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Mini Review

How to Sustain Agricultural Land for Safe Food Production?

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Abstract

Environmental degradation is a serious threat to the existence of humanity on earth. Anthropogenic activities severely deteriorate our environment through deforestation, unplanned urban area development, pesticide usage, tillage operations, intensive farming, etc. In order to cope these problems, certain strategies should be devised in order to ensure sustainability of agricultural production of safe and healthy food for an ever-increasing population of the world. This paper focuses on the causes of land degradation and recommends perspective solutions for the sustainability of agricultural land.

Keywords: Land Degradation; Sustainable Agriculture; Safe Food; Conservation Tillage; Bio-Organo-Phos

Introduction

Population growth is the ultimate cause of poverty and environmental degradation like air, water and soil pollution. Deforestation, a major factor responsible for environmental degradation is caused due to the use of deforested land for residential requirements of a growing population and also as fuel wood and fodder for cattle. Also, unplanned use of fertile soils/land for this purpose causes a severe loss in the agricultural land, resulting in the decreased area of agricultural crop production and ultimately may lead to a situation to starvation of food. This situation is adverse for developing countries like Pakistan, where agriculture is the backbone of the economy and serves as a source of livelihood for about 75% of the population. According to Thomas Malthus, population increases exponentially while food resources either remain stable or slightly increased, with the prediction that this situation would ultimately lead to starvation. While going deep into the subject matter, it has been found that there is a dire need to sustain agricultural land for safe delivery of food for the growing population of the world. Before we can suggest some remedies to cope this situation, we need to find out the reasons behind this decrease in the agricultural land in detail. The following paragraphs present the reasons in details.

Soil Erosion: Soil Erosion is one the most important factors responsible for degradation of agricultural land as it is the loss of fertile soil or arable soil from the earth's surface, resulting in the loss of soil fertility and ultimately the soil potential to sustain agricultural crops. Moreover, loss in soil fertility would convert that piece of land into barren land, thereby contributing towards environmental degradation. In order to avoid soil erosion, we need to practice terrace farming in sloppy areas like hills, deep ploughing for moisture conservation under rainfed conditions, relay cropping and planting trees wherever open place is available. These practices would help in the reduction of velocity of rain water which otherwise, causes severe soil erosion and would strengthen the soil particles through moisture conservation and plantation in open places.

Salinization: Salinization is also one of the most important factors affecting agricultural lands. It is caused due to the accumulation of salts in the rhizosphere which severely disturbs various physiological and biochemical processes of the plants, ultimately leading to reduced crop yield and productivity. Water logging results in the creation of a saturated zone near plant roots which severely disrupts the respiration in the roots and ultimately cause plant death. Moreover, it also results in the loss of nutrients from the

rhizosphere and causes nutrient deficiency and ultimately reduces soil productivity. It is caused due to the seepage of water from the water reservoirs like canals, rivers, etc.

Organic matter: Organic matter is one of the most important components of the soil which is directly associated with soil structure, water holding capacity, soil stability, buffering capacity, soil health and nutrient availability. It has a direct link with soil erosion as its presence help to hold soil particles together, thereby reducing the chances of soil erosion and ultimately the soil fertility. It has been found that extent of soil erosion is more in soil with soil organic carbon ≤ 2% [1,2]. Due to intensive farming practiced to feed the growing population of the world, the use of chemical fertilizers has been increased which has caused various environmental problems. Therefore, integrated use of organic, bio- and inorganic fertilizers should be encouraged [3-5].

Poor quality of irrigation water: Another factor responsible for environmental degradation is the poor quality of water for irrigation which is mainly caused by anthropogenic activities. Our water resources (surface and groundwater) are being contaminated with untreated wastewater from industries. Moreover, our water reservoirs are losing their capacity to store water due to soil, water and wind erosion. Contamination of surface waters with industrial effluents, contaminated soil deposits, pesticides and inorganic fertilizers results in the leaching of contaminants contained and ultimately go down to damage the water ecosystem. During intensive farming, the soil tillage technique also plays an important role to control soil erosion.

Environmental impacts of soil cultivation

Eutrophication: Due to over fertilization of our farming systems (point sources), water reservoirs are being contaminated with nitrogen and phosphorus, which results in an uncontrolled growth of algal blooms and microbial community. Due to increased growth of microbial community, the oxygen in the water reservoir will be depleted and would not be available for other aquatic life like fishes, thereby creating anoxic conditions and ultimate death of the aquatic community [6]. In order to control eutrophication, only required amount of fertilizers should be added, tillage practices like conservation tillage (no-till, ridge-till, and mulch-till) may also be practiced to control wind, water and soil erosion.

Soil structure: Intensive farming has initialized mechanized farming, which is the usage of machines for most of farming practices like ploughing, weeding, picking, harvesting, etc. Soil structure is very important as it plays a critical role in water holding capacity, porosity and ultimately the nutrient availability. In this regard, soil structure has been damaged due to mechanized farming. Poor soil structure can pave the ways to poor infiltration and high run off [7] which ultimately would result in soil, air and water erosion. In this regard, tillage practices should be minimized through conservation tillage [8].

Effect of CO_2 on the agriculture: Due to industrialization and other anthropogenic activities, the atmospheric CO_2 has been increased. An increase in atmospheric CO_2 is very helpful as it would increase the productivity of crop plants through its direct effect photosynthesis capacity [9]. But, it is the one side of the mirror which looks very attractive. In its other side, increase in atmospheric CO_2 would cause an increase in temperature, which is an important factor responsible for weather change as agriculture is inevitable based on weather conditions like precipitation, humidity, radiation etc [10]. Change in temperature would have a negative effect on the growth cycle of the crop plant, especially in the case of cereal crops and ultimately their productivity [11].

Conclusion

From the above discussion, it has been clear that there are various challenges being on the way to sustainable agriculture. In this context, salinity, water logging, shortage and poor quality of irrigation water, nutrient deficiency, damage to soil structure due to mechanized farming, eutrophication, high atmospheric levels of CO_2 and others are severely affecting our farming practices and ultimately towards sustainable use of agricultural land. In this regard, following practices are recommended:

- For salinity and water logging problems, phytoextraction using glycophytes could be a sustainable strategy.
- Rain water harvesting should also be practiced on a sustainable basis.
- Conservation tillage may also be practiced to avoid damage to the soil structure.
- Integrated usage of chemical, organic and biofertilizers.
- Chemical fertilizers should be used at recommended rates in order to avoid eutrophication.

- Treatment of industrial wastewater using sustainable approaches like biological ones e.g. bioremediation.

Conflict of Interest

The authors don't have any conflict of interest.

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