Journal of Advances and Scholarly Researches in Allied Education
Vol. 19, Issue No. 2, March-2022, ISSN 2230-7540

Sustainable Agriculture

Neelam Devi*

Qualified NET in Geography in 2019

Abstract - Eco food production must shift its focus from output to profit in light of the new agricultural reality. In the context of sustainable agriculture research, striking a balance between financial return & eco - design can be attained through a thorough examination of both inputs and outcomes. Though difficult, the current direction in research should be directed toward methods that can actually achieve this delicate balancing act. Agriculture is essential to the survival of all species on Earth. Agriculture has an impact on every aspect of human life, from the air we breathe to the fossil fuels we use.The future of humanity depends on progress in sustainable agriculture. In a larger sense, "agricultural sustainability" refers to environmental sustainability. In this article, we have compiled a variety of strategies proven to increase farm output, income, and longevity.

Keywords - Sustainability, Agriculture, Economic Stability, Environmental Conservation

----------X----------

INTRODUCTION

Agriculture that does not deplete natural resources or cause environmental damage is not considered sustainable. Nature-inspired agriculture is the practice of designing agricultural practices that mimic the efficiency and resilience of natural ecosystems. Successful sustainable farming is indistinguishable from thriving farm communities, prosperous lives for farm families, and high quality food for all. Though more than just a notion, sustainable agriculture is still in its infancy in the first decade of the 21st century. Small farmers, environmentalists, and a dogged group of agricultural scientists were not government policy makers, but rather the midwives of the sustainability movement in agriculture, which is intertwined with such larger problems as the global economy, dwindling petroleum reserves, & domestic food security. The inhabitants of the late 20th century realized that industrial farming was destroying the water & soil on which modern agriculture depends, and they set out to find more sustainable practices. Standard 20th-century farming was heavily influenced by industrialization, leading to the rise of vertically-integrated agribusiness. The abundance and low cost of food in the United States can be attributed in large part to the industrial approach and the enormous government subsidies it received. Unlike factories, however, farms are not based on mechanistic processes; they also exist in a social context. The industrial model's emphasis on high production has led to the degradation of soil & water, the loss of biodiversity—a crucial component of food security—higher reliance on imported oil, and the consolidation of farmland ownership among a smaller number of "farmers," effectively strangling rural economies. Naturally, ecological, low-input, alternatives, regenerating, holistically, Agronomic, biointensive, & biologically farming systems are all names given to different ecological techniques that have been developed in recent decades as a response to the extractive industrial paradigm. They all share a vision of "farming with nature," an agroecology that endorses ecosystems, recycles plant nutrients, protects soil from erosion, conserves & protects water, employs minimal tillage, & integrates crop and livestock enterprises on the farm, and together they have helped us better understand what sustainable systems are. No farming method, regardless of how sophisticated it is or how skilled the farmer who employs it, can be considered sustainable if it cannot also be financially viable for the average household. Smaller, family-run farms are ideally suited for adopting sustainable techniques. In turn, these farms typically succeed in regional food systems, where they may sell directly to customers. To keep up with the changing needs of consumers & industries they support, farmers who practice methods other than industrial agriculture must also adapt. One of the most difficult aspects of sustainable farming is breaking into new consumer markets.

Agriculture & Ecosystem

Agricultural intensification that primarily relied on outside inputs led to a notable increase in productivity but, over the long run, a reduction in sustenance, as well as trends of deteriorating soil quality & environmental hazards to human health. By the late 1970s, U.S. agriculture was dealing with the effects of severe land degradation brought on by erosive processes, the loss of soil organic matter, the decline of biological activity, salinization due to the overuse of fertilizers & water, and severe environmental pollution from agricultural runoff. Agriculture became the main non-point source of pollution, with pesticide & nitrate residues damaging the ecosystem by polluting even the groundwater.

The uncontrolled utilisation antibiotics & insecticides in cattle, which flooded the food chain, put the safety & health of both livestock and people in danger. High yielding monoculture not only caused widespread genetic resource erosion but also caused a rise in novel pests & pesticide-resistant strains, necessitating the use of more pesticides at higher concentrations. Environmentalists in the 1970s were outraged by agriculture's impact on the environment and demanded more sustainable agricultural practices. The significant advance in raising public awareness of the detrimental effects of pesticides (DDT) on the environment & health made possible by Rachel Carson's publication of Silent Spring in 1964 led to the incorporation of environmental concerns regarding the sustainability of contemporary technologies. These approaches' fundamental tenet was to rely on local resources & natural processes rather than the synthetic foreign inputs of industrial agriculture.

Around the 1970s, the theory of agro-ecology, which later became a recognized scientific field, tried to emphasize the potential for a long-lasting agricultural production approach based on a synergistic relationship with natural resources & processes. As a result, the system of alternative or regenerative agriculture that evolved alongside industrial farming in the United States and contributed most to the field of sustainable agriculture. To save resources and avoid pollution, it carefully & selectively combined natural processes (including nutrient cycling, pest control, crop production, etc) with newer technologies (such as enhanced agricultural cultivars, mechanization, & soil testing to allow the evaluated addition of fertilizers). This marked the actual beginning of a sustainable agriculture paradigm based on science. Eva Balfour, a proponent of alternative agricultural models and a champion of the natural balance, coined the phrase "sustainable agriculture" in 1970. Another regenerative agriculture pioneer who insisted on paying attention to natural soil processes to assure inexhaustible yield was Robert Rodale (1983).

Sustainability: How to Achieve It?

Sustainability principles centered on husbandry & economic justice have been formed by farmers or other agricultural thinkers. Every year, farmers and scientists increase the rate at which agro-ecology systems are refined and optimized to maximize productivity & profit. The number of Cooperative Extension offices & agricultural colleges that support sustainable methods is growing. In addition, more and more farmers each year recognize the practicality and financial and personal benefits of these methods. (The organic food market in the United States is the most rapidly expanding in the industry.) Sustainability in agriculture is slowly spreading, but at a snail's pace (one harvest, one field, one household at a time). Local markets and farm policies that encourage sustainable farming methods are currently being developed by consumers and grassroots activists outside of the agricultural sector. They're trying to get people thinking about the treatment of plants, animals, soil, and water in the food system. And they're trying to strengthen the basis of locally & regionally self-sufficient food systems by forging tighter relationships between producers and consumers. Future-oriented advocates of sustainable agriculture envision a system in which small and medium-sized diversified farms supply the bulk of their regional food needs, as opposed to large, monocropped industrial megafarms that transport food all over the world. (Idaho residents need not give up orange juice, and Californians can still enjoy cranberries at Thanksgiving.) Here are some of the most important factors to think about while attempting to make a farm more sustainable, along with links to pertinent ATTRA papers. There is no foolproof method for achieving long-term success on a farm, but the aforementioned ideas and resources can serve as excellent jumping-off points for learning more. Additionally, the ATTRA publication Applied the Principles of Sustainable Agriculture provides a deeper dive into several of these core concepts.

Jam processed on-farm is one example of a valueadded product. Photo by Nathalie Dulex.

Sustainable Agriculture & Sustainable Development

Determining future development objectives for agriculture became a good starting point when considering sustainable development. Despite the fact that the Brundtland Commission Report focused primarily on the environmental harm brought on by intense industrialization, it explicitly mentioned issues with global agriculture systems as well as the need for a new holistic strategy. The study supported agricultural systems that prioritize long-term sustainability over immediate profit, while also giving equal weight to people, technology, & resources. This signaled the beginning of a fresh approach to sustainable farming. The most crucial element of sustainable development was rapidly recognized to

be sustainable agriculture. Sustainability has been established as the fundamental goal to be sought in all future agricultural programs by international organizations like the Food & Agriculture Organization (FAO), the World Bank, & Consultative Group on International Agricultural Research (CGIAR).

Techniques for adoption of sustainable farming

Agriculture's concept of sustainability has many key aspects, including social (given a fair deal with its workers &equally correlation with the surrounding community), economic (should be a successful business contributing to a robust economy), & environmental (having potential to attenuate air, water, & climate pollution, build & maintain healthy soil, manage water wisely, & promote biodiversity) (Fig. 1). Working with nature rather than against it will be useful in order to meet these requirements. The following considerations must be made in order to move in this path-

- It's preferred to avoid irreversible land changes, such as erosion.
- Natural resources (including water, energy, soils, plants, animals, bio - diversity, ecosystem, etc.) should be used sparingly and with care.
- Because sustainability in agriculture depends on long-term stability and productivity, it is preferable not to rely solely on one type of resource (such as fossil fuels) but on a wide variety of them, such as wind, solar, geothermal, etc.
- In light of the global trend toward agricultural consolidation & increasing importance of modern infrastructure, it is imperative that farmers generate enough money to allow them to remain in their current roles.

The "3 R concept" needs to be given top priority. Reducing, Reusing, & Recycling Due to this, farming will become both environmentally and financially viable. Waste isn't waste unless we waste it, after all!

It is important to promote diversity on the farm area around it. selecting polyculture over monoculture (e.g., multi-year crop rotation, mixed cropping, mixed cropping, etc.), growing cover crops in the off-season when soils might be left bare, planting trees around the farm (e.g., agro-forestry practices), encouraging & tolerating natural predators that keep pests at bay, and etc. These practices act as windbreaks and also provide habitat for local birds (that could prey on insects that prey on crops) (e.g., snakes that feed on gophers, ladybugs that feed on aphids, spiders that feed on insects which spread diseases to crops).

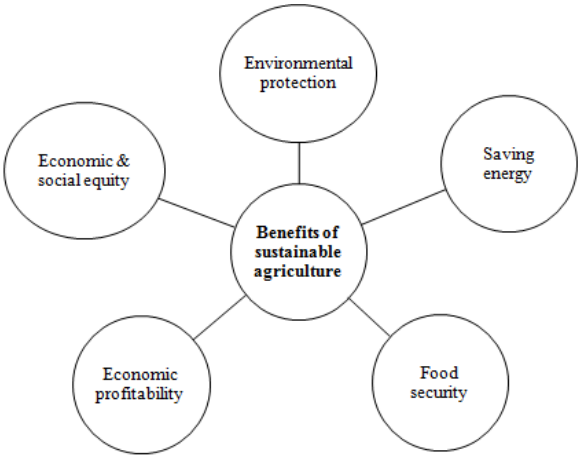

Figure 1: Benefits of Sustainable agriculture

Different sustainable farming methods & practices

I. Permaculture

The terminology "permaculture," initially meaning "permanent agriculture," was developed by David Holmgren (2002). It's a method for designing human communities according to natural principles, so that people and ecosystems can flourish together. To eliminate inefficiencies and boost productivity, this approach is designed to encourage "smarter, not harder" work practices. The focus here is on using permanent plants like fruit trees, nut trees, & bushes to create an artificial ecosystem that functions similarly to one that would occur naturally. Some of permaculture design techniques include herb spirals, keyhole & mandala gardens, hugelkultur garden beds, sheet mulch, cultivating grain without plowing, allowing each plant serve several purposes, & creating swales on contour to hold water at higher elevations.

Figure 2: Permaculture in Polam of Telangana, India

II. Biodynamic farming

As a farming method, it centers on nurturing the farm as if it were a living organism, paying close attention to its growth as a whole. The connections between the farm's many elements (including the ground, vegetation, animals, & microorganisms) are also taken into account. The biodynamic system combines "biological" activities, such as using organic farming methods that have been around for

a long time to increase soil health, with "dynamic" practices, which incorporate the impact of cosmic energies to infuse the farm, its inhabitants, and its products with vitality (Sharma, 2012). Cow manure, silica, & extracts of various plant parts, such as yarrow flowers, chamomile flowers, oak bark, stinging nettle shoots, and so on., were reported as the main ingredients in some biodynamic preparations by Reeve et al. (2011). These ingredients are either useful through field spray or composting.

Figure 3: Biodynamic farming in Gujarat, India's BhaikakaKrishi Kendra

III. Urban agriculture

Agriculture include not just the production of staple foods like grains, vegetables, mushrooms, & fruits, but also non-edibles like aromatic and medicinal herbs, as well as the raising of animals like chickens & fish.It reveals an alternative way of thinking about how turning cities into agricultural producers rather than just consumers of food might help with sustainability, better health, & eradication of poverty. It helps turn organic solid waste & wastewater into resources for growing agricultural items in addition to using vacant urban spaces for agriculture production (utilized for irrigation, the latter as fertilizer). Another concept is to separate dry and wet wastes and recycle kitchen wastes to make homemade compost, which would not only assist reduce the amount of garbage dumped in city landfills but also give every family a high-quality potting soil for gardening.

Figure 4: Maharashtra, India's urban agriculture

IV. Hydroponics & aqua-ponics

With the help of specialized nutrients that are given to water, plants are grown using these cutting-edge agricultural methods without the use of soil. Hydroponically grown plants either have their roots immersed in a mineral solution or planted in an inert medium like gravel or perlite.Vegetables such as cucumbers, lettuce, tomatoes, and peppers thrive in this environment. Aqua-ponics combines aquaculture (the farming of fish) with hydroponics (the cultivation of plants in water) by reusing the water used to cultivate the fish as a source of nutrients for the hydroponically grown plants. Both of these systems can be found in a variety of sizes, ranging from those suitable for use in the house to those used in large-scale businesses.

Figure 5: Aquaponics & hydroponics in Maharashtra, India

V. Agro-forestry & food forests

Agro-forestry is a systemic method of tapping into the synergistic benefits of planting trees & bushes alongside cropland. By fusing agriculture and forestry practices, we can develop land-use systems that are more resilient to ecological and economic stresses while also providing a higher return on investment & higher quality of life for future generations. Aside from providing farmers with a new source of income, trees also help by stabilizing soils, reducing nitrogen runoff, and improving the structure of the soil. The term "food forest" refers to a specific type of edible "forest" that is part of a permaculture system. Perennial food plants make up nearly all of the "trees" in this "forest," from the tall & dwarf fruit and nut trees in the canopy to the fruit shrub layer, the ground layer of perennial herbs, mushrooms, and vegetables, the climbing plants, & underground root vegetables.

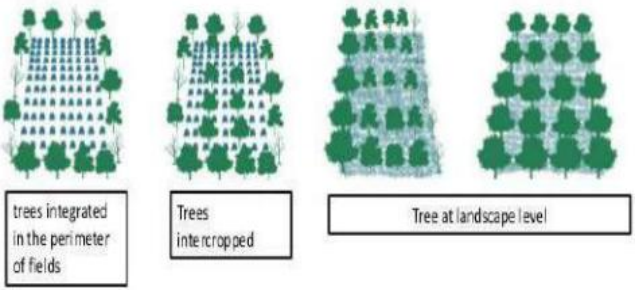

Figure 6a: Different Models of Agro-forestry

Figure 6b: Food forests & agroforestry in Himalayan region

VI. Rotating crops & poly cultures

Poly-culture & crop rotation, as opposed to monoculture, is a very scientific and innovative way to combat insect & pest harms (as certain pests choose specific hosts), preserve& improve soil quality, deal with climateoscillations, guarantee furtherrevenue to agronomists, & provide a healthier diet to the communal. The importance of planting crops that complement each other is emphasized here.

VII. Growing heirlooms and older varieties

Only a small number of types are grown commercially in order to satisfy consumer demand for produce that can be transported over great distances and kept for extended periods of time. Because of this decreased genetic diversity, food crops are less able to adjust to alterations in the prevalence of disease, pests, and climate. Cultivating heirloom & older kinds and preserving their seeds is crucial for preserving the gene pool of indigenous varieties, preserving the richness of seeds, or creating future climate-resistant types.

VIII. Natural animal growth

Industrial farming practices prohibit grazing cattle on farmland and require that crops be grown in areas free of waste. However, grassland & grazing animals share a mutually beneficial connection.In addition to providing a wide range of nutrients to the animals through regulated grazing, heavy foot traffic prevents soil erosion by compacting the soil, & manure that is left behind enriches the soil.

IX. Groundcovers, manual weeding, & mulch

Mulching & groundcovers are both effective ways to give the soil a layer of protection, control the growth of weeds, retain soil moisture, enhance soil health & fertility, & shield the soil from direct sunshine.Mulches could be made of organic or inorganic materials; organic mulches include straws, husks, saw dust, grasses & cover crops, manures & composts, etc., while inorganic mulches typically refer to polyethylene mulch, of which black plastic mulch is the most common. However, organic mulches have become more popular than inorganic ones due to their ability to decompose quickly and improve soil water retention & percolation.

X. Natural pest management

Instead of utilizing harmful chemicals, this strategy employs natural means (such as birds, animals, plants, & machinery) to combat insect pests.The farm can be managed in such a way that it can harbor natural predators of agricultural pests. It is possible to control the population of dangerous pests utilizing the prey-predator interaction.

CONCLUSION

In conclusion, sustainable agricultural systems use cutting-edge, scientifically based techniques to increase productivity while minimizing environmental damage. More creative business strategies can be used to profit from the techniques being used to promote agricultural sustainability. All farms can benefit from the many sustainable farming techniques outlined above, which yield a variety of fuels, foods, & fibers. These techniques can guarantee productivity, profitability, or long-term sustainability of the farming system with scientific application & good management.To prevent overexploitation or the subsequent conservation of natural resources & simpler and needed demographic shifts, it is crucial to understand that the Earth's carrying capacity to sustain human life indefinitely is diminishing.

REFERENCES

1. Agroecology: principles and strategies for designing sustainable farming systemswww.CNR.Berkeley.EDU/%7Eagroeco3/principles_and_strategies.html
2. ATTRA—National Sustainable Agriculture Information Servicewww.attra.ncat.org
3. Berry, Wendell. 1996. The Unsettling of America: Culture and Agriculture. 3rd edition. University of California Press, Davis. 256 p.
4. Bird, Elizabeth Ann R., Gordon L. Bultena, and John C. Gardner (eds.) 1995. Planting the Future: Developing an Agriculture that Sustains Land and Community. Iowa State University Press, Ames, IA. 276 p.
5. Carson, R. 1962. Silent Spring. Pub Houghton Mifflin.
6. FAO, (2017). The future of food and agriculture–Trends and challenges. Annual Report.
7. Harwood, R.R. 1990. A history of sustainable agriculture. In: Sustainable Agricultural Systems, C.A. Edwards, R. Lal, P. Madden, R.H. Miller, and G. House (Eds.). Ankey, 10: Soil and Water Conservation Society, pp.3-19.
8. Holmgren, D. (2002). Principles & pathways beyond sustainability. Holmgren Design Services, Hepburn.
9. Horne, James E. and Maura McDermott. 2001. The Next Green Revolution: Essential Steps to a Healthy, Sustainable Agriculture. Food Products Press, an imprint of The Haworth Press, Binghamton, NY. 312 p.
10. Jackson, Wes. 1985. New Roots for Agriculture. 2nd edition. University of Nebraska Press, Lincoln, NE. 150 p.
11. National Campaign for Sustainable Agriculturewww.sustainableagriculture.net
12. Reeve, J. R., Carpenter-Boggs, L., &Sehmsdorf, H. (2011). Sustainable agriculture: A case study of a small Lopez Island farm. Agricultural Systems, 104(7), 572-579.

13. Rodale, R. 1983. Breaking new ground: The search for a sustainable agriculture. Futurist, 1: 15-20.
14. Sharma, S. K., Laddha, K. C., Sharma, R. K., Gupt, P. K., Chatt, L. K., &Pareeek, P. (2012). Application of biodynamic preparations and organic manures for organic production of cumin (Cuminumcyminum L.). International Journal of Seed Spices, 2(01), 7-11.
15. Sustainable Agriculture Network. 2002. Resources from the Sustainable Agriculture Network. Sustainable Agriculture Research and Education (SARE) Program. Sustainable Agriculture Publications, 210 UVM, Hills Building, Burlington, VT 05405-0082. www.sare.org/htdocs/pubs/
16. Sustainable Agriculture Networkwww.sare.org
17. Sustainable Communities Networkhttp://sustainable.org/economy/agriculture.html
18. Sustainable Farming Connectionhttp://sunsite.unc.edu/farming-connection/
19. The New American Farmer: Profiles of Agricultural Innovationwww.sare.org/publications/naf/naf.pdf
20. UNEP/CBD/SBSTTA/14/INF/34, 2010. Sustainable agriculture and the sustainable use of agricultural biodiversity: concepts, trends and challenges. Convention on Biological Diversity, 10-21 May 2010, Nairobi, Kenya.

Corresponding Author

Neelam Devi*

Qualified NET in Geography in 2019