

ENVIRONMENTAL IMPACT OF FOOD PRODUCTION AND CONSUMPTION

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Summary

Agricultural food production and consumption covers activities ranging from agriculture to food consumption. Pollution and food contamination related to the use of production technologies and processes, as well as from the use of products aimed at increasing agricultural yields and facilitating food conservation, have significant environmental consequences. There are a number of important issues in agricultural food production and consumption that have significant impacts on the environment and human health such as soil bio diversity, desertification, water use and water pollution, energy, climate change, chemicals, food safety and biotechnology.

Soil organisms contribute a wide range of essential services 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, modifying soil physical structure and water regimes. They play a critical role in maintaining soil health, ecosystem functions and production. . In addition to vegetation deterioration, erosion, and salinization, desertification effects can be seen in loss of soil fertility, soil compaction, and soil crusting. Soil conditions must be made favorable for plant growth by, for example, mulching. Both primary food production and food processing are critically dependent upon reliable water supply and adequate water quality. Both types of activities can also have serious effects on water resources – a critical factor in sustainable agri-food production. The success of agricultural production is measured by the amount of solar energy that is captured and converted into food per unit land area as a result of manipulating, plant, land, water, and other resources. Special emphasis was placed on the promotion of sustainable forms of agriculture, methane fermentation,

manure management, rice cultivation and land use changes once farming was realized as an important factor in climate change, Many of the negative environmental effects of agri-food production are associated with chemical use especially that of mineral fertilizers and pesticides. Modern biotech has great potential to contribute to human well-being. Everyday something new is being discovered in the biotech field that could change the way we think about foods.

1. Introduction

Agricultural food production and consumption covers activities ranging from agriculture to food consumption. Depletion and contamination of natural resources occurs throughout the agri-food chain. Pollution and food contamination related to the use of production technologies and processes, as well as from the use of products aimed at increasing agricultural yields and facilitating food conservation, have significant environmental consequences. There are a number of important factors in agricultural food production and consumption that have significant impacts on the environment and human health. These factors include: soil biodiversity in agricultural food production, water use and water pollution, energy use, climate change, chemicals usage, desertification, and food safety and biotechnology

2. Soil Bio- diversity in Agricultural Food Production

The ever-increasing population growth and demand for food has resulted in the need for sustainable agriculture and viable agricultural systems. Soil is a dynamic, living matrix that is an essential part of the terrestrial ecosystem. It is a critical resource not only to agricultural production and food security but also to the maintenance of most life processes. Soils contain enormous numbers of diverse living organisms assembled in complex and varied communities. Soil biodiversity reflects the variability among living organisms in the soil – ranging from the myriad of invisible microbes, bacteria and fungi to the more familiar macro-fauna such as earthworms and termites. Plant roots can also be considered as soil organisms in view of 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. Soil organisms contribute a wide range of essential services 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, modifying soil physical structure and water regimes. Environmental factors, such as temperature, moisture and acidity, as well as anthropogenic actions, in particular, agricultural and forestry management practices, affect soil biological communities and their functions.

Soil organisms are an integral part of agricultural and forestry ecosystems. They play a critical role in maintaining soil health, ecosystem functions and production. Each organism has a specific role in the complex web of life in the soil [1,2]:

- The activities of certain organisms affect soil structure-especially the so –called soil engineers such as worms and termites-through mixing soil horizons and organic matter and increasing porosity.

- 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.
- Certain soil organisms can be detrimental to plant growth, for example, the build up of nematodes under certain cropping practices.
- 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 to the maintenance of soil porosity and organic matter content, through their growth and biomass.
- They can also be used to reduce or eliminate environmental hazards resulting from accumulations of toxic chemicals or other hazardous wastes. This action is known as bioremediation.

Sustainable agriculture (including 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. Improvement in agricultural sustainability requires, alongside effective water and crop management, the optimal use and management of soil fertility and soil physical properties. Management practices alter soil conditions and the soil community of micro, meso and macro organisms. The structure of soil communities is largely determined by the ecosystem characteristics and land use systems. For example, soil compaction, poor vegetation and the lack of presence of plant litter on the soil surface results in reducing the number of soil arthropods. Management strategies, including tillage, crop rotations and use of plant residues and manure, change soil habitats and the food web and alter soil quality, or the capacity of the soil to perform its functions. The goal of efficient agriculture is to develop agro-ecosystems with minimal dependence on agrochemical and energy inputs, in which ecological interactions and synergy among biological components provide the mechanisms for the systems to sponsor their own soil fertility and crop production functions. The mix of soil organisms in the soil also partially determines soil resilience, the desirable ability of a given soil to recover its functions after a disturbance such as fire, compaction and tillage.

Farming communities are concerned with land management issues such as water availability to plants, access to sources of fuel and fodder, control of soil erosion and land degradation, especially avoiding soil nutrient depletion and pollution of air, soil and water resources. Nonetheless, farmers are driven not by environmental concerns, but by economics, by issues of costs and returns and efficiency in terms labor and energy and use of external inputs. The means to create a more favorable environment within the soil and soil biological community for crop production involves site specific decisions concerning crop selection and rotations, fertilizer and planting practices and crop residues. Soil biota can increase or reduce agricultural productivity depending on its composition and the effects of its different activities. Vice versa, farming practices modify soil life including the total number of organisms, the diversity of species and the activity of the individual organisms and the aggregate functions of soil biota.

Over the last few years, the concepts of Integrated Plant Nutrient Management (IPNM) and Integrated Soil Management have been gaining acceptance, moving away from a more sectoral and inputs-driven approach. Integrated plant nutrient management advocates the careful management of nutrient stocks and flows in a way that leads to profitable and sustained production. Integrated soil management emphasizes the management of nutrient flows, but also describes other important aspects of the soil complex, such as maintaining organic matter content, soil structure, moisture and biodiversity. Capturing all the benefits of soil biological activity for sustainable and productive agriculture requires a better understanding of the linkages among soil life and ecosystem functions and the impacts of human intervention. The complex interactions among soil, plant and animal life, environmental factors and human actions must be effectively managed as an integrated system. A collaborative effort among scientists and farmers is required for the better management of soil biological resources.

Improvement in soil biological management results in economic, environmental and food security benefits:

Economic benefits: Soil biological management results in reduction of input costs by enhancing resource use efficiency. Less fertilizer is required if nutrient cycling becomes more efficient and fewer pesticides are required where a diverse set of pest control organisms are active. Improvement in soil structure also improves the availability of water and nutrients to plants.

Environmental protection: Soil organisms filter and detoxify chemicals and absorb the excess nutrients that would otherwise become pollutants when they reach groundwater or surface water. The conservation and management of soil biota help to prevent pollution and land degradation, especially through minimizing the use of agro chemicals and maintaining soil structure. Excessive reduction in soil biodiversity, especially the loss of unique species with unique functions may result in catastrophic ecological effects leading to loss of agricultural productive capacity.

Food Security: Soil biological management can improve crop yield and quality, especially through controlling pests and diseases and enhancing plant growth. Belowground biodiversity determines resource use efficiency, as well as the sustainability and resilience of low-input agro-ecological systems to ensure food security.

The improved management of soil biota and its diversity contributes both to the needs of farmers, especially in maintaining productivity and increasing returns from labor and other inputs, and to national interests through maintaining a healthy and well functioning ecosystem in terms of water quality and preventing soil erosion and land degradation.

3. Water Use and Water Pollution

Agriculture accounts for 70% of all water use. Both primary food production and food processing are critically dependent upon reliable water supply and adequate water quality. Both types of activities can also have serious effects on water resources – a

critical factor in sustainable agri-food production. Hence, it's important that water is used efficiently for the agricultural process. Efficiency in the use of water for irrigation consists of various components and takes into account losses during storage, conveyance and application to irrigation plots. Identifying the various components and knowing what improvements can be made is essential to making the most effective use of this vital resource. Irrigation systems to apply the water can be fairly expensive, with annual costs ranging from several tens to several hundred U.S. dollars per hectare. Therefore, it is necessary to maximize other inputs for crop production, such as use of fertilizers and pesticides to keep the irrigation costs low.

Water resources are being depleted at a rapid rate, with water tables falling worldwide. Shortage of potable water and agriculture water supplies now affects more than one-quarter of the world's population, resulting in poor child and adult health and long-term damage to local economic viability. The Global Environment Outlook report on the state of global environment that is published every two years reported: "If the present consumption pattern continues, two out of every three persons on earth will live in water –stressed conditions by the year 2025" [1]. The situation demands for water conservation, as it is the key to efficient water use. Conservation makes water available for other beneficial uses. While simple in concept, application of conservation measures impact on economics, social patterns, and institutional arrangements for allocation of water, as well as on the nature of our needs for water.

Improper use of pesticides and fertilizers, poor management of animal manure, as well as inefficient practices in the food processing industry can all contribute to serious pollution of ground and surface waters. In excess levels, nutrients over stimulate the growth of aquatic plants and algae. Excessive growth of these types of organisms consequently clogs waterways, use up dissolved oxygen as they decompose, and block light to deeper waters. This, in turn, proves very harmful to aquatic organisms as it affects the respiration ability of fish and other invertebrates that reside in water. The pollution of rivers and streams with chemical contaminants has become one of the most crucial environmental problems within the 20th century. Waterborne chemical pollution entering rivers and streams cause tremendous amounts of destruction.

A particular emphasis should be placed on the development, utilization and protection of water in all developed and other developing regions. Water plays a central role in all aspects of life. Several organizations such as United Nations Food and Agriculture organization and the World Bank are involved in water resource management programs and also in the regional analysis and country profiles on water resource development.

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