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IMPACT OF NITROGENOUS FERTILIZERS ON GROUND WATER QUALITY

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ABSTRACT

The important source and cause of agricultural pollution are Irrigational return flows, and use of nitrogenous fertilizers in which nitrate is the basic component. High concentrations of Nitrate in groundwater may cause methemoglobinemia, and have been cited as a risk factor in developing gastric an intestinal cancer. One of the most important negative effect of intensive use of nitrogenous fertilizer use is water eutrophication. Nitrates in the irrigational water serves as a nutrient to plants and crops. Ayers and Westcot, (1994) mention that nitrate in excess to 30 ppm causes severe problem in sensitive crops. Due to the impact of fertilizers on human and environment, it is quite necessary to reduce the nitrate concentrations to safe levels.

INTRODUCTION

According to annual publication of the department of fertilizers under the ministry of chemicals and fertilizers (Indian Fertilizer Scenario 2014), the use of nitrogenous fertilizers in the country has augmented by more than 50 percent since 2000.India is the second highest consumer of nitrogen in the world after China. According to the Food and Agriculture Organisation, India's annual consumption of nitrogen is 16.48 million tones. The increasing rate of nitrogen fertilizers have directly or indirectly causing nitrate pollution and led to an imbalance to the environment and degrade the groundwater quality.

SOURCE OF NITROGEN AND NITRATE

Nitrogen is the most abundant element in the atmosphere, composing nearly 80% of the air. Gaseous nitrogen can be found in many forms, the major ones consisting of **N_2, N_2O, NO, NO_2, NH_3.** Some of these gases readily react with rain water to produce nitrate and ammonium ions in solution. These ions can become part of the soil layer composition, or even enter into a groundwater solution. Nitrate is the most common pollutant identified in groundwater. The Nitrate is the most common form of dissolved nitrogen in groundwater. However, It can be found in the form of nitrite (NO_2-), nitrogen (N_2), nitrogen oxide (N_2O) and organic nitrogen. Nitrogen in groundwater generally originates from nitrate sources on the land surface and in the soil zone or sub – soil zone at shallow depth through nitrogen rich waste burial, agricultural activity and disposal of sewage water on or beneath the surface. In some situations nitrate that enters the ground water system originates as NO_3^- in wastes or fertilizers applied to the land surface. In other cases NO_3^- originates by conversion of organic

nitrogen or NH_4^+ which occurs naturally or is introduced to the soil zone by human activity through the process of nitrification. NH_4^+ is converted to NO_3^- a stable form of nitrogen compound by oxidation in very shallow groundwater in highly permeable sediments or fractured rocks containing considerable dissolved oxygen. It is in these hydrological environments in which NO_3^- commonly migrates large distances from the input areas. Nitrate that leaves the atmosphere can be converted back into elemental nitrogen, through the process of denitrification. This often takes place in the soil through the activity of bacteria that reduce the nitrate. Ammonium can undergo the process of nitrification, which is an oxidation reaction, that converts it to nitrate. Through this mechanism, the nitrogen in the ammonium ion is released back into the atmosphere .After the conversion from elemental into nitrogenous ions in solutions of rainwater, the nitrogen in these compounds can be exhausted back to the atmosphere by the pathways previously described, thus completing the cycle.
. Nitrogen fertilizers or manures used on a sandy soil are more susceptible to leaching to groundwater than nitrogen used on a clay soil. Water moves rapidly through sandy or other coarse-textured soils. Nitrogen loss to the groundwater from clay soils is smaller than those for the coarse-textured soils. Clay soils do not specifically retain nitrates. Water movement through clay soils is very slow and small. Water does not pass easily through clay soils so nitrates, which only move with water, do not leach to groundwater. Pore space in clay soils is often filled with water. Water-filled pores of clay soils lack oxygen. Lacking oxygen, a group of soil bacteria, called facultative anaerobes, substitute nitrates for oxygen for respiration. When bacteria use nitrates as a substitute for oxygen, they convert nitrates to nitrogen gas through a process called denitrification. More nitrates are lost by denitrification in clay soils than in sandy soils. Nitrate losses through denitrification in clay soils reduce the amount of nitrates that can potentially leach to groundwater.

AGRICULTURAL GROUNDWATER POLLUTION

The important sources and causes of agricultural pollution are Irrigational return flows, fertilizers and soil amendments, Use of Pesticides and Insecticides, Spills and surface discharge, stockpiles, Septic Tanks and Cesspools.

The anthropogenic sources most often cause the amount of nitrate to rise to a dangerous level. Waste materials and Septic tank are the anthropogenic sources of nitrate contamination of groundwater. Many local sources of potential nitrate contamination of groundwater exist such as sites used for disposal of human and animal sewage; industrial wastes related to food processing and sites where handling and accidental spills of nitrogenous materials may accumulate. When natural sources contribute a high concentration of nitrate to the groundwater it is usually as a result of anthropogenic disturbance. Natural forests conserve nitrogen but human disturbances can lead to nitrate pollution of the groundwater.

The agricultural pollution results due to return irrigational flows due to excessive irrigation and fertilizer use or in case of non irrigated lands it may occur due to excessive use of fertilizers and infiltration of rain water in such agricultural fields. The use of pesticides and insecticides also results in pollution of groundwater through infiltration. In keeping pace with the improved agricultural

practices, generally over irrigated fields are applied with excessive quantities of fertilizers and pesticides which get accumulated in the soil and are incorporated in ground water. Progressive increase in the mineral content of ground water resulting from the lack of drainage and return circulation of water in irrigated areas, is well recognized. Extensive deterioration in the quality of ground water has occurred in the commands of Nagarjuna Sagar (Andhra Pradesh), and Bikaner and Rajasthan Canals (Haryana and Punjab).

The average nitrate content in rain water reported by Handa, (1983) is less than 0.5 ppm. in India. Karanth, (1987) states that the unpolluted groundwater contain less than 5 ppm of nitrate. The higher content of nitrate in groundwater is associated with contamination from different sources.

IMPACT OF NITRATES ON HUMAN HEALTH AND ENVIRONMENT

As per the guide lines of **WHO and ISI,** the nitrate in potable water should not exceed 50 ppm and 45 ppm respectively. Higher concentration of NO_3^- in potable water on constant use leads to 'Blue babies' disease in infants fed on artificial feed. Normally, 1-2 percent of body hemoglobin is in Methaemoglobin, but when this exceeds 10 percent its clinical effects are more pronounced and quite notable.

It is possible to examine the toxicological effects of nitrate in three stages. The primary toxic effect of nitrate concentrations in drinking water of 50 mg NO3 - /L exceeds the value of the bowel in adults, digestive and urinary systems, inflammation is seen. Secondary toxicity, high nitrate concentration in drinking water caused disease in infants as methamoglobianemia.. Strong carcinogenic effects of these compounds have been identified in recent studies. One of the most important negative effects of intensive fertilizer use is water eutrophication. Increased amounts of nitrogen and phosphorous compounds in water as a result of the increase in the amount of higher aquatic plants and algae formation and degradation of water quality and water environment in the event of life is defined as eutrophication.

Nitrates in the irrigational water serves as a nutrient to plants and crops. Ayers and Westcot, (1994) mention that nitrate in excess to 30 ppm causes severe problem in sensitive crops.

There is global concern on the effect of overuse of fertilizers, especially N fertilizers on the environment. Part of applied fertilizer N is lost as NH_3, N_2, and NO_3 gases, which adversely affect the environment. NH_3 after oxidation to NO_3 also contributes to soil acidity, while other NO_3 are involved in depletion of the stratospheric ozone layer. Part of applied fertilizer N leaches down as NO_3 and contaminates the groundwater resources, which leads to health hazards such as methaemoglobinemia or the blue baby syndrome. An epidemiological study in Rajasthan revealed severe methaemoglobinemia (7–27% of Hb) in all age groups of the population, especially in < 1 year age group (Gupta et al., 2000). Malik (2000), however, reported that of the total 822 groundwater samples from Punjab and Haryana, 3.3% had NO3–N in the 0–10 mg/L range, 15% with 10–20 mg /l, and 58% contained > 22 mg/l. Nitrate pollution of groundwater is a serious

problem in Karnataka. Nitrate problem has also been reported from Andhra Pradesh (Rao, 1998), Tamil Nadu, and Maharashtra.

CONCLUSIONS

Due to uninterrupted use of nitrogenous fertilizers and desires to take more productions by farmers ,they use unscientific irrigational methods and thus creates imbalance to the environment. In order to balance the situation farmers are advised to rotate the crops and use the correct dozes of fertilizers. .As the nitrate pollution becomes the global problem, it is quite necessary to reduce the use of nitrogenous fertilizers by adapting the latest technology and switch over to traditional methods of organic farming for better green revolution.

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