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A Study on Management of Increasing Soil Pollution in the Ecosystem

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Abstract—*Soil is an important natural resource to sustain life on earth because of its diverse functions that it play in nature. It is the ultimate recipient of any waste that we throw or dispose of waste product in the environment. The different layers of soil involved in physical (sieving), chemical (adsorption-precipitation), and biological filter (decomposition of organic wastes) are necessary to maintain a healthy environment and reduce the pollution [1]. These buffering capacities of soil are limited and must be managed properly to maintain the qualities of healthy soil. Several human activities like agriculture, industrial setup, etc. pollute the soil with organic and inorganic substances (solid wastes, heavy metals, solvents) [2]. Over the years, there is an increasing worldwide concern of environmental pollution associated with soil because degradation of soil health increases the risk of health of all forms of life [3]. The potential organic (e.g., pesticides) and inorganic (e.g., heavy metals) pollutants released into the environment are toxic and persistent in nature [4]. They enter in the food chain and accumulate within the tissues of animals (biological magnification) [5]. Soil helps in protecting the groundwater by acting as a filter of these toxic compounds. This indicates pollution of soil can lead to water pollution if the process is unchecked. Therefore, we must focus on prevention of our motherland from contamination.*

Keywords*: Soil; pollution; remediation measures, pollutants.*

1. SOIL POLLUTION

The introduction of undesirable substances or contaminants in the environment is termed as pollution [6]. Soil pollution is the changes in properties of soil by the addition of materials that adversely effects on its functioning and health of organisms living on it [7]. It may occur naturally or can be aggravated by the experiments of man. Soil pollution results in decrease of soil quality, disturbance in the soil's natural composition leading to erosion of soil, imbalance in the population of soil flora and fauna, contamination of groundwater, decline in productivity of crops, etc. pesticides, insecticides, fungicides, etc. contaminate the soil [8]. Surface runoff help in spreading of these chemicals. They penetrate deep inside the soil and infect the groundwater system. The organic compounds which resist degradation, bioaccumulate in terrestrial and aquatic ecosystem by transferring from one place to other and have potential to impact on the health of human and environment are termed as persistent organic pollutants (POPs). Faulty irrigation practices and use of poor quality of water also help in degrading the soil [9].

1.1 Industrial Pollution

Disposal of industrial effluents from chemical industries, mining industries, paper industries, tanneries, steel industries, pharmaceutical industries, food processing industries, cement industries, thermal industries, nuclear power plants, etc. in soil cause such type of soil pollution. These include mainly heavy metals like lead, chromium, cadmium, mercury, etc. [10]. Burning of fossil fuels, smelting and processing of metals in factories dump the wastes in the soil. The heavy metals become toxic when they are present at high concentration. Acid rain caused due to smoke released from the factories, act as acidic pollutants in soil. Sulphur dioxide (SO_2) and nitrogen oxides (NO_x) act as a major sources of acid rain.

1.2 Solid Wastes

Unscientific disposal of any type of waste (city/village waste, sewage, nuclear waste) will contaminate soil. Municipal and domestic waste includes garbage, paper, plastics, glass, metals, paints, rubber, leather, textiles, varnishes, etc. Leakage of stored waste from dumping site pollute soil and groundwater [11]. Nuclear waste can cause mutation in the organisms. The problem of hospital wastes and e-wastes generated per day are dangerous urban waste and should be focussed on recycling instead of dumping. Disposal of waste at sanitary landfills are better than open burning. Improper management of night soil can increase the spreading of harmful diseases.

2. TYPES OF SOIL POLLUTION

2.1 Agricultural Pollution

Various chemical compounds used in agriculture to enhance the crop yield are fertilizers,

2.2 Oil Pollution

With growing population, the consumption of fossil fuels has increased tremendously. Crude oil and its hydrocarbon derivatives may pollute soil during its extraction,

transportation, storage and use. Spilling and leaking of such oil products are the major threat to soil and water quality, and health of plants and animals [12]. These toxic compounds remain for very long time in soil, affecting the physical and chemical properties of soil. They reduce the concentrations of nutrients in the soil.

Therefore, the common pollutants reaching the soil through different sources can be listed as

i) Fertilizers and other salts

ii) Pesticides

iii) Heavy metals

iv) Organic waste materials

v) Radionuclide

vi) Acid rain

3. EFFECTS OF SOIL POLLUTION

Fertilizers can change reaction of soil. Excessive use of acid-forming fertilizers (ammonium sulphate) and basic fertilizers (sodium nitrate) may develop soil acidity and alkalinity, respectively [13]. Leaching loss of nitrate (NO_3^-) can pollute groundwater. According to the World

Health Organization (WHO), 10 mg/L of NO_3^-N in water is safe for drinking water. Methemoglobinemia (blue baby syndrome) is seen in infants if this limit of NO_3^- is exceeded in water [14]. The adverse effects of nitrate poisoning are seen in animals, particularly in ruminants because the rumen microbes fail to convert nitrite (NO_2^-) to ammonia (NH_3), leading to accumulation of excess NO_2^- [15]. Nutrient enrichment of nitrogen (N) and phosphorus (P) in water bodies cause algal bloom and natural ageing of lakes (eutrophication) [16]. The process is extremely costly to recover and takes long time in natural way. The NO_3^- lost to the atmosphere in the form of N_2O gas by denitrification, contributes to the greenhouse effect [17].

Pesticides used to target specific pests may also kill beneficial organisms living in the soil (non-target damage, extinction of species, and habitat destruction), and the species which survive give rise to highly resistant generations known as super pests and lead to an outbreak of secondary pests. Several diseases of skin, nervous system, respiratory system, and other body organs are found in human as long term exposure to pesticides, and these may even lead to cancer, Parkinson, Alzheimer, etc. [18]. Some of these.

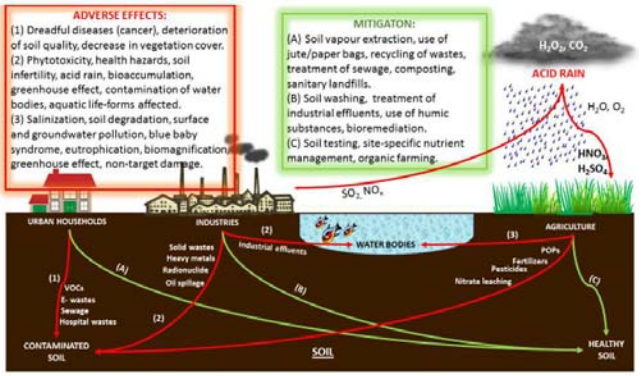

Fig. 1: Schematic representation of the sources and effects of soil pollution, and measures for mitigation. (1), (2), and (3) express the adverse effects of the sources of urban/city, industrial and agricultural wastes, respectively, while (A), (B), and (C) are representatives of the mitigation steps to control the soil pollution from the sources: (1), (2), and (3), respectively

chemicals remain in the soil for years, e.g., dichlorodiphenyltrichloroethane (DDT), aldrin, triazine herbicides, etc., while other pesticides like organophosphate insecticides (parathion, malathion), phenoxy herbicides [2,4-dichlorophenoxyacetic acid (2,4-D)], carbamate insecticides persist only for few days or months. The potentially toxic elements (Cd, Cr, Hg, etc.) are extremely phytotoxic, accumulate in plant tissues, and cause health hazards in humans and animals consuming these plants or their parts as food [19]. They are also reported to cause a nutrient imbalance in soil (soil infertility). Sewage sludge contains many pathogenic bacteria and forms the basis of spreading many types of diseases. Radioactive elements which enter in the food chain can cause abnormalities in animals. Acid rain leads to acidification of soil, hampers in functioning of microbes decreases enzymatic activities, reduces the vegetation cover, and can even alter the composition of forest species [20].

4. CONCLUSION

More studies and researches should be carried out in pollution remediation of soil resources. Region-specific, eco-friendly, and cost effective technologies should be identified. Biological measures has gained worldwide attraction due to its environment friendly nature but selection of appropriate species (plants and micro- and macro-organisms) is the new challenge associated with it. Soil and crop management practices should be dealt more scientifically with judicious use of the toxic inorganic chemicals so.

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