International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 14, Issue 9, 2022, pp.-11706-11709.
Available online at https://bioinfopublication.org/pages/jouarchive.php?id=BPJ0000217

Review Article

SUSTAINABLE FARMING: AGRICULTURE ASSESSING ENVIRONMENTAL FRIENDLY FARMING PRACTICES

SAHOO S.*, MAGAR B.B., HANSDA A.V. AND KAUSHAL S.
Department of Agricultural Sciences, University Institute of Agricultural Sciences, Chandigarh University, Mohali, 140413, Punjab, India
*Corresponding Author: Email - sahoosatyabrata908@gmail.com

Received: September 07, 2022; Revised: September 26, 2022; Accepted: September 27, 2022; Published: September 30, 2022

Abstract: Agricultural sustainability has been a trending topic of discussion in recent years. This review paper puts a focus on alternative farming methods that maximize on-farm methods to increase output and meet nutrient requirements, as well as that serve more general ecological and societal aims. Various environmentally friendly sustainable farming practices are the answer to the problems facing Indian agriculture today. This type of farming preserves soil and water resources, guards against climate change, enhances agro-diversity, ensures biodiversity, satisfies food demand, and protects livelihoods. In brief, it makes sure that society has access to enough wholesome food, the environment flourishes, and the farm is productive. The demand for agricultural products is increasing rapidly as the world population increases. The deep connection of agriculture to the global economy, human society and biodiversity makes it one of the most important frontiers for conservation in the world.

Keywords: *Sustainable agriculture, Organic farming, Permaculture, Conservation agriculture*

Citation: Sahoo S., *et al*., (2022) Sustainable Farming: Agriculture Assessing Environmental Friendly Farming Practices. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 14, Issue 9, pp.- 11706-11709.

Academic Editor / Reviewer: Dr Prashant Shrivastava, Dr S J Patil, A A Shahane, Dr P K Mishra

Introduction

Farming, animal husbandry, fishing, forestry, and other areas of plant production are all covered under the applied science of agriculture. Producing plants and animals for commercial gain is also an art, a science, and a business. As a type of art, it demonstrates a knowledge of how to carry out village duties with competence, but it does not necessarily demonstrate a knowledge of how to build solid foundations. It makes use of all technical advancement built on scientific principles, including those pertaining to corporate finances, industrial processes, plant protection, and plant reproduction. An agriculture that can consistently produce food and other resources for a population that is expanding over the world is essential to human existence and, by extension, to any human activity.

Agriculture started organically.

For many years, humans farmed without synthetic biocides or inorganic fertilizers, depending on plant and animal fertilizers and naturally occurring ingredients to protect crops from pests and diseases [1]. Growers all over the world successfully created and improved farming techniques that depended primarily on synthetic biocides and inorganic fertilizers beginning in the second half of the nineteenth century. However, organic farming has resurfaced in recent decades as a result of consumer demand for healthier food. The term "sustainable" has recently gained popularity and is used to describe a wide range of topics. Since the publication of the Brundtland Report in 1987, the concept of sustainable agriculture has gained popularity. The achievement of intergenerational equity goals is fundamental to sustainable development. In agriculture, sustainability aids in the pursuit of the optimal balance between the requirement for food production and the preservation of environmental ecosystems.

It is anticipated that by 2050, roughly 70% more food than is presently produced would be required to support the estimated 9.6 billion world population with their necessary daily calorie intake [2].

Sustainable agriculture helps us to produce nutritious meals without jeopardizing future generations' ability to do the same. Agricultural techniques are frequently found to be inefficient in terms of resource utilization, which is strongly related to production costs. In this regard, sustainable agriculture is also beneficial since it supports farm economic stability and helps farmers enhance their quality of life.

According to the World Bank Report 2018, India has 1796740 square kilometres of agricultural land accessible, whereas wasteland in India is expected to be 16.96 percent of the country's geographical area, or 328.72 Mha. According to data from the Ministry of Agriculture and Farmers Welfare, India, overall food grain output in the nation is expected to reach a record 316.06 million tonnes in 2021-2022, up 5.32 million tonnes from the previous year. To fulfil the need of India's expanding population, yearly food grain output must reach 333 million tonnes by 2050.

Sustainable Agriculture

Sustainable agriculture is the practice of farming based on ecological principles, which is the study of the interactions between organisms and their environments. It has been characterized as a long-term integrated system of plant and animal production techniques with a site-specific application.

Agricultural sustainability is founded on the premise that we must fulfil the demands of the present without jeopardizing future generations' capacity to meet their own needs. As a result, long-term stewardship of both natural and human resources is as important as short-term economic benefit. Human resource stewardship entails taking into account social duties such as worker working and living circumstances, rural community requirements, and consumer health and safety in the present and future. Stewardship of land and natural resources entails preserving or improving the quality of these resources and using them in ways that allow them to be regenerated for the future. Concerns of animal welfare must be addressed as part of stewardship considerations in agricultural businesses that incorporate animals.

Sustainable agriculture is not a singular final aim. The scientific knowledge of what defines sustainability in environmental, social, and economic dimensions is always developing, impacted by current concerns, views, and ideals.,

For example, agriculture's ability to adapt to climate change was not regarded as a serious concern 20 years ago, but is now gaining increased attention. Furthermore, the specifics of what defines a sustainable system may differ from one set of variables (e.g., soil types, climate, labor costs) to the next, as well as from one cultural and ideological standpoint to the next, making the term "sustainable" a contentious one.

As a result, rather than thinking of agricultural systems as ranging from unsustainable to extremely sustainable, it is more practical and relevant to conceive of them as ranging along a continuum.

Approaches to sustainable agriculture

Three major aims are integrated into sustainable agriculture. – environmental health, economic profitability, and social equity.

Environmental health

The concept of agricultural sustainability has increasingly come to be associated with the preservation of environmental quality both on and off the farm. Modern commercial agricultural systems, characterized by intensive tillage and cropping practices, as well as high rates of mechanization and chemical input use, have resulted in excessive amounts of soil erosion and nutrient loss, impairing soil resource productive capacity and placing greater emphasis on the use of purchased inputs [3]. Such agricultural techniques are increasingly seen as unsustainable. In these circumstances, sustainability is defined as the maintenance of the land resource's productive capability. Another environmental meaning of sustainability is the impact of agriculture on the natural environment outside the farm gate and aside from agricultural production. Pollution of surface and ground water resources as a result of chemical fertilizer transport from farm fields is one of the most often mentioned concerns about sustainable agriculture. Those with an ecological orientation toward sustainability are likewise concerned about the loss of species' habitat and the decline in biological variety. In contrast to worries about decreasing productive capacity, an ecological viewpoint on sustainability implies that natural resources should be safeguarded as such and should not be exploited [4].

Economic profitability

The notion of sustainability is applied to farmers and rural communities in addition to assuring long-term food production and environmental quality. Many experts define agricultural sustainability by examining the economic rewards from farming [5]. Farms in commercial economies those are unable to make adequate income because to poor farm product prices, lower yields, greater production expenses, or other non-self-staining factors. As a result, one condition of agricultural sustainability is the presence of economic returns sufficient to maintain farm enterprises and appropriately recompense producers [6]. A wider definition of sustainable agriculture extends the notion of farm viability to the preservation of rural community systems. According to this viewpoint, the possibilities for environmentally friendly agriculture that is efficient in food production and equitable in benefit distribution are best when agriculture operates within a healthy rural community framework that promotes local decision-making and stewardship ideals [7].

Social equity

The concept of equity surpasses food, environmental, and producer goals, and is widely used to describe sustainable agriculture. For many, the long-term maintenance of productive capacity, environmental integrity, or family farming is a critical component of sustainability. Thus, intergenerational equity in agriculture refers to the safeguarding of future generations' rights and chances to benefit from resources that are now in use [8]. Agricultural techniques that reduce long-term possibilities for food production or degrade water quality or other natural resources, regardless of their short-term advantages, are not considered sustainable. Concerns about equity are not confined to ensuring agriculture's future. The notion has been used to express the rights of less advantaged groups in society to basic food supplies, as well as the opportunity and resources needed to farm in ways that improve chances for sustainability [9]. Thus, intra-generational equity refers to the equal transfer of agricultural advantages within and between nations, regions, or social groups.

Different sustainable agriculture practices

Sustainable agriculture is a new phrase for developing agricultural techniques that are more friendly to environment and humans since it allows us to produce nutritious food without jeopardizing future generations' capacity to do the same. Several decades of study and practise have shown that the following farming strategies are helpful in ensuring sustainability, especially when applied in alongside: Organic farming, Conservation farming, Zero budget natural farming, Crop rotation, Cover crops, Permaculture, Polyculture Farming, Agroforestry, Natural pest predators, Aquaponics

Organic farming

Organic agriculture is a safe, sustainable agricultural practise that produces healthy crops while ensuring environmental sustainability. It foregoes the use of synthetic chemical fertilisers and pesticides on the land in favour of maintaining a healthy, productive soil and growing a diverse array of crops. As a result, the farm remains naturally balanced, with a diverse array of beneficial insects and other species acting as natural predators for crop pests and a soil rich in microorganisms and earthworms to ensure its health. Organic farmers reduce health and pollution risks by avoiding the use of synthetic chemicals.

The two most frequently acknowledged organic agricultural aims are:

(i) to acquire toxin-free agricultural products for long-term human health safety,

(ii) to achieve a closed nutrient cycle in order to restore negative soil nutrient levels.

Organic food has been continuously increasing in demand, both in established and developing nations, due to its lack of contaminants, with an annual average growth rate of 20% to 25%. Organic farming relies on "biologically driven nutrients" and contributes to a closed nutrient cycle, which is essential for achieving sustainable agriculture.

Organic farming is an agricultural method that avoids or limits the use of synthetic fertilizers, herbicides, growth regulators, and livestock feed additives. Organic farming is founded on the goals of environmental, social, and economic sustainability [10].The main traits include preserving soil fertility over the long term by maintaining levels of organic matter, promoting soil biological activity, careful mechanical intervention, nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, effectively recycling organic materials like crop residues and livestock wastes and weeds, and disease and pest control relying primarily on crop rotations, natural predators, diversity, and organic matter management.

In 1972, five groups from Europe, the United States, and Africa came together to form the International Federation of Organic Agriculture Movement (IFOAM), which today serves as the global umbrella organization for organic farming.

The broad principles and practices that are expected to be followed in organic farming as per IFOAM Standards are as follows:

- To promote and improve biological cycles within the agricultural system.
- To improve, maintain, and long-term soil fertility
- To locally mobilize nutrients and organic materials in closed systems.
- Using renewable resources in locally coordinated agricultural systems as much as possible.
- To prevent pollution in all its manifestations

Conservation agriculture

One of the new "biological and ecological" paradigms for sustainable agricultural intensification is Conservation agriculture (CA), which might incorporate trees, livestock, perennial and annual crops, pastures, and trees [11]. Conservation agriculture is a method that enhances others, like agroforestry [12] and organic farming, which can benefit from integrating CA principles, and crop-livestock systems based in CA that provide high sustainable animal carrying capacities [13]. The past four decades of CA experience have shown how the concurrent use of a set of practices that include minimal mechanical soil disturbance, organic soil cover, and diversified cropping can result in higher and more stable yields, better use of production inputs and, consequently, greater profitability while lowering production costs, improved crop, soil, and ecosystem health as well as the associated ecosystem services, and improved climate change adaptability.

Three principles of Conservation Agriculture

- Minimal mechanical soil disturbance: by planting seeds directly and/or applying fertiliser. (*i.e.*, no tillage)
- Permanent soil organic cover: (at least 30 percent) with crop residues and/or cover crops
- Species diversification: by utilising diverse crop associations and sequences that involve at least three distinct crops.

Zero Budget Natural Farming (ZBNF)

As the name suggests,Zero Budget natural farming is a type of farming where there are no costs associated with cultivating and harvesting the plants. This indicates that farmers do not need to buy pesticides and fertilisers to ensure the crops grow healthily. The technique calls for using readily available, locally produced, naturally biodegradable materials combined with scientific knowledge and traditional farming techniques based on biological processes that occur naturally. Shri Subhash Palekar brought this idea to light, for which he was honored the Padma Shri in 2016 [14].

Crop Rotation

Crop rotation is one strategy for sustainable farm management that aims to increase soil organic matter and lessen soil erosion. Crop rotation affects the life cycle of pathogens and insects by preventing them from reproducing. When specific plant species are included in crop rotation, plant nutrients are restored by reducing the need for chemical fertilizer. Crop rotation is a practical method for sustainable agriculture [15]. Diversified crop rotations (DCR) are a series of rotations of three or more crops, as opposed to monocultures or double farmed rotations [16]. By adopting crop rotation strategy carefully, it may be possible to preserve long-term soil fertility, eliminate trade-offs between crop viability and environmental effects, and disrupt the weed and disease cycle process through intrinsic nutrient recycling [17].

Role of DCR

To lessen runoff and water erosion, cover crops are another useful soil conservation technique. Although the use of cover crops to preserve soil and increase soil productivity is not new, there is a resurgence of enthusiasm for the technique. Cover crops are widely known for their ability to stop soil erosion. Between the growth seasons of the primary crops, cover crops offer permanent soil protection. After termination, cover crop leftovers continue to prevent soil erosion. When cover crops are added to the soil as green manure, they have less of an impact on preventing soil erosion than when they are left as mulch on the soil's surface. In light of this, the use of cover crops in no-till and intensive cropping systems is a viable complementary technique.

- Soil Health Improvement
- Resistance to Diseases
- Improvement in Physical and Chemical Properties of Soil
- Soil Quality Maintenance
- Cover Crops

Examples of a few typical cropping diversity systems with cover crops [18] are as follows:

- Corn-rye-soybeans-rye
- Corn-rye-soybeans-wheat-cowpea (or cowpea, winter pea, radish, oats, rye, crotalaria, hairy vetch blend)
- Wheat-brassica (radish/turnips)-corn-rye-soybeans-wheat-cowpea-corn
- Corn silage-winter pea-corn silage (or legume blends)
- Corn silage-rye or annual ryegrass-corn silage
- Soybeans-wheat-winter pea (or legume blends)-sunflower-rye

Permaculture

Early in the 1970s, Australian ecologists Bill Mollison and David Holmgren developed permaculture. Although permaculture has been practiced for a long time and is sometimes used in place of agroforestry, we are less familiar with the term [19]. It is constrained by the idea that a stable, sustainable culture can only be achieved via the integration of a system of sustainable agriculture [20, 21]. Its main goal is to strengthen the bond between agriculture and the community while ensuring the security of the food supply and the economy for long-term agriculture.

The four assumptions on which permaculture is based are

The environmental catastrophe is genuine, and if it worsens, it will endanger society's existence.

Humans are bound by natural rules that teach them how to manage the environment.

Exploiting cheap, plentiful fossil resources is to responsible for the industrial period and the population growth.

Energy resources are limited, yet because human beings have limitless demands, resources will eventually run out and civilization will revert to the preindustrial age.

Because humans and environment are intertwined in permaculture, it is impossible to separate them; consequently, caring for the earth also involves achieving human goals [22]. Permaculture is a philosophy, a sustainable practice and an act based on ethics of 1. Care for earth 2. Care for people 3. Setting limits to consumption.

Polyculture

The traditional method of producing food, known as polycultures, is still commonly used in allotments, home gardens, and market gardens in temperate climates. Growing many crops simultaneously provides producers with a wide range of nutritional options, increased productivity and financial stability, and effective use of space. Although the usage of monocultures has become more common due to specialized machinery and scale economies (large fields of a single crop).

Polycultures offer significant advantages, for example, they can enhance:

- Biodiversity
- Nutrient cycling
- Soil and water conservation
- Carbon sequestration.

The Benefits of Polyculture Farming

Whether in a tiny kitchen garden or a large-scale agricultural enterprise, there are many reasons to consider polyculture, but one of the best ones is probably that it may significantly increase your yield.

Resistance to pests: Surrounding certain plants in polyculture with herbs, whose potent smell confuses insects and obscures the smell of the plant, is a typical technique.

Better soil quality: Less fertilizer is required because plants like legumes, clover, and lupine replenish the nutrients that other plants remove from the soil.

Biodiversity: In order to emulate nature and protect against poor yields, polyculture farms attempt to enhance diversity. If one crop fails, another one can substitute.

Suppression of weeds: Unwanted weeds that can compete for resources are prevented by making better use of the available area and by planting cover crops.

Agroforestry

Agroforestry as a Transformative Solution

The deliberate blending of trees and shrubs with crops or animals is known as agroforestry, and it is one multipurpose strategy for our food system. For almost half - century, agroforestry has been acknowledged as a sustainable agriculture method [23] and the concept of including trees in agricultural landscapes predates the act of cultivating land. Reduced fertilizer and pesticide runoff, carbon sequestration, improved soil quality, erosion management, enhanced animal habitat, less fossil fuel usage, and higher resilience in the face of an uncertain agricultural future are some of the positive effects of agroforestry [24-26].

Agroforestry Practices and Products

Agroforestry may provide goods including lumber, vegetables, fruits, nuts, mushrooms, forages, cattle, biomass, Christmas trees, and herbal medicines in addition to the environmental advantages [27].

A diverse product portfolio would allow revenue streams to be spread out over the short-term (crops, forage, livestock, mushrooms, certain fruits like currants), medium-term (nuts, fruits like apples or persimmons, biomass, medicinal plants), and long-term (nuts, fruits like apples or persimmons, biomass, medicinal plants) (lumber, increased property value). This variety of products can also help farmers avoid risk; however, it may need innovative marketing [27].

Natural Pest Predators

A predator makes its living by capturing and preying on other organisms. Predators are often bigger and stronger than their prey. Many of the most prevalent predators in fruit production systems attack a wide variety of pest species and help in pest population density regulation.

Aquaponics

Aquaponics is an interaction between plants and aquatic ecosystems. The fish are grown, raised, and harvested in this farming. During the rearing stage, water containing fish waste (excreta) is utilised as a substrate to grow plants. The plants obtain all their nutrition from the water that contains fish excreta. In exchange, the plants and beneficial bacteria found in their roots purify the water. This cleansed water may be used again to raise the fish. The farmer will be able to sell both the growing plants and the fish to the market, providing a double source of revenue that would otherwise be limited if either plants or fish were sold.

Aquaponics is a sustainable farming method. Organic food may be grown without the use of any harmful chemicals to fish or plants. The farming setup is so simple that it may be done at home or as a commercial project to generate revenue for the business. Aquaponic farming has several advantages. These advantages make them unique in practice.

Following is some of the benefits of aquaponic farming:

- The yield is approximately six times that of traditional farming.
- Aquaponics utilizes 90% less water than conventional cultivation.
- There is less risk of pests and diseases because it is done in a controlled environment.
- It generates two streams of income: fish and plants.
- The fish and vegetation are farmed naturally, with no chemical substances used.
- Plants grow quickly as compared to conventional agricultural methods.
- There is no need for external fertilizer because fish excreta is the best natural fertilizer for plants.
- There is no need to possess expensive acreage because aquaponics can be started at home.
- Efficient use of resources in the aquaponics and less wastage
- Reusable materials reduce agricultural operational costs.

Application of research: Study of agriculture farming practices

Research Category: Sustainable agriculture

Acknowledgement / Funding: Authors are thankful to Department of Agricultural Sciences, University Institute of Agricultural Sciences, Chandigarh University, Mohali, 140413, Punjab, India

****Research Guide or Chairperson of research: Dr Shilpa Kaushal**
University: Chandigarh University, Mohali, 140413, Punjab, India
Research project name or number: Review Study

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: University Institute of Agricultural Sciences, Mohali, 140413, Punjab, India

Cultivar / Variety / Breed name: Nil

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Kristiansen P.E. (2003) *Sustainable weed management in organic herb and vegetable production. A thesis submitted for the degree of Doctor of Philosophy of the University of New England*, 225.
[2] FAO (2017) *The future of food and agriculture–Trends and challenges. Annual Report*
[3] Dover M. and Talbot L. (1987) *To Feed the Earth: Agro-Ecology for Sustainable Development.*
[4] Neher D. (1992) *Journal of Sustainable Agriculture*, 2, 51-62.
[5] Brklacich M., Bryant C. and Smit B. (1991) *Environmental Management*, 15, 1-14.
[6] Ikerd J.E. (1990) *Journal of Soil and Water Conservation*, 45, 18-23.
[7] Edwards C.A. (1989) *Agriculture, Ecosystems and Environ*, 27, 25-35.
[8] Keeney D.R. (1989) *American Journal Alternative Agriculture*, 4, 101.
[9] Francis C.A. (1990) *J. of Soil and Water Conservation*, 45, 65-67.
[10] Stockdale E.A., Lampkin N.H., Hovi M., *et al*., (2001) *Advances in Agronomy*, 70, 261–327.
[11] Landers J. (2007) *Integrated Crop Management, 5. FAO, Rome*.
[12] Sims B., Friedrich T., Kassam A.H., Kienzle J. (2009) *Paper presented at the 2nd World Congress on Agroforestry, Nairobi, Kenya*.
[13] Friedrich T., Kassam A.H. (2009) *The IV World Congress on Conservation Agriculture. 4-7 February 2009, New Delhi, India*.
[14] Anonymous (2016) *Venkaiah Naidu congratulates farmer on winning Padma Shri, Indian Express*, 25 Jan 2016.
[15] Shrestha J., Subedi S., Timsina K.P., et al., (2021) *Journal of Nepal Agricultural Research Council*, 7, 133–150.
[16] Wang L., Zhao Y., Al-Kaisi M., Yang J., Chen Y. and Sui P. (2020) *Agronomy*, 10(2), 235.
[17] Andam C.P., Choudoir M.J., Vinh Nguyen A., Sol Park H. and Buckley D.H. (2016) *The ISME Journal*, 10(7), 1731–1741, .
[18] Hoorman J.J., Islam R. and Sundermeier A. (2009) *Sustainable Crop Rotations with Cover Crops, Ohio State University Extension Factsheet. https://ohioline.osu.edu/factsheet/SAG-9*
[19] Tomczak J.M. (2007) *Spectral and optical properties of correlated materials (Doctoral dissertation, PhD thesis, EcolePolytechnique)*.
[20] Holmgren D. (2002) *Permaculture: principles & pathways beyond sustainability*.
[21] Whitefield P. (2004) *Earth care manual: A permaculture handbook for Britain & other temperate climates. Permanent publications*.
[22] Mollison B., Slay R.M., Girard J.L. & Girard J.L. (1991) *Introduction to permaculture. Tyalgum, Australia: Tagari Publications*.
[23] Nair P.K.R., Garrity D. (2012) *Agroforestry—The Future of Global Land Use, Advances in Agroforestry; Springer: Dordrecht, The Netherlands*, 9.
[24] Davis A.S., Hill D., Chase C.A., Johanns A.M., Liebman M. (2012) *PLoS ONE*, 7, e47149.
[25] Caudill S.A., DeClerck F.J.A., Husband T.P. (2015) *Agric. Ecosyst. Environ*., 199, 85-93.
[26] Winans K.S., Tardif A.S., Lteif A.E., Whalen J.K. (2015) *Agrofor. Syst*., 89, 421-433.
[27] Training Manual for Applied Agroforestry Practices (2015) *Gold M., Cernusca M., Hall M., Eds.; University of Missouri Center for Agroforestry: New Franklin, MO, USA*, 2006.