National Seminar on

SOCIO - ENVIRONMENTAL ISSUES AND SUSTAINABLE DEVELOPMENT

EDITOR

Dr. P. Brahmaji Rao

UGC Sponsored

Two Day National Seminar

on

Socio-Environmental Issues and Sustainable Development

6th & 7th March, 2023

ज्ञान-विज्ञान विमुक्तये

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MESSAGE

Socio Environmental issues obviously speak for sustainable development. "Environmental Justice' is the Social Justice and it is the clarion call of all the nations in the world. Happy to know that the Dept. of Environmental Sciences is organising two day national seminar on 'Socio-Environmental Issues and Sustainable Development' during 6^{th} & 7^{th} March, 2023.

I Congratulate the Director of the Seminar and the HoD for initiating this responsibility and I wish the seminar grand success.

(Prof. RAJA SEKHAR, P)

Editorial

The Department of Environmental Sciences, Acharya Nagarjuna University, Guntur is organizing two day **National Seminar on Socio-Environmental issues and Sustainable Development on 6th & 7th March'2023** which is sponsored by University Grants Commission(UGC), New Delhi. The unplanned haphazard growth and development of cities across the country might be fuelling the devastation due to natural calamities including impact of environmental degradation, climate change and loss of bio-diversity. Our Department has been organizing such events and days of significance on regular basis on the themes of climate, waste management, environment health and disaster management etc.

The objective of the conference is to have discussion on issues and challenges of Socio-economic, Environmental and Sustainable development in the era of Global warming and Climate change etc including discussion on policies of environmental resilience, reduction of Carbon footprints, SLWM, Green trading and emerging technologies for promotion of renewable resources etc. Further, these consultation/deliberations will be given a good opportunity for academicians, practitioners and researchers.

Climate change, pollution and nature loss, directly impacts a broad range of rights of food, health, development and the very right to life. Universal Declaration of Human Rights of gender, are endowed by virtue of their humanity and human dignity. However, climate change, biodiversity and habitat loss, and pollution threats to destroy lives, economies, and entire cultures and societies. These devastating and interlocking environmental emergencies harm human rights, including the rights to life, health, food, water and sanitation, culture, self-determination, and many others, with differential effects on the basis of gender.

Protection of the environment is necessary enabling condition for the effective enjoyment of human rights enshrined in treaties including the human right to a safe, clean, healthy and sustainable environment contained in the constitution, laws, policies and regional agreements adopted by more than 15 states. Article 21 of the Indian constitution provides for the fundamental right of life. Fulfilling these rights requires ensuring a safe and stable climate, the conservation of biodiversity and ecosystems. Socio-environmental Issues and Sustainable Development is a key concept that provides an answer to the question of how humankind coexists with the earth and with nature. Organizers hope that the discussions and deliberations during the seminar will come up with concrete action plans and remedial measures to some extent to resolve the issue of conflict between socio-environmental issues and sustainable development.

Editor & Seminar Director

Dr. P. BRAHMAJI RAO

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A Review on Improving Soil Quality for Sustainable Agriculture Production

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Abstract

Soil fertility is the ability of soil to sustain plant growth and optimize crop yield.Advancing food security and environmental sustainability in farming systems requires an integrated soil fertility management approach that maximizes crop production, while minimizing the mining of soil nutrient reserves and the degradation of the physical and chemical properties of soil can lead to land degradation, including soil erosion. This can be enhanced through use of fertilizers,organic inputs, crop rotation with legumes and the use of improved germplasm, combined with the knowledge on how to adapt these practices to local conditions.

The various chemical, physical, and biological properties of a soil interact in complex ways that determine its capacity to produce healthy and nutritious food. The integration of these properties and the resulting level of productivity is referred to as "soil quality". Soil quality is often adversely affected by soil degradative processes such as soil erosion, salinization, and desertification. There is a growing consensus that the concept of soil quality should not be limited to soil productivity, but should be extended to include the attributes of environmental quality, human and animal health, and food safety and quality. In fact, our knowledge of how soil microorganisms affect food quality, environmental quality and human and animal health is rather limited. Future research should seek to identify, and quantify reliable and meaningful biological ecological indicators of soil quality, including total species diversity, or genetic diversity of beneficial soil microorganisms and how they relate to the sustainability of agricultural systems.

Key words: Soil fertility, Soilquality, Soilproductivity, Sustainable practices

Introduction:

India has about 160 million hectares of arable land. But nearly sixty percent of this soil is labelled as distressed soil. That means in another twenty five to thirty years' time, we may not be able to grow the food that we need in this Nation.The most incredible is that without any technology, just with traditional knowledge, our farmers have been feeding over one billion people all these years. But unfortunately,the farming community is not given much importance, where farmers do not want their children to go into farming. On one hand, we are losing the quality of the soil, and on another, farmers are not putting their next generation into farming. It means in another 25 years we are definitely headed by a major crisis.

People have come to understand that agriculture should not only be high yielding, but alsosustainable (Reynolds and Borlaug 2006). Farmers concerned about the environmental sustainabilityof their crop production systems combined with ever-increasing production costs have begun to adoptand adapt improved system management practices which lead to the ultimate vision of sustainableagriculture.

Conservation agriculture has been proposed as a widely adapted set of management principles that can assure more sustainable agricultural production.

Rich Soil – The Most Precious Gift

The only source of water we have in a tropical nation is the monsoon. The monsoon comes down upon us over a span of forty-five to sixty days. This water that comes down in sixty days, have to be preserved in the soil for 365 days to feed the rivers, lakes and aquifiers.The only reason why water stays in the soil is because there is rich organic content. The leaves of the trees and animal waste are the source of this organic content. Where there are no trees and animal waste, the soil cannot hold water- it will flow away. Hence without substantial vegetation this cannot be possible.

Importance of soil

It preserves clean water and helps regulate the climate. Soil degradation reduces agricultural yields and threatens farmers' livelihoods. Soil that has been leached of its nutrients cannot support crops, or plants that prevent desertification.

Soil provides nutrients, water and minerals to plants and trees, stores carbon and is home to billions of insects, small animals, bacteria and many other micro-organisms.

Soil provides ecosystem services critical for life: soil acts as a water filter and a growing medium; provides habitat for billions of organisms, contributing to biodiversity; and supplies most of the antibiotics used to fight diseases.

Soil filters the water we drink, grows the food we eat, and captures the carbon dioxide that causes climate change. Soil is the largest carbon sink after the ocean and holds more carbon than all terrestrial plant life on the plan

These soil functions include air quality and composition, temperature regulation, carbon and nutrient cycling, water cycling and quality, natural "waste" (decomposition) treatment and recycling, and habitat for most living things and their food.

Soil provides a foothold for the plant roots; as a result, plants can withstand extreme conditions throughout their growth. The soil dissolves essential minerals and nutrients in the soil water. Soil water is important for photosynthesis (a process that results in the manufacture of sugars).Soil the real wealth of the Nationis depleting at an alarming rate. This will lead to a drop in nourishment levels and water crisis

Causes and Effects of Soil Degradation

Soil degradation is mostly due to decline in soil fertility, adverse changes in alkalinity, acidity or salinity, extreme flooding, use of toxic soil pollutants, erosion, and deterioration of the soil's structural condition. These elements contribute to a significant amount of soil quality depreciation annually. Excessive soil degradation thus gives rise to immediate and long-term impacts.

Physical factors

There are several physical factors like rainfall, surface runoff, floods, wind erosion, tillage, and mass movements that change the natural composition and structure of the soil and result in the loss of fertile top spoil thereby declining soil quality.

All these physical factors produce different types of soil erosion (mainly water and wind erosion) and soil detachment actions, and their resultant physical forces eventually change the composition and structure of the soil by wearing away the soil's top layer as well as organic matter. In the long-term, the physical forces and weathering processes lead to the decline in soil fertility and adverse changes in the soil's composition/structure.

2. Biological Factors

Biological factors refer to the human and plant activities that tend to reduce the quality of the soil. Some bacteria and fungi overgrowth in an area can highly impact the microbial activity of the soil through biochemical reactions, which reduces crop yield and the suitability of soil productivity capacity. .Human activities such as poor farming practices may also deplete soil nutrients thus diminishing soil fertility. The biological factors affect mainly lessens the microbial activity of the soil.

3. Chemical Factors

The reduction of soil nutrients because of alkalinity or acidity or water are the chemical components of soil degradation. They bring alterations in the soil's chemical property that determines nutrient availability.It is mainly caused by salt build-up and leaching of nutrients which corrupt the quality of soil by creating undesirable changes in the essential soil chemical ingredients. These chemical factors normally bring forth the irreversible loss of soil nutrients and production capacities such as the hardening of iron and aluminium-rich clay soils into hardpans.

Misuse or excess use of fertilizers

The excessive use and the misuse of pesticides and chemical fertilizers kill organisms that assist in binding the soil together. Most agricultural practices involving the use of fertilizers and pesticides often entail misuse or excessive application, thereby contributing to the killing of soil's beneficial bacteria and other micro-organisms that help in soil formation.

The complex forms of the fertilizer's chemicals are also responsible for denaturing essential soil minerals, giving rise to nutrient losses from the soil. Therefore, the misuse or excessive use of fertilizers increases the rate of soil degradation by destroying the soil's biological activity and builds up of toxicities through incorrect fertilizer use.

6. Industrial and Mining activities

Soil is chiefly polluted by industrial and mining activities. As an example, mining destroys crop cover and releases a myriad of toxic chemicals such as mercury into the soil thereby poisoning it and rendering it unproductive for any other purpose.

Industrial activities, on the other hand, release toxic effluents and material wastes into the atmosphere, land, rivers, and groundwater that eventually pollute the soil and as such, it impacts on soil quality. Altogether, industrial and mining activities degrade the soil's physical, chemical, and biological properties.

How can soil revitalization help sustainable agriculture?

But if you want to fix the soil that you have destroyed, it will take 15-25 years if you go at it aggressively. If you do it without much interest, it will take 40-50 years before you can get the soil to a certain level. If the soil is in a bad condition for that long that means two to three generations will go through terrible states of life.

Methods of soil revitalization

Some ways of restoring damaged soil include:

Use of organic farming techniques: Organic farming involves the application of natural means in farming, to reduce harm to the environment. Some organic farming techniques that help restore the soil include use of green manure (uprooted or sown crop parts incorporated or left on topsoil), cover crops, crop rotation and organic compost.

Green manure and cover crops: Green manures and cover crops serve as mulch to the soil preventing the soil from wind/water erosion and moisture loss. They also increase the soil organic matter content as they decompose in the soil. Green manure and cover crops that are legumes (plants which produce seeds in pods) have nitrogen fixing ability. The nitrogen fixing bacteria in their root nodules help capture nitrogen from the atmosphere.

Organic compost: Organic compost is a generally cheaper method of fertilizing the soils compared to inorganic fertilizers. Compost is a mixture of decomposed plant parts and animal waste. The key benefit of composting is that it increases soil organic matter content. Organic matter improves the soil fertility, the soil structure and its water holding capacity. It also sequesters carbon in the soil. The use of compost reduces use of chemical fertilizers

Crop rotation: This is a farming practice which involves growing different types of crops in one location sequentially. This practice reduces soil erosion, increases the soil fertility and subsequently crop yield.

Soil remediation: Soil remediation involves the removal of harmful contaminants such as, heavy metals, sewage sludge, coal tar, carcinogenic hydrocarbons, liquors and petroleum from soils. Soil remediation can be achieved using biological techniques like

Phytoremediation: The use of plants to remove contaminants from soils or to degrade contaminants to a lesser toxic form. Some plants have the ability to extract contaminants from soils. This process is called phytoextraction.Some other techniques are phytostabilization, phytotransformation and phytostimulation

Bioaugmentation: This is the introduction of genetically modified micro organisms into contaminated soils with the aim of degrading contaminants. The efficiency of this technique depends on a number of factors, some of which are the physico-chemical properties of the soil and the ability of the introduced micro organisms to compete successfully with the indigenous soil micro flora.

Land-based treatments: This includes techniques like land farming and composting. In land farming, contaminated soils are taken to land farming sites and continuously overturned and tilled to allow aeration. In composting, micro organisms present in organic material are used to biodegrade soil contaminants

Desalinization: Soil salinization occurs when high levels of soluble salts accumulate in the root zone. Saline soils frustrate crop growth and reduce crop yieldSuitable technologies such as reverse osmosis and electrodialysis to provide desalinated water for agriculture are currently available and can provide water for agriculture, but at a cost that is currently more expensive than that generally used for agricultural purposes. The adaptation of desalination to supply water for agriculture may be cost effective; especially when applied to high value crops where the cost of the water is not a critical issue.

Agro forestry

Agro forestry involves combining tree plantation with another enterprise, such as grazing animals, production of mushrooms, or managing woodlot for diversity of special forest products. Agro forestry system can produce firewood, biomass, feedstocks, pine straw mulch, fodder for grazing animals, and other traditional forestry products.

Many agriculture practices disturb the balance of nature. These result in loss of soil through soil erosion and also cause the reduction of soil fertility. Intensive cultivation without either natural or artificial argumentation of nutrients can only exhaust soil fertility. To overcome this problem nowadays farmers are adapting to agro forestry. Agro forestry is a farming system that integrates crops or livestock with trees and shrubs. The resulting biological interaction provides multiple benefits including diverse field income sources, increased biological production, better water quality, and improved habitat for both human and wildlife. Farmers adopt agro forestry practices for two reasons; i) they want to increase income stability and ii) they want to improve the management of natural resources under their care.

Constructing Dams:

One of the scientific methods to check soil erosion which happens maximum by river floods can be avoided by constructing dams across the rivers. Water speed can be checked and it considerably saves soil from erosion.

Use of Early Maturing Varieties:

Primary budding varieties of crops take really very less time to mature. Thus putting lesser pressure on the soil can help in reducing the soil erosion.

Ploughing the Land in Right Direction:

Ploughing the land in a perpendicular direction to wind direction. This also reduces wind velocity and protects the topsoil from erosion.

Soil Quality Index:

While some of the indicators of soil quality may be sensitive to change, others may be more subtle. The overlying question is whether we can measure and quantify these indicators and develop them into a Soil Quality Index that can be used reliably to monitor and predict the impact of farming systems and management practices on soil productivity, environmental quality, food safety and quality, and human and animal health. Moreover, can these indices provide an early indication of soil degradation and the need for remedial measures, and characterize changes in soil properties that would reflect the extent of rehabilitation or regeneration of degraded soils? The ultimate goal is to develop a mathematical relationship or model that could quantify the various attributes of soil quality, and from it derive one or more indexes for simulation and prediction.

Soil Quality Index = f (SP, P, E, H, ER, BD, FQ, MI)

SP = Soil Properties

P = Potential Productivity

E = Environmental Factors

H = Health (Human/Animal)

ER = Erodibility

BD = Biological Diversity

FQ = Food Quality/Safety

MI = Management Inputs

We would have to determine the interaction of these indicators and the relative weight of each. Much valuable information is already available from research on benchmark soils and long-term tillage and fertility trials. We can also speculate on how soil quality indices might be used, including the following:

- Assess the impact of management practices on soil degradation and soil conservation.
- Assess the accrued benefits on highly erodible lands under the Conservation Reserve
- Program that was authorized by the 1985 Farm Bill.
- Provide a basis for conservation compliance.
- Establish the loan value and price of land.
- Establish a more realistic base for tax assessment and tax credit.
- Assess the impact of management practices on human and animal health.
- Assess the impact of management practices on food safety and quality.

Relationship of Soil Quality to Alternative Agriculture and Sustainable Agriculture

Alternative Agriculture: The Strategy

The National Research Council (1989) defined alternative agriculture as a system of food and fibre production that applies management skills and information to reduce costs, improve efficiency, and maintain production levels through such practices and principles as:

- Crop rotations instead of monocultures
- Integrated crop/livestock systems
- Nitrogen fixing legumes
- Integrated pest management
- Conservation tillage
- Integrated nutrient management
- Recycling of on-farm wastes as soil conditioners and bio fertilizers

A U.S. House of Representatives Report (1988) considered low-input or alternative agricultural practices as promising strategies for preventing groundwater pollution and lowering farmer's production costs. The report implied that these goals could be achieved by reducing, or largely excluding, the use of chemical fertilizers and pesticides.

Sustainable Agriculture: The Goal

Sustainable agriculture is increasingly viewed as a long-term goal that seeks to overcome problems and constraints that confront the economic viability, environmental soundness, and social acceptance of agricultural production systems both in the U.S. and worldwide. Although there are many definitions of sustainable agriculture, most of them encompass the same elements: productivity, profitability, conservation, health, safety, and the environment. The U.S. Congress (1990) in drafting the "Food, Agriculture, Conservation, and Trade Act of

1990"-PL 101-624 (better known as the 1990 Farm Bill) defined sustainable agriculture as an integrated system of plant and animal production practices, having site-specific application, that over the long-run will do the following:

- Satisfy human food and fibre needs
- Enhance environmental quality and the natural resource base
- Make efficient use of non-renewable resources
- Utilize natural biological cycles and controls
- Improve the economic viability of farming systems
- Enhance the quality of life for farmers and society as a whole.

Conclusion

There is a strong consensus that the establishment of a global network for monitoring, assessing, improving, and restoring the quality of degraded soils is a logical and appropriate goal. Research is needed to quantify the indicators or attributes of soil quality into indexes that can accurately and reliably characterize the relative state of soil quality as affected by management practices and environmental stresses. The best indicator of soil quality probably will differ according to agroecological zones, agroclimatic factors, and farming systems. It is likely that soil quality indicators would be quite different for paddy rice compared with crops grown in well-drained soils. Conservation of agriculture improves soil aggregation compared to conventional tillage systems and zerotillage without retention of sufficient crop residues in a wide variety of soils and agro-ecologicalconditions. A high priority for future research is to identify and quantify reliable and meaningful biological/ecological indicators of soil quality, including total species diversity and genetic diversity of beneficial soil microorganisms. We need to know how these indicators are affected by management practices, and how they relate to the productivity, stability and sustainability of farming systems

The needed yield increases, production stability, reduced risks and environmental sustainabilitycan only be achieved through management practices that result in an increased soil quality incombination with improved crop varieties.

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Dr. Brahmaji Rao Pandu, Ph.D., is an Associate Professor at Acharya Nagarjuna University and the Head of the Departments of Environmental Sciences and Education. He published more than 146 articles in international and national journals and published five books on ecology and biodiversity. He is a senior faculty member in the environmental sciences department with 22 years of teaching and research experience. He guides doctoral students in conducting research in various areas of ecological studies: mangrove ecology, biodiversity conservation, water quality and pollution aspects, environmental toxicology, environmental impact assessment, and health. Under his supervision, 17 Doctorates and 5 M.Phil. degrees were awarded. He delivered more than 300 key note lectures as a resource person for national and international seminars, workshops, and awareness programmes. He has received the Best Research Paper Award for the International Conference on Environmental Science and Technology, organised by the American Academy of Sciences in Houston, Texas.

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