Oriental Journal of Physical Sciences Vol. 1(1 & 2),26-29 (2016)

Use of Nitrogenous Fertilizers and its Impact on Water Quality with Special Reference to Agricultural Development

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(Received: 19 Dec 2016; Accepted: 28 Dec 2016)

ABSTRACT

Water is an essential commodity of life on the earth. It plays a very important role in agricultural development. Agricultural activity impacts the water quality through the movement of chemical fertilizers and other poisonous materials from the agricultural fields to deep aquifers through surface runoff and deep percolation. 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 natural water may cause methemoglobinemia, and have been cited as a risk factor in developing gastric and 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. The agricultural water quality guide lines proposed by Ayers and Westcot (1994) mentions that the nitrate concentration ranges from 22.5 to 135 mg/l causes slight to moderate restriction and above 135 mg/l nitrate concentration causes severe restriction on crops for irrigational use. Due to the impact of fertilizers on human and environment, it is quite necessary to reduce the nitrate concentrations in natural waters to protected levels.

Key-words: Water Quality, Nitrates, Fertilizers.

INTRODUCTION

India is the second leading consumer of nitrogen in the world after China. The use of nitrogenous fertilizers in the country has been increased by more than 50 percent since 2000 (Indian Fertilizer Scenario - 2014). According to the Food and Agriculture Organisation (FAO), India's annual utilization of nitrogenenous fertilizers is in increasing trend. In order to achieve self capability in food grains, the farmers are using high doses of chemical fertilizers along with insecticides, pesticides, fungicides and other chemicals in agricultural fields. The rising trend of nitrogen fertilizers have directly or indirectly effect the environment and causing nitrate pollution and thus degrade the water quality. At the same time the farmers are using unscientific methods of farming such as flood irrigation, resulted water pollution through return irrigational flows.

Source of Nitrogen and Nitrate

Mc.Neeley *et al.,*,(1979) states that nitrogen is a very minor constituent of rocks. Igneous plutonic and and volcanic rocks provide localized source of nitrates to the circulating water. Nitrate is the most abundant element in the atmosphere, composing almost 80% of the air. Gaseous nitrogen readily react with rain water and generate nitrate and ammonium solution which passes through the soil zone and ultimately reaches to groundwater zone. 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.

Nitrogen is an essential plant nutrient and Nitrate is the most common pollutant as dissolved nitrogen in groundwater. Plants and animals cannot access nitrogen directly. The nitrogen in groundwater generally originates from the nitrate sources on land surfaces and in soil zone or subsoil zone at shallow depth through nitrogen rich waste burial, agricultural activity and disposal of sewage water on or beneath the surface. In other cases nitrate originates by conversion of organic nitrogen or ammonia by human activity through the process of nitrification. Nitrate is transported back to atmosphere in the form of elemental nitrogen by the process called denitrification.. This conversion occurs only through fixation naturally by plant- and soil-associated bacteria and lightning strikes but it may enhances due to human activity.

Nitrogen fertilizers or manures used on a sandy soil are more prone to leaching to groundwater than nitrogen used on a clay soil. Water moves rapidly through sandy soil, coarse-textured soils and fractured rocks. Water movement through clay soils is very sluggish and diminutive so water containing nitrates do not leach to groundwater. The amount of rainfall influenced the nitrate concentration in groundwater, when the amount of rainfall is low, the concentration of nitrate may become high due to the diluting effect.

Agricultural Water Pollution

The important sources and causes of agricultural pollution are return irrigational flows, use of chemical fertilizers and soil amendments, use of pesticides and insecticides, effluents discharge from septic tanks and wastewater treatment plants. The human-derived sources of reactive nitrogen include airborne emissions from fossil fuel , combustion by vehicles and electric utilities, fertilizer production that results in runoff from farms as well as suburban and urban lands and imported food that produces also contributes nitrate concentration in natural water.

Effluents from waste materials and septic tank are the anthropogenic sources of nitrate contamination of groundwater . However, there are many other local sources of nitrate contamination of groundwater exists such as dumping sites of human and animal sewage; industrial wastes and sites where treatment and inadvertent spills of nitrogenous materials accumulates.

Nitrate pollution is a very serious global problem and curative action is required. Nitrate contamination can occur in surface and subsurface waters. "*One mans food is other mans poison*", this proverb stands in good concurrence for fertilizers. Nitrogen is an essential plant nutrient. In order to meet the deficiency of nitrogen, farmers are using modern farming practices and applying nitrogen in the form of organic manure, sewage sludge and chemical fertilisers. The accumulation of higher concentrations of nitrate in river water arouse the growth of algae and other water weeds and thus it enhances eutrophication . Higher concentrations of nitrate in potable water can be harmful for drinking purposes and concentrations in drinking water must be limited for health reasons . The depth of the water table is responsible for the movement of water from the zone of aeration to zone of saturation.

The agricultural water 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 water pollution through infiltration. The process of chemical treatment to remove the nitrate from groundwater is noteworthy and very difficult. The only solution to reduce the nitrate contamination is to check it at the source itself so that the amount of leaching is restricted.

Impact of Nitrates on Human Health , Environment and Agriculture

Water quality guide lines proposed by WHO (2006) and ISI (2004),mentions that the nitrate in potable water should not exceed 50 ppm and 45 ppm respectively. When the nitrate concentration exceeds this limit there is possibility of gastro intestinal disorder in adults and common

problems in digestive and urinary systems. High nitrate concentration in drinking water causes a common disease in infants as blue baby syndrome or methamoglobianemia. It is important and further anxiety on the impact of nitrate in human being is that the nitrate can be converted into nitrosamines by a bacteria in the digestive tract which are potentially carcinogenic. Strong carcinogenic effects of these compound has been identified in recent studies.

One of the most important negative effects of intensive fertilizer use is water eutrophication in which there is increased amounts of nitrogen and phosphorous compounds in water resulting increase in the amount of higher aquatic plants and algae formation and degradation of water quality and water environment .

Nitrates in the irrigational water serves as a nutrient to plants and crops. Ayers and Westcot, (1994) proposed a modified water quality guidelines to assess the agricultural water quality on the basis of salinity, water infiltation, toxicity and diverse effects. On the basis of degree of restriction on agricultural use, the water quality problems has been classified into None restriction category, Slight to moderate restriction category and Severe restriction category. According to the guide lines, the nitrate content upto 22.5 mg/l causes no toxic effect, nitrate concentration ranging from 22.5 to 135 mg/l causes slight to moderate toxicity and above 135 mg/l nitrate concentration causes severe restriction on irrigational use.

Excessive use of nitrogen fertilizers are going to be contaminate the water bodies thus it affects the aquatic and human life. 25 to 30% decrease in protein content have been reported in corn, maize, gram and wheat crops when grown in soils fertilized with NPK fertilizers. Excessive and imbalanced use of chemical fertilizers has adversely affected the soil causing decreasing in organic carbon, reduction in microbial flora of soil, increasing acidity and alkaninty and hardening of soil.

CONCLUSIONS AND SUGGESTIONS

On the basis of the study reported from various workers in India Chaudhary and Handa(1973)Sehgal,V.K. *et al.,*(1989), Handa,B.K (1979,1983,1986) ; Jain,R.K. (1993); Rangrajan *et al.,* (1996) Rao, (1998) ; Malik (2000); Gupta *et al.,*(2000); Parashar,V.K.(2001,2013) it can be concluded that the nitrate pollution in India is a very severe problem and it is likely to grow high dimension with the passage of time and continuous use of nitrogenous fertilizers. As the nitrate pollution becomes the global problem, it is quite necessary to reduce the use of nitrogenous fertilizers by adapting the latest irrigation technology and switch over to traditional methods of organic farming for better green revolution and agricultural development in India..

In order to overcome the problem the following suggestions can be made:

- High nitrate water may be used as as substitute of nitrogenous fertilizers which helps in the abatement of nitrate pollution and also minimize the use of nitrogenous fertilizers.
- By doing better land management, reducing the use of artificial fertilizers and carefully managing the disposal of agricultural waste, the degree of the problem can be reduced.
- Farmers desire to take more agricultural productions by using unscientific irrigational methods and high doses of chemical fertilizers so the farmers should be trained and provide them proper knowledge of latest irrigation techniques, advised them to rotate the crops and use the proper does of fertilizers.
- The shallow groundwater having the nitrate concentration in between 30to 40mg/l should be regularly monitored and should not use for sensitive crop irrigation.
- Motivate the farmers to use organic manures in place of chemical fertilizers for better agricultural development.

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