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IMPLICATIONS OF REGENERATIVE FOOD SYSTEMS ON GLOBAL POPULATION

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ABSTRACT

Regenerative Food System is a type of food system that adopts strategies that lead to improved ecosystems and sustainable food systems. More and more people are looking to regenerative food systems as a solution to global poverty and innovations are needed to meet the needs of the growing population as agriculture and fishing are main livelihoods for most people around the world. Therefore, introduction of regenerative food systems readily available to small farmers (Nemes *et al.,* 2023) would be very useful. In this review, we discuss the challenges within current food systems and mitigation by regenerative systems including vertical farming, aquaculture, aeroponics, hydroponics, mariculture, ancient farming methods, precision agriculture, community supported farming models, blockchain technology and agroforestry and its impact on the global economy population. The implementation of some new technologies may also require upfront investment, which may hinder the adoption of these systems. This is an area for future research, and it would be interesting to examine the level of adoption of innovative practices and its impact on food security and reducing malnutrition in a growing population. The advancement of the regenerative systems led to an increase in food production and a shift from arable to urban agriculture within urban societies as well.

Keywords: Regenerative Food Systems, hydroponics, precision agriculture, community supported farming models.

INTRODUCTION

Food systems are defined as "consisting of all the factors (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation, and consumption of food, as well as the effects of these activities" (Losses, 2014). Agriculture and fisheries are the principal means of subsistence for most people around the world, and they have an impact on all these realities. The injunction to "produce more food" throughout the past two centuries has placed a significant amount of focus and pressure only on the agricultural sector, and it is not difficult to comprehend why this has been the case. It was not an easy task to enable the exponential growth of the global population, which moved from 1 to 7 billion people (Guthman, 2014) in two centuries and from 3 to 7 billion people between just 1960 and 2010, while there was only a linear increase in agricultural production observed.

So, there is a need for new narratives and improved ways for communicating them, and the first step in this process should be to provide an explanation of why food systems are so vital. To begin with, the majority of the world's impoverished and vulnerable people rely mostly on their revenue from farming and fishing as their primary source of financial support. Second, political instability, conflict, violence, and migration all have their roots in insufficient access to food and nutrition, as well as in poverty in rural areas (FAO 2016). Thirdly, agricultural methods have a significant influence on environmental health, the administration of natural resources, and the progression of climate change. The agricultural, cattle, and fishing industries all require a significant number of resources. They are responsible for around 30% of the entire energy demand and utilize approximately 70% of the freshwater resources (Kabat 2013). Fifth, agriculture is at least twice as effective as any other sector in decreasing poverty and will continue to play a crucial role in efforts to eliminate extreme poverty. This is one of the many reasons why agriculture is so important in the fight against global poverty (Christiaensen *et al.,* 2011).

The modern food system places an emphasis on quantity and strong clones have a track record of producing large quantities at a reasonable cost. According to Thomas (2007), "A knowledge of the chemical composition of foods is the first requirement in the dietary treatment of disease or in any quantitative study of human nutrition."

REGENERATIVE FOOD SYSTEM

Transformation of the food system is inevitable in recent times with consumers looking more into healthier foods and more environmentally conscious food systems. This transformation is essential to ensure constant availability of food along with food and nutritional security and restoration of the ecosystem. Evidently, a growing number of people are looking to regenerative food systems as a potential answer to several of the issues that currently exist with conventional food production. Regenerative agriculture or Regenerative Food System, otherwise referred to as agroecology (UNEP, 2021), can be defined as an integration of practices geared to food production that could be either focused on processes of food production or the outcomes of food production (Loring, 2022). In matters concerning the processes of regenerative agriculture, it would involve the ways of tilling or organic farming while outcomes of regenerative agriculture would involve improved biodiversity, carbon sequestering and resilience of the ecosystem. Therefore, regenerative agriculture is defined as the food systems that adopt the strategies that lead to improved ecosystems.

A more sustainable and equitable food system is the end goal of these agro-ecologically inspired solutions, which are based on the concepts of agroecology. The possibility that technological advancement can hasten the growth of human purchasing power is one facet of regenerative food systems that is receiving an increasing amount of attention. Innovation in the regenerative food systems is

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needed for meeting the requirements of a growing population while also conserving the environment and increasing human health.

Regenerative systems are high in both flexibility and diversity, and they involve cultural systems that conserve change by putting an emphasis on responsiveness to environmental cycles and feedback while also placing value on the diversity of ecosystems and food systems as outcomes. Regenerative systems are characterized by a high degree of both flexibility and diversity. Because of this, regenerative systems require high levels of ecological competence in addition to robust norms and institutions that place an emphasis on close relationships, careful monitoring, and the preservation of resources (Berkes 2008). Ancient agriculture and mariculture as well as modern grazing are the only two examples of the many types of regenerative food systems that have existed throughout history and continue to exist now. There is also a substantial body of evidence indicating that most environmental methods used by Indigenous peoples before European colonization were and still are of a regenerative nature (Ellis *et al.,* 2021).

INNOVATION IN REGENERATIVE FOOD SYSTEM

To innovate regenerative food systems, it is necessary to make use of new technologies and it is fundamental for the system's development. Vertical Farming is a type of crop production that involves growing plants in vertically stacked layers, most frequently in urban locations, employing artificial lighting and cultivating them in an environment that has been controlled. According to the findings of a study conducted by Despommier *et al.,* (2018), vertical farming can be significantly more productive and efficient than conventional farming methods, while also using less space and water. Some of the foods grown using vertical farming successfully include lettuce, leafy green vegetables, strawberries, cucumbers, kales and tomatoes (Mir *et al.,* 2022).

The percentage of the world's population residing in urban areas is growing at an alarming rate. Even though many cities have rules that make urban farming illegal, there is an increasing interest in the production of food within cities. Examples of potential technologies include hydroponics (in which plants are cultivated in nutrient-rich solutions), aquaponics (in which water and fish waste are utilized), and aeroponics (in which nutrient-rich water is sprayed onto — while in air – dangling roots). These greenhouses are currently providing fresh green for the markets in the surrounding area. Because of this, travel distances and storage periods become significantly shorter (Clinton *et al.,* 2017).

According to the findings of a study conducted by (Scherr *et al.,* 2012), block chain technology has the potential to improve the traceability and transparency of the food system. This, in turn, can improve trust and support to produce sustainable food. This study brought to light the potential for block chain technology to cut down on food waste by increasing the precision with which inventory is managed. The utilization of agroforestry is yet another frontier for innovation in the realm of regenerative food systems. The process of incorporating trees into agricultural systems is known as agroforestry, and it aims to produce a landscape that is both more diverse and more environmentally friendly. Mbow *et al.,* (2019) discovered that agroforestry can boost production, improve soil health, and give many advantages such as improved biodiversity and carbon sequestration. One example of this is precision agriculture, which involves the application of sensors and the analysis of data to achieve optimal crop output. According to the findings of a study conducted by Kim *et al.,* (2020), precision agriculture has the potential to increase agricultural yields while simultaneously lowering negative effects on the surrounding environment. Regenerative food systems require not only these technological breakthroughs, but also innovations in social organization and economic structure. The community-supported agriculture (CSA) model, for instance, is a method for the production and distribution of food in which customers buy a portion of the produce directly from a neighborhood farmer. This concept establishes a direct connection between buyers and sellers, which has the potential to contribute to the development of community resilience and food sovereignty. According to the findings of a study that was conducted by Hinrichs and Lyson (2007), CSA can give financial benefits to farmers and boost the availability of fresh, healthy food in places that are neglected.

A regenerative food system should not be resource-exhaustive or even carbon neutral; rather, it should have a net positive and regenerative impact, with the aim of achieving justice and addressing the disproportionate burdens of environmental harm and lack of access to natural resources due to systemic injustices related to race, class, and gender for present and future generations of human and nonhuman species. This can be beneficial for both present and future generations of human and nonhuman species.

CHALLENGES WITHIN CURRENT FOOD SYSTEMS AND MITIGATION BY REGENERATIVE SYSTEMS

The major challenge affecting the food system is the increase in population all over the world. Therefore, this leads to an increased food production to make the food system more sustainable. Human activities like industrialization, greenhouse gas emissions, use of pesticides, fuels, automobiles and technology have a direct impact on the climate change that ultimately affects the food system (Concern Worldwide, 2022). Climate change, lack of adequate labor, lack of access to land, displacement, soil fertility, food waste and health cover the challenges that are within the food systems. A broken food system can be identified with an increased population of the malnourished children in different continents due to face stunting, micronutrient deficiencies, wasting, obesity and overweight issues (UNICEF, 2022). Therefore, the provision of adequate and healthy foods becomes the epicenter of the concept of regenerative food systems. The deterioration of the environment, social unrest, and economic instability are all global concerns that are putting old viewpoints on progress to the test and driving us to reconsider our customary methods. Throughout the past several decades, the climate of the world has been changing at an alarming rate, and experts anticipate that this trend will continue and even quicken in the years to come (IPCC 2012). Significant population declines, the extinction of species, and the destruction of habitats are all contributing factors to the worrisome rate at which the world's biodiversity is being lost. The increased clearing of land for crop farming has been contributing to the loss of habitat, which may eventually result in the loss of plant variety. This loss of habitat has been occurring at an alarming rate. This calls for a reevaluation of both our policies and actions, as well as the establishment of adaptive management systems that acknowledge the interrelated and interdependent nature of the global changes that are currently unfolding (UNEP 2012).

These problems clearly show that it is important that things are done differently to improve the food system. The idea of sustainability has recently evolved as a guiding principle as well as a fundamental goal for the progression of civilization. A regenerative food system focuses on the concept of 'circular economy' and structures needed to improve food productivity (Duncan *et al.,* 2021). This involves focusing on resources available to ensure that circulation is in closed loops, renewable energy and embracing diversity. This by extension alleviates the challenges within the food system. In the recent technological advancement, digital solutions like block chain technology have been adopted to improve traceability and accessibility within the food system (Marti *et al.,* 2023). It has been found that regenerative food systems improve biodiversity, improve the soil health, and production of organic foods. When considering the food industry, the consumers have ranked regenerative organic practices as highly important in accessing food products from producers (Röös *et al.*, 2023).

EFFECT OF REGENERATIVE FOOD SYSTEMS ON THE HUMAN BUYING POWER

The seventies have seen a rise in interest in the topic of food security; nevertheless, due to the multifaceted character of the subject matter, it is challenging to address (Carrillo-lvarez *et al.,* 2019). An individual or household must possess enough food that is both safe and nutritious, have permanent physical and economic access to the food, and be able to use and benefit from the food in an appropriate manner to fulfill their physiological needs and lead a life that is both healthy and active to be considered to have complete food security. Finally, it is crucial that the consistency of these components be maintained over the course of time (Park *et al.,* 2020). The lower a family's income is, the lower its consumption capacity will be, and the greater the probability that it may find itself in a position of food insecurity due to a lack of access to food that is available in appropriate quantities and of sufficient quality (Vu *et al.,* 2021).

Numerous theoretical and empirical studies have supported the existence of the relationship between purchasing power and food security, which is measured by the incapacity of households to access food and the incidence of extreme poverty due to consumption. According to the findings of these studies, the likelihood that a family is experiencing food insecurity increases in proportion to the family's poor income (Wangu, 2021). Large households with a substantial number of dependent members present a greater risk. Mundo-Rosas *et al.,* (2019) found that households reduce their food consumption and ingest a greater number of micronutrient-poor foods. In certain circumstances, these foods are cheaper, or are perceived to be cheaper by families, which increases the risk of food insecurity. The primary challenge that poses a risk to the continued viability of dietary practices is the alteration of the environment, and more specifically the climate. It is projected that there would be a large rise in the levels of carbon–dioxide (CO2) and tropospheric ozone (O3) as well as an increase in the intensity of heat stress (Kirtman *et al.,* 2013). These stressors pose a significant threat to agricultural production worldwide, both in terms of the harvestable yield and the nutritional quality of crops. This has the potential to have a significant influence on food security, nutrition, and public health on a global scale. There is a widespread agreement that changes in temperature and precipitation would lead to significant decreases in the yields of essential crops. This prediction has been supported by several studies (Zhao *et al.,* 2017).

When combined, scientific innovation of regenerative farming and traditional knowledge of agriculture produce a vast array of possibilities for the transformation of community-level agricultural systems. Many rural communities, for instance, are implementing long-term changes to their agricultural practices to make their means of subsistence more resistant to the effects of climate change. The development of global agricultural systems can be aided by making changes at the local level. Crop yields and food production can be significantly increased using regenerative farming practices at the rural level, thereby increasing food security and food prices making it accessible to low-income households.

FUTURE AREAS OF RESEARCH WITHIN REGENERATIVE FOOD SYSTEMS IN ENHANCING PURCHASING POWER

With all the benefits of adopting regenerative food systems, the upcoming problem that it does not address is climate mitigation and its impact on the smallholder farmers(Marti et al., 2023). Rather, this system supports more biodiversity and regeneration of the ecosystem. Smallholder farmers depend mostly on the incomes earned from their food production practices. Some farmers may not easily adapt to the new technologies mostly because they may not be responding to the needs of the farmers (Mutyasira, 2023). Therefore, adopting regenerative food systems that can be easily accessible to the smallholder farmers (Nemes *et al.,* 2023) would be extremely beneficial. This will be a major area of research for the future, and it would be interesting to study the level of adoption of regenerative practices and its impact on food security and decrease in malnourishment of the growing population. Adoption of some new technologies may also need upfront investments which may cause a hurdle in embracing these systems.

As mentioned earlier, transformations in the food systems that have been incorporated to achieve a regenerative system include vertical farming, hydroponics, aeroponics, mariculture, ancient agricultural methods of farming, precision agriculture, community-support agricultural models, block chain technology and agroforestry. All these types of regenerative systems have led to increased food production and a shift from much reliance on rural farming to embracing urban farming through rooftop farming structures like hydroponics. An interesting area of research would be to study on how these practices can be adopted by common people living in the urban areas and have increase access to home grown produce.

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