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Research paper

POLLUTION ANDHEAVY METAL CONTAMINATIONIN AGRICULTURE

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Abstract

Pollution is an alteration of the quality of the components by contaminants to a degree that unreasonably affects their beneficial uses for both domestic and agriculture purposes. Soil, water and environment which are directly or indirectly responsible for crop growth has now been degraded in many areas (Globally 24% of arable land is degraded and lost its fertility) due to pollution and contamination. These pollutants can be categorised in to Point source and Non-point sources.Point source pollution is an observable, specific, and confined discharge of pollutants into a surface or underground water body where asNonpoint source pollution is defined as diffuse discharges of pollutants throughout the natural environment, this type of pollution is mainly associated in agriculture. Pollution in agriculture is mainly due to unbalanced use of fertilizers and pesticides, intensive land cultivation, irrigation with domestic waste water and industrial effluents. Domestic wastewater has always been a low cost input for farmers to go for irrigation in water scarce regions because of high nutrient content which helps to fertilize crops without spending substantial amounts on additional inputs which resulted in soil salinity which made land unfit for cultivation, degradation of soil fertility and bio-diversity, contamination in environmental quality,heavy metal toxicity like Fe, Cu, Mn, Cd, Pd, Hg, especially iron toxicity in low land rice fields which can directly entre in to the food chain and affect human health.

Hence management of pollution and heavy metal contamination in agricultural lands is a key requirement to improve the environment quality. Pollution of arable lands can be managed by use of pr-treated waste water by bio-remediation or by anaerobic biological treatment for irrigation, balanced application of fertilizers mainly throughsplit application to reduce NO_3 leaching, alternative use of plant residues to reduce the use of chemical fertilizers,crop diversification which helps in restoring soil health by enhancing the organic matter content and improving the soil physico-chemical properties, decreasing the use of chemical pesticides by giving more emphasis on using bio-degradable, photo-sensitive and environmentally safe pesticides (like pheromones, bio-control agents, especially bacteria and viruses, attractants and repellents and selective pesticides) and by phytoremediation. Phytoremediation is a new emerging technology for removing the contaminants from the soil by using plants especially the heavy metals, theseplants are able to uptake, degrade or eliminate heavy metals, pesticides, solvents, crude oil and its derivatives and various other contaminants in the soil.This paper finally emphasing the efforts should be made to increase the input use efficiency and decrease the use of external components to reduce the soil-water-environmental pollutions.

Key words: Pollution, Heavy metals, Point source, Human health, Agriculture

INTRODUCTION

Ever increasing population in India has put a great stress on the agriculture systems. To meet the food requirement of expanding population India would have to increase the production by use of certain innovative approaches and would have to considerably optimise the use of various agricultural inputs like irrigation water, fertilizers, pesticides *etc.*, to achieve this increased food grain production. Pollution in agriculture is mainly due to unbalanced use of fertilizers and pesticides, intensive land cultivation, irrigation with domestic waste water and industrial effluents. Domestic wastewater has always been a low cost input for farmers to go for irrigation in water scarce regions because of high nutrient content which helps to fertilize crops without spending substantial amounts on additional inputs which resulted in soil salinity which made land unfit for cultivation, degradation of soil fertility and bio-diversity, contamination in environmental quality,heavy metal toxicity like Fe, Cu, Mn, Cd, Pd, Hg, especially iron toxicity in low land rice fields which can directly entre in to the food chain and affect human health.

Pollution is an alteration of the quality of the components by contaminants to a degree that unreasonably affects their beneficial uses for both domestic and agriculture purposes. Soil, water and environment which are directly or indirectly responsible for crop growth has now been degraded in many areas (Globally 24% of arable land is degraded and lost its fertility) due to pollution and contamination. These pollutants can be categorised in to Point source and Non-point sources.Point source pollution is an observable, specific, and confined discharge of pollutants into a surface or underground water body where asNonpoint source pollution is defined as diffuse discharges of pollutants throughout the natural environment, this type of pollution is mainly associated in agriculture.Some of the heavy metal contamination and pollution associated in agriculture and their effect on food quality was given below.

1. **Heavy metals contamination in agriculture**

Lead: Addition of sewage sludge to agricultural soils add significant amount of lead to soil depending on the source of the sludge.

Mercury: Typical concentrations of mercury in sludge may range from 5 to 10 mg kg^{-1}. There is also a risk of direct discharge of elemental mercury to the soil during the active period of the plant and in connection with closure of the plant. Once deposited in the soil, mercury can participate in several chemical and biological processes, such as redox reactions, methylation processes, adsorption processes and complexation to soil humic acids or to inorganic ligands such as chloride, sulfate or (hydro) oxide ions.Phosphatic fertilizers generally have low mercury concentrations (<0.4 mg kg^{-1}) (Sauerbeck, 1993).

Cadmium: Addition in fertilizers/manures and in municipal sewage wastes (effluents and bio solids), urban composts and industrial sludge's

Arsenic: Mining and smelting of nonferrous metals can lead to significant soil contamination by runoff.Arsenic is widely used as a feed additive for poultry and swine production and the resulting manures can represent a significant source of soil arsenic. Arsenic from phosphate fertilizers,

Selenium: The primary cause of elevated soil selenium is its natural occurrence, most often in sedimentary rocks (shales) from which seleniferous soils wither (Maylan*d et al.*, 1989).Irrigated agriculture may redistribute and concentrate selenium that is by disposal of saline drainage water into closed impoundments where further evaporative concentration takes place.

2. **Unbalanced use of chemical fertilizers**

Nutrients are always been primary requirements to increase the crop growth and production. Application of unbalanced and excess amounts of nutrients to the soil than the crop nutrient requirements will causes the nutrient loss and, soil and environmental pollution becomes toxic to plants.Farmers apply fertilizer extensively to crop lands especially in rice cultivation. Fertilizer when applied to the soil, judiciously meets the nutrient needs of the crops, but not all of it gets used up by the crops, there remains residues in the soil.Use of fertilizers in agriculture is recognized as a potential source of water pollution. Report on water quality deterioration in Lake Biwa (Japan) showed that the drainage from agricultural land contributed to 47% and 23% of the total nitrogen and phosphorous respectively.

Intensive use of nitrogenous fertilizer

Nitrogen pollution of surface and ground water is among the major environmental concerns in intensive and irrigated agriculture. Leaching losses of nitrate or surface run-off of nitrogen in different forms pose a threat to pollution of groundwater and surface waters, respectively. The enrichment of groundwater with NO_3^- is facilitated by the absence of impervious layers in the sub-soil and shallow water table, commonly found in rice cultivated areas. In India, run-off of applied fertilizer could be expected majorly in a rice system where cultivators follow the practice to let off water from one field to another during flood irrigation of rice leading to nutrient losses ultimately polluting soil environment.

Iron toxicity in the lowland rice

Iron toxicity is widely distributed in tropical lowlands. It is usually associated with poor drainage, presence of iron in the parent rock and the soils of adjacent slopes through which ground water flows laterally into the lowland. Iron toxicity is caused by the reduction of ferric iron (Fe^{3+}) to the more soluble ferrous form (Fe^{2+}). Fe^{3+} is harmless to the plants; Fe^{2+} can be absorbed by the roots and produce toxicity in the plants. Iron toxicity also involves deficiency of several other soil nutrients, especially potassium, calcium, zinc and phosphorus. Ferrous iron can then affect the development of the rice crop in two ways, by coating the plant roots with iron oxide and thus reducing the absorption capacity of the plant for other nutrients and direct iron toxicity through excessive Fe^{2+} absorption by the plant

3. **Direct and indirect contamination of Pesticides**

Pesticides have made a great impact on crop production, preservation of food, fibre and other cash crops and on human health. With their introduction, farm practices have undergone revolutionary changes. The rate of increase in the use of pesticides in developing countries like India is considerably higher than that of developed countries. However the large scale and unscrupulous use of pesticides in intensive agriculture has led to many problems like human health hazards and pollution of environment. As little as 1% of the pesticides applied may contact the target organisms, much of the remainder moves into the soil, thereby soil flora and fauna may be adversely affected.The pesticide use in the rice crop accounts for about 17% of total use in the country.Persistent pesticides become attached to small soil particles which are easily moved by wind and water to different parts. This affects soils elsewhere. But in view of the fact that about one-third of potential food production in India is lost due to insects, weeds, diseases etc., use of pesticides is an integral part of modern crop management practices.

4. **Irrigation with salt water**

Irrigated lands can produce higher crop yields than those which only use rainwater.Irrigation water contains dissolved salts and in dry climates much of the water in the saline solution evaporates leaving its salts, such as sodium chloride in the topsoil.Such salinization restricts plant growth, lowers yields and eventually kills the crop and renders the land unfit for agriculture.Flushing out salts can also make the downstream irrigation water

saltier.Another problem with irrigated agriculture is water-logging. This occurs when large amounts of water are used to leach the salts deeper into the soil. However, if the drainage is poor then such accumulating water gradually raises the underground water table.

Threat to food quality and safety

The most important to consider in terms of food-chain contamination are As, Cd, Hg, Pb and Se. These heavy metals directly enter in to the food chain andaffect the human and animal health. Rice is the staple food in most Asian countries like India, but many paddy soils are now contaminated by illegal discharges of waste water from local factories.Rice variety and soil Cd concentration are major factors affecting edible rice safety, rice absorbing significantly more Cd from contaminated soil.Vegetables grown by irrigation with industrial effluents and sludge may be contaminated by the heavy metals. In China, an estimated 12 million tons of grain are contaminated by heavy metals every year. Excessive human intake of Cd is of concern as this element accumulates over a lifetime in the body, with impairment of kidney function being the main adverse effect.

Recommendations and future prospects:

Hence management of pollution and heavy metal contamination in agricultural lands is a key requirement to improve the environment quality. Pollution of arable lands can be managed by use of pre-treated waste water by bio-remediation or by anaerobic biological treatment for irrigation, balanced application of fertilizers mainly through split application to reduce NO_3 leaching, alternative use of plant residues to reduce the use of chemical fertilizers, crop diversification which helps in restoring soil health by enhancing the organic matter content and improving the soil physico-chemical properties, decreasing the use of chemical pesticides by giving more emphasis on using bio-degradable, photo-sensitive and environmentally safe pesticides (like pheromones, bio-control agents, especially bacteria and viruses, attractants and repellents and selective pesticides) and by phytoremediation. Phytoremediation is a new emerging technology for removing the contaminants from the soil by using plants especially the heavy metals, degrade or eliminate heavy metals, pesticides, solvents, crude oil and its derivatives and various other contaminants in the soil.

CONCLUSION

The finally this paper clearly indicating that soil, water and environment which are directly or indirectly responsible for crop growth has now been degraded in many areas due to improper management of agricultural inputs.Efforts should be made to increase the input use efficiency and decrease the use of external components to reduce the soil-water-environmental pollutions.Establishment and operation of cost-effective irrigation water quality monitoring systems should be made. Prevent sedimentationand soil runoff and proper disposal of the sewage from human settlements.Education of communities about the pollution impacts of the use of fertilizers and chemicals on water quality and food safety.

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