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Solid Waste Management Soil Depletion, Exhaustion, Erosion and Fertilizers; and Remedies

Preeti Khanduri

Department Of Botany, Government Post Graduate College, Kotdwar Garhwal (Uttarakhand)

1. INTRODUCTION

Soil is the most precious natural resource of any nation. Growing population, rapid industrialization and agricultural growth has increased the pressure on soil resources. Since 1945 almost 11 per cent of the Earth's land area, about 12 million square kilometres (4.6 million square miles), has been moderately to severely degraded. Every year farmers abandon 70,000 square kilometres (27,000 square miles) of formerly arable land because the soil no longer supports crops. India having 18% of the world's population on 2.4% of world's total area has greatly increased the pressure on its natural resources. Water shortages, soil exhaustion and erosion, deforestation, air and water pollution afflicts many areas. Our country is losing about 8.2million tonnes of soil nutrients annually as a result of soil erosion. The report of Government of India says that about 80 million hectares out of the total net cultivated areas of 140 million hectares are suffering from varying degrees of soil degradation. Today degradation problems are not just due to natural causes; most of them are due to man's own selfish motives. Soil exhaustion is the degradation and loss of soil which is a problem seriously affecting production of the world's food crops.

2. DISCUSSION

With the introduction of green revolution technologies, the modern agriculture is getting more and more dependent upon the steady supply of synthetic inputs (mainly fertilizers) which are products of fossil fuel (Dharambir et al., 2009). The organic recycling practices and crop rotation are getting largely replaced by chemical fertilizers for plant nutrition and by energy intensive monoculture systems for cash production. The organic matter level in arable lands have started to decrease even at worrying levels with a consequent soil erosion, nutrient run-off, lower water holding capacity and impairment of environmental quality due to pollution of both surface and ground waters (Magdoff, 1993). Many people have been discussing the basis of modern agriculture with regard to the large input of inorganic fertilizers and manuring techniques to increase productivity, agrochemicals to control weeds, pest and disease of crops (Magdoff, 1993; Van Breemen, 1993; Sequi, 1996; Skinner, 1996). But such profit is obtained at the cost of soil health-leading to its depletion and exhaustion. Soil exhaustion occurs when poorly managed soils are no longer able to support crops or other plant life. It has consequences beyond limited food production by increasing risk of soil erosion. Single-crop agriculture depletes soil nutrients because the same nutrients are required year after year and the soil has no time to replenish its stores. Our intensive industrial agricultural practices - narrow spectrum fertilizers, herbicides, pesticides, large scale monoculture planting, tilling and more - the opposite of bio-dynamic farming - lead to decreasing mineralization, lowering of humus levels. Top soil is being washed away by rain and irrigation and blown away by wind. The produce grown on these soils still looks normal, but is hollow as the mineral content has been steadily declining. Sick soils mean sick plants, sick animals, and sick people. Physical, mental and moral fitness depends largely upon an ample supply and a proper proportion of minerals in our foods as nerve function; nerve stability and nerve cell-building depend upon trace minerals. The soils which are seriously deficient in trace minerals, cannot produce plant life competent to maintain our needs, and with the continuous cropping and shipping away of those trace minerals and concentrates, the condition becomes worse.

Soil degradation has several causes, among them are deforestation, overuse of pesticides, excessive grazing of cattle, and short-sighted agricultural practices. Deforestation, one of the principal causes, occurs when forested areas are logged or cleared and much of the already thin earth erodes away. The resulting silt clogs rivers, lakes, coast estuaries, and coral reefs, killing fish and damaging aquatic ecosystems. Often the remaining soil can support crops for only a year or two before being unusable. Chemical pesticides help avert crop losses, but they can also cause long-term soil damage by destroying beneficial insects and the microorganisms necessary to replenish soil nutrients. Pesticide vapour and run-

off poison wildlife, both nearby and downstream, and are major polluters of lakes and underground aquifers. In the developing world, toxic chemical pesticides such as dichlorodiphenyltrichloroethane (DDT) are still widely used on crops and eventually consumed by humans. Excessive grazing is another major contributor to soil damage, in part because cattle compact the soil, making it less able to retain water. In heavily trampled areas, erosion and drought are often the result. Overgrazing also destroys native grasses, allowing weeds with deeper roots to replace them. Finally, livestock can damage rivers and streams by breaking up soil on their banks; the soil is then washed into the water, resulting in siltation. Short-sighted agricultural practices, such as not allowing fields to lie fallow and ploughing too frequently, contribute heavily to soil loss.

With the increase in population, our compulsion should be not only to stabilize agricultural production but to increase it further in sustainable manner. To achieve the targeted output, the consumption of plant nutrients also has to increase. For promoting better soil health and stability in production, the most desirable approach is to satisfy the future increase in nutrients needs through combined use of minerals, fertilizers, organic manures and bio fertilizers. (Kasthuri and Lalitha, 2010). Soil fertility is the inherent capacity of soil to supply nutrients to plants in adequate amounts and in suitable proportions (Brady, 1974). This claims that soil fertility depends on chemical, physical and biological factors which affect soil nutrients status and nutrient availability for plants. The soil fertility is usually measured by crop productivity, so soil fertility and crop productivity can be considered as two aspects of the same question (Tomati and Galli, 2002). A natural balance needs to be maintained at all cost for existence of life and property. Thus organic farming is a unique production management system which promotes and enhances agro ecosystem health, including biodiversity, biological cycles and soil biological activity and this is accomplished by using on- farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs. (Kumar and Jyothi, 2015). It is widely recognised that larger crop yield can be achieved only by increasing the availability of nutrients for plants, strictly dependent on the biological cycles in the soil (Magdoff et al., 1997). Therefore, maintaining a safe status of soil is a priority for agriculture production.

Organic matter is anything that contains carbon compounds that were formed by living organisms. Incorporating organic matter into soil can have several impacts because it alters the physical, chemical and biological balances in the soil by altering the amount of nitrogen and other nutrients that are available to plants, soil aggregation and the number and type of organisms present in the soil. All of these changes are related to the way organic matter is decomposed when it is incorporated into soil and to the particular type of organic matter used. (Rai and Rai, 2009). The importance of humus-like compounds to soil ecology, fertility and structure and the consequent effects on plant growth and crop yield have caused an increase in the use of stabilised organic matter as a soil conditioner (Chen and Aviad, 1990). The role of fungi in binding soil particles into stable masses has long been known (Waksman and Martin, 1939; McCalla, 1946; Harris et al., 1966) and subsequently confirmed (Lynch, 1981; Lynch and Bragg, 1985); the importance of bacteria in the soil aggregation through a cementing action due to their metabolites has also been clarified (Lynch, 1976; Burns, 1980) which improve soil structure stability. The organic carbon content of a cultivable soil is the backbone of the soil productivity which is called humus. Unfortunately, most of our cultivable soils are deficient on organic carbon content which is attributed to soil environmental set back, removal or burning of crop residues, indiscriminate and imbalanced use of chemical fertilizers and other soil degradation processes. Soil organic matter plays an important role in determining the physical, chemical and biological properties of soil. Properties of soil such as cation exchange capacity, water holding capacity, aeration etc. can be increased by improving the soil environment through application of organic matter (Sharma and Chakravarty, 2010). In general, the application of stabilised organic matter improves soil structure. The mechanism depends on two steps: the first is mainly additive effect in which the labile part of substrate undergoes microbial degradation, the second is a stabilisation phase in which the organic matter acts as a structural agent (Metzger et al., 1987).

The activities of some beneficial soil microorganisms like cellulose degraders, nitrogen fixers and phosphorus solubilisers are governed by the factors like soil temperature, soil moisture and soil organic matter. As a result of changing weather situation, the activity of soil microorganisms is changed and the increasing temperature causes faster rate of breakdown of organic matter resulting in more release of carbon dioxide gas at a time to the atmosphere. Also as organic matter dissipates, the soil's ability to store organic nitrogen declines. A large amount of nitrogen then leeches away, fouling ground water in the form of nitrates and entering the atmosphere as nitrous oxide, a green house gas (GHG) with some 300 times the heat- trapping power of carbon dioxide. According to IPCC, an increase in carbon dioxide and other GHGs in the atmosphere are expected to increase the average global temperature by 1.1^{o}C to6.4^{o}C, thus leading to change in climate. The change in climate particularly the rise in global temperature and change in rainfall pattern adversely affect the ecosystem leading to increasing magnitude of natural resource degradation in terms of soil fertility, soil structure, soil and water erosion, deforestation, siltation, water stagnation and depletion of soil organic carbon and nutrients, which are creating serious hindrance to agricultural productivity. Excessive dependence of modern agriculture on the supply of synthetic inputs and the adverse effects being noticed due to their excessive and imbalanced use have compelled the scientific fraternity to look for alternatives.

3. SUGGESTIONS

Proper soil management which includes crop rotation, organic fertilizer applications and irrigation methods helps to decrease the potential for soil exhaustion. The planting of crops from the same family in the same spot year after year should be avoided and crop rotation should be adopted. Rotating crops not only prevents soil exhaustion but also limits crop diseases and insect infestations. Fallow fields should not be left bare but planted by cover crops. Cover crops hold soil in place and, once plowed under; the uprooted cover crops provide organic bulk and nutrients to the soil, i.e, green manure (biofertilizer). Soil organic carbon can be sustained at a high level by incorporating left out crop residues into the soil, plough down of green manuring crops, application of organic manures like farm yard manure, compost, vermicompost, biofertilizers etc. The nitrous oxide evolution rate is influenced by the amount of fertilizer applied and a direct correlation has been found between increasing amount of fertilizer application and the nitrous oxide evolution rates. Hence, only the required quantity of nitrogen should be applied at the critical physiological stage. One means of both increasing the fertilizer use efficiency and reducing the loss is by the split application of fertilizer nitrogen (Gayathri, 2009). Puddling of soil (prior to transplanting) could be done to increase the bulk density of the soils, which reduces the percolation rates resulting in reduced leaching losses. The release of nitrogen can be delayed by coating the soluble fertilizer with some slowly soluble compound preventing its rapid dissolution in the soil. The use of nitrification inhibitors also help to reduce the leaching loss of nitrogen. Experiments to evaluate various nitrogen sources must not only consider the effect on yield but also the likely mode of nitrogen loss in specific fertilizers and soil conditions and management practices in use. However, bioremediated materials in agriculture is an indispensable help to restore the nutrient cycles often broken by agricultural malpractice, and to improve many soil properties, including the behaviour of chemical fertilizers (FAO,1995). Home gardeners should submit soil test samples to their local university extensions before planting their first garden and every few years thereafter. University soil scientists determine the amounts of nutrients in soil and provide recommendations that are crop and soil specific.

4. CONCLUSION

It is necessary to equip the extension machinery at the grass root level with full technical back-up, production and application technology in order to launch the biofertilizer programme successfully. Unfortunately, most of the farmers in our country do not have sufficient and clear knowledge about the use of biofertilizers which have enormous potential to fulfil the nitrogen and phosphorus requirement of the crops in soil without much emission of carbon dioxide and can be used to mitigate the bad effect of inorganic chemical fertilizers. An intensive awareness and publicity programme is required for disseminating the knowledge about biofertilizers and motivating the farming community. Governments and individuals are looking for solutions to soil loss and exhaustion. To avoid the dangers of pesticides, for example, many farmers now use benign pest-control measures, such as crop rotation, pest traps, and integrated pest management. Using recombinant DNA, or deoxyribonucleic acid, scientists in the field of biotechnology are developing hybrid plants that may provide greater yields even in exhausted soil. Many countries are trying other solutions, such as minimizing deforestation and working with ranchers and farmers on alternative grazing and planting strategies. Sustainable agriculture is the successful management of natural resources for agricultural production to meet the changing human needs, while maintaining or enhancing quality of environment and conserving natural resources particularly soil which forms the pivot of agriculture. What is actually needed is to educate and create awareness among people and promote reclamation measures for soil degradation.

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