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Regenerative Agriculture - Turning Dead Dirt into Living Soil

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Abstract

The increased agricultural intensification to meet the hunger of over growing population had led to excessive application of chemical fertilisers and agro-chemicals which on the other hand have led to the desertification of soil. Regenerative agriculture is the new hope towards the conversion of the dead dirt soil to lively and productive soil. Regenerative agriculture isn't a completely new way of farming, but more of these practices must be put into play as the current and future agriculture demands site-suited smarter and resilient technologies to attain sustainable yield and combat climate change with reduced environmental footprints.

Introduction

As an important entity for life soil needs proper care and management to provide nutrition to living beings. Without the required care for its revival, an exhausted soil could only be considered as a dead dirt with no life. Microbes as companions make nutrient as well as organic carbon available to plants and via plant other living beings derives their nutrients. With an intention of increasing the overall food productivity the soil fertility and health has been deteriorated over time due to unjudicial management practices. The increased land requirement has led to deforestation and thereby a reduction in net cultivated area around the world. All the above phenomenon has aggravated the challenging evil, the climate change. The effects of climate changes are innumerable and harmful for sustainability of soil health, crop production as well as ecosystem and environment. To address these challenges, a major paradigm shift is required from conventional resource exhaustive practices to climate resilient regenerative agriculture, to ensure food security and livelihood.

Function of Soil

As a living being the major role of soil is processing organic matter and release of nutrients into a form that plant needs via microbial mediation, so taking care of microbes in the soil is essential for human health. Soil constitutes mostly carbon. Carbon is the basic building block and driving engine, acts as basis of all life on earth. Forty percent (40%) carbon accumulation occurs in the roots. Glomalin present in rootzone that result in aggregation of soil and improve structure and presence of soil pockets (aggregates) control flow of air and water in rootzone. Roots have the innate ability to sequester carbon outside the atmosphere. So, a healthy root system is derived through healthy soil, with all the vital microbes and bacteria. Glomalin is a glycoprotein that not only acts as an adhesive for soil to control erosion, but also stores almost one-third of the world's

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carbon; hence, stabilizing effect of climate change.

Problems of Modern Agriculture

In Chemical conventional agriculture, soil is completely devoid of microorganisms as they cannot thrive. In order to survive in soil, they convert energy in soil organic matter by decomposing into forms useful to rest of the organisms in the soil. A number of decomposers can break down pesticides and pollutants in soil. But in order to do so, it will require a surmount capacity of energy, and in a soil containing over-whelming amount of chemicals in soil, suppresses the activities of these bacteria. In this vicious cycle of industrial agriculture, chemical fertilizers mask the problem of degraded soils. Modern crops are genetically altered to resist the spraying of toxic pesticides.

Over spraying of toxic chemicals like glyphosate paves it way and hampers day to day of human needs like drinking water. And it is suspected to cause cancer. The rate of usage of toxic herbicides is increasing at an increasing rate. This number was incomprehensible 20 years ago as they were predicted to increase yield (Godfray *et al*., 2010). But the law of diminishing returns states otherwise. It says that the rate of an increasing factor increases constantly, then increases at a decreasing rate, up to a threshold limit but then decreases at a decreasing rate on further usage; hence, diminished returns (or yield), irrespective of application.

Climate Change Leading to Desertification

Soil, plant and climate are connected. As the fate of water and carbon are tied to soil organic matter, on damaging the soils we give off carbon. Carbon is released to atmosphere and healthy soils have a tendency to absorb water and carbon dioxide (CO_2) but reverse course of action occurs once we damage this living entity, *i.e*., soil - this is what changes live soil into dead dirt, result is desertification. No live soil leads to no living plant, as a result, evaporation dominated over transpiration. When water gets released through the plant, it results humidity which in turn increases rainfall. What we don't realize is that 40% of rain come from inland *i.e*., smaller water cycles excluding the ocean water and when this happens, too much sensible heat is released through bare soil. Hot air pushes the rain clouds away. This leads to abnormal rainfall distribution at irregular intervals, thus increasing crop failure during proper growing season.

Consider this experiment. Take one sq. metre soil and make it barren. You will find it to be much colder at night and much hotter at midday. This destroys the micro climate over the area. Do that on a large scale over more than half of world's land and the macroclimate gets hampered. And on practicing this over a period of time, makes climate more complicate, leading to abnormal cycles of rainfall and unusual temperature hikes. United Nations predicted that the earth's remaining living top soil will be gone within 60 years, *i.e*., we have less than 100 harvesting seasons left with us.

Regenerative Agriculture: A Ray of Hope

Agriculture is pivotal in economic development and is integral to address global issues of the 21st century (*e.g*., food and nutritional security, climate change, growing energy and water demands, and biodiversity). The impact of climate change on agriculture and food security is of great concern because it exacerbates existing pressures on natural resources and demand to have efficient and diversified agriculture to enhance the productivity of major cropping systems for the rapidly increasing and progressively affluent human population (Smith and Gregory, 2013). The anthropogenic climate change (ACC) has already caused global warming by 1 °C (1.8 °F) until 2017, and the global temperature is rising at the rate of 0.2 °C (0.36 °F) per decade. About 75% of the Earth's land surface is already being altered by humans, and 85% of the wetlands are lost. Prime agricultural land is also being encroached upon by urbanization, which has doubled between 1992 and 2018. By 2050, there will be an additional global food demand for cereal production by 1 billion ton per year. On the other hand, arable land area is shrinking because of infrastructure development, especially in developing countries. The global per capita arable land area was 0.37 ha (0.91 acre) in 1961 and is projected to be 0.17 ha [0.42 acre; and less than 0.14 ha [0.35 acre] in developing countries] by 2050.

It is time for revolutionary ideas, such as the Green Revolution during the 1960's, which saved hundreds of millions from starvation by solving food-grain shortages by promotion of high-yielding varieties of seeds and fertilisers. It was a timely intervention that effectively addressed the need of the time. But half a century later, we need to revisit the global issues of the present times, especially those with regards to soil degradation, climate change, pollution, poor water quality, farmers' declining incomes due to a high dependency on external inputs, extinction of species and the environment degraded in the name of development. The resource scarcity and environmental pollution thus created are also the cause of conflicts, civil unrest, and eco-violence, especially in poor countries. To address these challenges, a major paradigm shift is required from conventional resource exhaustive practices to climate resilient regenerative agriculture, to ensure food security and livelihood.

The '4 per 1,000' initiative was launched by the French government at the COP21 Paris climate summit in 2015. It aims to boost carbon storage in agricultural soils by 0.4% each year to help mitigate climate change and increase food security. Bio-sequestration is storage and removal of carbon dioxide

from atmosphere by photosynthetic plants or bacteria, some techniques of grazing and farming to store carbon in the sink of the soil. Reducing emissions are not enough. Conversion to renewable sources of energy is also not enough. So, to heal climate, we first need to heal our soil and reclaim its living properties. It's as simple as to rely on nature to do its job, *i.e.*, photosynthesis of plants and improving quality microbes in the soil as they will do our job; this concept that draws down the most carbon is regenerative agriculture. Multi species cover cropping helps to enhance the life and functions of the soil. For instance, monocropping will feed the soil biology with single type of root system, whereas, diversifying species of plants over same piece of land would increase the biological time required for regeneration of soil. Animals grazing living plants are a part of carbon cycle. When they're kept on pasture and constantly move, they not only sequester carbon but also rebuild ecosystem. Urine and dungs of grazing animals accelerate plant growth. Regenerate lost nutrients in soil.

The much needed green revolution of the 21st century based on the concepts of regenerative agriculture must be soil based (better soil health), ecosystem based (enhanced eco-efficiency and minimal use of external inputs), knowledge based (using modern science and managerial skills), based on Law of Return, and focused on creating a positive soil and ecosystem carbon budget. Regenerative agriculture isn't a completely new way of farming, but more of these practices must be put into play as the current and future agriculture demands site-suited smarter and resilient technologies to attain sustainable yield and combat climate change with reduced environmental footprints.

Conclusion

Climate resilient regenerative agriculture could be the most reliable and sustainable option for the regeneration of the to be "dead dirt" to a healthy, nutrient surplus and fertile soil which could withstand the hunger of the ever growing and living population of plant, animals and microbes by combating the effects of climate change.

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