

# AGRICULTURAL SUSTAINABILITY AND ITS ROLE IN FOOD SECURITY

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## ABSTRACT

The term "sustainable agriculture" cannot refer to a single method of crop production since agriculture is practiced in such a diverse range of environments, both climatically and culturally, which demand different approaches. The challenges facing agriculture in the future, much like those facing agriculture today, will vary greatly depending on the geopolitical and socioeconomic situations of certain regions and will have little to do with any one collection of technologies. The ability of farmland to produce food and other agricultural goods indefinitely while also having sustainable implications for the greater ecology is what is indicated by the phrase "sustainable agriculture." "Sustainable agriculture" is dependent on a variety of vital ecosystem services, some of which include the fertility of the soil, water for irrigation, genetic diversity, and pollinators. These ecosystem services need to be maintained so that agriculture does not have an intolerable impact on the environment as a whole. If nothing is done to promote environmentally sustainable agriculture and food security, the challenges will only become more severe. Only through the worldwide adoption of ecologically responsible farming techniques and the "green revolution" will it be possible to realize the goals of sustainable food production and food security.

*Keywords: Agriculture, Food Security, food production*

## INTRODUCTION

A cornerstone of food security is having access to sufficient quantities of safe and nutritious food that are within one's budget and meet one's dietary demands and food preferences. This condition is said to exist when all individuals, at all times, are in possession of this circumstance. This idea encompasses a number of important characteristics of food provisioning, including availability, stability, accessibility, and use. The ability of the agricultural sector to meet the ever-increasing demand for food is the first consideration to take into account. One of its subdomains is concerned with the agroclimatic factors that influence crop and pasture productivity. The traditional conceptions of food security consisted of uncomplicated acts such as national food production, food grain storage, national food self-sufficiency, and food help; nevertheless, the definition and scope of food security have grown throughout the course of history.

The vast majority of these were macro-indicators of food availability, which formed the basis of conventional early warning systems for famines. The widespread food insecurity that prevailed during this time period inspired the development of these organizations, which were based on the presumption that the situation could be improved by the managed distribution of national food stockpiles or through the provision of international food aid. The consequences of climate change, the degradation of land, and the dwindling availability of resources such as freshwater, phosphates, fossil fuels, and rich topsoil are adding to the problems already encountered by agriculture in satisfying the requirements of a fast-rising human population. There is a maximum capacity for the amount of space that may be utilized for the expansion of arable land, and it is anticipated that annual agricultural output will improve by less than one percent over the next few decades.

Growing populations drive up the need for food, while rising earnings and the dietary preferences of the middle class favor meat and other animal products, the production of which requires more space, water, and power.

## **Food Demand**

It is anticipated that demand for agricultural goods will continue uninterrupted into the year 2040 in order to fulfill the needs of a growing global population as well as rising earnings per capita. Agriculture has already begun to have a significant impact on the ecosystems of the earth. The destruction and loss of habitats are to blame for the deterioration of biodiversity. It is conceivable to increase food production by clearing land and making more extensive use of the croplands that are already in existence; however, the environmental consequences and potential trade-offs of these prospective expansion options are not known. The world is currently confronted with a triple whammy, which consists of the following challenges: feeding a growing population that is both wealthier and more discerning, while also preventing famine among the most vulnerable individuals on earth.

We need to make major changes to the food production, processing, distribution, and accessibility systems in order to solve this problem. The Industrial and Agricultural Revolutions of the 18th and 19th centuries and the Green Revolution of the 20th century will play crucial roles in raising global output, but they will be constrained like never before by the Earth's limited land, sea, and air. The Industrial Revolution, the Agricultural Revolution, and the Green Revolution all occurred between the 18th and 19th centuries.

## **OBJECTIVES**

1. The Study of Agricultural Sustainability and Its Role in Food Security
2. The Study of Agriculture Development for Sustainable Food Production and Security

Through the Green Revolution and Eco-Friendly Approaches

## **Causes of Food Production**

In recent years, most of the attention paid by the media to the problem of world hunger has been concentrated on the relationship between growing populations and increasing food requirements. The ever-increasing global population is one demographic factor that almost certainly has a role in the ongoing food crisis we are experiencing. As a consequence of urbanization and an increase in the world's population, agricultural land is becoming increasingly fragmented. However, countries that are among the world's most food-insecure tend to have high birth rates and rapid population growth, which makes it more challenging to meet the nutritional needs of everyone in the population.

The fast increase in the population of India, which accounts for around 60 percent of the total worldwide increase, is a crucial factor in the development of this trend. The country that is expanding its economy the quickest also has one of the highest rates of population growth in the world. Regardless of whether or not there is a shift in fertility rates, it is anticipated that the population will more than double over the course of the next several decades. This region has the greatest rate of food insecurity of any location in the world, with undernourishment affecting one out of every four people living here.

The agricultural production in Sub-Saharan Africa is the lowest of any area on the planet, and the region also has the worst poverty rate of any place on the planet. It is impossible to produce food without croplands and water supplies, yet both of these resources are becoming increasingly scarce as the human population continues to grow. Growing populations impose pressure on available land, which may entail agriculture taking up a greater portion of the land than is already accessible. This often involves causing damage to forest resources

and overusing agriculture to an excessive degree. Even if people living in cities have access to a wider variety of food alternatives, their ability to assure their own nutritional well-being in the absence of a farm is contingent on the amount of spare income they have at their disposal. Every single day, the need for food on a worldwide scale increases even further. The number of people living on this planet has increased by almost a factor of four throughout the course of the last century.

## **Land Acquisition and Agriculture**

Land is the most important medium for the production of food, the supply of housing, the provision of shelter, the production of utilities, the manufacture of utilities, and the building of institutional support for the fundamental demands of modern civilization. The land that a farmer owns is their most significant asset, both in terms of increasing their agricultural production and keeping it at the same level. In addition, land requirements for other purposes, such as the growth of infrastructure, urbanization, the generation of bioenergy, and the conservation of biodiversity, will create rising limits on the total land area available for agricultural production. This is because these other reasons demand land. Agricultural land is in high demand for a wide range of applications, including but not limited to urban, residential, industrial, commercial, recreational, educational, and recreational uses. These are just some of the reasons why agricultural property is in such demand. Farmland's demand is heavily influenced by the price per acre that it commands on the market. If the price of agricultural land is low, then there will be a larger demand for it, but if it is high, then the opposite will be true. As a result, there is a negative correlation between the demand for farmland and its price.

## **Climate Change**

Climate change has the potential to have a large influence on agricultural production, regardless of whether it is driven by natural occurrences or by the actions of humans. It is anticipated that human activities such as the emission of greenhouse gases, industrial pollution, and deforestation will have direct effects on crop production systems used for food, feed, or fodder, animal health, the pattern of commerce in food and food products, and the balance of trade in food and food products. All of these aspects of the food and food product trade will be directly impacted. All of these factors will contribute to the acceleration of climate change. Both the previously observed differential pattern of warming and the contemporaneous variations in precipitation are altered as a consequence of these impacts. There is a possibility that climate change will have an impact on each of the four aspects that make up food security. As a result, the global climate change that is occurring in the latter part of the twenty-first century poses an additional obstacle that must be overcome by the farming industry. The rise in atmospheric carbon dioxide levels and global temperatures that will accompany climate change will have far-reaching consequences for the ecosystem. These effects will include changes to precipitation patterns, water availability, soil erosion, and agricultural yields in various locations. This is because of the influence that climate has on each and every one of these different factors. It is difficult to speculate on the overall repercussions of the multiple transitions that are now taking place as a result of climate change since the impacts of climate change vary greatly from site to location.

A drop in agricultural production as a result of climate change has significant repercussions for both the future availability of arable land and the safety of the food supply. There are a great number of additional possible scenarios that can be simulated, such as the outcomes of climate change with and without adaptation (as a result of advancements in technology, shifts in local policy, international trade liberalization, etc.) and mitigation (as a result of changes in CO<sub>2</sub> stabilization, temperature, rainfall variation, and distribution changes).

## **Climate Change's Impact on Food Production and Accessibility**

The impacts of climate change on agricultural practices and the availability of food are complex. As a consequence of alterations in agroecological circumstances and, separately, the rise and distribution of earnings, it has both direct and indirect impacts on the production of food. Using a diverse array of research approaches and starting assumptions, a multitude of studies have attempted to quantify the consequences. The continued emission of greenhouse gases will result in temperature and precipitation shifts, which will have a negative impact on the viability of agricultural land and the quantity of crops produced.

### **Climate Change's Impact on Food Consumption**

Because climate change affects the conditions under which food may be consumed safely, it also has an effect on people's ability to make nutritious use of the food they eat. Hunger may be caused or made worse by infectious diseases; this, in turn, makes the populations impacted more susceptible to infectious diseases; this, in turn, can lead to a large decline in labor productivity, an increase in poverty, and even mortality as a result of climate change and food insecurity. Emerging research suggests that the consequences of climate change on food safety and food security are extensive and include drought, rising temperatures, and heavy rainfalls. These effects are included in the phrase "food safety and food security."

### **Climate Change's Impact on Food Consumption**

One of the most significant challenges facing the agricultural industry today is figuring out how to provide food for a population that is continually increasing. The protection of the environment will take on a greater level of significance when the number of people living on the planet exceeds nine billion. Agriculture throughout the world is experiencing long-term repercussions as a result of population growth and the destruction of the natural environment. Promoting agricultural techniques that are both economically and environmentally sound is one approach to addressing the rising worry over a lack of food security. This is one strategy to address the growing concern over a lack of food security. In recent decades, a significant amount of once-productive agricultural land has been lost due to a variety of factors, including urbanization and other human uses, desertification, salinization, soil erosion, and other impacts of unsustainable land management practices. Researchers in the subject of sustainable land management have been examining the interplay between economic, environmental, and social variables in order to better organize the use of land and natural resources. Their goal is to better organize the use of land and natural resources.

### **Technologies for Increasing Sustainable Agricultural**

If the farm's agro ecosystem is able to maintain producing crops in a consistent and reliable manner year after year, then the farm may be deemed sustainable. At the core of the concept of sustainability is the idea of maintaining stability in the face of a particular, site-specific combination of environmental and economic constraints. The rate of technical advancement and the degree of innovation in forthcoming technologies will have a significant impact on the future stability of agriculture and, without a doubt, the productivity of agriculture in the future. In addition to the development of new fertilizers, herbicides, crop types, and machinery, the traditional definition of agricultural technology includes the aspiration that genetically modified crops will one day be able to boost food production while simultaneously reducing their negative effects on the environment. Farm management practices that place more of an emphasis on long-term productivity as opposed to short-term advances in output per hectare include things like the manipulation of naturally existing insect control agents. Farmers in India can choose from a variety of approaches to better manage their agricultural operations.

Because certain states in the semiarid interior of India have embraced intensive agricultural techniques that use irrigation water from canals and aquifers, these strategies have become even more important. It is possible that the amount of water that crops that have already been planted require may be reduced by the consistent application of these approaches, while at the same time, the primary yield from agricultural land may be

increased. Organic manure, vermin-culture technologies, and agronomic approaches like mulching, crop rotation, and the use of bio-pest management measures are all examples of alternatives to chemical fertilizers that are being utilized by farmers in India. Through the application of organic manure, the structure and texture of the soil may be restored. By carrying out this process, the nutritional content of the soil as well as its capacity to hold onto water are both enhanced. Farmers in India can benefit from a farm management practice called mulching, which helps conserve irrigation water by decreasing the rate at which water evaporates from the soil's surface. Mulching is a form of crop cover that is applied to the surface of plant beds.

Poverty and hunger are the most urgent issues facing the world's least developed countries in the modern era. There was a correlation between these issues and the degradation of the surrounding ecosystem. In low-income developing countries, the agriculture industry employs over 70 percent of the labor force, either directly or indirectly. Rural areas are home to a disproportionate number of the United States' poor and hungry people. Because of this, these places are extremely important for beginning efforts to put an end to poverty and Check to see that the food is fit for human consumption. At the World Food Summit, it was decided that "food security" occurs when "all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life." This was the definition that was given at the conclusion of the summit. This was a conclusion that was arrived at by a number of researchers. derived from the summit. It is necessary to have access to reasonably priced and easily accessible food sources throughout the year, whether such supplies come from personal agriculture or from commercial marketplaces. The rate of agricultural productivity in LDCs is low. The problem of land degradation is considerably exacerbated by a number of factors, including but not limited to increasing population pressure, erosion, water scarcity, and the dissolution of conventional methods for enhancing soil fertility.

In spite of the substantial positive impact that agriculture has on national economies, just three percent of national budgets are dedicated to the agricultural industry around the globe. Twenty years ago, the majority of LDCs eliminated their marketing boards, extension programs, and credit support in order to make their agricultural markets more accessible to subsidized exports from wealthier nations. As a direct consequence of this, agricultural businesses were eradicated, and within a decade, the majority of nations shifted from being net exporters of food to being net importers of food. Numerous LDCs have been pressured by international financial institutions and bilateral donors to build production and export capabilities for cash crops, which has led to an increase in the cost of food imported by LDCs. Although some countries, such as Tanzania, have achieved success in this field, it is often at the price of the production of staple foods as well as the infrastructure and institutions that are necessary to maintain the production of such foods.

In order to achieve agricultural sustainability, it is necessary to establish and implement farming techniques that not only increase food production to satisfy the requirements of an expanding population but also protect the environment and the natural resources it contains. Recent global food production has been reasonable; nevertheless, the techniques for agricultural expansion have been less than stellar in terms of ensuring food security and environmental sustainability. While recent global food production has been decent, it might be helpful in this context since it is an indicator of the health of the soil and of the growth of plants.

Therefore, from the point of view of agriculture, capitalizing on the activity of beneficial soil bacteria can be a step toward achieving sustainability in the farming business. Farmers have understood for decades, long before urea or dichlorodiphenyltrichloroethane (DDT) were invented, that it is essential for the sustained health and production of crops to have a diversified microbial community in the soil. Composting, crop rotation, and the incorporation of both fertile and non-fertile soils are examples of organic farming methods that have been employed by humanity since the beginning of time. The presence of microorganisms in the soil that are beneficial to the ecosystem is critical for many of these ecologically friendly solutions. However, at some point in history, these natural methods became extinct or extremely rare as a result of the immense burden (of a



rising population to feed) on the authorities and governments. As a result of the widespread use of agrochemicals and other inefficient farming practices, agro ecosystems have become increasingly degraded. As a result, bio control agents are needed to keep agricultural production at a satisfactory level.

Agriculture has always required plants and beneficial bacteria to operate together, and the symbiotic nature of this link has numerous beneficial benefits, including enhanced plant growth and higher agricultural yield. It is well recognized that microbes (mainly bacteria and fungi) that dwell in the soil zone near the root system of plants, known as the 'rhizosphere,' are crucial to agriculture. These microbes are known to protect plants in a sustainable manner from abiotic pressures (such as dry, wet, and salty conditions) and biotic stresses (such as insects and diseases). The use of plant growth-promoting microorganisms, often known as PGPM, is one of the most important resources for ecologically sound agricultural operations. The ability of PGP to fix nitrogen and its ability to produce induced systemic resistance (ISR) in plants are two of its most attractive characteristics. Another advantage of using PGP is that it can facilitate the creation of secondary metabolites, nutrition solubilizes, antibiotics, and several other useful compounds. Through the utilization of PGPM, pollutants such as heavy metals, herbicides, polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and others can be eliminated and recovered for use in agricultural settings.

These rhizosphere bacteria have a number of benefits, one of which is reducing the negative impacts that are caused by climate change. Another advantage is an increase in the productivity of soils that are dry or have been impacted by stress. PGPM causes both an increase in the amount of organic matter in the soil as well as a decrease in the amount of chemical load, which results in a more stable nutrient cycle. Additionally, these bacteria (Cu) hidden hunger, often known as a deficiency in critical nutrients such as vitamins and minerals, is a rising problem that PGPMs are increasingly being used to combat. Accordingly, individuals all around the world suffer from some kind of malnutrition. According to the United Nations report on the world's progress toward achieving the Sustainable Development Goals for 2018, an increasing number of people are going hungry. The process of bio fortifying crops involves the utilization of ion-chelating PGPM as well as nitrogen fixers. They are rapidly being utilized as bio inoculants in a sustainable manner all over the world as an alternative to chemical fertilizers and pesticides due to the numerous positive features that they possess.

## CONCLUSION

It is more important than ever before for people all across the world to collaborate in order to ensure that everyone has access to enough food to eat. Despite the fact that traditional agricultural practices have been in use for millennia, new ways of growing are necessary to ensure the continued viability of the agricultural sector. As a consequence of this, the success of the fight against hunger and the preservation of food security will be contingent on the outcomes of agricultural research that is both continuing and sustainable.

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