

Soil Biodiversity for Sustainable Agro-ecosystem Functioning

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Introduction

The distant and small particles in the cosmos is the heritage of approximately more than two million species and product of billion of year of evolution most of these biodiversity is in the soil beneath our feet but only 1 % of soil species have been identified so far. The soil biota constitutes greatest concentration of biomass of any part of planet and is composed of immeasurable amount of maggots, microbes and micro organism each of these wonderful features place a key role in food chain that maintain fragile balance of life in natural and Agro- ecosystem functioning. Soil are the home for more than 25 % of Earth's total biodiversity ,it reflects the variability of living organism it is the soil and there ecological complexes this includes diversity within and among species and of ecosystem. The terrestrial ecosystem are indispensably connected without soil. The vast unexplored soil biodiversity has tremendous potential for commercial exploitation through biotechnological tool in domain of agriculture , medicine, industrial processes and bioremediation of polluted natural resources. The diverse community of living organism keep the soil healthy ,fertile and play a key role in Sustainable Agro-ecosystem.

The soil is home to large proportion of world's genetic diversity of organism amongst them microbes (fungi, bacteria , protozoa) mesofauna (nematodes, acari and collembolan) and macro fauna (arthropods , earthworm, and ants) with some exception of mega fauna (moles and rodents) It has been reported that in one gram of soil there over ten million microbes .The food web is therefore incomplete without soil organism. It is infact fair to say that belowground biodiversity has not been given the prominence it deserves, despite the soil being the home of billions. A typical healthy soil contain several species of vertebrateanimals, several species of earthworms,20-30 species of mites ,1500 species of nematodes ,50-100 species of insects ,1500 species of nematodes hundreds of species of fungi, thousands of species of bacteria and actinomyces. The soil biodiversity is therefore the

driver of healthy soil for sustainable Agro-ecosystem functioning. However, the intensive agriculture activities reported to lead to loss of soil biodiversity this has been attributed to environmental degradations and consequently climate change .loss of soil biodiversity has been linked to an increase in soil pathogens especially in agro-ecosystem leading to increased cost of production.

Lack of awareness knowledge and understanding of soil biodiversity has been identified as major constraint for its management. Land intensification has challenged the conservation of soil biodiversity ,since it is focused only on increased crop yield with little or no regard to soil biodiversity. This leads to soil degradations and consequently to loss biodiversity function .It is therefore important to conserve and sustainably utilize soil biodiversity for increased agriculture productivity and functioning.

Soil Biodiversity – The Root of Sustainable Agro-ecosystem

Given the escalating population, growth ,land degradations and increased demand for food achieving sustainable agriculture and viable agriculture system is critical to the issue of food security and poverty alleviation is most, if not all developing countries. Soil biodiversity is fundamental to the sustained productivity and viability of agriculture system worldwide.



Sustainable Agro-ecosystem including forestry involve successful management of agricultural resources to satisfy human needs while maintaining or enhancing environmental quality and conserving natural resources for future generations. The sustained use of the Earth's land and water resources and thereby plant, animal and human health is depend upon maintaining the health of living biota that provide critical processes and ecosystem services.

However, current technologies and development support for increased agriculture production have largely ignored this vital management components.

Improvement in agriculture sustainably require effective management of soil biodiversity and there species conservation. Also crop, water management and management of soil fertility and soil physical properties, both rely on soil biodiversity and soil biological processes. This call for widespread adoption of management practices that enhance soil biological activity and thereby building up long-term soil productivity and health for sustained agro ecosystem functioning.

Food and Agriculture Organization (FAO) considers the issue of soil biodiversity and soil ecosystem management of great importance to the achievement of sustainable, resource effective and productive agriculture. Soil biodiversity has been identified as an area require particular attention under the program. Programs of Work On Agriculture Biodiversity of the conference of the parties (COP) to the convention on Biological Diversity.

What is Soil Biodiversity and its relationship to sustainable Agro-ecosystem?

Healthy soil contain enormous number of diverse living organism and assembled in complex and varied communities. They range from the myriad of invisible microbes, bacteria, and fungi to the more familiar macro- fauna such as earthworm and termites. Plant roots can also be considered as soil organism in view of their symbiotic relationship and interaction with other soil components. These diverse organism interact with one another and with the various plants and animals in the ecosystem forming a complex web of biological activity. Environmental factor such as temperature, moisture, and acidity as well as anthropogenic action in particular agricultural and forestry management practices effect to different extents soil biological communities and their function.

Soil and its living organism are an integral part of agricultural and forestry ecosystem playing a critical role in maintaining soil health, ecosystem functioning and productivity each organism has specific role in complex web life in soil.

- The activity of certain organism affect soil structure especially so called soil engineers such as worms and termites through mixing soil horizons and organic matter and increasing porosity. This directly determine resilience to soil erosion and availability of the soil profile to plant in Agro-ecosystem.

- The function of soil biota are central to decomposition process and nutrient recycling they therefore affect plant growth and productivity as well as the release of pollutants in the environment for example, the leaching of nitrates into water resources.
- Certain soil organism can be detrimental to the plant growth for example, the build up of nematodes under certain cropping practices however, they can also protect crops from pest and disease outbreak through biological control and reduced susceptibility hence, our agro ecosystem is sustained by below ground biota.
- The activities of certain organism determine the carbon cycle – the rates of carbon sequestration and gaseous emissions and organic matter transformation
- Plants roots and there interaction with other soil components and symbiotic relationship especially rhizobium bacteria play a key role in uptake of nutrient and water and contribute through their growth and biomass to soil quality and organic matter content. *Arbuscular mycorrhiza* fungal forms mutually beneficial association between species in fungal subphylum Glomeromycotina and root of 80% vascular plants (Smith and read 2008).The fungi aquaria carbohydrates from plants and provide phosphorus ,nitrogen and other mineral nutrients to plant via an extra radical mycelium network .
- Certain soil organism can also used to reduce or eliminate environmental hazards resulting from accumulation of toxic chemical or other hazardous wastes, this action called as Bioremediation.

The interacting function of soil organism and the effect of human activities in managing land for agriculture and forestry affect soil health and quality. Soil quality is capacity of specific kind of soil to function within natural or managed ecosystem boundaries to sustain plant and animal production maintain Or enhance water and air quality and support human health and habitation. Soil health include the ecological attributes of soil which have implications beyond it's quality or capacity to produce particular crop these attribute are chiefly those associated with soil biota it's diversity, it's food web structure, it's activity and the range of functions it perform soil biodiversity per say may not be soil property that is critical for the production of given crop but is a property that may be vital for the continued capacity of soil to support that crop. Primary importance is the contribution of soil organism to a wide range of essential services and to the sustainable functioning of all ecosystems but primarily agro-

ecosystem by acting as primary driving agent of nutrient cycling regulating the dynamics of soil organic matter, soil carbon sequestration and green house gas emissions ,modifying soil physical structure and water regimes. Enhancing amount and efficiency of nutrient acquisition by vegetation and enhancing plant health. These services are not only essential for functioning of agro system but constitutes an important resource for agricultural production and food security as well as sustainable management of agricultural systems. The conservation of healthy communities of soil biota and prudent use of specific soil organism through biological soil management can be used to maintain and enhance soil fertility and ensures productive and sustainable agricultural system.

Threat to the Soil Biodiversity

The world beneath our feet play an important role in sustaining Agro-ecosystem. Soil organism face many of same threat as above ground organism and receive far less research, media attention and legal protection. Habitat loss is the primary threat to soil biota. Agriculture is largest driver of habitat loss and biodiversity decline globally including land conversion to agriculture use and management practices within agro-ecosystem. Conversion of Amazonians forest to agricultural land use result in the homogenization of soil bacterial community and fungal diversity as well as reduction in macro fauna agricultural intensification further reduces soil biodiversity particularly larger bodies organism .Reduced Tillage system typically host less soil Biodiversity than natural ecosystem .in addition to agricultural land use changes urbanization and suburbanization leads to distractions of soil habitat through building construction and pavement which results in soil sealing .habitat quality can be degraded through pollution including excessive nutrient input and invasive species.

Protecting Soil Biodiversity

Conversion of soil Biodiversity can be maintained with protecting natural areas sustainable land and soil resource management. Restoring the degraded ecosystem, low input based farming system, physical soil management .There is need to value nature and food and raising awareness among people and advocating for living soil. Save soil population they surely save our population. International convention on Biological Diversity was conducted by United Nations like the Cartagena protocol on bio-safety. Nagoya protocol related to genetic

resources Aichi Biodiversity Target (2011-2020) and post 2020 global Biodiversity framework are also being planned. Current policies and implementation of green cities are being promoted for human health and sustainable agriculture.

Conclusion

Soil Biodiversity is critical resource for the sustainability of agriculture and the survival of human being, but the poor land management and deforestation degradations, pollution, desertification and urbanization threaten the loss of soil Biodiversity in the dynamic context of climatic changes scenario. Sustainable management and conservation of soil biodiversity are important for sustainable agro ecosystem and environmental safety.

