Agro-Ecological System and Its Application

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ABSTRACT:
The study of ecological processes as they relate to agricultural production systems is known as agroecology. By applying ecological concepts to agro ecosystems, new management strategies that could not have been thought of otherwise could be suggested. The link between agricultural production systems and ecological processes is covered by agroecology. It encompasses all methods that make agricultural practices more considerate of the environment and its ecological peculiarities. Agriculture, agronomy, scientific ecology, economics, and social sciences are all combined in the field of agroecology.

KEYWORDS:

Agro Ecosystems, Agriculture, Ecology, Farming, Soil.

I. INTRODUCTION

Worldwide, farming operations have significantly molded and preserved today's countryside, and the majority of semi-natural regions are managed with agricultural output as their primary goal. The usefulness of many farms to wildlife has, however, decreased due to changes in farming methods. The Royal Society for the Protection of Birds and the Farming and Wildlife Advisory Group of Agricultural and Conservation Organizations convened a conference that served as the beginning of the United Kingdom's first comprehensive national discussion on agro-ecological management to increase farm biodiversity. At Bedfordshire's Silos Agricultural College, this occurred in July 1969. Farmers and conservationists came together for the first time to build a bridge between the two polar opposites of land management. The weekend conference's main topic was the management of Pandey Grove Farm, a group of agricultural areas that were accessible for attendees to submit ideas for combining cattle and arable production with management goals to boost wildlife. 'Farming & Wildlife A Study in Compromise' was a report on the meeting that was published in 1971. The Silos weekend was followed by a very significant incident that occurred in Dorset on July 25–26, 1970.

Here, a 320-acre business called East Farm, Hammond in the Blackmore Vale, close to Sturminster Newton, was investigated in even more detail than Pandey Grove, and the investigation on the coexistence of farming and wildlife was expanded to take into account forestry, hunting, and freshwater fishing interests. A basic issue that surfaced in Silos was once more brought to the forefront in the Dorset negotiations at East Farm. It is a matter of applied ecology that has to do with the strategy of preparing a farm for wildlife interests as opposed to a sequence of impromptu actions taken by a farmer, which are more appropriately referred to as tactics. A farm's integrated conservation plan, which is based on a thorough understanding of how to provide the most valuable and diverse habitats, differs greatly from a number of unrelated actions, such as planting an odd clump of trees to improve the view or leaving hedges alone for the sake of leaving them alone however desirable the retention of any hedge may be.

Because a connection between the many physical characteristics is really desirable. Mammals, many birds, especially game birds, and some insects need to cross isolated patches of trees using connecting lines, transit routes, flyways, and stepping stones in most cases, hedges and wild patches become far more important as habitats if they make uninterrupted links. The remarkable amount of activity that the Silos conference had sparked off and that coincided with all the hoopla surrounding European Conservation Year in 1971 was brought up at the Dorset gathering. According to reports, there is now a gradually growing interest in planting woodland patches, shelter belts and field corners. One well-known agriculturalist predicted that over the course of the next ten years, farmers will plant thousands of acres across the nation. The conferences' sponsors, on the other hand, weren't as upbeat. The question of whether trees would always be planted in the best location appeared significant, as did the question of whether full acknowledgment of the need to ensure, farm requirements allowing, that this relatively new concept of providing connecting ecological ties will be applied [1], [2].

In many circumstances, the most that could be hoped for on a farm was a sequence of unrelated activities, but the significance of this specific issue of integrating physical elements was a crucial topic of applied ecology. It was seen as an essential component of the conservation message being conveyed to the farming and landowner sector. In reality, it took another 20 years for the Silos recommendations to evolve into a comprehensive government strategy that was outlined in the UK Biodiversity Action Plan of 1994. Although various national plans and pilot projects had been formed in the interim, the loss of farming ecosystems persisted despite government subsidies for drainage and hedgerow removal. In Great Britain, there was a net loss of 23% of hedges between 1984 and 1990. Despite the planting and regeneration of nearly 50,000 km of hedges, the net loss of hedges was caused by a combination of degradation and removal of hedges. There was a loss of quality in addition to the reduction in the length of this significant linear habitat. An average of one plant species per 10 meters of hedge was lost between 1978 and 1990, representing an 8% reduction in the diversity of plant species.

However, at the time the strategy was released, various integrated agricultural and conservation schemes had been started by government organizations as a result of Silos and other initiatives. These applied ecology projects combined agricultural and environmental goals in order to protect and improve wildlife habitats in rural areas that are used for farming. To help achieve biodiversity goals, they were concentrated in a few specific locations and ecosystems. The territorial agricultural departments oversaw the Environmentally Sensitive Areas (ESAs) Programme, which focused on regions with a high conservation importance. It gave farmers and crofters incentives to safeguard and improve the environmental aspects of their property and avoid harm to wildlife and landscapes that could come from various forms of agricultural intensification. The 'Wildlife Enhancement Scheme' aims to create a new and more constructive working relationship with owners and occupiers of Sites of Special Scientific Interest (SSSIs) and to fully utilize their knowledge of local circumstances and skills in land management. In 1991, English Nature began this three-year pilot Programme. The Programme has been expanded to encompass four areas by the end of March 1993.

II. DISCUSSION

In accordance with the OECD, agroecology is the study of the relationship between agricultural crops and environment. Agroecology, according to Dalgaard et al., is the study of how humans, animals, plants, and the environment interact within agricultural systems. Francis et al. use the term similarly, although they believe it should only apply to growing food. Agroecology is a comprehensive strategy that aims to harmonies agriculture, local communities, and natural processes for the benefit of the environment and human livelihoods. Agroecology is intrinsically interdisciplinary and encompasses a wide range of fields of study, including agronomy, ecology, environmental science, sociology, economics, history, and more.

Agroecology uses a variety of scientific disciplines to comprehend aspects of ecosystems like soil characteristics and interactions between plants and insects. It also uses social sciences to comprehend how farming practices affect rural communities, the financial barriers to developing new production techniques, and cultural factors that influence farming practices. Productivity, stability, sustainability, and equity are just a few examples of the agro ecosystem system traits that have been examined. Agroecology is not constrained to any particular size; it can encompass anything from a single gene to an entire population, or from a single field on a specific farm to entire global systems. In contrast to agroecology, which focuses on organisms in planned and managed environments, Wojtkowski distinguishes the ecology of natural ecosystems from agroecology by arguing that economics play no part in the ecology of natural ecosystems, whereas in the latter, human activities, and thus economics, are the primary governing forces that ultimately control the field. In his book from 2002, Wojtkowski covers the use of agroecology in agriculture, forestry, and agroforestry [3], [4].

Varieties

In a 2003 conference report, Butte distinguished four types of agroecology. The two primary types are agronomic agroecology, which he describes as being focused on creating knowledge and practices to make agriculture more sustainable, and ecosystem agroecology, which he believes stems from Howard T. Odom’s ecosystem ecology and focuses less on rural sociology. The third, more established variation is what Butte terms ecological political economy, which he defines as emphasizing radical politics while criticizing the politics and economy of agriculture. The newest and smallest type of population ecology, which Butte calls agro-population ecology, is based primarily on more recent theories of population ecology, such as population dynamics of constituent species, and their relationships to climate and biogeochemistry, as well as the role of genetics.

However, it is very similar to the first type. Different points of view are mentioned by Dalgaard et al. They include what they refer to as early integrative agroecology, which includes studies by Henry Gleason and Frederic Clements. In the second, hard agroecology, which they define as being more reactive to environmental

politics but founded in quantifiable units and technology, is credited to Hecht. They use the term soft agroecology themselves and characterize it as attempting to quantify agroecology using soft capital like culture or experience. People may refer to agroecology as a science, a movement, or a practice. The 1990s saw an increase in the use of the name as a movement, particularly in the Americas. In this regard, Miguel Alfieri, who Butte groups with the political agro ecologists, has published a lot. He has used agroecology in alternative agriculture, sustainable agriculture, and other fields. and conventional wisdom.

History

The history of agroecology varies depending on whether you are using the term to describe a body of knowledge or a practice, as many indigenous cultures around the world have historically utilised and still use practices that we would now consider utilizing agroecology knowledge. Maori, Nahunta, and several other indigenous peoples are examples. Prior to European colonization of the Americas, the Mexican people who lived in Tenochtitlan employed a technique called cinemas that, in many ways, is similar to the usage of composting in sustainable agriculture today. Many different societies have used agro ecological techniques like nutrient cycling and intercropping for hundreds of years. Indigenous peoples currently make up a sizable share of both individuals engaged in the effort to convert more farming to an agro ecological paradigm and those employing agro ecological practices.

Pre-World War Two Academic Theory

According to Glassman and Francis et al., Kluges' study of crop ecology in 1928 is credited with establishing the first link between agronomy and ecology. The study of where to cultivate crops is the focus of this endeavor. According to Wesel et al., Basil Benson’s 1928 publication of the phrase marks the first time the term agroecology has been used. According to Dalgaard et al., the term ecological application in agriculture was first used in 1930 by German zoologist Frederic’s in his book on the zoology of agriculture and forestry and then in 1939 by American crop physiologist Hansen.

After World War II, Academic Theory

Agroecology may have first appeared in Tickler’s 1965 book Agroecology. He examined the various elements plants, animals, soils, and climate in an agro ecosystem, their interactions, and the effects of human agricultural management on these elements. According to Glassman, agronomists focused on the cultivated systems in agriculture while ecologists focused more on experiments in the natural environment after World War II. However, in the 1970s, agronomists began to recognize the value of ecology, and ecologists started using the agricultural systems as study plots, and agroecology studies expanded more quickly. The term agroecology and the idea of agro ecosystems began to appear in more books and articles in the 1970s. Dalgaard et al. claim that Harper's notion of agro ecosystems from 1974, which they view as the cornerstone of contemporary agroecology, was likely inspired by the idea of process ecology such as that researched by Arthur Tinsley in the 1930s. Agroecology, according to Dalgaard et al., is a combination of Henry Gleason's studies on plant population ecology and Frederic Clements's ecological research on ecology that included social sciences, community ecology, and a landscape perspective [5], [6].

In the 1970s, ethnos botanist Ephraim Hernandez X.'s research on indigenous knowledge in Mexico paved the way for brand-new agroecology teaching initiatives. The public became aware of the environmental consequences of agricultural production as a result of works like Silent Spring and The Limits to Growth, which led to an increase in sustainability studies beginning in the 1980s. In his 1982 article Agroecology Del Tropic Americano, Montalvo advanced the idea that the socioeconomic backdrop is vital and that it cannot be isolated from agriculture when developing agricultural practices. In 1985, Miguel Alfieri and Glassman investigated the effects of farm and crop consolidation on pest populations and the socioeconomic, technological, and ecological factors that influenced producers' decisions regarding the best food production methods. In Sustainable Agriculture and Integrated Farming Systems, published in 1995, Eden’s et al. examined the economics of systems, ecological effects, and ethical and value considerations in agriculture.

Societal Shifts

Agroecology has been incorporated into a number of social movements' overall organizing tactics. Agroecology has been employed by organizations like La via Compazine to achieve food sovereignty. Farmers have also used agroecology to combat the global agricultural development trends brought on by the green revolution.

Application of Agroecology

A notable illustration of agroecology is agroforestry. It's a method of farming that incorporates trees, showing how nature and food production can coexist. Animals on farms can find shelter and food while grazing under trees, and their dung improves the soil. Additionally, growing trees on land that would otherwise be used for grain crops can produce another crop, such as fruit, nuts, or lumber. In addition to giving farmers another source of income, this prevents soil erosion due to the trees' deep roots' contribution to the development of a sound soil structure. A really sustainable solution is agroecology. We face numerous issues with the food system, including obesity, starvation, and the collapse of the biodiversity, both globally and locally. These issues are a result of intensive farming practices. They deplete natural resources by concentrating on quick profits instead of long-term sustainability, which is better for the environment, wildlife, and local populations. A really sustainable alternative food system is what we need. The good news is that agroecology has many of the answers. The Ten Years for Agroecology project serves as a blueprint for how the UK and the rest of Europe may make the transition to a food and farming model to lessen the effects of climate change, encourage wildlife recovery, and provide a healthy diet for a growing population.

Organic Occupy in Agroecology

Many agricultural practices, including organic, biodynamic, and permaculture, that you might be more familiar with fall under the broad category of agroecology. Agro ecological farming includes organic farming. A tight set of requirements must be met by all organic growers. These guidelines provide greater animal welfare, fewer pesticides and antibiotics, and no genetically modified organisms (GMOs). Organic farming methods also promote healthy soil, increased on-farm work, and more. To formally confirm farmers, satisfy these stringent criteria, certified organic farms are inspected once a year. Therefore, going organic is a terrific approach to assist the development of agroecology by bringing together citizens and farmers who practice it.

Engaging with local farmers and producers is the simplest approach to support agro ecological farming. Join a local veg box Programme, become familiar with their farming methods, or purchase organic food. Food that is branded organically is guaranteed to have been produced in accordance with some of the strictest environmental requirements. Everyone, including farmers, caterers, retailers, and everyday residents, must promote a new way of thinking about food, farming, and the environment in order to realize an agro ecological future. With the help of the organic community, we continue to advocate for agro ecology in government so that decision-makers are aware of the benefits it provides for the environment, the climate, and human health. We advocate for increased assistance, empowerment, and guidance for farmers so they can investigate how to make the shift to agro ecology [7], [8].

Application

Agroecology, as an agricultural philosophy, can be used in a variety of contexts to advance sustainable and regenerative agricultural practices. Here are some important agroecology applications:

1. **Agroforestry:** Techniques used in agro ecological practices frequently entail including trees in farming operations. Agroforestry, which offers a number of advantages, combines the growing of trees with the raising of livestock or crops. Trees provide shade, which can lessen heat stress on cattle and crops. They also fix nitrogen, provide shelter for helpful insects and birds, and add to soil fertility by producing leaf litter. Agroforestry systems can increase biodiversity, improve the condition of the soil, and produce extras like fruits, wood, or fodder.
2. **Crop Diversification and Rotation:** Agroecology encourages the use of intercropping systems and different crop rotations. Crop rotation, which is planting various crops in succession on the same area, breaks the cycles of pests and diseases, boosts soil fertility, and lessens the need for synthetic fertilizers and pesticides. Growing several crops together in the same field maximizes resource use and encourages organic pest control. Cropping systems that are more diverse improve ecosystem services including resilience and nutrient cycling.
3. **Conservation Agriculture:** Agro ecological conservation agriculture emphasizes diversified crop rotations, permanent soil cover, and little soil disturbance. Conservation agriculture contributes to the preservation of soil structure, the prevention of erosion, the retention of moisture, and the promotion of beneficial soil organisms by decreasing or eliminating tillage, preserving crop leftovers as soil cover, and encouraging various crop rotations. This strategy boosts long-term sustainability while enhancing soil health and water efficiency.
4. **Biological Pest Control:** Agroecology promotes the application of organic pest management techniques. Agro ecological systems establish homes for pests' natural adversaries, such as beneficial insects, birds,

and spiders, by fostering biodiversity and ecological balance. This can support biological pest management and lessen the demand for synthetic insecticides. Agro ecological practices include employing trap crops to keep pests away from primary crops or planting floral strips to attract pollinators and beneficial insects are examples of prevalent agro ecological practices.

5. **Organic Farming:** Agroecology is closely aligned with the concepts of organic farming, which emphasize the use of natural inputs, reduce the use of synthetic chemicals, and encourage ecological balance. To maintain healthy soil and manage pests and illnesses, organic farming uses compost, organic fertilizers, and natural pest control techniques. Similar practices are prioritized by agroecology, which incorporates organic farming methods within a larger ecological context.
6. **Local and Indigenous Knowledge:** In agricultural practices, agroecology acknowledges and values local and indigenous knowledge systems. Traditional knowledge frequently provides important insights into regional crop varieties, farming methods, and agro ecological practices that are tailored to particular ecosystems and cultural contexts. Agroecology promotes community engagement, local empowerment, and the blending of traditional knowledge with cutting-edge scientific methodologies.

Advantages

The following are some of the main benefits of agroecology:

1. **Environmental Sustainability:** Agroecology is concerned with sustainable farming methods that reduce harmful effects on the environment. Agroecology encourages biodiversity conservation, safeguards soil health, enhances water quality, and lessens pollution by minimizing or eliminating the use of synthetic fertilizers and pesticides. It places a strong emphasis on maintaining and improving ecosystem services, including as nutrient cycling and natural pest management, which create more resilient and sustainable agricultural systems.
2. **Soil Health and Fertility:** Using tactics like crop rotation, cover crops, and organic soil amendments, agro ecological practices priorities soil health and fertility. These techniques aid in enhancing soil structure, nutrient availability, water-holding capacity, and the growth of advantageous soil microbes. Higher crop yields, decreased erosion, improved carbon sequestration, and long-term agricultural production are all benefits of healthy soils.
3. **Resilient Agricultural Systems:** Building resilient agricultural systems that can adjust to environmental changes and uncertainties, such as climate change, is the goal of agroecology. Agroecology practices such as mixed farming, agroforestry, and diverse cropping systems are widespread, and they improve resilience by lowering the risks connected to single-crop monocultures. Agro ecological systems are more resilient when they use crops that have been adapted to the local environment and traditional knowledge.
4. **Increased Biodiversity and Ecological Balance:** Agroecology places a strong emphasis on incorporating ecological concepts into agricultural systems, which encourages biodiversity and ecological balance. Natural pest management is enabled through diverse crop rotations, intercropping, and agroforestry practices, which also reduce the need for chemical inputs by fostering habitats for beneficial insects, birds, and other species. In order to take advantage of the ecological interactions that take place in diverse and well-balanced agricultural landscapes, agroecology recognizes the value of ecosystem services.
5. **Local Communities:** Agroecology can help local communities, farmers, and the environment in both social and economic ways. Farmers who use agroecology might increase their profit margins by lowering the input costs related to synthetic fertilizers and pesticides. Additionally, agroecology supports small-scale farmers and local food systems by increasing community involvement. Additionally, agro ecological practices frequently give preference to local customs and traditional knowledge, giving farmers and communities more influence over their agricultural systems.
6. **Food Security and Nutrition:** By encouraging varied and nutrient-dense food production, agroecology has the potential to enhance food security and nutrition. Intercropping and different cropping systems can increase food output and offer a larger variety of nutrients in diets. The focus of agroecology on local food systems can help lessen reliance on international supply chains, guaranteeing access to nutritious, wholesome, and culturally appropriate food. The overall goal of agroecology is to provide a holistic and sustainable approach to agriculture that fosters soil health, biodiversity conservation, resilience, and social well-being. Agroecology has the ability to address the issues of food production, environmental degradation, and social fairness in agriculture by incorporating ecological concepts into farming practices [9], [10].

III. CONCLUSION

American agronomist Basil Benson coined the term agroecology for the first time in 1928. The only application of ecological principles to agronomic research processes was what he understood agroecology to be. Over the course of the 1960s, 1970s, and 1980s, this concept evolved steadily. By that point, the concept of an agro-environment had begun to change into that of an ecosystem that had been altered by human activities for economic gain. Agro-ecology expanded significantly in the 1990s and 2000s. Agro-ecosystems are currently utilised to comprehend and define the full system of food resource production, distribution, and consumption, including all of its economic, environmental, social, and agricultural components.

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