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SUSTAINABLE AGRICULTURE; AGROECOLOGY AND ENVIRONMENTAL PROTECTION

(SÜRDÜRÜLEBİLİR TARIM; AGROEKOLOJİ VE ÇEVRE KORUMA)

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ÖZET

Günümüzde sürdürülebilir tarımsal üretimin sağlanması; ürün kalitesinin artırılması yoluyla gelirin yükseltilmesi, minimum girdi kullanımıyla çevresel zararların azaltılması, yeterli miktarda ve besin değeri yüksek gıdaların üretilmesiyle gıda güvenliğinin sağlanması ve doğal kaynakların korunması açısından öncelikli hale gelmiştir. Sürdürülebilir tarım; yeterli miktar ve kalitede üretimi hedefleyen ekonomik amaçları, tarımsal üreticilerin yaşam kalitesini artırmayı amaçlayan sosyal hedefleri ve doğal kaynakların etkin kullanımıyla çevresel kirliliğin azaltılmasını hedefleyen çevresel amaçları kapsayan bütüncül bir yaklaşımdır. Bu hedeflere hassas (akıllı) tarım teknolojilerinin uygulanmasıyla ulaşılabilmektedir.

Ekolojik bir tarım uygulaması olan agroekoloji, yerel gıda sistemi deneyimlerine dayanan ve konvansiyonel tarım sistemlerine alternatif olarak ortaya çıkan sürdürülebilir bir yaklaşımdır. Tarladan sofraya uzanan tüm süreçleri kapsayan agroekoloji, yalnızca bir üretim yöntemi değil; aynı zamanda bir bilim dalı ve toplumsal harekettir. Rejeneratif tarım ve permakültür gibi çevre dostu uygulamaları içeren agroekolojik yaklaşım, ekonomik ve sosyal sürdürülebilirliği desteklerken toprak, su ve gıda kaynaklarının korunmasını ve ekolojik duyarlılığı esas alan bir gıda sistemini hedeflemektedir.

Anahtar Kelimeler: Sürdürülebilir Tarım, Agroekoloji, Çevre Koruma

ABSTRACT

Presently, ensuring sustainable agricultural production has become a global priority by enhancing income through improved product quality, minimizing environmental degradation via reduced input use, ensuring food security through the provision of nutritious food, and preserving natural resources. Sustainable agriculture represents a holistic approach encompassing economic objectives aimed at high-quality production, social goals focused on improving farmers' quality of life, and environmental targets geared toward reducing pollution through the efficient management of ecosystems. These objectives can be strategically achieved through the integration of precision (smart) agriculture technologies.

Agroecology, as an ecological practice, offers a sustainable alternative to conventional agricultural systems by drawing on local food system experiences. Beyond being a mere production method, agroecology functions as a scientific discipline and a social movement that spans the entire value chain from farm to table. By incorporating regenerative agriculture and permaculture, this approach fosters social sustainability while simultaneously safeguarding soil and water resources.

Keywords: Sustainable Agriculture, Agroecology, Environmental Protection

1. INTRODUCTION

The ever-increasing number of problems related to agricultural production, coupled with the growing awareness that ecological problems have reached levels that threaten the lives of all living things, is bringing agroecology and sustainability in healthy food production to the forefront. The term agroecology comes from the Latin agro, meaning "field" or "agriculture," the Greek word "eco" meaning "house" or "environment," and the Greek word "logy" meaning "science." Agroecology is a contemporary science, a practice, and a movement. As a science, it attempts to explain and examine the workings of an agroecosystem using primarily biological, biophysical, ecological, social, cultural, economic, and political mechanisms, functions, relationships, and designs. As a set of practices, it enables more sustainable agriculture without the use of hazardous chemicals. As a movement, it seeks to make agriculture more ecologically sustainable and socially equitable (Wezel et al., 2009). In summary, It is the holistic examination of ecological, economic and social dimensions or in short, the ecology of the entire food system, the application of ecological concepts and principles to the design and management of sustainable food systems, the integration of research, education, action and change that brings ecological, economic and social sustainability to all segments of the food system.

Agroecology is an umbrella concept encompassing "Sustainable Agricultural Systems." Agroecological practices aim to improve ecosystems by utilizing natural processes, creating beneficial biological interactions and synergies among their components, and optimally utilizing ecological processes and the services created to develop and implement practices. Furthermore, it is a form of ecological agricultural management that can balance and enhance all ecosystem services provided by agroecosystems, thus contributing to the sustainable development of agriculture.

As a science, agroecology is:

- The holistic examination of ecological, economic, and social dimensions, or in short, the ecology of the entire food system,
- The application of ecological concepts and principles to the design and management of sustainable food systems,
- The integration of research, education, action, and change that brings ecological, economic, and social sustainability to all segments of the food system (Özkaya et al., 2021).

Industrial agriculture relies heavily on agricultural chemicals purchased from outside the farm, company seeds, large agricultural machinery, and intensive water use. In agroecological agriculture, the farm largely sources its inputs internally. Instead of agricultural chemicals, it relies on public knowledge and relevant scientific and ecological information. As a social movement opposed to the industrial model, agroecology is seen as a solution to current challenges such as climate change and malnutrition, strengthening the economic viability of rural areas and building local food systems. Short marketing chains support fair and safe food production, small-scale food production and family farming, the well-being of farmers and rural communities, food sovereignty, local knowledge, social justice, local culture, and local seeds and breeds.

The concept of agroecology, first used in the 1930s through the 1960s, was defined as ecological methods and pest management used primarily in agricultural production at the field level. In the late 1980s, the concept of agroecology emerged within the framework of the farm-level agroecosystem approach. This focused on the impacts of synthetic chemicals and other industrial inputs used in production on natural resources and the environment.

The concept of agroecology began to become institutionalized and established in the 1990s. During these years, numerous studies and research studies on agroecology were conducted and published, and the number of courses offered in higher education on the subject increased. The United Nations Conference on Environment and Development held in Rio de Janeiro, Brazil, in 1992 also played a role in this process. In the 2000s, agroecology began to be defined within the framework of the current food system approach. This approach, which includes ecological, economic, and sociopolitical dimensions, encompasses the ecology of the entire food system (Wezel and Soldat 2009). Thus, agroecology, drawing from its strong roots in ecology and agricultural sciences, has been integrated with interdisciplinary, participatory, and action-oriented approaches, thus gaining a framework that aims to address the political and economic conditions affecting the agri-food system (Özkaya et al., 2021).

The Green Revolution, based on the use of largely uniform, largely hybrid seeds and synthetic agricultural chemicals, resulted in increased productivity in irrigated areas, but this increase has been limited, particularly in non-irrigated areas, and has created significant ecological, economic, and social problems. In recent years, climate change and stagnant yields in industrial agriculture have led companies and some international organizations to consider using agroecology as a foundation for industrial agriculture. In response, La Via Campesina, an international organization of peasant organizations, organized the International Agroecology Forum in Nyeleni, Mali, West Africa, from February 24–27, 2014. Participants at the forum opposed the reduction of agroecology to a toolkit for industrial agriculture and pledged to use agroecology as a lever to transform industrial food production into a food system that is good for the people and the environment (Rosset & Altieri, 2017).

2. MATERIAL AND METHODS

The concept of agroecology encompasses various approaches, such as "Organic Farming," "Permaculture," "Regenerative Farming," and "Natural Farming." However, there are certain distinctions. For example, organic farming focuses more on the use of biopesticides. The large-scale production of these products by corporations leads to input dependency for farmers. Agroecology envisions the highest level of autonomy for farmers within existing conditions.

Some inputs used in organic farming, such as sulfur, can lead to the extinction of some predatory insects (Rosset & Altieri, 2017). On the other hand, there are also businesses that practice organic farming as monocultures. These businesses also exploit migrant, refugee, and precarious workers and sell their products to distant markets, providing production for high-income consumers. However, it is impossible to reduce agroecology to a mere technique. Agroecology also addresses income distribution as a problem and approaches the issue from a political perspective. Agroecology also controls pests and diseases through the "ecological services" provided by polyculture, natural strips, natural field boundaries, and so on.

In agroecological agricultural practices, it's more accurate to speak of specific principles rather than prescriptions. Different practices may apply to each region, and even to each farmer. Agroecology integrates traditional knowledge—local knowledge or, more generally, folk knowledge—with modern, scientific agricultural knowledge. In industrial agriculture, the farmer is considered an almost empty vessel in terms of knowledge. It's assumed that knowledge is entirely imparted to him from the outside. Thus, companies producing so-called "modern" agricultural inputs manipulate and bind the farmer. Agroecology, on the other hand, is based on "constructive education" as an educational approach. Everyone creates and constructs their own knowledge by utilizing the information they receive. (Freire, 1991)

3. AGROECOLOGICAL PRINCIPLES

3.1. Genetic Diversity

In agroecological village farms, a farmer cultivates multiple eggplant or black-eyed pea varieties or village populations. This offers a significant advantage in terms of genetic diversity and intra-variety differences. However, the "Industrial Agriculture" approach and the seed laws enacted in response to it have led to companies significantly reducing intra-variety genetic differences. The prevailing agricultural approach dictates that all plants within a variety be uniform. While uniformity is desired for some qualities within a variety, there may be differences in other qualities. For example, in what we call "village population" seeds, eggplants produced in the same field can vary considerably in shape, color, and so on. Even companies are prohibited from producing and selling certified seeds from such a village population according to our seed law.

It is known that rich genetic biodiversity within a species at the field and farm level leads to less damage to plants from both biotic stresses such as disease and abiotic stresses such as drought.

Industrial animal farming, which involves raising large numbers of animals from a single breed in confined and limited areas, with limited genetic diversity, also poses a risk. In all agricultural systems, locally adapted animal breeds can make the most of local forage resources and exhibit greater resistance to diseases and parasites. Furthermore, these animals are compatible with cultural identity and traditional knowledge and practices. Current breeding programs focus on developing a select number of animal breeds around standardized and measurable traits. However, translating traits such as robustness, resilience, and adaptability, which are common to local breeds, into measurable selection criteria is difficult. However, in recent years, agroecological traits, including reproductive capacity, functional longevity, health, and behavioral traits, have begun to be emphasized (Özkaya et al., 2021).

3.2. Species Diversity

Industrial agricultural enterprises generally grow a small number of crops, while agroecological agricultural enterprises grow a large number. For example, multiple crops can be grown in the same field. Intercropping or companion crops are some of these practices. This is usually a legume and a grain (such as beans or corn). Each species contributes to the other. Legumes fix nitrogen, while beans benefit by intercropping with corn. In Mexico, corn, beans, and squash are grown together. Squash, by covering the ground, reduces evaporation and inhibits weed growth. Multicropping can also be achieved by raising perennials, annuals, or livestock under trees. Animals consume various crop residues, byproducts, or grasses, while also feeding the plants with their manure. Trees extract nutrients from the lower soil layers. Multicropping and the presence of perennial crops allow the farm to more easily weather economic and climatic shocks. For example, trees soften the effects of drought or storms (Rosset & Altieri, 2017).

3.3. Ecological Matrix

In areas where industrial agriculture is not dominant, agricultural fields are surrounded by forests, maquis, and pastures. This creates a cohesive environment between the production unit and the adjacent ecosystem. Parasites of pests such as insects that cause agricultural damage, predatory insects, and other pests reside in these areas. Such a matrix suppresses pests and diseases. Undoubtedly, pests can also proliferate at the edge of fields. Various studies have been conducted on this topic. It has been found that the positive impact of this matrix decreases in very large field areas. One study identified corridors that allow wildlife to flourish between large vineyard plots. This positive impact was found (Nicholls, Parrella, & Altieri, 2016).

Agroecological principles can be applied at the landscape level as well as at the field level. Organic farming often substitutes inputs, such as the application of biopesticides for synthetic inputs. This perpetuates farmer dependency. In agroecology, pests and diseases can be suppressed and controlled through practices such as biodiversity and landscape protection, rather than external inputs from industry. The term "landscape" encompasses the entirety of a rural area. The term "Application of Agroecology at the Landscape Level" also refers to the consideration of nature beyond cultivated and cultivated areas.

Altieri (2015) defines the transformation from industrial agriculture to an agroecological agricultural system in three stages:

1. Increasing efficiency in input use.

Integrated Pest Management (IPM) specifically focuses on this issue. Fields and orchards are monitored, and if diseases or pests exceed a certain threshold, synthetic pesticides are applied if necessary. However, first, efforts are made to control the pest through other means. This reduces pesticide use, but agroecological goals are not yet achieved.

2. Input Substitution

In many organic farming operations, synthetic pesticides are replaced with environmentally friendly inputs. These inputs are purchased from companies, such as commercial compost and plant-derived pesticides. In this case, the agricultural operation remains a monoculture, the ecological infrastructure of the system remains unchanged, and the perspective remains that of industrial agriculture. Similarly, the focus is on symptoms and limiting factors. However, in agroecology, root problems are addressed.

3. System Redesign

Through the diversity and synergy achieved by optimally combining plants and animals, the agroecosystem reaches a level capable of supporting its own soil fertility, natural disease/pest regulation, and crop productivity. To break monocultures, it is necessary to ensure biodiversity across time and space. Crop rotation can foster biodiversity over time. For example, legumes can be used to increase organic matter for a period.

When agroecology is implemented in all its components, pests and diseases can be controlled without biopesticides or even homemade plant-based pesticides. Some practices used in organic farming, such as sulfur, can kill some pests while also killing other predatory insects. Therefore, an agroecological structure where homemade pesticides are either unnecessary or used only occasionally will only be possible by establishing an agroecological structure that goes beyond input substitution.

For example, the agroecological transformation in Cuba has four stages:

Stage 1: Increasing productivity in traditional practices: for example, using legumes, reducing energy input, and improving technological efficiency.

Stage 2: Input substitution: for example, biological pest control and better use of renewable resources.

Stage 3: Redesigning the system based on ecological processes.

Stage 4: Agroecological nexus: Developing a sustainable culture that considers the interactions of all components within the food system.

As seen in these stages, agroecological practices solely at the field or landscape level are not sufficient. The entire economy must also be organized according to agroecological principles.

Change and integration are necessary across all elements, including marketing, agricultural policy, consumption, and exports. For example, without establishing direct marketing channels from farmers to consumers and implementing local production and consumption, achieving multi-production and biodiversity will be difficult.

4. CONCLUSION AND RECOMMENDATIONS

Today, ethical issues such as ensuring environmental sustainability, equitable distribution of agricultural products, the necessity of preserving the ecological balance, the threat of species extinction, the concept of gender equality in agricultural production, and the need to ensure the healthy ingredients of the agricultural products we consume appear likely to cause further changes in the agricultural production model in the near future. It is predicted that the "food systems production model," which prioritizes efficient production, a sustainable environment, and healthy food production, will become the dominant view in the near future. Therefore, we need to reexamine our agricultural production models from an ethical perspective.

Technology produced within the technology transfer paradigm is more suited to the industrial agricultural system and the conditions of large farmers, and technology is often a commodified input (pesticides, fertilizers, etc.). The goal is to enable farmers to farm with externally supplied, modern inputs (synthetic pesticides, chemical inputs, corporate seeds, heavy machinery, excessive water, industrial feed, etc.). This development is detrimental to both the environment and, particularly, to small and medium-sized farmers and consumers.

In industrial agriculture, and even in organic agriculture based on input substitution, extension efforts can be implemented without sufficient dialogue. However, in true agroecology, practices or innovations that adapt principles to specific regions can be quite different, and local knowledge, farmer participation, and creativity are also required. For these reasons, using a top-down technology transfer approach in agroecology is both pointless and unproductive. Similarly, research that excludes farmers will yield counterproductive results and will not succeed. Participatory research is necessary. Agroecological practices require and develop innovative, scalable systemic solutions. A concerted effort is necessary to translate these solutions into practice and, with successful results, to disseminate them.

Furthermore, considering that climate change disrupts the ecological balance, threatens life on Earth, that the industrial food system contributes to this change, and that nutrition positively or negatively impacts human health, the importance of an agroecological production style becomes clear. Therefore, agricultural production must be restructured and expanded using an agroecological production style. For a more socially, justly, and economically viable agriculture that maintains ecological balance, we can change the global food system through the coordinated struggles and actions of urban-based food movements that fight for ecology and climate, recognize that eating is an ecological and political act and defend the right to access healthy food, and farmers who fight for "peasant rights." As La Via Campesina does, "Local Struggle, Global Resistance!" should be our fundamental principle, and "Food Sovereignty" should be our fundamental goal to protect the ecological balance, contribute to all living creatures in nature, to farmers, and ultimately, to our own health.

We can update our collective knowledge networks through "learning by doing" and "farmer-to-farmer" transfer methods, and utilize academic knowledge as well as local and traditional knowledge. The natural neighborhood models developed among farmers should be supported by consumer organizations and producer-consumer partnerships. This can eliminate intermediaries and shorten food supply chains. Many practices similar to the suggestions above are already being developed in our country. For all these practices to become realistic

alternatives, our needs must be comprehensively defined, a genuine confrontation with the current paradigm must be undertaken, and radical steps must be taken.

Despite the current lack of political support, many farmers are producing using agroecological principles and achieving positive results. A policy framework that supports agroecological production will enable both reducing input costs, a burden on millions of farmers, and achieving agriculture that is friendly to nature, producers, and consumers. Success in this area can only be achieved through the combined efforts of farmers and consumers.

Therefore, research is needed to develop plant nutrients based on local resources that are ecologically, economically, and socially viable using an agroecological approach. In the following plan, meetings should be held with farmers, as currently conducted by our Ministry of Agriculture and Forestry, to monitor the practical application challenges of scientific studies. Proposals should be developed to address these challenges.

Research activities based on measuring agricultural systems and their performance can only be evaluated preliminary using an agroecological approach over a minimum of two or five years. The implementation of broad-spectrum and interdisciplinary approaches requires the results of long-term research. However, solutions encompassing agroecological principles, which we must develop, organize, adapt to the region, and disseminate, must be implemented as soon as possible.

The development and widespread adoption of agroecology as a movement can be considered the greatest guarantee of the future of Turkish agriculture. The fundamental problem with the agricultural system in Turkey is the system itself, the industrialized/corporated agricultural production relations.

Therefore, for agroecology to be implemented in Turkey, it is essential to fundamentally address the (industrialized/corporated) system and to analyze the system itself with a clear and concise ideological framework.

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