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Impact on Fertility of Soil due to Climate Change

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Introduction

The most recent report of the Intergovernmental Panel on Climate Change (IPCC) indicates that the average global temperature will probably rise between 1.1 and 6.4 °C by 2090–2099 as compared to 1980–1999 temperatures, with the most likely rise being between 1.8 and 4.0 °C. The levels of CO_2, a major greenhouse gas, in the atmosphere are expected to be higher than today (TPCC) and IPCC reports that the 21'"century is likely to be warmer. Climate change can have a very big impact on soils and the functions that soil performs. In agriculture, climate change will affect crop production as changes in soil, air temperature and rainfall affect the ability of crops to reach maturity and their potential harvest. These are the consequence of global warming due to the emission of greenhouse gases like CO_2, CH_4, and N_2O into the atmosphere. The climate heats up; reductions in the amount of water available may be made up initially by irrigation. However, scarcity of water may prevent water from being used for irrigation. Increasing damage to the land, or land degradation, will occur in the form of soil erosion, desertification, salinization, or loss of peat soils, further impacting the capability of soils to support the needs of agriculture.

Agriculture is considered one of the major contributing sectors to the economy not only of rural areas but also of the whole country. The livelihoods of the majority of rural communities mainly rely on agriculture to meet their subsistence needs. The farmers of our country are always producing huge quantities of various crops, yet our agricultural production is not still secured for the alarmingly increasing population. Besides soil health and other input factors, the agricultural production system depends on climatic factors of a locality. The unpredicted climate changes directly affect the environment and more particularly soil and crop productivity, for which farmers have to suffer and the rural economy is adversely affected.

Soil is one of the most valuable natural resources. The change in climate particularly the rise in global temperature and change in rainfall pattern adversely affects the ecosystem leading to an increasing magnitude of natural resources degradation in terms of soil fertility, soil structure, soil and water erosion, wind erosion, deforestation, siltation, water stagnation and depletion of soil organic carbon and nutrients, which are creating serious hindrance to agricultural productivity.

Soil organic matter is any material produced originally by living organisms (plant or animal) that is returned to the soil and goes through the decomposition process. At any given time, it consists of a range of materials from the intact original tissues of plants and animals to the substantially decomposed mixture of materials known as humus. Most soil organic matter originates from plant tissue. Plant residues contain 60-90 percent moisture. The remaining dry matter consists of carbon (C), oxygen, hydrogen (H), and small amounts of sulphur (S), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg). Although present in small amounts, these nutrients are very important from the viewpoint of soil fertility management. To produce more crop yield from less land area for a large population, there is a dire need to feed the soil for sustaining soil fertility by maintaining organic carbon content in the soil. It plays an important role in determining the physical, chemical, and biological properties of soil. Plant nutrient availability can be increased through the process of decomposition of organic matter. Properties of soil such as cation exchange capacity, water holding capacity, aeration, etc, can be increased by improving the soil environment through the application of organic matter. The activities of some beneficial soil microorganisms like cellulose degraders, N-fixers, and P-Solubilisers are governed by the factors like soil temperature, soil moisture, and soil organic matter. As a result of changing weather situations, 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 in the atmosphere. It has been reported that the practice of zero or minimum tillage may slow down the rate of decomposition of organic matter and helps to get rid of higher carbon dioxide emission from the air.

Biofertilizers have enormous potential to fulfill the nitrogen and phosphorus requirements of the crops in soil without many emissions of CO_2 and can be used to mitigate the bad effect of inorganic chemical fertilizers. The bacteria (Rhizobium) in the root nodules of legume crops have the ability to fix atmospheric nitrogen in the soil without any detrimental effect on the soil environment. It is very much important to include one legume crop i.e., the cropping system. Phosphate solubilizers are most

efficient in increasing the availability of native phosphorus in soil. The use of rock phosphate in acidic low P soils can be effective to increase crop production. Owing to continuous deforestation, soil organic matter has been reducing alarmingly. Soil organic carbon can be sustained at a high level by incorporating left outcrop residues into the soil, plough down green manuring crops, application of organic manures like FYM, compost, vermicompost, biofertilizers, etc. Mulching with crop residues over the ground surface is used to control soil temperature, reduce moisture loss through evaporation and enhance water infiltration. Mulching also tremendously helps in preventing soil erosion. The use of improved technology, seeds, and practice of crop diversification are also influencing soil. According to FAO, sustainable agriculture is the successful management of natural resources for agricultural production to meet the changing human needs, while maintaining or enhancing the quality of the environment and conserving natural resources. It indicates some important aspects like meeting changing needs of today and tomorrow, economic viability at enhanced productivity, successful management of resources-external, internal, renewable or non-renewable, maintenance, preferably enhancement of Quality of environment and conservation of natural resources particularly soil and water which form the pivot of agriculture. Therefore, the organic agriculture movement can be considered to be the roost efficient sustainable approach to crop production for food security where recycling of organic crop residues and fewer external inputs are involved to produce high output. Organic agriculture is the only way in enhancing soil health by reducing the severe impact of weather changes and to some extent C02 gas emissions. Plantations can lower the atmospheric temperature by the process of transpiration. It is the peak time not only for the coming new generation but also for every human being to be aware of climate change. Each and every grower should recycle their farm wastes into the soil through in situ incorporation and or making compost or vermicompost, instead of burning, to increase the soil organic carbon or soil organic matter for long-term restoration of soil environment, fertility, and productivity for food security of the nation.