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Research Paper

A Geographical study of Ground Water Contamination: Causes, Effects and Solutions

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Abstract:
A mainstream of India's water problems are those relating to groundwater—water that is found underneath the earth's surface. This is because we are the Indians largest user of groundwater in the world, and therefore highly dependent on it. Unfortunately, just over 260 cubic km per year, India uses 25% percent of all groundwater extracted globally, ahead of USA and China. And because 70 percent of the water supply in agriculture today is groundwater, it will remain the lifeline of India's water supplies for years to come. Despite this, we have an extremely poor understanding of groundwater, which impacts both policy and practice. This is largely because of two reasons, Groundwater is invisible—it is literally not visible to the eye because it is well below the ground. What is out of sight, is usually mind blowing. Groundwater is also a highly multifaceted subject that is governed by many conditionality's'. It is this ignorance, by both users and people in governance, that has contributed to the haphazard situation we find ourselves in today.

Key Words: ***Groundwater, Invisible, earth, Freshwater Rocks***

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I. Introduction:

Groundwater is the largest substance of freshwater for mankind. Isotope techniques are used to regulate the origin and replacement rates of groundwater, obtained through the use of steady and radioisotopes obviously present in groundwater. Groundwater constitutes 30 per cent of the world's available freshwater. A further 69 per cent is locked up in polar icecaps, while rivers and lakes only represent one per cent. Groundwater is often concealed deep in aquifers, penetrable rocks and sediments and is extracted using pumping wells. Frequently, aquifers can be renewable water resources, slowly restocked by rainfall infiltration over hundreds up to many thousands of years. Water managers in many regions of the world, have had to deal with an over-exploitation of accessible aquifers and are often forced to rely on deep ancient groundwater sources for reliable freshwater supplies. Supplementary to this are threats emanating from the spill of contaminants and toxins into the groundwater, for instance from agriculture, industry or urban activities. Groundwater is a perfect natural resource that has a significant purpose for the global economy. Majority of the countries of the world are depended on the ground water resources. Other than drinking water supplies, groundwater is used for irrigation and the food industry Groundwater is one of the sources of clean water that humans use. This source is being polluted once man-made products such as oil, gasoline, road salt, and other chemicals are mixed with it. If the groundwater is already polluted by such products, it is no longer fit to be disbursed by humans and animals as it is already unsafe and contaminated. Groundwater contamination also occurs when the chemicals from the land's surface move down to the groundwater through the soil. An example is when liquid industrial waste is poured onto the land and finds its way into the groundwater supplies. Another instance is when farmers use pesticides and fertilizers, and some chemicals move from the soil into the groundwater supply. Additionally, toxic substances from mining sites, underground storage tanks, and septic tanks can also cause groundwater pollution once the landfills are leaky, which could lead to groundwater contamination.

Ground Water contamination leads to Underground Pollution:

It is a natural phenomenon that Soil pollution can give rise to underground water pollution. When contaminants introduced into the soil gradually infiltrate into the underlying water, propelled by mechanisms like rainwater runoff, dispersion, or other pathways. When contaminants are introduced into the soil, they keep moving from the soil surface and go deeper until they reach the groundwater, causing intrusion and, thus, groundwater contamination. For instance, big industrial plants dump their chemical waste on top of the soil, assuming it will not pollute it. These chemicals dumped by the industries gradually get immersed by the soil, destroying its habitable properties for plants and underground animals. As the chemicals remain to travel from the soil surface, they will eventually reach the groundwater, causing groundwater pollution and contamination. Another example of this is in the area of agriculture. Pesticides, fertilizers, and animal waste are mixed and spread out on land, pollutants such as nitrates and bacteria may be developed and continue to seep through the soil. These pollutants will continue to move down until they reach the groundwater supplies. The pollution and contamination of the groundwater could cause serious adverse effects on plants, animals, and humans using the contaminated groundwater as their main supply of basic needs. What's more, soil pollution from unprocessed waste tanks, landfills, and mining and quarrying sites could also cause groundwater pollution through the same process as the others.

II. Literature Reviews:

1. **Burkart and Kolpin** (1993) examined the influence of a variety of hydrogeological and land-use factors on the concentrations of nitrate and atrazine in shallow aquifers over an area encompassing portions of twelve States in the Midwestern U.S. They sought to identify correlations between individual factors, such as aquifer type or depth to groundwater, and the concentrations of the constituents.
2. **Nightingale and Bianchi** (1980) used linear correlation coefficients and multiple linear regression to examine the relationship between soil and aquifer permeability's and measurements of conductivity, anion, and cation concentrations. They found that salinity was correlated to soil and aquifer permeability, but that nitrate levels correlated only with the estimated specific yield of the aquifer system.
3. **Helgesen et al.** (1992), selected one well at random from each region and tested a water sample for a variety of agricultural and petroleum related chemicals. Non-parametric hypothesis tests showed significantly higher 41 mineral concentrations under irrigated croplands and petroleum-producing areas than under undeveloped range land.
4. **Baker et al.** (1994) used an approach similar to that of Burkart and Kolpin (1993), samples of water from rural wells submitted by more than 43,000 participants in twelve states were analyzed for nitrate and herbicide concentrations. They found that the age of the well, its depth, and its proximity to feedlots or barnyards significantly influence the likelihood of finding elevated nitrate concentrations in the samples.

Significance Ground water

It is significant to note that Groundwater is a vigorous supply of water on Earth, providing as much as 50% of the global population's drinking water supply, and 40% to irrigate crops. Earth scientist, estimated that 2.5 billion people worldwide needy on groundwater sources for basic needs to survive, particularly people living in rural areas that do not get their water needs delivered from a county/city water company. It is horrifying to note that with the Earth's population expected to surge by 3 billion people by 2100, conserving groundwater and surface water sources is critical. Hitherto, with population increases comes more pollution, and with climate change, sustainable groundwater management is the only solution to protect the Nation's most important natural resource. As mentioned, groundwater characterizes a large amount of the world's water supply. As groundwater gets stored beneath the Earth's surface, it is protected from external contamination, so the water quality is much better than obtaining drinking water supplies from surface waters. But, it is not only the resourceful use of drinking water that makes it so important. Many other industries and applications dearly need groundwater.

Statement of the Problem

Groundwater pollution takes place normally due to the discharge of pollutants into the ground that eventually find their way into natural underground water reservoirs known as aquifers. Once the pollutants discharged it seriously penetrate groundwater, they cause contamination. Groundwater pollution is mainly caused by the release of substances, intentionally or accidentally, through unscientific activities or natural causes. The pollutants usually move within aquifers dependent on biological, physical, and chemical properties, while diffusion, dispersion, adsorption, and water flow velocity facilitate their movement. On the other hand, generally, contaminants progress gradually within aquifers, leading to concentrated levels and forming a distinct trail decoration. As the contamination trail spreads, it might connect with springs and ground wells, making the water unsafe for human consumption.

Objectives of the Study

1. To identify the major causes for the ground water contamination.
2. To ascertain the damage caused by the chemical particles.
3. To identify the natural causes for the pollution.
4. To pinpoint the pesticides that pose danger to the ground water.
5. To know the health problems caused due to the contamination of ground water.

Methodology of the Study:

A growing global population, coupled with more intensive agriculture and increasing industrial use, have led to an ever-rising demand for groundwater. The study is based on secondary data. Secondary data collected from the Journals, Magazines and Newspapers, data released from the UN 2020.

Causes of Groundwater Pollution

There are several causes of groundwater pollution. Some of the common ones include:

1. **DISPOSAL OF AGRICULTURAL CHEMICALS**

Millions of tons of agricultural chemicals, such as fertilizers and pesticides, are used worldwide to increase crop production and by institutions such as Golf Courses. However, one thing that people don't understand is that excessive use of these chemicals can lead to contamination of groundwater. Chemicals such as pesticides are known to remain in the ground for years, and when diluted with rainwater, they seep deeper into the groundwater.

2. **TRANSPORTATION OF PETRO-CHEMICALS**

Transportation of petroleum products is mainly done underground using pipelines. Petroleum storage tanks are either located underground or above ground.. Leakages from these substances can lead to contamination of water. In India, it is estimated that 22,000 chemical spills every year are from trucks, storage containers, and train spillages, especially when transferring oil. The chemicals spilt become diluted with water and seep into the ground, where they may cause pollution of ground water. It drastically increases the environmental pollution.

3. **NATURAL SOURCES CAUSES POLLUTION**

Naturally befalling substances found in the soil and rocks can be dissolved in water, causing contamination. Such substances include sulfates, iron, radionuclides, fluorides, manganese, chlorides, and arsenic. The natural causes of pollution can be tested using the Groundwater Assessment Platform, a GIS platform that controls groundwater contamination levels using environmental, geological, and topographical data. At the same time, others particles, such as the decaying materials in the soil, may seep into underground water and move with it as particles. Reports by WHO 2020 indicate that the most common pollutants are fluoride and arsenic which emanates from the industries.

4. **DEFAULT SEPTIC SYSTEMS**

Across the world, septic systems are the chief reason of underground water pollution. 65% of households in the India, depend on septic systems to dispose of their wastewater. This is a huge number of people relying on septic systems, and that makes it one of the main pollutants. The high number of septic systems means that cases of leaking are too high, releasing contaminants such as nitrates, oils, bacteria, chemicals, detergents, and viruses into underground water. Commercial septic tanks pose an even bigger danger because they release organic chemicals such as trichloro ethane. Rules and regulations in most countries require the septic tank to be constructed far from the water sources to prevent contamination, but at times, this code is often violated, and it will in the paper documents but people would not follow the same.

5. **UNSAFE WASTE DISPOSAL**

Unsafe wastes such as photographic chemicals, motor oil, cooking oil, paint thinners, medicines, swimming pool chemicals, paints, and garden chemicals should not be disposed of in septic tanks or the environment as they cause serious contamination of rivers, ponds and lakes. Instead, these chemicals should be disposed of with the help of a licensed dangerous waste handler.

6. **PROBLEM OF LEAKAGE OF SOLID WASTE**

The chemicals discharge from the large industries and agricultural land and from spillage from road accidents of chemical laden lorries from these substances are leached into the groundwater through rainfall and surface runoff. Every so often underground contamination happens when the waste is collected and taken to landfills. As long as the landfills lack a clay liner and leachate, the chances of chemicals from the wastes leaching and posing a threat to the groundwater are very from top to bottom.

7**. PROBLEM OF DEFECTIVE LEAKAGES:**

There are shallow lagoons used to store liquid waste. In India, for example, has over innumerable surface impoundments located in Mangalore, Mumbai, Gandhinagara, Andaman Nikhobar, Chennai, which can threaten groundwater. In an ideal world, the collected discharges should have clay liners or leachates to prevent seepage of water contamination. But even with the leachates, ensuring they're in good condition is essential. Defective leachates can cause leakages, leading to pollution of water sources especially water bodies and water sources.

8. **INJECTION WELLS**

Injection wells serve diverse purposes, encompassing storm water collection and disposal of industrial and commercial effluents. Yet, inadequate regulation can lead to improper disposal of hazardous chemicals. Misplaced, poorly regulated, or inadequately designed injection wells pose a risk of groundwater contamination.

Effects of Groundwater Confirmation

There is no doubt, the groundwater pollution can be dangerous. It can cause serious effects to the environment and all the organisms interacting with it. Here are some of the effects of groundwater contamination:

1. Harmful effects on human health

Contaminated groundwater has injurious effects on human health. In areas where septic tank installation is not set up the mark or safely, human waste may contaminate the ground water source. The human waste may contain hepatitis-causing bacteria that may lead to permanent damage to the liver. Also, it may cause dysentery, which leads to severe diarrhea, dehydration, and, in severe cases, death. Additional health problems include poisoning from excessive pesticides and fertilizers or natural chemicals.

2. **Disturbs Industrial and Economic Growth**

Impurity of groundwater sources reduces the area incapable of supporting plant, human, and animal life. That reduces the land value and yield, forcing people living in such areas to spend more on buying food and water. Additional effect is groundwater pollution leads to less stability in industries relying on it to produce their goods. That's because the industries in the affected areas will have to outsource water from other regions, which may turn out to be expensive. In some cases, they may even be forced to close down due to poor water quality.

3**. Harmful Impacts on The Environment**

Groundwater contamination can lead to devastating environmental fluctuations severely. One such alteration is the loss of certain nutrients essential for the ecosystem's self-sustenance. In addition to this, when the contaminated pollutants mix with water bodies, severe damage occurs on the part of the aquatic ecosystem. Aquatic animals such as fish, prawns, sea shells, quills may die off quickly due to too many contaminants in the water.

SOLUTIONS TO GROUNDWATER CONTAMINATION

Notwithstanding the grave effects of groundwater pollution on the environment and the inhabitants, we can lessen the impact in several ways. Following are some of the measures to consider:

1. **Severe Legislation has to implemented**

Stringent rules and regulations has to implemented for the protection of ground water. Safe Drinking and Clean Water regulations should ensure the protection of drinking water by establishing measures for it to meet health standards.

2. **The Use of Water Cleaning Systems**

Systematic Water treatment systems should be installed in outlets that dispense water for human consumption. The techniques used include chemical disinfection, boiling, solar distillation, filtration, ozone water disinfection, activated charcoal absorption, and ultraviolet disinfection. Groundwater Remediation is also another management technique. Chemical techniques such as ion exchange, ozone gas injection, membrane separation, and chemical precipitation can also be used for effective implementation.

3. **Proper maintenance of the Sources of Pollution**

A containment device that acts as a leak back-up should be put in place, and any unused underground tanks should be removed. Underground pipeline installation should be designed professionally. Inspections should be done regularly, and any causes of corrosion or leakage noted should be resolved immediately. The landfills should be designed with proper clay and leachate. The maintenance should be done regularly. The location of the landfill should also be far from groundwater areas. Further, any hazardous waste should not be dumped in the landfill unless it is designed and meant for that purpose. At the same time, the landfills must be far away from the human habitants.

4**. Mobilize people to participate in the recycling initiative.**

Apart from oil, other recyclable materials such as plastic, bottles, and paper waste can also be taken to recycling plants. The state should provide recycling pick-up areas. Together with other environmental organizations, the state can mobilize people to participate in the recycling initiative. People can spread their awareness campaign nearby their areas holding placards, banners and educating the public about the significance of recycling and its uses.

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