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A Better Future through Sustainable Agriculture

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Abstract
It is necessary to switch from production to profit-driven sustainable farming in the modern agricultural environment since it is changing. In the framework of research for sustainable agriculture, a thorough examination of input and output can create a balance between economic return and environmental concern. Although it is a substantial difficulty, research should concentrate on methods that can create balance in a more usable way. We have outlined many techniques to raise the farming system's overall productivity, profitability, and sustainability.

Key words: Sustainability, agriculture, economic stability, environmental conservation.

Introduction
The term "sustainable" has gained a lot of popularity recently and is used to describe a variety of topics. Sustainability in agriculture aids in finding the ideal balance between the requirement to produce food and the maintenance of environmental ecosystems. It has been estimated that by 2050, 70 percent more food would be required than is currently produced in order to ensure that the estimated 30 billion people on the globe receive the recommended quantity of calories each day (FAO, 2020). Sustainable agriculture allows for the production of healthy food while preserving the ability of future generations to attempt to do the same. Agricultural processes are typically found to be relatively inefficient in terms of resource usage, which is strongly connected to production costs. In this context, sustainable agriculture is equally significant. In this sense, sustainable farming is also advantageous since it promotes farm economic stability and helps farmers improve the quality of their lives.

What precisely is sustainable agriculture?
The phrase "sustain," derived from the Latin sustinere (sus-, from below, and tenere, to retain), means "to preserve in existence or maintain." In agriculture, sustainable means "capable of sustaining their production and value to society." It is farming that serves the demands of current and future generations while also assuring profitability, environmental health, and social and economic equality. It prefers natural-like practices for preserving soil fertility, preventing water pollution, and protecting biodiversity indefinitely.

Techniques for implementing sustainable farming
Sustainability in agriculture is a complex concept with many facets, including social (having a fair deal with its workers as well as a mutually beneficial relationship with the surrounding community), economic (should be a profitable business contributing to a robust economy), and environmental (having the potential to reduce air, water, and climate pollution, build and maintain healthy soil, manage water wisely, and promote biodiversity) (Fig. 1). Working with

nature rather than against it will be beneficial in trying to attain these criteria. To continue in this direction, keep the following points in mind:

1. Water, energy, soil, plants, animals, biodiversity, ecosystems, and other natural resources should be used with care.
2. As long-term stability and productivity are the prerequisites for sustainable agriculture; rather than its complete self-sufficiency, more renewable and varied resources (e.g., wind energy, solar energy etc.) should be used.
3. Enough income should be produced to stay on a farm in face of worldwide farm consolidation and infrastructure development.
4. Encourage diversity both inside and around the farm. Choosing polyculture over monoculture (e.g., multi-year crop rotation, inter-cropping, mixed cropping, etc.), growing cover crops during off-season when soils would otherwise be left bare, and planting trees around the farm (e.g., agro-forestry practices) that will act as windbreaks as well as provide habitat for local birds (which can prey on insects that prey on crops), promoting and tolerating natural predators that keep pests away (e.g., snakes that feed on gophers, ladybugs that feed on aphids, spiders that feed on insects which spread diseases to crops).

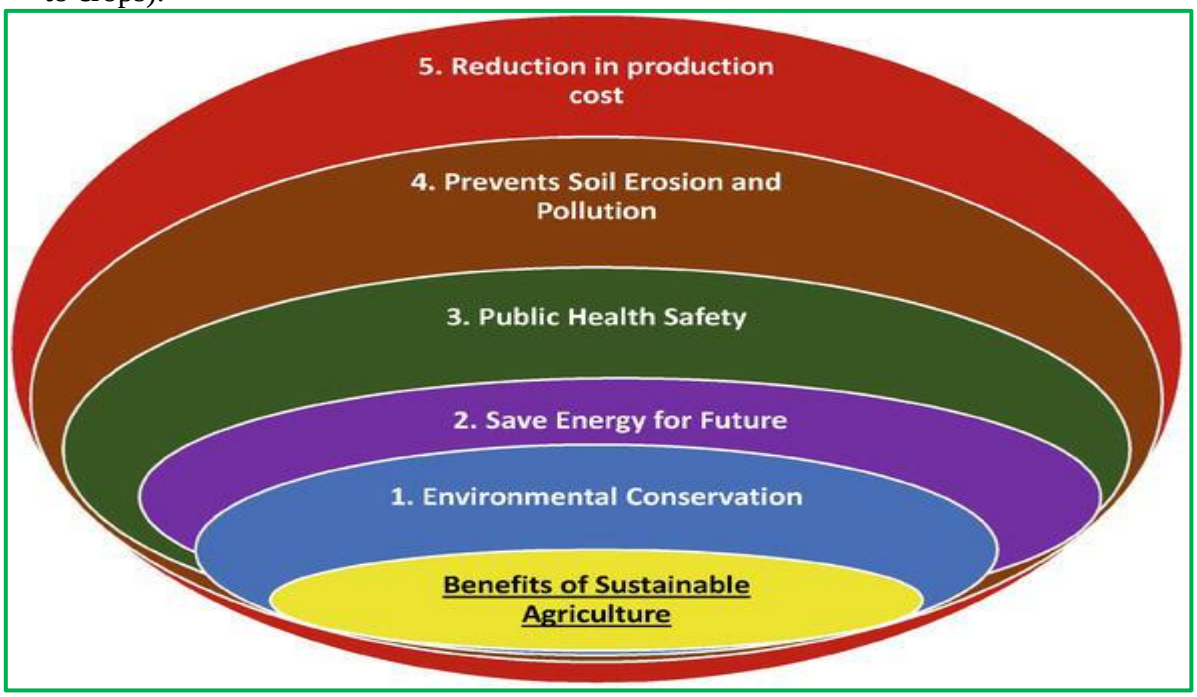

Fig.1. Benefits of Sustainable agriculture

Various methods and practices for sustainable farming

1. **Agro-forestry and food forests:** Agro-forestry is an integrated approach of using the interactive benefits from combining trees and shrubs with crops. It combines agricultural and forestry technologies to create more diverse, productive, profitable, healthy and sustainable land-use systems. Besides becoming an additional source of income for farmers, trees create a favorable microclimate (that maintains favorable temperature and soil humidity, while protecting crops from wind or heavy rain), stabilize soils, minimize nutrient runoff and improve soil structure. Food forests are designed permaculture systems that consist of a multilayered edible "forest." Such a "forest" is composed almost entirely of perennial food plants, including a canopy of tall and dwarf fruit and nut trees, a fruit shrub layer, layers of perennial herbs, mushrooms and vegetables at the ground level, climbing plants, and root vegetables underground.

Fig.2. Agro-forestry and food forests

2. **Natural animal raising:** Industrial agriculture keeps livestock grazing away from the farm to protect the crop from animal consumption, while also keeping crops away from manure. Grazing animals and grassland, on the other hand, have a mutually beneficial relationship. On the one hand, managed grazing provides a wide variety of nutrients to the animals; on the other hand, excessive footfall helps to compact the soil, preventing soil erosion, and the manure left behind enriches the soil.

Fig.3. Raising Animals Sustainably on Pasture

3. **Poly culture and crop rotation:** In order to tackle pest and weed problems (as some pests prefer specific host), maintain and enhance the soil quality, cope up with weather fluctuations, ensure additional income to the farmers and a healthy diet to the community, poly-culture and crop rotation over monoculture is very scientific and innovative approach. Here emphasis is given on the fact that crops which are growing together should be complementary to each other.

Fig.4 Crop Rotation and Polyculture

4. **Natural pest management:** In this method of controlling pest insects, birds, animals, plants and mechanical practices are used instead of using chemicals. The farm can be managed in such a way that it can harbor natural predators of agricultural pests. Using the prey-predator relationship, the population of harmful pests is kept under control.

Fig.5 Pest control method

5. **Hydroponics and aqua-ponics:** These revolutionary agricultural techniques entail growing plants without soil and sustaining them with customized nutrients supplied to water. Crops are cultivated in a hydroponics system with their roots directly exposed to a mineral solution or in an inert media such as gravel or perlite. This technique is often used to cultivate cucumbers, lettuce, tomatoes, and peppers. Aqua-ponics combines the raising of aquatic animals (such as fish) with the cultivation of hydroponic vegetables, in which water containing waste material from the aquaculture fish is utilized to nourish the hydroponic plants. Both of these systems are widely available, ranging from tiny home scale systems to large commercial-scale systems.

Fig.6 Hydroponics and aqua-ponics

6. Mulching, groundcovers and manual weed control: In order to provide a protective layer to the soil, restrict proliferation of weeds, conserve soil moisture, improve soil health, fertility and shield soil from direct sunlight, mulching and groundcovers is a good option.

Fig. 7 Organic Mulching Materials for Weed Management

Mulches can be of both organic and inorganic origin; the former consists of straws, husks, saw dust, grasses and cover crops, manures and composts etc. while the later mostly indicates the polyethylene mulch in which the most popular is the black plastic mulch. However, organic mulches have attained more value than the inorganic one as the former is easy to decay and can increase percolation and water retention in soil

6. **Permaculture:** David Holmgren and Bill Mollison created the word "permaculture," which originally meant "permanent agriculture" (Holmgren, D., 2002). It is a system that applies natural principles to the creation of human settlements, allowing people to coexist with the natural environment. The fundamental goal of this system is to eliminate waste and boost system efficiency by "working smarter, not harder." The emphasis here is on the utilisation of perennial crops such as fruit trees, nut trees, and shrubs that work together in a structured system that simulates how plants in a natural environment would operate. Herb spirals, keyhole and mandala gardens, hugelkultur garden beds, sheet mulching, and growing grain without tillage are all permaculture design approaches.

Fig: 8 Permaculture in Polam of Telangana, India

9. Biodynamic farming: It is an approach of farming system where the farm is treated as a living system and significant emphasis is given on overall development of the farm. Reeve et al. (2011) revealed certain biodynamic preparations that may either be administered by field spray or by composting and have as their major constituents cow dung, silica, and extracts of various plant parts including yarrow flowers, chamomile flowers, oak bark, stinging nettle shoots, etc.

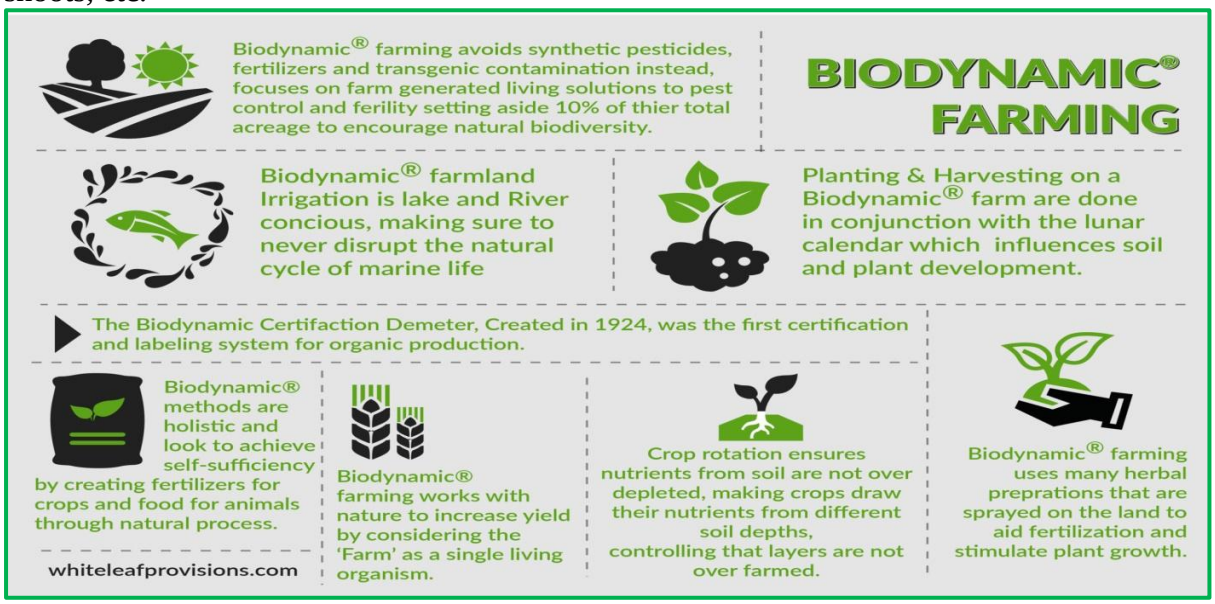

Fig.9 Biodynamic Farming

Conclusion

To summarize, a sustainable farming system utilizes innovative science-based practises to enhance productivity while minimizing environmental damage. More innovative entrepreneurship ideas can be implemented to profit from these agricultural sustainability procedures. The various sustainable farming practises discussed above are appropriate for all farms and produce various types of fuels, foods, and fibres. With scientific application and proper management, these practises can ensure the long-term productivity, profitability, and sustainability of the farming system.

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