e-ISSN 2320 –7876 www.ijfans.org
Vol.11, Iss.10, 2022
Research Paper **UGC CARE Listed (Group -I) Journal**

Physical and Chemical Analysis of Ground Water Quality in Block Jatusana of District Rewari, Haryana (India)

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ABSTRACT

The output of agricultural goods in the state of Haryana is significantly impacted by the city of Rewari. The area receives an estimated total of 657.3 millimetres of rainfall on a yearly basis on average. On occasion, there are issues with floods, and at other times, there is a situation of draught as a result of the uneven distribution of rainfall in the area. Because the soil in this region is composed of sandy loam, irrigating the land requires a large quantity of water. Both the ground water level and water quality in the state of Haryana, which is located in India, are topics that are covered in this article. The state of Haryana was compelled to take action when it was determined that the levels of harmful ions and microbes in certain sections of the state surpassed the maximum allowable limit for India's drinking water. The rate of industrialization and urbanisation in Haryana has led to an all-time high in the state's water usage, which has also reached an all-time high. It was found that the majority of the population in Haryana depends heavily on groundwater to meet their requirements, which may be attributed to the fact that surface water resources in the region are restricted and have already reached capacity. Even though its use increases crop production because it contains organic material and important nutrients for the growth, untreated sewage water still contains unwanted elements and heavy metals in it. This is the case even though it does contain important nutrients and organic material for the growth. Despite the fact that using it leads to an increase in crop output, this is still the case. It is imperative that the ground water quality be monitored at regular intervals because the human population is afflicted with a wide variety of water-borne illnesses as a direct result of the use of polluted drinking water.

Keywords: Physical, Chemical, Analysis , Ground , Water, Quality

1. INTRODUCTION

Water is one of the "Panchatattva" criteria that must be present in order to develop a healthy human body, which means that it must be present. It is estimated that water accounts for around 75% of the total weight of all living things, including plants and animals. It plays an important role in the digesting process, as well as the circulatory system, the elimination system, and a number of other bodily functions. There are two major classifications that can be used to describe the water resources that may be found on our planet.

1) Water that is present on the ground, and

2) Water that is present on the surface

The term "ground water" refers to the moisture that finally becomes trapped below the surface of the earth after making its way through many layers of sand, rock, and soil. Ground water accounts for about 98% of the entire quantity of fresh water that is available on earth in liquid form, which is 10.5 k km^3 of the total according to the data that have been gathered.

Haryana is primarily a farming state despite having just 1.4% of the total land area available for cultivation. It is also the state that supplies the nation's food reserves with the second biggest supply of food grains, making it the second most important contributor. There are roughly 3.8 million hectares (m ha) of cultivable land in the state, and 2.99 million ha, which is equivalent to 84% of the net planted area, is irrigated.

The businesses of drinking water production, agricultural irrigation, and manufacturing are all making use of the resources that are offered by ground water. Ground water is the natural resource that is completely essential for the upkeep of our system that provides for our survival. On the other hand, as a consequence of rapid population increase, industrialization, the application of fertilisers, and other activities carried out by people, it has become heavily polluted with a wide array of potentially harmful substances. In general, the quality of the ground water may be defined using a large variety of different physical and chemical parameters. These criteria can be broken down further into subcategories. Some of the factors that are included here include total hardness ($CaCO_3$), fluoride (F), total dissolved solids (TDS), iron (Fe), pH, magnesium (Mg), nitrate (NO_3), chloride (Cl), sulphate (SO_4), calcium (Ca), and alkalinity. These features are the root cause of exceedingly significant dangers posed to the health of the Indian population. The passage of time, such as the pre-monsoon and post-monsoon periods, is responsible for alterations of this scale. The objective of this study project, which will take place during the pre-monsoon season, is to assess the levels of physical and chemical pollution that are present in particular areas of the Jatusana block of the Rewari district in the state of Haryana (India)

2. LITERATURE REVIEW

Ground water quality and quantity in the Indian state of Haryana are discussed below. When it was discovered that drinking water in some parts of the state of Haryana had dangerously high concentrations of toxic ions and microorganisms, the state was forced to take action. Haryana's water consumption is at an all-time high as a direct result of the state's rapid rate of industrialisation and urbanisation. Surface water resources in the region are limited, and they are at capacity, hence it was determined that the bulk of the population in Haryana relies largely on groundwater to satisfy their requirements. Researchers from several institutions found that industrialisation, urbanisation, microbiological contamination, and climatic influences are all contributing to a decline in Haryana's ground water's quantity and quality. The results of the probe proved this to be the case. This study aims to summarise the current state of ground water levels and quality in Haryana, India, including the issues that exist and the need for further study to enhance groundwater levels and quality. In order to achieve this goal, we shall make use of the data at our disposal. To wit: (Keshav Gangurde)

2.1 Ground water quality and contamination

Manchanda et al. (2014), Subsurface water in Pataudi has been found to contain abnormally high levels of nitrates due to human activity. This water is very susceptible to contamination**.**

Sunil Kumar Tobriya (2016), This was found to be the case when comparing the two types of agricultural soil. This was found out by contrasting the findings of the current study with agricultural soil in which the crops are watered by either water from tube wells or canals. This was revealed to be the case throughout the course of analysing the two separate types of agricultural soil. A study of the two various kinds of agricultural soil brought this obvious fact to light for me. It was determined over the process of doing study on the two separate types of agricultural soil that this is, in fact, the case. The level of fertility of agricultural land that is irrigated with sewage water is higher than the level of fertility of agricultural land that is irrigated with water that comes from natural sources. The level of fertility of agricultural land that is irrigated with water that comes from natural sources is lower. This is due to the fact that water that originates from natural sources such as rivers and lakes has less nutrients and more microbes than sewage water does. This is because the concentration of nutrients that can be found in wastewater is noticeably larger than the concentration that can be found in natural water. The rise in the proportion of soil samples that were studied and analysed for total nitrogen (+109.09%), organic carbon (+49.19%), available phosphorus (+72.08%), electrical conductivity (+58.62%), available potassium (+49.03%) and also water holding capacity (+22.30). When utilised as a source of irrigation, raw sewage causes a significant increase in the amount of heavy metals that are present in the ground. This can have serious health consequences. This may have a detrimental impact on the health of humans. To be more specific, an increase in the quantity of zinc, copper, and lead was seen as a direct result of the use of this method. To provide more clarity, the quantity of zinc grew by +470.05%, the quantity of copper rose by +232.27%, and the quantity of lead rose by +106.64%. The findings that were obtained do not demonstrate a significant difference between the concentrations of the metals Cd (+27.41) and Fe (+51.40) in soil that was irrigated with sewage and soil that was irrigated with tube wells. Both types of irrigation resulted in similar levels of both metals in the soil. The end outcome of either kind of irrigation was metal concentrations in the soil that were virtually identical. In the end, regardless of whatever kind of irrigation was used, the metal concentrations in the soil were almost exactly the same. The end effect was essentially identical levels of metal content in the soil, regardless of the method of irrigation that was utilised. The continued application of sewage effluents to the fields will, without a doubt, lead to an increment in the number of heavy metals that are present in the soil. This conclusion can be reached with absolute certainty. If the farmers continue to utilise water that has not been treated in any way for the purpose of irrigating this area, then the future will bring negative consequences for the people and animals who live in this region. According to the findings of a study into soil samples obtained from an experimental location, the quality of the soil is outstanding, and these numbers fit within the permitted limitations defined by the Indian standard. The soil was obtained from a site where certain tests were being carried out. When taken together, these two investigations point to the Indian standard being acceptable.

3. CONCEPTUAL FRAMEWORK

Any human-made intervention with the potential to harm the aquatic ecosystem is considered a "pressure" under the Water Framework Directive (WFD). Any action with potentially adverse consequences fits these criteria. The phrase "environmental degradation" describes any action that might harm the planet. The term "environmental impact" is used to describe the likelihood that a certain activity may have a negative effect on the natural world. There are five separate pressures, and the groundwater's total pressure can be altered by any one of them or a combination of them. It is claimed that an aquifer is vulnerable to contamination if there is a high probability that groundwater inside the aquifer may become contaminated as a result of the impact of human activities on the aquifer. When human activities have an effect on the aquifer, this may occur. Instances like this are possible when the two are related in some way. The two concepts, "inherent vulnerability" and "particular vulnerability," are not synonymous because of the distinction that may be made between them. When the geological and hydrogeological features of a region are considered, a measure of the groundwater's "intrinsic vulnerability" to contamination by human activities may be made. The degree to which groundwater is vulnerable to contamination is one indicator of this sensitivity. The potential for groundwater to become tainted with chemicals is accounted for in this idea. This sensitivity is not dependent on the details of the contaminating substances, but does take into account regional geological and hydrogeological features. In contrast, when we discuss groundwater's susceptibility to a single contaminant or set of contaminants, we are talking to its general sensitivity. Our focus here is on its susceptibility to contamination by a given substance. In particular, we are referring to its susceptibility to damage from a synergistic effect of many types of pollution. Consideration of the inherent vulnerability components and the characteristics of the agents in issue is required for susceptibility assessment (Zwahlen, 2004).

Land-use planning, which is conducted on the basis of the characterisation of the physical geography, has been used throughout human history to address the question of how to make socioeconomic activity consistent with the conservation of the quality and quantity of ground waters. This has been done to answer the question of how to safeguard the quality and quantity of ground waters while maintaining the viability of social and economic activities. The goal of these efforts is to determine how to maintain both the quality and quantity of ground water while also accommodating for the needs of a thriving economy. This was done in response to a need to ensure that human and commercial activities would not compromise the quality or quantity of ground water. This step was done in response to a call for action to ensure that human and economic activities wouldn't compromise the quality or quantity of ground water supplies. That is to say, this action was done because of the need for social and economic activities to be reconciled with the maintenance of ground water quality and quantity. Books are available on a wide range of subjects, including those that provide an overview of the crucial choices that must be made to save groundwater. These books and magazines can be purchased separately. One measure taken to save assets is an assessment of susceptibility to contamination on a fundamental level. The inherent vulnerability to contamination should be evaluated so that preventative actions can be taken in connection to the use of resources. Despite this, a sizable portion of land has to be covered before the groundwater protection system can be considered fully functional. Medical experts agree that both of these strategies are worthwhile preventative steps to take. The process of vulnerability mapping is primarily motivated by the need to ensure the safety of the resource, which in this case is the groundwater body. Water abstractions for human use, such as drinking water and other kinds of ingestible water, are the major focus of wellhead protection zones. Wellhead protection zones do concentrate some emphasis on reducing risk, however resource preservation is the primary driver of this practise.

Numerous countries in the European Union have regulations on the books pertaining to the conservation of water resources, and one of these laws mandates a certain distance be kept away from the wellhead of water abstraction sites to ensure the safety of drinking water. [Insert citation here] Nonetheless, the subject of how to properly demarcate its boundary has been contested in each of these countries in a variety of different ways. Several countries in the European Union have comprehensive legal provisions relating to the conservation of water resources, including the wellhead protection area of water abstraction sites for drinking water. However, the many different countries that make up the European Union have taken different approaches to the creation of the safeguards. Twenty percent of Germany is covered by wellhead protection zones, whereas in Spain, such zones have just begun to form. The Netherlands is yet another country with designated wellhead safeguard zones. This shows that Germany, in order to compete successfully, needs to catch up to Spain in this area. In many cases, Spanish land is divided into three zones, each based on its distance from an abstraction point. In Spain, this type of zoning is used more frequently than any other.

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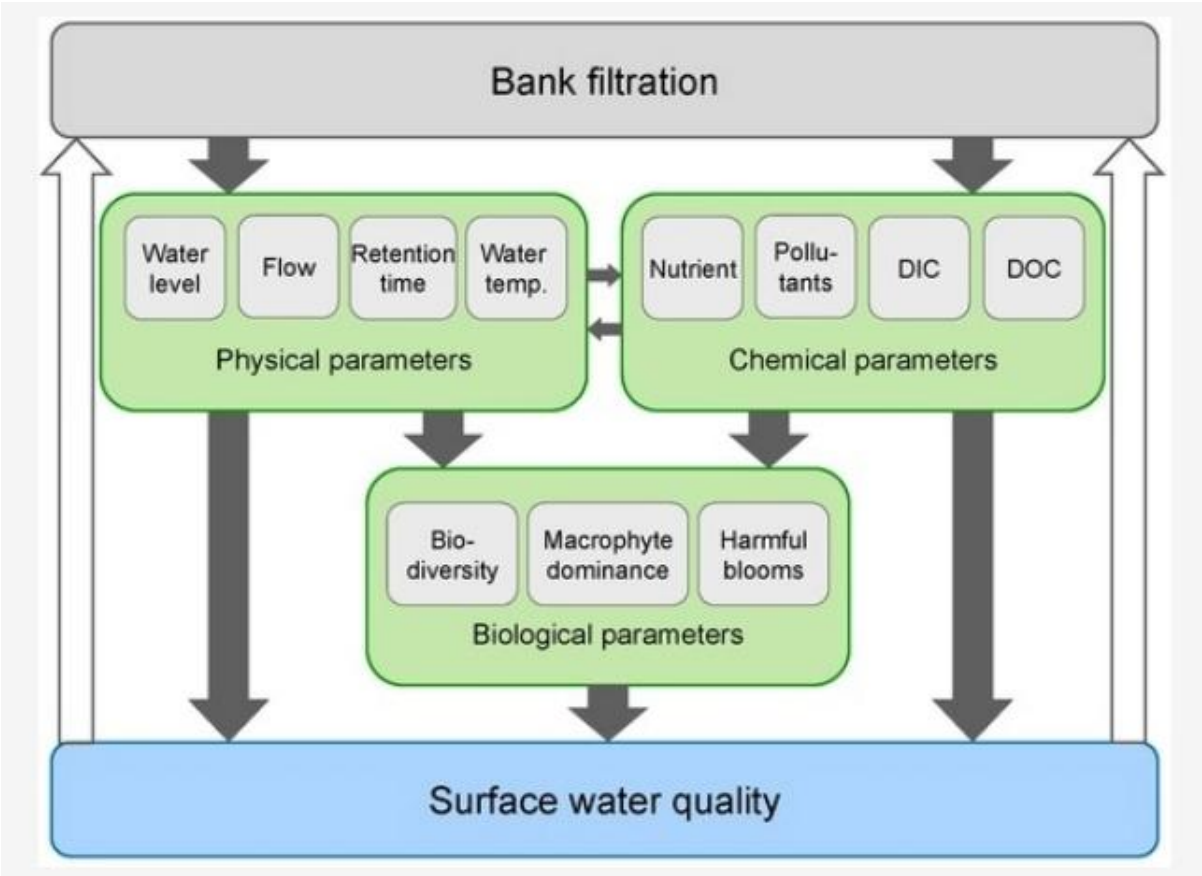

Figure 1 Bank filtration

The method that is used to filter surface water before it is allowed to seep into aquifers is called bank filtration (BF). Because BF is present, we may deduce that the hydraulic head of the surface water is higher than that of the groundwater in the vicinity. This may happen as a consequence of natural processes, such as in lowland rivers or at high water stages, or it may happen as a result of groundwater abstraction from wells that are positioned near to the surface water. Both of these scenarios are possible. This latter event, which is referred to as "induced bank filtering," is brought about by the procedure described above (IBF, Figure 1). If a stream, lake, or river is being impacted by BF, it is commonly described as as a losing stream, lake, or river. However, it is conceivable for water bodies to be losing in some portions while gaining in other sections of the water body. It is not unheard of for surface rivers to get contaminated with BF as a consequence of groundwater removal in the surrounding area of such waterways.

4. METHODOLOGY AND RESULT

Location of Study :- In the Indian state of Haryana, the Jatusana block may be found to the east of the district of Rewari (India). In terms of geography, the location of the research area is at a latitude of 22 degrees and 5 minutes north and a longitude of 72 degrees and 22 minutes east of the legislative meridian. The Jatusana block has a total land area of 275.24 square kilometres and is made up of a total of 62 distinct villages. The entire irrigated area in the study region is 171.69 square kilometres, and it gets an average annual rainfall of 560 millimetres. In this part of the world, the months of May and June tend to be the hottest, while December and January are often the months with the lowest temperatures. During the summer, the temperature of the area where the study was conducted varies from 280 degrees

Celsius to 43 degrees Celsius, while during the winter, the temperature ranges from 6 degrees Celsius to 21 degrees Celsius.

Ground Water Sampling and Testing : In order to collect samples of the ground water in a number of the villages located in the Khol block of the Rewari district in the state of Haryana, researchers travelled to a variety of these communities. In the weeks leading up to the start of the monsoon season, we collected samples of ground water using hand pumps, tube wells, and bore wells. Bore wells were our primary method of extraction. During the time leading up to the start of the monsoon season, we took all of the essential precautions and collected samples of ground water in containers that had been previously washed and rinsed. Each bottle has the potential to hold one litre of liquid inside its limits. Some of the different physical and chemical characteristics that were applied to and analysed in each of the ground water samples included the odour, total hardness (CaCO3), fluoride (F), total dissolved solids (TDS), pH, magnesium (Mg), calcium (Ca), chloride (Cl), sulphate (SO4), iron (Fe) , nitrate (NO3) and alkalinity.

Ground Water Several Indices of Quality: Using Indian Standards according to BIS-10500: 2012 and WHO standards, the outputs of a variety of distinct physical and chemical parameters were examined (WHO). The subsequent text provides an explanation of these criteria.: -

Table 1 Ground Water Quality Parameters

Sr. No.	Parameters	Units	Indian Standard BIS-10500:2021 (Acceptable Limit)	WHO Standard (Acceptable Limit)
1	Odour	-	Agreeable	Agreeable
2	Total Dissolved Solids (TDS)	mg/l	500	500
3	Total Hardness ($CaCO_3$)	mg/l	200	100
4	ph	-	6.4-8.4	6.4-9.4
5	Fluoride (F)	mg/l	1.0	1
6	Calcium (Ca)	mg/l	75	75
7	Magnesium (Mg)	mg/l	30	30
8	Iron (Fe)	mg/l	0.2	0.3
9	Chloride (Cl)	mg/l	250	250

10	Sulphate (SO_4)	mg/l	200	200
11	Nitrate (NO_3)	mg/l	45	45
12	Alkalinity	mg/l	200	200

Table 2 Ground Water Quality Parameters of Jatusana Block villages

Sr. No	Name of village.	Odour	TDS	$CaCO_3$	pH	F	Ca	Mg	Fe	Cl	SO_4	NO_3	Alkalinity
1	**Asiaki Gorawas**	None	470	270	7.8	0.68	74.1	28.3	0.02	90	39	8.5	210
2	**Aulant**	None	500	90	8.8	3.01	14	14.1	0.02	60	24	0.7	450
3	**Babdoli**	None	460	150	8.8	0.54	32	28.1	0.02	80	38	0.8	160
4	**Balawas Jamapur**	None	270	120	7.8	0.8	18.2	14.2	0.02	80	52	2.2	130
5	**Baldhan Kalan**	None	480	80	8.9	3.32	12.1	16.1	0.03	68	28	0.8	470
6	**Baldhan Khurd**	None	260	110	7.4	0.6	20.1	13.5	0.03	90	42	1.9	110
7	**Berli Kalan**	None	920	280	9.1	0.8	22.1	56.1	0.05	290	48	9.8	270
8	**Bohatwas Bhondu**	None	1380	170	8.4	1.42	22.1	27.1	0.1	250	198	5.4	490
9	**Boria Kamalpur**	None	1290	180	8.9	1.22	2..08	29.1	0.1	290	230	6.1	520
10	**Chandanwas**	None	890	270	9.5	0.7	22.1	54.1	0.07	310	485	8.9	290

11	**Dakhora**	None	125 0	470	8	0.9 4	38	86.1	0.1	380	124	17.1	160
12	**Daroli**	None	158 0	260	8.7	1.3 2	42	38.2	0.02	460	35	1.6	450
13	**Dehlawas**	None	440	160	8.5	0.5 9	30.1	26.1	0.01	70	36	0.7	140
14	**Didoli**	None	131 0	430	6.9	0.8	14.1	96.2	0.02	350	72	15	260
15	**Kahari**	None	143 0	330	6.8	0.7	26.1	66.1	0.01	370	58	8	390

Discussions : - Before the beginning of the monsoon rainy season, samples of ground water were collected in the Jatusana Block of the Rewari District in the Indian state of Haryana. The different physical and chemical characteristics of these samples are covered further down in this article. This information was analysed, and the findings were compared to those that were provided by the World Health Organization as well as the Indian Standards according to BIS-10500: 2012. (WHO): -

Odour: - There might be a number of reasons why the water has an unpleasant odour, such as the presence of mineral salt, the decomposition of chemical material, mineral salt, organic matter etc., among other possible explanations. During the course of this research, not a single ground water sample produced any odour that the human nose was capable of picking up.

Total Dissolved Solids can also be abbreviated to "TDS," which stands for Total Dissolved Solids. TDS concentrations were monitored over the course of this inquiry, and the findings indicated that they varied anywhere from 260 mg/l all the way up to 1580 mg/l. In all, this investigation yielded a total of a total of 260 mg/l.

pH: Both the Indian Standards and the standards that were developed by the WHO agree that values falling within the range of 6.5 to 8.5 are considered to be satisfactory in this context. Both sets of standards recognise this magnitude of variation in data as being within an acceptable range. During the course of this particular experiment, it was found that the pH may land anywhere on a scale ranging from 7.1 to 9.5.

Fluoride (F) : The results of the most current research indicate that the concentration of fluoride (F) in the water might range anywhere from 0.59 mg/l to 3.32 mg/l. [Further citation is required] After further investigation, it was determined that this magnitude indeed existed. The quantity of fluoride (F) that was present in the hamlet of Dehla was 0.59 mg/l, but the concentration of fluoride (F) that was present in the town of Baldhan was 3.32 mg/l. It was revealed that the municipality of Baldhan had the highest concentration of fluoride (F) in the world (F). The World Health Organization (WHO) and the Indian Standards have come to the conclusion that 1.0 mg/l is the maximum quantity of fluoride (f) that should be present in water that is used for human consumption. The World Health Organization has suggested doing so.

Calcium (Ca) - During the course of this examination, calcium amounts ranging from 2.08 mg/l all the way up to 74.08 mg/l were found to be present. The greatest amount of calcium that was found to be present in the liquid sample was 74.08 mg/l. The overall calcium concentrations measured came out to a total of 74.08 mg/l once everything was said and done. Both the World Health Organization (WHO) and the Indian Standards agree that there should never be more than 75 mg/l of calcium in a solution at any given time. This is the maximum quantity of calcium that should ever be present.

Magnesium (Mg) – According to the findings of the ongoing research project, the concentration of magnesium (Mg) might be anywhere from 13.48 mg/l to 96.22 mg/l. This range of possible values was arrived at. The researchers came to the conclusion that this particular spectrum of possible values was suitable for use. It was determined that this spectrum was well within the bounds of acceptability and plausibility. While the hamlet of Baldhan had the lowest concentration of magnesium (Mg), which was discovered to be 13.48 mg/l, the town of Didoli had the highest concentration of magnesium (Mg), which was measured as 96.22 mg/l. The town of Baldhan had the lowest concentration of magnesium (Mg), while the town of Didoli had the highest concentration of magnesium (Mg). Both the World Health Organization (WHO) and the Indian Standards agree that the maximum quantity of magnesium that should be present in drinking water is 1.0 mg/l. This recommendation was made by both organisations.

Iron (Fe) - The most recent piece of research has showed that the quantity of iron (Fe) that is detected in each of the ground water samples is below the allowable limit. This conclusion was reached after analysing all of the ground water samples. The facts support this interpretation, thus this is the inference that one can make. When compared to the acceptable range, the results of the measurements revealed that this was, in fact, the situation. This is something that the World Health Organization (WHO) as well as the Indian Standards Institution have both agreed upon and certified.

Chloride (Cl) - During the course of this examination, the levels of chloride (Cl) that were found to be present ranged anywhere from 60 mg/l all the way up to 660 mg/l. A wide range of chloride (Cl) concentrations was shown by the findings of this experiment. According to the guidelines provided by the World Health Organization (WHO) and the Indian Standards, the total amount of chloride that is present in a single beverage should not exceed 250 mg/l.

Sulphate (SO_4) - In this particular study report, the quantities of sulphate (SO4) that were found to be present ranged anywhere from 24 mg/l all the way up to 485 mg/l. The outcomes of a single experiment served as the foundation for this paper. The World Health Organization (WHO) and the Indian Standards agree that the maximum quantity of sulphate (SO_4) that can be present in a solution is comparable to 200 mg/l. This limit was established in order to protect human health.

Nitrate (NO_3) - Nitrate (NO_3) concentrations in the sample ranged from 0.7 mg/l to 17.1 mg/l, according to the most current study of ground water quality. An upper limit of 11.4 mg/l of nitrate (NO3) is considered safe by both the WHO and the Indian Standards.

Alkalinity - The alkalinity levels that were identified in this research report ranged from 110 mg/l all the way up to 520 mg/l. The Indian Standards specify that a maximum of 200 mg/l of alkalinity may be present in a given solution at any one time.

Table 3: Rewari block groundwater quality categorization

Water quality	Class	Percentage
Good	A	38
Saline	B	
Marginally Saline	B_1	17
Saline	B_2	11
High SAR Saline	B_3	16
Alkali Water	C	
Marginally Alkali	C_1	2
Alkali	C_2	8
Highly alkali	C_3	3

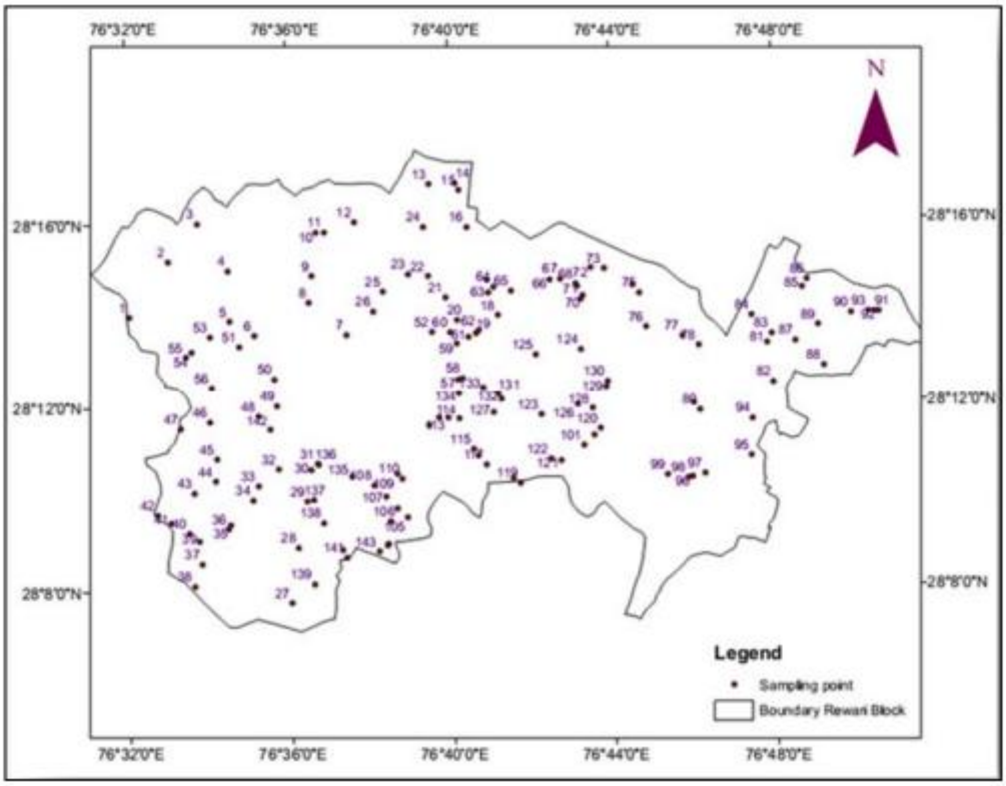

Fig 1: Sample site locations in the Rewari neighbourhood

5. CONCLUSION AND MANAGERIAL IMPLICATION

5.1 Conclusion

It is vital that the state of Haryana maintain a stable supply of ground water of a high quality in order to assist the expansion of Haryana's fast expanding industrial sector, as well as its tourist and urbanisation sectors. This will allow for the growth of all of these businesses. In the body of work that is going to be presented here, an effort has been made to hone in on the problem of Haryana's deteriorating ground water quality and level in an effort to be as detailed as is humanly feasible. According to the results of the research, Both the ground water level and water quality in the state of Haryana are seeing a precipitous decrease at the same time. This is happening at the same time. One of the factors that has contributed to overexploitation is the agricultural sector's continually growing need for ground water over the course of the past four decades. This demand has led to an overuse of the resource. In the process of designing either the pattern or the intensity of the cropping that took place, the quantity of ground water that was reachable was not taken into consideration at any point. The slow accumulation of home and industrial effluents over the course of time has led to the pollution of ground water, which has in turn led to difficulties with human health. These problems are a direct outcome of the poisoning of ground water.

According to the data that was gathered, approximately 76 percent of all districts in the state of Haryana are affected by problems that are associated with the availability of ground water, the quality of ground water, or both of these aspects of ground water. These issues can be traced back to a number of different factors, including both human and natural factors. There are many different ways in which these problems might present themselves. As a direct result of this, the state of Haryana has to adopt the appropriate safety measures to preserve its ground water and continue conducting quality checks on it over time. Both the capacity for yearly recharge and the ability to collect rainwater that falls on rooftops may be enhanced, which will result in an increase in the quantity of ground water that is available. Rainwater that falls on roofs can also be collected. Prior to the start of the monsoon season, an investigation was conducted to look at the physicochemical properties of ground water samples. These samples were gathered from a broad variety of villages that can be found in the Jatusana Block of the Rewari District in the state of Haryana in India. The ground water samples from block Jatusana were analysed for a variety of chemicals and elements, and the results showed that everything from the water's colour to its odour to its pH to its calcium and sulphate and nitrate concentrations were well within the safe ranges established by the Indian Standards (BIS-10500: 2012) and the World Health Organization (WHO).

This was done by comparing the levels of these parameters at each site to the acceptable limit that was established by the World Health Organization. In order to accomplish this goal, a comparison was made between the amounts of these parameters found at each place and the permitted limit determined by the Indian Standards. In order to do this, a comparison was carried out between the parameters that were discovered at each place and the highest level that the Indian Standards consider to be appropriate (WHO). It has been shown that there is a regional variation in both the physical properties and the chemical characteristics that characterise the quality of ground water. These differences are due to the fact that different regions have different geological formations. These qualities may be categorised as either physical or chemical, depending on their manifestation. As a direct result of the consumption of dirty drinking water, the human population is susceptible to a wide variety of diseases that are transmitted through water. As a direct result of this, the quality of drinking water must be evaluated at regular intervals in order to prevent the spread of these diseases. IBF results in the removal of water from a broad range of surface waterways all over the globe, such as ponds, small and deep lakes, and rivers of varying flow. This occurs on every continent except Antarctica. These many water sources are as follows: The processes that have an influence on the quantity and quality of drinking water are the exclusive focus of the research that has been done on IBF to this point. Up until this moment, its influence on surface waterways has been overlooked, despite the fact that it is a useful, cost-effective, and dependable technology for the production of drinking water. This is in spite of the fact that it is one of the strategies that may be used to the situation.

5.2 Managerial Implication

Contamination of ground water and the planning of how land will be used are inextricably linked to one another.

Land uses and commercial operations, particularly those that take place in catchments for drinking water, need to be subject to the regulatory monitoring of the government in order to assure their safety. This is especially important in catchments for groundwater.

The restrictions that state governments establish on land zoning and subdivision have the potential to be very useful instruments for the conservation of groundwater provided they are implemented in the appropriate manner.

The provision of incentives might lead to a change away from practises that contribute to the pollution of groundwater, which would be a positive outcome.

One helpful technique is to provide financial incentives to farmers in order to encourage them to switch to alternative fertilisers and pesticides that are less likely to cause leaching or degradation of the soil.

When implemented in a stringent manner, the idea known as "Polluter Pays" has the ability to reduce the negative effects of pollution.

5.3 Limitation and Future Research

In order to accurately represent the intricacies of real systems, mathematical models of the movement of groundwater need to be oversimplified. As a direct result of this, there are restrictions placed on the level of accuracy that may be reached via the simulation of groundwater systems. It is crucial to have an awareness of these constraints whenever one uses models or evaluates the results obtained from using models.

The amount of pollution has a considerable and detrimental effect on the quality of the ground water. The presence of certain chemicals in ground water at concentrations that are greater than the limits that have been established for safe drinking water is what is known as ground water contamination. These limits have been set to ensure that people have access to clean drinking water.

Iron, fluoride, arsenic, and nitrate are just some of the most often found pollutants. Geological processes deep within the Earth's crust produce these poisons. Human activities including agricultural operations, residential effluents, and industrial effluents can bring other sorts of contaminants into water systems, such as fertilisers, pesticides, heavy metals, and microorganisms. Nitrates, nitrites, and nitrates are all examples of contaminants that may be introduced into water systems.

The Central Ground Water Board (CGWB) published the findings of its 2013 investigation on the properties of the ground water in the Indian state of Haryana. The board concluded that the ground water exceeded the BIS and WHO recommendation level for unsafe drinking water due to high quantities of iron, chromium, copper, cadmium, nickel, lead, arsenic, and nitrate. According to CGWB research, both surface water springs and underground water springs contain significant levels of As, Pb, Fe, and Zn.

This increase in heavy metal content is the result of industrial activities that contaminate ground water, such as the production of fertilisers, pesticides, dyes, electroplated metal components, batteries, and alloys. Other activities that contribute to this contamination include dye production and the manufacturing of alloys. Additionally, the contamination of surface water is facilitated by these processes..

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