Biodiversity of Soil Microorganism and Sustainable Development with reference to Agriculture.

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Abstract: Biodiversity supports key economic activity and jobs in diverse sectors such as agriculture, fisheries, forestry, pharmaceuticals, pulp and paper, cosmetics, horticulture, construction, and biotechnology. The green revolution apart from introducing the high yielding varieties, mechanization of farming practices and irrigation also responsible for the indiscriminate use of inorganic fertilizers and pesticides that have rendered the soil dead. This study has been undertaken to draw attention to the need, to help promote the adoption of strategies that enhance the important roles and functions of soil biodiversity for sustainable and productive agriculture and to encourage integrated soil management approaches building on available information and knowledge, expertise, technologies, progress, and opportunities

***Index Terms* – Microorganisms, soil fertility, organic matter, sustainable, ecosystem**

Introduction: Biodiversity, the variety of life on earth, is essential for sustainable development and human well-being. Biodiversity plays a very important role in global and local economies. The production of food depends on biodiversity and the services provided by ecosystems. There are thousands of different crop varieties and animal breeds that form the rich genetic pool of species. Biodiversity is also the basis for soil fertility, pollination, pest control, and all aspects important for producing food.

The green revolution apart from introducing the high yielding varieties, mechanization of farming practices, and irrigation also responsible for the indiscriminate use of inorganic fertilizers and pesticides that have not only rendered the soil dead but also contaminated the water bodies and leached into the groundwater. Various organizations are working towards creating awareness and motivating farmers to take up organic farming. Though there is some awareness among the farmers regarding organic farming the availability of organic matter that suffices the extent of cultivable land is an issue of concern. The rapid composting method that intends to convert degradable waste may perhaps be helpful to a certain extent.

Data and Sources of Data

The data is based on the participation in programs and discussions with the officials of NGOs - AME (Agriculture Man Ecology) at Madanapalli, Spandana at Palamner, Chaithanya at Kothakota, Jaimangali sub-watershed of Sujala watershed project at Madhugiri, and officials of the Department of Agriculture. Secondary data from organizations - AME foundation, LEISA India, and participating in workshops, farmer field schools (FFS), and participatory technology development programs (PTD) organized by AME.

Ecosystems function as natural water infrastructure, costing less than technological solutions. Forests protect water supplies, wetlands regulate floods, and healthy soils increase water and nutrient availability for crops and help reduce off-farm impacts. If sustainable development is to be achieved all developmental projects must be assessed on a holistic basis, considering their wider environmental and socio-economic. Natural resources and environmental stocks have already been severely reduced by economic growth. Some of the threats to biodiversity are Degradation, fragmentation, loss of habitat, spreading of invasive species, unsustainable use of natural resources, change of Climate, inappropriate fire regimes, and changes within the aquatic environment and water flows.

Sustainable development is defined in many ways. The World Conservation Organization defines Sustainable development as "improving the quality of human life while living within the carrying capacity of supporting ecosystem". In one of the reports of the United Nations sustainable development is said to be the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development is based on economic wealth, social equity, and environmental health. Sustainable development would not be possible if biodiversity is not conserved, and the natural resources are utilized intelligently and reused/recycled as far as possible. Biodiversity is the key component of environmental health leading to sustainable development.

Biodiversity is the foundation for sustainable development availability for crops and help reduce off-farm impacts. Biodiversity and ecosystem functioning provide goods and services essential for human health – including nutrients, clean air and water, and regulation of pests and vector-based diseases. Biodiversity is essential for the regulation of the immune response. Biodiversity is the basis of traditional medicine, and many top-ranking global prescription drugs contain components derived from plant extracts. It is the basis for sustainable livelihoods.

Ecosystem processes are often ignored and are not generally valued as part of the economy until they cease to function. Ecosystem services are the processes provided by nature to support human life. For example, Pollination, decomposition of waste, water purification, renewal of soil fertility, and moderation of floods. When economic value is assigned to these services, it becomes very high. For example, insect pollinators help produce many commercially important fruits such as almonds, melons, blueberries, and apples. The global economic value of pollination services performed by insects is remarkable.

Sustainable use of natural resources and ecosystems, including oceans and forests, can be achieved by conservation, management, and designing of production and consumptive patterns that ensure natural resources are made available for present generations without compromising the needs of future generations.

The management of agricultural ecosystems is an essential part of any overall strategy for biodiversity conservation. Moreover, the productive management of agricultural biodiversity is the key to meeting future food needs while also maintaining or enhancing the other goods and services provided by agricultural ecosystems. Better use of crop and livestock genetic resources is the key to achieving sustainable increases in food production, not only through breeding enhanced varieties and breeds, but also through a more intelligent deployment of genetic diversity in the field to reduce pest and disease outbreaks; Wider application of integrated pest management and of other approaches for the management of the components of biodiversity in agricultural ecosystems – such as pollinators, soil biota and the natural enemies of pests and diseases – contribute to productivity increases and reduce the use of external inputs at the same time.

Microorganisms constitute a cosmopolitan, extensive and diverse assemblage of morphologically and physiologically distinct organisms such as bacteria, viruses, protests, fungi, nematodes etc. that provide their habitats functional and ecological characteristics. Most microbes are also associated with plants and animals, not only as pathogens but as associative organisms as well that mutually benefit each other.

Microbial diversity poses great complexity, divergence and variability at different levels of biological parameters, especially in terms of genetic variability within taxonomic groups (genera and species), number of species in confined region, relative abundance of taxon and functional groups in communities. The patterns of microbial diversity are also obscure and therefore, estimating prokaryote diversity in natural ecosystems is a priority in current ecological research. Other important aspects to be addressed are the range of the processes, complexities of the interactions, and final benefits (functional aspects) of the whole community-level characterization to the plant, soil, and other organisms living together.

The area of soil surrounding the root zone is a unique place of physical, biochemical, molecular, and ecological interface through which the roots and microbes in the surroundings gain their nutrition and health supplements. This zone, the so-called rhizosphere is supposed to be self-regulatory by secreting/excreting numerous chemicals in the surrounding soils, which, then attracts of many microbial communities to survive there, and in return, keep plants healthy. Microorganisms form a vibrant living community in the soil contributing to several nutrient transformations. They are involved in organic matter decomposition, N2 - fixation, solubilization, and immobilization of several major and minor nutrients. Microbes also play an important role in soil structure maintenance, soil-borne disease control, and plant growth promotion through the secretion of hormones.

Microorganisms are involved in several biochemical processes that contribute to improved plant nutrient availability. These include mineralization, nitrogen fixation, nitrification/ denitrification, phosphate solubilization, antibiosis, siderophores production, plant growth regulation and induced resistance.

The spread of Green Revolution agriculture affected both agricultural biodiversity and wild biodiversity. There is little disagreement that the Green Revolution acted to reduce agricultural biodiversity, as it relied on just a few high-yield varieties of each crop. This has led to concerns about the susceptibility of a food supply to pathogens that cannot be controlled by agrochemicals, as well as the permanent loss of many valuable genetic traits bred into traditional varieties over thousands of years. The Green Revolution has been criticized for an agricultural model that relied on a few staple and market-profitable crops, and pursuing a model that limited biodiversity.
Healthy soils contain enormous numbers of diverse living organisms and are assembled in complex and varied communities. They range from the varieties of invisible microbes, bacteria, and fungi to the more familiar macro-fauna such as earthworms and termites. Plant roots can also be considered soil organisms given their symbiotic relationships and interactions with other soil components. These diverse organisms interact with one another and with the various plants and animals in the ecosystem, forming a complex web of biological activity. Environmental factors, such as temperature, moisture, and acidity, as well as anthropogenic actions, in particular, agricultural and forestry management practices, affect to different extents soil biological communities and their functions.

Soil and its living organisms are an integral part of agricultural and forestry ecosystems, playing a critical role in maintaining soil health, ecosystem functions, and productivity. Each organism has a specific role in the complex web of life in the soil. The activities of certain organisms affect soil structure - especially the worms and termites - by mixing soil horizons and organic matter and increasing porosity. This directly determines resilience to soil erosion and the availability of the soil profile to plants. The functions of soil biota are central to decomposition processes and nutrient cycling. 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 organisms can be detrimental to plant growth, for example, the buildup of nematodes under certain cropping practices. However, they can also protect crops from pest and disease outbreaks through biological control and reduced susceptibility.
The activities of certain organisms determine the carbon cycle - the rates of carbon sequestration and gaseous emissions and soil organic matter transformation. Plant roots, through their interactions with other soil components and symbiotic relationships, especially *Rhizobium* bacteria and *Mycorrhiza*, play a key role in the uptake of nutrients and water, and contribute, through their growth and biomass, to soil quality and

organic matter content. Certain soil organisms can also be used to reduce or eliminate environmental hazards resulting from accumulation of toxic chemicals or other hazardous wastes.
The interacting functions of soil organisms and the effects of human activities in managing land for agriculture and forestry affect soil health and quality. Soil quality is the capacity of a specific kind of soil to function, within natural or managed ecosystems boundaries, to sustain plant and animal production, maintain or enhance water and air quality, and support human health and habitation. The concept of soil health includes the ecological attributes of the soil, which have implications beyond its quality or capacity to produce a particular crop. These attributes are chiefly those associated with the soil biota: its diversity, its food web structure, its activity and the range of functions it performs. Soil biodiversity as such, may not be a soil property that is critical to produce a given crop, but it is a property that may be vital for the continued capacity of the soil to support that crop.

Of primary importance is the contribution of soil organisms to a wide range of essential services and to the sustainable function of all ecosystems: by acting as the primary driving agents of nutrient cycling, regulating the dynamics of soil organic matter, soil carbon sequestration and greenhouse gas emission, modifying soil physical structure and water regimes, enhancing the amount and efficiency of nutrient acquisition by the vegetation and enhancing plant health. These services are not only essential to the functioning of natural ecosystems but constitute an important resource for agricultural production and food security as well as the sustainable management of agricultural systems.

Some of the plant species are known for producing organic material to improve soil quality. These species are nitrogen fixers that also produce large amounts of biomass. Species like Cajanus cajan, Glyricidia sepium, Sesbenia sps, Albizzia sps and cassia semeia are few examples some of which can also be grown on bunds of the farms. Apart from these species like *Dolichos lab lab, clitorea ternate*, *Macrotyloma uniflorum* can also be grown after the crop removal and ploughed into the soil for green manuring.

Sustainable agriculture that also includes forestry involves the 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 dependent upon maintaining the health of the living biota that provide critical processes and ecosystem services. However, current technologies and development support for increased agricultural production have largely ignored this vital management component. Soil organisms have been shown to be potentially useful indicators of soil health because they respond to soil management in time scales that are relevant to land management. For example, changes in microbial biomass, or abundance of selected functional groups of organisms (e.g. Mycorrhizal fungi), may be detected well in advance of changes in soil organic matter content or other soil physical or chemical properties.

Conclusion: The conservation of healthy communities of soil biota and cautious use of specific soil organisms through biological soil management can be used to maintain and enhance soil fertility and ensure productive and sustainable agricultural systems. On the other hand, the consequences of neglecting or abusing soil life will weaken soil functions and contribute to greater loss of fertile lands and an over-reliance on chemical means for maintaining agricultural production. This important relationship between soil life and agricultural productivity emphasises the need to bring together experience and ideas from farmers’ experiences and modern science on the management of agricultural biodiversity in agricultural ecosystems.

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