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Ramakant

ADVANCES IN ORGANIC FARMING

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CHAPTER 1
INTRODUCTION TO ORGANIC FARMING IN INDIA: PRODUCTION ISSUES AND STRATEGIES

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ABSTRACT:

The contemporary organic movement, which promotes sustainable, ecologically friendly, and socially responsible agricultural practises, has grown into a major influence in the world's agriculture and food industries. The objective of this research study is to examine the development, difficulties, and potential of the contemporary organic movement. The book dives deeply into the movement's historical background, tracing its origins from early agricultural pioneers through the creation of organic certification standards and laws. It looks at the difficulties the organic movement has been having, such as doubts about the reliability of certifications, market competition, and scalability. The study also looks at how the contemporary organic movement has affected world agriculture, biodiversity preservation, and rural lives. Developing methods to enhance and increase the beneficial effects of organic agriculture requires an understandings of the history and current issues facing the organic movement. The research also emphasises the movement's possible future directions, which include embracing cutting-edge technology, enhancing cooperation with conventional agriculture, and integrating into sustainable food systems.

KEYWORDS:

Biodiversity Conservation, Modern Organic Movement, Market Competitiveness Organic Certification, Sustainable Agriculture.

INTRODUCTION

Indian agriculture has a strong native heritage in organic agricultural methods. The crop + livestock farming method is still dominant in more than 85% of farm-households as of right now.However, up to the 1960s, during the pre-green revolution era, the rate of national agriculturalincrease could not keep up with population increase, and a ship to mouth condition essentially existed. This was a key component in the development and widespread adoption of high yielding varieties (HYVs), which were incredibly sensitive to the application of chemical fertilizers and water. As a consequence, the overall output of food grains surged tremendously, from only 50.82 million tonnes in 1950–1951 to 264,000,000 tonnes in 2013–2014, or by a factor of five. The widespread use of HYVs in conjunction with other green revolution technologies in cereal crops, the expansion of the gross irrigated area from 22.56 million ha in 1950–1951 to 89.36 million ha in 2010–2011), and the rise in fertiliser consumption from 0.07 million tonnes in 1950–1951 to 25.54 million tonnes in 2012–2013 are the main causes of this increase. Together, they have caused a significant rise in agricultural productivity, particularly for food grains, which has resulted in India's position changing from one of net food importer to one of food exporter in numerous commodities[1]–[3].

However, according to the National Institute of Agricultural Economics and Policy Research's calculation of the total factor productivity growth score, technology-driven development was greatest in Punjab and lowest in Himachal Pradesh. It suggests that several states in India, including Himachal Pradesh, Uttarakhand, Madhya Pradesh, Rajasthan, Jharkhand, and the north-eastern area, have not been significantly impacted by modern agricultural inputs like chemical fertilisers and pesticides. India uses 128.3 kg/ha of fertiliser and 0.31 kg a.i./ha of pesticides on average per hectare. Furthermore, nutrient usage efficiency is on the lower side despite all technological developments. However, it has been scientifically and conclusively shown that combining organic manures with chemical fertilisers increases the effectiveness of the latter due to the simultaneous enhancement of the physical, chemical, and biological qualities of the soil. With frequent application of organic manures, the soil's ability to store water is also enhanced. In 2025, it is predicted that a variety of organic resources with a combined nutritional potential of 32.41 million tonnes would be used.Only 7.75 million tonnes of these organic resources have been calculated to contain a significant amount of nutrients ($N + P_2O_5 + K_2O$) that can be extracted from faeces, animal manure, and crop residues[3]–[5].

Area under organic farming, production and export78 million hectares of land are used for organic agriculture worldwide, which includes both cultivated and wild harvest. By 2014–15, India has brought 4.89 million ha under the organic certification process, up from the 42,000 ha that were under certified organic farming in 2003–04. Out of this, 1.18 million hectares are farmed, while the remaining 3.71 million ha are used for wild forest harvest gathering. India now holds the tenth spot among the top ten nations with cultivable land certified as organic. India is third in terms of wild collecting after Zambia and Finland. There are around 6.50 lakh producers working throughout the nation in different capacities. While Madhya Pradesh has the greatest area under the organic farming system, Sikkim State has been proclaimed an organic state since January 2016 and has the highest net sown area (100%) under organic certification.

In 2014–15, it was projected that the domestic market for organic goods will be worth Rs. 875 crores. India has many agro-climatic zones; hence each state creates its own unique speciality goods. The country's export volume and value over the last three years have shown a sharp increase over time, with the biggest volume going to the United States and the highest value going to the European Union in 2013–14. Soybean makes over 70% of all exporting goods. With the help of the UK's Soil Association, the first organic items from India were available in the middle of the 1970s. The word Jaivic Krishi or Jaivik Kheti refers to a collection of local or regional ecological agricultural systems that have emerged in various regions of India.

Concept and Principles organic farming

The whole system is founded on a deep grasp of nature's processes, making it the finest model for farming because it does not need any inputs or excessive amounts of water. The soil in this system is a living entity and the living population of microbes and other organisms in the soil are significant contributors to its fertility on a sustained basis and must be protected and nurtured at all costs; the system does not believe in mining the soil of its nutrients and do not degrade it in any way. More significant is the whole soil ecosystem, including the soil cover and soil structure.

Organic farming may be described in its most basic terms as a type of diversified agriculture where crops and livestock are managed through use of integrated technologies with preference to depend on resources available either at the farm or locally. Other advantages of organic farming include its dependence on locally accessible, fossil fuel independent resources with little to no agro-ecological stress and low cost.In general, any system adopting organic farming practises and being founded on these principles may be categorized as organic agriculture since the organic community has embraced the following four essential concepts[6].

The principle of ecology. Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them, and help sustain them. The principle of health: Organic Agriculture should sustain and enhance the health of soil, plant, animal, human, and planet as one and indivisible.The fairness principle: Organic agriculture should be based on connections that guarantee justice with respect to the shared environment and life chances.The care concept states that organic agriculture should be handled responsibly and with caution in order to safeguard the environment, present and future generations' health, and human welfare[7], [8].

DISCUSSION

Components of organic farming

1. Maintaining the health of the soil via efficient use of natural resources is crucial to organic farming. They are listed below.
2. Soil enrichment: Stop using chemicals, utilise crop residue as mulch, use organic and biological fertilisers, practise crop rotation and various crops, prevent over-tilling, and keep soil covered with vegetation or biological mulch.
3. Controlling temperature: Cover soil, grow shrubs and trees on a bund
4. excavate percolation tanks, maintain contour bunds on muddy terrain & adopt contour row cultivation, excavate farm ponds, and keep low height planting on bunds to save soil and rainwater.
5. Harvesting solar energy: By combining various crops and planting times, green stands may be maintained all year round.
6. Developing your own seeds, producing compost, vermicompost, veritas, liquid manures, and botanical extracts on-site are all examples of self-reliance in inputs.
7. Maintaining life forms requires the development of habitat, the avoidance of pesticide usage, and adequate variety.
8. Animals should be included into management strategies since they not only produce animal products but also enough manure and urine to be used in soil.
9. Utilise alternative energy sources including solar power, biogas, and other environmentally friendly machinery.

Different forms of organic agriculture

using deep-rooted permanent pasture species or green crops to cover the soil, using preparations BD-500 and BD501, compost made with preparations BD-502 - BD-507, liquid manure made with preparations BD-502 - BD-507, and cow powder to keep the soil covered in pasture, crops, or mulch, and avoiding damaging farming practises like excessive rotary hoe use or cultivation in unsuitable weather. Nine biodynamic formulations, numbered 500 to 508, have been created to date. Out of them, formulations 500 and 501 have a lot of traction and are widely utilised by organic agriculture. While formulations 502 to 507 are enrichers and boosters for compost, formulation 508 is preventive in nature and aids in the management of fungi.

Organic and towards organic agriculture

Organic is more of a description of the farming practises used on a farm than it is of the food itself, and these practises integrate science, innovation, and tradition. In order to practise organic agriculture, one must abandon the intensive use of synthetic chemical fertilisers, insecticides, fungicides, herbicides, PGRs, and genetically modified plants in favour of a large-scale use of animal manures, beneficial soil microbes, bio-pesticides, bio-agents, and indigenous technological know-how that is based on scientific principles of agricultural systems.The conversion of highly intensive agriculture areas to organic systems, according to scientific evidence, causes a significant decrease in crop yields, particularly towards an organic approach in wheat during the first 3–4 years, before the soil system recovers and crop yields reach a comparable level. A gradual approach may be preferable in this situation since converting all cultivated lands to organic production techniques might endanger the nation's food supply system.

The Working Group on Horticulture, Plantation Crops, and Organic Farming for the XI-Five-Year Plan suggested a spread of organic farming on 1-5 percent area in the high productive zones and larger spread in the less exploited areas, such as rainfed and hill areas, while taking into account this fact on the one hand and looking into the global scenario of organic agriculture on the other. Although integrated crop management, which includes integrated nutrient management and inter/mixed cropping, is also regarded as a towards organic approach, it would be appropriate to adopt it in the food bowl regions that make up the lion's share of the world's food basket because it has been shown to increase the use efficiency of all expensive inputs, particularly fertilisers and water. The government's initiatives to increase output while using less land, resources, and labour will also benefit from this method.

In addition, India has a huge cultivated area spread across many states, which is more susceptible to weather whims, particularly those in rainfed, dryland, and mountainous regions. It has always been difficult for academics and policy makers to raise agricultural production, increase farmer income, and maintain soil resources in various agricultural systems. Currently, these regions utilise much less fertilisers and pesticides than the national average. These are the regions that should first be targeted for organic agriculture via the development of sound plans and the identification of niche crops that produce more under organic farming methods and have a sufficient market demand. It is important to note that 78% of Indian organic consumers prefer Indian brand organic, and many other countries also require a variety of organic foods from India, including tropical fruits, vegetables, essential oils, flowers, herbs, and spices, as well as organic cotton.

The domestic and export markets must be taken advantage of in order to increase the income of the farmers. Additionally, the widespread adoption of organic agriculture in these regions will serve to enhance the nation's total food output while simultaneously maintaining the ecosystems' fragile ecosystems. Sikkim, a state in the country's northeastern highlands area with limited agricultural production, serves as a good illustration of this point. Fertiliser use peaked in 2002-03, when it was at 21.5 kg/ha, and rice production was at 1.43 t/ha. However, 11 years later, in 2013-14, it grew to 1.81 t/ha, and more intriguingly, no yield drop was seen throughout the conversion period.There was also a productivity boost in other crops, with maize, finger millet, and buckwheat productivity increases of 11%, 17%, and 24%, respectively.

Practical production issues and strategies for success

Even though organic farmers face a number of challenges, there are really three main problems that limit crop output when compared to conventional farming. The problems include adequate nutrition supply achieved by organic management for absorption and improved biomass yield, crops require nitrogen, phosphorus, potassium, and a number of other secondary and micronutrients. These nutrients must be delivered in a way that avoids synthetics and environmental deterioration. The subject of how to supply the nutritional needs of crops via organic manures and where to get them is the starting point for discussions about organic farming.

Management of insects and diseases: This problem is crucial since it affects the environment and agricultural yield. Is it feasible to control illnesses and pests without using synthetic chemicals?This is a serious problem for many organic farmers since it has been shown that when weeds are managed organically, they thrive vigorously when manures from other farms are used.

Supply of sufficient nutrient through organic management:

In India, there is ample room for producing enough organic inputs, which equates to 7 mt of nutrients. Livestock makes up the largest portion of all sources. Crop leftovers (30%) and other sources (15%) are next in importance.Vermicompost, agricultural wastes, and rural compost are further sources. Additionally, the idea of promoting organic farming for specific crops should be abandoned in favour of the Integrated Organic Farming System (IOFS) model, which was developed at Umiam.The following actions may be taken in order to solve the problem of an adequate supply of nutrients in organic systems.

Practice through farming system:

Since cattle alone contributes to roughly 40% of the nation's total organic manure, organic farming is seen to be incomplete without it. The primary agricultural technique used by Indian farmers historically has been crop + dairy farming. There are 38 different kinds of agricultural systems, according on an analysis of the farming methods used by 732 marginal families across the 30 NARP zones. Out of them, 47% of families have integrated agricultural and dairy systems, 11% have crop and dairy systems with goats, and 9% have integrated crop and dairy systems with poultry.As a result, the nation has a natural advantage in promoting and moving towards organic agriculture. Organic farming systems that are integrated (IOFS): In comparison to current systems, the integrated organic farming system models developed at Coimbatore (Tamil Nadu) and Umiam (Meghalaya) as part of the Network Project on Organic Farming (NPOF) could increase net returns by three to seven times and provide up to 90% of seeds/planting materials, nutrients, bio-pesticides, and other inputs on the farm within two years of their establishment.

Multiple cropping and crop rotation:

Mixed cropping, which involves growing a variety of crops on the same piece of land either concurrently or at various times, is a standout aspect of organic farming. Care should be made to keep the crop of legumes at least 40% of the time. When choosing crop pairings, it's important to keep in mind that plants have sentiments, likes, and dislikes as well. For example, maize gets along well with beans, cucumbers, and marigolds. Onions and beans don't mix well together, on the other hand. The whole farm should always contain at least 8–

10 different sorts of crops. At least four different kinds of crops, one of which should be a legume, should be grown in each field or allotment. If a single crop is grown on a plot, then alternative crops should be grown on the neighboring plots. Vegetable seedlings that can be used for home consumption may be planted randomly at a rate of 50 to 150 plants per acre for pest control and diversity maintenance, and marigold plants can be sown at a rate of 100 per acre in all agricultural fields.

Crop rotation refers to the succession of several crops grown on the same Direct seeded rice + soybean under organic management land. Follow the rotation strategy for three to four years. All crops with a high nutritional requirement should come before and after a crop combination that is dominated by legumes. Controlling soil-borne illnesses and pests is made easier by rotating crops that serve as hosts for pests and non-pests. It also aids in weed management. It is superior for increasing soil fertility and production. Crop rotations work to improve soil structure by using various root systems. When growing cereal and vegetable crops in rotation, legumes should be utilised often. Rotation planning should include green manure crops as well. Below are some guidelines for choosing crops and kinds for organic farming, along with examples.

1. Leguminous crops should come before non-leguminous crops, and vice versa, for example, green gramme should come before wheat or maize. The next crop may be either a legume, a nonlegume, or both if the previous crops were produced as intercrops or mixed crops.
2. Exhaustive or non-restorative crops need to come after restorative ones.Examples include sesame, cowpea, green gramme, black gramme, and groundnut.
3. Crops that don't drop leaves or need less work should be planted after leaf-shedding cropssuch as legumes, cotton, wheat, and rice.
4. Grain crops should come after a green manuring crop.For instance, dhaincha-rice, green gram/cowpea-wheat or maize.
5. Less fertilised crops ought to come after highly fertilized.
6. Green manures.

The main additional method of supplementing the soil with organic matter is the use of green manures. Due to its capacity to fix nitrogen from the air with the aid of its root nodule bacteria, the green-manure crop delivers organic matter in addition to extra nitrogen, especially if it is a legume crop. The green-manure crops also function as a barrier against leaching and erosion. Because they are produced for their green leafy material, which is abundant in nutrients and preserves the soil, green manure should be added to the soil before blooming. Green manures will not decompose into the soil as rapidly but will gradually enrich it with nutrients for the next crop. Intercropping and incorporating green manure crops will offer the twin benefits of controlling weeds and soil fertility. *Sunhemp*, *Sesbania rostrata*, and *Sesbania aculeate* (Dhaincha), among others, are commonly farmed green manures.

Combination of Organic Nutrient Sources

It has been shown that combining many organic sources to provide nutrients to crops is extremely effective since it is impossible to satisfy nutritional requirements from a single source. For instance, the rice-wheat system needs around 30 t FYM per year to satisfy its nutritional requirements. By implementing techniques for cropping systems incorporating green manures, legumes, and combined application of FYM + vermicompost + neem cake, this may be very readily controlled. The absorption of neem cake into the soil has been shown to be quite beneficial, and this sort of management also aids in lowering the occurrences of insects and diseases. Some of the combinations that may be utilised to fulfil the nutritional requirements of crops include FYM (partially composed dung, urine, bedding, and straw), edible and non-edible oil cakes, enhanced composts, and efficient microbes. Per tonne, FYM comprises around 5–6 kg of nitrogen, 1.2–2 kg of phosphorus, and 5–6 kilogramme of potash. Although FYM is the most popular organic manure in India, farmers do not generally pay enough attention to the resource's correct conservation and effective application. For locations with less than 1000 mm of precipitation and for all other areas, the heap approach is advised for creating better-quality FYM.

Some oilcakes that are not edible, such castor and neem cakes, also have insecticidal characteristics. In terms of non-edible oil cakes, such as castor, cotton, karanj, mahua, neem, and safflower cakes, neem cake is having higher N (5.2%), while castor and Mahua cake is having higher P_2O_5 (1.8%) and K_2O (1.8%) respectively. To make compost on the farm, a farmer can use any one or a combination of composting techniques, including the Indore method, NADEP compost, NADEP phospho compost, IBS rapid compost, coirpith, sugarcane waste, pressmud composts, poultry waste compost using paddy straw, vermicompost, pitcher khad, and bio-gas slurry. An efficient microorganism is a conglomerate culture of many effective microorganisms that are often seen in nature. N_2-fixers, P-solubilizers, photosynthetic bacteria, lactic acid bacteria, yeasts, rhizobacteria that promote plant development, different fungi, and actinomycetes are the most significant among them. Each microbe in this consortium contributes in a positive way to the cycle of nutrients.

CONCLUSION

It is possible to develop ways to reinforce and increase the beneficial effects of organic agriculture by understanding the development and difficulties of the current organic movement.The understanding acquired from researching the contemporary organic movement may have repercussions for biodiversity preservation, global agriculture, and rural life. In conclusion, further study in this area is necessary to improve our comprehension of the contemporary organic movement. Better results for organic agriculture and its effects on the environment and society may be achieved by highlighting the significance of sustainable agriculture and addressing the problems the movement is facing. Recognising organic farming's importance in promoting sustainable food systems might also encourage more cooperation and integration between organic and conventional farming. To build a more sustainable and resilient future for agriculture and food production, it is necessary for academics, politicians, farmers, and consumers to work together to strengthen the contemporary organic movement.

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CHAPTER 2

ANALYSIS OF INSECT AND DISEASE MANAGEMENT

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ABSTRACT:

Significant risks to agricultural production, food security, and ecological balance are posed by insect pests and plant diseases. This study intends to investigate integrated pest and disease control as a thorough strategy for long-term crop protection. The research explores integrated disease management (IDM) and integrated pest management (IPM) concepts, highlighting the significance of prevention, monitoring, and decision-making based on ecological, economic, and social concerns. It looks at the integration of several management methods, such as biological control, cultural practises, chemical control, and host plant resistance, to lessen dependence on solitary approaches and lower the likelihood of resistance development. The study also explores how integrated management affects agricultural economic viability, human health, and environmental sustainability. Promoting crop protection practises that are socially acceptable, commercially feasible, and ecologically benign requires an understanding of the principles and advantages of integrated pest and disease management. The paper also emphasises how this information may be used in agricultural policy, extension services, and research to assist farmers and stakeholders in implementing integrated methods to managing pests and diseases.

KEYWORDS:

Disease Management, Integrated Insect, Integrated Pest Management, Integrated Disease Management, Sustainable Agriculture.

INTRODUCTION

The use of oil cakes with insecticidal properties, the use of green leaf manures likecalotrophis, and slightly higher phenol content in plant parts under organic management all contribute to the generally lower incidence of pests and diseases under organic production systems compared to inorganic systems.The number of natural enemies on the farm also grows under organic management. When compared to integrated and inorganic management, natural enemies of crop pests and diseases such Coccinellids, syrphids, spiders, Micromus, Chrysopa, and campoletis were more prevalent under organic management. Coccinellids, which naturally decrease leaf folders and hoppers, were shown to be two to three times more prevalent in cotton, groundnut, soybean, potato, and maize crop areas managed organically. Similar to how spider populations are reported to be twice as high under organic treatment as opposed to inorganic management for pest control. Comparing organic management to integrated and chemical management, it was discovered that the variety of soil arthropod populations, including Collembola, dipluran, pseudoscorpians, cryptostigmatids, and other mite populations, was greater under organic management[1]–[3].

Weed Management

Weeds are a significant issue in organic management, and almost 43% of organic producers indicated the need to find low-cost and free weed control methods in order to successfully practise organic farming. It is necessary to slash weed between the plants. You may remove the weeds from around the plant bases and use them as mulch. The weeded materials need to be used as mulch directly on the ground. Other weed control alternatives for organic management include weeding by hand or machine, old seed beds, and weeding in general. Additionally, intercropping, diversified farming, and good crop rotation are all crucial for weed control.

Rats and termites are two more major practical obstacles that organic farmers must overcome. Some Indigenous Technical Knowledges (ITKs) used for termite management include applying dye made from Noni mixed with garlic extract to trees, applying tank silt to sandy wetlands, using alotropis plant material soaked in enough water for 24 hours, filtered, and poured on termite-infested soil, and applying sheared human hair from a barbershop to live mounds and along walls. ITKs for rat control include partially cooked sorghum grains covered with cement or white cement and packed into little packets and scattered in the field, as well as bits of cotton or thermocol dipped in a jaggery solution and manufactured into small packets and dispersed in the field[4]–[6].

Crop productivity and economics under organic management

Numerous crops reacted well to better yields under organic systems, according to an analysis of yield reported at different sites under organic management over inorganic management. In comparison to integrated and inorganic management methods, the sustainable yield index of basmati rice, rice, cotton, soybean, sunflower, peanut, lentil, cabbage, and French beans is greater under organic management. The scientific Package of Practises (PoPs) for organic crop production should be implemented from a cropping systems viewpoint, according to long-term outcomes of organic management, in order to maintain crop productivity at a level that is equal to or greater than that of chemical farming. A location-specific package of practises for the organic production of crops in cropping systems suited for 11 states has been produced under the ICAR-Network Project on Organic Farming (NPOF), and may be used to achieve the highest productivity under organic management. Green gram, chickpea, and cowpea do well among the pulses.

When on-farm organic inputs are applied, the cost of output per unit area under organic agriculture is equal to or cheaper than that under inorganic management. However, the cost of production rises by around 13% if organic inputs from outside the farm are bought and used. As a result, on-farm production of inputs such as mixed cropping, crop rotation, residue recycling, composting, etc. should naturally be a pillar of organic agriculture.Soil that has been handled chemically vs organically in the field environmental champion Growing crops organically on a regular basis has the potential to sequester carbon up to a 63 percent increase in C stock in ten years, increase soil organic carbon 22% increase in six years, reduce energy usage, and increase water holding capacity, all of which promote farming that is climate resilient[7], [8].

It may be inferred that in order to sustain a crop yield and revenue level that is equivalent to or greater than that of chemical farming, scientific organic farming packages with an ecological viewpoint are required. Additionally, accelerated adoption of the towards organic (integrated crop management) approach in intensive agricultural areas (food hubs) and certified organic farming with a blend of tradition, innovation, and science in the de-facto organic areas (hills) and rainfed/dryland regions can support safe food security and climate resilience in addition to raising farm households' income. The core goal of organic agriculture, the health of people, animals, and the environment, will also be favourably impacted by this strategy.

Nutrient Management in Organic Farming: Principles and Practices

Inorganic fertilisers, which are supposed to circumvent the soil's natural processes and feed plants directly, are not allowed, making it difficult to regulate nutrients in organic farming systems. It is challenging to match the crop need for nitrogen with the supply of nitrogen that results from the mineralization of organic materials, such as crop wastes, green manure, composts, and other organic sources. In organic farming, one theory is known as the law of return, which holds that any nutrients taken out of the crops or cattle must be replaced in order to preserve fertility. Organic agricultural techniques need effective nutrient management. Recycling, controlling biologically linked processes like nitrogen fixation, and the sparing use of unprocessed, slowly soluble off-farm items that disintegrate in the same manner as soil minerals or organic matter all promote the provision of nutrients to crop plants.

A compost's carbon-to-nitrogen ratio (C:N) may be used to determine its maturity and N availability. N from the soil is more likely to get bound up when the C:N ratio climbs beyond 20:1. An initial C:N ratio of 30 is best for composting since the organisms involved in the stabilization of organic waste need roughly 30 parts of carbon for every component of nitrogen. According to research workers, the ideal figure might vary from 26 to 31 depending on the surrounding circumstances. Generally speaking, organic materials that will be employed as nutrition sources must meet the following requirements. I.e., moisture should be between 15 and 25 percent by weight, colour should be dark brown to black, no foul odour should be present, particle size should be minimum, bulk density should be less than 1 g/cc, total organic carbon should be at least 2.0 percent by weight, total N should be at least 0.8 percent by weight, total phosphates should be at least 0.4% by weight, and The heavy metal concentrations may be as high as 10 ppm of arsenic, 5 ppm of cadmium, 50 ppm of chromium, 300 ppm of copper, 0.15 ppm of mercury, 50 ppm of nickel, 100 ppm of lead, and 1000 ppm of zinc.

DISCUSSION

There are many natural products or organic fertilisers that have been authorised for sale in stores. These components are often leftovers from the preparation of fish, pork, and soybeans.These materials come in a wide range of commercial formulations and nutritional assessments.They often supply P, K, or both in addition to N and vary from 1 to 12 percent N. Other straightforward fertilisers that simply contain one macronutrient include green sand (K), potassium sulphate, blood meal (N), and rock phosphate (P). Blood and bone meal are two by-products of the meat processing industry that have lately drawn attention due to concerns about food safety and the possibility for disease transmission.One or more minor elements are often present in organic fertiliser sources. A certifying body may allow additional synthetic fertilisers under certain conditions to make up for small element shortages like a zinc or copper shortfall. When acceptable source materials are used, soil levels will rise to a point where they are adequate.

When a deficit or imbalance is shown by a soil test, an organic gardener may benefit from specific, authorised supplies of K, Ca, and Mg. Gypsum, lime, and potassium-magnesium sulphate are a few materials that have been used in agriculture for a long time and have been shown to be valuable. These substances may be used to address calcium, magnesium, or potassium deficiency or imbalances, and lime can be used to increase the pH of the soil. Gypsum is often used to increase water penetration on clay soils with weak structure as well as to replace exchangeable sodium before reaching a high-sodium soil.Pyrites may also be added to sodic soils as a soil supplement. Kelp and other processed seaweed-derived materials include nutrients, as well as often plant hormones and growth regulators. According to some, microbial soil stimulants boost growth or lower soil pests.

Nutrient Sources

The most effective methods for controlling the total supply of nutrients on organic farms are crop rotations. Crop diversity may maintain or improve production efficiency while providing several agronomic and ecological advantages. The most cost-effective strategy to provide N to subsequent crops and to minimise nitrate leaching, nutrient runoff, and soil erosion is to grow cover crops and green manure crops that incorporate N-fixing legumes. For a green manure crop to fix between 60 and 90 kg N per hectare, it typically needs 50 to 60 days of growth. The most reasonably priced organic supply of N is compost, along with vermicompost and other enhanced composts. Additionally, these composts include generally well-balanced levels of P, K, Ca, Mg, S, and other minor nutrients. Despite the low real P and K concentrations in composts, the total additions might be rather significant owing to the large amount of material added. Green manure, farm yard manure (FYM), vermicompost (VC), compost, enhanced compost, bio-gas slurry, non-edible oil cakes, chicken manure, Azolla, biofertilizer, biodynamic compost, and Panchgavya are nutrient sources often utilised in organic farming.

Green manure (A) Green manures, sometimes referred to as cover crops, are plants that are cultivated to enhance the organic matter content and soil structure. They may be used in addition to animal manures and are a less expensive option to chemical fertilisers. planting a green manure is different from merely planting a legume crop in a rotation, like beans. Green manures are often buried under the surface of the soil while the plants are still young, before they blossom or produce any crops. They are produced for their nutritious green leafy material, which also serves as soil cover, with the goal of boosting the amount of organic matter and humus in the soil. Fast-growing, nutrient-rich legume crops that are resistant to biotic and abiotic stressors, have a smoothing effect against weeds, and have greater leaves are the best crops to use as green manures.

Commonly used crops for green manuring include Sesbania aculeata suitable for rice-wheat, 55 days old crop producing 17-30 tonnes green matter per ha), *Sesbania speciosa* suitable for wet lands, when raised on field borders along the bunds, 90-day old crop contributes 2-4 tonnes green matter per ha and *Crotolaria juncea*suitable for almost all regions of the country and adds 15-25 tonnes fresh biomass in 50-60 days). They may be cultivated alone or alongside other crops.In order to ensure a C:N ratio of 22:1 or below so that net mineralization occurs, green manure crops should normally be harvested or integrated into the soil when near to full bloom (but before seed set). This is because the C:N ratio of these crops rises as they mature.

Sesbania aculeata and Crotalaria juncea are the two most often utilised green manure crops. Sesbania and Crotalaria should be sown at a rate of 25–30 kg per hectare to produce green manure. Green manure seed dissemination is a common practise. However, if line planting is used with 45 cm between rows, a superior green manure crop may be grown. Depending on summer precipitation, one presowing irrigation should be used, followed by 1-2 irrigations to ensure adequate development of the green manure crop. Typically, sowing takes place from the final week of April to the first two weeks of May. Around 55 to 60 days after seeding, the green manure crop would be rejected. Before puddling and transplanting rice crops, the Trichoderma should be sprayed on turned Sesbaniarotalaria crops in the field.

Indigenous FYM Production Technology (B) Farm Yard Manure (FYM). Dung, urine, bedding and straw that has partly decomposed make up farm yard manure. The main sources of dung and urine, respectively, are undigested and digested materials. Because lignin and protein, which make up more than 50% of the organic matter in dung, are resistant to further degradation and are present in complex compounds, the nutrients in dung are released extremely slowly.Urine nutrients become easily accessible. About 50% of the nitrogen, 15% of the potash, and practically all of the phosphorus that animals defecate are found in dung.

Farmers utilise on average 3-5 kilogrammes of bedding material per animal. Per tonne, FYM comprises around 5–6 kg of nitrogen, 1.2–2 kg of phosphorus, and 5–6 kilogramme of potash. The amount of manure that may be generated per animal year, if properly stored, would be as much as four to five tonnes, containing 0.5% nitrogen. In the event that it is available, well-decomposed FYM should be applied at a rate of 15–20 tonnes per ha for cereals and 5–10 tonnes per ha for pulses. This may provide 75–100 kg of N, 35–40 kg of P2O5, and 75–100 kg of K2O per ha. Trichoderma powder should be added to help breakdown FYM.

Vermicompost (C) Vermicomposting is a straightforward biotechnological method of composting in which certain species of earthworms improve the waste-to-product conversion process and provide vermicompost as the superior byproduct. It is clear that vermicompost offers all nutrients in easily accessible form and also improves nutrient absorption by plants since worm castings (also known as vermicompost) contain a greater proportion (almost twice) of both macro and micronutrients. In comparison to the conventional way of making compost, vermicomposting transforms home compost in only 30 days, lowers the C:N ratio, and preserves more nitrogen.

Vermicomposting may be done in a number of ways, including cement rings, heaps above ground, tanks above ground, and trenches below earth. When comparing these techniques, the heap method of creating vermicompost performed better, and earthworm populations, biomass output, and ultimately vermicompost production were all greater. *Eisenia foetida* and *Eudrilus eugenae*, two African species of earthworms, are best for making vermicompost. Earthworms should also be protected from rats, termites, ants, and birds, and plant-based materials like grass, leaves, or vegetable peelings should be used in the process. Pits are made to be 1 m deep and 1.5 m wide, but the length can vary depending on what is needed. The bottom of the pit is covered with a polythene sheet, which is then covered in a 15-20 cm layer of organic waste material (which helps to improve the nutritional quality of compost), before cow dung slurry is sprinkled on top. Pseudomonas fluorescens culture may also be introduced at a rate of 200g/100kg. Pit is entirely filled in layers as indicated, then the top is covered with dirt or cow dung, and the material is left to disintegrate for 15 to 20 days.

Organic debris that has been broken down over time by the activity of bacteria and other creatures is known as compost. Different types of heterotrophic microorganisms, such as bacteria, fungus, and actinomycetes, among others, carry out the biodegradation process.

Organic materials decompose rapidly in thermophilic and mesophilic conditions in heaps, pits, or tanks with sufficient moisture and aeration, producing compost, a humified substance with a brown to dark brown appearance. Compost may be made from items like leaves, fruit peels, and animal manures. Compost is an inexpensive, simple-to-make substance that may be given to the soil to enhance the quality of the soil and the crops while also enhancing the soil's structure. This enhances soil airflow, enhances drainage, and lessens soil erosion.Compost increases soil fertility by introducing nutrients and by facilitating plants' uptake of the nutrients already present in the soil, leading to higher yields.The compost's rate of decomposition is influenced by the C:N ratio. Low C: N ratios may cause ammonia to be lost along with too quick of a breakdown. A decomposition process that takes too long and yields a poor-quality final product may be the effects of a high C: N ratio.The 25:1 to 40:1 C:N ratio range is ideal. Decomposing organic matter should maintain a moisture content of between 50 and 55 percent.

Enrichment of Compost

The quality of various composting techniques for nutrient enrichment via the use of rock phosphate, pyrite, and microorganisms is superior in terms of N, P, K, and S content. Rockphosphate is applied at a rate of 12.5% to a combination of plant waste, FYM, and soil in the proportion of 8: 1: 0.5 throughout the composting process in order to enrich the compost. Similar to this, pyrite is added to plant waste during composting at a rate of 10% in a combination of FYM, soil, and plant residue in the ratio of 8: 1: 0.5% in the form of slurry. In order to add inoculums to the compost to enrich it, a mixture of FYM (10 kg), soil (2 kg), and inoculums in 100 to 150 litres of water were added to the top layer of composting. This mixture produced one tonne of enriched compost.

Bio-gas Slurry

An excellent source of organic manure is o-gas slurry. When compared to the manorial product of aerobic decomposition, anaerobic digestion of raw animal dung by microorganisms in the bio gas plant gives greater benefits in increasing the manorial value of the slurry. Nitrogen is lost between 30 and 50% during the aerobic breakdown of organic matter, but it is nearly entirely conserved during anaerobic digestion. About 15 to 18% of the total nitrogen is transformed into ammonical nitrogen, which is the major source of soluble nitrogen, during anaerobic bio-digestion. To prevent the loss of ammoniac nitrogen, precautions must be taken both during the slurry's storage and application to the soil. Animal dung contains all chemical components, except carbon, oxygen, hydrogen, and sulphur, which are all preserved in bio-digested slurry, which is said to be richer in plant nutrients than FYM. Before planting seeds or transplanting seedlings, air dried bio gas slurry may be used by spreading it on agricultural ground at least one week beforehand. On a dry weight basis, the bio-gas slurry had a nutrient content of 1.43 percent N, 1.21 percent P, and 1.01 percent K. In general, it is advised to apply 10 tonnes per ha of bio-digested slurry once every three years to preserve soil organic content while also giving crops organic fertilisers that include nitrogen, phosphorous, and potassium.

Non-edible oil cakes

Contrary to other organic manures, non-edible oil cakes are more nutrient-rich. Numerous oil cakes, including those made from castor, neem, mandus, karanja, linseed, rapeseed, and cotton seed, may be used as suitable organic sources. The alkaloids nimbin and nimbicidine found in neem cake successfully suppress the nitrification process while enhancing rice production, nitrogen absorption, and grain protein content. Rice has been grown effectively on salty coastal soils using mahua cake. They are insoluble in water, but approximately a week or ten days after application, their N becomes immediately accessible to plants.The majority of non-edible oil cakes are highly prized for their alkaloid content, which prevents soil nitrification.

CONCLUSION

Understanding the principles and advantages of integrated insect and disease management provides chances to advance sustainable agriculture and tackle the difficulties of pest and disease management.Studying integrated management has the potential to change how agricultural policy, extension services, and research are conducted. Supporting farmers and other stakeholders in implementing integrated pest and disease management strategies may result in crop protection practises that are socially good, commercially feasible, and ecologically responsible. To sum up, further study in this area is necessary to advance our comprehension of integrated insect and disease control. Stressing the value of sustainable agriculture and ethical pest management may improve crop protection and ecosystem health. Recognizing the benefits of integrated methods might also encourage farmers and stakeholders to embrace these practises. To preserve the long-term health and productivity of agricultural systems, integrated management of insect pests and plant diseases involves cooperation among researchers, policymakers, farmers, and agricultural professionals.

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CHAPTER 3

ANALYSIS OF WEED MANAGEMENT IN ORGANIC FARMING

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ABSTRACT:

A key component of organic farming, which prioritises ecological balance above the use of chemical pesticides, is weed control. To maintain sustainable crop production, this research study will examine several weed control techniques used in organic farming. The study explores the fundamentals of organic weed management, with special emphasis on the use of cultural, mechanical, and biological control techniques to prevent weed development and crop competition. In controlling weed populations, it examines the efficacy of cover crops, crop rotation, mulching, manual weeding, and biological agents such beneficial insects and microorganisms. The study also looks at how organic weed control affects the biodiversity, soil health, and overall ecological sustainability of agricultural systems. It is essential to comprehend the approaches and difficulties involved in managing weeds in organic farming if one wants to advance ecologically sound, commercially successful, and ethically sound agricultural practises. In order to encourage the adoption of sustainable weed control practises in organic agriculture, the research also underlines the possible uses of this information in organic certification programmes, farmer training, and policy development.

KEYWORDS:

Biological Control, Cultural Control, Mechanical Control,Organic Farming, Weed Management.

INTRODUCTION

Weeds are a unique family of pests that severely restrict agricultural yield on any size. They are substantial contributors to agricultural output losses and compete with the crops for nutrients, air, light, and moisture Overall, weeds caused the highest loss (34%) with animal pests and plant pathogens being less important, causing losses of 18% and 16%, respectively, according to an assessment of agricultural yield losses brought on by pests weed losses outweigh those from all other types of agricultural pests combined. Farmers' decision to use synthetic chemicals to reduce losses from weeds, pests, and illnesses has various negative repercussions on the environment and people's health Insecticides (26%) and fungicides (23%) accounted for lesser shares of overall expenditure than herbicides 46% of worldwide pesticide. While many nations throughout the globe still see herbicides as the primary weed management tool, non-chemical approaches are becoming more widely acknowledged for their many benefits to both people and the environment[1]–[3] .

For the protection of human and environmental health as well as to prevent the emergence of herbicide-resistant weeds, non-chemical weed management techniques are encouraged Depending on the environment, plant type, population number, and other elements, we may have different ideas of what a weed is. Weeds are those plants that have a detrimental impact on agricultural output on a farm. In the first place, weeds compete with crops for resources like water, nutrients, and sunshine, which might lower agricultural yields. Additionally, the expense of eradicating weeds and the insects and illnesses they harbour raises production costs. Weeds may obstruct harvesting equipment and further degrade crop quality by contaminating it. The designation of being a weedy plant is given to plants that fit into the weed category by a set of similar features, notw6ithstanding the absence of a universal description for each situation. Weeds are resourceful and competitive, and they react quickly to good growth circumstances[4]–[6].

Weeds also possess a number of traits that improve their capacity for reproduction. They may reproduce by vegetative growth, seeds, or both.They make use of several seed dispersion techniques.A single propagule is sufficient to establish a colony of sexually reproducing plants, and they yield a large number of seeds.

In addition to other qualities that crop growers find objectionable, weeds may lower agricultural yields by competing with crops for resources like sunshine, water, nutrients, and space. Additionally, weeds may serve as a home for certain plant viruses and host insects. Some weed species, such eastern black nightshade and wild garlic, may impair the quality of the harvested crop.Without well thought-out weed control measures, organic farming cannot produce crops profitably. Competition arises when one of the resourcesnutrients, light, moisture, and spaceis insufficient to meet the needs of both weeds and economically viable crops.

Weeds naturally spread more quickly, take up the habitat for crops, and lower the potential yield of most cultivated crops.The ultimate objective of weed management is to eliminate or minimise the harmful impacts of weeds on crops. All techniques that increase a crop's capacity for competition and lessen weeds' capacity to lower production are referred to as integrated weed management (IWM).Since the growing use of agro-chemicals has allegedly led to issues with the environment and human health, there is now a resurgence of interest in organic weed management techniques. In certain instances, the usage of herbicides has been proven to contribute to the dominance of certain weed species in fields because such weeds become resistant to the herbicides.Additionally, certain herbicides have the power to eliminate weeds that are not harmful to crops, which might lead to a decline in biodiversity. It's crucial to know that weeds can never really be eradicated under an organic system; they can only be controlled.

Organic farming is a comprehensive approach to production management that fosters and improves the health of the agro-ecosystem, including biodiversity, biological cycles, and soil biological activity. The term organic farming refers to a production method that primarily or entirely forgoes the use of synthetic fertilisers, pesticides, growth promoters, and additions to animal feed. The adoption of nutrient-responsive, high yielding crop cultivars together with the indiscriminate use of synthetic agrochemicals like fertilisers and insecticides as part of the green revolution technologies have increased productivity[3].

Its detrimental impact on the deterioration of soil and environment has recently been the subject of repeated concerns. These include soil erosion, a reduction in soil organic matter, a lack of water availability, pesticide contamination of food and water, and a negative impact on biodiversity. Therefore, it is vital to reduce environmental deterioration to the absolute minimum and increase the productivity of damaged soils. The practice of organic farming is one way to do this.The main objective of a weed management strategy in an organic system is to lower weed competition and reproduction to a level that the farmer can tolerate. In many instances, not all weeds will be totally removed. However, by reducing the formation of weed seeds and perennial propagulesthe portions of a plant that may generate a new plantweed control should lessen competition from present and future weeds. Consistent weed control may lower weed control expenditures and help create a crop production system that is less expensive[7]–[9].

Methods of weed management

In an organic farm, weed control depends on an integrated cropping system strategy. Crop plants and weeds should coexist in harmony in an organic agricultural system. Farmers may intervene in such a system to shift the balance whenever feasible in favour of crop plants.

Crop Rotation

Long rotations and diverse cropping systems are often used by organic farmers to improve soil fertility and economic diversification. Crop rotation is another important component of a weed control strategy. Crop rotation is the regular alternation of several crops grown on the same plot of land. It is a crucial tactic for creating an effective long-term weed management programme. Weeds often flourish in crops with growth needs comparable to their own, and cultural practises intended to benefit the crop may also promote weed growth and development. growth the same crop in the same field year after year is known as monoculture, and it leads to an accumulation of weed species that have adapted to the crop's growth circumstances. When a variety of crops are utilised in a rotation, changes in the cultural practises connected with each crop may disrupt weed germination and growth cycles.Where late-germinating weeds are a concern, an early crop can be followed with tillage and a vigorous, competitive summer annual crop to suppress these weeds. When a crop with a dense, closed canopy, such as potatoes, is grown before growing a crop that is less competitive with weeds, the dense crop reduces the development of weeds[10], [11].

DISCUSSION

Cover Crops

Weeds are suppressed by the crop's quick growth and extensive ground coverage. Incorporating cover crops into the cropping system, such as rice bean, groundnut, rye, red, clover, buckwheat, wintering crops like winter wheat, or forages, might inhibit weed development.

1. High-competitive crops may be produced as'smother' crops with a limited lifespan in the cycle.
2. An organic farming system may benefit greatly from cover crops, which also help to prevent soil erosion, improve soil structure, increase soil fertility, and control weed growth.
3. There are several strategies to control weeds using cover crops. Cover crops have the ability to control weed growth, lower weed populations in the next crop, and lower weed seed inputs into the soil seedbank:
4. In lieu of a fallow season, annual or short-term perennial cover crops may be used to prevent soil erosion, preserve soil fertility, and compete with weeds for nutrients, water, and light.
5. Rapidly growing cover crops that create a thick canopy may shade out emerging weeds and outcompete them.

Additionally, cover crops may operate as a living mulch or organic mulch to further reduce weed growth throughout the growing season.

Intercropping

Growing a smother crop in between rows of the main crop is known as intercropping. Using intercrops, weeds may be controlled. Nevertheless, intercropping as a seed control tactic has to be used with caution. If there is competition for water or nutrients between the intercrops, the main crop's yields might be significantly reduced.In highland rice, maize, or sorghum, intercropping soybean and groundnut significantly decreases the weed issue.

Mulching

In many farming systems, adding mulch after planting might have certain advantages. By restricting light penetration and changing the cycles of soil moisture and temperature, mulches lessen weed competitiveness.vivified mulch Clover is an example of a plant species that often grows thickly and low to the ground and is used as living mulch. You may plant living mulches either before or after a crop has begun to grow.In order to prevent live mulch from competing with the real crop, it is crucial to kill it or somehow regulate it. Before transplanting broccoli, use a live mulch made of Portulaca oleracea to control weeds without compromising crop output. Living mulch often has other goals than weed control, such as enhancing soil fertility, reducing insect issues, or improving soil structure.

Organic Mulches

Many materials that may be generated on a farm, including as hay, straw, grass mulch, agricultural wastes, and animal or poultry bedding, are used as organic mulches.There may also off-farm sources for other materials, like leaves, composted municipal trash, bark, and wood chips. Farmers must take into account the sort and amount of mulch that will be used, as well as the mulch's cost and the equipment required to handle it. The usage of organic mulches might be prohibitively expensive for farmers in instances were carrying and spreading them is necessary. Look into the organic mulches that are offered close by. Municipalities often offer to transport organic waste for free since doing so saves them money on landfill fees. However, its quality in terms of heavy metal pollution, microbiological load, etc., should be taken into account.Look at methods for producing mulches on a farm. Have organic mulch materials, particularly those that are purchased off-farm, tested for heavy metals and nutritional content.

Benefits and drawbacks

Clean agricultural machinery often. If equipment and tools are utilised in several locations, they must be fully cleaned before being used in another area. Cleaning is crucial, particularly when moving equipment between fields.Limit the volume of off-farm traffic that comes to productive areas on foot or by car.Apply weed-free mulch and compost to your landscaping. For instance, straw mulch may contain seeds that may later be an annoyance. Wet the straw and enable weeds to sprout rather than preventing them from being carried into a field with straw mulch. Dry out the straw bale once the weed seeds have sprouted to destroy seedlings by tearing it apart.Properly compost animal waste. Animal manures often include weed seeds, with the amount and kind of viable weed seeds introduced depending on the source of the manure. Before applying compost manures to the soil, weeds and other undesirable organisms must be carefully eradicated. Compost materials at a temperature of at least 180°F

(82°C) for at least three days to destroy the bulk of weed seeds in bovine dung. In the majority of composting systems, this temperature is rather simple to achieve.Before planting, check the seeds and transplants. Weed seeds may infect crop seeds, particularly grain seeds.The potting soil in transplants could include weed seeds if it wasn't sanitised before usage. Always inspect seeds and transplants before planting, and only purchase them from reliable vendors.

Planting Strategies

For many row and horticultural crops, the timing, density, and arrangement of fast growth and early canopy closure may reduce weeds. This makes it desirable to use transplants wherever feasible while growing horticulture crops. Utilising transplants will raise manufacturing costs, thus the financial advantage must be balanced against the expense. Use of transplants should be taken into consideration when it is feasible economically, which is the case with many vegetable crops.

Planting Date

Depending on the weather and the state of the soil, different crops may need different planting dates from year to year. Even though a farmer must take these things into account when choosing a planting date, planting may be scheduled to reduce competition from potentially dangerous weed populations. A cash crop should sometimes be seeded or transplanted early to achieve canopy closure as soon as feasible. On the other hand, some farmers think that from the standpoint of weed control, planting on the latter side of the window of suggested planting dates makes sense. Due to warmer soils, later planting permits one or two weed pre-cultivations and may also offer the cash crop a head start.

Use of Manure and Compost

Utilising organic manure may have an impact on succeeding crops as well as the competition between crops and weeds. Weed density in agricultural fields is influenced by the kind of organic manure used and the application technique. broadcasting is better for weeds than for crops. The poor breakdown of composts also encourages weed growth in fields. Legumes may help to reduce weeds when used as a natural alternative to artificial nitrogen fertilisers to meet the crop's additional nitrogen demands.

Legume residues slowly release nitrogen, reducing the encouragement of unwelcome weed growth. Weeds may be prevented from growing by applying organic manure close to the rows where it will be more likely to be absorbed by the crop.With the intention of depending on the mid-season release of nutrients from compost and/or green manures for primary fertility, expensive bagged organic fertiliser may be used at modest rates at planting or as a side dress.

Water Management

The key to managing water effectively is weed control in agricultural production. Weed growth in a field is influenced by irrigation timing and technique. Since drip irrigation provides water directly to the crop's root zone, weed development is minimal. Careful irrigation management may lessen weed burden on crops in a variety of different ways. Mulching, intercropping, and other water management techniques serve to lessen the weed issue in rainfed agriculture.

Mechanical Weed Control

Although labour- and time-intensive, mechanical weed removal is the most efficient way to control weeds, especially on an organic farm. The kind and quantity of weeds as well as the structure and shape of the crop will determine the implementation method, timing, and frequency. In cultivation, weeds that are just starting to emerge are killed or newly shed weed seeds are buried below the depth at which they would sprout. It's crucial to keep in mind that every ecological strategy for managing weeds starts and ends with the soil seed bank. The stockpile of weed seeds in the soil is known as the sole seed bank. A farmer may make wise weed control choices by keeping an eye on the seedbank's makeup. The best mechanical weed seedling management methods include burying weed seedlings to a depth of 1 cm and cutting them at the soil surface.

In addition to cutting and cultivating instruments like mowers and stimmers, mechanical weeders also include thistlebars and other dual-purpose devices like hoes, harrows, and tines. The morphology of the crop and the weeds determines the appropriate tool to employ, as well as when and how often. While inter-row brush weeders are seen to be more efficient for horticultural usage, tools like fixed harrows are better suited for arable crops. Vegetables including carrots, beets, onions, garlic, cilantro, and leeks are the major uses for the brush weeder. The competitiveness of the crop and the weeds' development stage affect the best time to use mechanical weed management.

Flame Cultivation

On the majority of organically grown crops, broadcast flame culture may be employed successfully prior to sowing the crop. It works better on a flat soil surface than one that is crooked or uneven, it works better against broadleaf weeds than grasses, however it loses power as weeds become older. Grasses and perennial weeds can withstand flames the best. While flaming burns grasses and perennial weeds to the soil's surface, these weeds may sometimes sprout again. After flame cultivation, it is important to carefully sow or transplant crops to avoid disturbing the soil and promoting the germination and establishment of weed seeds.

Methodology of allelopathy utilization in organic weed management

Crops should be grown in the following ways to better utilise allelopathy's ability to reduce weed pressureswitching between crops that germinate in the fall and those that do so in the spring switching between annual and perennial crops; and switching between crops that are dense and closed.Plant-to-plant interactions, soil-to-plant interactions, plant-microbe interactions, and crop residue interactions all play a part in enhancing crop yields. Allelochemicals generated by rotational crops then interacted with a variety of physiological functions, perhaps fostering crop growth and productivity. In sustainable agriculture, breeding new cultivars with high allelopathic potential may have a significant impact on biological weed management. The significant allelopathic qualities of several crops, including sorghum, cucumber, rice, wheat, and soybean, imply that these features may be genetically connected.

Beneficial Organisms

Few studies have been done on the use of predatory, parasitic insects or microorganisms to control weed populations. However, in the future, this may serve as a helpful management tool. A weevil for the aquatic weed salvinia, a rust for skeleton weed, and possibly the most well-known natural enemy, a caterpillar to manage prickly pear, have all proven effective thus far. Significant research is also being done on genetically modifying microbes and fungus myco-herbicides to be more successful in controlling particular weeds. Myco-herbicides are solutions containing pathogenic spores that are sprayed on plants using typical herbicide application tools.

Integrated Weed Management (IWM)

IWM is a scientific decision-making process that combines the use of macro and microenvironment data, weed biology and ecology, and all available technology to control weeds by the most practical and environmentally friendly means. A single management strategy known as integrated weed management integrates several preventive, cultural, genetic, mechanical, biological, and chemical weed control practises. Although no one control method is likely to completely eradicate weeds, the systematic use of IWM's multiple components may significantly aid weed management efforts. When appropriately used, IWM may result in sustainable food production, reduced labour costs, and decreased weeding expenses for crops.

The cost, the method's effect on the soil, and the environment should all be taken into consideration when choosing a weed control strategy. When creating a proper weed control strategy, the weather and climate of the farm site should also be taken into account. An IWM approach encourages the use of all available weed control methods, including the selection of a well-adapted crop variety or hybrid with good early season vigour and appropriate disease and pest resistance, which is plant breeding; appropriate planting patterns and optimal plant density; precise timing, strategic placement, and appropriate quantity of nutrient application; appropriate crop rotation, tillage practises, and cover crops; suitable choice of mechanical, biological, or chemical weed control methods; and appropriate choice of mechanical, biological, or chemical herbicides.

CONCLUSION

Understanding the methods and difficulties involved in managing weeds in organic farming presents opportunity for advancing agricultural practises that are socially and ecologically acceptable. The research of organic weed control may have an impact on policy formation, farmer education, and organic certification programmes. Supporting the use of environmentally sound weed control methods in organic farming may result in more resilient and sustainable agricultural systems.

In conclusion, further study in this area is required to advance our comprehension of weed control in organic farming. Ecological concepts and integrated weed control may help produce organic crops more successfully while also preserving the environment. Recognising the benefits of various weed control techniques might also encourage farmers to include them into their organic farming operations. To maintain the long-term viability and profitability of organic agriculture, weed control in farming needs cooperation among researchers, organic certifiers, legislators, and farmers.

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CHAPTER 4

ORGANIC CROP PRODUCTION: IDENTIFYING AND MANAGING PESTS AND DISEASES

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ABSTRACT:

Identification and control of pests and diseases are essential components of organic crop production, which substitutes sustainable and environmentally friendly methods for synthetic pesticides and chemicals. This research study will examine the methods used in organic farming to recognise, control, and prevent pests and diseases so that crop production is robust and sustainable. The research dives into the fundamentals of organic pest and disease management, highlighting integrated strategies that give priority to biological control, monitoring, and preventative techniques. It looks at how to control pest populations and stop disease outbreaks by using beneficial insects, trap crops, companion planting, and natural therapies. The study also looks at how improving soil health, crop variety, and ecological balance might make organic crops more resistant to pest and disease stresses. In order to promote ecologically sustainable, commercially successful, and socially acceptable agricultural practises, it is essential to comprehend the approaches and difficulties in managing pest and disease problems in organic crop production. In order to encourage the adoption of sustainable pest and disease control practises in organic agriculture, the research also underlines the possible uses of this information in training, extension services, and policy development for organic farming.

KEYWORDS:

Biological Control, Disease Management,Integrated Pest Management, Organic Crop Production, Pest Management.

INTRODUCTION

According to the FAO, organic farming is a comprehensive approach to food production management that fosters and improves the health of the agro-ecosystem, including biodiversity, biological cycles, and soil biological activity. It emphasises the use of management practises above the usage of off-farm inputs while taking into consideration the need for regionally tailored systems according to regional circumstances. This is achieved by avoiding the use of synthetic materials wherever feasible and instead employing agronomic, biological, and mechanical processes to carry out any necessary system functions. 'Organic agriculture' is a production method that maintains the health of soils, eco-systems, and people, according to the International Federation of Organic Agriculture Movement (IFOAM). Instead of using inputs with negative impacts, it depends on biological processes, biodiversity, and cycles that are tailored to local circumstances[1]–[3].

Organic farming blends science, creativity, and tradition to benefit the environment as a whole, foster just relationships, and improve everyone's quality of life.In organic farming, control of pests and nitrogen are crucial elements in determining crop viability. Weeds, insect pests, illnesses, nematodes, rodents, and other creatures that affect (cause quantitative or qualitative losses to) our crops are often considered pests.In the case of traditional agricultural systems, farmers or farm managers utilise synthetic chemical pesticides as a fast cure as part of an integrated pest control strategy. Contrarily, organic farming mostly depends on various non-chemical management practises for managing or controlling these pests owing to the restriction on synthetic chemical pesticides.

Identification of diseases and pests

The procedure of acquiring information about a plant issue and figuring out the reason is known as diagnosis or identification. Once the root problem has been identified, a solution or treatment may then be suggested. Plant issue diagnosis might need a lot of investigation. Sometimes there is a lack of knowledge, and other times the main issue is obscured by less significant but more glaring issues. How well we understand the host, pathogen, environment, and how these components interact will determine how well we can diagnose plant issues. As a result, one of the key components of a plant pathologist's education is diagnosis. The use of management methods may be a waste of time and resources and can result in further plant losses without accurate identification of the disease or pests, as well as the disease-causing agents. Many times, due to inaccurate or misidentification of plant issues, experts in agricultural research, development, and extension are unable to provide crops a proper remedy. Plant disease symptoms, the kind of damage caused, and the presence of insect pests are the primary indicators for identifying a specific disease or pest. The following section includes a list of some of the most significant illnesses and insect pests, organised by crop[4]–[6].

Maintenance of Agro-biodiversity at Farm

Organic farming requires the upkeep of a suitable environment for supporting various living forms. By assuring agricultural diversity and planting a broad variety of trees and shrubs that are adapted to the local climate, this agro-biodiversity may be established. In addition to improving soil health, these plants and trees attract birds, pollinators, and many other natural enemies of insect pests of crops by offering them refuge and food sources. The populations of pests are controlled in agro-ecosystems by these birds and their natural enemies (predators, parasites, or parasitoides. Attracting pollinators facilitates pollination, especially in cross-pollinated crops, which increases crop production. These shrubtree species may be used in multistory border planting schemes.

For example, for a 10-acre organic farm, five-six neem trees (*Azadirachta indica*), one to two tamarind two gular (*Ficus glomerata*), eight to tenber (*Ziziphus mauritiana*), one to two aonla (*Emblica officinalis*), one to two drum stick (*Moringaoleifera*) and 10-15 bushes of other wild species fit to the locality should be planted in plain region of the country. The subabool (*Leucaena leucocephala*) is a valuable source of fodder as well as green, nitrogen-rich leguminous leaves that may be used as soil mulch or to make high-quality compost. Lemon may be used as well to draw in natural enemies and pollinators. This increases the fruit output as well. Many of the aforementioned tree species provide fruits, increasing the farmer's revenue. Neem, which has broad-spectrum pest management abilities, produces leaves and seed kernels that are used to make neem leaf and neem seed kernel extracts that are used to manage a number of insect pests and viral disease vectors[7]–[9].

For the purpose of preparing preparations for pest/disease management, a few plants with pesticidal effect, such as *Adhathoda vasica, Vitex negundo, Calotropis procera* or *C. gigantia, Datura spp., Ipomoea carnea* (Besharam), etc., should be planted between rows of

Glyricidia/Sesbania. Some of these plants are also used as natural remedies for farm animals to treat illnesses. For the preservation of ecological diversity, a crucial element of any successful organic farming system, there should be hedgerows or a live fence surrounding the farm or garden made of coppiced or pollarded, multipurpose, deep-rooted trees and shrubs and medicinal herbs like *Adathoda vasica, Vitex negundo, Jatropha curcas*, etc. The Calotropis species encourage the early development of predatory insects like lacewings and ladybird beetles, which then travel to and control the aphids on primary crops, on the north plains.

Tillage, land configuration and crop spacing

Tillage is a traditional method of managing pests in agriculture. Many weeds' roots are exposed by deep summer ploughing, which also makes them easier to dry. It also aids in revealing insect stages that are hibernating so they may be eaten or killed by desiccation. Summer ploughing destroys the sclerotia and other resting structures of several harmful fungus and nematode stages. In addition to giving soil suitable aerations and growth conditions, intercultural activities aid in weed control. The treatment of weeds, pests, and diseases in organic farming should thus include summer ploughing and appropriate interculture.

Crops, particularly those containing turmeric, ginger, pulses, vegetables, maize, etc., should be planted on raised beds or bunds, especially during the rainy season, to guard against several soil-borne illnesses brought on by Pythium and Phytophthora species.Crop spacing should be maintained on the wider side to prevent the creation of an environment that is conducive to pest and disease attack. Crops that are widely spaced have sufficient aeration, have lower humidity levels, and are less attractive to insects as refuge, preventing a high infestation of pests and illnesses.In the case of basmati or non-basmati rice, leaving a 2' area empty every 3–4 metres aids in the management of brown plant hopper, sheath blight disease, and other pests. Okra has a larger plant-to-plant spacing, which reduces the spread of the white fly-borne yellow vein mosaic disease.

DISCUSSION

Soil Solarization and Pest Management

Using transparent plastic sheets, soil solarization raises the soil's temperature by letting shorter-wavelength solar radiation heat the soil while blocking longer-wavelength light from entering the soil at night. To many soil-borne plant pathogens of a mesophilic nature (such as Fusarium spp., Verticillium spp., etc.), nematodes (root knot nematode), weeds (annual grassy weeds and some broad-leaved weeds also), and hibernation stages of insect-pests, soil solarization maintains soil temperature continuously above lethal range (up to 600 C). Additionally, soil solarization produces a microbial vacuum that is quickly filled by a competitive microflora, which aids in lowering the number of soil pathogens. By changing the soil environment via nitrogen cycling and solubilization, it also encourages crop development. This procedure is carried out in the summer to maximise the benefits of solar heating. The advantage of solarization may be obtained for up to three successive crop seasons with only two months of exposure. Clear polyethylene sheets should be between 25 and 30 mm thick. Before solarization, the soil has to be properly moistened and well-prepared for the greatest possible heat transmission into the soil. This is a recommended practice for managing diseases such as root rot and wilt, root knot nematode, and weeds in high value crops and nurseries. After the soil has been solarized, seeds should be sown or nursery plants should be transplanted without causing too much soil disturbance. When biological agents are applied to the soil just after the polyethylene sheets are opened when solarization is complete, disease control and plant development benefits are maximised.

Conversion of soil to organic and suppressive to pests and diseases:

An organic farm's soil should be transformed into a pure organic soil by using low input alternatives like a 2:1 mixture of compost and vermicompost applied at a rate of 2.5 tonnes per acre, and it should also be enriched with biofertilizer cultures like Azotobacter and phosphate solubilizing bacteria or consortia of microbes during final land preparation. Legumes must be planted alongside crops as a need to maintain soil fertility.A low input alternative called Jivamrut is used at 200 lights per acre. Low grade rock phosphate is applied at a rate of 300 kg/acre to phosphorus-deficient soils. After germination, Jivamrut may be applied repeatedly during watering. Recycle all residual biomass onto the field after harvesting legumes picking of pods or separation of grains. Additionally, compost the whole leftovers from other crops before recycling it.

During the last stage of soil preparation, mix organic manure with preparations of Trichoderma, Pseudomonas fluorescens, and Bacillus subtilis5kg/ha to inhibit several soil- or seed-borne diseases of various crops, including nematodes. Numerous significant insect pests, such as foliar insects, termites, and white grubs, have been reported to be successfully controlled by applying *Beauveria bassiana* or *Metarhizium anisopliae* to the soil at a rate of 2.5 kg/ha. Crushed oil cakes 500 kg and 100 kg of neem cake used with organic manures and biodynamic preparations have been shown to improve the population of competitive microorganisms in the soil as well as their suppressiveness against soil borne plant diseases.

Multiple cropping and mixed cropping

The unique aspect of organic farming is mixed cropping, which involves growing a range of crops on the same area either concurrently or at various times. Care should be made to keep legume crops at least 40% of the time throughout each season. Because various plants get their nutrients from different depths of soil, mix cropping encourages photosynthesis and prevents competition for resources. The legume conserves atmospheric nitrogen for subsequent or companion crops. Through the fall of their leaves, deep-rooted plants collect nutrients from the soil's deeper layers and transport them to the soil's surface. Thus, these deeply rooted plants continue to return nutrients from lower layers to the higher layer. aid in preventing soil erosion as well.

Farmers should choose their crop combinations based on the season and their demands. In addition to the aforementioned, mixed cropping is another tactic to make up for losses brought on by pests and diseases. The mixed crop may make up for losses in the primary crop if disease or pests cause harm to it. In addition to smothering weeds between the rows of widely spaced crops, certain mixed crops, such as cow pea or dhaincha, also enrich the soil with nitrogen. Any additional crop with weed-smothering qualities that is compatible with the primary crop may be planted between the rows of the main crop. Marigold intercropping between crops spaced far apart helps reduce weed growth and control a variety of crop worm species.

There should always be at least 8–10 different kinds of crops on an organic farm. Each field or allotment needs at least four different kinds of crops, one of which should be a legume. If just one crop is planted in a plot, the neighbouring plots should be planted with different crops. Plant 50–150 home-use vegetable seedlings per acre at random, along with 100 marigold plants per acre, to maintain variety and fight pests.Even intensive crops like sugarcane may be cultivated with the best yield by combining different legume and vegetable crops in the right proportions. For inter/mixed cropping, it is best to choose crop combinations that have synergistic benefits, such as maize with beans and cucumber, tomatoes with beans and cucumber, and tomatoes and sugarcane with onions and marigold.

Crop Rotation

The foundation of organic farming is crop rotation. It is the practice of producing a variety of crops on a plot of land over a certain period of time that are distinct or different from one another. Crop rotation is essential for maintaining the health of the soil and allowing the natural microbial processes to function.Crop rotation is often practiced for three to four years. All high-nutrient-demanding crops, such as combinations of crops with a dominant legume, should come before and after low-nutrient-demanding crops.Controlling soil-borne illnesses and pests involves rotating a host crop with non-host crops for a specific pest. Through various root systems, it also aids in strengthening soil structure. When growing cereal and vegetable crops in rotation, legumes should be utilised often. Rotation planning should include green manure crops as well to maintain soil fertility and production.

Crop rotation is one of the key tactics for disrupting the life cycle and population growth of pests, diseases, and weeds in agro-ecosystems. In order to control a specific pest or disease, care should be made to include non-host crops while doing crop rotation.Crop rotations provide the following significant advantages: a. They take use of the differences in nutrient requirements between various crop groups, which increases soil fertility.It breaks the life cycle and population build-up of pests, diseases, and weeds in agro-ecosystems and improves soil structure via various root systems.

Use of resistant varieties

The use of pestdisease resistant or tolerant and weed-smothering varieties must be included in our package of practises to manage the pests because synthetic chemical pesticides are strictly forbidden in organic crop production and there aren't many options under biological, botanical, or other permitted strategies of pest management. Crop types that are pest-resistant or tolerant differ from area to region; as a result, they should be chosen based on location. In order to control the pests or disease, rigorous use of biological or botanical pesticides should be combined with cultural management if resistant or tolerant types are not readily accessible.

Another area that may be used in organic farming is induced resistance. It has been observed that treating seeds with bioagents like Trichoderma and Pseudomonas fluorescens/Bacillus subtilis causes a wide spectrum of disease resistance in numerous crops. The greatest technique for controlling pests and pathogens is prevention, especially in organic crop farming when there are few effective choices for management beyond the threshold of disease or insect assault. The seed or planting materials should be as devoid of pests, weed seeds, and disease-causing pathogens as feasible. Some of the seed treatment formulas and techniques that have been shown to work well in organic farming.

Hot water treatment

The inoculum of plant diseases and the hibernation stages of insect-pests are often removed from seed, bulbs, setts, and nursery stocks by hot water treatment. Most pathogens and pests are removed from seeds when they are treated for 25–30 minutes at a temperature of 52–54^{0}C. Pathogens removed include fungal, bacterial, phytoplasmal, and viral pathogens. The viability of seed is relatively unaffected at this temperature. When it comes to organic farming, hot water treatment may be quite effective in getting rid of seed borne inoculum as there are no choices for wide spectrum fungicides, antibiotics, or systemic insecticides.Many of the seed-borne infections, such as *Xanthomonas campestris pv. oryzae* and *Bipolaris oryzae*, may be wiped out by treating rice seeds in hot water at 540 C for around 25 to 30 minutes. When treating seeds in hot water, extreme caution must be used since even a tiny increase in temperature over what is advised might harm seed germination and a decrease in temperature cannot completely remove the inoculum from the seed.

Seed Treatment with Biocontrol Agents

Many of the seed and soil borne plant diseases and nematodes may be suppressed by treating seed or planting materials with fungal or bacterial bioagents like *Trichoderma viride* or *T. harzianum* or *Pseudomonas fluorescens* or consortia of multiple bioagents. Another effective method of delivering bioagents to the rhizosphere is seed treatment. These bioagents have also been observed to encourage plant development and consequently early establishment of seedlings in addition to reducing plant diseases. Seed bio-priming is the process of treating seed with these bioagents and storing it overnight at a temperature and humidity that will activate the bioagents before planting. It is the ideal technique for treating seeds and aids in the rapid establishment of the bioagent in the targeted application niche. For seed bio-priming, treatment of the seeds should be done in the evening, followed by an overnight incubation period under shade before spreading the seeds the following morning.

Mechanical methods

The most efficient mechanical techniques of pest management include removing the damaged plants and plant components, gathering and destroying egg masses and larvae, installing bird perches, light traps, sticky-colored traps, and pheromone traps. Install 'T' style bird perches with a height of 5 to 6 feet in larger agricultural plots to attract birds to sit there and eat the bug larvae and adults infesting the crop. The farm's planted border trees and bushes also serve as bird perches. Termites, numerous moths, borers, and white grub adults may all be captured and killed with light traps. Methyl-euginol pheromone traps are excellent for catching and eliminating adult fruit flies in orchards and cucurbitaceous plants.

Weed management and removal of alternate and alternative hosts

One of the main issues with organic farming is weed control. In addition to directly reducing agricultural output and quality, weeds may harbour various plant infections and insect pests, especially during the off-season. These pests can then be spread to crops by vectors and other ways during the growing season, which results in indirect direct losses as well. In organic farming, weed control mostly depends on cultural, manual, mechanical, and other methods due to the restriction on chemical pesticides. Use of weed-seed-free seeds and planting supplies is a preventative approach. In order to prevent the spread of some weeds, such as *Trianthema portulacastrum* and *Amaranthus viridis*, attention should be made to degrade weeds just before to fruiting stage during compost production. The farm animals should only be fed weeds and grasses that are in the pre-fruiting stage. Reduce the number of weed seeds in the soil by using the stale seed bed approach, which involves watering of the field before to planting, enabling weed seeds to grow, and then destroying them during preliminary tillage. The two major methods for managing weeds in organic farming continue to be manual weeding and mechanical interculture using different hoes and tools. Keep weeds that host insects and agricultural plant diseases out of organic fields as much as you can (remove alternative hosts.

Balance Crop Nutrition for Pest and Disease Management

For crops to reach their maximum production potential, a well-balanced diet is essential. The use of manures and fertilisers to achieve this equilibrium is a standard procedure in the production of commercial crops. It has long been understood that macro and microelements influence the size, quality, and production of crops as well as the assault of weeds, pests, and diseases. In the same way as crops have nutritional needs, so do pathogens. Following is a summary of the two main goals of applying nutrients to crops to protect them against pathogens:

Avoiding plant stress might make crops more resistant to disease assault. Manipulating nutrients in favour of plants and against pathogens Since organic manures are the only source of major and micronutrients for crop plants, plant health is maintained and it is better able to resist pest and disease attack in the production of organic crops. Crops produced organically are often less susceptible to pests and illnesses.

Use of Bio-pesticides

Trichoderma viride or *T. harazianum* are shown to work well for treating nematodes and fungal illnesses. For one hectare, four to five kg of formulation with the appropriate quantity of live spores is adequate. In order to achieve the necessary degree of disease control, they may be sprayed on at regular intervals. The majority of seed and soil borne illnesses are controlled by *Pseudomonas fluorescence* formulations 4g/kg seed, either alone or in combination with *Trichoderma spp*. It may also be sprayed on crops to control crop diseases. Formulations like *Beauveria bassiana, Metarhizium anisopliae, Nomuraea rileyi,* and *Verticillium sp.* are available on the market for managing insect pests and may handle their particular insect problem. Many insect pests, such as termites, caterpillars, and beetles, may be controlled by heavily applying *Beauveria bassiana* to fields of inorganically cultivated crops or orchards. Lepidoptera, Coleopterans, as well as several other insect species may be controlled by formulations of the bacterial bioagent Bacillus thuringiensis at 0.5-1.0 kg/ha.

CONCLUSION

Understanding the methods and difficulties of managing pests and diseases in the production of organic crops presents chances to encourage ecologically and socially acceptable farming practises. The training of organic farmers, extension services, and policy formulation may all benefit from the information obtained through researching pest and disease control. Supporting the adoption of environmentally sound methods for managing pests and diseases in organic agriculture may result in more resilient and sustainable agricultural systems.In conclusion, further study in this area is necessary to advance our knowledge of pest and disease control in the production of organic crops. Better results for the production of organic crops and environmental protection may be attained by highlighting the significance of integrated strategies and ecological principles. Recognising the benefits of various pest and disease control techniques might also encourage farmers to include them into their organic operations. In order to preserve the long-term viability and profitability of organic agriculture, researchers, organic certifiers, policymakers, and farmers must work together to address pest and disease control in organic crop production.

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CHAPTER 5

EMBRACING SUSTAINABILITY: THE WORLD OF ORGANIC AGRICULTURE

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ABSTRACT:

A growing trend in food production, organic agriculture places an emphasis on soil health, biodiversity, and a reduction in the use of synthetic chemicals. The purpose of this research paper is to examine the tenets and methods of organic farming and how they relate to the production of sustainable food. The research goes into the fundamentals of organic farming, such as the utilisation of natural resources, crop rotations, cover crops, and integrated pest control to preserve soil fertility and advance ecosystem functioning. It looks at how standards and laws for organic certification affect the reliability of organic goods and customer confidence. The study also looks at the economic, social, and environmental advantages of organic farming, such as increased food safety, less environmental impact, and improved rural lives. For the purpose of developing more resilient and sustainable food systems and tackling global concerns like food security and climate change, it is essential to understand the guiding principles of organic agriculture as well as any possible difficulties. The report also emphasises how organic farming might be used in urban farming and community-supported agriculture to help the shift to more environmentally friendly methods of food production.

KEYWORDS:

Integrated Pest Management,Organic Certification, Organic Agriculture,Organic Inputs, Sustainable Food Production

INTRODCUTION

Since the earliest days of hunter-gatherer civilizations, through pastoral and swidden stages, to agricultural societies, with an accompanying move away from nomadic to sedentary lives, the procurement of food, textiles, and other resources from plants and animals has been a key priority for human communities. However, as agricultural productivity rose, the detrimental consequences on the underlying resource base also grew. Agriculture has a long history of causing environmental harm. Some of these effects include air pollution from greenhouse gases like carbon dioxide, methane, and nitrous oxide; land degradation due to clearing, cultivation of sloped land, and salinity; water pollution from fertilisers, pesticides, overuse, and wetland draining; and the loss of biological and ecological diversity. For instance, herbicides have received a lot of attention in traditional weed research, yet they haven't led to a long-term drop in agricultural weed populations. Instead, because to extensive weed species resistance that has arisen, farmers have become dependent on herbicides[1]–[3].

While some may contest the extent of the harm, formal policies put in place in many nations to lessen those effects and the financial rewards offered for verified good environmental performance OECD 2001 reflect the seriousness of these agricultural sustainability issues. Bans on an increasing number of pesticides, such as the fumigant methyl bromide, financial incentives for revegetation, fines for water pollution, and funding for research into efficiency improvement such as fertiliser applications or damage abatement technologies are just a few of the policies designed to improve the environmental sustainability of agriculture. The several policy instruments may be used haphazardly or, preferable, strategically, integrating the tools and creating an environment that is conducive to adoption and progress. Environmental management systems EMS for agriculture have lately gained popularity with certain farmers, governmental organisations, and consumers in terms of assessing performance. EMS are very new and have a number of drawbacks, including as credibility, complexity, financial risk, ambiguous customer demand, and uneven environmental improvement data[4]–[6].

Organic agriculture must be adjusted to the regional agricultural, social, geographical, and climatic conditions if it is to be the solution to the sustainability issue. The European model of organic agriculture, particularly its present market-driven approach, may not be the best one for other nations. The guiding principles of organic farming serve as a template for customising organic methods to each unique agricultural environment. For instance, there will always be areas where some crops cannot be economically or sustainably cultivated utilising the variety of organic techniques now available. Rational judgements regarding the possibilities and constraints of organic agriculture may be made, and general prerequisites for success can be established, as more information on the environmental, social, and economic performance of organic agriculture in a wide variety of settings becomes available OECD 2003.

It seems sense that environments like those in Europe, where organic agriculture first took off, would be the most ideal. However, it has also been shown that low-input systems in isolated areas with poor conditions, such as rangeland grazing, are well adapted to organic farming. Early proto-organic producers confronted agricultural circumstances in New Zealand and Australia that were considerably unlike from those in Europe. Australia's uneven and infrequent rainfall, old, depleted soils, widespread producing areas, and tiny population centres provide significant difficulties for both conventional and organic agriculture. It was going to take some experimenting and adapting. Because the permitted organic fertilisers are insufficient, broadacre organic farming depletes the soil of phosphorus in several areas of south-eastern Australia. on contrast, raising beef cattle organically is simple on the rangelands of western Queensland, farther north, and the farms there seem to be just as sustainable as they were before the conversion.

It is obvious that the sustainability issue must be discussed in terms of certain farm types.The majority of agricultural and food production sectors in many nations have been impacted by organic farming, which often began in niche markets like direct to customer or on-farm processing. It has been modified to fit social and agronomic factors in the area to create practical, sustainable agricultural methods. This has led to the emergence of several successful organic businesses all over the globe, demonstrating the critical role that organic agriculture can play in ensuring that agriculture is entirely sustainable.Organic farming is a tiny portion of the agribusiness industry, which is a tiny portion of the larger global socioeconomic system and its prevailing cultural ideals. As a result, organic agriculture has a limited ability to affect things like global commerce, worker relations, and agrichemical regulation[7]–[9].

The US National Organic Programme discussions, where members from the organic movement were subordinate to government entities, provide as an illustration of this lack of influence Merrigan 2003. The movement may have internal goals, but global markets and politics will unavoidably have an impact on how it develops.In spite of the significant expansion during the 1990s, organic agriculture still only accounts for a very small fraction of total commercial agricultural output when taken in a broader context than the success of the organic movement.This introduction provides an outline of the origins and growth of the organic movement from those in early 20th-century Europe to its present status as a well-known, successful niche industry in world agriculture. The chapter discusses some of the significant figures and developments that helped to create contemporary organic agriculture and provides information on the state of organic farming in various nations worldwide. The development of the fundamental concepts is also explored in order to comprehend the goals and procedures of organic agriculture. The difficulties facing organic agriculture are finally listed[10], [11].

DISCUSSION

Definition of Organic Agriculture

The term organics, or the O-word, as sarcastically referred to organic agriculture in acknowledgement of the word's ambiguity, is a problematic one that may be used to refer to a variety of things. In his book Look to the Land from 1940, Northbourne used the word organic in reference to farming, writing that the farm itself must have a biological completeness; it must be a living entity, it must be a unit which has within itself a balanced organic life.Northbourne obviously wasn't only talking about organic inputs like compost when he said that a farm should be managed as an integrated, complete system.In many nations, it is illegal to use the term organic in relation to agricultural production or food, and different certifying bodies have different standards for compliance.

Due to their historic ways of production, many farmers in less developed nations may already practice organic farming. To simply explain what organic agriculture is meant to accomplish, it is helpful to provide a broad description of the field.Agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity, are promoted and enhanced by organic agriculture, according to the international food standards organisation Codex Alimentarius. It prioritises the use of management practises above the usage of off-farm inputs while taking into consideration the need for regionally tailored systems according to regional circumstances. In order to do this, it is best to use agronomic, biological, and mechanical approaches rather than synthetic materials to carry out any necessary system functions.

The definition of organic agriculture as it is used in this context comes from the Codex.The phrase is now used to refer to the whole organic and biodynamic supply chain, from inputs to finished manufactured items, as well as the movement's cultural and social facets, rather than simply its on-farm production facets. The term organic movement may no longer be suitable and should instead be used to refer to the whole business. However, the fact that organic agriculture continues to play a significant social and political role implies that it is more than simply an enterprise. Even when a market for conservation farming lower tillage has been established in the business sphere, the social movement for it still exists.

Organic standards are dynamic, and certification criteria are often updated every several years. The majority of certification organisations have some kind of certification review committee that takes into account newly developed materials, updated knowledge of currently permitted inputs, and newly developed manufacturing and processing methods.The phrase conventional agriculture, which is often used, refers to the traditional, dominant agricultural methods that are pushed and studied by the majority of government and corporate entities and are employed by farmers and growers all over the globe. Typically, conventional agriculture only places legal requirements on management constraints.

Organic and conventional farming are rather mutually exclusive. Organic farming could not exist as a notion until an alternative agricultural paradigm that allowed for a differentiation to be drawn was established. In fact, the phrase organic didn't really take off until the 1960s. It is acknowledged that the term conventional conceals the wide range of management techniques employed; for instance, a conventional grain farmer may use mineral fertilisers but also green manures and avoid pesticides, or a permaculture orchardist may decide to use herbicides to control woody weeds in sloped land. Growing EMS usage is a sign that different supply chain nodes understand the need for better tracking of agricultural effects.

The origins of organic agriculture

Modern organic farming has its roots in the 'industrially based' agriculture of today. Before the development of chemically synthesised fertilisers, biocides, pharmaceuticals, mechanisation, and fossil fuels that enable industrial agriculture to work, many of the practises of organic agriculture were the only options available to farmers. Farmers had little choice but to operate within biological and ecological processes in the absence of such technology. For instance, the only sources of fertiliser available to replenish the nutrients lost from harvested fields were leguminous plants, animal dung, and human waste. Because there were no insecticides to manage them, crops that were not rotated led to a buildup of pests. According to this viewpoint, conventional industrial agriculture deviates from the traditions that agriculture has upheld from its start, while organic agriculture is the original and principal form of agriculture.

This division between industrial and organic agriculture began at the turn of the 19th century, when it was realised that plants really absorbed mineral salts found in humus and manure, not organic matter. The two main proponents of this hypothesis, Sir Humphrey Davy and Justus von Liebig, presented their theories in the works Elements of Agricultural Chemistry Davy, 1813 and Organic Chemistry in its Application to Agriculture and Physiology, respectively. They claimed that inorganic mineral fertilisers might take the place of manures and bring agriculture into the scientific realm, increasing output and effectiveness as a consequence. The first inorganic fertilisers were produced commercially during the agricultural revolution of the 1840s. Like all revolutions, it was not without flaws, and fertiliser use did not really take off until the outbreak of World War Two.

People who were worried about the way that agriculture was going began to speak out and band together in the 1920s. Rudolph Steiner, the creator of the 'Anthroposophy' concept, delivered his lectures on agriculture in 1924. Though these lectures and other Steiner teachings laid the groundwork for biodynamic agriculture, which differs from organic agriculture primarily due to its astrological, mystical, and spiritual components, they were prophetic in their denunciations of industrial agriculture and in their attempts to chart an alternative course. Due to Steiner's work, the first organic certification and labelling system, Demeter, was developed in 1924.

A renowned scientist named Robert McCarrison was investigating the health of the fighting men of India at the time and the reasons for their absence of western ailments. He advocated for health as a positive idea of energy as opposed to a bad form seen as the absence of sickness. A diet high in whole foods, cultivated on land where all manures were returned i.e., according to the law of return, with a limited quantity of fresh plants and grains and meat, was the foundation for good health. Following up on his findings, McCarrison fed two groups of rats a diet similar to that of the Indians and the destitute in Britain. The rats fed an Indian diet thrived, but the other rats had a number of illnesses and undesirable societal repercussions. McCarrison then went on to discuss the value of eating a healthy food cultivated on land that has been fertilised with manures and other organic waste.

In the 1920s, Sir Albert Howard developed an experimental agricultural research institution there as well. Although Howard was a very skilled scientist and had more than enough schooling to comprehend the new chemical concepts, his childhood on a farm in Shropshire made him quite dubious of the approach. He said that he learned considerably more from the local peasant farmers than from his scientific background since he was a close observer of them. Howard engaged in a broad variety of initiatives, including a very successful plant breeding programme and research on the impact of fodder production on farm animal health. As a result, he came to think that there is an unbreakable link between the soil's health and the health of the plants and animals that rely on it for their food. The 'Indore process,' which is now indelibly tied to his name, is the outcome of his adapting eastern ways of composting to Indian circumstances as a result. His book The Waste Products of Agriculture Howard 1931, which condensed these experiences, helped him propagate his message across many countries.

Beyond Europe: further evolution and new alliances

The efforts and writings of individuals like Howard, McCarrison, and Steiner had an effect on the subsequent generation of organic pioneers. With the founding of the first organisations like the Rodale Institute in the United States of America USA, Soil and Health in New Zealand, and the Soil Association in the United Kingdom UK, this second wave gave birth to the organic movement. Northbourne 1940 see above coined the phrase organic in connection to farming for the first time.The Haughley experiment, which contrasted organic and non-organic agriculture over time, was being set up in the UK by Lady Eve Balfour. Her work The Living Soil Balfour 1943, which drew inspiration in part from the Haughley experiment, was also very significant. She also served as the Soil Association's first president and founding member in 1946. The Soil and Health Association in New Zealand, established in 1942 by dentist Dr. Guy Chapman under the original name of the Humic Compost Club, predates both of these institutions.

Hans and Maria Mueller were pioneers of organic agricultural practises in Switzerland. Steiner's biodynamic farming inspired Herr Mueller, who in the 1950s created the organic-biological farming technique. The scientific foundation for Hans's work was supplied by Hans-Peter Rusch, a physician, microbiologist, and close friend of Hans, in his book Bodenfruchtbarkeit Soil Fertility, which connected soil microbiology with fertility. With the establishment of the trademark Bioland, today the biggest certifier in Germany, this movement took on a more organised shape in the 1970s.In the late 1930s, J.I. Rodale was eager to learn about and engage in organic agriculture in rural Pennsylvania, USA. He soon saw how crucial it was to develop and maintain the natural health of the soil in order to maintain and safeguard human health. He established the Soil and Health Foundation in 1947, which ultimately evolved into The Rodale Institute. Additionally, he was the author of several books on organic farming, gardening, and health, all of which had the guiding principle that healthy soil, equals healthy food, equals healthy people.

In Japan, separate developments were taking place. 'Nature farming' was first used by Mokichi Okada in 1936. To better mankind, nature farming incorporates both spiritual and agronomic components. As a result, it bears striking resemblance to Rudolph Steiner's anthroposophy and biodynamic farming. 'Kyusei nature farming' is promoted by the Sekai Kyusei Kyo organisation, which was established and has offices and experimental farms spread over South-East Asia. The Mokichi Okada Association, an offshoot organisation, was established in 1980 with the intention of proving the scientific viability of its agricultural practises Setboonsarng and Gilman 1999. Masanobu Fukuoka started a separate kind of natural farming in Japan about the same time as Okada was starting his movement. Fukuoka, who had studied soil science and microbiology, sought to practise what is frequently referred to as do nothing farming. Fukuoka's agricultural methodology had a spiritual foundation. The persistence and growth of these groups emphasise how crucial it is to see organic farming as a worldwide phenomenon rather than just a European one.

There were many of these pioneers whose political and theological beliefs would be repugnant to today's environmentally conscious, socially conscious, politically left-of-center organic supporters, even if many of their concepts are still applicable to current organic agriculture. Many early proponents of organic farming had conservative political views and were fervent Christians, even to the point of fundamentalism and evangelicalism. Conford 2001 has provided extensive documentation of the political, philosophical, and theological reasons of these organic forerunners in the UK. The organic movement experienced substantial change and turmoil in the 1960s, which is why some of its early pioneers' ideals are now alien to it. The release of Rachel Carson's book Silent Spring in 1962 marked a significant turning point and the beginning of the contemporary environmental and organic movements.

This transformation may be seen as a revolution or, at the very least, a substantial advancement of the organic movement. As with how most people participating in the present organic movement see politics and religion, many of the environmental issues and notions of modern organic agriculture would be rather foreign to many of the pioneers in organic farming. Environmental activism may have rescued the organic movement from oblivion since it had lost the post-World War Two debate about the future of agriculture and had seen a sharp fall by the 1950s. So, despite a line of continuity in ideas and membership from the beginning to the present, the contemporary organic movement is quite different from its early incarnations. In addition to the founders' concerns for healthy soil, good food, and healthy people, environmental sustainability is now at the centre of the organization.

The publication of Silent Spring brought to light the harm that pesticides and other chemicals were causing to the ecosystem on a worldwide scale. As a result, in addition to the arguments that the organic movement had been making for many years, Silent Spring also introduced a whole new set of reasons against industrial farming.The 1960s, when Silent Spring was released, saw a lot of social unrest and tremendous societal change. New school debates on political and philosophical thinking were arising. Many of them also had a significant impact on the evolving organic movement. Limits to increase Meadows et al. 1972, which examined the topic of the increase of the human population and the global economy, is an example of one of these theories.

Another was Small is Beautiful: A Study of Economics as if People Mattered by E.F. Schumacher 1974, which had a number of radical notions, such as the notion of forgoing economic growth in favour of a more meaningful working life and making quality of life the primary objective of economics. Additionally, Schumacher served as the Soil Association's president.In the 1970s, organic farming reemerged as Eco agriculture, and new organic groups were established as well as old ones were strengthened. Many of these organisations were centred on the certification of farmers and producers. Organic farming was obviously outside of conventional agriculture and national politics, and despite the movement's members' persistent efforts, they had little success with the government despite the rising interest in it. However, the degrees of self-organization were quickly rising, moving from isolated units acting independently to more coordinated action.

One of the milestones by which social and political movements might declare they have matured is the creation of a formal worldwide network. This was the year 1972, when the International Federation of Organic Agriculture Movements IFOAM, which is now the only international non-governmental organisation NGO devoted to organic agriculture, was established. Its development and maintenance were not simple tasks. In its early years, it was highly dependent on a great deal of goodwill and the labour of many unpaid individuals, like many other organic groups, and its financial stability was often in jeopardy. It has developed into an entity that commands the respect of states and multilateral bodies, having previously been one that national government disregarded or fought against. IFOAM's stated aim is to lead, unite, and assist the organic movement in its full diversity.

In the 1980s, organic farming saw rapid expansion. Numerous factors contributed to this, many of which were beyond the movement's control. The public's concerns about the increasing loss of important farmland features, the intensification of livestock production such as the use of battery hens, and food scares such as bacterial contamination led to the public's first exposure to the workings of industrial food production and processing systems, many of which they found revolting and shocking. Because organic food provided an alternative, consumption of organic food significantly increased after food scares. In several industrialised nations, growing affluence and disposable money led to organic food being very in among upper socioeconomic strata.

This is very paradoxical since organic agriculture rejects the idea of using the production and consumption of food as a social status symbol.

CONCLUSION

Understanding the tenets and difficulties of organic agriculture presents opportunity for advancing more resilient and sustainable food systems.Studying organic agriculture may have an impact on various agroecosystems, urban farming, and community-supported agriculture, facilitating a shift to more environmentally friendly methods of food production.In conclusion, further study in this area is necessary to advance our comprehension of organic farming. Stressing the value of organic principles and practises may result in food production systems that are more socially and ecologically responsible. Recognising the importance of organic farming in tackling global issues like climate change and food security may also assist agricultural practises and policy choices that support resilient and sustainable food systems. In order to build a more sustainable and food-secure future for everyone, academics, governments, farmers, and consumers must work together to transition to organic agriculture.

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CHAPTER 6

MODERN ORGANIC MOVEMENT: NURTURING SUSTAINABLE FARMING PRACTICES

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ABSTRACT:

The contemporary organic movement, which promotes sustainable, ecologically friendly, and socially responsible agricultural practises, has grown into a major influence in the world's agriculture and food industries. The objective of this research study is to examine the development, difficulties, and potential of the contemporary organic movement. The book dives deeply into the movement's historical background, tracing its origins from early agricultural pioneers through the creation of organic certification standards and laws. It looks at the difficulties the organic movement has been having, such as doubts about the reliability of certifications, market competition, and scalability. The study also looks at how the contemporary organic movement has affected world agriculture, biodiversity preservation, and rural lives. Developing methods to enhance and increase the beneficial effects of organic agriculture requires an understanding of the history and current issues facing the organic movement. The research also emphasises the movement's possible future directions, which include embracing cutting-edge technology, enhancing cooperation with conventional agriculture, and integrating into sustainable food system.

KEYWORDS:

Biodiversity Conservation, Modern Organic Movement,Market Competitiveness, Organic Certification, Sustainable Agriculture.

INTRODUCTION

Even scientists who were opposed to alternative agricultural systems began to become more interested in and knowledgeable about organic agriculture in the 1980s. They discovered that the academic environment and funding sources were more supportive of its study than in previous decades, which led to a flurry of research, a large portion of which, regrettably, was comparisons of organic and non-organic agriculture rather than research intended to support or assist organic producers. The degree of interest in organic farming and the amount of data amassed regarding organic practises had increased to the point by the decade's end that Nicolas Lampkin's seminal book Organic Farmin could be published with great success.Trends that started in the 1970s and picked up speed in the 1980s grew throughout the 1990s and into the new century. Around the globe, demand and output both continued to increase enormously, often at a rate of 20–30% annually. The achievement of formal political and legislative recognition[1]–[3].

Normally, this process would have begun by legislating over organic farming. Intergovernmental agreements were then made to facilitate international organic trade, primarily by developing a system that parallels and duplicates IFOAM's Organic Guarantee System and shows that certification standards in the exporting country are equivalent to those of the importing country. International/intergovernmental organisations like the European

Union (EU) and the United Nations Food and Agriculture Organisation were also gaining significant political momentum. More food scares like the bovine spongiform encephalopathy (BSE) outbreak in the UK and the public's growing awareness of genetic engineering, which in some regions of Asia, Australasia, and especially Europe became a highly charged political issue, contributed to ongoing public concerns about food and its production systems.

Science has increasingly been used to show the advantages of organic farming and the drawbacks of industrial farming. This aided organic movements in arguing for much tighter collaboration with other environmental organisations, such as nature preservation organisations. Additionally, it demonstrated that fruitful research could be conducted on organic farms. Since the 1980s, a large number of international organic research centres and organisations have been founded. They actively participate in new research projects in the agronomic, environmental, and social sciences, document and publish their findings to meet the high demand for information, and offer extension and training to farmers and advisors. By conducting impartial assessments of items intended for use in certified organic cultivation, handling, and processing, a number of NGOs and businesses have started to serve as an adjunct to the certifying organisations. Such groups include the Organic Materials Review Institute and Pesticide Action Network North America[4]–[6].

By the late 1990s, worries about organic agriculture following the path of industrial agriculture and losing its focus were growing Examples of this include the sharp increase in supermarket sales and the growing volume of organic food being sent over long distances to meet demand in developed nations.In Ikerd, this issue is covered in further detail Due to these worries, the neglected problem of social fairness has come back into prominence for example, making sure that farmers are paid fairly for their output. The connections made between the Fair Trade and the organic movements as a result are one result of this. The idea of imposing Fair Trade standardswhich have hitherto only been applied to farmers in the developing worldon European organic growers is now the subject of heated controversy. The exponential growth of farmers markets in the USA and UK, where traditional produce markets have been revived by requiring stall holders to be both local and only sell goods they have produced, is a practical example of reforming the links that existed between organic producers and consumers in the 1960s and 1970s[7]–[9].The majority of consumption occurs in developed nations. The most popular crops are traditional basic foods like cereals, fruit, vegetables, meat, and dairy products, while there is also growing demand for cash crops like sugar, coffee, and wine.

The principles of organic agriculture

Understanding organic agriculture's guiding principles is crucial for achieving. These guidelines include the essential aims and restrictions that are thought to be significant for producing high-quality food, fibre, and other items in a manner that is ecologically sustainable.The fundamentals of organic farming have evolved along with the movement.The integration of modern organic agriculture with the broader environmental movement has led to concepts that are more strongly focused on the environment than those from the first half of the 20th century. In addition, the ideas haven't been formalised or properly articulated until the last 30 years. Since they were ingrained in the farmers' practises and mentality for a large portion of the history of organic agriculture, the following concepts were not codified:

1. The idea that a farm is a living thing that is sensitive to its surroundings and tends to be a closed system in terms of nutrient fluxes.

2. The idea that soil fertility may be improved through time by creating a living soil that has the power to impact and transmit health to plants, animals, and people via the food chain.
3. The idea that these connections make up a larger system that contains a dynamic that is yet not fully understood.
4. The conviction in science and the insistence that, despite the fact that these concepts may go against the grain of current scientific thought, they can be examined, developed, and ultimately explained by the application of the proper scientific analysis.

The necessity to explain the core principles of organic agriculture to outsiders didn't arise until the organic movement became worldwide and its arguments began to get acceptance in the larger political and social arenas. The main group responsible for outlining the fundamentals of organic farming is IFOAM. As of today, the 'fundamental criteria' of the IFOAM organic guarantee system have been published as the principles. They assisted to introduce the criteria and make the objectives of organic farming more clear. Over the ensuing time, there have been several modifications and additions to the initial seven principles. Members of the General Assembly submitted proposals for revisions, which were discussed and decided upon during the annual General Assembly. As part of the standards reform, they have also been modified. The present principle aims of organic agriculture for production and processing are the result of this process. Compared to the seven principles of the 1980s, the current list is far lengthier and includes more principle aims than actual principles.

There has been a growing perception in recent years that the primary goals have deteriorated, become inconsistent, and have become bloated. A taskforce to revise the principles was established by the global board as a consequence of a resolution adopted at the IFOAM General Assembly in 2002. The group will present its findings to the 2005 General Assembly for approval after extensive engagement. As a result, they are currently a work in progress, with a first draught already available. The draught principles are more philosophically and structurally similar to the original 1980 principles than the current principal objectives.The Danish Research Centre for Organic Farming (DARCOF), in response to perceived ambiguities in current principles and the necessity for unambiguous principles to guide research planning, started a national discussion on the fundamentals of organic agriculture at around the same time.

The concept of health has a holistic viewpoint and views health as including self-regulation, regeneration, balance, and more than just the absence of illness. It applies to every aspect of agriculture, including ecosystems as a whole and specific components like soil, plants, animals, and humans. As exemplified by Lady Eve Balfour's quote, Healthy soil, healthy plants, healthy people, which has become the motto of many organic organisations including The Soil Association (UK), Soil and Health Association (NZ), and the Rodale Institute (USA), this principle connects organic agriculture to the issues that were of concern to the founders of the organic movement in the 1920s to 1940s, which were based on human health. The idea also states that people are not independent from natural systems, but rather are an essential component of them. Since people are a vital component of natural systems, when those systems are harmed, there will inevitably be negative effects on mankind as well. The study underlined how reliant humanity is on these services by demonstrating that they are worth significantly more than the global gross domestic product and natural capital, such as plants that provide oxygen.

The ecological principle is a more expansive version of the 1980s' first principle, which said that organic farmers must operate in a closed system and use local resources. According to this broader perspective, organic agriculture should operate similarly to how natural ecological systems do. Ecological systems are thought to be self-contained, self-maintaining, and self-sufficient. For instance, the majority of plant nutrients cycle continuously within the ecosystem, and the systems are self-regulating in that plant and animal populations are kept within specific bounds by a variety of both positive and negative feedback mechanisms. Instead of using interventionist techniques like pesticides derived from natural sources, farms should instead design farming systems that are self-regulating, work within closed systems for nutrients, avoid fossil fuels, and grow plants that increase biological control agent populations to control pests.

In order to ensure the humane treatment of animals, the fairness principle is concerned with the interactions between the many groups of people engaged in agriculture, such as landowners, employees, and consumers. Even though the social equity component of organic agriculture was less prominent in the 1980s and 1990s, there are growing requests for it to be given more attention. This implies that customers should be able to purchase high-quality goods at fair prices, that employees shouldn't be treated unfairly and should be given a living wage, and that farmers should be paid a fair price for their produce. The organic and fair-trade movements are now collaborating closely to implement these concerns, which are also central to the fair-trade movement. The idea that the actions of the current generation should not harm future generations also applies to generations that will follow the present. Producers of livestock are obligated under the concept to treat animals humanely and ethically. This is a complicated and divisive topic since opinions on how to treat animals have evolved significantly over the last several decades and vary significantly between cultures.

As a result, the organic movement continues to address animal rights, compassionate treatment of animals, and even the need of livestock in organic systems. In this discussion, the emphasis is on making sure that cattle are healthy, that their living circumstances are in line with their physiology and natural behaviour, and that stress and discomfort are kept to a minimum. As a result, there are certification requirements for livestock house designs, stocking densities, avoiding foods that animals wouldn't normally consume, and not breeding animals with intrinsic flaws like weak legs in turkeys.When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically, the Precautionary Principle is a manifestation of the Principle of Care. In actuality, the precautionary and care principles work in opposition to the logic of risk management and cost-benefit analysis, which requires proof of a proposed activity's negative effects in order to forbid its usage. Activities that have the potential to be dangerous must demonstrate their safety before being approved, according to the precautionary and care principles. The care principle makes sure that new technologies that are probably hazardous are not used in organic agriculture without a full study of them and safeguards against possible damage.

This perspective, which holds that the technology has a high potential for producing unanticipated negative effects and that the cost of such effects will be borne by people other than those benefiting from the technology, is a key factor in the organic movement's decision to ban the use of genetically modified organisms. Despite the fact that genetically modified organisms (GMOs) are now prohibited under organic standards, IFOAM World Board member has written on facing up to GMOs. This suggests that applying the organic movement's standards for assessing new technology will be difficult and controversial. In contrast, organic agriculture has quickly embraced a variety of innovative technologies, such ensilaging grass and cutting-edge equipment, since their potential to have unanticipated bad effects is limited, their usage is reversible, and the user is the one who will suffer the most if there are issues. The concept of care also extends to the ecosystem as a whole and future generations, which are often left out of risk management and cost-benefit calculations.

DISCUSSION

The principles

A holistic or whole system approach to land management and agricultural output is the foundation of organic agriculture. In contrast to industrial agriculture, where pests are seen in isolation and managed with pesticides, this is shown by the method to pest management, which relies on the design and interaction of the farm as a whole to control pests. In the early days of organic farming, the farm was considered as a single, self-managing organism rather than a collection of discrete elements. The idea that a farm is an organism is where the name organic comes from, and it is based on the same reasoning thesis that the whole world is one organism. The shared interchange of resources labour, inputs, and output between farms at the village or district size would have also felt natural to the early pioneers of organic agriculture. A farm worker from a third nation may now use inputs obtained from one country in a second country to generate food for a fourth country.

Humans are clearly seen as a part of nature in organic farming, not as something distinct or something to be dominated or controlled. This viewpoint highlights the need for people to cooperate with, rather than compete with, ecological and other natural processes. Using renewable energy, guaranteeing closed nutrient cycles, and avoiding pollution are a few examples. However, since organic agriculture is integrated into larger society, it can only accomplish these goals if society as a whole does as well. Working within closed nutrient cycles is challenging, for instance, when there is no practical way for the community that eats organic products to return the nutrients in the food to the farm.

While adopting a holistic perspective and desiring to engage with natural systems, organic agriculture considers the state of scientific knowledge and understanding of such systems to be insufficient. According to the ecological point of view, such systems are incredibly complex and, on certain scales, essentially unpredictable. When people intervene in and alter natural systems, this perspective of unpredictability is particularly relevant; the risk being that the adverse unanticipated impacts are likely to be far bigger than the anticipated advantages. This is an additional example of the precautionary principle in action since it may take decades or even centuries for the harmful impacts of changes to ecological and other natural systems to manifest, at which time it will be hard to reverse them. In addition to being extremely ethical, organic agriculture places a strong emphasis on protecting both human and animal welfare. For example, it makes sure that farmers get a fair wage for their efforts and are not taken advantage of by customers. Additionally, there is a strong undercurrent of social justice that can be traced all the way back to the first proponents of organics and is present in all major green movements. People need to reengage with agriculture because they have a perception that it is distinct from other industries and more basic. Such reconnection is seen by the organic movement as a crucial first step in resolving many societal issues.

These organic farming concepts contrast with industrial farming and the underlying reductionist philosophy, which allows for the isolation of crops and the treatment of specific problems like nutrition, pests, and diseases rather than as a whole. Invade, Ambush, and

Warrior are just a few of the military commercial names of numerous pesticides and herbicides, which show how divided between humans and environment industrial farming is! Additionally, farming is not seen as an essential component of a society but rather as simply another kind of industry that should not be given any more privileges or restrictions than other forms of production. Industrial agriculture and the mentality that supports it are radically different from organic agriculture and its philosophy. The quick rise of market-driven organic agriculture during the 1990s has masked this distinction between them. Understanding the organic movement's worldview and guiding ideas, which often include views that are drastically at odds with those of mainstream culture, is crucial to understanding it thoroughly.

Challenges for Organic Agriculture

While organic agriculture seeks to be ecologically sustainable, there are still problems that need to be resolved and it has not yet achieved its objectives. Several important themes that were chosen for in-depth research, such as the influence of tillage in organic agriculture and the industrialization of organic production systems, are covered in length. It is a recurrent query about the movement's yields Similar to concerns about sustainability, productivity is influenced by a variety of elements, such as the farmer's history, the farm's resourcefulness, and regional and federal support systems. Does modern conventional agriculture effectively feed the world? could be the right response. Because of issues with food distribution and social structure, as well as major issues like poverty, racism, and gender inequality, high input, high yielding systems are now unable to feed the globe.Since the 1980s, organic literature has often included comparisons between organic versus conventional farming. The researchers have examined a broad range of elements on a variety of farm types, such as dairies, orchards, and mixed cropping farms, including yield, economics, resource use efficiency, environmental consequences, and social issues. Prestigious publications have published several significant instances of comparative study, lending vital credence to arguments that organic agriculture is effective and sustainable. Comparing farming methods may provide important details about the performance and productivity of an agricultural enterprise, ideally across a number of years. However, they are susceptible to significant restrictions, such as management site variety interactions and externalities such as energy, pollution, and health that may not be considered. Over a long period of time, significant amounts of government and commercial funding have been devoted to improving plant and animal germplasm, soil fertility and pest control techniques, as well as human capability for traditional agricultural systems. It would be anticipated that this assistance would provide traditional producers significant benefits. There may also be further, deeper, inherent distinctions across systems. Some agricultural practises make an effort to generate more than just items for sale. In addition to managing an agricultural industry, organic farmers must also function as stewards of the soil. Contrary to traditional farmers, who are not subject to the same constraints, they are also required to abide by an expanding number of environmental and social regulations. In a recent chat, Wes Giblett, a biodynamic dairy farmer in Western Australia, stressed that the aim is to grow topsoil, highlighting how successful sustainable farming is based on sound agricultural management as seen by deeper topsoil. Wes oversees Western Australia's only organic dairy, which serves a State with a population of about 1.5 million people that is 2.5 million square kilometres in size10 times bigger than Germany. Although he runs a highly profitable, vertically integrated dairy products company, his main agricultural priorities are topsoil, cow welfare, and helping to advance organic farming in his area. Finding the fundamental processes and overarching principles is more valuable than restricting the examination of organic agriculture to a comparison approach. By outlining the advantages and disadvantages of the organic system, organic farmers may benefit and receptive conventional farmers can get access to pertinent information. Organic farming is a real alternative for many farmers and consumers in a world with numerous options. Improving the productivity and environmental effect of organic agriculture depends on providing that decision with reliable research and critical analysis.

CONCLUSION

It is possible to develop ways to reinforce and increase the beneficial effects of organic agriculture by understanding the development and difficulties of the current organic movement.The understanding acquired from researching the contemporary organic movement may have repercussions for biodiversity preservation, global agriculture, and rural life. In conclusion, further study in this area is necessary to improve our comprehension of the contemporary organic movement. Better results for organic agriculture and its effects on the environment and society may be achieved by highlighting the significance of sustainable agriculture and addressing the problems the movement is facing. Recognising organic farming's importance in promoting sustainable food systems might also encourage more cooperation and integration between organic and conventional farming. To build a more sustainable and resilient future for agriculture and food production, it is necessary for academics, politicians, farmers, and consumers to work together to strengthen the contemporary organic movement.

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CHAPTER 7

SOIL FERTILITY: NOURISHING ORGANIC FARMING SYSTEMS

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ABSTRACT:

In order to produce food sustainably and with high agricultural productivity, soil fertility is essential. The goal of this study article is to examine the idea of soil fertility, its essential components, and the practises that may be used to improve soil health for sustainable agriculture. The research digs at the aspects of soil fertility that support plant development and nutrient availability, such as vital nutrients, organic matter, soil structure, and microbial activity. It examines how chemical contamination, nutrient depletion, and soil erosion affect soil fertility and the viability of agriculture. The study also explores the role of different soil management techniques, including conservation tillage, cover crops, crop rotation, and organic additions, in enhancing soil fertility and fostering long-term soil health. For robust and effective agricultural systems, environmental impact mitigation, and solutions to global issues like food security and climate change, it is essential to comprehend soil fertility and its management. In order to encourage the adoption of soil-friendly agricultural practises, the research also emphasises the possible uses of this information in sustainable farming methods, soil conservation initiatives, and policy development.

KEYWORDS:

Conservation Tillage, Nutrient Management, Soil Fertility, Sustainable Agriculture, Soil Health.

INTRODUCTION

For environmental and financial sustainability, all agricultural methods rely on maintaining soil fertility. Understanding the interactions between soil's chemical, physical, and biological components is essential for managing soil fertility effectively, yet historically soil chemical fertility has received more attention. The fundamental physical and chemical properties of soils, as well as their ability to sustain biological activity, vary widely. Of course, agricultural practises also have an impact on soil fertility, but how much depends on the particular soil and environmental factors. In order to evaluate the impact of agricultural practises on soil fertility, local knowledge is required.It cannot be assumed that organic management is more or less sustainable than certain other farming methods, even if organic farming possesses characteristics of sustainable agriculture. Many of the practises used in organic farming are applied on both organic and conventional farms, even though all organic farming systems run without the use of synthetic chemical inputs. Inefficient nutrient usage, rotations that are suitable for the landform and soil type, conservation tillage, biodiversity, and the use of legumes are only a few of the sustainability-related challenges that many conventional farming systems successfully handle[1]–[3].

As a result, rather than two distinct categories of organic and non-organic, changes in soil properties linked with agricultural management practises occur on a continuum. Soil fertility management and sustainability are similar to each other in synthetic chemical farming systems and organic farming systems, respectively.The requirement of being heavily reliant on the biological fertility of the soil, which in turn affects parts of the chemical and physical fertility, is a crucial characteristic of organic farming methods.Temporal and geographical variety in plant, animal, and microbial life are goals of organic agricultural systems. To improve nutrient usage efficiency from poorly soluble fertilisers and promote good soil physical processes, special attention is put on developing a varied microbial population. Contrarily, agricultural methods that predominantly rely on synthetic chemical fertilisers to improve soil chemical fertility may neglect crucial parts of soil biological fertility that might improve the chemical and physical fertility of the soil.Instead of more depleted soils in other locations, current criteria for organic practice may work better on chemically productive soils in temperate climates.

Globally, the most chemically productive soils are predominantly found in temperate regions, whereas poor soils are often more prevalent in tropical latitudes. Despite the fact that variations in the distribution of essential plant nutrients affect how reliant agricultural systems are on inputs, there are regional exceptions to these broad generalisations. Organic farming methods developed in areas with chemically productive soils, particularly in Europe and North America. Contrarily, early forms of contemporary organic farming have thrived for hundreds of years on chemically unproductive soils such as tropical soils in Africa, South America, and Asia, and they may include substantial amounts of organic matter such as animal and human waste. On the opposite end of the spectrum, large sections of arable land are designated as organic, mostly due to the impossibility of employing synthetic inputs such as in Australia's enormous desert regions. The largest variety of plant species is correlated with intrinsic soil chemical infertility on a worldwide scale [4]–[6].

It is important to use care when interpreting the findings of field experiments and paired comparisons such as organic vs conventional farms examining the impact of organic farming methods on soil fertility components. Studies that last a long time give soil biological processes a chance to stabilise. Few published field studies examining the impact of agricultural practises on soil fertility, however, have been carried out for more than eight years, and the majority have been carried out in areas with inherently rich soils and moderate temperatures Additionally, it is necessary to assess soil fertility in organic farming systems at the level of certain management practises, although this is not always feasible To enable a more thorough assessment of the effects of soil disturbance arising from changes in agricultural practises on soil fertility, both direct and indirect effects of certain management practises on the components of soil fertility should be taken into account.In this review, we look at soil fertility components in the context of organic agricultural systems and how soil fertility is managed using certified organic practises. The components of soil fertility are examined in relation to data from extensive field studies assessing organic farming. The idea of soil fertility is also considered in light of how it relates to the use of organic farming techniques in a variety of climatic zones and on a variety of soil types[7]–[9].

Components of Soil Fertility

If the physical, chemical, and biological characteristics of soil that affect its fertility are not taken into account, the phrase soil fertility is of limited use.Although generic criteria for good soil physical and chemical fertility which account for various soil types are widely accepted, standards for good soil biological fertility are more challenging to establish. Furthermore, compared to chemical fertility, measuring soil physical and biological parameters is not widely used since there are few commercial services accessible to farmers. Because organic farming places a larger focus on biological processes, a significant portion of the chemical fertility of the soil relies on how management practises support advantageous biological activities.

Due to the positive effects of increased organic matter inputs on soil organisms and soil structure, improved compared to conventional practises. Without the actions of soil organisms, organic matter contributes nothing to enhance soil aggregation. For organic farming methods to successfully use soil nutrient reserves and poorly soluble fertilizers as well as to avoid nitrogen N leaching from mineralizing legume wastes, improved soil structure and root development may be crucial.Compared to conventional farming methods, organic farming techniques may not always result in improvements in all facets of soil physical fertility. In certain circumstances, soil type is more important than management for determining the physical features of the soil, for example. An organically managed soil had a higher likelihood of being compacted than a conventionally managed soil, despite having a higher potential productivity, and improvements in some measures of physical fertility[10].

DISCUSSION

Soil Chemical Fertility

The chemical fertility of soil indicates its ability to sustain both biological and physical processes as well as to supply plants with an appropriate chemical and nutritional environment. processes including mineralization of organic matter and dissolution of minerals play a significant role in the preservation of soil chemical fertility in organic systems. Organic farms depend on these activities more than conventional farms do, even though they also take place in conventional agricultural systems in organic farming systems, conventional approaches for estimating fertilizer applications may not be suitable for establishing and sustaining soil chemical fertility. The majority of chemical fertility tests were created to forecast the release of nutrients from highly soluble sources utilising connections discovered between plant uptake and chemical extracts of soil nutrients The following factors may prevent these relationships from being directly applicable to organic farming systems. The availability of nutrients is more dependent on dynamic soil biological processes. The release and uptake of nutrients occurs without obvious changes in soil chemistry because nutrients are quickly absorbed by plants or soil microorganisms without accumulating.

For instance, discovered that whereas the potential for organic N mineralization was three times greater in organic farms, soil inorganic N was only one-quarter that of conventional farms. Similar to this, came to the conclusion that owing to the increased mobility of P ions in a biodynamic system, regular soil testing would not have been adequate to forecast phosphorus P fertility.A continuous but time-consuming measurement of trends in soil and plant analyses is one option for keeping track of soil fertility in organic farming systems. Additionally, in organic agricultural systems, sequential testing could be more effective at forecasting the availability of nutrients to plants throughout the course of a growing season. To estimate soil reserves, plant accessible, and water-soluble P, the Organic Advisory Service in the United Kingdom uses a sequential P extraction method.

Given the concern that organic farming systems are depleting soil nutrient reserves, combining soil analysis and nutrient budgets offers another way to monitor soil chemical fertility in organic farming systems Watson The inputs and outputs of nutrients from a certain region over a specified period of time are quantified by nutrient budgets Deficits raise concerns about the sustainability of the system in terms of soil chemical fertility while surpluses point to the possibility of nutrient losses to the environment and signal that soil nutrient stores are being used up Fortune et al. 2001. The effectiveness of nutrient utilisation may also be assessed using nutrient budgets. However, nutrient budgets may not be correct since it is difficult to accurately quantify N fixation and leaching on commercial farms and to estimate the nutrient contents and application rates for manures and composts the majority of estimates for nitrogen fixing come from published research.

Soil Biological Fertility

Developing sustainable agriculture systems may begin with learning how to control positive soil biological activities. Optimising plant output by preserving a rich biological variety in the soil is a key component of organic farming The ability of a soil to maintain biological fertility is influenced by its natural physical and chemical composition as well as management techniques. The Sustainable Agriculture Farming Systems Project SAFS trial revealed that soil type, measurement time, specific management practise, management system, and spatial variation were ranked in decreasing order of relative importance for influencing the composition of microbial communities]Organic matter additions, increased plant variety, decreased tillage techniques, and specific soil amendments are management techniques that might be employed to optimise the advantages of soil organisms Neither organic nor conventional farming methods can hope to expand the size or activity of the soil biological community without additional inputs of organic matter Stockdale

The possible contribution of soil biological activities to preserving soil chemical fertility in organic farming systems is a topic of discussion. Theoretically, organic farming depends more on soil biological fertility than conventional farming systems do for chemical fertility and sustainability. The fertilizers allowed in organic farming systems are mostly insoluble in soil IFOAM 2002, and soil organisms either mediate or enhance the mechanisms that control their ability to release nutrients in order to make up for the lack of soluble nutrient inputs, organic farming may change how the soil microbial community functions by improving its capacity to release nutrients from organic and poorly soluble sources Oberson Other field research shown that there was no difference in how crops responded to the application of rock phosphate in soil that had been managed conventionally and organically, indicating that organic management had not enhanced the availability of rock phosphate to crops.

The precise nature of biological activity under long-term organic and conventionally managed agricultural systems, particularly in extensively worn soils, requires more scientific investigation.It is possible to increase several facets of the biological and chemical fertility of soil by practises that improve the function of arbuscular mycorrhizal AM fungus and root nodule bacteria. It may also be crucial to develop plants to become more dependent on these symbioses. However, it is unknown if this process has a substantial impact on overcoming P deficit. By giving plants access to P as soon as it is released into the soil solution, AM fungi may also increase plants' availability to poorly soluble P sources including rock phosphate and P adsorbed in soil. Due to the reduced use of soluble P fertilisers under organic farming practises, the amount of root colonisation by AM fungi may be larger and the variety of AM fungi may also be greater. However, it is extremely challenging to quantify the advantages of AM fungi for plant productivity and sustainability and they seem to be depending on the environment.

Using agricultural inputs, it could be able to boost the activity and abundance of certain soil organisms. Simple organic chemicals like sugars and complex humic substances, for instance, may promote microbial activity, resulting in transient increases in biological activity and, perhaps, nutrient release and increased physical fertility. This finding is particularly important if selectively activated microbes have positive impacts on soil fertility. All agricultural systems need a deeper knowledge of the dynamics and variety of soil biological processes, yet sometimes a soil has too much biological activity. This may happen if organic matter is repeatedly disturbed and subjected to fast disintegration, which results in the loss of the material's usefulness as a source of slow-release nutrients and a contributor to preserving or enhancing soil structure.

Managing Soil Fertility in Organic Farming Systems

It is important to understand the objectives and guiding concepts behind the methods used to control soil fertility in organic farming systems. This has been covered in a number of studies of different organic farming systems as well as in organic production standards. Organic farming techniques strive to be as self-sufficient as feasible in nutrients and organic matter by creating and recycling resources on the farm in order to accomplish the long-term objective of sustainability. Therefore, emphasis is placed on procedures that enable effective nutrient and organic matter re-use on the farm. Additionally, only non-synthetic fertilisers that are weakly soluble in soil solution are allowed under organic production requirements. According to Lampkin 1990 and IFOAM 2002, managing nutrients in organic agricultural systems involves more than just switching out soluble fertilisers for insoluble ones. Organic farming methods must use management techniques like those covered below in order to create and maintain sufficient soil fertility.

The unscientific nature of the ban on manufactured inputs in certified organic farming systems; however, the opposite practise of attempting to maximise crop yield using synthetic inputs regardless of the environmental consequences is also not based on science treatment designs demonstrate how a farmer's predisposition towards reaching certain production-related goals affects management decisions. The goal of this paper is to evaluate the impact of organic farming methods on soil fertility, not to defend the basic tenets of such systems.Although it has been said that organic farming methods fundamentally vary from conventional methods, this cannot be supported in terms of soil fertility. Crop rotations, legumes, organic matter inputs, and the use of fertilizers that are not readily soluble in soil are some of the ways that soil fertility is managed in organic farming systems similar techniques also characterise conventional farming systems that address sustainability issues, such as the use of legumes to manage plant and animal nutrition in broadacre livestock-crop production.

Livestock

By adding organic matter and nutrients in the form of manure and urine, livestock may directly increase the chemical and biological fertility of the soil Although animal traffic may reduce some aspects of soil physical fertility pasture phases are associated with reduced tillage, dense rooting, increased root exudation, and soil organic matter content, which increase soil aggregation and biological fertility and lessen erosion Because they compete with plants for nutrients, weeds may diminish chemical fertility and can be controlled by livestock. The usage of manure aids in the goal of nutrient and organic matter self-sufficiency, but it is not always readily accessible, and its treatment during storage and handling must limit gaseous and leaching losses of nutrients Livestock rotations may be a crucial part of agricultural systems that are sustainable. Increased variety of creatures, from soil bacteria to mammals and birds, was seen on organic farms, in part due to the preservation of mixed farming in organic farming systems and the concomitant improvements in spatial and temporal habitat variability In organic farms without cattle, it may be challenging to manage nutrients, especially nitrogen N, however dairy farms may be an exception due to their vulnerability to N losses.

Legumes

As long as they are well nodulated, legumes are a crucial part of organic farming systems in pastures, green manures, cover crops, or food crops because they minimise or completely eliminate the requirement for external N fertilisers. The ability of the soil community to increase organic N mineralization, the fixation of sufficient N in the legume biomass, and the capacity of farming practises to maximise the beneficial soil fertility and environmental effects of legumes and minimise their unfavorable effects such as increased acidity and N leaching are all necessary for the sustainability of using legumes to supply crops with N in conventional or organic farming systems

Although the biomass from legumes may be effective in fixing nitrogen, the leftovers' accessibility to future crops might be increased. Although all of the N budgets revealed a surplus, N usage efficiency was poor on average 0.3, analysis of farm-scale nutrient budgets for 88 organic farms in temperate regions. Similar to this, legumes had the ability to provide crops with enough N, there was often a deficiency. Typically, organically generated crop wastes and manures have low N contents and sluggish mineralization rates when legume pastures are only sometimes introduced. Improvements in management practises that enhance the quality of legumes as microbial substrates, careful scheduling of the absorption of organic residues, and matching crop type with N mineralization dynamics may all increase the availability of legume-N to succeeding crops.

Reduced soluble N inputs must be made up for by increased organic N mineralization for legumes to retain sufficient N availability to plants. According to several studies organic agricultural systems usually have greater levels of potentially mineralisable N. Although there was no difference in the gross N transformations between a pair of conventional and organic arable farms,attributed the higher average rates of N mineralization 30% for integrated farming to higher soil organic matter contents. Since mites may enhance the variety of soil fauna, this may also be significant in organic farming systems. Mite diversity in a conventional soil under wheat was connected with gross N immobilisation.

The ability of organic management practises to enhance the positive impacts of legumes while decreasing the possibility for N leaching is a necessary component of the sustainability of employing legumes to meet the N needs of crops. Legumes may be intercropped with other crops to improve how effectively soil nutrients are utilised. Legumes have positive environmental effects, including improved soil structure, erosion protection, increased biological diversity, stimulation of rhizosphere organisms, acidification of alkaline soils, and decreased energy use and carbon dioxide CO_2 production on and off the farm, recommendation for increased use of legumes in farming systems.

CONCLUSION

Understanding soil fertility and the methods used to regulate it provide opportunity for fostering robust and fruitful agricultural systems. The understanding acquired from investigating soil fertility may have ramifications for the creation of policies, programmes for soil protection, and sustainable agricultural practises. Supporting the use of soil-friendly agricultural practises may result in more sustainable and reliable food production systems. In conclusion, further study in this area is necessary to improve our comprehension of soil fertility and its management. Adopting soil-friendly practises and putting a focus on soil health may improve agricultural output, environmental conservation, and food security. Recognising the importance of sustainable soil management may also aid in promoting agricultural practises and policy choices that enhance soil fertility and long-term agricultural sustainability. In order to maintain the long-term health and productivity of agricultural systems, it is important that researchers, policymakers, farmers, and agricultural professionals work together to address soil fertility.

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CHAPTER 8

FERTILIZERS IN ORGANIC FARMING: A COMPREHENSIVE EXPLORATION

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ABSTRACT:

In order to improve soil fertility and encourage healthy plant development without violating the principles of organic agriculture, fertilisers are essential in organic farming. In order to produce crops sustainably, this study article will examine the concepts, kinds, and effects of employing fertilisers in organic farming. The research dives into the fundamentals of organic fertilisation, which place an emphasis on using organic and natural sources to provide plants with vital nutrients. It examines the nutrient content and release properties of various organic fertilisers, such as compost, animal dung, green manure, and plant-based materials. The study also investigates the effects of organic fertilisers in organic farming systems on soil health, biodiversity, and environmental sustainability. Promoting agricultural practises that are socially acceptable, economically feasible, and ecologically benign requires an understanding of the principles of fertiliser usage in organic farming. In order to encourage the use of sustainable fertiliser practises in organic agriculture, the research also underlines the possible applications of this information in organic farming training, certification programmes, and policy development.

KEYWORDS:

Animal manure,Compost, Green manure, Organic farming, Organic fertilizers.

INTROEDUCTION

For instance, in poor sandy soils, less organic matter may be permitted than what is necessary. The European Union guidelines restrict manure application to 170 kg N ha-1 y-1, but the National Association for Sustainable Agriculture Australia (NASAA) in Australia sets a limit of 15 and 20 t ha-1 y-1 for off-farm manure and compost applications, respectively.It might be helpful to quantify the relative efficiency of different nutrient sources in order to determine how successful they are as fertilizers. The yield plateau of the response curve of the fertilizer in issue is often compared to a soluble source of the same nutrients to determine the relative efficacy of different nutrient sources. Due to their limited solubility in soil, minerals utilised as nutritional inputs in organic farming systems nearly invariably have a relative effectiveness. The relative effectiveness of organic matter inputs can also be assessed based on their recalcitrance, but the degree to which they are physically shielded from degradation in soil aggregateswhich would vary depending on the type of soilis equally important[1]–[3].

In organic farming, silicate minerals and rocks made of silicate minerals are utilised as fertilisers and soil conditioners. The primary constituents of igneous and many metamorphic rocks are silicate minerals, which vary in composition and rate of disintegration. Dissolution is more pronounced in soils with low pH, high moisture and temperature, and soil solutions that are not in equilibrium with mineral surfaces. Dissolution is favored by minerals with small grain size and large surface area. Silicate minerals are best suited as fertilisers in highly weathered tropical soils where acidic, nutrient-poor soils and heavy rainfall events favour dissolution. They are also best suited for leaching soils, particularly sands. Plants and microorganisms speed up the dissolution of silicate minerals in addition to the natural chemical and physical abilities of soil to do so. By releasing H^+ ions and organic acids into the soil, they reduce the pH by releasing organic ligands that attack mineral surfaces and form complexes. By preventing the balance between the soil solution and minerals from being attained, nutrient intake by plants encourages more dissolution[4]–[6].

However, rocks and minerals high in silica may be poor sources of potassium, despite research on plant uptake of nutrients in silicate minerals focusing on release of K. Few soils exhibited an increase in exchangeable calcium (Ca) or magnesium (Mg), and nine soils showed an increase in exchangeable potassium (K) when the dissolution of powdered granite in 20 acid soils from Western Australia was tested. The relative effectiveness of granite as a potassium fertiliser was 0.14 compared to KCl, and incubation experiments and field and pot trials have demonstrated that between 1 and 10% of the potassium in feldspar is released up to 14 months after application.Ca, Mg, and certain micronutrients may also be provided to plants via silicate minerals. A number of silicate minerals and rocks, including amphibolite, basalt, diabase, dunite, gneiss, granite, phenolite, serpentine, syenite, and volcanic ash, have been the subject of studies that have measured the release of Ca and Mg.

Silicate minerals have been recommended as soil ameliorants rather than nutrients, particularly for lateritic soils in tropical climes.Silicate minerals raise soil pH to diverse degrees on various soils, albeit not as much as lime. Rock phosphate may be employed in organic farming systems that lack access to sufficient amounts of manure to balance P lost from the soil in harvested goods. The utilisation of phosphate rocks and the variables influencing their relative efficacy. Reactivity, particle size, surface area, soil properties, and plant properties all have an impact on the relative effectiveness of these factors. Although many of the parameters influencing rock phosphate dissolving are well recognised, it may be difficult to estimate how successful each one will be. Citrate solubility has become a common test for the peculiar reactivity of rock phosphate sources. Different rock phosphate reactivity led to a ten-fold variation in dry matter yield between the least and most reactive in a study of the relative efficacy of 14 rock phosphates[7]–[9]. The relative efficacy also relies on the specific soil and plant variables and may make rock phosphate essentially ineffective or as effective as superphosphate.By controlling soil biological activities, it may be possible to boost the relative efficacy of poorly soluble minerals. As was previously indicated, certain soil microbes may solubilize P and promote the dissolution of silicate minerals, while AM fungi can improve plant availability of rock phosphate. In a P-limited environment, bacteria preferentially colonised the surface of P-containing minerals. If particular techniques and inputs can be developed to target and boost populations of the soil organisms involved, the capacity of these processes to improve nutrient availability to plants may be maximised. As an alternative, plant species and types may be selected based on how well they dissolve minerals. Additionally, because nutrient deficiencies have the potential to stimulate the mechanisms by which plants dissolve minerals, breeding plant varieties in inadequate nutrient environments may result in varieties that are better able to dissolve minerals and form associations with more advantageous AM fungi.

Altering the minerals themselves is another method for enhancing the efficacy of silicate minerals and rock phosphates. High-energy milling, or ball-milling at high energy intensities, alters the structure and bonding of minerals yet is appropriate for use in organic synthesis. Five rock phosphates' relative efficacy was up to three times higher after high-energy milling as compared to unmilled rock phosphates. High energy milling for 120 minutes enhanced the release of Ca and Mg from basalt and dolerite from 2% to nearly 18%. After 120 minutes of high-energy grinding, the feldspar's quickly dissolved K rose from 0% to 27%. By increasing their exposure to the microbial processes that lead to their breakdown, co-composting of rock phosphates and silicate minerals may also improve their relative efficacy. However, more thorough study is required to validate this. Others have shown that shaking silicate minerals enhanced the quantity of Ca, Mg, and K released from silicate minerals in organic extracts that are easily accessible to farmers, including brewer's yeast and calf urine.

On the subject of micronutrients in organic agricultural systems, very little research has been published. The conclusion that organic farming would not be feasible on soils lacking in micronutrients unless steps are made to supplement those minerals using fertilisers. Micronutrients may be supplied to plants by seaweed extracts, and there are ways to make the most use of them.The best time to harvest seaweeds and the nutrients that each species contains are not well understood, and their nutritional content is not sufficient to fulfil agricultural needs. Additionally, rather of using nutrients, they could promote plant growth and yield by acting on plant hormones. Growing grass species rich in trace elements helps sustain the micronutrient nutrition of animals, however this needs further research.Organic farming may not be sustainable since it has the potential to deplete nutrient stores in the soil. In other situations, the nutrients that are now ‘mined' in organic farming systems were previously provided as fertiliser when the land was cultivated using conventional methods. N, P, and K have been the main topics of published nutrient budget comparisons between organic and conventional farms. They show that nutrient budgets in organic farming systems may be balanced, but that budgets are often negative because nutrients are not effectively supplied. Because manure is less easily accessible outside of temperate areas, maintaining soil nutrient levels may be more challenging. According to many Australian research, P availability restricts productivity on organic livestock-crop farms and jeopardises the long-term viability of Australia's organic farming systems. a few of the organic grain-livestock farms in their research did not use fertilisers, and those that did only utilised a tiny quantity of chicken dung in their fertilisation programmes. Legumes were used to balance N budgets in a comparison of organic and conventional mixed livestock-cereal farms in New Zealand, whereas P and S budgets were balanced on farms using compost, rock phosphate, and elemental S and negative on farms using none of these, respectively. It is obvious that additional study is needed in this area, which also underlines the potential importance of soil microbes in organic agricultural systems, provided that they can be controlled to more efficiently cycle nutrients.Development of microbial products that may be applied to soil to encourage nutrient release and improve plant growth in organic farming systems is receiving a lot of commercial interest. Numerous other organic fertiliser types are allowed;however, the majority have not been well researched in the field. The ability of these materials to increase soil fertility over the long term and when used in conjunction with other management techniques has to be further investigated. Otherwise, claimed results will only be based on anecdotal evidence[10], [11].

DISCUSSION

Long-term effects

For a variety of organic and conventional treatments, the soil fertility has been evaluated in a number of published long-term field studies Despite the fact that full farms cannot be compared in this research, studies employing paired comparisons such as farms next to one anotherhave solved this issue. provides examples of changes in the physical, chemical, and biological characteristics of soil fertility from several of the field studies. Variations in soil fertility depended on time and were more obvious in areas that had undergone organic management for more than four years as opposed to less than three. Many of the claimed advantages of organic farming methods rely on their capacity to raise soil organic carbon (C), although not all field studies have shown this to be the case. Despite C inputs of 2.1 t ha-1 more than the typical treatment over the course of three years, the Californian apple trial's soil organic C content remained steady.

Since total organic C content might alter over a long period of time, measurements in this instance were only made in the second and third years under organic management. Only after the addition of a green manure crop to the organic treatment in the SAFS experiment was theoretically mineralisable N greater in the organic treatment than the conventional treatment. In the Rodale study, when manure was used in the organic crop-livestock treatment to improve mineralizable C and N compared to the organic crop rotation, there were differences in the quality of organic matter between the organic treatments. The application of manure in the organic crop-livestock treatment boosted mineralisable C and N relative to the organic crop rotation in the Rodale study, where variations in organic matter quality across the organic treatments were observed.

Biological activity rose throughout the pasture stages of the Apelsvoll experiment The Roseworthy experiment, however, found very minimal changes between the systems in terms of soil biological fertility.In semi-arid regions where it is challenging to enhance soil organic matter levels or biological activity, research is required to understand the impact of organic farming methods on sustainability. Species variety is often said to be essential to the integrity and long-term viability of soil ecosystems, however this is still up for debate. The assertion that organic farming practises modify the function of the soil biological community to make up for the lack of soluble fertilisers needs further investigation. However, cover crop breakdown was more dependable over time in organically managed soil in the SAFS experiment, where decomposition rates in a laboratory comparison of organic and conventional soils were comparable.

The DOK trial's findings show that in biodynamic systems as opposed to conventional systems that use synthetic fertilisers, microbial cycling of P contributed more to the amount of P that is accessible to plants. However, only 10% of the inorganic P released into the soil solution was a result of organic P mineralization, and the biodynamic soils' greater P mineralization rate only partially made up for their reduced P availability. Other findings from the DOK experiment contrasted the biodynamic and conventional treatments, the latter of which also got manure. The biodynamic treatment had greater functional diversity, microbial C, incorporation of 14C-labelled plant material into the microbial biomass, and it mineralized 58% of the added C, compared to 50% in the conventional soil and unfertilized controlThis is despite the fact that both treatments received the same amount of manure. The quality of the manure inputs or the use of herbicides in the conventional treatment, which decreased microbial measures by lowering weed populations, may have contributed to the variations between the treatments.

To assess the impact of organic and conventional farming techniques on a few chosen soil functions, soil quality indicators have been utilised. Lack of organic matter inputs was blamed for the conventional treatment's inferior soil quality rating in the Washington State apple study The conventional treatments outperformed the organic treatments in the Apelsvoll study for the soil chemical and biological components of fertility examined. The total soil fertility of the mixed agricultural systems was greater than that of the arable rotations within each management system. However, the organic treatments scored higher than the conventional treatments for the soil function of reducing environmental effect, including nutrient runoff and soil.

Due to a lack of manure applications, negative N budgets, and a larger decline in soil N over time, organic arable rotations may have had lower mineralizable C and N levels than organic livestock treatments in field experiments.Due to better soil biological and physical fertility and less N leaching, mixed livestock-cropping systems may have higher intrinsic fertility than arable rotations, according to results from the Apelsvoll study.

The utilisation of green and animal manures, however, minimised the discrepancies between the rotations of livestock and crops in organic systems studies show how difficult it is to generalise about soil conditions in organic farming systems without considering particular practises and local knowledge of the soil and environment.Globally, chemically fertile and infertile soils have given rise to organic farming methods, although the majority of national and international organic certification criteria were developed in areas with younger, chemically rich soils. While organic farming methods may increase the physical and biological fertility of the soil, consistent results are not always seen. If inputs do not match those extracted in product, soil nutrient mining may result, reducing soil chemical fertility.

Based on existing certification requirements, the inability of organic farming techniques to increase organic matter and soil biological fertility in certain severely weathered soils and semi-arid areas might result in unsustainable practises. Without additional holistic management that considers all aspects of the farm environment, including climate, topography, and soil type, simple adherence to national or international organic standards that deal with soil fertility will not automatically result in sustainable organic farming systems. Problems are more likely to arise in soil that is chemically deficient and heavily weathered. This underlines the need of having a localized understanding so that appropriate modifications may be made in response to a drop in soil fertility components. Commodity modifications and a focus on long-term, preventive remedies rather than reactive ones are two examples of adjustments that may be made. The degree to which conventional management methods may combine organic farming techniques that are used to increase soil fertility may be a key element in the creation of more environmentally friendly agricultural practises as a whole.

Emerging fields of study, such the emphasis on soil priming, together with nanotechnology approaches to soil dynamics, have the potential to enable more thorough scientific exploration of organic farming claims that have only been supported by anecdotal data. A complex process of nutrient release in highly biologically active soils may be demonstrated by combining research in molecular microbiology, soil microbial diversity, and growing interest in soil ameliorants like microbial cocktails, compost tea, and relatively insoluble minerals. In soils that get flushes of highly soluble nutrients, such in typical farming methods, contributions to soil fertility from activated biological processes are likely to be limited. However, this may also happen when using large amounts of manure or improperly decomposed organic waste. Furthermore, it is unclear that organic farming methods that only mirror the typical focus on nutrient replacement in conventional farming systems would result in the quantitative and qualitative increases in soil biological fertility required to make them viable.

Finally, compared to typical farming methods, the idea of sustainable yield for a specific region may offer more room for exploration. This is a challenging query since, in reality, production may be accomplished without soil for example, in hydroponics. Generally speaking, chemical inputs into traditional agricultural systems are essentially limitless and they have the power to outweigh certain potential biological processes' contributions. This is less probable in organic farming systems that are more resource-limited, where altering nutrient cycling via soil organic matter management has more consequences. In this case, it is possible to predict the sustainability of the soil resource under the given circumstances commodity, management practise, climate, and soil type without running the risk of overfertilization, which would increase output to a point where one or more types of land degradation would result.

Although it is uncommon to think of productivity in any agricultural system as being too high, this might be the case if excessive fertilization or soil disturbance causes nutrients to be lost via leaching or soil erosion. Calculating the potential sustainable yield for any agricultural land use is likely to need management strategies that create a long-term balance among the three soil fertility components.

CONCLUSION

Understanding the concepts and effective use of fertilizers in organic farming presents chances for advancing socially and ecologically conscious agricultural practises. The research of organic fertilizers may have an impact on policy creation, certification programmes, and training for organic farmers. Supporting the use of environmentally friendly fertilizer practises in organic farming may result in more resilient and virtuous agricultural systems. To sum up, further study in this area is necessary to advance our comprehension of fertilisers in organic farming. Better results for organic crop production and environmental conservation may result from highlighting the significance of organic principles and environmentally friendly fertilization techniques. Recognizing the benefits of various organic fertilisers may also encourage farmers to include them into their organic farming practises. To preserve the long-term viability and success of organic agriculture, researchers, legislators, organic certifiers, and farmers must work together to address the usage of fertilisers in organic farming.

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CHAPTER 9

ORGANIC AGRICULTURE CROP AGRONOMY: SUSTAINABLE PRACTICES FOR ABUNDANT YIELDS

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ABSTRACT:

Crop agronomy, which focuses on the management and production of crops using environmentally friendly and organic methods, is an important part of organic agriculture. In order to produce crops sustainably, this study article will examine the concepts, methods, and developments in crop agronomy in organic agriculture. In order to maximise yields while preserving soil health and biodiversity, the research goes into the fundamental concepts of organic crop management, including crop selection, crop rotations, intercropping, and nutrient management. It examines how conservation tillage, green manures, and cover crops may improve soil fertility and inhibit weed development. The study also looks at how crop agronomy affects organic agriculture systems' ability to control pests and diseases, utilise water efficiently, and maintain a healthy environment. In order to encourage crop production that is environmentally benign, commercially successful, and socially responsible, it is essential to understand the fundamentals and recent developments of crop agronomy in organic agriculture. In order to encourage the adoption of sustainable crop agronomy practises in organic agriculture, the research also emphasises the possible uses of this information in organic farming training, sustainable agriculture development, and policy-making.

KEYWORDS:

Crop Agronomy, Crop Management, Conservation Tillage, Organic Agriculture, Sustainable Crop Production.

INTRODUCTION

The methods described in the numerous organic standards that have been created and published in many nations form the foundation of organic crop husbandry. The International Federation of Organic Agriculture Movements (IFOAM) produced the organic standards that are the most frequently accepted (IFOAM 2002). To accomplish crucial soil fertility, nutrient management, and plant protection objectives, organic farming techniques place a focus on using on-farm inputs rather than inputs from outside sources. The basic concepts of organic farming that support the development of organic plants include self-regulation within an agroecosystem, multi-year management cycles, and an emphasis on prevention rather than response[1], [2].

The maintenance of a site-specific and market-focused crop rotation is the fundamental component of organic crop husbandry. By producing crops with a variety of profiles in nutrient need and supply, growth habit, and phytosanitary features, alternating a broad range of crops across time and area may promote effective use of the soil resource of a farm. Crop rotations are becoming more crucial for nitrogen management as stockless farming becomes more specialised locally and worldwide, and there is a growing dependence on manure sources that are not produced on the farm. Although the shift towards stockless systems may raise concerns about sustainability in certain contexts, conflicts are more likely to develop as excellent organic farming practices are jeopardised the more crop husbandry is market-oriented or economically driven. For instance, more components must be grown as cash crops rather than sacrificing enough soil fertility-building components in a cycle, whether it includes cattle or legumes[2], [3].

In this chapter, a variety of alternative cultural techniques utilised in organic farming to accomplish various farm management goals are covered in addition to crop rotations. Organic farming is essential to overall landscape management. Even small-scale farming may help to raise and improve a holding's percentage of non-productive land. It might be challenging to develop permanent elements like hedges, tree lots, or ponds in certain situations, particularly on rented farms. Instead, blooming field edges or corridors may be included as a yearly enrichment of the agroecosystem, boosting the quantity of faunal components for better self-regulation across neighboring fields. This chapter primarily focuses on mixed and stockless annual cropping systems as opposed to solely perennial agricultural systems like tree and vine crops[4]–[6].

Crop Rotations

The word crop rotation signifies that crops are cultivated throughout time in a fairly definite sequence. The cycle will be repeated after a certain number of years duration of the crop rotation. The cropping plan is the list of crops that will be cultivated in a given year on the farm's available land. The cropping strategy is the same each year if the crop rotation is stable and unchanging. Crop rotation includes two components a spatial component where the crops cultivated this year are divided throughout the available area, and a temporal component where crops are grown over time in a certain sequence succession of crops in time. The notion of crop rotation may be strengthened by using the interplay between spatial and temporal factors. Spatial crop rotation is the process of rotating the crops on the available land such that a specific crop is never produced adjacent to a field with the same previous crop. This aids in preventing the persistence of semi-mobile pests and illnesses from one year to the next[7]–[9].

Contrast this with farms with little or no animals, where the crop rotation may be dominated by economically attractive crops.The rotating system must, from the perspective of productivity, satisfy demands for the preservation of soil fertility, nutrient delivery, and weed, insect, and disease management Crop rotation choices are also influenced by economic factors, such as labour management and sustaining farm cash flow despite changing market conditions and environmental factors. In organic farming, the conflict between immediate needs and long-term needs presents difficulties for farmers, and managing a series of crops that provide both immediate monetary benefits and indirect ecological services requires complex skills.

Nutrient Management

Organic cycles often have two elements to their structure. First, periods with non-legumes like cereals, root crops, or field vegetables rely on the accumulation of humus, organic nitrogen (N), and depleting the resources. Second, legumes are used as a soil fertility-increasing component, from annual to multi-year crops, primarily in the form of forage legumes, with much less in the form of grain legumes.In organic farming, the focus is on using certified inputs and best practises for land management to create healthy, biologically active soil. Plant remnants, animal dung, rock dusts, and biological activators are some of the inputs utilised in rotations (IFOAM 2002). Additionally, soil processes including nitrogen cycling and soil structure development are enhanced by the promotion of biological activity. The soil's mineral nutrients are subsequently used by plants in pastures and crops. The relative rates and significance of certain processes vary across farming methods, the underlying soil processes and nutrient pools are the same in organic and conventional soils. According to previous studies, improvements to soil under organic management are often subtle rather than dramatic for a review of soil fertility,

Most crops need careful N control to increase yields while reducing nitrogen loss. This transportable nutrient is often easy to provide in organic farming, whether via legumes or animal manures, but it is also simple to lose from the system. In particular at higher pH levels, phosphorus (P) is a particularly immobile nutrient, and sources of P that have received an organic certification often have limited solubility. The lack of sustainability in current organic P management in many contexts has therefore been addressed by numerous recent studies. P and K were being depleted in certain systems, notably arable cropping, using farm-scale nutrient budgets. However, N was often not a concern. Dairy farms had low nutrient budgets because they relied so little on outside inputs, but horticulture farms had considerably higher budgets, perhaps as a consequence of significant outside manure inputs. The longer-term reduction of P soil reserves in certain organic farms in Germany, where the older organic farms contain less P than the younger organic farms a tendency not seen in associated conventional farms.

Organic farmers may store nitrogen and other nutrients for use in subsequent crops while reducing the danger of environmental contamination by increasing the amount of carbon (C) inputs in the soil as a matter of fact, enhanced soil structure was dependent on regular, and most likely substantial, inputs of fresh organic mattera typical practise in organic agriculture. The long-term (20–120 years) effects of fertilisers and manures are compared review of a number of conventional field trials. The farmyard emphasises a number of pre-crop effects, including soil physical, chemical, and biological aspects as well as ecological services like crop protection and weed control. Rotating green manuring results in more biodiversity throughout time and area.

Green manure is classified as a major crop, an intermediate crop, and a companion crop depending on the time of year and the aim of the cultivation. Intermediate crops are sometimes known as catch crops or cover crops. The expectations for N-conserving activities in the crops usedprimarily fast-growing crucifers and grass species are made explicit in the first term. The second phrase is similar but additionally underlines the activity of covering the soil with plants as a means of conserving the soil. By integrating many partners simultaneously, under sowing or, more recently, living mulch systems, enhance the complexity of a developing system. The intercropping system, a concept that was often used in old agricultural systems all across the globe, is another term for this kind of planting design. It currently encompasses a variety of farming methods, including under sowing, dual cropping, strip farming, agroforestry, hedging, shelterbelts, and windbreaks. All of these techniques entail a greater variety of plants on a farm, which might improve the likelihood that agroecological processes will take place. Improvements in soil fertility, resource capture, pest and disease control, weed management, and risk management are all possible advantages of intercropping. To fully meet the agronomic requirements of many crops, intercropping calls for competent farm management.

In situ mulch crops have been used in intercropping systems that have undergone extensive testing, especially in the United States of America. Soil fertility and weed control when leguminous cover crops were used in cabbage, but they also noticed that interspecific competition was a significant issue. Based on relative vigour, timing of development stages, and complementary resource consumption, secondary crops must be carefully matched with the main crop and the current growing circumstances. Row crops with little weed competition may benefit most from intercropping.

Tree, shrub, and vine crops in perennial farming systems provide opportunities for both short-term and long-term intercropping. In addition to the use of cover crops on the orchard floor of many crops including apples and wine grapes, plantings of commercially and environmentally valuable species within or around the orchard have also been used for pollination, disease and pest control in crops such as such as leeks and carrots.The usage of crop combinations designated for one-year set-aside is facilitated by particular programmes within the European Union (EU). This is often handled within the framework of a biennial or longer grass clover crop, out of which one year is funded by subsidies and not used for animal feed. By removing the last cut as roughage and adding more biomass as C and organic N to the soil, a one-year forage crop may have similar benefits, although at a lesser level. While the fast decomposed biomass of green manure offers more nutrients and energy sources for soil organisms and increases the fertility for the succeeding crop, the one-year green manuring is most important as a source of humus.

the phytosanitary benefits of glucosinolate-containing crucifers also known as bio-fumigationagainst the occurrence of soilborne illnesses are significantly connected to their allelopathic qualities. Due to the presence of gallic acid, buckwheat as green manure may have comparable effects on different weeds. Various green manures, such as radish, marigold, and sudangrass, might minimise root knot nematode infestations, a serious pest in vegetable agriculture Due to increased predator activity or greater herbivore confusion, living mulches may be particularly effective against a variety of pests German surveys on organic agricultural and vegetable holdings found that 60% of arable farms and 63% of vegetable farms used cover crops or undersowing, in contrast very limited use of green manure crops as part of crop rotations in Dutch organic farms (3 of 68 farmers interviewed). The use of cover crops was the most prevalent soil fertility management technique identified by organic farmers in a study conducted in the USA (72%).

With regard to the proportions of forage legumes, grain legumes, and cover or under sown crops, devised a variety of rotations that varies in duration and structure. The percentage of grain legumes shouldn't be more than 33%. Forage legumes may obtain mixes of up to 50% when grown in mixtures of clover and lucerne and grass species. Higher amounts of legumes might result in significant production losses throughout the course of rotations due to incompatibility, soilborne illnesses, and other causes.The variety of possible cover crops and under sowings employed in the rotations is an example of how species biodiversity has increased in organic farming. Under ideal circumstances, under sowing in the previous cereals might be substituted with forage legumes. After the harvest of the cereal crop, a stubble crop should be seeded in its place if the under sowing crop performs poorly. To be able to tolerate a poor performance, the one- or multi-year forage legume portion of the rotation is too crucial for the success of the rotation as a whole for example, for N fixation and other activities. When winter crops are replaced with spring crops, cover crops could be the best option. Pre-crop harvesting and following crop planting are separated by enough time to allow for correct seedbed preparation, rigorous mechanical weeding as needed, and significant root growth and above-ground biomass for soil protection.

The percentage of the various crop groups utilised in the rotation will vary somewhat in response to the requirements of various farm types. Rough fodder from mixed farms with ruminants may be produced in rotation with between 30 and 50% of grass-clover or grass-alfalfa combinations. Animals that only have one stomach, such as pigs and chickens, are mostly fed grains of legumes and cereals. As a result, the ratios of cereals and forage legumes are changing more in favor of cereals. From an economic standpoint, forage legumes are becoming less necessary on farms with arable crops. But from the standpoint of sustainability, these farms need to continue using the set-aside approach for at least a year. Cooperation between mixed farms, preferably organic ones, has the potential to increase the forage legume segment from one to two years, allow for the import of animal manure as a replacement for the produced and exported forage fodder, and maintain the farm's arable land, all of which have significant positive effects on labour management.

An alternate set of advantageous rotational pairings, however they must be modified for each location and crop circumstances. Spring grains may be more suitable than winter cereals in areas that are more arid. Early maturing cultivars need to be selected for cultivation if harvest times often occur too late for the timely planting of consecutive harvests. Depending on the level of soil moisture, cover crops may be used in place of partial fallows in the rotating pattern. Their worth cannot be determined just by limited economic standards. Long-term improvements in soil organisms, soil structure, soil management, trafficability, infiltration rate, and mineralization rate are examples of indirect impacts that become increasingly visible.

Farm design

How can the progress of managing rural landscapes be measured? A thorough strategy was developed, which was used to analyse various European farm types and landscapes. Environmental and ecological standards were used to evaluate the abiotic environment's quality. The cultural environment was analysed using psychological, physiognomic, and cultural geography criteria, while the social environment was evaluated by looking at economic and sociological factors. A different group of Dutch agronomists created a methodology for the prototyping of farming systems that was clearly more farm and production oriented and in which the ecological infrastructure management was an essential component for the assessment of each system's environmental friendliness. This methodology did not require as many visits to the site or working sessions as the other approach. The factors, which include certain related topics, are particularly relevant for agroecological evaluation.

Farms are a natural component of the landscape. Therefore, the quality of the environment at the field, farm, and regional levels is directly influenced by how agricultural systems are managed. The Landscape and Nature Production Capacity of OrganicSustainable Types of Agriculture, M is a collection of in-depth approaches to the subject that was sponsored by EU funding.

Which farmland should bereconverted to or preserved as natural vegetation or habitat, and which should be retained for production, is an issue that has grown increasingly more pertinent for organic practitioners in line with larger concerns about how agriculture affects the environment. There are many approaches to enhance a farm's landscape quality.

CONCLUSION

Understanding the fundamentals and most recent developments in crop agronomy in organic agriculture provides chances to promote crop production that is both socially and ecologically responsible. Crop agronomy research may have an impact on policy-making, sustainable agricultural development, and training for organic farming. Supporting the use of sustainable crop agronomy techniques in organic farming may result in more robust and environmentally responsible crop production systems. In conclusion, further study in this area is necessary to advance our knowledge of crop agronomy in organic farming. Better results for crop production and environmental conservation may result from highlighting the significance of organic principles and sustainable crop management techniques. Recognising the benefits of various crop agronomy techniques may also assist farmers in incorporating these techniques into their organic farming operations. To maintain the long-term viability and effectiveness of organic crop production, crop agronomy in organic agriculture involves cooperation between researchers, policymakers, farmers, and agricultural experts.

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CHAPTER 10

NO-TILLAGE SYSTEMS WITHOUT CHEMICALS: ADVANCING SUSTAINABLE CROP PRODUCTION IN ORGANIC AGRICULTURE

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ABSTRACT:

Chemical-free no-tillage systems have drawn a lot of attention as a sustainable and ecologically beneficial method of growing crops in organic agriculture. In order to produce crops sustainably, no-tillage methods without pesticides should be used, as will be examined in this study article. The research dives into the fundamentals of no-tillage farming, which emphasises cover crops, residue retention, and little soil disturbance in order to improve soil health and biodiversity. It looks at the effectiveness of natural predators, crop rotation, intercropping, and other organic weed and pest management techniques for controlling pests and weeds without using synthetic pesticides. Additionally, no-tillage systems' effects on soil carbon sequestration, water conservation, and overall ecosystem resilience in organic agriculture systems are investigated by the study. To promote crop production practises that are socially acceptable, economically viable, and ecologically benign, it is essential to comprehend the concepts and advantages of no-tillage systems without chemicals. The research also emphasises how this information may be used in policy-making, sustainable agriculture development, and organic farming training to encourage the wider use of chemical-free no-tillage methods in organic farming.

KEYWORDS:

No-Tillage Systems, Organic Agriculture, Sustainable Crop Production, Soil Health, Weed Management.

INTRODUCTION

Despite the huge demand for organic food, producers throughout the globe are faced with a potentially dangerous problem. Despite the fact that the majority of organic farmers are concerned with soil quality, including the physical, chemical, and biological characteristics of soils, they typically employ multiple inversion tillage operations ploughing, disking, cultivation to prepare seedbeds, incorporate cover crops, and control weeds. These actions could lower soil quality. Because organic producers cannot employ inexpensive pesticides to manage weeds and provide nutrients, labour and input costs in organic systems are often high Additionally, compared to chemical-based no-till methods, organic farms may experience larger soil losses due to their dependence on inversion tillage[1]–[3].

Organic High-Residue Reduced-Till Systems

High-residue reduced-till systems (HRRT) have a great deal of promise to overcome the organic farming industry's conflict between high tillage costs and soil quality. HRRT should ideally be a crucial component of a comprehensive strategy for managing organic farms that results in both immediate productivity and profit and long-term production capacity. The ideal organic HRRT system can simultaneously offersynchrony of nutrient supply with crop demand; and multiple non-nutrient effects, such as weed suppression, soil aggregation, resistance to erosion, biological pest management, and water infiltration and availability.The primary elements of HRRT for organic growers are as follows, based on grower experiences and research data: regular use of grass and legume cover crop mixtures permanent soil coverage with either dead or preferable living plant residues; and strategic limited number of soil disturbance events, used to manage weeds and regulate rate of decomposition of organic substrate. Maintaining or improving active soil organic matter (SOM) and its accompanying soil quality attributes is one way to achieve an economic balance between the short-term need for seasonal crop productivity and the long-term need for sustaining production capacity[4]–[6].

Cover crops – their uses in organic agriculture

High-residue cover crop production and management are seen as being necessary for viable organic cropping systems. Cover crops are non-cash crops that are utilised to perform or accomplish various goals, whether they are made up of grass, legumes, or combinations. Cover crops reduce soil erosion and absorb leftover nutrients and water when planted immediately after cash crops.In order to prevent pollution and enhance soil quality, cover crops act as scavenger or capture plants. They accomplish this by supplying vital food stores and habitat for beneficial species.Since many cover crops are planted in dense plantings, develop quickly, and smother weed growth, they are sometimes referred to as smother crops. Before planting cash crops, cover crops are often cultivated and destroyed. In this form of application, they may be added as green manure or destroyed and utilised in no-till systems as dead mulch[7], [8].

Living mulches are cover crops that are interceded and cohabit alongside cash crops for all or part of the growing season. An excellent living mulch for organic gardeners is low-growing, simple to create and maintain using non-chemical methods, does not hinder the development and production of the cash crop, and provides a suitable home for beneficial insects. According, living mulches are especially useful for fast-growing cash crops that get additional water and nutrients via in-row drip irrigation systems.Specialised blooming and high nectar cover crop mixes are planted as farms cape plantings or companion plants in field edges, or they are placed in rows or patches spaced evenly over the field. Farms cape plants should ideally include permanent and reseeding annual species that smother weeds, safeguard the environment, improve soil quality, and provide habitat and protection for beneficial insects.

Non-inversion tillage tradeoffs

Multiple field operations are often necessary for inversion tillage, which causes excessive soil aeration, the breakdown of new organic wastes and SOM, and the deterioration of soil structure. Permanent no tillage and inverted tillage are two extremes, and rotational tillage is a balance between them. To establish a balance between immediate productivity and long-term production capacity, rotational tillage is defined here as the planned sequencing of no-till and non-inversion tillage practises.By avoiding inversion tillage in favor of a delicate balance between no-till and non-inversion tillage practises, the rotational-till idea is a sort of reduced tillage. Since they provide only little interference on soil structure, not ill and non-inversion tillage practises are favored.

It is possible to utilise a variety of non-inversion tools, from superficial tillage with rototillers, rotary hoes, powered harrows, or high-residue cultivators to deep subsurface soil loosening with chisel ploughs or subsoiling and spading machines.Non-inversion tillage includes shallow rototilling since the subsurface layers' integrity is preserved.Non-inversion tillage is employed in organic cropping systems with the aim of achieving essential weed control, improving short-term nutrient availability, incorporating crop residues and soil amendments, and reducing soil compaction with the least amount of soil disturbance and degradation of SOM. Non-inversion tillage should ideally be completed in only one or two field operations. Without causing too much disturbance or aerating the lower soil layers, shallow non-inversion tillage may kill cover crops and weeds and absorb their remains 5-8 cm deep. Deep placement of in-situ crop wastes and soil additives may be made possible by non-inversion in-row subsoiling, which also reduces compaction This results in deeper root exploration and greater availability of water and nutrients. Another method of rotating tillage that may produce low bulk density/high tilth soil in specified plant-growing regions on bed tops is the use of permanent controlled-traffic raised beds.

High-residue, grass-legume combination production and proper management are highly advised cultural practises for enhancing soil quality and productivity in all cropping systems, whether organic, chemical, or integrated. Many organic gardeners regularly and highly regard the use of cover crops as green manures. Many supporters and some practitioners of organic agriculture think that organic no tillage is the best system to achieve a desired balance between short-term productivity and production capacity because cover crops are now widely used in chemical no-till systems.The real challenge is how to grow organic no-till cash crops without the use of herbicides, not whether integrating organic farming systems with no-till techniques is a good idea. The majority of farmers and agricultural experts are aware of the possible immediate and emergent advantages of integrating organic no-till farming; nonetheless, experience has often proved underwhelming. However, in warm long-season areas when organic cash crops are successfully planted in high-residue dead cover crop mulch, excellent weed control and high yields are often attained.

Growers can bridge the gap between the ideal situation and weed management issues that frequently arise in organic no-till fields by using site-specific tillage rotations strategic sequencing of no tillage and non-inversion tillage. There are two unique scenarios in which organic no-till gardeners could go back to utilising non-inversion tillage tools. First, a producer may decide that a remedial weed management strategy has to be utilised to stop the generation of weed seeds and protect the cash crop shortly before or after planting cash crops. Second, growers may decide to use one or a combination of non-inversion tillage tools to kill remaining vegetation, incorporate plant residues and applied soil amendments, reduce subsoil compaction, and prepare an improved seedbed for drilling cover crops after harvesting cash crops and before planting overwintering cover crops.

Overwintering cover crops might then be utilised as a high-residue mulch for the spring or summer planting of organic no-till or reduced-till cash crops.In conclusion, organic no-till systems are only advised in situations where high-residue cover crops can be successfully produced and maintained, and where the cover crops' root and shoot biomass surface residue mulch positively influences the productivity of cash crops. Organic no-till systems offer the highest success rates, according to research and farmer experience. One, in warm, long-season climates, particularly Mediterranean-like regions; two, in fertile, well-drained soils, particularly on sloping, erosion-prone land; three, with late plantings, i.e., when there is not an early-season market demand; four, when cash crops are established from transplants or large seeds; and five, when cover crops produce high residue levels of persistent biomass that can suppress weeds.

DISCUSSION

Crop protection in organic agriculture

Many of the same crop protection problems that face conventional agricultural methods also affect organic farming. Growers both internationally and locally use quite different approaches to crop protection in organic agriculture. On one end of the range, organic producers use large-scale operations with substitution-based strategies to command premium pricing in a specialised market. On the other hand, resource-constrained farmers growing food for subsistence automatically use pest control strategies based on conventional wisdom. Compared to those producers who have formed the conceptual core of organic agricultural movements across the globe, organic growers at both ends of the spectrum are less driven by environmental and public health concerns. These farmers see fundamental differences between organic and conventional farming, not only in terms of the pest and disease issues that crop production must deal with, nor just in the variety of producers' solutions, but also in the conceptual frameworks that support crop management practises.

The conceptual concepts used in both conventional and organic agriculture are sometimes oversimplified in discussions. The use of planned treatments of broad-spectrum pesticides biocides, insecticides, fungicides, and herbicides is no longer considered traditional pest management. Choosing cultivars that are resistant to insects and diseases, crop rotation, and crop residue elimination are just a few of the cultural controls that are included into best practises in conventional agriculture. Other methods include pest monitoring, selective pesticide usage and timing, pest monitoring, and cultivar selection. In the same way, organic farming goes beyond conventional farming by using natural fertilisers and pesticides rather than synthetic ones. While some organic growers do simply substitute manure for fertilizer and pesticides derived from plants for synthetic pesticides, more frequently, organic practises involve a wide range of cropping and soil management techniques that uphold ecosystem health and promote ecosystem services.

For the purposes of this chapter on pest and disease management, organic agriculture is defined as plant and animal production systems that place a strong emphasis on sustainable and renewable biological processes. Nutrients are supplied at rates necessary to maintain nutrient balances through decomposition of nitrogen (N)-fixing green manures and plant or animal-based soil amendments, and pest management heavily emphasises promoting plant health, vegetation management, and biological control. The use of microbials, botanicals, soaps, oils, minerals, and augmentative releases of predators are examples of curative pest treatments; synthetic fertilisers or pesticides are often not used, unless exemptions are permitted. Based on some of the concepts from invasion ecology, we will utilise a theoretical method to characterise pests and illnesses in agricultural systems. An intricate and lively academic debate about alien animals, plants, and birds is called invasion ecology.

We investigate if distinct invasion tendencies for bacteria, nematodes, fungus, and herbivorous arthropods can be identified in organic vs conventional agricultural settings. We may analyse how crops handled organically may provide barriers against the invasion by pests and diseases by borrowing the word invisibility and, when feasible, comparing them to crops managed conventionally. Depending on the scale of observation, poor invisibility has often been associated with high biodiversity in natural ecosystems, and this association may also exist in managed agroecosystems. Agroecosystems that are maintained organically tend to be more diversified than those that are managed conventionally. Additionally, organic farmers typically establish managed natural vegetation strips on purpose, which has an impact on both soil and above-ground biodiversity. We may anticipate less pest and disease transmission on organic farms than on conventional ones if enhanced biodiversity in agroecosystems limits invasiveness. We contend that while there are few outliers, this assumption is often realised.

We contrast the variety of pests and illnesses that threaten crop yield worldwide in both organic and conventional agricultural methods. Although the focus of this article is on arthropod pests and illnesses, we also provide some findings on pests that affect vertebrates and other invertebrates. The three components of pest and disease control, including organic and conventional techniques, are then discussed. These components are avoidance of colonisation or establishment; population regulation via biological processes; and curative treatments.We critically review comparative research projects on conventional and organic pest control conducted in many regions of the world to illustrate these aspects of pest and disease management in action. We also highlight the opportunities and limitations of organic crop protection in various farming contexts. We finish by making recommendations for future study areas that will increase our understanding and ability to provide efficient crop protection in organic agriculture.

Pests and diseases in organic versus conventional agriculture

The same pests and illnesses that affect conventional farming operations, reducing production or necessitating the use of expensive inputs, can pose a problem for organic farmers growing the same crops. One notable distinction is that organic farmers refrain from using broad-spectrum synthetic pesticides, which significantly impair the system's natural controls and encourage the growth of secondary pests. Well-known secondary pests in pesticide intensive systems include spider mites in temperate orchards treated for codling moth, rice brown planthopper in pesticide-treated tropical paddy rice, Rhizoctonia black scurf in potato after nematicide applications that reduce fungi-feeding collembola and apple scab as a result of decimation of earthworm populations by the fungicide benomyl slowing down decomposition of infected leaves. Because their natural adversary complex has been preserved, a sizable number of important pests in conventional systems are thus controlled at low levels in organic systems.

In organic agricultural practises, natural pest and disease management are not only preserved but actively encouraged. Organic farms often have lower prevalences of soilborne plant diseases than conventional farms when it comes to root and foot rots in older plants. This kind of disease suppression has often been linked to greater levels of microbial activity and diversity, larger numbers and variety of microfauna, and lower soil and crop N concentrations in organic soils compared to conventional soils. Due to lower nitrogen concentrations in foliar tissues or phloem on organic farms than on conventional farms, attacks by some airborne diseases in particular many powdery mildew and rust diseases and sucking insect pests aphids and whiteflies can also be less severe in organic crops than in conventional crops.

However, some arthropods are favoured in organic farming situations, especially below-ground pests that are nourished by abundant organic matter, such as garden symphylan, cutworms, wireworms, and slugsor hardy pest insects that have few biological controls and are ineffectively controlled with permitted organic inputs, such as the strawberry weevil or Lygus bug. Similar to Pythium species, which may swiftly grow in newly added organic materials to soil, damping-off pathogens can cause havoc in organic crops. In humid regions, some foliar diseases, such potato late blight and onion downy mildew, which may spread fast and are managed by regular fungicide applications in conventional farms, can be devastating to organic crops. Pests of stored goods should also provide a difficult challenge for organic agriculture, since synthetic pesticides are not allowed. However, it seems that pests in stored goods are a widespread issue that presents difficulties for both conventional and organic farms.

Vertebrate pests, including deer and other ungulates, fruit- and seed-eating birds, rats, rabbits, and squirrels, colonise or sometimes visit both conventional and organic farms, thereby lowering production and impacting food quality. Some farming techniques that are increasingly prevalent on organic farms, such cover cropping, farm scaping with non-crop flora, and mixed cropping, promote beneficial fauna and deter some vertebrate pests, but they may also enhance the habitat for other vertebrates like gophers, voles, and noxious birds. While many fumigants, anticoagulants, and poisons are not used in organic farming, many conventional farming practises overlap with them in order to control these pests, such as sanitation, exclusion, trapping, and the use of a range of repellents visual, vegetation management, aural.

Therefore, organic farmers may anticipate finding many of the same pests and diseases in their farms that conventional farmers do. However, the dynamics of these creatures rely on how well the management system incorporates natural controls and how well the organism's resource needs are addressed. Because of this, even if the same crop host is there, many pests and diseases are less likely to develop and spread in the agricultural field when organic practises are used. By encouraging favorable circumstances for population expansion for various pests and diseases, organic farming practises provide unique difficulties for producers with few pesticide choices.

Pest and disease management in organic versus conventional agriculture

In organic agriculture, crop protection is achieved using three general strategies: preventing pest and pathogen colonisation; managing the abundance of pests and pathogens at low levels through biological processes; and using curatives that are permitted by organic agriculture guidelines. The latter includes substituting synthetic chemical inputs used in traditional crops after pest or disease levels start to grow. The first two options are often preventative management strategies. The crop is seen as a host, the crop field and environs as a biotic community with its abiotic circumstances, and the pest or disease as an invader that colonises the crop habitat, establishes itself, and then explodes because preventive crop protection in organic systems is based on ecological processes.

Several techniques for separating the crop from pest/pathogen source pools and managing pest and pathogen populations once established via community resistance are barriers to pest outbreaks Community resistance includes elements like resource depletion, competition, and predation that make the ecosystem unsuitable for the spread of intruders. In traditional agriculture, community resistance makes up for synthetic pesticide use resilience above ground entails the preservation and improvement of beneficial fauna, either directly or via a variety of flora. The soil food web may be activated by adding organic elements that break down slowly in order to improve community resilience.

The main goal of these activities is to increase biodiversity. Application of biocides that have been authorized for use organically, substances that affect behaviour coming from natural sources, or inundate releases of other species competitors, predators, or parasites are examples of curative actions that may be implemented when pest or disease populations start to increase. In traditional agriculture, curative treatments may replace synthetic pesticides and may support other strategies, such as biodiversity enhancement. Prophylactic methods that stop pest and pathogen colonization, establishment, or buildup are essential for successful crop protection in organic systems, often in conjunction with therapeutic interventions when necessary.

pests and diseases from colonizing or taking hold in organic agriculture Sanitation, source isolation, and other preventive measures stop pests and diseases from colonizing the crop field, orchard, vineyard, storage facility, or other agricultural environment. Sanitation, clean seeds or vegetative propagating materials, crop rotation, timing adjustments, removal of specific weeds, fencing or netting against vertebrates, sealing or repelling against storage pests are practises to prevent colonisation and establishment of pests and pathogens that apply to both organic and conventional farming. They are much more crucial for organic farming, however, since there are less options for treatment. The employment of different crop protection techniques to avoid pests and diseases colonizing the crop is at least as frequent in conventional agriculture as it is in organic agriculture. We look at seed sanitation and crop rotation as examples of some of the unique issues organic producers face.

All inputs in organic agriculture, including seeds and vegetative materials, must, where possible, come from the organic production chain, according to EU regulation 2092/91 for organic farming. Seeds and vegetative material that has been officially registered must be true to type, pure, and healthy in terms of percentage germination and absence of pests and plant diseases. There is no scientific support for the belief that seed grown under organic settings would have more vitality than seed grown under conventional ones. It is more probable that the pathogens that get associated with the seeds throughout the seed production phase and during seed storage are what essentially affect the germination and emergence capabilities of seeds. In traditional seed manufacturing enterprises, seed samples are examined for the presence of pathogens, and diseased seed batches are eliminated in order to sell the seeds as certified disease-free. However, organic seeds are still often produced by small businesses since they lack the necessary infrastructure. As a result, seed-borne illnesses may cause issues for organic producers as long as organic seed production is subject to less rigorous regulation than conventional seed production.

CONCLUSION

Understanding the tenets and advantages of chemical-free no-tillage systems present opportunity for advancing crop production methods that are socially and ecologically responsible.Studying chemical-free no-tillage systems may help with policy formation, organic farming education, and the development of sustainable agriculture. Supporting the widespread use of chemical-free no-tillage techniques in organic agriculture may result in more durable and environmentally responsible crop production systems.

In conclusion, further study in this area is necessary to advance our knowledge of chemical-free no-tillage systems. Better results for crop production and environmental conservation may result from highlighting the significance of organic principles and sustainable crop management techniques. Recognizing the benefits of no-tillage systems in organic farming may also assist in encouraging farmers to incorporate these practises into their organic operations. To maintain the long-term viability and profitability of organic crop production, no-tillage systems without pesticides need cooperation between researchers, legislators, farmers, and agricultural experts.

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CHAPTER 11

ORGANIC AGRICULTURE: CONTROLLING ESTABLISHED PESTS AND PATHOGENS WITHIN REGULATIONS

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ABSTRACT:

In controlling established pests and diseases that may negatively influence crop yields and overall farm production, organic agriculture has special problems. This study intends to investigate the most common pests and diseases in organic farming, the factors promoting their development, and long-term control techniques. The research explores the significant pests and diseases, including nematodes, fungus, bacteria, whiteflies, and aphids, that have established populations in organic agricultural systems. The effects of crop monoculture, climate change, and soil quality on the growth of these pests and diseases in organic fields are also examined in this study. In order to lessen the burden of these pests and diseases without using synthetic pesticides, the study also studies a variety of sustainable management options, such as crop rotation, biological control, integrated pest management (IPM), and disease-resistant cultivars. Promoting environmentally friendly and resilient crop production requires an understanding of the difficulties presented by firmly established pests and diseases in organic agriculture and the adoption of sustainable management solutions. In order to enhance efficient pest and disease control in organic agricultural systems, the research also identifies possible uses of this information in organic farming practises, educational initiatives, and decision-making processes.

KEYWORDS:

Established Pests, Established Pathogens, Integrated Pest Management, Organic Agriculture, Sustainable Management.

INTRODUCTION

A variety of mechanisms come into play after a pest or disease is established in a crop, field, or storage facility. These processes may either promote the abundance and spread of the pest or pathogen in the system invasion occurs or they can suppress it persistence at low levels. These procedures either include the quality of the host or product or the existence of suppressive chemicals in the neighborhood that inhibit the disease or pest's ability to reproduce in the agricultural environment. Additionally, physical barriers or increased distances between hosts reduce the ability to spread by a virus or pest. For low disease severity or decreased success of herbivorous insects, host plant quality may be optimized. Indeed, a key component of organic farming is cropping tolerance to viruses and pests. Selecting varieties with genetically based resistance traits, managing the phenotype, health, and nutrient concentration to reduce its suitability for pests and pathogens, or managing crop and non-crop vegetation to reduce the concentration of food plants for herbivores can all help produce resistance to pest and pathogen exploitation. Competitors and natural enemies are examples of suppressive agents. This toolbox of crop defences contains strategies that may be used in tandem to shield the crop against yield loss in the field or in storage facility Integrative approaches are essential to effective crop protection in organic farming[1]–[3].

Resistance In Host Plants

In order to maintain adequate nutrient status for plant productivity and health without excess nutrients or imbalances that support high levels of herbivores or pathogens, and when toxic or repellent properties are sufficient to directly reduce pest or pathogen exploitation and survival, the host plant quality is optimal for crop protection.The first strategy is fairly adaptable and enables a producer to react to disease and pest dynamics. The choice to utilise a resistant cultivar is predetermined for the season, however. The likelihood of invasion, the severity of the pest or pathogen, any resulting loss in yield quality or quantity, marketability, compatibility with other crop protection techniques, and the potency of the resistant cultivar against the intended pest and other potential exploiters will all influence its use. These generalisations should be taken with the proviso that one organism's famine is another organism's feast, meaning that very high nitrogen levels may attract insects while discouraging plant parasitic nematodes if ammonia is generated from the nitrogen source. High levels of mustard oil both attract and repel insects that are specialised in eating crops from the mustard family[4], [5].

By controlling the kind and amount of nutrients and moisture delivered to the crop, plant quality-based resistance may be developed depending on the target pests or diseases. When potassium (K) is abundant, for instance, the quantity of soluble N circulating in the phloem tissue is decreased, which delays aphid fecundity. For example, high N levels may promote the population expansion of certain aphids. In contrast, a lack of water speeds up protein breakdown and mobilisation and improves the nutritional quality of the phloem for aphids, whilst an abundance of moisture may make the crop more susceptible to diseases that cause root rot. When organic gardeners employ certain nutrient sources, their crop plants may develop mineral balances that make them less attractive to pests and vectors like the bean fly and the European maize borer Consequently, management techniques.

By controlling the quality of an insect or pathogen's food supply, one may increase or decrease the host plant's resilience Likewise, certain physiological circumstances heighten the Disease occurrence and severity may be reduced with good management techniques. For instance,High N levels in the soil and plant tissues may make a crop more susceptible to diseases like powdery mildewrust, mildew, and certain root-rotting diseases. However, a lack of specific components might make some people more susceptible to certain diseases. Illnesses, such as Verticillium wilt in cotton, which is made more likely by K deficiencies, and calcium deficiency.Pythium root rot is made more susceptible when (Ca) is scarce.For several crops, there are naturally resistant varieties that provide resistance. against illnesses brought on by nematodes, bacteria, viruses, fungus, and certain insectpests. The mechanisms behind the resistance include things like tough physical characteristics. Leaves, hairy tissues, and waxy substances to poisonous secondary plant chemicals in thefruits, seeds, or vegetation. Some of the resistance traits are effective against a variety of pests.Many illnesses are caused by a variety of genes. For instance, leaf hardness has a major role. obstruction to disease invasion and insect herbivore grazing on many crops.

Nicotine, glucosinolates, and cyanogenic glycosides are examples of alkaloids. found in tobacco, cabbage, and cassava, are not only poisonous to the majority of herbivores but also to a lot of plant diseases. The inhibitory substances may be generated by stress, insect feeding, or constant presence constitutive resistance. or symbiotic and pathogen infection. If a single gene controls pest exploitation resistance, a series of biochemical processes are often caused by a specific disease or pest elicitor, leading to high resistance. In a disease or pest population may often rather readily evolve to this kind of resistance. While resistance to selection is more difficult to select via intense selection pressure, against several, minor resistance-related variables.

Organic gardeners should be aware that this might result in a very low degree of infection or feeding.They prefer increased genetic variety and the resulting yield stability, therefore they take this for granted. Many organic gardeners choose open-pollinated types over hybrids for the same reason.Additionally, a combination of modest resistance based on numerous genes andeven when it is inadequate, alternative strategies include biological management of pests, illnesses, or vectorsindependently eradicate a disease or pest.Plant resistance characteristics may function indirectly by influencing natural adversaries. For instance, certain Zea mays plants produce a combination of chemicals when caterpillars feed on them. Volatile substances that attract wasp parasites. varieties that cause these triggered reactions. By attracting parasitoids in particular, scent emissions will probably maximise biological control Varietal selection for biological systems with the greatest efficacycontrol is still in its infancy and is often used to find gene sequences that may be shifted to traditional cultivars. the development of cultivars that are especially suitable for organic Despite recent advancements in manufacturing systems, the options are still restricted. varieties for standard circumstances[6]–[8].

DISCUSSION

Community resistance – vegetation

The genetic and phenotypic variety of wild plant populations is an important feature. Due to genetic diversity and induced reactions, individual plants may appear in natural settings with a mosaic of resistance levels. Such variability boosts the longevity of plant defences throughout time and naturally lowers the likelihood of counter-resistance in fast developing diseases and phytophagous arthropods. Insects and diseases that are experts on a specific subset of the plants or varieties planted in the combination are less likely to congregate when using a mixed cropping or mixed varietal system. Under these circumstances, herbivores, especially specialist feeders, are less likely to identify their host plant and are more likely to abandon the field than when appropriate hosts are gathered in monocultures. Indirect impacts via plant quality and volatile emission may also play a part in the effects of crop combinations on herbivore suppression, while the seeking efficiency of parasitoids may also be decreased. Plant pathogen spread is prevented by resistant ingredients in the mixture creating barriers and traps. In contrast to monoculture, 56% of herbivores had lower population densities in polyculture, 16% had greater population densities, and 28% had comparable or variable densities, analyses of the literature on pest population densities. Although intercropping is a crucial component of many traditional, low-input cropping systems in the tropics, it is seldom employed to produce goods for the organic market, particularly in temperate areas.

Community Resistance Pathogens and Herbivores

It is debatable to what extent competition between herbivores or between bacteria ultimately lessens plant damage in natural systems. It is feasible that guilds of plant exploiters may be changed to include more neutral invaders and avoid the buildup of the few most harmful species in agroecosystems, where the decrease of target pest populations is often the aim. The 'dilution effect' of the pestiferous taxa may theoretically be produced by organic practises that support the community's diversity of plant-supported microorganisms and herbivores, hence lowering crop damage levels and yield loss. Innovative methods targeted at certain species haven't always been a success, however. For instance, additional feeding of rodents in Canada to boost the population of rival, non-pest species failed to lower vole concentrations or repair damage.

Curative Control

According to country-specific organic agricultural regulations, there are only a few possibilities for curative control. Inputs to the crop production system known as curatives are added after a pest or disease has been established in the crop and has threatened to lower yields if no action is taken. A sample list of naturally occurring insecticides, microbiological agents, and other substances commonly permitted under organic standards. The degrees of toxicity and side effects that are non-target for these materials vary.

Many nations permit the use of copper fungicides to treat enduring issues like downy mildew on grapes and late blight on potatoes. Similar to how scab is controlled on apples and pears, powdery mildew is managed on a variety of crops using sulphur fungicides. Even while sulphur sprays used in traditional apple production may be used more often than synthetic fungicides, their potential negative effects on the environment may still be less severe. Given its wide range of effects and propensity to persist in soil, copper may have a substantial influence on the environment. As an exception to the norm, certain synthetically created curatives, such pyrethroids, are permitted for specific applications. Curative uses are becoming increasingly limited, however, since organic rules are continually being changed. For instance, several nations have already outlawed the use of copper fungicides.Most organic regulations permit the use of different plant extracts as long as they are not combined with petroleum-based synergists or transporters. However, they are mostly utilised as insecticides and are relatively seldom used. Nowadays, commercial formulations of compost extracts are employed increasingly often. Depending on the initial material, the composting and fermentation processes, and the ultimate microbial activity, they may be quite successful at controlling illness.

By releasing certain biocontrol agents in a flood, curative biological control may be achieved. A relatively small number of species, mostly parasitoids and predators for the control of insects and mites and some fungi and bacteria for the control of pathogens and insects, have been registered for field use despite the fact that numerous specific biological control agents against plant pathogens, insect and nematode pests have been identified. Under controlled climatic circumstances using simple potting mixes, biocontrol of soilborne diseases has been effective, but it has often failed when chosen microorganisms have been applied to field soil . This is true for foliar microbial biocontrol agents as well, maybe even more so because of the greater exposure to the elements. Pseudomonas fluorescens, a bacterial biocontrol agent, could not live as well in organically managed soil as it did in conventionally managed soil, as we recently discovered. According to invasion biology theory, it can be more challenging to develop a biocontrol agent in an organic soil with a diversified microbial community than in a conventional soil with a depleted microbial population.

Although surveys show that biological control agents are rarely used on organic farms, with the exception of *Bacillus thuringiensis (Bt)* for caterpillar control and various parasitoids and predators in greenhouse production, one might expect that organic growers would use biological control proportionally more than conventional growers. The majority of nations have organic standards that permit the use of biological control agents as long as petroleum-based transporters or synergists are not included in the formulation. It's likely that higher biodiversity in organic agroecosystems outdoors could lead to intraguild rivalry or predation, which will lessen the efficacy of invasive biological control agents.

Pest And Disease Management Case Studies in Organic Versus Conventional Agriculture

The relative efficacy of organic and conventional crop protection techniques is contrasted in very few repeated, on-farm research. This is especially true with pest vertebrate species. provides instances of current field comparisons between organic and conventional farming for various crops and regions. These studies demonstrate that there are some exceptions to the general rule that biodiversity is greater on organic farms and that pests and diseases are often controlled by organic practises. Only a few studies track pest populations and associated yield losses. There are even fewer studies that monitor diseases and pests simultaneously for integrated crop protection. To demonstrate certain limitations and advantages of organic agricultural practises, we provide two comprehensive, integrated case studies drawn from European agriculture and commercial operations in the western United States. Many of the general themes mentioned above are illustrated by these examples and , including: the holistic approaches that characterise organic agriculture, the types of pests and pathogens affected by different management practises, the possibility of various but equally effective crop protection methods and the significance of diversity in promoting ecosystem services for organic agriculture.

Pest And Pathogen Regulation in Organic Versus Conventional Cereal Crops in Europe

With the exception of France, conventional agriculture in north-western Europe has progressively decreased the percentage of cereal crops since the 1980s. The primary cause is a drop-in price supports, which has led to prices so low that it is no longer economical to produce cereals with the same intensity as was formerly done in this area with the use of straw shorteners, high fertilisation, and regular treatments of fungicide and insecticide. Cereal crops are nevertheless lucrative on organic farms despite being cultivated less intensively. They are also crucial crops in longer rotational systems. Oats, rye, and triticale are a few of these crops that are also utilised as winter cover crops to lessen nitrate leaching. Numerous comparative studies of agricultural systems have concentrated on cereal crops due to the stark contrasts in production techniques between organic and conventional farms in Europe. The majority of comparisons have placed identical farms next to one another. A few articles examined repeated experimental treatments, and even fewer included extensive surveys across several farms.

Inorganic farming methods' reduced N application rates have a significant impact on above-ground pathogens and pests as well. Despite frequent fungicide treatments in the conventional system, powdery mildew, snow mould, and stripe rust of wheat were less severe in a long-term organic experimental farm in the Netherlands than in a nearby conventional experimental farm. This was ascribed to reduced N concentrations in the organic wheat tissue, albeit it may also be related to a more open canopy structure and an unfavorable environment. The majority of above-ground diseases, including snow mould, powdery mildew, Septoria leaf and glume blotch, and Fusarium scab, were found to be less severe in organic farming systems than in conventional and integrated farming systems in a thorough examination of 150 Dutch wheat fields. In terms of snow mould, glume blotch, and fusarium scab, the variations were considerable. Contrary to the two-farm research noted above, stripe rust did not substantially vary between organic and conventional farms, while leaf rust and powdery mildew on the ear did. Once again, there was a significant correlation between N application rates and disease incidences, which were greater in conventional farms than in organic farms. Since N is released from soil organic matter in the summer and can be higher in organic than in conventional farms at that time, it is possible that the severity of leaf rust and powdery mildew on the ears of organic wheat plants was greater than that of conventional wheat plants.

In addition to supporting huge aphid populations, plants rich in N are often more vulnerable to viral infection. So the population may increase rapidly when high soil nitrate levels coincide with aphid flights. Aphid populations may sometimes be as high in organic farming systems as in conventional farming systems since organic farmers, unfortunately, have limited control over when N is delivered into the soil. In the traditional agricultural system, leaf miners and cereal leaf beetles were typically more prevalent and were linked to high N application rates. The numbers of aphids, leaf miners, and cereal leaf beetles were not significantly different between organic and conventional farms in a thorough field assessment, although there were considerable fluctuations between years. However, it is crucial to make an effort to maintain mineral N concentrations low, even at organic farms. This may be achieved by concentrating on the accumulation of organic matter over many years and reducing the use of additional organic fertilisers during crop development.

Concerns regarding grain moulds and mycotoxins on organic grains have arisen since fungicides are not used in their manufacturing. These worries are not always well-founded.In the Netherlands, organic farms saw less severe fusarium scab of wheat than conventional farms. Deoxynivalenol (DON) concentrations and Fusarium contamination of grains were both found to be lower in organic farms than in conventional ones in several German studies however, in some French studies, the severity of Fusarium head blight and mycotoxin levels were found to be comparable between organic and conventional wheat production. In British research, DON concentrations were likewise comparable across organic and conventional grains, although they were below the European threshold level. Rye and barley grains from organic and conventional farms had equal average levels of ochratoxin A contamination, whereas wheat grains from organic farms had much lower levels of contamination than wheat grains from conventional farms. As a result, there is no justification for supposing that mycotoxins would be an issue in organic cereal products. The lower N contents and higher variety of non-pathogenic fungus on the ears of unsprayed plants may be the key causes of decreased contamination levels at certain organic farms. Furthermore, the stress of certain fungicides may increase the amount of mycotoxin produced per unit of mycelium.

Despite finding much more non-pest butterflies in organic farming, when compared to pesticide-intensive agricultural production methods, the total populations of epigenic predatory arthropods were similarly greatest in organic farming systems. Carabid abundance and species richness were greater among epigenic predators in organic cereal fields compared to staphylinid and spider abundance and species richness, which were more or less comparable across management regimes. The larger range of food supplies linked to increased plant diversity within fields and in adjacent habitats may be discovered as one of the causes of the typically higher arthropod diversity on organic farms.

The ability to manage disease in cereal crops may potentially benefit from increased plant variety in the field.By increasing the distance between sensitive plants, different cereal crops, such as barley and wheat, have sometimes been planted in combinations to reduce the occurrence of barley powdery mildew. But when bean density grew in combinations of wheat and field beans, the severity of powdery mildew on the wheat crop increased this was likely due to the higher N content of the wheat plants. Various barley powdery mildew pathotypes have been successfully controlled by cultivar combinations with various resistance genes. Cultivar mixes have been used extensively and successfully in the former Eastern Germany, and they are being used extensively in rice production in China. Unfortunately, this method is not yet commonly used by organic producers. Relay cropping of clover between rows of cereal plants is a different kind of mixed cropping that is becoming more common throughout Europe. According to unpublished research by G.A. Hiddink, A.J. Termorshuizen, J.M. Raaijmakers, and A.H.C. van Bruggen, this practice aids in weed management, gives N to the next crop, and helps reduce disease, notably take-all caused by Gaeumannomyces graminis.As a result, organic farming methods that support biodiversity both above and below ground tend to strengthen the arable agricultural system's resilience, allowing many pests and illnesses to be handled by their natural enemies. A thorough rotation, soil organic matter management that promotes high turnover rates and generally low residual mineral nutrients with minimum variations, crop or cultivar combinations, and varying field margins are some of these practises. Although this is the ideal situation for the production of grain, it is not always the case, and the wide diversity in organic farming practises naturally leads to wide differences in the severity of pest and disease outbreaks.

CONCLUSION

The information learned by researching well-established pests and diseases may have an impact on policies, training initiatives, and organic agricultural techniques. In organic agricultural systems, highlighting the value of sustainable management practises including crop rotation, biological control, and disease-resistant cultivars may improve crop yield and environmental protection. In conclusion, further study in this area is necessary to advance our knowledge of diseases and pests that are well-established in organic agriculture. The success and resilience of organic crop production may be increased by using integrated pest control techniques and sustainable management methods. Recognizing the importance of various sustainable pest and disease management techniques may also assist farmers in successfully controlling pathogens and established pests in their organic operations. To maintain the long-term viability and productivity of organic agricultural systems, addressing established pests and diseases in organic agriculture involves cooperation between researchers, policymakers, farmers, and agricultural experts.

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CHAPTER 12

ANALYSIS OF ROOT DISEASE INCIDENCE AND MICROBIAL COMMUNITY STRUCTURE

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ABSTRACT:

Significant risks to plant health and agricultural output are posed by root diseases. In order to maintain plant health sustainably, this research article will look at the prevalence of root illnesses and how they affect the microbial community structure in the rhizosphere. The research explores the causes of root infections, such as soil-borne pathogens and environmental variables, as well as their incidence and severity in diverse crops and agricultural systems. It looks at how the microbial community in the rhizospherewhich includes helpful microbes, pathogenic microorganisms, and plant growth-promoting rhizobacteria (PGPR)affects the prevalence of root diseases. The study also investigates the influence of crop rotation, soil enhancements, and biocontrol chemicals on the microbial community structure for root disease suppression. For the purpose of creating efficient and long-lasting strategies for managing plant health, it is essential to comprehend the link between the occurrence of root diseases and the makeup of the microbial community. The paper also emphasises possible agricultural uses for this information, including suggestions for enhancing soil health, crop resilience, and overall sustainable agricultural systems.

KEYWORDS:

Microbial Community Structure, Plant Health Management, Root Diseases, Rhizosphere, Sustainable Agriculture.

INTRODUCTION

Foliar illnesses were not significant on Californian tomatoes that had been watered, mostly by furrow irrigation, in either the experimental trial or the field surveys. Rarely, early-season rainfall led to the development of illnesses such bacterial spot. Additionally, virus symptoms were seldom seen. The prevalence and severity of foliar diseases were comparable in organic and conventional agricultural methods. In conventional tomato fields, root infections were fairly prevalent and sometimes severe, whereas they were missing or hardly noticeable in low-input and organic areas.Corky root was significantly more severe in the conventional system with a 2-year rotation in the SAFS experiment than it was in the low-input and organic systems, and only marginally more severe in the conventional system with a 4-year rotation[1]–[3].

The same applied to *Pythium aphanid ermatum*-induced root rot. Other root rot severity variations were often not statistically significant. Six, seven, eight, and nine years after the experiment's beginning, these observations were made. Both conventional therapy and alternative treatments showed notable changes over the last two years. Compared to the traditional systems, which over time turned into a hardpan, both alternative systems featured winter cover crops and substantially improved water penetration. In comparison to conventional plots, the organic plots showed lower soil and plant tissue nitrate concentrations as well as increased microbial biomass and a related food web especially nematodes that feed on bacteria. According to A.H.C. van Bruggen's unpublished data from 1998, there were positive associations between the severity of corky roots and N concentrations in the soil and plant tissues[2]–[4].

Corky root incidence and severity were found to be lower in existing and newly converted organic farms (ORG) than in conventional farms (CNV) in a field assessment of tomato-producing farms in California. N concentrations in the soil and tomato tissue served as the primary explanatory factors for corky root occurrence and severity levels. At greater N concentrations, corky root was more prevalent and severe. However, the severity of the sickness was inversely linked with N mineralization potential and fluorescein diacetate (FDA) hydrolysis, both indicators of microbial activity. Experiments conducted in greenhouses supported these associations. Corky root suppression in ORG soils was linked in other greenhouse and laboratory trials to bigger populations and increased variety of actinomycetes in the rhizosphere. Actinomycetes and bacteria had communities that were more comparable across samples with the same soil management (CNV or ORG) than between samples with different management kinds (CNV v. ORG).

As early as 1993, four years after the project's start, populations of plant-parasitic nematodes, particularly Pratylenchus spp., were much lower in the organic and low-input systems of the SAFS experiment than in the conventional systems. Root knot symptoms on tomatoes were uncommon, and treatment changes were inconsistent. According researchers, bacterivorous nematodes were often more prevalent in the organic and low-input treatments than in the standard ones. As a result, the organic and low-input treatments performed better than the conventional ones in terms of the enrichment index, a measure of resource availability, and the channel index, a measure of the dominance of the fungi-based over the bacteria-based food web. In addition, the structure index, which measures the number of trophic layers and the capacity to control opportunists, was often greater in organic and low-input systems than in conventional systems[5]–[7].

As shown in the organic and low-input plots of the SAFS experiment, *Meloidogyne javanica* suppression in a bioassay was inversely connected with the channel index, showing that suppression was related to a bacteria-dominated food web. *M. javanica* suppression and microbial biomass have been shown to positively correlate in the past. At that time, neither the management strategy nor the overall amount of nematode trapping fungus were shown to be associated with the suppression of *M. javanica*, although the variety of nematode trapping fungi was higher in the organic plots. Therefore, it was generally observed that populations of plant parasitic nematodes and fungal pathogen root infections were lower in organic soils than in conventional soils, and this was correlated with either greater microbial diversity and activity, better soil structure, or a more complex soil food web in the organic soils. These traits are diagnostic of a healthy soil that can withstand perturbations from invasive species. By using organic techniques like winter cover crops, compost treatments, and avoiding industrial pesticides and fertilisers, one might achieve such good soil[8]–[10].

Pest incidence, tomato injury and arthropod community structure

In the SAFS experiment, plant and fruit samples were taken every two weeks to track the presence of arthropod pests. The number of pests varied a lot from one year to the next. Russet mites were sometimes an issue, thus in the early years, sulphur was applied to all fields. The common treatments required pesticide sprays because to the severity of the tomato fruit worms, armyworms, and potato aphids. In the organic method, insecticidal soap and Bt were sometimes used. Because they were less efficient than synthetic pesticides, populations of aphids and armyworms were sometimes larger in organic plots, but overall, insect pests did not vary substantially across management approaches. Due to the relatively small plot size (0.11 ha per plot), a thorough on-farm field survey was required, which was the reason why there were no discernible changes between treatments.

Arthropods from tomato leaf were vacuum-extracted for the field surveys. The main pests that affect tomatoes, including thrips, aphids, tomato russet mites, flea beetles, leaf-eating caterpillars, leafminers, fruit-eating caterpillars, and fruit-piercing insects, were present in all fields. The season-long average levels of damage were substantially linked with the mean abundance of the most prevalent species of that pest group that were found in hoover samples. In other words, the percentage of tomato leaflets damaged by western flower thrips Frankliniella occidentalis, the percentage of tomato leaflets damaged by pit-feeders (*Epitrix hirtipennis*), the percentage of fruits with deep wounds typical of fruitworm damage, and the abundance of tomato fruitworm (*Helicoverpa zea*) were all significantly correlated.

Insect pest damage varied between fields and among pest groups such as leaf grazers, foliage pit-feeders, and fruit punctures but there was no appreciable difference in the average levels of general and specific types of damage in organic and conventional field. At the time of crop harvest, the average quantity of phytophagous insects on conventional and organic tomatoes was almost the same.Although crop N levels were noticeably lower in organic fields, neither the presence of pests nor the severity of damage could be attributed to tissue N levels.Nevertheless, despite the wide range of distinct farming practises and conditions represented within these management categories, community-level profiles richness and abundance of herbivores and natural enemies in commercial tomato fields under organic and conventional management were noticeably different. In comparison to conventional farms, organic farms featured a more varied arthropod fauna, with an average of five 30-second vacuum samples from each farm revealing roughly 40 arthropod morphospecies in conventional tomato against 66 morphospecies in organic tomato. In comparison to conventional farms, the abundance of natural enemies was almost two times higher on organic farms.

The frequency of application, the range of toxicity, and the permanence of pesticides were all negatively related to some of the most well-known natural enemies. In comparison to areas left in bare fallow, fields maintained with cover crops or annual weeds throughout the winter wet season exhibited at least a magnitude greater abundance of these parasitoids and flea beetles. It's possible that perennializing the agricultural environment via vegetative fallow techniques, which preserved vegetative cover throughout the rainy season, allowed for the continuation of certain arthropod populations throughout the year. Compared to annual crops that are interrupted by bare fallow, natural enemies are often boosted in vegetative fallow and permanent crop ecosystems. However, pesticide applications would undermine whatever possible stability that local vegetational cover might provide. In general, practises more often utilised on organic farms, such cover crops and low intensity pesticide applications, were linked to an increase in parasitic wasps the main cause of heterogeneity across farms and more predators.

It is obvious that the absence of synthetic pesticides and fungicides did not result in a 36% yield reduction in organic tomato cultivation. In fact, there were no discernible changes between the CNV and ORG treatments in terms of insect damage in the SAFS experiment or the field surveys. Arthropod communities were not observed during the SAFS experiment, but there were significant differences in the arthropod community profiles between the fields of ORG and CNV farmers species diversity of herbivores, abundance, and species diversity of natural enemies), suggesting that natural biological control on ORG farms may be offsetting pesticide inputs in CNV operations. Although specific management strategies and the landscape of ORG and CNV farms were linked to the patterns of abundance of certain pests and natural enemies, these management plans were typically resilient to the different pest control issues on different farms.

DISCUSSION

Organic plant breeding and seed production:ecological and ethical aspects

Like all farmers, organic farmers seek for the finest cultivars for the circumstances of their farms. The variety pool available to pick from often comprises of 'conventional' types that were developed for traditional agricultural systems that heavily rely on synthetic fertilisers and agrochemicals to regulate or outweigh environmental influences. Conventional plant breeding may be used in these agricultural systems to optimise output at high input. It seems sense that the criteria for types appropriate for organic farming systems should be centres on maximising output at lower input and stable yields under less predictable situations as organic farmers abstain from using such chemical inputs. The majority of variety studies, however, demonstrate that the organic industry may benefit from plant breeding advancements and that current varieties can adequately address some of the key objectives of organic farmers. In certain crops, like the tomato, the degree of disease resistance has improved in addition to the production potential of the types.

Modern cultivars are used by many organic farmers in industrialized nations;however, this does not always mean that they are the best for organic farming. Farmers that practice organic farming have long come to terms with their reliance on conventional breeding since effort is often directed on improving other agronomic aspects of their agricultural systems. However, how to create types that are more suited for organic agricultural methods is now receiving greater focus. This issue is much more pressing now because normal plant breeding relies heavily on genetic engineering, therefore relying only on conventional breeding is no longer an option. The organic industry recognised that it should also be concerned with how varieties are produced and spread, and if such practises adhere to both the ecological and moral ideals of organic agriculture. The idea of naturalness, which includes three approachesthe non-chemical approach, the agroecological approach, and the ethical approachin which the integrity of life is taken into accountCan embody these values as they are implemented in the organic sector.

The whole plant breeding and propagation chain will need extra research efforts and practical measures to arrive at varieties and seeds generated in compliance with the requirements and principles of organic agriculture It entails generating crop ideotypes and selection criteria for breeding programmes, as well as registration and maintenance operations. It also includes defining crop ideotypes, screening and selecting existing varieties for propagation, and in situ conservation of genetic resources.The creation of varieties suited to organic farming settings will need to be done in stages since it takes at least 10 years and a lot of money to create each new variety.In the near term, the first step is to specify desirable properties and choose the best-performing types from the available selection. Stimulating the production of organic seeds of the aforementioned chosen types is the second stage in completing the organic production chain. This is required in Europe by EU Regulation 2092/91, which prohibits the use of conventionally propagated seed beginning in 2004 and prohibits any further derogations.

This applies to crops that already have a large enough variety of organically acceptable cultivars. As part of the National Organic Programme (NOP), comparable laws have been implemented in the United States of America (USA). Influencing national protocols and procedures for testing varieties for value for cultivation and use (VCU) and the release of new varieties is a crucial step in enhancing the likelihood that varieties with traits crucial to the organic sector will enter the market. The long-term phase is creating breeding programmes for the enhancement of varieties appropriate to the needs of the production of organic food.It is crucial to include all stakeholders' farmers, traders, breeders, and policymakers in projects in order to generate acceptable ideas and methods and overcome practical challenges in order to achieve quick and balanced development in all of these processes.

Variety characteristics

In organic farming, variety selection is a crucial component of effective production. On the other hand, nothing is known about how different kinds fare in organic environments. The traditional variety testing selects for excellent performance under high input circumstances, much as conventional plant breeding attempts to optimise yields under high inputs. The organic farmer is more interested in varieties that can perform well with stable yields in different years at the specific site due to the large diversity of organic farming systems and conditions, which results in a larger genotype-environment-management (G E M) interaction than in conventional agriculture. There are organic variety trials in several countries, although not for every crop and every year. Some are carried out by farmer organisations, while others are by research facilities or private seed corporations.

Yield Stability and Plant Health

Long-term studies reveal that compared to conventional agriculture, yields in organic agriculture vary substantially more. A higher coefficient of variance reflects this. This volatility from year to year has emerged as one of the most significant reasons limiting the expansion of the organic market share for various crops. The primary goal of an organic farmer is system stability in order to decrease risks and maximise yields. This may be accomplished by choosing the right cultivars and improving agronomic techniques. The appropriateness of the available varieties is one of the variables that limits how stable a crop's production may be. Instead of a variety that promises better yields but generally fails to deliver on that promise due to, say, disease susceptibility, organic farmers would prefer to have a variety with an acceptable yield and strong stress tolerance. Reliable varieties are ones that can survive adverse weather and soil conditions such as a variable rate of nutrient mineralization over a number of years. To assist the ability of the organic farming system to self-regulate, farmers opt for varieties that are generally more resilient and adaptable.

Product quality

The non-chemical method also affects characteristics of product quality in the organic industry, such as onion long-term storage without chemical sprouting inhibitors for each crop and market segment, different features are prioritised. Crop ideotypes should be developed and created for each crop in order to increase communication between farmers, dealers, and breeders. In the near term, these crop ideotypes may help with a better selection of acceptable varieties from the range of conventional varieties already available. However, they are also required to meet the selection requirements for novel cultivars from breeding initiatives especially geared towards organic and low-input farming. The selection criteria for organic crop ideotypes are quite similar to those for conventional crop ideotypes, including disease resistance and high producing capacity. The distinction is that types for organic farming must function effectively in low-input environments. Another distinction is the presence of extra plant health and yield-supporting traits, such as long stems, ears that are elevated above the flag leaf, and ears that are not too compact. But it's also crucial to have traits like a long-lasting green index for the upper leaves of wheat in order to boost photosynthesis during the last stage of grain filling.

Variety testing

Trading in seeds of different arable crop varieties is restricted in many nations, particularly in Europe. As a result, varieties must be registered on a national variety list, a European variety list, or a list of another nation. A recognised institution must evaluate the variety following the so-called VCU methodology and determine that it performs better than other kinds in order for it to be listed. Such a conventional procedure is designed to evaluate varieties under traditional agricultural practises; as a result, it could prevent the introduction of new varieties with particular low-input features that are not covered by it. Another crucial point is that some characteristics necessary for organic farming systems, including the effective utilisation of nutrients in organic fertilisers, do not manifest themselves under conventional circumstances.

Research organisations have recently been successful in influencing the protocol for testing cereal varieties for the organic sector by including traits crucial for evaluation for organic farming systems and criteria to choose research sites. These countries include Austria, Germany, Switzerland, and the Netherlands. Such a technique has been accepted by the appropriate authorities, who are now working to enable VCU to test grain varieties under organic circumstances. The future of this VCU testing is questionable since the majority of it is being funded as a research initiative that seeks to compare the findings with those obtained under traditional testing.

Seed production

The chain of production for organic foods still generally lacks organic seed production.The process of creating new selection criteria for new varieties, from plant breeding through maintenance to release and propagation of variations, includes establishing organic seed production. Despite several small-scale farmer efforts to grow varieties organically, the usage and production of organic seeds on a broad scale are still in their infancy.Although several businesses have joined this sector, not all kinds that are now available or sought may be propagated organically for technical or financial reasons. Which types should be propagated, and how, are the two problems related to the generation of organic seeds.The first issue is substantially addressed in the preceding paragraph, and the second will be addressed by talking about diversity, technical considerations, and criteria for seed quality.

CONCLUSION

Insights for enhancing soil health, crop resilience, and sustainable agricultural systems may be acquired through research on the prevalence of root diseases and the makeup of microbial communities in agriculture. In conclusion, further study in this area is necessary to improve our comprehension of the intricate relationships that exist between root illnesses and the microbial population in the rhizosphere. In agricultural systems, root infections may be suppressed and plant health can be improved by highlighting the value of cultivating beneficial bacteria and biocontrol agents. Recognizing the importance of various sustainable plant health management techniques may also assist farmers in controlling root infections and preserving soil health in their farming operations. To preserve the long-term sustainability and productivity of agricultural systems, it is important for researchers, policymakers, farmers, and agricultural professionals to work together to address root disease incidence and the microbial community structure.

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CHAPTER 13

ORGANIC FARMING: ADVANCEMENTS IN PLANT BREEDING FOR SUSTAINABLE AGRICULTURE

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ABSTRACT:

In order to create crop varieties that are suitable for organic agricultural systems and have desired features like disease resistance, drought tolerance, and nutrient efficiency, plant breeding is a critical component of organic farming. The purpose of this study article is to examine the tenets, procedures, and developments of plant breeding in organic farming for the enhancement of sustainable crops. The research dives into the fundamentals of organic plant breeding, which place an emphasis on using natural genetic diversity and conventional breeding methods to create cultivars that are suitable for organic farming. It looks at how to include farmers and stakeholders in the breeding process by using farmer-led selection and participatory plant breeding. The study also explores how plant breeding might increase crop variety, foster climate change resistance, and promote agroecological principles in organic agricultural systems. In order to promote crop improvement that is environmentally benign, commercially successful, and socially responsible, it is essential to understand the fundamentals and recent developments of plant breeding in organic farming. In order to encourage the use of sustainable plant breeding techniques in organic agriculture, the research also emphasises the possible applications of this information in organic farming practises, training programmes, and policy-making.

KEYWORDS:

Farmer-Led Selection, Organic Farming,Participatory Plant Breeding,Plant Breeding, Sustainable Crop Improvement.

INTRODUCTION

Modern cultivars were created with the intention of achieving high input productivity and consistent product quality. For organic agricultural systems, the G, E, and M interaction scenario and the purpose of breeding programmes are distinct.The E is high due to many factors, including the fact that farmers must manage more biotic and abiotic challenges as well as more environmental diversity within and across farms when input levels are low. Second, the M is low because an organic farmer has fewer tools at his disposal to counteract that volatility. As a result, the demands on varieties. This has an impact on the genetic input. To boost production stability under low-input, organic settings, organic farmers look for novel cultivars that have a mix of necessary traits. It is unclear how breeding, through enhancing the farm system's natural capacity for buffering and consequently output stability, might help crops and varieties adapt to the organic, lower-input environment[1]–[3].

Modern wheat cultivars, for example, often lack the capacity to adapt to various environmental changes, including arid locations with less productive soils like southern Australia. In traditional breeding, there is a tendency to select for single genotypes that are generally adapted to a wide range of conditions where environmental variance may be substantially overcome by high inputs. These kinds are generalists and are not always better in or more suited to a particular habitat. Because there are fewer tools available to organic farming systems to combat geodiversity, environmental circumstances vary more, necessitating a wider range of so-called specialised cultivars. But it's challenging to create specialised types inexpensively. The performance of crops, like wheat, in organic agriculture may be restricted by traditional pedigree line breeding since organic types need a specific amount of buffering capacity. In addition to that issue, the present new varieties are genetically similar to one another since they are mostly descended from a small number of parental lines[4]–[6].

An organic breeding programme should have a fresh, broader genetic foundation. When looking for adaptation to organic farming, this feature of extending the foundation is even more crucial. By building composite cross populations and then selecting them under organic farming circumstances, a wider genetic basis may be attained. Composite crossings include the intercrossing of a number of carefully chosen kinds, and the hybrids are then bulked together for propagation. Those chosen as crossing parents may include current high-yielding varieties as well as cultivars developed before to 1960 during the era of heavy inputs that are better able to absorb nutrients under low-input circumstances and historic landraces as a source of adaptation. This method may serve as the starting point for further selection of superior genotypes and lines as prospective sources of new and better suited varieties. Additionally, we may anticipate choosing certain lines with strong combining potential for variety mixes[7]–[9].

A straightforward and efficient method of boosting the genetic diversity within a crop and enhancing yield stability is to create variety combinations from three or four current varieties or taken from composite cross populations.Through combining, for example, high yielding varieties with varieties that have superior baking quality and weed control in wheat, mixtures may solve a number of agronomic issues. There are topics of interest to both conventional and organic plant breeders, according to conventional scientists' research, such as crop features linked to competitiveness against weeds and soil-borne disease prevention.The legal and administrative structures must be reevaluated and adjusted for any breeding plan that aims to restore and expand functional genetic diversity. The registration rules continue to be based on the pure line of practice. The market must be ready to embrace diverse crops and goods, however.

In situ and on-farm conservation of genetic resources

It is important for local and national breeding programmes to have access to seeds from both formal and informal seed systems in order to retain increased genetic diversity in situ and a large gene pool to boost genetic resources for the organic sector. Identification of suitable genetic resources, either for direct use or as possible parental lines in breeding programmes, is urgently needed. The benefit of genetic resource conservation in situ is that accessions may coevolve and adapt to the needs of organic farms.Because necessary traits, such as low-input tolerance and deep or intensive root architecture, may have been stifled by selection under contemporary, high input circumstances, evaluating and using gene bank material may be beneficial.This technique for creating valuable accessions is quite inexpensive[10], [11].

Participatory selection

Alternative solutions should be created in order to increase varietal variety. In developing nations, decentralised and farmer-participatory systems are well-known and might provide a chance to integrate the knowledge and skills of formal breeders with organic farmers. Farmers may participate in the selection of new crosses or base populations as well as existing open-pollinating varieties may be involved in the breeding process in a variety of ways Farmers carry out the whole process of source germplasm selection, trait identification, cultivar development, and varietal assessment under the traditional farmers' breeding paradigm.

In a fully participatory breeding paradigm, farmers work alongside breeders with a background in business or institutions to participate in all four processes. On the other hand, there is the formal breeders' fully controlled scientific breeding paradigm. The participatory varietal selection model, in which farmers are only involved in varietal evaluation; and the efficient participatory breeding model, in which formal breeders involve farmers in both the initial phase of selecting source germplasm and the final phase of evaluating potential varieties. In the Netherlands, farmer breeders and the official potato breeding industry have a long history of working together. Together with the formal breeders, farmer breeders are engaged in choosing the germplasm for novel combinations based on their daily practical experience and refined intuition.

The official breeder carries out the intricate cross-breeding between wild relatives and contemporary types and provides the interested farmer breeders with the seedlings for three years of further selection. The breeding firm or official breeder receives the most promising phenotypes, who are then subjected to further testing to see if they may develop into a variety This participatory potato breeding method includes organic growers as well.Farmers' newly developed varieties must be protected by a common ownership legal framework that permits fair access and profit sharing. Examples of networks of organic farmers and breeders that provide such a system may be found in many different nations.

DISCUSSION

Genetic modification, in vitro techniques and ethics

Genetic engineering is the topic that receives the greatest attention when discussing the use of contemporary biotechnology advances from an ethical standpoint. Extrinsic arguments, which address the effects of creating genetically modified organisms (GMOs), are distinguished from intrinsic arguments, which focus on the technology itself. The significance and viability of the inherent reasons, which are important in the organic sector's rejection of GMOs, are often discussed.The hazards to human health, animal welfare, and the environment are emphasised in ethics committee discussions and public debates. The majority of risk analysis techniques solely consider the outcomes and impacts of genetic engineering in the context of utilitarian ethics balancing costs and benefits. The inherent worries relate to the technology itself rather than its effects. The fundamental argument against genetic engineering is that it is unnatural and violates the worth and integrity of plants and animals.

Particularly for those scientists and ethicists who believe extrinsic reasons to be more value-neutral and objective, these arguments are far more contentious.However, non-utilitarian ethicists, who make reference to human qualities, embrace the intrinsic concerns more. These qualities, including humility and respect for the inherent worth ofnature or life, are crucial in determining people's fundamental views towards the natural world. This ethics of integrity is connected to the biocentric ethical theory, which holds that every living thing has a value tied to its species-specific or defining nature. To suggest that a living thing has inherent value is to imply that it has worth beyond what humans can use it for. Never should a living being be treated as just an item for human use, as if it had no moral obligations. For a summary of these many hypotheses. We shall explain why intrinsic concerns and biocentric ethical philosophy are key factors in organic agriculture's rejection of genetic engineering in the part that follows.

Risks for human health and the environment

The rejection of GMOs in organic agriculture is more driven by a difference in risk perception than by the existence or lack of scientific evidence for an objective danger. An organic perspective on risk is founded on a wholistic understanding of life We also view this technology as inherently risky, because it is based on the reductionist scientific principles that have been shown to be flawed and are increasingly discredited, the IFOAM EU Group (2003) said. Supporters of organic agriculture see genetic engineering as a hazardous technique for a number of reasons, including:

1. The employed gene constructs are artificial constructions. Pure DNA would be rejected by the recipient organism if it were introduced. To have any impact, artificial constructions must be created.
2. The low efficiency of the technology, which means that their effectiveness is assessed via a process of trial and error.
3. Numerous unwanted and unanticipated consequences result from the introduction of foreign DNA .
4. Genetic engineering is inspired by the notion of genetic determinism, which is just a partial representation of reality, as is the risk analysis now used by scientific committees. Nongenetic, epigenetic impacts have been demonstrated to be as important as or even more significant in certain situations than the influence of DNA throughout the development of the organism as a whole. Contrary to earlier theories, the expression of DNA in the genome is far more dynamic.
5. Reductionist solutions to agricultural issues are seen as band-aid fixes.

Insect resistance to insecticides used in conjunction with GMOs or to *Bacillus thuringiensis*, which is employed in insect-resistant GMOs, has been shown and unexpected repercussions are caused by the organism or ecosystem as a whole's dynamic complexity. It is impossible to ensure the controllability of the technology and the stability of the gene creations. Genetic engineering is founded on a manner of thinking that is typical of the physical sciences from a global perspective. The argument shifts from being extrinsic to being intrinsic by framing the risk issue in terms of holistic risk perception.

Incompatibility with the principles of sustainable agriculture

As long as these ideas are not stated explicitly, this argument is flawed. Different perspectives on how people relate to nature are behind various definitions of sustainability. According to Verhoog, applying the industrial method to biological systems is unnatural and does not accord with their nature. The industrial method has a propensity for total anthropocentric control over nature, which in some ways eliminates nature. Pure nature, or nature that has not been affected by humans, is its antithesis. However, it is difficult to discuss pristine nature in relation to agriculture since all forms of agriculture include meddling with the natural world.

The philosophy of organic agriculture may be summarized by saying that nature and culture are considered as the two poles of a polarity relationship, and both poles need to be taken care of. This kind of agriculture or integration of nature and culture recognizes the autonomy, inherent worth, and independence of nature and all other living things biocentric approach. Numerous manifestations of this provide further reasons against genetic engineering:

1. Using natural ingredients rather than artificial ones. GMOs are created by inserting artificial, not natural, gene constructions into living things. The most significant variation from conventional breeding is the forced introduction of artificial and synthetic gene constructs which can only be produced in an artificial environment in vitro into the genomes of plants and animals. These gene modifications were created by humans. Stimulation of the self-regulation of organisms and the environment using natural processes.
2. In general, non-evolutionary time scales, the gene constructions include genes that would never be transported by natural methods. Genetic engineering is seen in organic agriculture as a technique that coerces organisms into doing what people desire rather than evoking a response in which the natural entity maintains its relative independence as a collaborator. The way humans handled reproduction throughout the domestication of cows is instructive. The animal's independent function in reproduction is being taken away from it and replaced by human control via artificial selection, artificial insemination, embryo transplantation, genetic alteration, and cloning.
3. Honoring the distinctive qualities or inherent worth of various plant and animal species, agroecosystems, and landscapes. Another allusion to the acceptance of nature's autonomy, but this time on a moral plane. integrity is a term that is employed in this moral sense. Different degrees of integrity may be identified when referring to the particular nature of plants integrity of life, plant-specific integrity, genotypic integrity, and phenotypic integrity. The authors have evaluated several plant breeding and propagation methods using this moral instrument to see if they respect the integrity of plants. The end result is that DNA-level procedures such protoplast fusion and genetic editing violate every aspect of a plant's nature.
4. The conclusion is that genetic engineering and the inherent worth of plants are incompatible. Our finding is that the organic agricultural industry often employs inherent arguments against genetic engineering. These arguments often center on a particular understanding of the interaction between human nature and cognition, emotion, and volition. A holistic perspective of living things is referred to as having cognitive components. Emotive components describe a biocentric perspective on existence in which living things are seen as partners who should be valued and as having inherent worth. In organic agriculture, the volitional aspects allude to moral judgements about what should or shouldn't be done while taking other factors into consideration.

The integrity of plants may also have an impact on how other contemporary methods of breeding and propagation are used in organic breeding and propagation programmes. It may imply that: sterility, such as cytoplasmic male sterility, will not be accepted in the final product (variety) without including restorer genes; patents on life are not accepted; reproductive barriers between species will be respected and not violated; in vitro techniques are not compatible with organic principles.

These factors have only been included as basic requirements for the 2002–2005 period of the International Federation of Organic Agriculture Movements' Basic requirements for Organic Production and Processing.

Molecular markers are used in organic breeding programmes

Genetic alteration is not involved in DNA diagnostic procedures, which permit selection at the DNA level. The approaches, which are often based on biochemical and molecular markers, might therefore be used in organic breeding programmes to enhance trait selection procedures in the field, although their applicability for organic agriculture has not yet been shown. In organic plant breeding, the interplay between genotype and environment is crucial, and markers may help determine how well genotype characteristics behave in different environments in addition to field selection. The methods employed for DNA diagnostics should draw particular attention, since some of them make use of chemicals and radioactive isotopes, which are neither appropriate or allowed in organic farming.

Research into organic breeding ideas and methods is the conclusion.

More study is required to examine and improve plant breeding ideas, tactics, selection criteria, and breeding methodologies for more dependable and better-adapted cultivars for the organic industry. How under organic growing circumstances do traits like nutrient absorption and use efficiency, weed control, disease tolerance, crop growth dynamic, and yield stability interact with one another, and to what degree are these traits genetically determined? However, it is also unclear how these traits might be used as field selection criteria or what function molecular makers could play in organic breeding programmes.Conventional breeding firms would want to know what the advantages of choosing under organic growing circumstances are due to the logistical issues.

Do organic farmers need generalists with less G–E interaction or specialists with adaptations to particular geographical conditions?The economic interest in developing specialised breeding programmes for organic farming systems will be hampered by the restricted area under organic production, particularly in the case of minor crops and essential but low-yielding crops like cereals and grain legumes. Public rebreeding efforts and research should be supported by governments. International collaboration is also necessary for this. The needs of conventional agriculture will eventually be met by the variety requirements for the organic sector, which will reduce the dependence on high chemical inputs and expand the breeding industry's focus in a low-input direction for contemporary agricultural development. Nutrient absorption and crop protection methods are frequent topics of study for both organic and conventional plant breeders.

CONCLUSION

Plant breeding research may have an impact on legislative decisions, training initiatives, and methods used in organic farming. In organic agricultural systems, highlighting the significance of sustainable plant breeding techniques may promote crop development and environmental protection. In conclusion, further study in this area is necessary to improve our comprehension of plant breeding in organic farming. The adaptability and success of organic crop development may be increased by using participatory methods and including farmers and stakeholders in the breeding process. Recognizing the importance of various sustainable plant breeding techniques may also assist farmers in creating cultivars that are suitable for organic farming. To maintain the long-term sustainability and productivity of organic agricultural systems, it is important that academics, legislators, farmers, and agricultural professionals work together to address plant breeding in organic farming.

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CHAPTER 14

BIODYNAMIC AGRICULTURE TODAY: A COMPREHENSIVE ANALYSIS

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ABSTRACT:

The goal of biodynamic agriculture is to develop a unified, self-sufficient agricultural system. It is an ecological and holistic method of farming. The purpose of this study article is to examine the values, methods, and benefits of biodynamic farming for sustainable agriculture. The research dives into the fundamentals of biodynamic farming, which include using sustainable and organic agricultural methods, observing cosmic and lunar cycles, and boosting soil health through composting and biodynamic remedies. It looks at how biodynamic farming systems might promote resilience and ecological balance via closed nutrient cycles, biodiversity, and farm self-sufficiency. The study also investigates how biodynamic farming affects soil fertility, plant and animal health, and general ecosystem functions. Promoting agricultural methods that are socially responsible, economically feasible, and ecologically beneficial requires an understanding of the concepts and methods of biodynamic agriculture. The paper also emphasises how this information may be used in agriculture, including suggestions for enhancing soil health, biodiversity preservation, and more broadly sustainable agricultural practises.

KEYWORDS:

Biodiversity, Biodynamic Agriculture, Organic Farming, Sustainable Farming, Soil Health.

INTRODUCTION

A complete agricultural system on mixed farms, which must always include both crops and cattle, might be characterised as biodynamic agriculture. The foundation of the system is respect for and attempts to become aware of the spiritual aspect of all living things as well as the inorganic surroundings. Rudolf Steiner provided insights into this spiritual component in 1924 in-depth explanations of the spiritual nature of animals, plants, and physical elements, or of planetary impacts Farmers should use these descriptions as a guide to help them behave and be aware in a way that advances the agricultural system. Steiner also suggested the creation of specialised preparations as a brand-new aspect of agriculture.Landscape and environment are integrated into biodynamic agriculture as integral components of the whole. Through effective legume crop management, it reduces fertilizer inputs from outside the farm[1]–[3].

General Principles in Biodynamic Farming

Around 3270 estates with a combined area of 104,000 hectares are recognised under the Demeter label globally, spread across 35 different countries. They are in compliance with both the relevant national organic agricultural regulations and the global Demeter regulations, according to Demeter International. On Demeter farms, a wide range of businesses are conducted, including temperate arable farming, winemaking in France, cotton production in

Egypt, and silkworm rearing in China.One of the fundamental principles of biodynamic farming is the farmer's purposeful unique design of life processes based on site circumstances. This concept underlines that, in addition to economic goals and descriptive ecology principles, people also have a responsibility for the evolution of their social and natural environments.

The individual holding design in the context of the complex interplay of all influencing circumstances is the foundational idea upon which this theory is built. The natural foundation consists of the pedosphere, ecosphere, and terrain, as well as the atmosphere and cosmic environment other than the sun, these are largely the moon and the planets. Crop plants, animals, the farmer, and the overall socioeconomic environment all have an impact on different layers of this natural environment and are in turn impacted by these levels, forming a complex web of interrelationships. Consequently, a farm becomes an individuality in which the different components. Organs provide unique purposes and are connected through feedback loops. By using a range of management techniques, biodynamic farming attempts to deliberately form these interrelationships into directed processes.Always, encouraging healthy living circumstances is the main goal[4]–[6].

Designing the various farm businesses and activities properly will help maintain and continually enhance soil fertility, plant and animal health, as well as product quality in a mostly closed system. On the aforementioned goal, the following tenets are built. They stand in for the implicit goals of the biodynamic approach that must be put into practice on the holdings. Produce that bears the Demeter International brand has been cultivated and prepared in accordance with their guidelines.

Demeter as an organisation does not have affiliations with all biodynamic farms or gardens. The aforementioned guidelines must be followed by all farms that produce under the Demeter brand. These guidelines, although useful for other farms producing biodynamically, are not necessarily mandatory.

Design of the Social and Economic Setting

On biodynamic farms, the idea of land ownership is being questioned more and more, and the land is no longer always seen as private property. Frequently, money is given to trusts for philanthropic purposes or organisation like these. Pioneering efforts are being made to create economic connections between producers and customers that are founded on the ideas of respect and mutual responsibility. Working in agriculture is also seen as a therapeutic opportunity, and those who are mentally or spiritually sick, troubled children, addicts, and prisoners are often incorporated into farm communities. The education of apprentices is given top attention, and several nations have extensive training programmes or agricultural universities that focus on teaching biodynamic farming techniques. Another area that receives a lot of attention is the regular courses and seminars for working farmers.These principles provide each farm plenty of leeway to develop its own plan in accordance with the living circumstances in the area. This meticulous design gives rise to the farm identity, to which significant attention is devoted. The way the soil is cultivated, the precise layout of crop rotations, fertilisation schedules, variety selection, distribution of livestock categories, enterprise balance, social dynamics on the farm, and business relationships with customers are all up to the farmers and unrestricted. They are, nonetheless, recorded as a result of the national Demeter inspections, and they are analysed and debated in specialised publications, at regular association meetings, and at an annual international conference in Switzerland[7]–[9].

DISCUSSION

Biodynamic Farming

The principles of biodynamic farming are particularly related to the spiritual brilliance of all natural phenomena, including that of the cosmos and the inorganic pedosphere. The formation of the spiritual world, which has a variety of structures and is expressed in the physical-sensory reality, is said to occur via physical-world activities. This concept of growth, however, is not purely teleological since it sees people as active makers of the future, both in a good and a bad sense. As a result, the biodynamic ecological paradigm is one of development rather than conservation.These ideas are founded on anthroposophy, a diverse worldview that was developed has as its central tenet that everything and everything that occurs in the world has its origins in a spiritual realm that is both present and may, at its heart, be an object of human knowledge.

Insofar as it relates to how we see nature; anthroposophy sees itself as adding a second dimensionthe spiritual onethat in no way would negate or replace any fundamental natural rule. Steiner wrote several books and gave numerous talks on how to build the capacity to learn about this spiritual world via awareness of the sensory world, as well as how this spiritual world behaves and looks. In June 1924, when Steiner gathered with roughly 60 farmers in Koberwitz, a town close to Wroclaw, Poland, and offered eight lectures on a new agriculture based on spiritual science, the biodynamic farming method was born. These eight lectures still serve as the cornerstone for biodynamic farming today, while many of its components have been refined and developed over the previous 80 years by extensive research and practical application. These lectures were given by Steiner at the request of farmers engaged in the growth of anthroposophy, and when he delivered the Koberwitz lectures, he did it in accordance with his audience.

Biodynamic Farmers and Researchers

Research on the preparations and cosmic forces is often linked to biodynamic research The impact of the preparations on soil parameters, plant development, root growth intensity food quality and plant development have all been the subject of several efforts to produce proof. The outcomes are quite variable the majority of research, however, evaluate the total effects of the biodynamic approach, of which the use of preparations is but one aspect.The biodynamic technique has consistently been proven to have a demonstrably favorable effect on soil structure, enzyme activity, CO_2 exchange, and earthworm populations.

To provide reasonable, realistic recommendations for the frequency and timing of their use, research on the efficacy of biodynamic preparations must be advanced. However, since these practises were suggested as a component of a comprehensive farming system, the idea behind which is based, in particular, on a holistic understanding of agricultural processes, discussions are necessary to determine whether it makes sense to assess the impact of individual biodynamic practises in isolation from the overall method. Although it has not yet been achieved, a comprehensive, holistic, systemic kind of science would be ideal for biodynamic farming. What would constitute comprehensive research is not quite obvious. Without a doubt, phenomenological descriptions of the general surroundings have been extensively explored during the last 80 years in the framework of anthroposophical study. However, is holistic research based on interdisciplinary research and on the overall analysis of data from separate, potentially isolating investigations.

Last but not least, biodynamic researchers are tasked with creating an ongoing conversation between their field and the traditional natural sciences. The challenges at hand include crucial paradigmatic concerns, different worldviews, and value systems that need for clear communication. Individual scientists have occasionally harshly criticised biodynamic research and denied it any validity.These objections, albeit they are likewise based in an unresolved conflict of world views, are unfounded since they ignore significant areas of biodynamic management and study. To describe and clearly address this issue will be one of the challenges facing biodynamic science.

Organic livestock husbandry and breeding

The objectives of this chapter are to provide a brief review of organic animal husbandry in general and to go into further depth on issues related to organic animal housing and breeding. Animal husbandry might be seen as the whole of the animal agricultural industry. In a more limited sense, housing for animals is taken into account. Peer-reviewed journal articles on organic animal husbandry are rather hard to find. These authors also note that comparisons with conventional farms have not always been made and that sample sizes included were sometimes rather small.The majority of the scientific literature on organic animal husbandry comes from North America or Europe. Due to few resources and the accessibility of contemporary technology, many agricultural systems in developing nations are often organic. However, due to a lack of precise definitions, information regarding such systems is not included in this study. In contrast to Asia, where organic animal agriculture is still a relatively new idea, certain Latin American nations are already beginning to export organic meat. However, Australia's organic farming is mostly built on vast grazing grounds.

Argentina has a similar situation. Livestock products were among the top five organic goods in 14 of the 16 European nations. Between 1999 and 2001, the Network on Animal Health and Welfare in Organic Agriculture (NAHWOA), which was funded by the European Union (EU), held five workshops on topics like the variety of livestock systems, human-animal relationships, feeding and breeding, and health management. The workshop's final recommendations and conclusions were published online at www.veeru. reading.ac.uk/organic. The publishing of the academic book Animal Health and Welfare in Organic Agriculture was another initiative of the network. Sustaining Animal Health and Food Safety in Organic Farming (SAFO) is another Concerted Action Project financed by the EU with an emphasis on food quality. The primary activity, similar to the NAHWOA network, is scientific interchange, which is aided by five workshops conducted between 2003 and 2005. Additional conferences on a few themes related to organic animal production have been conducted throughout Europe.

At least in nations with significant animal production, the percentages of animals raised organically are likely different for different animal species. For instance, fewer than 2% of pigs or other poultry species were raised organically in Germany in 2002, compared to 17% of all beef cows, 8% of sheep, and 7% of geese. Other European nations showed comparable trends in 1998. Under traditional agriculture, pigs and poultry are raised more densely stocking density, housing conditions, source of feed. Therefore, switching these farms to organic agriculture is more challenging. Farms that raise beef or sheep are often maintained rather intensively to make conversion easier.

All organisations that are members of the International Federation of Organic Agriculture Movements (IFOAM) and the farmers who work with them must adhere to its requirements (IFOAM 2002). These requirements include basic guidelines, minimal specifications, suggestions, and derogations such as the formal replacement of an organic input with a conventional input in cases when an organic input is not available. Because of the foundation for regulation provided by the IFOAM standards, member organisations are able to adopt stricter regulations. The Codex Alimentarius of the Food and Agriculture Organisation (FAO) of the United Nations is another example of a more comprehensive standard. All producers in EU nations who wish to market their animal products as organically produced must adhere to the EU legislation regulating organic livestock production. All nations wishing to export organic goods to the EU must adhere to these standards.The organic movement has not given as much thought to organic animal husbandry standards as it has to organic plant production standards. This might be explained by the fact that the organic movement began with the creation of soil and plants.

Possible conflict area

Sections pertaining to housing may be found in both the EU rules and the IFOAM standards. Generally speaking, according to the organic criteria, housing conditions ought to satisfy the livestock's typical biological and ethological demands. Because animals are social creatures, they must be housed in groups. They need organic material for enjoyment and other uses, such as soft ground for reclining. Therefore, it is prohibited to utilise housing systems like crates for sows, completely slatted pens for growing pigs or cattle, or battery cages for laying hens that are often employed in traditional agriculture.Additionally, the animals must have access to outside spaces, such as a pasture or an outdoor run. This provides more room and exposure to environmental factors sun, rain, and wind. The majority of solutions for intensive housing prevent farm animals from ever having access to the outdoors.

The EU legislation specifies the stable's and the outside area's minimum sizes. Animals in industrial animal production may sometimes undergo mutilation such as beak trimming, tail docking, teeth cutting, and dehorning to lessen the harmful consequences of the circumstances in which they are housed. Although the reasons of dense housing are still present, the symptoms are gone. Mutilations should be avoided or kept to a minimum and only permitted as an exception in organic agriculture. However, others contend that under alternate housing arrangements, certain mutilations are required. Pigs rooting in pastures, for instance, might obliterate the vegetation. Ringing the nose lessens pasture damage. However, nasal ringing seriously interferes with the species-specific behaviour need and may even cause harm. In large flocks of laying hens, which are typical in alternative housing arrangements, feather picking may be a more serious issue. Beak clipping is a serious intervention that affects the animal's physical integrity. Therefore, it's crucial to take the right management precautions to prevent such mutilations in alternate housing systems.

The aforementioned organic livestock housing laws set up favorable circumstances for animal welfare. They might be seen as strong principles, comparable to the prohibition of pesticides in plant cultivation, and this should be conveyed to customers. There is a dearth of literature on the distribution of housing systems in organic agriculture throughout various, predominantlyEnglish-speaking nations. However, it seems that housing arrangements vary widely amongst nations.For instance, organic pigs in Austria are often kept inside with access to an outside run typically with a solid concrete floor for fattening pigs and gestating sows, but not for far-reaching breeding.

There are several grading systems and methodologies available to evaluate animal wellbeing at the farm level. The animal needs index (ANI 35), one of these approaches, is significant in Austria. For registration as organic farms, a specified minimum point threshold must be met.

The identical approach was used Finnish dairy farms. Although many scientists are increasingly advocating for the addition of more animal-based factors for on-farm evaluation methods, the ANI scores are now predominantly computed on the environment of the animals rather than on animal-based data.According to investigations, farmers are not always upholding appropriate standards for housing animals. For instance, in Germany, some farmers did not adhere to all the requirements of the country's laying hen legislation. So, it makes sense to provide training to those working for organisations that certify organic products so they are aware of the requirements and can make sure they are met.

Numerous optional options or derogations are included in the aforementioned rules. In certain circumstances, it seems that the exceptions are taken to be the norm. For instance, in Germany, organic advisors often advise against utilising loose housing systems for cattle in the winter if the animals have access to a pasture in the summer. There may be further challenges with interpretation. After 2010, an exception from the EU law permits tethering stalls for cattle in small herds. Therefore, a definition of a small herd is necessary in order to implement this exemption. These uncertainties raise the possibility that some farmers would strive to meet the bare minimum and, as a result, fall short of customer expectations. When purchasing organic goods, consumers in the majority of European nations give animal welfare a high priority.

In certain circumstances, the EU rule permits transitional measures, such as loose housing for cattle or access to the outdoors until 2010. On smaller farms, stanchion barns are still prevalent.High investment expenditures are often associated with reconstruction for vacant homes. As a result, a lot of farmers seem to hold off until the conclusion of the derogation period. In the meanwhile, they will market their goods as organic. Once again, this may undermine consumer confidence.Regulation observance alone does not ensure animal wellbeing. Again, the rules provide the prerequisite for welfare. There are many more variables that affect good wellbeing and might be governed in the standards.

As a result, achieving high animal welfare requires competent management, and farmers need to be schooled in the necessary management practises to do so. It is possible to assess animal wellbeing at the farm level using reliable scientific methodologies While farmers in some nations struggle to change their intensive housing systems, issues with more extensive systems might arise in other nations. For instance, cattle or sheep may have issues with water supply, protection from harmful weather impacts, or even against predators in broad grazing systems like those in Australia or Argentina.Alternative housing systems are sometimes somewhat new, hence knowledge is scarce. The typical education of farmers sometimes excludes housing systems because they are seen to be too exotic. Therefore, efforts should be made to fill these practice-related knowledge gaps.

CONCLUSION

Understanding the concepts and methods of biodynamic agriculture provides chances to promote agricultural methods that are socially and ecologically responsible. The understanding acquired through researching biodynamic agriculture has potential applications in the field of agriculture, including suggestions for enhancing soil health, conserving biodiversity, and establishing sustainable agricultural practises. In conclusion, further study in this area is necessary to deepen our understanding of biodynamic farming. Better results for environmentally friendly farming and protection of the environment may be achieved by highlighting the significance of ecological harmony, closed nutrient cycles, and regenerative practises. Recognizing the need of diversified and sustainable farming methods might also encourage farmers to use biodynamic principles in their farming endeavours. To address biodynamic agriculture and assure the long-term sustainability and productivity of farming systems, it is necessary for researchers, policymakers, farmers, and agricultural professionals to work together.

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CHAPTER 15

ENVIRONMENTAL POLLUTION AND ITS IMPACT ON ORGANIC FARMING

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ABSTRACT:

Organic farming has considerable obstacles from environmental contamination, which affects the sustainability of the ecosystem overall as well as the quality of the soil and crops. This study looks at the causes and consequences of environmental pollution on organic farming and looks into sustainable agriculture mitigation measures. The research explores the several types of environmental pollution, such as soil contamination, water pollution, and air pollution, which may have an impact on organic farming systems. It examines how contaminants affect the health of plants, beneficial insects, and soil microbes in organic fields. The study also looks at how organic agricultural methods, such crop rotation, cover crops, and composting, might lessen the consequences of pollution on the ecosystem. Promoting organic farming that is ecologically benign, commercially successful, and socially responsible requires an understanding of the problems caused by environmental contamination and the adoption of mitigating measures. The research also emphasises how this information may be used in policy-making, education, and organic farming practises to enhance efficient pollution control and long-term agricultural systems.

KEYWORDS:

Crop Quality, Environmental Pollution, Mitigation Strategies, Organic Farming, Soil Health.

INTRODUCTION

Farm animal housing arrangements may cause contamination of the environment via gases, dust, and scents. Liquid manure or slurry is produced by all intensive housing systems. Production of solid manure is a common component of straw-based systems. Dung spreading and storage might cause emissions from the stable. greater dust concentrations in the stable and greater emission rates are the results of straw-based systems. However, slurry systems have greater smell emission rates.

Assuming that storage facilities for liquid manure are covered, ammonia (NH_3) emissions are greater from solid manure storage. Ammonia emissions will be greater when spreading slurry than solid manure if slurry is not applied directly to the soil. Slurry-based systems also produce more methane emissions. However, solid manure systems seem to produce more nitrous oxide emissions than other types of manure.Yards that are covered with vegetation may emit more ammonia. Covered yards are additional places where ammonia emissions occur. Emissions will also rise with greater outside yard space or pens. Again, reducing possible emissions inside the existing system for instance, by low temperatures, increasing the frequency of cleaning may be the answer rather than going back to traditional housing systems[1]–[3].

Profitability

Welfare-friendly systems often result in greater labour or investment costs. High investment costs are often associated with changing from intensive to welfare-appropriate housing for example, switching from stanchion barns to lose housing systems for cattle. However, within a certain area, acceptable systems which lack slurry channels, sophisticated equipment, and insulation could be less costly than intensive systems.

However, this gain might be offset since suitable systems have more room per animal than intensive systems. However, as straw-based systems need more labour than systems without straw due to the harvesting, transportation, and rebidding of the straw, energy costs may be lower reduced heating andventilation in non-insulated, straw-based systems. Exercise garden clean-up also means more effort is needed. Lower energy expenses, improved performance, and greater health might offset the increased investment or labour costs.However, organic livestock production systems often have poorer productivity than conventional systems due, for instance, to a lower stocking rate relative to arable land. Therefore, in order to maintain profitability at a reasonable level, greater prices or subsidies will be required[4]–[6].

Breeding

Breeding involves selecting animals to achieve breeding objectives, combining performance information in appropriate ways such as selection indices, and using the appropriate breeding procedures such as natural mating and artificial insemination.There isn't much information available about organic animal breeding. In 2003, the Gesellschaft für kologische Tierhaltung, a network on organic animal breeding, was established in Germany. This network has produced three workshops for research on cattle, pigs, and poultry The findings of a debate on organic animal breeding in the Netherlands were published. The majority of theories on alternative breeding techniques, according to these writers, were created for dairy cows. There has been much study on conventional animal breeding, and some of the findings may be applied to organic farming.

The need of preserving and sustaining genetic variety is emphasised in IFOAM guidelines and EU laws. These recommendations state that native breeds and strains should be preferred since they are better suited to regional circumstances. Breeds should have strong disease resistance, according IFOAM guidelines. The disease resistance legislation in the EU is very detailedSelection should avoid specific diseases or health problems with some breeds or strains used in intensive agriculture, including difficulties like abrupt death, difficult deliveries, and pale, soft, exudative (PSE) meat in pigs.

The origin of animals is a further issue related to breeding. Livestock acquired off-farm should come from organic farms, in accordance with organic standards. Due to the customary methods used by many breeding businesses or hatcheries, this might be challenging. However, in order to increase the genetic diversity, some animals could originate from traditional farms. According to EU regulations, a maximum of female nulliparous animals of 10% of equine and bovine species and of 20% of adult porcine, ovine and caprine species per year are allowed to supplement natural growth and renewal of the herds up to 40% when a major extension is undertaken or a breed is changed or endangered. In reality, whether it comes to ruminants or pigs, breeding animals are mostly purchased as males from traditional farms, while females are primarily produced on the farm[7]–[9].

Problems with conventional breeds

For specialist performance such as milk, growth rate, meat amount, or eggs, high yielding breeds are used. Such unidirectional high performance may put the organism under stress, for instance by metabolic stress. Animals that produce high yields are often very sensitive to management changes or errors. There are several health issues that affect performance, such as limb issues, metabolic disorders, mastitis in dairy cows, and illnesses of the reproductive system in laying hens and breeding sows. High achievements can only be achieved with a lot of concentrates, as well. Due to competition with human food, organic farming should strive to limit feeding farm animals with concentrates in order to address the issue of global hunger.

The preservation of breeds that are less susceptible to illnesses or poor management is one goal of organic agriculture. As a consequence, productivity and 'hardiness' could be compromised. Another option is to offer a feed ration with a reduced nutritional content in order to not fully use the genetic potential of a breed that produces high yields. For all types of animals, this is not recommended. It could work with dairy cows or pigs being raised for meat. For instance, in organic agriculture Holstein Friesians often get less concentrates. Modern hybrid poultry lines both meat and layer strains may have certain health issues if their nutritional needs are not met. For instance, chickens may have behaviour issues such as feather plucking and continue to feel hungry.

DISCUSSION

Genetic Diversity

Genetic diversity has significantly decreased as a result of intensive animal production and selection for maximal unidirectional performance. A third of all domestic breeds are thought to be in risk of extinction or at the very least endangered. In the last 15 years, over 300 breeds have gone extinct globally. Half of the breeds that existed in Europe at the start of the 20th century are now extinct. Additionally, the practises of international breeding businesses have boosted genetic homogeneity by reducing breed-specific biodiversity. For instance, some Holstein bulls have more over a million offspring. For poultry, pigs, and high-yielding dairy breeds like Holsteins, genetic degradation is extremely severe. Sheep and goats nevertheless exhibit more variety.The fact that native breeds are often extremely well suited to local circumstances is one benefit of doing so. When the going gets tough, they are often more suitable than current breeds. This may also apply to areas where a specific breed is not indigenous, as in the case of Brahman cattle in Australia. Local breeds may have some undiscovered qualities or features that are significant. They often possess traits like lifespan or disease resistance that are crucial for sustainable agricultural systems. Furthermore, the cultural history of the nation of origin includes unique breeds.

Contrary to popular belief, both conventional and organic agriculture often use the same breeds.For instance, barely 10% of unusual breeds are employed in German organic dairy farms. In the last ten years, this rate has not altered. Due to their superior performances, the majority of German or Dutch farmers and organic advisors choose contemporary breeds.Better health or lifespan may somewhat offset lower performances. Higher product pricing or subsidies are additional forms of compensation. Governments in numerous European nations provide subsidies for the preservation of endangered breeds. These subsidies, however, are often insufficient to fully make up for diminished output. Therefore, it can be advantageous to exploit the preservation of an ancient breed as a marketing strategy to persuade customers to pay a higher price. The German Swabian-Hall saddleback pig is a good illustration. The meat is effectively promoted as a premium product by a marketing firm, emphasising its excellent quality and regional provenance. The sows are often mated with Pietrain boars as a compromise to get more muscle. The corporation employs the unique marketing label known as controlled origin that was given to it by the EU.

This strategy was quite effective. The population significantly grew within 15 years and is no longer thought to be in grave danger of becoming extinct.For example, see for a list of the various initiatives the FAO has undertaken in the area of cattle genetic diversity conservation. The FAO established the Commission on Genetic Resources for Food and Agriculture (CGRFA), the principal international platform for formulating genetic resource policy. In 1992, the CGRFA launched a worldwide plan for the management of farm animal genetic resources. The technique aims to stop the genetic deterioration of animal resources while still ensuring their usage. The plan offers a structure for helping nations, regions, or other stakeholders implement management programmes. FAO created the Domestic Animal Diversity Information System (DAD-IS) as a communication and informational instrument to carry out the worldwide plan.

A worldwide databank for farm animal genetic resources was also developed by FAO. This databank contains information gathered from 189 different nations. There are now 6379 breeds from 140 nations, representing 30 mammalian and avian species. The global watch list for domestic animal variety was published using these data as a foundation. In 2006, the FAO intends to release a study on the status of the world's animal genetic resources. Approximately 9000 entries for breeds, kinds, and variations of livestock, as well as extinct ones, are included in inventory of endangered livestock breeds. More than 180 endangered British and North American breeds were identified thorough details on cattle biodiversity and made preservation suggestions.Organisations working in several nations to protect cattle breeds that are in risk of extinction such as the transnational working International Rare Breeds.

Breeding objectives

The subject of significant debate is the breeding goals suitable for organic farming. Some organic dairy producers lack knowledge of contemporary breeding methods and place a lot of faith in the methods used by conventional breeding firms Due to the wide range of situations, breeding goals will not be the same for every situation.For the sake of organic breeding, existing goals may sometimes get a different weighting within the selection index. Other times, new goals will be included. Longevity, vigour, and fertility are the main breeding goals for all farm animal species in organic agriculture.Breeding for disease resistance has received a lot of scientific attention recently, especially in cattle and sheep. One excellent example of a health recording system is the Scandinavian dairy cow health tracking system. Within that programme, veterinarians compile information on veterinary procedures. In other nations, measurements like somatic cell countswhich serve as a mastitis indicator are routinely supplied during milk recording. This strategy's possible drawback is the need for comprehensive performance recording systems.

Alternative breeding approaches

Selection indexes are used in most breeding programs. Different production traits are multiplied with economic factors and these partial indexes are added up to an overall value. Also, in several conventional breeding schemes for dairy cows, functional traits like health, fertility or longevity have gained more importance over the last few years despite their low heritability. One suitable method for organic selection indexes would be to put another weight on some of these traits so that the ranking of available sire animals will change. Normally, functional traits like longevity or health will get a higher priority and performance traits a lower priority. For example, better persistence of milk performance within lactation may be an aim, and also a lower milk production in the first lactation. Both traits are often not considered in conventional breeding programs. Ecological breeding indexes could be good an alternative until specific animals bred for organic agriculture are available. There are some examples where such technology.

For example, twice a year a list is published in Germany with a ranking of breeding bulls from different breeds. In Switzerland, catalogues of conventional breeding companies also contain ecological indexes. The disadvantage is that only those traits could be used for which data are collected. For other potentially useful traits for organic agriculture, no information is yet available. Furthermore, bulls that are ranked highly were usually bred for high unidirectional performances. Professor Bakels in Munich, Germany, developed breeding for lifetime performance as a concept. The idea is that a dairy cow, which realised a high lifetime milk performance, must also be healthy and fertile. Within a breed, families with very high lifetime performances are identified and bred, using rotational breeding and also slight inbreeding. Economic advantages of a high lifetime performance are that rearing costs are spread over more cows, and that selection possibilities are higher because more descendants are available. However, only conventionally reared, AI bulls are used, often from North American origin. There are farmer groups in Germany, the Netherlands, Switzerland and Austria working with lifetime performance. They publish yearly catalogues with recommended bulls from which 90% are bred specially for lifetime production or organic farming. The idea of lifetime production could also be transferred to sows and laying hens.

In the Netherlands, the concept of family breeding was developed by the farmer Dirk Endendijk. He successfully bred cows that produced more than 10,000 kg per lactation using the original Dutch Friesian cattle. Mainly animals present at a given farm are used for breeding within that system. Another typical feature is the use of several bulls at a time for natural mating. Like the concept of lifetime performance, cow families with a high lifetime production are used, again also utilising some inbreeding. Crossbreeding is used in some countries for dairy cows, such as Holstein Friesian × Jerseys in New Zealand. In the tropics, cross breeding is common, normally combining the advantages of local and high-yielding European breeds. In doing so, heterosis effects could be used higher performance in offspring than in the parental generation. Examples include improvements in milk production, parasite and disease resistance, adaptation to climate, or progeny survival rates. However, the use of crossbreeding requires higher inputs. Another question is what to do with the F1 animals. The F1 generation can be either produced continuously or a rotational crossbreeding is possible.

Compared to dairy cows, alternative breeding techniques are far less popular in pigs and poultry.The organic pig industry offers a wide range of options, from typical lean meat for retail chains to rather fat breeds for banger manufacture. As a result, it might be challenging to establish acceptable breeding objectives for all potential organic marketing objectives. At traditional slaughterhouses in nations like Germany and Austria, just the quantity of lean meat is paid for. The intramuscular fat percentage (IMF) is also taken into account in other nations, such as Switzerland or Denmark. As IMF is closely associated to sensory qualities like flavour, tenderness, and juiciness, it is crucial for meat quality. Pigs' IMF and PSE meat have decreased as a result of breeding for more muscular animals. Another factor is fat quality, which is crucial for making sausages, for instance.

Lean meat is also popular among buyers of organic products. It will be essential to persuade those customers of the benefits of meat with a higher IMF since there is a conflict of interest.Some breeding businesses aim for characteristics in mother breeds like fertility or lifelong performance. Alternately, conformation criteria may be taken into account, such as how the limbs are positioned in relation to their susceptibility to lameness. Additionally, some businesses take into account behavioural qualities like mothering prowess or appropriateness for group dwelling. For instance, a connection between piglet mortality and sows' avoidance of the farmer. This is crucial in the loose farrowing sow housing that organic agriculture prefers. Similar to cow breeding, there is a lack of appropriate measurement techniques for specific characteristics, such roughage conversion. Breeds produced for outdoor pig rearing in the UK are one example of breeds designed specifically for certain living situations.

Poultry

The development of hybrid breeding has resulted in completely distinct strains of fowl for the production of meat or eggs. Numerous health issues, such as sudden death syndrome, limb issues, or ascites in broilers, have been made more prevalent by selection for extremely high performances. The EU law for organic agriculture, at least for meat poultry, takes this into consideration by prescribing minimum slaughter ages that are substantially higher than for conventional farming.Male layer chickens are often murdered as soon as they hatch since it is not cost-effective to fatten them. This is a significant ethical issue. Additionally, traditional laying hens are typically only kept for one laying season, which lasts for roughly a year. Once again, this may be seen to be unethical. The feeds authorised for organic farming make it exceedingly difficult to feed high-yielding chicken breeds in accordance with their nutritional needs. With the current protein feed options, providing poultry with critical amino acids is especially challenging.

Because of the aforementioned factors, organic agricultural performance levels should be decreased. For birds in alternative housing systems, vitality and adaptability will be particularly crucial since current layers have been chosen under cage-like settings. Under different housing circumstances, many hybrid strains may experience feather plucking and cannibalism.Selection against these behavioural disorders, however, may be helpful since there is some heredity.At least for laying hens, the majority of organic poultry producers employ common hybrid breeds. For meat fowl like turkeys or broilers, there are several breeds that grow more slowly that were developed, for instance, in France for the manufacture of the free-range designation. The fact that these birds are hybrids, however, also means that the farmers are unable to breed their own livestock.

Tests conducted in Germany and Denmark have shown that purebred layers produce much less eggs than current hybrid strains. For the last 30 years, these purebred strains have only been chosen for looks. As a result, it seems that there is not yet an ideal breed for organic agriculture. Purebreds produce at an unacceptably low rate, while contemporary hybrids are prone to cannibalism and feather plucking. In the long term, creating breeds that can produce both meat and eggs could be the answer for organic farming. However, the performance of both meat and eggs will be inferior to that of current hybrid breeds. Customers must thus be persuaded to purchase these more costly goods. Organic meat and eggs are rather expensive. Additionally, organisations or organic farmers' efforts will be required. The organic market is too tiny for the large breeding corporations to establish an organic breed in the near future.

Utilising performance information is further complicated by genotype-environment interactions (G-E). Generally speaking, G E interactions imply that animals of the same origin may behave differently in various settings. It might be challenging to evaluate animal performance in significantly diverse situations since the G E interactions are more significant in extremely varied contexts. For instance, a purebred laying hen performed similarly in cage-style and other types of housing. However, the evaluated hybrids produced less in cage systems compared to other systems. Under semi-scavenging circumstances, a native breed in Bangladesh performed better than Lohmann Brown chickens. There is currently no data on the G–E interactions between conventional and organic agriculture. It requires a lot of data to estimate G E interactions, which is a crucial prerequisite.Another issue is that testing labs often use animals, preferably pigs or chickens, in a traditional manner. For instance, only concentrates are utilised in intensive feeding and housing systems, which is prohibited in organic farming. Results produced under such circumstances could also not translate to biological circumstances.

Breeding practices

Breeding practises should maintain the animals' natural behaviours, per IFOAM guidelines and EU legislation. Natural mating is thus desired. Methods that rely on sophisticated technology need to be avoided. Cloning and embryo transfer are forbidden.Although AI is allowed, using hormones to stimulate ovulation and childbirth is not approved unless it is necessary for medical reasons.Farmers may become increasingly reliant on breeding businesses as a result of invasive procedures like artificial intelligence (AI) or embryo transfer that disregard an animal species' natural nature. Additionally, since fewer breeding animals are utilised using these approaches, the genetic foundation of a breed will be diminished. Organic livestock management strives to use natural breeding practises. With some animals, AI is still widespread. For instance, most organic dairy producers in Germany continue to utilise AI, although most beef farmers rely mostly on natural mating.

It is not permitted to transfer embryos (ET) in organic farming. Breeding bulls, however, are often created by ET. In many nations, standards for bulls should be established for natural mating. Rotating breeding animals around farms is another way to promote natural breeding, as does paying certain farmers to maintain male breeding animals. Because the sire is better able to identify estrous females, natural breeding usually has a greater success rate in terms of offspring. However, many offspring will be impacted if the father inherits health issues that don't manifest right away.Another query is the appropriateness of using quantitative trait loci (QTL) techniques to organic farming. Gains may be enhanced by identifying the genes responsible for certain breeding features. Molecular approaches like checking for the malignant hyperthermia syndrome (MHS) gene in pigs to lessen stress vulnerability are becoming more and more frequent in traditional breeding. However, since the use of genetically modified organisms is prohibited in organic agriculture, these experiments use genetic engineering techniques that are dubious.

There is a dearth of specialised scientific literature on organic cattle rearing. In certain instances, organic animal housing standards should be more carefully established, and they should be under the supervision of qualified individuals. But maintaining high standards alone won't ensure animal wellbeing. In this setting, management is crucial. It is important to continue educating farmers, consultants, and veterinarians about organic animal management.Alternative housing solutions often come at a greater price for example, more labour and space. Farmers must thus either get higher prices or subsidies. Alternative methods might pose particular threats to the environment or to the health of animals. Further research into risk-reduction strategies should be done without sacrificing the benefits of the animals' natural behaviours.

Organic livestock management strategies are highly diverse. As a result, defining breeding objectives for all reasons is difficult. The qualities that make an animal ideal for organic or sustainable animal husbandry include those that improve food quality, adaptability, lifespan, disease resistance, or roughage conversion. The preservation of genetic variety is one goal of organic farming. Old domestic cattle breeds that are in risk of extinction often possess the required traits such adaptability and vigour, which makes them ideal for organic farming. lesser results, however, translate into lesser profitability. Farmers once again need to look for greater prices or subsidies.

CONCLUSION

Learning about environmental contamination and its impacts may have an impact on how organic farming is done, how policies are made, and how children are taught. In organic agricultural systems, stressing the value of mitigation techniques like crop rotation, cover crops, and composting may improve pollution control and environmental protection.To sum up, further study in this area is necessary to improve our comprehension of environmental degradation and its consequences on organic farming.

The resilience and success of organic agricultural systems may be increased by using mitigation methods and sustainable farming techniques. Recognizing the importance of various sustainable pollution control techniques may also assist farmers in successfully reducing environmental pollution in their organic activities.

To maintain the long-term sustainability and productivity of organic agricultural systems, it is important that academics, legislators, farmers, and agricultural professionals work together to address environmental contamination in organic farming.

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CHAPTER 16

ANIMAL HEALTH AND NUTRITION: EMPHASIZING ORGANIC FARMING PRACTICES

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ABSTRACT:

In organic farming, nutrition is crucial since it affects soil quality, crop nutritional content, and overall farm output. In order to promote sustainable agriculture, this research study will examine the significance of nutrition in organic farming and how it affects crop nutrition and soil fertility. In order to increase soil fertility and nutrient availability, the research goes into the concepts of organic nutrient management, which place an emphasis on using organic matter, composting, and cover crops. It looks at how mycorrhizal fungi and helpful soil microbes might improve plant nutrient absorption in organic environments. The study also looks at how nutrition affects crop quality, productivity, and pest and disease resistance in organic fields. Promoting agricultural practises that are socially acceptable, commercially successful, and ecologically friendly requires an understanding of the importance of nutrition in organic farming. The research also emphasises how this information may be used in policy-making, education, and organic farming practises to enhance efficient nutrient management and long-term agricultural systems.

KEYWORDS:

Crop Nutrient Content, Nutrition, Nutrient Management, Organic Farming, Soil Health.

INTRODUCTION

Animals play a significant role in organic farming systems, both conceptually and practically, where emphasis is placed on creating an integrated system that balances the needs of humans, animals, and the environment while using local feed and waste recycling. Organic animal husbandry prioritizes the health and wellbeing of its animals. Animals, as opposed to crops, are sentient beings as well as components of the agricultural system, and as such, they need unique moral care. They are persons who need care, who are capable of suffering, who can interact with one another as well as with the people and environment around them. Therefore, managing animals is significantly different from managing crops[1], [2].Since this is wrong, humans have a moral duty to treat animals humanely and to step in before they suffer or pass away. In terms of preventing pain, organic agricultural practises go far further than just increasing animal welfare. Access to 'natural' behaviour for animals under organic management is one of the fundamental tenets of organic farming, which significantly broadens the definition of welfare.

Lund highlights the significance of incorporating naturalness into the theoretical underpinnings and actual implementation of animal welfare in organic animal husbandry.Synthetic medications may be used to treat ill animals in accordance with the purpose of preventing suffering for animals. Use of chemicals is only permittedand even encouragedin this specific situation in organic farming in Europe. Antimicrobial treatments are totally forbidden in the United States of America (USA). Therefore, some farmers shift their illness management strategies and resort to ostensibly supplementary or alternative therapies, sometimes in conjunction with analgesics often known as painkillers. No matter how diseases are controlled, breeding for increased disease resistance, introducing more species-appropriate housing, and promoting a well-balanced diet are some of the more fundamental changes that should be made to husbandry practises in order to avoid suffering and the need for disease treatment. We shall talk about feeding and illness control after Horning covers the topics of breeding and housing[3]–[5].

In this book, the importance of organic farming in a worldwide context is underlined, thus we discuss non-certified organic farming from the viewpoints of how it is practiced in many parts of the globe. For certified organic animal products, there are often very few local markets such as in the majority of African nations, and export restrictions due to disease status apply to all livestock goods. Fruits and grains make up the majority of certified organic goods, which are exported to wealthy customers in places like north-western Europe. Most farmers find the certification processes to be too expensive, particularly when no one wants to pay more for organic goods, there is no support for organic growers, or premium pricing are hard to come by. In their 2005 article on non-certificated organic farming, categorized the hidden world of ecological farming into four categories[5], [6].

One explicitly organic approach for example, joining a certification organisation two similar approaches three low external input sustainable agriculture weighting local resources and processes and four traditional farming food grown without chemicals, or organic by default.we'll bear in mind the fundamental principles of organic animal husbandry and also discuss the possibilities for producing organic livestock using instances from uncertified regions. The term organic farming in this context refers to farming that emphasises a harmonious relationship between the use of the land and the care of animals, as well as generating certified animal products.Regarding distinct farming methods and environmental requirements, there is a lot of variation across nations and regions; farm settings vary from mountainous to grassland regions, and farming methods range from traditional to intensive systems. This chapter aims to present and debate many elements of nutrition and animal health in organic farming systems. A succinct summary of the most recent research on animal welfare, sickness, and health in organic agriculture is provided. We will concentrate on the links between animal health and welfare and nutrition in particular. The majority of our focus will be on dairy cows and grassland feeding, but we will also provide additional instances[7]–[9].

Organic livestock production and animal disease patterns

It is challenging to have a worldwide perspective on the evolution and makeup of organic livestock production. Official data on organic cattle production are not available in any depth, not even in Europe, where the practice is widespread. 5.8 million hectares on 155,100 farms in 25 nations of the European Union (EU) were devoted to organic farming in 2003, making up roughly 3.5% of all the land in Europe.The area and quantity of farmers who convert varies per nation. For instance, the amount of land utilised for organics rose in 2003 in Germany, France, Portugal, Greece, Austria, and Spain, but fell in Denmark, the UK, and the Netherlands.

On a worldwide scale, there are a wide range of organic livestock products on the market. The biggest markets in the EU are found in Germany, France, the United Kingdom, and Italy, as well as in Denmark, Austria, and Switzerland. There is a lot of diversity across product categories. The organic percentage of the overall market for beef was 1.6% in 2003, 1.2% for milk and milk products, 1.3% for eggs, but 0.6% or less for pig and poultry meat. The average market share in the EU for crops was between 1% and 1.8% in 2001. For the organic markets for milk, beef, sheep and goat meat, it is challenging to balance supply and demand. In 2001, the distribution of organic items offered alongside conventional ones varied greatly per nation. But in the EU, on average, 32% of milk, 31% of beef, 46% of sheep and goat meat, and 31% of ilk, had to be sold to conventional shops, sometimes for less money than was paid for organic food.

DISCUSSION

Animal Illness Patterns

Organic farming specifically aims to promote the health and wellbeing of animals. Although health is sometimes interpreted to mean no diseases, it really refers to a wide range of factors Here, we concentrate on the health issues that organic animal farming encounters. We shall tackle this problem by providing a brief summary of study results concerning illness levels, mostly in Europe. When evaluating the findings of organic research, it's important to keep in mind how organic livestock production has evolved and altered over the last several years standards, attitudes, infrastructure.We concentrate on how humans contribute to the production of organic cattle towards the chapter's conclusion and provide recommendations on how to more systematically include health care principles.

Changes in living circumstances, feeding practises, outdoor production, treatment standards, or shifts in farmers' attitudes and views are the main causes of changes in disease patterns linked to the conversion to organic farming. All of these adjustments may affect disease patterns in both good and negative ways, and as the conversion period may be marked by adjustments and novel herd management techniques, the conversion itself may have a detrimental impact on the herd's disease status. Based on a review of peer-reviewed journal articles on various aspects of animal welfare and health in organic farming. Mastitis, lameness, and metabolic illness in adult cattle, as well as internal parasite infections in young animals, are significant disease concerns that are identical for conventional and organic dairy herds. The severity of these issues seems to differ more across farms than between conventional and organic farming. In contrast to conventional farms, which had essentially no dry period mastitis, showed that 50% of examined organic herds in England and Wales had quite high levels of the condition. The frequent use of antibiotics in dry cow treatment in conventional herds in the UK may be responsible for the discrepancies in these results. Data comparing claw lesions with lameness are inconclusive. Furthermore, rumen acidosis owing to greater grain proportions in the feed diet and more grazing have likely produced a much higher frequency of liver abscesses in Danish organic dairy cows compared to conventional dairy cows.

Lungworm illness may be a concern in dairy cows, especially in recently converted herds when the animals have not previously been on pasture. Gastrointestinal parasites and coccidia can also pose issues, especially in early calves. 45% of Danish organic dairy farms were forced to resort to anthelmintic treatments during the 2002 grazing season, despite the fact that the majority of these infections are manageable with the right management practises.On Swedish smallholder farms, nutrition, endoparasites, haemonchosis, diarrhoea, high lamb mortality (3–36%), and lean ewes seem to be the most significant health issues in organic sheep production. These issues were listed as the most frequent health issues in 37 flocks of organic sheep, albeit they are not notably different from those in flocks of conventional sheep.

Lameness, mastitis, fly strike, fasciolosis, and other helminth infections were shown to be the most common health issues among organic farmers in the UK (Roderick and Hovi 1999). Chemotherapy and chemoprophylaxis are restricted or prohibited, which necessitates the use of management techniques like closed flocks and reduced stocking numbers. Production of organic sheep and goats may be seriously threatened by internal parasites, especially gastrointestinal nematode. According to Thamsborg et al. (1999), the majority of organic sheep farmers must depend on grazing management techniques including frequent shifts to clean pastures and supplemental feeding. In certain nations, regular even preemptive use of anthelmintics is still a component of the control approach. To combat *Haemonchus contortus*, for instance, Lindqvist et al. (2001) in Sweden estimated that 20% of organic farmers spray ewes around lambing.

Production of organic pigs varies greatly throughout Europe. Switching ruminant production methods to organic systems is far easier for farmers to do than it is for pigs and poultry. Depending on the system, farrowing, suckling, or even fattening occurs outside, whereas in other systems, housing with modest outside exercise spaces is given in colder temperature nations like Germany, Denmark, and the Netherlands. These techniques allow for more area per pig than traditional farming. Although there is a paucity of information on pig illness patterns, health and welfare issues seem to be different between organic and conventional agriculture.

In a UK survey conducted in the late 1990s, respiratory illnesses and diarrhea were seen as minor issues whereas external parasites and infertility were recognised as the main concerns. A case study showed that among outdoor sows, traumatic lameness, injuries, and sunburn were the most common clinical findings. Small Nordic case studies have shown a low incidence of diarrhea and respiratory disorders but an increased incidence of joint diseases compared with indoor herds. Endoparasites and ectoparasites have been reported to be quite common in various studies, likely as a result of outdoor access, a high intake of insoluble fibre, poor cleanliness, and the usage of permanent pastures.

Following a recent Ascaris infection, several organic herds have had severe issues with milk stains in the liver, leading to rejections at slaughter. The organic cattle used relatively little antibiotics. Numerous Danish studies have shown that piglet mortality is high in organic systems, while it is similar to that in traditional outdoor systems.Intensive organic egg layer flocks generally tend to have the same illness issues as conventional flocks, but sometimes to a greater degree. The Danish Poultry Council discovered that organic flocks had a greater laying period mortality rate than any other flocks that produced eggs. Without a doubt, free-range farming is linked to certain particular illness issues. Free-range flocks are more susceptible to coccidiosis, helminth parasites, histomoniasis, and ectoparasites, and they also run the danger of contracting illnesses from wild birds such pasteurellosis, salmonellosis, and avian TB.

In July 2005, concern was raised over the free-range status of organic poultry flocks in Europe after avian flu outbreaks in Asia, Russia, and Kazakhstan as a recent example of disease epidemics involving migratory birds. When compared to caged and restricted chickens, organic and other free-range systems have both good and negative welfare effects. According to unpublished data from the Danish Poultry Council from 1997, Kristensen showed that the mortality of organic laying hens in Denmark is 15% to 20% 4-5% in conventional battery cages; 9–10% in free-range production, despite subsequent studies showing noticeably lower mortality on organic farms. Coccidiosis, external parasites, feather plucking, and cannibalism were all mentioned as important potential issues in organic and other free-range systems, where beak clipping is not permitted and is not seen to be an acceptable solution to the issue. Recent European research have corroborated these issues. A certain amount of feather plucking may be a normal preening procedure, but in less ideal circumstances, it causes serious health and welfare issues. Regarding these issues, breed and strain of chicken also matter.

Roughage feeding and providing the chickens with suitable outdoor living spaces shelter, shade, opportunities for dust baths, and places with plants will greatly lessen issues with excessive feather plucking and cannibalism. Overcrowding, poor living conditions, and nutritional inadequacies such as a lack of key amino acids may exacerbate the issue. Bestman demonstrated the need of farmers comprehending the needs of the birds in order to properly adapt the system to the natural behaviour of the poultry. Poultry must be raised organically in order to be produced, and they should also be raised organically as adults. As cage-adapted birds may not adjust to the floor under organic circumstances and may develop feather picking, this implies that hens are raised on the floor. Breast blister and coccidiosis appear to be the main disease issues in broiler production.

Animal Nutrition and Feeding: The Challenges of Organic Farming

For the health and wellbeing of animal herds, a healthy, well-balanced feed diet is essential. The creation of a well-balanced animal production system presents many challenges when adhering to the principles for organic livestock production about naturalness, supporting the species-specific characteristics of animals, and at the same time emphasising local production, minimal transport, and outdoor life certified organic herds primarily depend on the breeds and breeding objectives of conventional herds. This could lead to a conflict becauseHigh production levels are frequently the goal of conventional breeding, which could conflict with natural behaviour or other breeding objectives or characteristics.

Attempting to sustain a production level that is physiologically viable while still enabling natural behaviour, development, reproduction, and longevity in the herd by feeding animals in line with their natural needs encouraging rumination through eating in ruminants. However, feeding animals with high genetic potential for production in accordance with organic farming norms may not fulfil the animals' nutritional needs, which may damage their wellbeing. The difficulty of organic animal feeding is to find a quantity and quality of organic feedstuffs that support the physiology and production of the animals. Simultaneously, the methods of feeding such as accessibility that causes the animals the least amount of stress are modified to the shifting conditions of the animals such as from the dry season to lactation, and allowing them the greatest amount of freedom of choice is also essential for their well-being and performance. To guarantee the health and wellbeing of the animals, the fundamental nutritional needs must be satisfied in terms of the amounts of minerals and vitamins. Supplementation with vitamins, trace elements, and minerals is not a common practice in various nations, whether it is certified organic or not. Feeding with bioactive forages is another component of the connection between animal health and nutrition related worm management.

Feeding with home-grown feed

A fundamental tenet of organic farming is that the animal herd is an integral element of the overall agricultural system. As a result, organic herds should rely largely on homegrown feed and minimise the use of imported feed. On many organic farms, a high level of productivity, comparable to that of conventional herds, is maintained through utilising the genetic potential for output. This places extremely high demands on both the caliber of the feed and the quantity of food consumed. The goal of feeding organic livestock exclusively home-grown feeds must be achieved in a way that satisfies their nutritional needs while maintaining ecological and financial sustainability. The best strategy to achieve this goal will depend on the local and regional environment and how well the balance between the animal herd and the land can be maintained. Grassland feeding will predominate in organic dairy farming (such as in Switzerland), and wintertime hay feeding may satisfy more than 90% of the nutritional needs of dairy cows. On the basis of pure grassland feeding, an example using beef cattle from Australia is provided.

Use of Roughage

Roughage feeding, which may have a significant influence on health and disease patterns, is given a lot of attention in organic farming. According to the Danish Cattle Advisory Board from 1998, a high percentage of roughage in cattle would often be beneficial to the rumen environment and lead to fewer metabolic diseases. Ruminal acidosis may provide issues that need additional research, according to recent discoveries. The use of roughage, such as pH-lowering silage, in organic pig production may minimise the frequency of nematodes while reducing the occurrence of gastrointestinal bacterial diseases such salmonella, dysentery, and lawsonia. Roughage has a lower energy density than most concentrates, thus using it often might be troublesome since it could lower the energy density of the ration to a level that is insufficient for high levels of production, resulting in the possible contradiction between breeding for high output and using roughage extensively.

Unbalanced diets, particularly those with insufficient calories and an overabundance of crude protein, may increase the risk of this. Due to the lack of commercial organic concentrates and the need for home-grown pasture, this resulted in poorer reproductive efficiency in cattle in Norway in the mid-1990s.Due to reduced energy levels in the diets, organic milk output in the majority of European nations ranged between 80% and 95% of that of conventional herds. In spite of the larger negative energy balance between production and feed intake in organic herds, a Danish study found that the level of subclinical ketosis in organic dairy herds was at the same level as conventional herds, but occurring at a later stage of lactation than in conventional herds. This was explained by the availability of food twenty-four hours a day, regular activity, and the feeding of roughage to the young.

Challenges in tropical areas: feeding from 'organic by default' to 'organic as agoal'

However, we should also take into account the prospective growth of organic production systems in other nations, such as tropical nations. A large portion of the current organic livestock production is now carried out in highly intensive production systems in Europe and North America. With the exception of the very significant use of pharmaceuticals to manage vector borne illnesses Animal disease treatment in organic animal husbandry, many systems may nearly be considered organic by default.

Since grazing is a common system foundation, the potential benefits of switching from organic by default to organic by principle will be briefly examined below in connection to grazing. In regard to a future conversion to organic systems, it is also important to debate and investigate different systems. we provide an illustration of how a small-scale dairy system that is totally zero-grazed may possibly transition to a partially pasture-based production system by employing homegrown feed.The difficulty in many current systems is to start producing better pasture and legumes for high output cows instead of relying on bringing feed concentrates onto the farm. In addition, it is important to talk about the compatibility of

Holstein-Friesian cattle in tropical agricultural systems in terms of naturalness, disease resistance, supporting the local ecology, and recirculation.

CONCLUSION

Understanding the role that nutrition plays in organic farming presents prospects for advancing efficient and sustainable agricultural practises.The information learned through researching nutrition in organic farming may have an impact on how organic farming is practiced, how policies are made, and how organic farming is taught. In organic agriculture systems, highlighting the significance of nutrient management may improve soil health, crop quality, and environmental preservation.To sum up, further study in this area is necessary to advance our understanding of nutrition in organic farming. Enhancing soil health and crop nutrition in farmers' agricultural operations may be supported by adopting sustainable nutrient management practises and appreciating the importance of various and nutrient-rich organic crops. To maintain the long-term sustainability and productivity of organic agriculture systems, it is necessary for researchers, policymakers, farmers, and agricultural professionals to work together.

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CHAPTER 17

GRAZING AND GRASSLAND MANAGEMENT: AN IN-DEPTH ANALYSIS

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ABSTRACT:

Sustainable livestock production methods that support ecological harmony, healthy soil, and all ecosystem services must include grazing and grassland management. In order to assist sustainable agriculture, this research article will examine the guiding ideals, procedures, and contributions of grazing and grassland management. The influence of several grazing practises on feed quality, plant biodiversity, and soil carbon sequestration is explored in the research, including rotational grazing, intense grazing, and holistic planned grazing. It looks at how managing grasslands may improve animal nutrition, support sustainable livestock production, and lessen its negative effects on the environment. The study also investigates grasslands' potential for storing carbon and reducing climate change. For the purpose of fostering livestock production that is socially responsible, economically viable, and ecologically benign, it is essential to comprehend the concepts and practises of grazing and grassland management. The research also emphasises how this information may be used in policy-making, education, and animal farming practises to assist sustainable agricultural systems and successful grassland management.

KEYWORDS:

Grazing, Grassland Management, Rotational Grazing, Soil Health,Sustainable Livestock Production.

INTRODUCTION

Grassland makes for almost 60% of the certified organic land area. Globally, there are numerous difficulties in farming grasslands in various environments not just those that are certified organic, starting in sub-Saharan Africa, where 50% of farmers are either pastoralists or agropastoral and where a large portion of the land is communal grazing areas with some transhumance. Different grazing methods occur in huge land areas in European nations like Switzerland, Romania, Poland, Scotland, and Norway, but in nations like Denmark, the Netherlands, and the UK, it requires careful planning of the grassland and other crops. This is crucial to keep the peace on a farm level because there is very little acreage available in comparison to the number of animals, including very little permanent grassland. An example of feeding and milk production based on the management of a crop-livestock integrated system in Denmark with an intense dairy herd[1]–[3].

An example of pure grazing systems-based organic beef production using Australian grassland farming. About 70% of Australia's geographical area is comprised of rangelands. The most common use is for the production of livestock, which is essentially an organic-by-default production system that uses few inputs and low intensity production using natural pasture species and, sometimes, enhanced or supplemented pasture.Cattle are mustered twice a year on average, with the use of horses, motorcycles, cars, helicopters, or small aircraft. Stock handling is kept to a minimum. Some kinds of land have a carrying capacity of only one steer per square km. The Channel Country makes up a large portion of the internally drained Lake Eyre Basin, where rain from the subtropics travels hundreds of kilometres over dry terrain before emptying into the lake, which is surrounded by deserts. In semi-arid regions, sheep arthe most common livestock, along with beef cattle. The prevalence of Bos indicus breeds in the wet tropics and subtropics reduces problems brought on by cow tick or lice[4]–[6].

Animal Disease Treatment in Organic Animal Husbandry

Reduced usage of synthetic chemicals is one goal of organic farming. However, sickness must be treated for the wellbeing of the animal, and biomedical veterinary medicine of synthetic chemical origin is often seen to be the most efficient remedy. By requiring a two- to three-times-prolonged withdrawal period after treatment and a cap on the number of treatments per animal per year or lactation, European nations have reached a compromise regarding the use of synthetic chemical veterinary medicine that promotes health promotion and non-medical disease prevention.

In the event of illness, it is the farmer's duty to take necessary action and intervene in connection to each particular animal. The issue is not whether to interfere but rather whatever kind of therapy, if any, would best stop pain and promote healing. Options for supportive therapy should be thought of rather than only illness treatment. These include strategies for assisting the recovery of an animal in an imbalanced state of health. Using the dairy industry as an example, a treatment may include manual milking between machine milkings very early on in a mastitis case; giving more bedding in emergency cases such as after calvingor cleaning infected wounds, traumas, or certain claw diseases such as abscesses with soap and water[7]–[9].

Culling, drying up individual udder glands, and allowing cows with high somatic cell counts to remain with nursing calves for an extended length of time are examples of longer-term management techniques. A thorough examination of animals and their products, such as milk, is essential, and the most key element is a prompt response to any serious condition. Many of these therapies require a lot of effort, such hand milking and massaging the udders, which may restrict their use in, for instance, intensive agricultural systems in northwest Europe.The fundamental principles of organic farming may be considered as driving a considerable effort to improve the health status in herds, including disease control by farmers, according to previous and current Danish research. Many organic farmers have mentioned a conversion in the herd and heart in interviews, which changed the way they cared for their own animals instead of only phoning the doctor.

Alternatives to Conventional Disease-Treatment Methods

The US organic livestock regulations completely prohibit the use of biomedical products, which highlights the need for the creation of organic animal care strategies that are sustainable. Diseases in organic farm animals must preferable be treated with phototherapeutic products or homoeopathic remedies provided that their owners follow the instructions in EC Regulation No. 1804/1999.therapeutic impact is successful for the animal species and the disease being treated is wanted. The term phytotherapy refers to a variety of various treatments and chemicals. based on plant-based ingredients and often characterised within the context of traditional medicine. The medical discipline of homoeopathy has its own philosophy and methods, and gives a viewpoint on health and illness that differs greatly from that of traditional biomedicine. The legal standing of phototherapeutics has been debated in numerous European nations.

Additionally, as they are not approved for use in production animals, homoeopathic products provide a bureaucratic barrier to the advancement of these strategies. creation of various There has been discussion of research frameworks and study designs, to Improve knowledge of the processes behind this therapy strategy. both acupuncture Other approaches for the treatment of farm animals include chiropractic. Like any kind of therapyThey will need a considerable amount of specialised schooling. Treatment with acupuncture. usually calls for a veterinarian, and treatments might take anywhere from 20 and 60 minutes. restricts the uses it can be put to. Acupuncture has been demonstrated to be very helpful in reproductive issues of all types, including birth circumstances, in animals used for production.

DISCUSSION

The involvement of the veterinary advisers

The veterinarian and other animal health professionals should help the farmers in achieving their objectives for the herd and organic standards in regard to health promotion, illness prevention, and disease management. A research and development project involving health planning in several organic dairy herds in Switzerland has highlighted the significance of the conversation between farmers and advisors to develop organic strategies for better health and less disease. In the UK, health planning is a component of conversion to organic farming. More research in Denmark has revealed that farmers only occasionally involve their veterinarian in the growth of the organic herd, and that one key factor is the veterinarians' lack of understanding and support, who do not view organic farming as anything unique to which they should be able to relate.

In a working group report for a European workshop, came to the conclusion that veterinarians seemed to be generally ignorant about and suspicious of organic farming. According analysis, the organic agricultural guidance system is not sufficiently specialised from the perspective of the farmer. As a result, there seems to be considerable potential for the growth of cooperation on strategies for health promotion, alternative disease management techniques, as well as communication channels between farmers and animal health specialists. The adoption of the so-called Farmer Field School method by Danish organic dairy herds from countries in Asia and Africa seems to be one recent and extremely successful development in the organic environment. The establishment of farmer organisations, where farmers provide advice to other farmers, seems to encourage the search for creative solutions to health and disease issues, which in turn improves the health status on the farm.

Zoonotic diseases and food safety aspects

Through the food chain, a number of infectious pathogens may spread from farm animals to people and result in sickness. Although they may also occur in organic farming, these illnesses are often linked to highly industrialized animal production. In particular, there is an elevated risk for zoonotic illnesses from outdoor reservoirs like Campylobacter. Although minimal variation in prevalence of this illness is found between organic and conventional farming, in both poultry and pigs, Salmonella is another significant zoonotic infection. Different feeding practises, a reduced stocking density, grazing, and giving roughage such as silage with a low pH may all help to lessen the risk. Salmonella germs may survive the outdoors for up to a year, therefore pasture resting times may be crucial. For instance, in the Netherlands, 35% of organic poultry samples tested positive. It is premature to take precautions against some illnesses and risk factors for food contamination like Salmonella.

One zoonotic helminth infection that may have a reservoir in wild pigs and foxes is trichinosis.Similar to toxoplasmosis, the probability of such an infection being transferred into outdoor organic pig herds is much greater than in indoor production. The zoonotic potential of bovine spongiform encephalopathy (BSE) has increased. The disease, which was transmitted by using diseased sheep or cattle's meat and bone meal as livestock feed, first appeared in the early 1970s from an unusual source, presumably a cow or another animal that had contracted the illness as a consequence of a genetic mutation. Animals imported from conventional herds may be at risk for BSE since BSE has been linked to the intake of bone meal, which has not always been outlawed in non-organic herds.

Biosecurity And Risks Connected to Animal Management

Particular biosecurity hazards are associated with certain industrial situations. For instance, there will be a higher possibility of dangerous organisms spreading when disease incubation or weed dispersion are difficult to manage, such as in intensive dairy systems or hill farming in the UK. Additional biosecurity and animal welfare issues are brought on by the transportation of animals between farms, sometimes over great distances. Animals for slaughter are either moved between farms and grazing areas or from farms in rural locations to abattoirs, some of which are certified organic, in various European nations. The export and import of animals, transhumance, and the usage of communal grazing grounds should be in-deathly evaluated and regulated in the context of each unique location when talking about the prospective growth of organic agriculture in places where this is not yet established.

The NAHWOA Recommendations demand that biosecurity be given more weight in the standards. However, access to outdoor surroundings, lower flock sizes, and low stocking rates minimise the risk of various illnesses linked to dense populations, high input levels, confined environments, and restricted mobility.Animal health is a problem for the production of organic livestock in both established organic farms and emerging organic farming regions. Many organic farming systems still struggle with disease prevalence, and sustainable methods of managing organic herds still need research.To better integrate the idea of alternative systems into the many different current agricultural systems is one of the main obstacles to the more widespread expansion of organic farming. For instance, community grazing is a method of raising cattle that is often used in many parts of the globe, and this has to be taken into account when switching to organic farming.

In certain instances, conversion may take place at the communal level as opposed to the farm level.Numerous rural villages have very little resources. The use of local resources and avoiding the importation of feed, medicines, and animal breeds are just a few examples of how organic practises may be relevant to support the environmental and economic sustainability of these communities, even though there may not be a specific market for organic products from or in these communities.They may act as regional guiding lights for sustainable growth.Health promotion initiatives and illness prevention techniques have to be the foundation of disease management. When sickness strikes, quick action utilising alternative tactics and, if available, disease treatment approaches are essential. For the organic approach to animal health and welfare to be supported, veterinary services and extension must be converted to a far higher level.

Animal nutrition and health in organic agriculture

The role of humans in organic herds is to provide as many opportunities for the animals to engage in their species-specific natural behaviour as possible such as flock life, outdoor life, and mother-offspring relationships, as well as to act as caretakers who support animal wellbeing by meeting their nutritional needs and who step in when necessary to avert a potential crisis.The best crop rotation systems, high-quality feed production in terms of pasture management and harvest at the right time, choice of the best crops, conservation and storage under ideal conditions can all be used to address many of the challenges associated with home-grown or locally grown organic feed. However, some importation into the farm, such as trace nutrients and minerals, seems required. Monogastric animals' dependency on synthetic amino acids in conventional farming systems has to be addressed in organic farming systems utilising more long-term, sustainable approaches, such as breeding and production objectives. The differences between conventional and organic livestock systems often appear to be less than those across nations and regions in terms of agricultural systems.

Animal welfare and ethics in organic agriculture

Animal welfare is a concern in Western civilization that relates to the quality of the animal's existence. Animals were acknowledged as sentient beings in the European Union (EU) in 1997 by the Treaty of Amsterdam, with England, Austria, and Norway serving as examples of nations enacting new, more stringent animal welfare laws. Large fast-food restaurants and supermarkets have collaborated to create animal welfare standards for their suppliers in the United States of America (USA).Animal welfare problems have a long history in organic farming. Animal welfare is commonly mentioned as an aim of the organic movement, however there has also been some harsh criticism of organic animal rearing in this area.

Representatives from conventional agriculture have often criticised the wellbeing of organic animals, despite the fact that some have stated that organic animal husbandry offers the finest potential welfare in modern farming.Although it is not always represented in the sales statistics of organic goods, consumers have valued the organic method of rearing animals, and animal welfare is often cited as a benefit when selling organic animal products.What are the causes of these conflicting views on animal welfare in organic production systems, one must wonder? This chapter will evaluate the core principles of organic farming and determine if there is a concern with animal welfare.

Animal Welfare and Ethics

There is no consensus on what it really means for animals to have a high quality of life, despite the fact that this is generally agreed upon. The two dog owners who both assert that they provide their dogs the highest quality of life is an excellent illustration of this The first constantly keeps the dog leashed to prevent it from being driven over by a vehicle, ingesting anything poisonous, or escaping. It also ensures that the dog is fed healthy food, additional vitamins, and has regular coat clipping. The other dog owner doesn't place as much importance on a healthy food or a well-groomed coat. The dog may run free, play in the mud, and sometimes discover and eat rotting meat leftovers on lengthy treks. This dog's owner is willing to take some risks in order to offer the dog the delight of freedom since doing so will enable the dog to act normally. Which dog has a higher quality of life is the challenging question.

It won't be feasible to provide a conclusive response to the issue, even if we seek guidance from science. It is important to learn all you can about how certain illnesses influence an animal's quality of life. Animal welfare is not only a question of statistics.However, the significance in life is another consideration. For many years, academics and philosophers tried to come up with a single definition of animal wellbeing, but now it is widely acknowledged that animal welfare is not only about facts but also about values. A single definition is thus unachievable due to the interaction between facts and values, or between science and ethics.

The study of ethics, or normative ethics, examines our fundamental principles of right and evil in life. The interaction between people and animals and the standards that constitute a healthy and ethical relationship are the focus of animal ethics in particular. Fundamental issues like the proper level of care do animals even have a right to welfare claims, or may they just be utilised for human amusement? must be resolved. The second point to be addressed is when wellbeing is good enough in our world of finite resources if we determine that animals should be given welfare.Welfare standards are a part of ethics; what constitutes a high standard of living for animals? Therefore, when assessing animal welfare concerns in organic farming systems, it's important to know if certain organic values may be used to assist inform choices about the right level and kind of animal welfare.

Organic values

Organic farmers are a diverse group with a range of objectives and viewpoints. However, the organic movement has worked to advance organic farming, including organic production standards, based on certain common principles. In this chapter, the ideals of organic farming are examined in terms of the organic movement as a whole, not specific farmers. Organic farming has deep roots in the environmental movements of the 1970s and 1980s as well as in ecological and biological farming methods advocated in the early 20th century. The exception is biodynamic farming, which is founded on the agrarian philosophy of Rudolf Steiner. Despite having a distinct philosophical foundation, actual biodynamic animal husbandry is quite similar to other aspects of the organic movement. We won't think about biodynamic farming any further in this case.

Since it is theoretically possible to give something intrinsic value while excluding it from direct moral concern, these definitions as they are used here do not address the issue of intrinsic value; on the other hand, an animal may be the subject of moral concern while being independent of, or lacking, an intrinsic value. the connection between these various strategies.Leading eccentric thinker and biologist Aldo Leopold once said: A thing is proper when ittends to preserve the biotic community's integrity, stability, and beauty. When, it is incorrectIt tends in the opposite direction This claim underlines the global perspective.and systems thinking linked to eccentric ethics.In large part, organic farming is founded on eccentric principles Lund andGenerally speaking, eccentric ethics reacts to the samedifficulties that are important to organic farming, particularly the environmental concerns and thestrive for a holistic perspective, since this perspective has implications for the quality of life for agricultural workers.

Animal Welfare an Issue According to Organic Values

The primary goal of eccentric ethics, which aligns with the ideals upheld by the organic farming movement, is to preserve or develop healthy, sustainable ecosystems. Eccentric ethics place a strong emphasis on nature as a whole. It is evident from the organic farming principles (IFOAM 2000) and IFOAM's published policy papers that the main objectives of the organic movement, in general, are ecological sustainability rather than animal welfare. Only one of the 17 fundamental principles included in the IFOAM Basic Standards expressly addresses animal welfare, while the other 13 all deal with sustainability.The eccentric approach fundamentally prioritises the health of the system above the welfare of the individual creatures living within it. For instance, the organic perspective holds that treating animals with chemicals, antibiotics, or other things that may adversely influence the environment should be avoided, regardless of the effects on particular animals. Because of the potential for food residues and the fact that these microorganisms will ultimately develop resistance, the usage of such compounds is therefore seen as being unsustainable.

Thus, the EU permits a maximum of three courses of treatments with chemically-synthesised allopathic veterinary medicinal products or antibiotics within a year (Council Regulation 1999), while the American national organic standards forbid the use of antibiotics at all if products are to be labelled as organic. Organic farming faces this contradiction between system health and individual wellbeing, which may be part of the reason why organic systems have come under fire for their treatment of animals.It is evident that ecocentric ethics do not provide a clear foundation from which to construct an animal ethics paradigm for organic farming. There are other, less extreme forms of ecocentric ethics, on the other hand, where people are also given moral weight. This ecocentric pluralism accords value to both specific creatures and ecological entities like ecosystems and species. It can also be argued that ecocentric ethics is based on a fundamental respect for nature and acknowledges the interconnectedness of all living things and their relationship to their environment, which means that both humans and animals should be treated with kindness and respect because they are integral and significant parts of nature.

As a result, it is possible to regard animals to be moral beings who need respect and attention as significant members of the ecological community and are more than simply a means of production. For instance, some ecocentric philosophers, like the Norwegian Arne Naess, contend that because all living things are connected metaphysically, injury to one would equally hurt all. Others have said that domesticated farm and companion animals are a vital component of human civilization and as such, they are entitled to the same level of good wellbeing as human children. Animal welfare problems in organic production systems cannot be adequately anchored by well-established moral frameworks like animal rights and utilitarian animal ethics. The dominant paradigm among Anglo-Saxon animal ethicists to date, utilitarianism, takes into account the suffering, needs, and interests of particular animals, but its one-sided emphasis on utilitarianism, interests, or pleasure makes it less ideal for farming.

In Singer's utilitarian theory, killing is not entirely forbidden, but whether it is morally acceptable depends on how highly one values the interests of the parties involved. For instance, it is necessary to balance the interests of the animal that will be killed with those of the gourmet meat consumer. This might be acceptable if, for instance, the animal has a broken leg and must undergo a protracted recovery process that could affect its interest in living, or if it is argued that since an animal has no concept of death, it does not have its interests violated if it is mercilessly and without provocation killed. Even still, it is quite challenging to defend industrial farming from a sentientistic utilitarian perspective.The individual animal in the moral and ecological order, as well as joy, pain, and suffering, are also understood differently in organic farming. Organic farming, which includes other items as morally significant, does not operate effectively from an ethical standpoint that limits moral concern to sentient beings. Since they see the intrinsic worth of sentient animals as being on par with that of humans, animal rights theories fail to function as a complementing philosophy for organic animal husbandry. Animal agriculture is rendered impossible as a result, and supporters argue that all types of animal agriculture need to be banned. Therefore, it is difficult for organic farming to establish an animal ethics that can provide direction on how organic animals should be managed using these two models of well-known and commonly used animal ethics theories.

CONCLUSION

Promoting sustainable and productive livestock farming methods is made possible by understanding the grazing and grassland management concepts and procedures.Studying grazing and grassland management may provide information that might be used to policy, education, and animal agricultural practises. Putting more emphasis on sustainable grassland management may improve animal productivity, environmental protection, and grassland carbon sequestration.

To sum up, more study in this area is crucial to improving our understanding of grazing and grassland management. Farmers may be assisted in improving livestock productivity and ecosystem services in their agricultural operations by using sustainable grazing practises and appreciating the significance of diversified, well-managed grasslands. To maintain the long-term sustainability and productivity of livestock production systems, researches, policymakers, farmers, and agricultural experts must work together to address grazing and grassland management.

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CHAPTER 18

THE ORGANIC PERSPECTIVE ON ANIMAL WELFARE: A COMPREHENSIVE UNDERSTANDING

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ABSTRACT:

Animal welfare, which includes the moral treatment and wellbeing of animals in agricultural practises, is a crucial component of sustainable agriculture. In order to further ethical and sustainable livestock management, the purpose of this study article is to investigate the fundamentals, factors, and practises of animal welfare in agriculture. The research focuses into the moral aspects of providing for the shelter, health, and comfort of animals as well as their freedom from hunger, discomfort, suffering, and misery. It examines how animal wellbeing affects livestock production, product quality, and the general health of the environment. The study also looks at how animal welfare certifications and norms help to promote ethical agricultural methods. Promoting livestock production that is socially responsible, commercially successful, and ecologically benign requires an understanding of the significance of animal welfare in agriculture. The research also emphasises how this information may be used in policy-making, education, and livestock farming practises to enhance ethical animal care practises and long-term agricultural systems.

KEYWORDS:

Animal Welfare, Certifications, Ethical Considerations, Livestock Management, Sustainable Agriculture.

INTRODUCTION

Three kinds of definitions have emerged from the scientific-philosophical discussion of what animal wellbeing really entails. The subjective experience method contends that an animal's wellbeing relies on how it perceives its environment; in other words, what counts are the animal's subjective emotions, such as pleasure, pain, or fear. The biological functioning method underlines that qualities like health, productivity, and reproduction may be used to gauge an animal's wellbeing since they are indicators of its biological function. If these tasks are completed well, the welfare of the animal is likely to be high. Biological functioning and coping successfully with the environment are both included in one of the most popular welfare definitions[1]–[3].

A n animal's ability to exhibit natural behaviour and lead a natural existence in line with its genetically encoded nature or telos is what determines that animal's wellbeing. Not only will welfare mean controlling pain and suffering, it will also entail nurturing and fulfilling the animals' natures, argues.The third type may be the most in line with organic principles. Along with natural behaviour, other factors like food that is tailored to an animal's physiology and a habitat that resembles the species' native biotope are also thought to be significant. According to studies of organic farmers, they largely see animal welfare in terms of natural living. According to the organic perspective, the fulfilment of an animal's nature is valued more highly than the absence of pain and suffering. Natural life is valued for its intrinsic worth in addition to its use as an instrument[4], [5].

Only inasmuch as it improves the animal's health or well-being would it be favored as an instrumental value. In order to attain the good, certain unpleasant experiences for the person may be accepted since allowing animals to live in the wild is seen as beneficial in and of itself. Negative experiences are seen in part as a normal aspect of existence that can never entirely be eliminated from the range of experiences that an individual animal may have. This does not suggest that such experiences are not harmful to the person when they occur, but rather that they constitute a crucial component of the functional feedback system that links a person's actions to their environment this strategy and contend that while a natural life does not guarantee the absence of pain, frustration, and discomfort, contact with nature may add some beneficial qualities to an animal's life, the effects of which are not always quantifiable. Animal wellbeing is preferred valuable experience and a good life[6]–[8].

A worthwhile experience maybut need notcontain components that seem to have a short-term negative influence on the person, but it nevertheless causes the person to learn something that will be useful in the long run.Different types of bad experiences may be regarded differently if this strategy is refined further.

For instance, many of the welfare issues in modern farming arise either because the animal lacks adaptations to such systems or because the animal has an adaptation that can no longer serve a purpose in current raising methods Since animals in the wild are prepared to deal with unpredictable conditions, of which predators are an important part, stress caused by situations for which they lack adaptive strategies such as a noisy fan in the pig house may be deemed to be worse than stress experienced by outdoor pigs when a fox sneaks around their paddock. This shouldn't deter farmers from defending their piglets from foxes in any way.

But with the loud fan, the pigs shouldn't have to worry about the prospect of being subjected to this type of stress. Of course, it may be questioned whether the pigs would benefit from the experience in the sense stated, but it would expose the animals to a broader variety of experiences and introduce excitements that would still be within their genetic adaption.

As a result,the fan would stand for a type 2 challenge and the fox for a type 3 challenge.Holmes Rolston, an ecocentric philosopher, proposed in 1988 that animal husbandry should follow a homologous principle in order to resolve the problem of animal suffering: Do not cause inordinate suffering, beyond those orders of nature from which the animals were taken.pain that is imposed by culture must be equivalent to pain that serves an ecological purpose.

The organic agricultural movement shares this viewpoint. Animal welfare is seen differently in organic farming than it is in conventional farming, where the biological functioning method is often accepted as the standard. The latter strategy is preferred by researchers as well since it makes measuring welfare states very simple.As a result, a disparity in definitions of welfare may in part explain the criticism of animal welfare in organic farming. While conventional farmers and scientists may focus on the risk of parasite infections, predator attacks, cannibalism, and the homegrown feed's low content of some essential amino acids, organic farmers may believe their chickens have good welfare because they live in an environment where they can engage in most of their natural behaviours. They believe that the wellbeing of these creatures is being jeopardized [9], [10].

General Welfare Problem in Organic Production Systems

When attempting to determine if organic production methods have a general concern with animal welfare, a number of factors must be taken into account. The first one is the question of what an animal's good quality of life should include. Since there is no one description that applies to all situations, it is important to be specific when defining the notion.Another problem is that any manufacturing method has both its advantages and disadvantages, as seen in the preceding example with the two dog owners and their canines in the introduction. Many of the issues brought on by intense production and crowded settings are absent from or at least less common in organic farming. Less common are production diseases like respiratory illnesses linked to overcrowding and housing, extreme production targets, or feeding schedules that are not adapted to the biology of the animals. These issues can arise from abnormal animal behaviours, like tail-biting in pigs. Instead, issues are linked to a lack of disease management and the increased dangers brought on by giving the animals a more free-range and unrestricted lifestyle. Different management and feeding philosophies and practises among organic farmers may lead to additional welfare issues in organic systems as opposed to conventional ones.

Third, since organic animal husbandry is relatively new, it is still being developed. As a result, study is required to pinpoint and enhance procedures that could address certain animals' welfare requirements. In order to build the management skills required to oversee a production system like organic farming, which depends on biological and ecological services to fulfil production goals, it also needs time to convert the thinking of previously conventional farmers. As a result, it is important to take into account both the existing state and the welfare potential of biological systems. There is significant welfare potential in the organic standards. For instance, they often go beyond and include more criteria than animal welfare laws in many nations, such as access to pasture and enriched environments. One may make the case that animals confined in barren habitats are less likely to have good wellbeing than those that live in stimulating environments which often refers to free-range situations. Many certifying bodies including the EU rulesalso demand humane treatment during transit and slaughter, while organic standards sometimes limit or outright prohibit mutilations including tail docking, castration, and beak clipping.

DISCUSSION

Dilemmas

Organic farming has to handle some welfare conundrums. The tension between the welfare of the system and that of the individual has previously been covered. The clash between the ideals of natural living and individual welfare as understood in terms of prevention of suffering or promotion of health is another conundrum brought on by the ecocentric approach, and it is another reason why animal welfare in organic farming has come under fire. The high emphasis organic producers put on natural living suggests that a more natural habitat is favored to a well-controlled setting where the animal is protected from hazards but has less opportunities for a natural existence. Since cannibalism or epidemics of feather plucking may cause significant harm in free-range systems, organic systems mandate them for chickens. The Danish Ethical Council Concerning Animals condemned organic chicken rearing in the middle of the 1990s, citing death rates that were double that of conventional poultry herds. But at the same time, management approaches like offering foraging opportunities in free-range systems might help to lower the danger of cannibalism outbreaks.

The preference for natural mating, despite the fact that artificial insemination programmes are superior in terms of disease resistance and the elimination of deformities, and the idea of outdoor grazing, which is preferred despite higher risks for parasitic diseases like trichinosis and erysipelas infections in pigs and cattle, as well as Coccidiosis and Ascarid infections in poultry, are other examples of this conundrum. Organic animal welfare and food safety also provide a challenge since outdoor raising raises the risk of zoonotic parasite infections like Salmonella and Campylobacter. These are not issues with animal welfare, but they could affect the health of people who consume animal products.Many of the issues associated with natural living can be resolved through better management, breeding, and system development. Despite the fact that these issues are a reflection of divergent underlying value systems, it is crucial for the organic movement to acknowledge that natural living and organic feed alone are insufficient to ensure the welfare of each individual animal.

Welfare effects of organic feed

Roughage fed to all species must be organic, which is typically advantageous to the animals. This is especially true for ruminants, including pigs and poultry, where it serves as behavioural therapy and adds extra Fibre to the diet, promoting digestion. There have been worries that dairy cows may get illnesses such milk fever as a consequence of the decreased intensity feeding brought on by the restricted concentrate diet. These concerns have not materialized, however. Contrarily, organic dairy cows tend to have less metabolic illness issues than conventional cows. In poultry, a challenge is how to provide adequate methionine and, to a lesser degree, lysine to developing animals, especially in areas where the environment makes it difficult to produce soybeans.

The issue has emerged as a result of IFOAM and EU guidelines banning synthetic amino acids in feed and restricting the use of animal products which are naturally present in chicken diets. These standards are also leaning towards mandating only 100% organic feed. It is debatable and complicated, and it cannot be completely explained here, whether feed enrichment with synthetic amino acids equivalent to adding vitamins to the diet is the best answer to the problem. Given that the alternative is often either protein insufficiency or excessive protein feeding, it seems like a workable approach from the standpoint of animal welfare. Particularly, the first choice creates a great deal of stress on the animal and raises the possibility of feather plucking.

There aren't many options for organic feed in certain nations, especially those where there aren't many organic farms. Since it becomes difficult and costly for farmers to supplement weak crops with bought feed, this may lead to welfare issues. Purchasing conventional feed is an option, but it is also more costly since the animals must go through a new conversion process before the goods can be labelled as organic. Findings from research on organic systems' wellbeingScientific understanding of animal welfare in organic herds is poor. The few studies that have been published focus only on health, not wellbeing in general. Where the disparities between organic and conventional systems are most apparent, dairy production rather than the more intensive production systems of pigs and poultry is the subject of the majority of published research.

With the exception of parasite-related disorders, which are more common in organic farming, these studies generally show that animal health in organic herds is the same as or better than in conventional herds. This implies that there may be some merit to the criticism of organic farming and the issues with parasite infestations. Evidently, organic farming has not yet been able to provide effective alternatives to conventional therapies for the management of both internal and external parasites. The impact of these parasitic infections on animal wellbeing are difficult to assess, at least for pigs and poultry, but parasite infestation must be taken into consideration as a risk factor for animal welfare, even when no symptoms are immediately visible.

Despite the fact that skipped antibiotic treatment is often cited by veterinarians as a concern, it does not manifest as greater somatic cell counts or mastitis occurrences. The use of antibiotic therapy is still employed for severe instances, but other approaches seem to be being adopted in their place. Given that practises vary among nations, this issue may be overstated.Overall, it seems that organic farming does not have an issue with general welfare but rather offers the chance to enhance welfare provided the proper management techniques are used.However, there are certain issues or problems that must be resolved.

Organic Farming and The Traditional Animal Protection Movements

Movements for organic farming and animal conservation have quite distinct histories. While the latter often concentrate on the welfare of individual animals and animal experiments, the early alternative agricultural groups tended to be more concerned with the detrimental impacts of industrialized animal farming. Animal Machines had comparable impacts on cattle output as the book Silent Spring, which became a call to action for environmental protection. Due to a growing concern for environmental concerns and a desire to find alternate sources of income, these publications helped fuel the interest in alternative agricultural practises that emerged in the late 1960s. The organic movement has taken into account animal wellbeing in connection to the agroecosystem of which the animals are a part, unlike other animal protection groups, which developed out of concern for the welfare of the individual animal.

Organic pioneers described welfare as a spillover effect of a healthy system in an interview study. The notion of natural living was shown to be significantly more important to organic farmers than those championed by animal protection groups, such as rights, dignity, and intrinsic value. This attitude was supported by questionnaire research. However, collaboration between conventional animal welfare agencies and organic organisations has developed as awareness and understanding of farm animal care have improved.The Humane Society of the United States has a department for Farm Animals and Sustainable Agriculture, and there are collaborative certification programmes today, for instance in Canada and the German-speaking nations of Europe.It is crucial to be able to ensure the wellbeing of animals used in organic production since it is vital to organic farmers, consumers of organic goods, and not least, organic animals. However, further study on such production methods is required.

In order to establish measures of wellbeing suited for organic production systems, the differences in understanding of the animal welfare concept compared to conventional systems need to be better clarified. These indicators will enable the certification bodies to gauge the welfare status of organic farms and to share that information with customers. It will help the farmers determine if they are accomplishing the objectives of organic farming.To address the welfare issues that organic farming is experiencing, further research is also required. In order to achieve this, welfare issues relating to natural living's lack of control and freedom must be addressed. These investigations will include topics including how to prevent parasite infections, cannibalism and feather plucking in poultry, as well as piglet mortality in outdoor settings. How to manage the danger of zoonotic disease transmission via organic agriculture systems is a key topic of study. Additionally, the conflict between systemic and individual wellbeing must be resolved, for instance, by research on therapies other than the use of drugs like antibiotics and anthelmintics.

Although organic farming depends more on biological answers and less on management, it is not the only kind of farming that requires this type of study to be developed. Preventive action is thus essential. Alternatives to such treatment might have significant economic repercussions since they may indicate that items cannot be marketed as organic. The Network for Animal Health and Welfare in Organic Agriculture's final report acknowledged the need for more research on animal health and welfare in organic farming.As a reaction to the problems that conventional agriculture encountered, organic farming emerged, finding answers that went beyond the context and forming fresh viewpoints. To generate 'win-win' scenarios that are advantageous to both the system and the individual animal, this new approach and ingenuity are still needed. Developing husbandry systems where animal welfare is an integral and beneficial component of the system and not perceived as a problem to be addressed, that is, systems where animals contribute with goods or services through their natural life, is the challenge for organic farming.

It is crucial to define the term animal welfare clearly when making claims about animal wellbeing and to support such claims on scientific evidence. The debate of criticism and general topics will become more productive as a result. Animal welfare is seen from a wider, systemic viewpoint in organic farming, and a natural existence is often recognised as a prerequisite for excellent welfare. The conundrum that natural living does not always indicate animal welfare for each individual animal must be acknowledged, just as providing organic feed does not always result in an increase in quality of life. The few evidence to date does not suggest that animals raised in organic systems have lower health or wellbeing than those raised in conventional systems.

Rather, organic agricultural techniques have a significant potential to promote wellbeing. Each agricultural system, however, presents unique difficulties, and organic farming must be aware of and address these difficulties. One such area includes problems and hazards associated with a decreased level of control over the animal's surroundings, such as parasite-related diseases.Animal welfare must be both theoretically and practically guaranteed in organic farming. Given the welfare of the animals as well as the expectations and demands of animal welfare in contemporary society, this is required. Even if system sustainability is a general aim, it is vital to create systems where the health and wellbeing of each individual animal are protected, and where natural living is in line with the welfare that each animal experiences.

CONCLUSION

The ability to promote sustainable and responsible livestock management is made possible by understanding the significance of animal welfare in agriculture. Studying animal welfare may provide information that can be used to policy, education, and livestock farming practises. Emphasising the value of certifications and norms for animal welfare may improve the wellbeing of cattle and promote ethical agricultural practises.

Further study in this area is necessary to improve our comprehension of animal welfare in agriculture. Enhancing animal welfare and sustainability in farmers' agricultural operations may be supported by adopting responsible animal welfare practises and appreciating the importance of moral livestock management. Working together to address animal welfare is necessary to maintain high ethical standards in animal husbandry while ensuring the welfare and productivity of livestock production systems over the long run.

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CHAPTER 19

ORGANIC CERTIFICATION: NAVIGATING STANDARDS AND COMPLIANCE

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ABSTRACT:

The integrity and authenticity of organic agricultural products are crucially ensured by organic standards and certification, which also help to increase consumer confidence in the organic sector. This study intends to investigate the fundamentals, history, and importance of organic standards and certification in fostering ethical and accountable agricultural practises. The research dives into the development of organic standards, covering their beginnings and fundamental tenets, which include the outlawing of synthetic chemicals and genetically modified organisms (GMOs), as well as the encouragement of environmental preservation and animal care. It examines how certifying organisations and the certification procedure work to ensure that organic standards are being followed. The study also looks at how market access, customer perception, and farmer livelihoods are affected by organic certification. For organic agriculture to be promoted as being ecologically beneficial, commercially viable, and socially responsible, it is essential to comprehend the significance of organic standards and certification. The paper also emphasises how this information may be used in policy-making, education, and organic farming practises to promote efficient organic certification and long-term agricultural systems.

KEYWORDS:

Consumer Trust, Certification Bodies, Organic Standards, Organic Certification, Sustainable Agriculture.

INTRODUCTION

Ironically, many of the ideals upheld by the movement that founded organic agriculture are now being threatened by the regulatory framework that was designed to safeguard its integrity, including standards-setting and conformity assessment procedures. In order to define, harmonise, and ensure the integrity of organic agriculture as it transitions from movement-driven agricultural niches to mainstream markets globally, organic standards and certification systems have been crucial. However, when organic market growth reached US$25 billiongovernments became more engaged in organic regulation, which caused the movement itself to lose control over the definition of organic agriculture. Increased worldwide commerce in organic goods has led to the development of intricate organic regulatory frameworks that are rife with overlaps and duplications between the different government regimes and the private regulatory system. In especially for small-scale farmers in developing nations, the bureaucratization of organic agriculture is putting up hurdles to trade[1]–[3].

In addition to giving a quick overview of the present state of organic standards development and conformity assessment efforts, this chapter also examines three significant regulatory issues that organic agriculture must deal with. The International Federation of Organic Agriculture Movements (IFOAM), which dominates the private sector, and the public sector, which is run by various national and regional governments, are at odds. It is also challenging to strike a balance between local producer realities and consumer demands for a clear understanding of what organic agriculture means globally. The chapter briefly sketches potential avenues for harmonization among organic regulatory systems, proposes ways to balance local and global needs by incorporating flexibility into standards-setting processes using examples from IFOAM processes, and outlines two encouraging developments for organic smallholder producers: 1 the creation and rising acceptance of internal control[4]–[6].

History of the development of Organic Standards and Certification

With roots in the 1920s work of Rudolf Steiner and Sir Albert Howard, organic agriculture emerged as a different kind of agricultural system that is in harmony with natural processes. The first unofficial regulatory mechanisms, such as weakly formulated codes of conduct and unofficial inspections, were created as organic agriculture expanded in the 1950s and 1960s. Organic farming was then well outside the mainstream of the agri-food industry, and one well-known organic merchant said that nobody took us very seriously.

The IFOAM was founded in 1972 as a result of this bringing together the many organic movement players. Pioneering farmers' organisations actively engaged in organic farming and extension work in the 1960s and 1970s started to feel the need to define organic farming more specifically in order to provide direction to new organisations who had just joined. The initial IFOAM Basic Standards for Organic Agriculture (IFOAM 1980) were the result of processes to create organic standards. Since then, various adjustments have been made to these standards[3], [7].

The regulatory procedures through which the organic movement certifies that farmers and processors conform with organic standards have also grown considerably more developed at the same time as organic concepts and practises have been formalized into standards. customers started to demand an independent assurance of adherence to organic principles and procedures as organic marketplaces expanded beyond small communities where farmers and customers knew one another.The organic movement expanded to include private certifying organisations to address this demand. The earliest of these sprang from organic farmers' groups.To satisfy market demand, new certifying organisations evolved throughout time.Members worried about the future growth of the organic trade started requesting IFOAM to assess these certifying organisations' performance in the middle of the 1980s as a means of fostering collaboration and increasing mutual trust.

The General Assembly approved the creation of the IFOAM Accreditation programme in 1992. In 1993, this programme started accepting applications for accreditation from organisations that certify organic products. The International Organic Accreditation Service (IOAS), which was needed to run the IFOAM Accreditation programme, was founded in 1997 following years of deliberation. There were 32 IFOAM recognised certification organisations functioning in over 70 countries as of December 2004, and two further applications were being considered (IOAS 2004b).One of the biggest and most well-established private, non-governmental systems of industrial production, processing, and commodity trade is the system in place to regulate organic agriculture. However, as the amount and value of organic produce have grown globally, governments have been more interested in regulating the sector. Although the United States of America (USA) States were not the first government body to regulate the organic business.

By the 1970s, France, Spain, and Denmark had passed laws governing organic farming; Oregon and California followed suit. Which was passed in 1991, had a significant impact on the development of future organic regulatory frameworks. Regulations were then developed in a number of nations, including the USA, Canada, and Japan. Governments all around the globe have either created, or are in the process of creating, organic legislation that specify what constitutes organic farming and processing, as well as how organic certifying organisations may be authorized to function inside their borders. Unfortunately, due to a lack of cooperation between governmental bodies regarding procedures of mutual recognition and equivalence, this has seriously hindered the international commerce of organic goods. The lack of synergy between the several national or regional governmental regulatory regimes and the commercial regulatory framework run by the IOAS and IFOAM further muddies the picture[8]–[10].

DISCUSSION

Organic Standards and Standards Setting Processes

65 of the 364 organisations that provided organic certification as of 2003, as determined by a poll of the periodical The Organic Standard, claimed to have created their own standards. 60 countries participated in the development of organic regulations in the same year, including 37 that had fully implemented regulations for organic agriculture (15 EU countries; 11 in the rest of Europe - Cyprus, Czech Republic, Hungary, Iceland, Lithuania, Norway, Poland, Slovak Republic, Slovenia, Switzerland, Turkey; seven in the Asia-Pacific - Australia, India, Japan, Philippines, South Korea, Taiwan, Thailand; Argentina; and Costa Rica, the USA, Tunisia) witih Tunisia, the United States, and the European The IFOAM Basic Standards (IBS) and the Codex Guidelines, two worldwide standards, are added to these numbers to give one an indication of the difficulty in defining what organic agriculture is.

Since more current standards and regulations are often greatly affected by previous ones, it is helpful to examine the organic standards globally in chronological order. Farmers' organisations, as previously indicated, created the initial wave of standards; the first of these was released by the Soil Association in the United Kingdom (UK) in 1967 (Commins 2003). These were important sources for the early development of IBS, which in turn influenced the creation of EEC Regulation 2092/91 for the European Union (EU) in 2001 (Commins 2003). The European rule then had a significant impact on the Codex Guidelines as well as the majority of other organic laws, in part due to the significance of the EU market and other governments' want to promote trade with the EU. Since Europe, the United States, and Japan are the three largest markets for organic goods, the majority of other countries have devised mechanisms to verify compliance or equivalent with their standards.

As was already established, IFOAM released its Basic Standards for the first time in 1980 in an effort to unify the definition of organic across a movement that was becoming more and more international. Twenty languages have currently received the IBS (IFOAM 2004). The membership of the IBS, which consists of around 700 organisations from over 100 countries and represents manufacturers, producer associations, non-governmental organisations, merchants, retailers, consumers, and academics, among others, regularly updates the standards. Any entity with a major interest in organic agriculture may join with full voting privileges; organisations with a lesser level of involvement may join as associates. The General Assembly, the federations' highest governing body, revised IBS up to 2002.

To improve access to standards participation for members who would be unable to travel to the General Assembly, it was decided at the time to separate standards revision processes from the General Assembly. This would give more time for discussion on the movement's strategic directions. The activity of the standards committee and the committee in charge of updating the IFOAM Accreditation criteria is supervised by a norms management committee. IFOAM has created rules for the updating of IBS and for advice in any new standard creation or modification to an existing standard in order to assist this effort and guarantee transparent procedures.IFOAM, a non-governmental organisation, is always looking for new methods to prove the legitimacy and trustworthiness that are often taken for granted in governmental institutions.

IFOAM is obligated to follow the ISEAL Code of Good Practises for Setting Social and Environmental Standards, which was formally introduced in April 2004 as a member of the International Social and Environmental Accreditation and Labelling (ISEAL) Alliance. A complaints resolution mechanism, comment periods, the publication of a work schedule, the requirement to consider comments from at least two rounds of submissions by interested parties, the prompt publication of standards, and periodic revision are just a few of the procedural requirements listed in the Code. The Code also stipulates requirements for effectiveness, relevance, and international harmonization, as well as participation in the process of developing standards, including the need to actively seek input from interested parties while paying special attention to the needs of underprivileged groups like developing nations and small and medium-sized businesses. Key stakeholders, especially government agencies, are given extra confidence of the integrity of the IFOAM standards establishing procedures via the use of such instruments by ISEAL membership.

Because certified certification organisations are expected to base their own certification standards on the IBS, the IBS are standards for standards. The IBS are broken down into basic guidelines, requirements, and suggestions. With practise and application, suggestions may eventually become norms. As a result, there is a built-in mechanism for incorporating fresh knowledge.The Codex Guidelines are the other established worldwide standard. The Food and Agriculture Organisation of the United Nations (FAO) and the World Health Organisation (WHO), the Codex Alimentarius Commission's two parent bodies, established it in 1961. Only member nations with decision-making authority via international bodies are permitted to take part as observers in an intergovernmental organisation. These recommendations were intended to ease the standardization of organic standards at the global level, eliminate false advertising, and ensure fair trade practises in line with overall Codex goal.

In terms of governmental legislation, the Japanese Agricultural Standard of Organic Agricultural Products (JAS) was first implemented in 2000 after the EEC Council Regulation 2092/91 on Organic Agriculture was originally issued in 1991. The National Organic Programme Rule CFR Part 205 of the US Department of Agriculture was ultimately authorized in 2002 after getting over 300,000 mostly unfavorable public comments on the draught rule presented in 2000. Since then, further government rules have been created or are being written, the majority of which are based on international norms and the laws of those nations with significant organic markets.

Conformity Assessment Processes

Similar to organic standards, there are substantial parallels between the government's conformity assessment procedures and the commercial certification programme conducted by the IOAS employing IBS. The worldwide commerce of C organic goods has actually turned into a nightmare due to the absence of a multilateral framework for organic regulation among nations and a lack of cooperation between governments and the private regulatory system. This section, which primarily focuses on the EU system, describes specific aspects of the private accreditation programme as well as the major governmental conformity assessment procedures.The IOAS administers the IFOAM accreditation programme, which is carried out in accordance with IFOAM accreditation standards that are continuously updated. IFOAM recognised certification organisations must create their own standards for certification based on IBS since IBS are standards for standards.

The IFOAM programme has been striving to promote mutual recognition among its approved certification organisations as an international accreditation programme, promoting commerce and consumer acceptance of goods with an organic certification. The IFOAM mark was introduced in 1999 to be used in combination with the logo of recognised certifying organisations in order to increase identification of IFOAM accreditation among merchants and consumers (Commins 2003). In order to make it easier for goods certified by one accredited certification body to enter another market, a mutual recognition agreement among IFOAM accredited certification organisations was devised. However, perceptions of quality disparities among recognised certifying organisations have limited its deployment. This lack of coordination has serious ramifications for commerce and lessens the attraction of the private international certification system as a unified regulatory approach.

In the field of conformity assessment, which is controlled by the International Accreditation Forum and its members as national accreditation authorities, the IOAS is unique since it is a non-governmental body that runs an international certification programme. It sought and received recognition by the US National Institute of Standards and Technology, a non-regulatory federal agency within the US Commerce Department's Technology Administration, in August 2004 in order to prove its competency to the largely government-run verification systems. Based on an assessment of the IOAS against ISO/ IED Guide 61, which covers certification for both IFOAM standards and ISO/IEC 65 (IOAS 2004a), this recognition has been granted.Government-run conformity assessment programmes mostly function at the national level, in contrast to the IFOAM certification programme, and there are no international agreements in place to allow the transfer of organically certified goods from one country into another. As a result, in order for the goods it certifies to be sold on different markets as organic, a certifying organisation functioning in one nation must now get accreditation after accreditation.

The EU Council law 2092/91 created a conformity assessment system that allows for recognition of private certification bodies by a designated authority according to specified criteria as the first fully developed law. Other nations have often adopted this model when creating their legislation, with departments of agriculture typically serving as the designated authority (Commins 2003).The fact that the EU recognition system was designed to only be applicable to certifying organisations established in the EU is one of its distinguishing features. In the EU, legally compliant certified organic goods may be freely sold in any member state.

When it became clear that the first alternative would significantly hinder and slow down organic commerce from other nations, a second option known as the importer derogation was adopted under Article 11(6) as an exception rule. In this instance, an eager importer submits an application to the appropriate body in an EU nation asking for authorization to sell the product as organic in the EU. If equivalent to the EU rule can be shown, a short-term importer-dependent permission is issued. 90% of imports to the EU are made via this method, which makes importers in the EU bear a heavy administrative cost while forcing manufacturers in poorer nations to rely heavily on them. Furthermore, the EU member states have applied the import derogation rule in significantly different ways, which has led to uncertainty for both importers and exporters.The third alternative stated in Article 11 (7) allows for an exemption when, at the request of an EU member state, an individual inspection body in a third country might be accepted after being evaluated using methods that are suitable. The inspection body need not always be checked out in person. However, there has only been a single case of this option being used as of the middle of 2003.

Given that in practise they must show compliance in order to achieve third country status, the effect of the EU conformity assessment system has been to push third countries to adopt the EU law (Swedish National Board of Trade 2003). With the exception of the USA and Japan, which let foreign certifying organisations to apply directly for recognition, the majority of other nations have followed the EU's lead and only accept certification that is located locally.The National Organic Programme (NOP) regulation of the United States Department of Agriculture (USDA) offers two more avenues for the acceptance of foreign certifying organisations in addition to direct application by a foreign certification authority. These include the accreditation of a foreign certification organisation by a nation whose standards comply with US law and the accreditation of a foreign certification body by a government that has signed an agreement of equivalence with the USDA (Joint Working Party on Trade and Environment 2002).

According to the JAS system, products can bear the label organic if they have been certified by a recognised certification body in Japan, if they have been certified by a Registered Foreign Certification Organisation (RFCO) in the exporting nation through the recertification of imports where the organic raw material is certified by a recognised certification body in the export country while the importer is certified by an RFCO in Japan, or through the use of contracted inspection services. This last choice is intriguing since it enables a link between the commercial and public sectors.The EU rule stipulates conformity with Annex 3 of the regulation and ISO/IEC Guide 65 as requirements for the accreditation of private certifying organisations. There are criteria that are not included in ISO Guide 65, such as parallel manufacturing. With certain certification requirements that are not included in the ISO standard, this format is comparable to the IFOAM system. Japan and the USA have each created unique criteria. In addition, several nations have opted to base their standards on IFOAMs, including Australia and India.

One Harmonized Global Organic Regulatory System

Private and public organic standards and conformity assessment systems have recently proliferated. The development of organic agriculture and commerce is seriously threatened by the inconsistency between governmental regulatory regimes and private and public systems.The price of market access through certification keeps going up because certification bodies must obtain organic accreditations to satisfy market demands and regulatory requirements for each import market not to mention additional accreditations for other market-based requirements. Government requirements, if they exist, must be followed to guarantee that a product may be marketed as organic in an import market. At the same time, given the support and faith in the organic movement, market demands may compel the usage of the private system.

Costa Rica is one of the few third countries subject to the EU organic regulatory regime, but, local certification bodies are not recognised in EU markets and farmers are still asked to certify under different European certification bodies, depending on the client's preferences. The UK retailer Sainsbury's policy to only accept organic goods from IFOAMaccredited certification organisations for its own-label organic products serves as an example of the importance of retailers in expressing certification preferences. Private and governmental parties are unable to effectively collaborate, which raises costs and complicates matters.The rising comprehensiveness and complexity of organic standards and regulations, as they are changed and improved, add to the costs of compliance and verification. Although the notion of organic agriculture is rather straightforward, it has now been codified in standards and laws that may total almost 100 pages of legal and technical prose.

The 'Entire Standards' of the English-language version of the US NOP Rule is 554 pages long, including regulation and supplemental material, while the 'Consolidated material' of the European Council Regulation 2092/91 is 94 pages long. It is difficult to translate these demands into something that smallholder farmers in Northern Uganda or East Timor can use. Complex market and regulatory record-keeping requirements place a major burden on compliance since smallholder producers in developing nations have high rates of illiteracy. There are numerous accounts that highlight the difficulties faced by smallholders, such as one from Mexico where at least ten small producer groups lost their organic certification in 1999 due to their inability to handle the paperwork required for certification.

For many farmers in developing nations, especially those with a history of using few or no synthetic chemicals, in nations with low labour costs, among other factors, organic agriculture holds great promise as a development option. While poor nations may have comparative advantages in exports of organic agricultural goods, they are disadvantageous in the larger context of international commerce in agricultural commodity items. This is a consequence of agricultural subsidies provided by important developed economies like the US and the EU, which distort commodity prices and hinder developing nations from using their trade advantages in this area. Exports from developing countries are additionally hampered by declining terms of trade, reliance on a small number of commodities for export revenue, tariff protection for items with value-added, and a rise in private sector transfer pricing. The expanding number of voluntary product standards, especially for smallholder producers, poses another obstacle for developing nations since they might eventually turn into non-tariff trade barriers. These obstacles include large management and informational demands, increased capital needs, and higher certification expenses.

Although organic farming may provide enormous market potential for farmers in developing nations, improper management of organic regulation can result in non-tariff trade barriers like other product and process standards. For instance, emerging nations have been forced to accept mostly foreign organic standards as their own, with little recognition that the circumstances for agricultural production might differ greatly across locations. Government regulatory systems are also primarily designed to communicate with one another via bilateral recognition of compliance. This disadvantages manufacturers and exporters from developing nations whose governments do not emphasize the development of organic regulatory systems since they will have to find other, more costly routes to reach import markets.

Several intriguing problems are raised in relation to international trade law. The Technical Barriers to Trade Agreement (TBT) of the World Trade Organisation (WTO) states that member governments must use international standards or relevant portions of them as the foundation for their technical regulations where they exist, unless doing so would be ineffective or inappropriate for achieving the legitimate goals pursued, such as due to fundamental climatic or geographic factors Along with the Codex Guidelines, the IBS are typically regarded as worldwide standards since they are included in the ISO Directory of Standards. There hasn't been a codified method to assess and encourage harmonization of organic standards and regulations, even though the IBS have been used informally as baselines for the creation of national organic rules.

Additionally, the TBT encourages the principle of equivalence by requiring members to positively consider accepting as equivalent technical regulations of other members, even if these regulations differ from their own, so long as they are satisfied that the objectives of their own regulations are adequately met (WTO 1994). For the field of conformity evaluation, similar guidelines are outlined.

However, it is far simpler for a regulatory authority to demand adherence to its own standards than to attempt to determine what equivalence with several foreign nations would imply.Technical rules may not be developed, enacted, or implemented with the intention of, or with the effect of, being more trade-restrictive than necessary to fulfil a legitimate objective. The defence of the authenticity of organic goods is, in fact, the genuine goal. The IFOAM Organic Guarantee System Manager described the state of organic regulation as a increasingly chaotic system for international trade, so it stands to reason that the current regulatory framework for organic agriculture is more trade-restrictive than necessary if the end result is higher costs, resource waste, and the exclusion of smallholder organic farmers, who are important players in the industry.

Fortunately, the present regulatory impasse is seen by both commercial and governmental regulatory bodies as a severe danger to the survival of organic farming and trading. This has been made clear through the work of the International Task Force on Harmonization and Equivalence in Organic Agriculture (ITF), which was established by IFOAM, UNCTAD, and the FAO in order to jointly organize a conference on international harmonisation and equivalence in February 2002. The fact that IFOAM, the IOAS, numerous important nations, including the EU, are actively involved and dedicated to finding a solution via these procedures is encouraging. However, the development of specific actions to advance in the direction of equivalence and harmonisation, both across government bodies and between the IOAS and governments, will be sluggish.

Regarding future directions, IFOAM has been seriously considering its role in developing organic standards and conformity assessments since 1995 in order to rethink it in light of the rising government involvement in organic regulation. The organic movement should keep pushing for advancements and innovation in organic standards development, which is one avenue that has a solid foundation in present practise.Setting standards is a process that both the public and commercial sectors are constantly updating.

For instance, the earliest draughts of the EU and JAS laws did not include coverage for cattle; nevertheless, this was eventually incorporated. The breadth of IFOAM's standard-setting is greater than the regulatory bodies' more constrained approach for instance, the inclusion of a chapter on social justice since 1996, and the introduction of specific chapters on aquaculture and forestry in the most recent versions. It is also conceivable to believe that such cutting-edge organic standards-setting may ultimately find its way into other organic standards and regulations when new fields of standard-setting are progressively integrated into IBS, in part via private standards creations of its members.

However, there are other ways IFOAM may become engaged in advancing innovation in organic standards-setting given the pressing need for harmonisation. The IFOAM World Board is putting out a new paradigm in the hopes that it would foster innovation while also making it easier to collaborate and harmonise with governmental organisations. Government and corporate certification standards that adhere to an IFOAM Basic Norm and were created in accordance with a new Basic Norm for Standard-setting that IFOAM would produce would be registered by IFOAM. IFOAM will create and register new certification standards in accordance with current and growing demands in organic production and processing across the globe and will make them publicly accessible for usage, as stated in a recent proposal for modifying the IFOAM Guarantee System.

The IFOAM World Board is attempting to reconcile the need for standardisation and simplicity with the need for innovation in standards-setting by establishing several levels of standards, including a more general standard norm supported by more particular standards. It is too early to assess the potential outcomes and ramifications of such a move since the specifics of the plan are still being worked out.There would need to be some kind of government acknowledgment of the IFOAM standards norm, regardless of whether the IBS continue as they are or are transformed into a general standards norm supported by certification standards. There is a compelling argument for government acceptance of IFOAM standards, especially in light of the TBT Agreement's requirements for harmonisation with international standards and IBS's inclusion in the ISO Directory of Standards as an international standard. With the help of its members and other interested parties, IFOAM is in a unique position to preserve and update the worldwide organic standards-setting process.

Since 1980, IFOAM has shown that it can achieve this quickly and affordably. The second established worldwide organic standard, the Codex Guidelines, would need to be cultivated in some way. What is required is political backing for such a standards-setting framework from national and regional governments.Even IFOAM admits that governments' strength is primarily in the field of enforcement with regard to conformity assessment.

A new cooperative model of regulation between private and governmental systems as well as among governmental programmes will need to be developed, however, given the overlap between private and public systems and the number of market participants who are requesting IFOAM accreditation despite being required by law to ensure governmental regulatory compliance. The IFOAM World Board's plan to update its own Guarantee System also calls for IFOAM to acknowledge and register public and private oversight organisations whose certification standards are compliant with an IFOAM Basic Norm for Conducting Organic Certification.

As a consequence, other sorts of registers would be created, such as the above-discussed registration of certification standards and the record of authorised monitoring agencies. The system would be open to certification organisations operating under acknowledged supervision and according to approved standards.Additional recommendations for cooperation are emerging from the ITF process, even as IFOAM proposes modifications to its own regulatory framework. The creation and acceptance of common definitions, the creation of a database system for cross-referencing comparisons of various organic standards and regulations, a comparative analysis of IFOAM Basic Standards and Codex Guidelines, a comparison of IFOAM accreditation criteria and ISO Guide 65, and comparisons between IFOAM, Codex, EU regulation, USDA NOP, and JAS requirements are just a few of the short-term actions being proposed by the ITF to lay the foundation for cooperation.It is envisaged that these practical initiatives would make long-term harmonization easier.

CONLUSION

Understanding the significance of organic certification and standards presents opportunity for advancing ethical and transparent farming practises. Studying organic standards and certification might have an impact on education, legislation, and educational practises related to organic farming. In the organic business, highlighting the value of organic certification may improve market access, customer image, and farmer livelihoods. To sum up, further study in this area is necessary to improve our comprehension of organic standards and certification. Adopting efficient certification procedures and appreciating the importance of upholding organic standards will benefit both farmers and consumers, therefore boosting the sustainability and legitimacy of the organic agriculture industry. To maintain the long-term development and credibility of organic agriculture, academics, legislators, certifying organisations, farmers, and consumers must work together to address organic standards and certification.

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CHAPTER 20

STRIKING A BALANCE: LOCAL AND GLOBAL IN ORGANIC STANDARDS-SETTING

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ABSTRACT:

Setting organic standards is a vital process that determines the requirements and best practises for organic farming, maintaining uniformity and credibility in the organic sector. In order to advance ethical and accountable farming practises, this research article intends to examine the fundamental ideas, approaches, and difficulties in developing organic standards. The research examines the important players, such as farmers, consumers, certifying organisations, and governmental organisations, who are essential to the creation of organic standards. It looks at the guiding principles and standards for organic production, including the ban on synthetic chemicals and genetically modified organisms (GMOs), as well as the encouragement of biodiversity and environmental preservation. The study also looks at how international organisations and regulatory authorities contribute to the worldwide harmonisation of organic standards. For organic agriculture to be promoted as being ecologically beneficial, commercially viable, and socially responsible, it is essential to comprehend the significance of organic standards-setting. The research also emphasises how this information may be used in policy-making, education, and organic farming practises to help the development of sustainable agricultural systems and successful organic standards.

KEYWORDS:

Certification Bodies, Organic Standards-Setting, Organic Agriculture, Regulatory Bodies, Sustainable Practices.

INTRODUCTION

Finding a way to strike a balance between the need to ensure that organic standards are adjusted to local production realities and the need to give consumers a guarantee that certified organic products produced anywhere in the world meet strict organic standards is a second challenge for the future of global organic regulation. The overall tendency has been for the jurisdictions with significant import markets to demand conformity with their own organic standards rather than participate in a more drawn-out and time-consuming process of seeking for equivalent, given the power disparities.The fact that developing nation manufacturers must adhere to the strictest provisions of each legislation, which may be in conflict, while trying to sell their products into two or more distinct import markets with varying regulatory standards only serves to confuse matters further[1]–[3].

The USA regulation does not forbid factory farming origin or nitrogen use, but it gives very strict instructions on the composting method to be used. The EU regulation sets limits to the amount of nitrogen per year/hectare, forbids the origin of manure from factory farms, and states that it should be composted. As a consequence, our farmers are forced to adhere to the most stringent provisions of both legislations, as is understandable.Aside from the absence of harmonisation, production systems in developing nations with drastically diverse agricultural and socioeconomic situations face additional challenges when import country organic regulations are applied[3]–[5].

Lists of permissible inputs, for instance, are part of EU regulations and are based on European organic standards. There may be disagreement over the use of substances ranging from native botanical extracts, guano, and peat to even copper-based substances because what works as an input in one farming system may not be available, appropriate, or widely used in another context.Despite IFOAM's ongoing struggles to maintain this balance, there are still valuable lessons to be learned from its dynamic model, which was developed through experience with developing and updating global organic standards as well as running an international accreditation system that is active in more than 70 nations. This has allowed for a balance between the need for consistency in standards in a globalized world and the need for flexibility in adapting standards to local conditions. IBS are baseline standards for standards and must be fleshed out by an accredited certification body to become standards for certification. For better or worse, it has also promoted the expansion of public and private organic certification standards, particularly as IBS are not the only accepted worldwide reference standard[6]–[8].

IFOAM has fostered the creation of optional national or regional standards based on the IBS via consensus-based procedures, even though only one IFOAM standard is seen to be required for the movement (IFOAM 2000).Initial steps are being taken, albeit IFOAM regional organisations have not yet accepted this generally. For instance, the creation of regional standards is one of the tasks of the regional organisation AgriBioMediterraneo, which consists of 146 IFOAM members from three continents and 16 Mediterranean nations (ABM 2005). Regional certification standards could be established based on a general IFOAM Standards norm if regional standards are well suited to the proposed improvements to the IFOAM Guarantee system.

The creation of Criteria for Variation is an additional instrument designed to provide flexibility to the IFOAM standards-setting procedures. IFOAM acknowledges that in some circumstances, climatic, geographical, technical problems as well as economic, regulatory, or cultural factors may require variation to IBS requirements (IFOAM 2002).Requests for approval of changes may be sent to the IOAS for standard comparison and review, with the IFOAM World Board or other approved body making the ultimate decision.Variations may be taken into account if at least one of the following conditions is met: the IFOAM Basic Standards (IBS) requirement is ineffective; organic production or processing is prevented from developing; compliance with legal sector regulations and product requirements is prohibited; or the requirement conflicts with the producers' or processors' religious or cultural beliefs.

Additionally, the desired change must be in line with the main objectives of the IBS (IFOAM 2002).The American Organic Standard, a private sector standard for North America created in 2003 by the industry via the Organic Trade Association (IOAS 2003), was the first version to be authorised.The Criteria for Variation method creates a procedural window to for a review of certain organic standard requirements and the potential granting of exceptions if it can be shown that such adjustments would best assist organic farming in a given local context.

Organisations from developing nations may, among other things, utilise such a tool to promote the adoption of certain locally suitable inputs that adhere to the larger ideals of organic agriculture. The approach may be helpful as a specific, concrete, and short-term solution to the longer-term processes of determining equivalency of entire sets of standards and harmonisation, even though it has not been widely used yet within IFOAM, possibly due to the overwhelming and urgent need to resolve the public-private interface of organic regulatory regimes.A harmonised standards architecture based on general baseline standards upon which local or regional standards can be fleshed out, along with an allowance for justified variations, offer useful models and tools that can be built upon, even though much work still needs to be done in developing organic regulatory structures at an international level that are truly sensitive to the needs of producers and the local realities that they face.

Ensuring smallholder access to organic guarantee systems

Smallholder organic production and market accessibility serve as a particular illustration of the significance of taking local circumstances and reality into account. Smallholder farmers play a vital role in organic agriculture and have a big impact on the expansion of the organic market. According to estimates, smallholder farmers generate 60% to 70% of the organic goods transported into Europe. Without particular care, many people with just a few, if any, hectares under cultivation are unable to afford the substantial financial and administrative expenditures of organic certification. In order to ensure that smallholders have access to organic guarantee systems, this section describes two recent advancements in organic agriculture. The first is the creation and rising adoption of participatory guarantee systems (PGS), and the second is the creation of internal control systems (ICS) for organic inspection and certification.

Internal control system (ICS), a meta regulatory tool created by IFOAM and the IOAS, is one of their tools. An external inspector could come to check on the internal inspection system if a group of hundreds or thousands of farmers were organized into a producer association, and if the producer association had an internal inspection system where local inspectors, whether they were extension workers or farmers, were trained to check other farmers for compliance to organic standards, where inspection reports were maintained for all participating farms, and where issues of non-compliance were addressed The ICS is able to lower inspection and certification expenses in this manner. It should be noted that the producer group generally bears the costs associated with human resources during the early stages of the development and implementation of the ICS, which calls for significant human resources, strong farmer commitment, and organisational capacity. These expenses will eventually go down, nevertheless.

The empowerment of the producer group is a possible benefit of using the ICS tool in smallholder certification, in addition to savings in the expenses of inspection and certification. The internal control method enables producers and their organisations to take charge of the verification of their compliance with organic standards rather than relying on outside inspectors to visit and assess progress. Through training and capacity development in verification, documentation, and monitoring procedures, producers' ownership of the process may be bolstered. As it firmly puts the decision-making concerning compliance in the producer association's hands, at least initially, it may also improve the social control mechanisms of the producer group. Producers who had been in the organic programme for a while and had observed the changes as a result of the implementation of an ICS in one ICS implemented by an organic rice producer cooperative in North East Thailand stated that they had become more organised, that they met more frequently together, and that they were learning much more than before about the certification process because they were a part of it. Participating in the ICS gave them the opportunity to consider their future goals and the next stages for their farms, even if it is more work for them since they must now, among other things, establish production plans and record production inputs.

However, there are several methods to put an ICS into practice. The aforementioned illustration serves as an illustration of an endogenous kind of ICS where producers actively participate in ICS management. A buyer arranges producers and controls the ICS by implementing external norms to manage the supply chain and outsourcing farmers in the exporter-led model, which is at the opposite end of the spectrum. To fully comprehend the effects and dynamics of these many ICS manifestations, further study is required.

Although there is a lot of hope and faith that the ICS process will meet the needs of smallholder producer certification, there has been some disagreement regarding the technical issues of how to verify such systems, including the precise external inspection sampling rate that is suitable. Since 2000, IFOAM has paid for a number of seminars for certification agencies and governmental agencies to promote debate and consensus on the function of ICS in organic certification procedures. The fact that ICS is both a harder verification and inspection tool while also serving as a capacity-building instrument for development is a major difficulty. There are obvious conflicts between these various functions. The application of ICS to varied settings must be flexible since producer groups are structured differently across the globe. An ICS must have a few characteristics in order to be accepted by both commercial and public regulatory bodies as a functioning platform for organic certification.

Thankfully, there has been progress in getting ICS accepted by the government as a tool for organic inspection and certification. In late 2003, the EU released a guide for evaluating the comparability of organic producer group certification programmes used in developing nations. Despite the fact that this is only a guidance document and does not have any legal implications for member states as they implement EEC 2092/91, it establishes a helpful precedent for future development and acceptance and should lead to a more uniform method of handling organic certifications through ICS. Instead of addressing market and customer desires, the regulatory acceptance of ICS has been the exclusive focus of discussion. The guarantee of independent third-party certification is still in place since the ICS is a tool to lower the expenses of an external examination rather than to completely replace it.The application of the idea of internal control systems to other certification programmes that deal with smallholders, such Fairtrade and Utz certifications, is an additional intriguing development. There is also interest in extending the idea further for more widespread use as a general management system or overall quality management system that can accommodate higher expectations imposed on the producer group, such as those for food safety systems.

DISCUSSION

Developments In Participatory Guarantee Systems

While the growth and acceptance of ICS is encouraging for the 150,000 smallholders who are represented by close to 350 smallholder groups that export organic products, the current over-regulated high-cost environment has prompted some organic farmers to think about leaving these systems. Many farmers question why people no longer trust them and why they must spend so much money on several organic certificates when they are certain that they are adhering to organic principles. They are aware that their dedication to organic farming is rooted in firmly held beliefs about how agriculture ought to be carried out rather than just getting access to a growing market. A counterforce within the organic movement is pushing for a return to more straightforward regulatory frameworks and organic marketing strategies targeted at the local community, where formal certification is not required due to the presence of interpersonal trust relationships. Even if this movement is expanding, alternative assurance programmes for regional markets have existed for the same amount of time as the organic movement itself.

The counterforce is present not only in developing nations, where smallholder producer groups find it increasingly difficult to cover the human resource and financial costs of the management systems and documentation necessary for certification, let alone the costs of multiple certifications. It is also present in industrialized nations like the USA. As an example, the North East Farmers' Association of New York created the Farmer's Pledge, which requires farmers to sign an affidavit as an alternative to or addition to traditional certification (NOFA-NY 2003). Although there isn't a formal inspection procedure, clients are encouraged to visit farms to assess the honesty of the farmers for themselves.

The Certified Naturally Grown alternative labelling programme for small farms, which grow to USDA organic standards but see the costs and burdensome paperwork of USDA accredited certifications as unnecessary, is another illustration of how farmer frustrations with the growing bureaucratization of organic regulations are beginning to take concrete forms in alternative verification mechanisms like community-based certification, self-assessment, or peer-review systems.Without the establishment of a peer review panel, it was feared that the US organic standards would be compromised in favour of the interests of large agribusinesses. Some small organic farmers have grown so disenchanted with the controls imposed upon them by the USDA (see Blackwelder et al. 1998), which they argue do not represent the interests of small producers, that they took the USDA to court over the issue.

This countermovement is merely a slight undercurrent at IFOAM conferences, meetings, and workshops, but it is picking up steam in member conversations. A first workshop on Alternatives to Certification for Organic Production was organized in April 2004 as a starting point. People from 20 nations representing a broad variety of assurance options such as farmers' pledges, second-party assurance systems, group certification, and participatory network assurance took part in this workshop. The systems that took part ranged from the Teikei system in Japan, which is a co-partnership between producers and consumers, to the Centro Ecologico networked with the Ecocide Network of Agroecology in Southern Brazil, which operates through network certification with visits made by an ethics commission made up of farmers, consumers, and technical consultants.

The majority of these systems operate through alternative marketing channels, including farmers markets, community supported agriculture (CSA), and box schemes local, non-profit organisations that buy and distribute organic food cooperatively. Through these channels, there is a chance to build a relationship with consumers that is characterised by information sharing and mutual trust. New Zealand provides an intriguing illustration of how the system is incorporated into popular shopping channels. The goal of the Organic Farm New Zealand initiative was to provide the estimated 1500 smallholder organic farmers who lacked organic certification access to an assurance mechanism. This programme makes use of generally recognised organic criteria, and its validation is based on a mix of peer review by farmer groups, internal inspection, and approval by a regional group certification committee.

One of the main goals of the workshop was to examine and assess the variety of current informal methods by the people who work with them, given that there is a general lack of knowledge regarding the status of alternative approaches and the range of different systems represented within the category of participatory guarantee systems. In order to obtain more acceptance by the organic movement and prospective organic regulators, especially in nations where rules have not yet been put into effect, the strengths and shortcomings of participatory systems were explored.

Participatory guarantee systems have the potential to be crucial for boosting domestic organic markets in developing nations, lowering dependency on exports, and promoting long-term food security. For instance, Daniel notes that the lack of national organic standards in India has contributed to the development of a locally acceptable strategy which involved both producers and consumers. Weekly farm inspections are necessary to monitor adherence to locally created regulations. According to a wealth of case studies from around the globe, local markets for organic products in developing countries could grow significantly in the coming years, assuming that consumer confidence in organic assurance can be increased and that local consumers can have access to more organic produce through supermarkets, specialty stores and farmers' markets.

Even though participatory guarantee systems have a lot of potential for local markets, they will have a hard time gaining traction in countries with large import markets, like the USA and the EU, which do not accept participatory certification. When it comes to recognising participatory guarantee systems for their domestic markets, developing country governments who have succeeded in gaining recognition of their domestic regulatory regimes through the adoption of standards and systems that are consistent with key import regimes find themselves in a difficult situation. One might imagine how beautiful the world would be if rules and controls weren't necessary, and everything was based on trust. But we must confront the facts. The development of the necessity to safeguard the organic movement may be seen in the history of the word sustainability.

While standards and controls for organic agriculture are undoubtedly necessary, especially given the size and scope of the organic trade, trust in organic guarantee systems must be restored if organic regulation is to become a truly effective and harmonised system that is both global in scope and sensitive to local conditions of production. Beyond national, regional, and even public-private lines, organic regulators must learn to trust one another.Organic regulators and consumers must learn to have a little faith in farmers to iron out the kinks in organic agriculture in order to streamline organic standards and conformity assessment procedures and guarantee that organic agriculture is affordable for everybody.The International Task Force on Harmonization's efforts to bring the various regulatory agencies together to learn more about one another's systems and assess the strengths, weaknesses, and competencies of the various programmes and models are among the mechanisms and activities that enable trust building. On the basis of this, the gradual process of harmonisation may start.

The establishment of the subsidiarity concept will be very beneficial with regard to the need to balance the local and the global in organic agriculture. As a result, the fundamental tenets of organic agriculture will be firmly established and constantly upheld, and the rest of us will have the confidence to leave the day-to-day management of organic farming to farmers who are most familiar with their own local circumstances.Finally, while the organic movement investigates what formalised regulatory systems can learn from participatory guarantee systems and how they can mutually reinforce each other to create a diverse yet complementary web of regulatory structures up to the task of providing assurance across an even more diverse sector, work is urgently needed to strengthen and improve acceptance of internal control systems as a tool for smallholder group certification.

CONCLUSION

Understanding the significance of organic standards-setting provides chances to promote ethical and sustainable agriculture practises. Education, policy, and organic agricultural practises might all benefit from the information obtained by researching organic standards-setting. The consistency and legitimacy of the organic business may benefit from placing more emphasis on the importance of good organic standards-setting. In conclusion, further study in this area is necessary to improve our comprehension of the development of organic standards. To ensure the legitimacy and worldwide harmonisation of organic standards, cooperation with key stakeholders such as farmers, consumers, certifying organisations, and regulatory authorities is essential. In order to address organic standards-setting, we must work together to promote organic agriculture systems that are both ecologically and socially responsible, building trust and confidence among customers and organic sector stakeholders.

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CHAPTER 21

ANALYSIS OF DETERMINATION OF PERMANENT VERSUS PRODUCTIVE AGRICULTURE

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ABSTRACT:

Finding the ideal balance between long-term sustainability and short-term output in agricultural systems is at the centre of the debate between permanent and productive agriculture. The purpose of this research study is to examine the fundamental ideas, benefits, and difficulties of both approaches to agriculture. The research explores the ideas of permanent agriculture, which prioritise ecosystem resilience and conservation via practises including agroforestry and perennial crops. In order to supply the urgent need for food, it also looks at productive agriculture, concentrating on annual crops and intensive farming techniques that strive for high yields. The study examines the effects of these strategies on natural resources, soil health, biodiversity, and farmer livelihoods as well as their environmental, economic, and social ramifications. For the purpose of fostering resilient and sustainable food systems, it is essential to comprehend the interactions between permanent and productive agriculture. In order to promote holistic and adaptable agricultural systems that can fulfil both current and future demands, the research also identifies possible uses of this information in agricultural practises, policy development, and educational settings.

KEYWORDS:

Agroforestry, Intensive Farming, Permanent Agriculture, Productive Agriculture, Sustainability.

INTRODUCTION

Communities that are vibrant, successful, and alive are crucial to ensure permanency. The ability to endure makes live beings and living organisations distinct from one another.Systems that are not alive necessarily move towards entropy. To counteract this inescapable deterioration of matter and energy, however, living systems are able to capture, process, and store solar energy. Permanence is thus inextricably linked to robust, dynamic, organic processes of production. The shape, pattern, hierarchy, and distinction that are ultimately lost in the natural drive towards entropy can only be restored by organic systems. Organic farming's first guiding ideas were those of living systems[1], [2].

Productivity, not permanency, is what modern agriculture aims to achieve. Profits and expansion are the guiding principles of productivity in today's capitalist market economy. Neoclassical capitalism mandates that all surpluses and profits be reinvested in production equipment in order to increase productivity and growth, and that profits be maximised in order to ensure effective resource allocation and utilisation. Capitalism has no provisions for the renewal or repair of the natural or human resources it uses to generate its production.

Industrial agriculture makes no investments in reviving the organic life in the soils or the social life in the communities, which are ultimately what determines its long-term production.All industrial organisation exhibits the processes of specialization, standardization, and control consolidation. The founder of modern economics, Adam Smith, wrote extensively on the possible productivity improvements that may be attained by specialization, or what he termed division of labour. Simply expressed, division of labour meant that each worker specialised in carrying out one job or a small number of duties throughout the manufacturing process. Each worker may execute their respective responsibilities considerably more effectively and so be far more productive by taking on fewer tasks[3], [4].

Standardization was also necessary for industrial systems to allow for the division of labour and to make sure that every step of production could work seamlessly with those that came before and after. Specialised procedures could be planned and automated thanks to standardization, and companies could buy raw materials from a variety of sources. Consolidation was made easier by the manufacturing process' simplification and scheduling, which gave each decision-maker the ability to control or manage more resources, including land, labour, and capital. Finally, via economies of scale, consolidation enabled industrial groups to increase productivity.Unavoidably, industrialization produced fewer, bigger, more specialist, and uniform groups.If left uncontrolled, these crucial industrialization processes ultimately directly clash with the fundamental elements of sound, living systems. The inherent hierarchy present in healthy, living, biological systems is destroyed by specialization, standardization, and consolidation[5]–[7].

Specialization reduces difference, standardization eliminates shape and pattern. Industrial systems increase productivity by eliminating any barriers to matter's ability to release energy, which quickens entropy's tendency. Because the natural environment and society impose restrictions on maximising profits and expansion, they are eliminated. Natural organic systems, on the other hand, contain internal mechanisms that regulate their growth and reproduction rates and specify their healthy mature size or scope. Internal controls regulate the energy released from living systems, releasing excess energy for productivity or external use while holding back just enough energy for rejuvenation and regeneration. Living systems are able to preserve their variety, structure, and hierarchy, which enables them to keep their productivity and overall well-being. Lacking natural internal restraints, the industrial organisation expands uncontrolled like a malignant tumour until it exhausts its energy source and ends the life of its host[8], [9].

The challenge to organics of increased demand

Unfortunately, organic agriculture is evolving towards industrial agriculture in an attempt to boost the productivity and profitability of organics and provide availability to organic meals for more people. Although the goals may appear commendable, this transition threatens the longevity of organic farming, which is its primary goal. Since the 1930s, organic farming has been exposed to the classic three-step cycle that happens with each new thought directly confronting orthodoxy, as organic farmer and author Elliott Coleman has noted. The orthodoxy first rejects it. After that, it challenges its validity for decades. It finally makes an effort to supplant the notion. The industrial food industry is now seeking to take over organic farming after being finally compelled to acknowledge consumers' increasing preference for goods produced organically.

During the 1900s, the demand for organic food grew quickly, which encouraged organic producers to believe that organic farming may soon replace conventional farming. Moving organic goods into conventional food marketing channels at the time looked difficult due to the patchwork of varying organic standards and certifying companies.In order to create national organic standards and eventually harmonise organic standards across countries, organic growers started political groups. In order to meet the demands of the increasingly international industrial food system, national and international standards for organic certification would permit the free movement of organic foods both inside and between countries.Ironically, it's possible that organic farmers have sowed the seeds of their own demise. The industrial productivity principles, not the organic permanence principles, are what drive the food system that organic farmers sought to adapt. Instead of maintaining harmony and balance, the industrial food system is typified by unchecked specialisation, standardisation, and consolidation. National organic standards only provided a platform for corporate management of organic production and distribution to become more centralised

Additionally, international harmonisation requires all organic farmers to adhere to the same set of organic criteria without taking into account their unique ecological, social, economic, or cultural circumstances. Harmonisation of standards forces organic farmers to synchronise production costs across countries, driving returns to organic farmers and farm labour worldwide to the lowest possible levels everywhere in a clichéd race to the bottom. Many of the historical ecological, social, and cultural barriers that have prevented the exploitation of people and the worldwide exploitation of natural resources in the quest of maximum profits and expansion are eliminated by the homogenization of organics.

It should come as no surprise that many of the first and most prosperous organic farmers later adopted the industrial theory of production. Their little organic businesses expanded to become large industrial conglomerates. Some sold their lucrative businesses to well-known food companies, who often kept their once-respected organic labels. The majority of the top organic industry brands are now owned by the greatest food businesses in the world, and they are sold by the biggest food merchants in the world.If the present pattern continues, certified organic agriculture may soon only be available from growers with an industrial mindset. Producers driven by the ideas of production rather than permanence will soon dominate the organic producer associations advising governments on organic standards and certification. It will ultimately be necessary to modify organic standards to take into account industrial manufacturing techniques. Due to competition, other organic producers will be compelled to adhere to minimum requirements at little expense, compelling them to use industrial techniques in order to survive. Then, certified organic production will have fully industrialised.

Mining, manufacturing, and even traditional agriculture have all been shown to have detrimental ecological and social effects. These effects are all a natural result of the industrial approach to resource management, which inherently compromises the ecological and social wellbeing of living systems. However, those organic farmers who have stayed dedicated to the historical principles of living systems will discover new possibilities as the effects of these conflicts of values become more apparent.This ethical method of organic farming has been referred to as deep organic, sustainable organic, and philosophical organic. The historical foundations of organic farming in ecological, social, cultural, and spiritual ideals of permanence are adequately reflected by all three words. Deep Organic appears to be the most straightforward and appealing of the three.

DISCUSSION

Deep organic farming

Deep ecology, a phrase coined by the Norwegian philosopher Arne Naess in 1973, is comparable to deep organic. 'Shallow' and 'deep' layers of the environmental movement, according to Naess, existed. The shallow movement focused mostly on problems affecting human wellbeing, such pollution and the depletion of natural resources. The deep movement focused primarily on basic philosophical questions of how people should interact with their surroundings. According to Naess, Western philosophy represents an antiquated worldview in which people believe they are distinct from one another and from the rest of nature. However, a deeper understanding shows that people are not really distinct or alone, but rather are intimately linked to other people and the rest of the world. People are part of the web of life, the flow of energy. The first proponents of organic farming had a clear understanding that farms, farmers, and their surrounding social and natural environment were all components of the same energy flow and web of life.

Deeply organic farming and deep ecology both have philosophical roots that query how we ‘should' interact with one another and our environment. Deep organic farming is founded on the idea that people are not distinct from one another or the environment, but rather are deeply linked to both. Each component of the same whole soil health, human health, and societal health is equally important. But deep organics goes beyond holism and cultural ethics; it expresses a basic faith in the moral and the spiritual, in a higher order of things, and in a set of unbreakable universal principles to which all living things eventually must submit. It makes the supposition that there is rightness and goodness in relationships, which give life direction and significance.

Deep organic farming is compatible with organic farming's biological and spiritual foundations. Permanent organic farming requires a strong philosophical commitment to the enduring ideals of permanency.The fundamentals of sustainability are those of permanence. A sustainable farm must provide for today's requirements without sacrificing tomorrow's potential. Since the Sun is the ultimate source of sustainability, a sustainable farm must be able to support an ever-renewing, regenerative, developing, diversified, holistic, interconnected human civilization. Permanent agriculture is a sustainable agricultural.

Sustainability

Ecological integrity, social fairness, and economic viability all in harmony and balance are the fundamental tenets of sustainability. To establish balance and harmony between addressing the demands of the now and leaving chances for the future, sustainable systems must be managed. Ecological integrity relies on harmony and balance between living systems' production and potential for regeneration. Individual liberty and justice for everyone must coexist in harmony and balance for social justice to exist. The harmony and balance between short-term gains and long-term investments are essential for economic survival. To create equilibrium and harmony among the ecological, social, and economic elements of living systems, sustainable systems must be controlled. Sustainable living methods are based on the traditional concepts of organic farming.

These organic farming tenets are the result of a profound philosophical knowledge of the appropriateness of human interactions with one another and with the environment. They understand that an agricultural system cannot be ecologically sound without also being socially and economically sound. Without also being fair on the environment and the economy, it cannot be socially just. It also has to be socially and environmentally sustainable in order to be commercially successful. These organic farming tenets are really diverse manifestations of the same energy flow and web of life. Such ideals cannot be constrained by a rigorous set of rules since they cannot be encapsulated in a set of standards or regulations. These values are ingrained in people's brains, spirits, and common sense of good relationships not only as farmers, but also as customers, citizens, and morally upright individuals.

The ideals of maximal profit and development, not the ecological, economic, and social principles of permanence, guide industrial farms, whether they are organic or conventional. The industrial farmer feels driven to put the financial bottom line first. Industrial farming is all about division, specialization, and supremacy; it has little regard for the integrity of its biological systems. Instead of being essential components of economic viability, the environment and society are seen as barriers to economic efficiency. Economic viability in industrial farming is at best measured in years, not decades, centuries, and most definitely not permanence.The historical balance of ethical, social, and economic values in organic farming is directly opposed by the economic concepts of industrial organic farming.

Berry has never asserted that traditional or organic farmers in the past have ever really cultivated harmony with nature or sustainability. He only asserts that loving connections are the key to achieving both social and natural balance. The integrity and trust between farmers, farm workers, eaters, and local residents are essential for the sustainability of food and agricultural systems.Some may wonder whether it's reasonable to expect community-based food systems to feed everyone on the planet. However, a worldwide network of local food systems might be created by connecting small community-based food systems via human connections. Through personal relationships of integrity between members of various communities, it is possible to guarantee locally but link worldwide the linkages between the health of the soil, the health of the population, and the health of society. A fair distribution of advantages among farmers, farm workers, and customers occurs when individuals are linked by connections of integrity, both within and between generations.

This isn't some idealistic look at the future. Without the development of a sustainable global food system, human life on Earth cannot exist indefinitely. The fertility of the soil is as essential to human life now as it was when all people were hunters and gatherers. Our dependencies are less obvious and more intricate, yet they are just as crucial. People will still be dependent on other earthly life in fifty years, even if there may be twice as many people on the planet. When the non-renewable fossil energy and mineral resources on which modern farming systems rely have been damaged and exhausted, what will they do? A society defined by honest interactions between individuals and between humans and the environment is not some distant ideal; it will soon be necessary. A social movement that started out of need will continue as a post-industrial movement in the direction of a better quality of life for people on a personal, social, and spiritual level.

Hopefully more individuals will soon learn that shallow-organic foods are only subpar copies of the deep-organic foods they were looking for. More people are starting to understand that superficial environmentalism is only a cheap imitation of deep ecology, free elections and constitutions are only cheap imitations of social equity and justice, and free markets are only cheap imitations of economic integrity, according to growing global movements for environmental, social, and economic justice. People will be more receptive to a revitalized knowledge that all life is anchored in the soil as more people seek out enduring worth via honesty and integrity in all facets of life.

Literally, a return to the historical principles of organic farming is essential to the destiny of mankind. Today's global civilization is just as reliant on fertile soil as it was in the time of ancient Chinese farmers or Roman farmer-warriors. People's health, as well as the health of society, still depends on the condition of the soil. Farmers from ancient Rome through the middle of the 20th century demonstrated that the lack of industrial chemicals does not guarantee a healthy agricultural. The survival of human existence on Earth relies on farmers adhering to sustainable farming practises remaining on farms small enough to know and love, in the company of neighbors they know and love, and producing food for loved ones. In order for farmers and society to continue to develop economically, socially, and environmentally, the people of a society devoted to connections of integrity will re-connect with farmers who are committed to the organic principles of permanence.

CONCLUSION

Understanding the interactions between permanent and productive agriculture provides chances to support resilient and sustainable food systems.The information learned through comparing productive vs permanent agriculture may have an impact on agricultural practises, legislative decisions, and educational initiatives. Promoting a balanced strategy may result in improved results for soil health, biodiversity, environmental preservation, and farmer livelihoods In conclusion, further study in this area is vital to improving our understanding of how productive and permanent agriculture interact. Fostering adaptable agricultural systems that can satisfy both present-day and future-day requirements requires striking a balance between sustainability and production. Building resilient agricultural systems that assure food security and environmental health for future generations needs integrated and collaborative efforts among farmers, researchers, policymakers, and consumers to address the problems and capitalise on the advantages of both methods.

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CHAPTER 22

ECONOMIC MANAGEMENT: THRIVING IN ORGANIC AGRICULTURE

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ABSTRACT:

In order to maintain the feasibility and success of organic farming practises, economic management, which entails striking a balance between costs, profits, and sustainability, is a crucial component of organic agriculture. The purpose of this study article is to examine the fundamentals, difficulties, and approaches to economic management in the context of organic agriculture. The research dives into the economic aspects, such as production costs, market pricing, and consumer demand for organic goods, that affect organic farming. It looks at how marketing and certification might help organic farms become more profitable. The study also looks at the financial advantages of organic farming, such as improved farm resilience, less reliance on inputs, and access to premium markets. Promoting economically sound and sustainable agricultural practises requires an understanding of the economic management concepts used in organic agriculture. The research also emphasises how this information may be used in policy-making, education, and organic farming practises to assist efficient economic management and the expansion of organic agriculture.

KEYWORDS:

Certification,Economic Management, Market Prices, Organic Agriculture, Sustainable Farming.

INTRODUCTION

Many in the organic farming industry have gone beyond debating whether organic farming is effective to focusing on how it functions and developing effective fallback plans in the event that it is not. There was a shift towards investigating new choices on an organic farm even in the 1980s, as opposed to comparing farm outcomes between the two systems. Despite this decision, comparisons persisted in many nations, if only to highlight improvements brought about by organic management.With a follow-up produced one of the earliest and best-known economic comparisons between organic and conventional farming in the United States of America (USA). Examined numerous facets of organic agriculture in an edited book. Yield, production, input costs, output pricing, and total farm revenues were all included in the topics, which applied to both existing farms and those undergoing conversion[1]–[3].

A model of the broad adoption of organic farming in many nations was also included in this study. Since then, various studies have been published that examine the variations between the two systems in some or all of those concepts. An overview of research done in the organic dairy sector is provided. The studies conducted have served to highlight prevalent aspects in particular industries, under certain climatic and soil conditions, in particular geographical areas, and within a particular policy framework. This is because many different combinations of profitability to different factors land, labourwere analysed in. Recent studies have placed increased attention on some subjects other than financial rewards, such sustainability and energy efficiency metrics.Here, there is no effort to offer an in-depth analysis of the economics of organic farming. Instead, it aims to draw attention to important factors that influence returns to management in organic agriculture, often by contrasting them with those on conventional farms. On established organic farms, the profitability of the farm is determined by discussing production, input costs, output prices, premiums, and subsidies[4]–[6].

Production And Productivity

Production that is input-related is called productive. Productivity is often defined as output per unit of land tonnes of grain, head of cattle but it may also be defined as output per unit of labour, energy, or water required, or investment. A common misconception is that organic management results in poorer agricultural yield per hectare than conventional management. Although it's often the case, it's not always the case. There are several standard guidelines that may be followed.Changes in yield are often correlated with how intense the operation was prior to conversion. This is true both inside and across businesses for instance, after switching to organic management, changes on intensively farmed cereals are bigger than those on widely farmed cereals. For instance, following conversion, yield changes in intense horticulture operations can vary from those in intensive cereal-livestock farming. More farmers tend to switch to organic farming in nations with a relatively high proportion of agriculture in extensive industries, such as dairy farming, as opposed to crops only such as Austria and Switzerland, which may reflect the ease of conversion within this industry compared to other industries[7], [8].

Figures for changes in yield as a result of a change in management system also vary across nations, much as the intensity of agriculture in a particular sector, such cereal-livestock, varies between countries. In the 1990s, for instance, crop yields after conversion decreased by up to 40% in some European nations, including the UK, Germany, Denmark, and the Netherlands, while they decreased by between 10% and 20% in Australia, Canada, and the USA and were occasionally even higher than those under conventional farming. Researchers discovered average grain yield declines of between 30% and 40% in a number of European nations, whereas yield decreases of 20% to be usual in organic systems in Switzerland. Dairy yield fluctuations across nations are more comparable. According to Lampkin and Padel, annual yield fluctuations per cow are roughly 10%, and stocking rates are 20% to 30%, which results in a 30% to 40% decrease in milk yields per hectare.

The number of cows per hectare and per cow in European nations has decreased by up to 20%. On seven pairs of farms in Australia, saw a drop in milk litres per acre of between 30% and 35%. When compared to 111 conventional dairy farms in Canada, showed that average milk sales per cow on 7 organic farms were 4% lower, and those per hectare were 41% lower. The average amount of milk sold per cow on six organic farms in the USA was 13% lower than it was on 27 conventional farms in the same area, however stocking density data were not supplied.

The United Nations Food and Agriculture Organisation (FAO) stated that organic management may even increase yields in developing countries where the decision for organic agriculture is frequently made in the context of no-use of pesticides and fertilisers There are very little statistics available for underdeveloped nations.

The cost of production

The sole metric for assessing agricultural productivity is yield. The inputs that are utilised to produce such yields should also be taken into account. These inputs may take the shape of materials, as will be covered below, but they can also take other forms. For instance, using a different cycle from that used on conventional farms, where synthetic fertilisers and pesticides can handle such jobs, is one strategy to manage soil fertility and insect concerns on organic farms. When calculating productivity and profitability, the whole farm must be taken into account because of the different rotation, which may also entail a greater variety of crops.The net profitability of the farm that is, the amount of total earnings left over after all expenses have been covered is significant to the farmer. The input expenses may be just as crucial to the farm's profitability as the amount produced and the prices obtained for the output.

In many agricultural operations, organic farmers may use less inputs, such as fertilisers and pesticides, and sometimes more manpower, such hand weeding. This isn't always the case, however, since organic farms may also need to spend money on pheromones, compost, and mineral fertilisers to control nutrients and pests.Total variable costs, according to Padel and Lampkin, were generally 50%–60% cheaper for organic cereals and grain legumes, 10%–20% lower for potatoes and horticulture crops, and 20%–25% lower for dairy cows, mostly because of lower concentrates. The additional cost of organic feed often results in no decrease in average input costs for pigs and poultry.The fixed costs were also outlined by Padel and Lampkin in 1994. While other expenses like electricity, maintenance, equipment depreciation, property taxes, and depreciation and capital costs were reported as comparable in most nations, but higher in Germany and lower in Australia, labour is shown to be mostly higher on organic farms. This difference was substantially less noticeable than in the previous studyor nonexistentin a subsequent survey of Australian cereal-livestock producers.

Because labour costs vary so much across sectors, they are often a contentious topic. For instance, it is more likely to be comparable or greater in vast sectors such as extensive grain cultivation than in intensive businesses such as horticulture, where manpower may significantly help to replace pesticides. Within industries, there could be variances nevertheless. For instance, research on dairy farms in Australia and Canada indicated that worker costs were comparable to or lower than those in the USA. It is crucial to address the more current findings in respect to price premiums since this variable is largely dependent on time. A paper on premium pricing for wheat, milk, and meat in numerous European nations between 1994 and 1997. Between 50% and 200% were normal premiums for wheat, between 8% and 36% for dairy, and between 20% and 30% for beef. Because some of the goods was offered on the traditional market without premiums, the average premiums for the remaining two categories were low.

Cereal premiums in the EU nations in 2001 were slightly over 100%. The premiums were listed as 70% for oilseeds, 166% for potatoes, and 32% for wine.According to Halpin and Brueckner (2004, p. 70), the average price premium for all organic products in Australia is 80%. Whole meal flour, muesli, olive oil, spaghetti the highest score was 287%, many vegetables beans, zucchini, carrots, hard cheese and minced beef were among the goods that received scores of above 100%.However, not all organic goods are offered on the organic market, and the proportion of food that is paid more varies widely. For instance, in Australia, the range was estimated to be between 10% sheep meat and 95% fruit and vegetables, with about 75% of all grains, 2/3 of all beef, and 50% of the organic milk supply being sold in the organic market.

DISCUSSION

Profitability

An overall image of organic farms compared to conventional farms shows lower yields and productivity per farm, cheaper input costs, and higher output prices. The findings of the many research they cited varied from lower net returns in the studies conducted in the USA, UK, and Switzerland to comparable results in Australia and better net returns in the studies conducted in Germany, Denmark, and Wales.Of course, a key factor in the outcomes is the inclusion of premiums. Premiums were more prevalent than they were in other nations in certain, such those in Europe. For instance, relatively few farmers in the Australian research got premiums at the time of the first survey in the middle of the 1980s. In subsequent research, all farmers got premiums even though net farm returns varied, being comparable to conventional neighbours' in one year and much lower in the next.

Obviously, other elements may have a bigger impact on the big picture than price premiums.Net revenues per hectare on organic farms were typically within 20% of conventional farms in various studies on both arable and dairy farms in 10 European countries. The results for organic farmers were found to be comparable to or superior to those of conventional farmers when the indicator was profit per family labour unit. Profits vary greatly depending on the location and the kind of business. However, specialist, highly intensive farms were often not viable under organic management. Arable organic farms in particular were doing well. Premium pricing and subsidies for conventional and organic farming were included in the calculations, which were significant contributors to the profit figures.

The lack of statistics on pig, poultry, and horticulture farms may suggest that not many farmers in those sectors have switched to organic management.This same research demonstrated primarily greater revenues per hectare for organic farms in a time series analysis of data for five nations Switzerland, Germany, Austria, the Netherlands, and Denmark between 1990 and 2001. The patterns of annual results on organic and conventional farms are quite similar, demonstrating that the differences between the two systems are less essential for the profitability of the farm than external variables like climate, pricing, and policies.

While their results were comparable to those of other local farmers, biodynamic farms in Australia's dairy research exhibited a significantly lower net return over the three years studied than their conventionally farmed counterparts. These outcomes were attained with no premium pricing or minimal premium rates for the biodynamic milk. The biodynamic farmers would have required a premium price of roughly A$0.10 per litre of milk, a premium not seen as exorbitant in some other nations, to achieve returns comparable to those of their conventional neighbours. The Canadian research revealed that organic farms had net revenue per hectare that was 12% lower, but their returns on total assets were 1 percentage point better. The USA research revealed a 16% decrease in net revenue for each produced litre of milk.

Established Farms

research and equivalent or greater in others. Comparative profitability is an issue that is unlikely to have a clear solution since the outcomes rely on a variety of variables, only some of which can be controlled by the farmer. The farmers have some influence over how the farm is run, the crops that are grown there, and even the businesses that are included.The kind of climate and soil, as well as the cost of inputs and outputs, premiums, and subsidies vary by nation and period, with policies evolving through time. Perhaps the organic movement's tendency to downplay system comparisons in the 1980s was understandable, especially if they were made to persuade the conventional sector that investing in this system was justified rather than to identify the areas where the change in management system had the greatest impact and how to improve the system.

The issue of what should be considered in the ultimate analysis remains in the discussion of whether farming organically is financially worthwhile. The farmer's personal advantages are also considered.From the perspective of society, the distinction between the two management methods' off-farm consequences is another important consideration. Although notoriously difficult to measure, this is nonetheless important for understanding the whole picture of the systems' overall efficiency. This element is already taken into account in some of the studies described in the form of subsidies and premium pricing, but these additional earnings must also cover the additional expense of small-scale marketing.Therefore, there is no simple solution. The research included here suggest that although the outcomes could be favourable for organic farmers, they are not required to be. The farmer would be prudent to evaluate a number of considerations before deciding whether to convert, including the physical characteristics of the farm and the farmer, marketing opportunities, and the political atmosphere of the nation at the time.

Conversion Challenges

It depends on a number of variables whether a farmer can transition to organic farming without going bankrupt. The ability of the farmer to adjust to a changing management style and the capability to take into account the availability of agricultural resources in relation to the history of the fields, market potential, and political environment are crucial in this regard. This last problem concerns government assistance, such as financing for research and production subsidies, or lowering barriers through relaxing rules that obstruct organic production and commercialization. The impact of conversion in various nations was the subject of numerous chapters, who also cited a number of early studies. The transformation of the cereal-livestock sector in Australia. The misunderstandings about whether and how organic agriculture may succeed are perhaps among the most difficult to dispel, notwithstanding any physical and financial challenges that may arise in the changeover. One of the main issues has always been the lack of knowledge on the necessary adjustments and how to apply them. An essential initial prerequisite is managerial skill, which refers to the capacity to manage the farm in a manner that is suited to the system.

Most farmers face some unique physical issues in the early years of switching to organic management, but these issues are unlikely to persist once the system is in place. One component of conversion that can take some time is a biological shift in the soil biota towards a new equilibrium. The establishment of soil microorganisms is necessary for organic management. For instance, Australian organic grain growers noted that since they did not burn straw as part of their organic system, they had difficulties during the changeover with seed germination and planting because the straw clogged the equipment, requiring the alteration of their planting apparatus. But after the first several years, the straw did degrade much more quickly, perhaps as a consequence of fungus that had a chance to grow over time. When compared to production levels later in the conversion period, some farmers have experienced output declines in the early years. This lack of particular biological activity may also be a contributing factor.

When changing management systems, a change in farm layout is often advised; this would need resources. For instance, modifications to rotations and the usage of cattle throughout the rotation may need additional capital investments in fencing and livestock acquisition. However, the shift may result in some kind of decline in stocking rate on farms where cattle needs concentrates that must be procured off-farm.Another factor for needing greater investments is the necessity for more farm storage to accommodate a change in marketing strategy. Organic items may not always have their own storage area with buyers of farm food, however this issue could become better with time.

Farmers often cannot rely on premiums for the goods at the same time when concerns of change need attention and action. A farmer may only be certified as being in conversion during the first stage of organic management. As a result, premiums are less secure now than they would be after the farm has earned full organic certification. Although the duration of this time varies from country to country, it usually lasts between one and three years.No matter what issues arise, the farmer must prepare in advance and consider all potential outcomes, including the use of available resources, the requirement for investments, potential changes in yields and total productivity, the availability of labour and machinery, market accessibility, and likely output prices and cash flow.

CONCLUSION

Learning about economic management in organic agriculture may have an impact on how we farm, make policies, and educate future generations. By focusing on efficient economic management, organic farmers may experience greater results, more farm resilience, and less reliance on inputs.In conclusion, further study in this area is necessary to advance our comprehension of economic administration in organic agriculture. Effective economic strategies and an understanding of the financial advantages of organic farming may assist farmers as they switch to organic methods and promote the expansion and sustainability of the organic agricultural industry. In order to address economic management and build an environment that supports organic agriculture's economic success and contributes to the larger objectives of sustainable agriculture and food security, it is necessary to work together with farmers, researchers, policymakers, and market player.

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CHAPTER 23

RISK AND UNCERTAINTY IN ORGANIC FARMING: NAVIGATING THE UNKNOWN

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ABSTRACT:

Given the intricate and changing structure of agricultural systems, organic producers are inevitably confronted with risk and uncertainty. This study article intends to examine the numerous risks and uncertainties connected to organic farming as well as the techniques used by farmers to increase their adaptation and resilience. The research explores the causes of risk in organic agriculture, including climatic unpredictability, market swings, and pressures from pests and diseases. It examines how crop rotation, diversity, and novel technology might reduce risks and improve farm resilience. The study also looks at the role that institutional support, social networks, and farmer knowledge play in handling uncertainty. For organic farming to be supported as a sustainable and economically successful agricultural practice, it is essential to comprehend risk and uncertainty. The research also emphasises how this information may be used in organic farming methods, policy development, and educational initiatives to help efficient risk management and improve the sustainability of organic agriculture.

KEYWORDS:

Adaptation,Organic farming, Resilience,Risk,Uncertainty.

INTRODUCTION

Transitioning from conventional to organic agriculture entails dangers and many ambiguities. The factors mentioned abovechanges to the soil biota brought on by farming system changes, a steep learning curve for farmers in terms of general organic farm management with a focus on the unique characteristics of each farm, and a potential need for additional investments in machinery, fencing, livestock, and storage while outputs and marketing may be in flux make up the risk during conversion. As the physical processes calm down and the farmer gains greater knowledge of the management system needs, these risks should gradually decrease.Differences in production variability, however, could be a more enduring aspect of the two management systems. The early literature mentions yield on organic farms that are closer to the norm in exceptional years, although these yields are not always seen[1]–[3].

In Australia, where weather extremes are widespread, researchers did identify an association between organic management and lower variability of wheat yields. Nearly ten years later, found that yields were greater in four of the five drought years in plots with two organic systems at the Rodale Institute in the USA, while the fifth year had mixed results. The better water-holding capacity of the soil in the organic plots is credited by the authors as the reason for the variation in yields under harsh circumstances between the systems.Depending on local agreements, there may be a wide variety of output pricing for organic goods, from fixed prices for a certain time period to a defined percentage or amount added to conventional prices to a completely unregulated market. More external variables than organic management specifically affect the variation in revenue caused by variations in farm product prices[4]–[6].

Large-scale conversions

In order to conduct these analyses, it is necessary to establish assumptions regarding future input and output prices, yields, subsidy and premium levels, the way consumers and producers will respond to price changes price elasticity of demand and supply, population growth or decline, and the adoption rate, for example. Only a few results are shown as examples since there are too many potential possibilities to list here.Although farm revenues are often taken into account in this regard, organic farming has an impact on a number of other variables as well. A change in management method by many farmers would significantly alter the land usage of an entire nation since organic management necessitates a change in rotation for reasons of soil fertility and insect control. As a result, there will be changes in the relative weighting of the overall production of various goods at the national level, in output prices, and impacts on farm incomes at the state and individual levels[7]–[9].

Food security, employment and income in linked businesses, social and environmental advantages, and public spending are other issues that are sometimes examined but are not included here. Different nations will see different shifts in output and returns, both in terms of direction and size. Taking the UK as an example, a 10% increase in organic farming would result in a drop in the production of wheat, barley, potatoes, sugar beets, oilseeds and cattle and an increase in the production of oats and field beans. Large-scale conversion would result in a drop in the overall output of all cereals wheat, oats, barley, and canola in Australia on large-scale cereal-livestock farms while increasing the number of sheep.

The same Australian research assessed overall agricultural revenues using a 30% adoption rate as the baseline. When 30% of farmers converted, overall returns to the sector would decline by 7% in the worst-case scenario, where premiums for crops were anticipated to reduce from 15% to 0% with no premiums for animal products at any stage extreme assumptions. In the best-case scenario, overall returns to the cereal-livestock sector would reduce by 3% at the 30% adoption rate, with premiums falling from 15% to 7.5% probably more probable.Numerous studies have been conducted with the presumption that a very high percentage of agriculture would transition to organic practises, often 100%. However, this is improbable and would not occur under circumstances that are simple to imagine. Political pressure may, for example, lead to more research on organic farming, information systems that are easier for organic farmers to access, lower consumer prices as a result of lower marketing costs, which will increase demand for organic food, and increased confidence among conventional farmers to convert when, say, 10% or 20% of farmers have converted. The thorough research on the Danish agricultural industry looked at what occurred at lower levels of conversion as well as the original assumption that 80% of farmers had switched to organic farming.

The findings indicated that the overall revenues to the agricultural community would start to decline only after around 25% of farmers had switched to organic farming, even under conditions of common input and output pricing and assumptions of decreasing premiums with a rising number of farmers across all sectors. If it happened, the agriculture industry's political and social environment would have significantly altered, necessitating new projections based on assumptions that are more realistic than those now in use. Research has been done to determine the effects of widespread shifts in farming practises towards organic management. Although total returns to farming and to farmers were also examined, total output is often the key aspect taken into account. According to the studies cited here, switching to organic management would result in minimal changes that would make the agricultural industry difficult to adapt to, particularly if the conversion rate is not increased drastically.

DISCUSSION

SWOT analysis

The market for organic food has grown significantly. The worldwide retail market was anticipated to be worth roughly US$16 billion in 2000, with demand expected to increase by 15% to 20% annually in a number of regions. The international market for organic food and drinks was predicted to reach between US$23 billion and US$25 billion in 2003, compared to estimates for 2001 that were closer to US$20 billion (ITC 2005). In one of the major markets, the USA, sales of organic food and non-food increased by roughly 20% in 2003 and reached US$10.8 billion. According to a 2005 ITC estimate, the organic retail industry was worth $30–32 billion USD. There is a broad rising trend that can be seen, indicating that both the supply and demand for organic goods are increasing. Since the 1980s, there has been an increase in interest in organic farming. A rise in knowledge and administrative abilities on farms has both sparked and sparked this expansion. Although there may not yet be many individuals with in-depth knowledge of organic agriculture on a global scale, there are now individuals with experience in a variety of relevant fields, including farm management, soil science, plant pathology, entomology, veterinary science, plant and animal husbandry, marketing, economics, and political and social science.

Weaknesses and threats

In the same way that food scandals in the conventional market promote organic agriculture, scandals in the organic market, such as those involving farmers, certifying bodies, or unintentional issues, have the opposite effect.Untrustworthy conventional farmers may be enticed to sell their goods on the organic market given that organic food commands higher prices. This might be a concern, particularly in places where the term organic lacks legal definition. For instance, two issues might develop in Australia since the word organic has not been defined for the domestic market, despite rules covering export market needs. The first is the potential for fraud on the domestic market, where there is little room for recourse; other issues could arise on the import market, where the Australian government is unable to forbid the importation and sale of non-certified goods that are labelled as organic due to WTO rules governing national treatment. Second, certifying bodies could be inclined to skimp. Such approach in an effort to provide the least expensive certification service is understandable in a market where every goods must be certified and where certification businesses compete for business.Thirdly, accidents might potentially cause issues. In mid-2002, the pesticide nitrofen was found in the poultry feed on more than 100 German organic chicken farms. The feed was kept in a building that had previously been used to store pesticides.

International Trade

Standards and systems tailored to each nation's particular conditions were created by individual nations or institutions within each nation. These weren't always founded on scientific theories or ideas that the scientific community recognised. Many of these issues persist, despite modest progress in solving them.International commerce for exporters may be hampered by the disparities in standards and compliance frameworks across nations since exporting nations must abide by the demands of importing nations. Following the needs of the importer might become expensive since the major importing nations have varying standards and certification requirements. The International Task Force, which was established by the FAO, the International Federation of Organic Agriculture Movements (IFOAM), and UNCTAD, has been working to find a solution to this problem since 2002. For farmers in many nations, particularly in developing nations without national certification programmes, the issues might be overwhelming.

Private certification programmes that persuade local shops to accept only items certified by the specific private certification programme in certain countries exacerbate the issue of various organic standards and certification for imports. Local certifiers who support goods from regional farmers, like the UK Soil Association, which cites an aim of 70% of organic primary products to be derived from the UK in the Organic Action Plan, accomplish a similar impact. As a result, it should come as no surprise that some exporting nations argue that organic import restrictions serve local farmers rather than the primary objective of giving customers assurance that the product was cultivated organically. It is not debatable if regional standards are suitable.

Finding effective means of facilitating international commerce in the context of regional standards and certification processes, however, is a challenge.As many standards are not founded on scientific considerations, the question of allowable variances in standards is another topic that need further study. One such is the conversion period, which establishes how long farmers must wait before they qualify to use the name organic. Access to expensive pricing is made simpler as a result. The conversion time is established in a variety of ways on a global scale. For instance, the EU and the Codex Alimentarius Commission part of the FAO and World Health Organization's food and veterinary standards activities require a minimum of between two and three years, though the conversion period can be lowered to one year if certain criteria are met.

IFOAM has a conversion period of 12 months for plant production. The assertion made by certain exporters that a reduction in conversion for their local conditions may be suitable is potentially valid, but importing nations that set the conversion period at a fixed level do not take that into consideration. For instance, whether the conversion period is intended to allow for the breakdown of compounds that are inappropriate for organic agriculture or the development of beneficial agents, local factors like climate will have an impact on this process. In nations with various climates, variable conversion times would be suitable.A stable supplyexample, through the participation of supermarkets and reasonably low prices are crucial for the expansion of organic agriculture, in addition to the importance of consumer confidence in the product, which is encouraged through a reliable and well-known certification scheme In general, organic food is more expensive than conventionally cultivated produce of thesame quality.

Although the demand for these items is very price sensitive, several polls have indicated that customers are prepared to pay extra for them. Demand quickly changes away from organic items as costs for conventional goods rise.Despite the fact that high consumer prices are sometimes attributed to farmer output premiums, the farm price is frequently a negligible portion of the ultimate consumer price for many items. The retail price is also influenced by other factors including transportation, waste, processing, handling, and sales. Costs are expected to be affected by the absence of institutional facilities for organic goods, which is also likely to have an impact on costs for many items with modest sales volumes. This has been acknowledged by, for instance, the governments of the Netherlands and Denmark, who spend a substantial portion of their support for organic agriculture to supporting and promoting the improved efficiency of the supply chain for organic goods.

Government assistance varies throughout nations, and this may provide manufacturers in nations with regulation an unfair edge over those without it. For instance, the price and volume of output in one country may be impacted by subsidies for organic farming there, whether they take the form of direct payments to farmers, research funding, or the creation of a national certification programmed. This implies that in order to sell to such nations, manufacturers in other nations will need to make goods more effectively. To put it another way, a benefit for certain farmers in one country entails a loss for other farmers in another. Some governments, particularly those of the EU, are in favors of organic farming.In addition to raising farmers' income, subsidies also help farmers sell their goods more cheaply, which lowers consumer prices and, in turn, lowers demand. However, the possibility of a price decrease is expected to be limited by rising input prices, particularly those of land.

CONCLUSION

Research on risk and uncertainty in organic farming may have an impact on agricultural practices, government policy, and educational initiatives. By promoting resilience and flexibility in the face of adversity, stressing good risk management techniques may benefit organic farmers. To sum up, further study in this area is necessary to advance our comprehension of risk and uncertainty in organic farming. The resilience and sustainability of organic agriculture may be improved by encouraging the use of risk-mitigation measures, acknowledging the significance of farmer expertise, and gaining institutional support. Collaboration between farmers, academics, policymakers, and extension services is needed to address risk and uncertainty in order to create all-encompassing strategies that aid organic farmers in managing uncertainty and creating resilient agricultural systems.

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