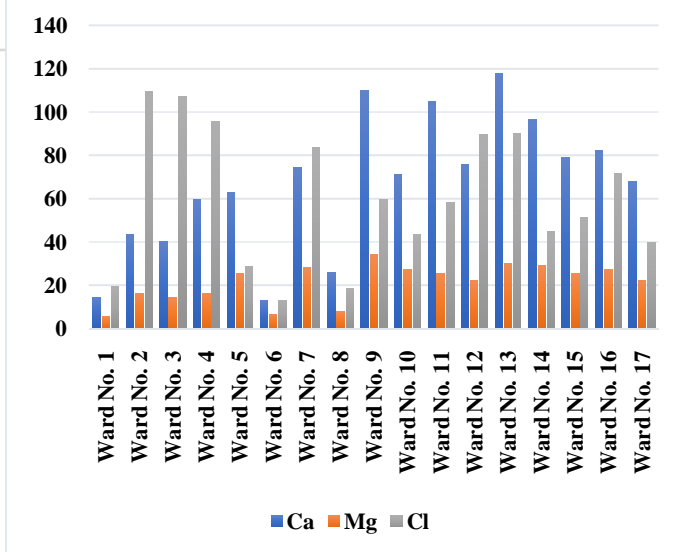


Figure 3: Ward Wise variation of Turbidity (D. L. is 1).

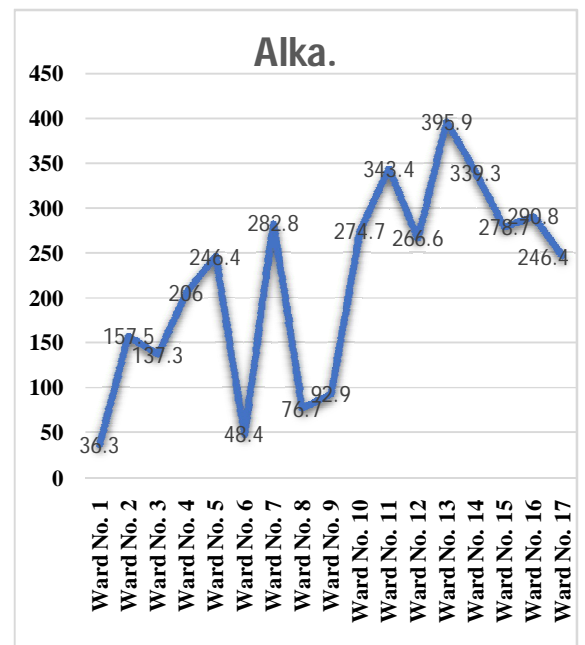
**Figure 2: Ward Wise variation of pH
(D.L: 6.5-8.5).**



**Figure 5: Ward Wise variation of TDS
(D.L.-500) and TH (D.L.- 300).**



**Figure 6: Ward Wise variation of Ca (D.L.-75),
Mg (D.L.- 30) and Cl (D.L.- 250).**



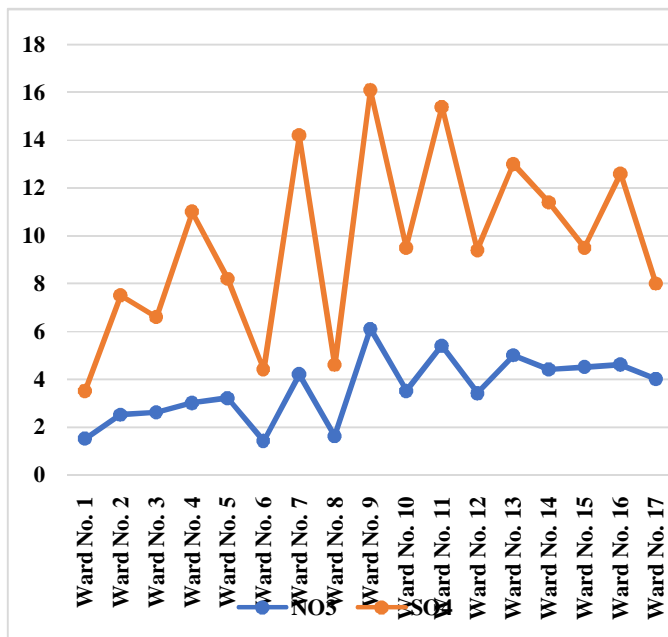


Figure 8: Ward Wise variation of Nitrate (D.L.-45) and Sulphate (D.L.- 200).

Figure 7: Ward Wise variation of Alka. (D. L.- 200).

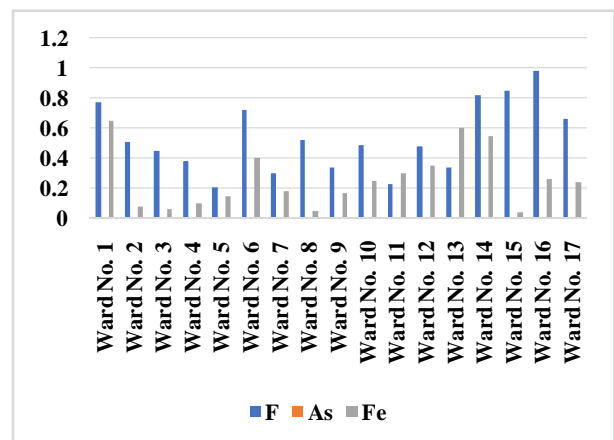


Figure 9: Ward Wise variation of F (D.L.-1), Fe (D.L.- 1) and As (D.L- 0.01).

Method of Redressal:

We all are working on the process of purifying water, I will discuss some of these through which water can be cleaned to some extent, but our work is still ongoing, this process cannot provide a complete solution, better solutions are needed. Although there are many equipment and processes like reverse osmosis for water purification, these are quite expensive and it is difficult for all families to install them in their homes, and also there is lot of wastage of water in this. Most of the people in Kahalgaon city live below the poverty line and cannot afford such a costly solution, hence by using an old and less costly solution they can clean the water to some extent and use it. The problem can be solved to some extent by drinking the water after cleaning it with the Black Plumwood and then purifying it with a simple water purifier. Putting the wood of Black Plum in the water tank does not spoil the water and also saves from stomachache, diabetes, arthritis, dysentery and serious digestive diseases. In earlier times, when wells were dug in villages, large pieces of Black Plum wood were placed at its

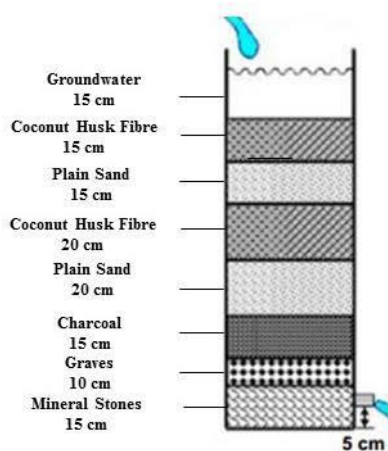
bottom so that the water of the well always remained pure. Various traditional methods have been used historically to ensure safe drinking water, including the use of natural materials like wood, charcoal, and herbs with antimicrobial properties (WHO, 2017).

The method of using Black Plum (*Syzygiumcumini*) wood for water purification is one such traditional approach, known for its medicinal properties and historical usage. We are currently working on water purification processes that can provide an affordable alternative to expensive filtration technologies. While RO and other advanced filtration systems are effective, they come with high costs and significant water wastage, making them unsuitable for many families in Kahalgaon, where a large proportion of the population lives below the poverty line (Gleick et al., 2018). Studies have shown that its bark and wood contain tannins, flavonoids, and phenolic compounds that exhibit antibacterial and antifungal activity, which may contribute to maintaining water quality (Sharma et al., 2019). Additionally, these bioactive compounds have been associated with therapeutic benefits, including relief from stomachache, diabetes, arthritis, and digestive disorders (Gupta & Kumar, 2021).

One traditional yet effective method involves using Black Plum wood in water tanks. Historical records and anecdotal evidence suggest that placing pieces of this wood in water sources helps maintain water quality. This practice was commonly observed in old village wells, where large pieces of Black Plum wood were placed at the bottom to prevent microbial growth and keep the water pure (Singh & Verma, 2020).

There are many benefits of adding Black Plum wood to water, such as:

- Black Plum wood has anti-bacterial and anti-fungal properties. Therefore, adding Black Plum to a water tank kills harmful bacteria and fungi present in the water.
- By adding Black Plum wood, algae and green moss do not accumulate in water.
- By adding Black Plumwood the water remains clean and the tank does not get contaminated.
- Black Plum wood provides extra minerals to the water and keeps its TDS balanced.
- By adding Black Plum wood, the water remains clean and balanced and a healthy water flow is also obtained.



**Figure10: Black Plum wood
inside the water tank.**

**Figure 11: Diagram of the
principle of a simple water**

Conclusion:

After testing the water of all the wards, we have come to the conclusion that the actual condition of water in Kahalgaon Town is not good, people there need to be made aware to improve it. There is a lack of awareness among the people, and due to which they are still forced to use such water in daily lives. The people use their underground water in daily lives, due to which a lot of water born diseases are arising in that area and they do not have any other solution. With the help of the solution mentioned in our research paper, they can adopt this process and use clean water in daily life to some extent.

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