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Perspective

Threat and Mitigation of Ground Water Contamination in India

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In India groundwater is a critical resource, which accounting for over 65% of irrigation water and 85% of drinking water supplies. Groundwater is the world's largest freshwater resource, is important for irrigated agriculture and hence for global food security. The groundwater is considered to be less vulnerable than surface sources to climate fluctuations and can therefore help to stabilize agricultural populations and reduce the need for farmers to migrate when drought threatens agricultural livelihoods [1]. In other words, groundwater resources provide a reliable drought buffer in large regions of the world [2]. However, uncontrolled extraction without commensurate recharge and leaching of pollutants from fertilizers and pesticides has resulted in pollution of groundwater [3]. Leaches from agriculture, ground water is threatened with pollution from various sources viz., domestic wastes, industrial wastes, agricultural wastes, run off from urban areas and soluble effluents. All of these contaminants can find their way into local water bodies, and subsequently lead to the water quality problems. Ground water can be contaminated when rainfall and surface runoff pass through contaminated soil.

Water resource studies for groundwater quality is one of the most important aspects [4,5]. Water pollution is a major global problem which requires serious efforts and reframe of water resource policy at all levels. The pressure on groundwater is growing as surface water resources is decline day by day. This pressure is due to rapidly increasing pumping of groundwater, accelerated by the availability of pumping technologies, cheap drilling and energy subsidies that distort decisions about exploiting groundwater. In India, groundwater is used intensively for irrigation and domestic purpose, a variety of land and water-based human activities are causing pollution of this precious resource. Naturally, ground water contains mineral ions. Ions dissolve slowly from soil particles, sediments, and rocks as the water travels along mineral surfaces in the pores or fractures of the unsaturated zone and the aquifer.

Groundwater pollution occurs when used water is returned to the hydrological cycle. For the Nation as a whole, the chemical and biological character of ground water is acceptable for most uses. Ground water is less susceptible to bacterial pollution than surface water because the soil and rocks through which ground water flows screen out most of the bacteria. Bacteria, however, occasionally find their way into ground water, sometimes in dangerously high concentrations. Water is a solvent and dissolves minerals from the rocks with which it comes in contact. The most common dissolved mineral substances are sodium, calcium, magnesium, potassium, chloride, bicarbonate, and sulfate. In water chemistry, these substances are called common constituents. Water typically is not considered desirable for drinking if the quantity of dissolved minerals exceeds 1,000 mg/l (milligrams per liter) [2]. Water from some wells and springs contains very large concentrations of dissolved minerals and cannot be tolerated by humans and other animals or plants. Many parts of the Nation are underlain at depth by highly saline ground water that has only very limited uses. Dissolved mineral constituents can be hazardous to animals or plants in large concentrations; for example, too much sodium in the water may be harmful to people who have heart trouble. Boron is a mineral that is good for plants in small amounts, but is toxic to some plants in only slightly larger concentrations. Water that contains a lot of calcium and magnesium is said to be hard. The hardness of water is expressed in terms of the amount of calcium carbonate-the principal constituent of limestone or equivalent minerals that would be formed if the water were evaporated. Water is considered soft if it contains 0 to 60 mg/l of hardness, moderately hard from 61 to 120 mg/l, hard between 121 and 180 mg/l, and very hard if more than 180 mg/l [4-6]. Very hard water is not suitable for domestic uses; it will leave a deposit on the pipes, tanks and boilers.

India is now the biggest user of groundwater for agriculture in the world [7,8]. Groundwater irrigation had expanded at a very rapid pace in India. The data from the Minor Irrigation Census conducted in 2010 shows evidence of the growing numbers of groundwater irrigation structures (wells and tube wells) in the country. The share of groundwater in the net irrigated area has also been rise. In addition to net irrigated area of about 29.75 million hectares between 1970 and 2007, groundwater accounted for 24.02 million hectares (80%) [9]. Groundwater contamination occurs when man-made products get into the groundwater and cause it to become unsafe and unfit for human use. The main quality problem encountered with ground water in India is due to excess fluoride, arsenic, iron, nitrate and salinity. Nitrate contamination is mainly anthropogenic, due to the use of fertilizers and discharge of fecal material [10-12]. Salinity may have different origin, but the most common is the infiltration of brackish water in a fresh aquifer due to the over exploitation of this aquifer. The sewage pollution alone was reported to be responsible for 80% of the total water pollution in the country [10,13,14].

The Indian cities and towns are accountable for their wastewater discharge. Pollution by agricultural run-offs has too main effects on the environment. Application of pesticides is responsible for poisoning. They are especially difficult to remove from freshwater, and thus, can be found in municipal or bottled water, even after conventional treatment. The recent study drew the alarm about the concentration in pesticides such as organo-chlorines and organo-phosphates that was exceeding the WHO standards in almost all the Indian brands of bottled water [15]. The fertilizers, they have an indirect adverse impact on the water resources. In spite of these well-known adverse effects, and the worrying growth of fertilizer and pesticide use in the India agricultural sector, these products are still subsidized by the government.

Threat	Sources	Health and ecosystem effect
Nitrates	Fertilizer runoff; manure from livestock operations; septic systems	Suffocation and death in infants; digestive tract and other cancers. Algal blooms and eutrophication in surface water
Pesticides,	Runoff from farms, landfill leaks	Some linked to reproductive and endocrine disorders; nervous system damage and cancers
Petro-Chemicals	Underground petroleum storage tanks	Benzene and other petrochemicals can cause cancer even at low exposure
Chlorinated solvents	Effluents from metals and plastics degreasing; fabric cleaning; electronics and aircraft manufacture	Linked to reproductive disorders and some cancers
Arsenic	Naturally occurring	Nervous system and liver damage; skin cancers
Radioactive materials	Nuclear testing and medical waste	Increased risk of certain cancers
Fluoride	Naturally occurring	Dental problems; crippling spinal and bone damage
Salts	Seawater intrusion	Freshwater unusable for drinking or irrigation

Table 1: Major groundwater pollutants and their effect on human health and ecosystem (United Nations, 2007).

Citing the dangers as discussed above protection of groundwater has become a prime importance in present scenario, to protect groundwater Government of India has come up with some laws and legislations.

The different incidents of aquifer pollution described which may seem isolated. In northern India there is problem of nitrate; even in central India laced with solvents; yet another cluster in south India have become too salty for human use. Several cities and towns around the globe required alternate supplies of water because their groundwater has become unusable. Once ground water is polluted by industry, it is very difficult to clean up. The lesson learnt from the Bichhri experience, which is situated about 12 km away from Udaipur, the groundwater of Bichhri, spread over an area of 300 hectares, is stark red. The groundwater moves naturally to other aquifers side which also pollutes ground water. It is not possible to live with contaminated groundwater for a long time as we could make do with a gradually more irritable climate and polluted air. We have damaged portions of some aquifers but large part of the resource still remains pure for the moment.

Some important steps we can take to change course of inevitable destructive phenomenon of polluted ground water. Water pollution control requires action at all levels of the society. The ideal method to abate diffuse chemical pollution of waterways is to minimize or avoid the use of chemicals for industrial, agricultural, and domestic purposes. Adapting practices such as organic farming and integrated pest management could help protect waterways. Chemical contamination of waterways from industrial emissions could be reduced by cleaner production processes. Other interventions include proper treatment of hazardous waste and recycling of chemical containers and discarded products containing chemicals to reduce solid waste buildup and leaching of toxic chemicals into waterways. A variety of technical solutions are available to filter out chemical waste from industrial processes or otherwise render them harmless. Changing the pH of wastewater or adding chemicals that flocculate the toxic chemicals so that they settle in sedimentation ponds are common methods. The same principle can be used at the individual household level.

Evidence shows that a number of chemicals that may be released into water can cause adverse health effects that associated burden of disease can be substantial, and investment in research on health effects and interventions in specific populations and exposure situations is important for the development of control strategies. Pollution control is therefore an important component of disease control, and health professionals and authorities need to develop partnerships with other sectors to identify and implement priority interventions. Solid actions are needed to safely manage the use of toxic chemicals and monitoring regulatory guidelines. Recycling and the use of biodegradable products must be encouraged. Technologies to reduce air pollution at the source are well established and should be used in all new industrial development.

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