

A Review of Agroecology and Sustainability of Agriculture in India

Dr. Sandeep Kumar, Dr. Alpana Joshi, Prof. (Dr.) Divya Prakash
Shobhit Institute of Engineering and Technology (Deemed to be University), Meerut
Email Id- dr.sandeepkumar@shobhituniversity.ac.in, alpana.joshi@shobhituniversity.ac.in,
divya.prakash@shobhituniversity.ac.in

ABSTRACT: *Agroecology is the application of ecological concepts and methodological design for long-term enhancement and management of soil fertility and agriculture productivity. It provides a strategy to increase diversified Agro-ecosystem. So it is benefiting the effect of the incorporation of plant and animal biodiversity, nutrient recycling; biomass creation and growth through the use of natural resource systems based on legumes, trees, and incorporation of livestock. These all make the basis of a sustainable agriculture and aim to improve the food system and societal sustainability. The agroecology supports production of both a huge quantity and diversity of good quality of food, thread and medicinal crops, together with family utilization and the market for economic and nutritionally at risk populations. Sustainable agricultural practices have to tackle the conservation of biodiversity, enhanced ecological functions, social tolerance, self-reliance, fairness, improved quality of life and economic productivity of crops and live- stock. Sustainability of agriculture is viewed critically from the point of food and ecological security at the regional scale. The aim of this article is to give an overview to identify the ideal conditions of best agriculture practices and the implications and future prospects of Agro-ecology for sustainable agriculture in India.*

KEYWORDS: *Agroecology; Sustainability; Agriculture; Agroecosystem; Prospects.*

1. INTRODUCTION

India is primarily an agro-economy-based nation, with agriculture employing 70-75 percent of the population. Agriculture and food production are essential to life, and the economy plays a critical role in the creation and maintenance of healthy communities. However, in the Indian context, agriculture's advantages are not completely realized, and thousands of people go hungry every day for the following two obvious reasons:

- A lack of contemporary scientific techniques, equipment, and implements, as well as restricted agricultural land resources, combined with a fast-growing population.
- As a result, despite the introduction of the green revolution in many areas of the nation, a large portion of the population is malnourished.

The decision to use pesticides to enhance agricultural output was taken in the 1960s; however, the severe repercussions and harmful ecological and environmental effects were not recognized until much later. Although the green revolution has increased crop productivity, it has had negative consequences for the environment (e.g., land degradation, refuse in soil fertility, salinization, soil erosion, health hazards, poor agricultural land sustainability, biodiversity loss, organic matter loss, nitrogen mineralization, and microbial biomass). As a result, a strong focus has been placed on the introduction of new technology.

In 1952, India had 0.33 hectares of accessible land per capita, which had decreased to 0.12 hectares by the end of 2004. According to India's Central Statistics Office, agricultural goods accounted for

51.9 percent of GDP in 1950-51, but just 13.7 percent in 2012-13. This expressed serious worry about India's agricultural situation[1].

Agro-ecology is a new ecological idea and philosophy for planning and managing agricultural operations, as well as a scientific framework for doing so effectively. Agro-ecology is a scientific field that defines, classifies, and analyzes agricultural systems from the viewpoint of ecosystems, while also acknowledging the tight connection between these systems and their social and economic contexts. It's about natural systems and their long-term viability in the face of exploitation, rather just farms and their management methods. The agro-ecology method, which aids in increasing production, may compensate or recover the lost productivity. Farmers in Bihar, Uttar Pradesh, and Karnataka have set world records for rice and potato output using agro-ecological base farming techniques. Agro-ecological farming is supported by about 500 million small farm holding households across the globe. It has the potential to improve the food chain, provide money to farmers, and provide nutritious food to consumers while also reducing climate change. India and many other emerging nations have recognized the need for sustainable agriculture to meet rising food demand. The Indian government has recently incorporated sustainable agriculture in the corporate sector for effective company operations[2].

Agriculture's long-term viability may be ensured by two important factors: lower costs and improved soil fertility. Rainwater harvesting and scientific management to optimize water use and vermin control results in higher revenue generation, guaranteeing diverse agricultural systems and synergistic advantages. Agro-ecology is developing as a viable alternative for ensuring sustainability since it does not rely on conventional farming methods, but rather is a continuous process of progressively evolving agricultural patterns in order to farm more efficiently and enhance lives. Agro-ecological techniques are indeed environmentally beneficial. Climate change and shocks such as hurricanes, droughts, and price spikes in food and fertilizer make farms and communities more adaptable. Because trees are integrated into agricultural systems, organic matter richer soils have higher carbon sequestration[3].

Since 1960, global per capita crop demand has been a comparable rising function of per capita real income whether evaluated as the caloric or protein content of all crops combined. From 2005 to 2050, this connection predicts a 100–110 percent rise in world grain consumption. In all, a country's agriculture and economics handle critical social and environmental issues including hunger and poverty, climate change and the environment, as well as community health, income, and employment. Local people may take the lead in developing solutions by transitioning to greener, more productive agro-ecological farming. The primary goal of this essay is to identify the best methods and policies for achieving agricultural sustainability in India[4].

1.1.Sustainability or Agroecology:

Bensin invented the word "agroecology" in two scholarly papers, while Gliessman and Warner coined it more recently. It is a scientific field that studies, designs, manages, and evaluates productive and resource-conserving sustainable agricultural systems using ecological theory. Agroecology, which draws on natural and social sciences, offers a framework for evaluating four important factors, and its significance is recognized by the world's leading food policy and agricultural research organizations[5].

Agro-ecology offers a paradigm for evaluating agriculture's four main system properties: productivity, resilience, sustainability, and equality. Agro-ecology, which entails the advanced application of cutting-edge plant and soil science, as well as social science, aids in the development of "vigorous, productive, and reasonable" food systems aimed at biologically rich, ecologically or environmentally sound, as well as locally sensitive agricultural practices. Agro-ecology, according to cultivators, is both a science that "studies agricultural systems from an ecological and socio-economic perspective" and a movement, similar to organic farming. Agro-ecology may be taken from perm culture to build closed systems, or it can focus rediscovering onwards methods that imitate or cooperate with the environment rather than attempt to control and fight it. A shift to a more environmentally friendly, productive, and agro-ecological agriculture[6].

The concept of sustainability is based on the idea that people's and communities' well-being is dependent on three basic pillars, referred to as the "bottom line components," namely, the social, economic, and environmental systems, which are in constant interaction and equilibrium for society's benefit today and in the future.

Sustainability is a framework for questioning and reflecting on suggested strategies, events, budgets, and choices. It's a method of looking at a community, a civilization, or a planet in the widest conceivable time and space context. Although it has a broad definition, recognizing sustainability is mostly a restricted effort since each community has unique social, economic, and environmental requirements and concerns. Six principles of sustainability may assist a community in ensuring the integration of its social, economic, and environmental systems. Although the list of principles is helpful, each of the things on the list has the potential to overlap and interact with one or more of the others[7].

1.2.Life satisfaction:

A number of factors go into determining one's quality of life, including (Figure 1):

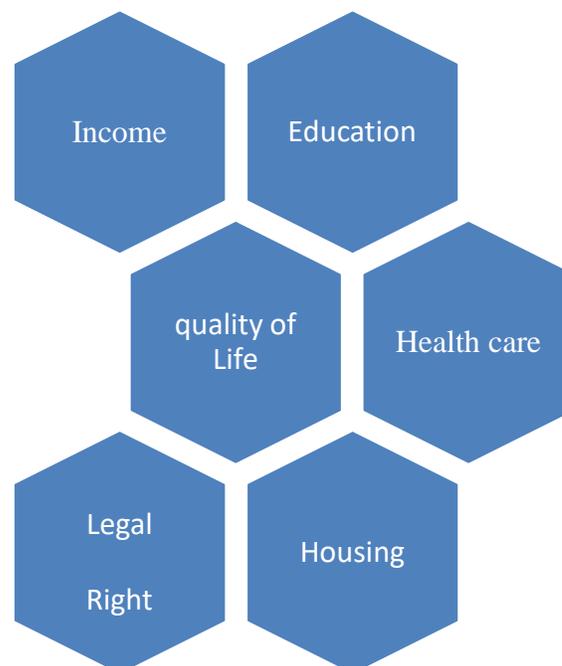


Figure 1: Illustrate the value of Life, like housing , Education, Healthcare.

The concept of sustainability is based on the idea that people's and communities' well-being is dependent on three basic pillars, referred to as the "bottom line components," namely, the social, economic, and environmental systems, which are in constant interaction as well as equilibrium for society's benefit now and into the. Sustainability is a framework for questioning and reflecting on suggested strategies, events, budgets, and choices. It's a method of looking at a community, a civilization, or a planet in the widest conceivable time and space context. Though it has a broad definition, sustainability recognition is primarily a limited effort because each community has unique social, economic, and environmental needs and concerns. Six principles of sustainability may assist a community in ensuring the integration of its social, economic, and environmental systems. Although the list of principles is helpful, each of the things on the list has the potential to crossover and interact with one or more of the others. The discretion of people based on their requirements and beliefs about what they can achieve, for now and for future generations, determines the quality of life or "livability," which varies from community to community. One community may have adequate safety, education, and surroundings, whereas another may have job opportunities and historical landmarks that make it an appealing place to live. Each community must define and plan for the quality of life it desires and believes it is capable of achieving, both now and in the future[8].

1.3.Vitality of the economy:

A sufficient level of economic vitality in the local community is required for long-term viability. This aspect of sustainability is dependent on job opportunities, adequate agricultural infrastructure, adequate tax support and benefits, as well as basic infrastructure facilities (such as communications as well as services, or an appropriate market atmosphere).

1.4.Equity in the social and intergenerational spheres:

Regardless of civilization, age, gender, artistic conditions, faith, or other individuality, a sustainable community's income and opportunities are available to everyone (Figure 2).



Figure 2: Agricultural sustainability for sustainable development of Indian Agriculture.

Congenial environment: The focus of a sustainable community is a substantial eco-friendly environment and congenial coexistence. Protection of existing resources and the recovery or restoration of damaged ecosystems (such as mining impacts and land use changes) may be required to maintain a pleasant environment in order to achieve sustainability.

1.5. Resilience to disasters:

Community flexibility and resilience to risks and disasters, whether natural (hurricanes, earthquakes, floods, fire, and drought) or anthropogenic, are also part of sustainability options (mining or industrial processes). The resilient community also assumes responsibility for the risks and is self-adaptive to the extent possible[9].

1.6. Participatory process that is enjoyable:

Participatory actions are critical to a community's long-term viability. It leads to a significant increase in awareness and the dissemination of information to support community wisdom in developing a sense of rights and a broader understanding of the importance of sustainability.

1.7. How does sustainable agriculture differ from conventional farming?

Sustainable agricultural practices aim to conserve biodiversity, improve ecological functions, social tolerance, self-reliance, improve quality of life, and increase crop and livestock economic productivity. In terms of resource best recycling use of nutrients and organic matter, closed energy flows, water and soil conservation and stability, and pest-natural adversary populations, this differs from conventional agriculture. Agricultural sustainability is important in terms of food and environmental security, and agricultural diversity can be restored over time and space using techniques like crop rotations, cover crops, intercropping, and gather mixtures[10].

1.8. Agro-long-term ecology's benefits:

An agro-ecological approach recognizes the multifaceted nature of agriculture and facilitates a wide range of long-term benefits, such as those listed below:

- Agriculture that is environmentally friendly.
- Increased ecological resilience and decreased environmental degradation risk.
- Conservation of natural resources.
- Improved nutrition and health (reduced incidence of pesticide poisoning).
- Maintaining economic stability.
- Management of climate change (via reduced fossil fuel consumption, increased energy-efficiency, increased carbon sequestration or moisture retention in soil).
- Increased social stability and resilience.

The System of Rice Intensification (SRI), which uses less water and chemicals while increasing yields by up to 68 percent, has demonstrated the apparent benefits of sustainable Agro-ecology in India. The added benefits include lower crop prices, increased cultivator income by 15%, and the involvement of 305 beneficiaries in value addition in various commodities in Tramlined. Over the last 60 years, the application of an agro-ecological methodology to agriculture has resulted in a remarkable global revolution in natural plant communities' management, as well as local agricultural practices as well as food systems.

DISCUSSION

Agroecology is the use of ecological concepts and methodological design to improve and manage soil fertility and agricultural productivity over time. It outlines a plan for diversifying the agro-ecosystem. As a result, it benefits the effects of incorporating plant and animal biodiversity, nutrient recycling, biomass creation, as well as growth by the use of natural resource systems that rely on legumes, trees, and livestock integration. All of these elements form the foundation of a sustainable agriculture, with the goal of improving the food system as well as societal sustainability. This means that, in the future, agro-ecological technologies must not only increase agricultural productivity, but also ensure that the quality of the natural resource base is preserved and improved. All of this adds up to long-term increases in agricultural production and a stronger social economy. Farmers will also be able to develop their skills and expertise while maintaining their use of agroecology farming practices, according to the future prospects. It also necessitates a close examination of the farmer's experience. Agriculture's long-term viability should be considered in terms of ecological integrity, social acceptability, and economic viability. It is critical to reducing global food insecurity, land degradation, and desertification, and, as a result, eradicating poverty in the future.

CONCLUSION

Analyzing the performance of Agro - ecosystems in the face of changing conditions and gaining a better understanding of sustainable agriculture can aid in the exploration of agro-future ecology's prospects. Agro-long-term ecology's viability would necessitate fundamental changes for agricultural benefits as well as structural solutions to address global challenges such as massive land degradation or desertification. There is also a growing recognition that previous strategies for developing and promoting technologies have contributed to serious or widespread environmental as well as natural resource degradation issues. This means that, in the future, agro-ecological

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