A Study on Eco Sustaining Agriculture

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Abstract- ***Sustainable agriculture is farming in sustainable ways (meeting society's food and textile needs in the present without compromising the ability of future generations to meet their own needs) based on an understanding of ecosystem services, the study of relationships between organisms and their environment. It is a long-term methodological structure that incorporates profit, environmental stewardship, fairness, health, business and familial aspects on a farm setting. It is defined by 3 integral aspects which are: economic profit, environmental stewardship and social responsibility. Sustainability focuses on the business process and practice of a farm in general, rather than a specific agricultural product. The integrated economic, environmental, and social principles are incorporated into a "triple bottom line" (TBL); when the general impacts of the farm are assessed. Unlike a traditional approach where the profit-margin is the single major factor; Agriculture sustainability is also involved with the social and environmental factors.***

There are several key principles associated with sustainability in agriculture:

1. ***The incorporation of biological and ecological processes into agricultural and food production practices. For example, these processes could include nutrient cycling, soil regeneration, and nitrogen fixation.***
2. ***Using decreased amounts of non-renewable and unsustainable inputs, particularly the ones that are environmentally harmful.***
3. ***Using the expertise of farmers to both productively work the land as well as to promote the self-reliance and self-sufficiency of farmers.***
4. ***Solving agricultural and natural resource problems through the cooperation and collaboration of people with different skills. The problems tackled include pest management and irrigation.***

Sustainable agriculture can be understood as an ecosystem approach to agriculture. Practices that can cause long-term damage to soil include excessive tilling of the soil (leading to erosion) and irrigation without adequate drainage (leading to salinization). Long-term experiments have provided some of the best data on how various practices affect soil properties essential to sustainability.

The most important factors for an individual site are climate, soil, nutrients, and water. Of the four, water and soil quality and quantity are most amenable to human intervention through time and labor. When farmers grow and harvest crops, they remove some nutrients from the soil. Without replenishment, land suffers from nutrient depletion and becomes either unusable or suffers from reduced yields. Sustainable agriculture depends on replenishing the soil while minimizing the use or need of non-renewable resources, such as natural gas (used in converting atmospheric nitrogen into synthetic fertilizer), or mineral ores (e.g., phosphate). Possible sources of nitrogen that would, in principle, be available indefinitely, include:

1. ***recycling crop waste and livestock or treated human manure***
2. ***growing legume crops and forages such as peanuts or alfalfa that form symbioses with nitrogen-fixing bacteria called rhizobia***
3. ***industrial production of nitrogen by the Haber process uses hydrogen, which is currently derived from natural gas (but this hydrogen could instead be made by electrolysis of water using renewable electricity, or***
4. ***Genetically engineering (non-legume) crops to form nitrogen-fixing symbioses or fix nitrogen without microbial symbionts.***

The last option was proposed in the 1970s, but is only gradually becoming feasible

Sustainable options for replacing other nutrient inputs such as phosphorus and potassium are more limited.

More realistic, and often overlooked, options include long-term crop rotations, returning to natural cycles that annually flood cultivated lands (returning lost nutrients indefinitely) such as the flooding of the Nile, the long-term use of biochar, and use of crop and livestock landraces that are adapted to less than ideal conditions such as pests, drought, or lack of nutrients. Crops that require high levels of soil nutrients can be cultivated in a more sustainable manner with appropriate fertilizer management practices.

I. INTRODUCTION

It has been defined as "an integrated system of plant and animal production practices having a site-specific application that will last over the long term", for example to satisfy human food and fiber needs, to enhance environmental quality and the natural resource base upon which the agricultural economy depends, to make the most efficient use of non-renewable and on-farm resources and integrate natural biological cycles and controls, to sustain the economic viability of farm operations, and to enhance the quality of life for farmers and society as a whole.

Modern industrial agriculture is a system of monocrops that erodes soils, pollutes air and water, and relies on synthetic pesticides and fertilizers. Sustainable farmers and ranchers are known for their deep respect for the natural world. They use less fossil fuel, produce fewer greenhouse gases, and often depend on human labor rather than chemicals and energy-intensive technology. Sustainable farms encourage biodiversity, conserve scarce water resources, and build healthy soil through techniques like composting and planting cover crops. Sustainable ranchers raise a moderate number of animals at a time not more than the land can support and often rotate the animals around a pasture to minimize their impact.

Improving natural capital is a central aim, and dividends can come from making the best use of the genotypes of crops and animals and the ecological conditions under which they are grown or raised. Agricultural sustainability suggests a focus on both genotype improvements through the full range of modern biological approaches and improved understanding of the benefits of ecological and agronomic management, manipulation and redesign. The ecological management of agro ecosystems that addresses energy flows, nutrient cycling, population-regulating mechanisms and system resilience can lead to the redesign of agriculture at a landscape scale. Sustainable agriculture outcomes can be positive for food productivity, reduced pesticide use and carbon balances. Significant challenges, however, remain to develop national and international policies to support the wider emergence of more sustainable forms of agricultural production across both industrialized and developing countries.

II. WATER

In some areas sufficient rainfall is available for crop growth, but many other areas require irrigation. For irrigation systems to be sustainable, they require proper management (to avoid salinization) and must not use more water from their source than is naturally replenishable. Otherwise, the water source effectively becomes a non-renewable resource. Improvements in water well drilling technology and submersible pumps, combined with the development of drip irrigation and low-pressure pivots, have made it possible to regularly achieve high crop yields in areas where reliance on rainfall alone had previously made successful agriculture unpredictable. However, this progress has come at a price. In many areas, such as

the Ogallala Aquifer, the water is being used faster than it can be replenished.

Several steps must be taken to develop drought-resistant farming systems even in "normal" years with average rainfall. These measures include both policy and management actions:

1 improving water conservation and storage measures,
2 providing incentives for selection of drought-tolerant crop species,
3 using reduced-volume irrigation systems,
4 managing crops to reduce water loss, and
5 not planting crops at all.

III. SOIL

Soil erosion is fast becoming one of the world's severe problems. It is estimated that "more than a thousand million tonnes of southern Africa's soil are eroded every year. Experts predict that crop yields will be halved within thirty to fifty years if erosion continues at present rates." Soil erosion is occurring worldwide. The phenomenon is being called peak soil as improper soil management techniques in some areas of the world are jeopardizing humanity's ability to grow food in the present and in the future. Without efforts to improve soil management practices, the availability of arable soil will become increasingly problematic. Intensive agriculture reduces the carbon level in soil, impairing soil structure, crop growth and ecosystem functioning, and accelerating climate change. Soil management techniques include no-till farming, keyline design, windbreaks to reduce wind erosion, incorporating carbon-containing organic matter back into fields, reducing chemical fertilizers, and protecting soil from water run-off.

IV. METHODS

What grows where and how it is grown are a matter of choice. Two of the many possible practices of sustainable agriculture are crop rotation and soil amendment, both designed to ensure that crops being cultivated can obtain the necessary nutrients for healthy growth. Soil amendments would include using locally available compost from community recycling centers. These community recycling centers help produce the compost needed by the local organic farms.

Using community recycling from yard and kitchen waste utilizes a local area's commonly available resources. These resources in the past were thrown away into large waste disposal sites, are now used to produce low cost organic compost for organic farming. Other practices includes growing a diverse number of perennial crops in a single field, each of which would grow in separate season so as not to compete with each other for natural resources. This system would result in increased resistance to diseases and decreased effects of erosion and loss of nutrients in soil. Nitrogen fixation from legumes, for example, used in conjunction with plants that rely on nitrate from soil for growth, helps to allow the land to be reused annually. Legumes will grow for a season and replenish the soil with ammonium and nitrate, and the next season other plants can be seeded and grown in the field in preparation for harvest.

Monoculture, a method of growing only one crop at a time in a given field, is a very widespread practice, but there are questions about its sustainability, especially if the same crop is grown every year. Today it is realized to get around this problem local cities and farms can work together to produce the needed compost for the farmers around them. This combined with growing a mixture of crops (polyculture) sometimes reduces disease or pest problems but polyculture has rarely, if ever, been compared to the more widespread practice of growing different crops in successive years (crop rotation) with the same overall crop diversity. Such methods may also support sustainable weed management in that the development of herbicide-resistant weeds is reduced. Cropping systems that include a variety of crops (polyculture and/or rotation) may also replenish nitrogen (if

legumes are included) and may also use resources such as sunlight, water, or nutrients more efficiently.

Replacing a natural ecosystem with a few specifically chosen plant varieties reduces the genetic diversity found in wildlife and makes the organisms susceptible to widespread disease. The Great Irish Famine (1845–1849) is a well-known example of the dangers of monoculture. In practice, there is no single approach to sustainable agriculture, as the precise goals and methods must be adapted to each individual case. There may be some techniques of farming that are inherently in conflict with the concept of sustainability, but there is widespread misunderstanding on effects of some practices. Today the growth of local farmers' markets offer small farms the ability to sell the products that they have grown back to the cities that they got the recycled compost from. This will help move people away from the slash-and-burn or slash-and-char techniques that are the characteristic feature of shifting cultivation. These are often cited as inherently destructive, yet slash-and-burn cultivation has been practiced in the Amazon for at least 6000 years. Serious deforestation did not begin until the 1970s, largely as the result of Brazilian government programs and policies.

There are also many ways to practice sustainable animal husbandry. Some of the key tools to grazing management include fencing off the grazing area into smaller areas called paddocks, lowering stock density, and moving the stock between paddocks frequently.

- Sustainable intensification

The increased production of nourishment while simultaneously contributing a positive effect on natural and social investment; is a prospect of sustainable agriculture. Sustainable Intensification encompasses specific agriculture methodologies that increase production and at the same time help in improving environmental outcomes. The desired outcomes of the farm are achieved without the need for more land cultivation or destruction of natural habitat; the system performance is upgraded with no net environmental cost. Sustainable Intensification has become a priority for the United Nations as of late; the goal is to create an interrelation between agriculture and landscape. Sustainable intensification differs from prior intensification methodologies by placing specific importance on broader environmental and social outcomes. The concept of SI has been gaining traction across farms on the globe. By the year 2018; it was predicted in 100 nations a combined total of 163 million farms adopted an agriculture substitution-redesign threshold because of the utilization of SI concepts. The amount of agricultural land covered by this is 453 million ha of land. That amount of land is equal to 29% of farms worldwide. In light of concerns about food security, human population growth and dwindling land suitable for agriculture, sustainable intensive farming practises are needed to maintain high crop yields, while maintaining soil health and ecosystem services. The capacity for ecosystem services to be strong enough to allow a reduction in use of synthetic, non-renewable inputs whilst maintaining or even boosting yields has been the subject of much debate. Recent work in the globally important irrigated rice production system of East Asia has suggested that - in relation to pest management at least - promoting the ecosystem service of biological control using nectar plants can reduce the need for insecticides by 70% whilst delivering a 5% yield advantage compared with standard practice.

- Soil treatment

Soil steaming can be used as an ecological alternative to chemicals for soil sterilization. Different methods are available to induce steam into the soil in order to kill pests and increase soil health.

Solarizing is based on the same principle, used to increase the temperature of the soil to kill pathogens and pests.

Certain crops act as natural biofumigants, releasing pest suppressing compounds. Mustard, radishes, and other plants in the brassica family are best known for this effect. There exist varieties of mustard shown to be almost as effective as synthetic fumigants at a similar or lesser cost**.**

- Urban planning

The use of available city space (e.g., rooftop gardens, community gardens, garden sharing, and other forms of urban agriculture) for cooperative food production may be able to contribute to sustainability. A recent idea (2014) is to create large, urban, technical facilities for Vertical farming. Potential advantages include

year-round production, isolation from pests and diseases, controllable resource recycling, and reduced transportation costs.

Increasing threats of climate change have influenced cities and public officials are thinking more proactively about the ways they can deliver services and food more efficiently. The environmental cost of transportation could be avoided if people take back their connection to fresh food. This raises questions; however, about the excess environmental costs associated with local farming vs more large scale operations which offer food security around the world.

V. BARRIERS

- Epistemic barriers

Since World War II, dominant models of agriculture in the United States and the entire national food system have been characterized by a focus on monetary profitability at the expense of social and environmental integrity.

In sustainable agriculture, changes in lower rates of soil and nutrient loss, improved soil structure, and higher levels of beneficial microorganisms are not quick. The changes are not immediately evident to the operator when using sustainable agriculture. In conventional agriculture the benefits are easily visible with no weeds, pests, etc. and the "process of externalization" hides the costs to soil and ecosystems around it. A major barrier to sustainable agriculture is the lack of knowledge of its benefits. Many benefits are not visible, so they are often unknown.

- Geographic barriers

Not all geographic regions lend themselves easily to sustainable agriculture. While all parts of the world with human population need food to survive, many of these places are located in climates that make food production difficult. In Nunavik, which is located in northern Canada, it was discovered that the sustainable agricultural development needed to provide its native population with better nutrition would be difficult to adopt due to the regions isolation and arctic climate. Sustainable agriculture in regions where resources are scarce can be difficult due to the restrictions on the productive abilities of the area. Certain areas lack fertile soil to grow crops, others lack the technology to produce models for sustainability, and some do not have enough water for agricultural upkeep.

- Solutions to geographic barriers

The technological advancement of the past few decades have allowed access to these areas and the means to develop sustainable agriculture in some of these previously obstructed regions. The implementation of greenhouses has been an effective method in overcoming the geographic barriers in certain parts of the world. For example, Nepal has implemented greenhouses to deal with its high altitude and mountainous regions. Greenhouses have also been used to provide sustainable agriculture to arid climates in places such as Africa and Mexico. Greenhouses allow for greater crop production because of increased humidity and also use less water since it is a closed system.

Desalination techniques have been developed to allow greater access to fresh water in areas that have historically had limited access. The desalination process turns salt water into fresh water and will allow the irrigation of crops to continue without making a harmful impact on the water supply. While desalination can prove to be an effective tool to provide fresh water to areas that need it to sustain agriculture, it requires money and resources. Regions of China have been considering large scale desalination in order to increase access to water, but the current cost of the desalination process makes it impractical.

- Promote Environmentally Sustainable Agriculture

For agriculture to be sustainable, land and water must be used efficiently to reduce negative impact on the environment and ensure resilience to climate change.

We cannot achieve global food security without preserving the services that ecosystems such as trees and forests provide, and we can’t sustain forests without thinking of how we will feed a growing global population.

The World Bank champions a landscape approach to managing land, water and forest resources. This weighs the benefits of pristine natural resources with the benefits of production for food and other commodities. The goal is to maximize productivity,

improve livelihoods and minimize negative environmental impact. Put more simply, we can use natural capital without using it up.

One such approach is "Climate-Smart Agriculture" or CSA which has huge potential to increase productivity, enhance resilience, and lower our footprint. This includes practices such as improving the management of livestock and rangelands and enhancing soil carbon.

- Better Management of Livestock and Rangelands

The Bank supports investments to better manage environmental and health problems related to raising livestock, which includes reducing methane emissions and nutrient runoff. To date, the Bank has helped improve environmental practices on livestock farms and implement better waste management systems to reduce methane emissions and preserve soil quality.

Protecting pasture and rangelands so that they continue to be productive is equally important.

The Bank helps prevent the degradation of pastures and other landscapes, upgrades grasslands to more productive species, strengthens pastoralist associations and improves land and water rights. To boost the resilience of these landscapes to climate change, the Bank promotes practices that increase crop yields while enhancing the retention of carbon in soils, as well as agro-forestry, which could potentially sequester carbon and preserve agricultural productivity, even during extreme weather events. The Bank has helped empower pasture users' associations to improve pasture management.

- Promoting Sustainable Forest Management

Forests absorb about 15 percent of the planet's greenhouse gas emissions. Unless properly managed, they are vulnerable to deforestation and degradation—about 13 million hectares of forests are lost every year. The Bank works with countries to sustainably manage their forests--through improved management systems, stronger forest governance and law enforcement, community forest management that emphasizes benefit sharing, improved pest management and fire prevention, conservation and restoration activities and use of the latest technologies. With Bank support, watershed management has been improved in China and Albania, 70 million hectares of rainforest are now protected in Brazil and forest law enforcement has been strengthened in 7 Eastern European countries including Belarus, Moldova and Russia. The Bank has also worked with farmers to regenerate forests in Ethiopia, which has boosted food security.

- Advantages and disadvantages of eco sustaining agriculture

Sustainable agriculture is a term that is used to define farming practices that are conducted with three main aims; environmental conservation, economic profitability as well as social equity. In simple terms, it can merely be referred to as responsible farming. It entails farming with the goal of obtaining better yields while making sure that the environment is well protected to support farming even in several years to come. Sustainable agriculture has quite a number of advantages, the reason why most governments today are advocating for farmers to adopt it. One thing that should be noted about sustainable agriculture is that it does not advocate for the use of chemicals and commercial fertilizers in the cultivation of crops. The reason for this is because the commercial fertilizers that are being manufactured today contain harsh ingredients that alter the PH levels of soil and also leave certain harmful effects on the environment that can pollute it in various ways, hindering soil fertility. Thus, sustainable agriculture is advantageous in that, it helps in the preservation of the natural ecosystem, thus, healthy produce.

- Disadvantages of eco sustaining agriculture

1 It limits the proper use of the land.
2 It also hinders the full exploitation of land, labor and capital.
3 This is because it advocates for the use of productive resources sparingly.
4 It is also hard to maintain the fertility of the soil by simply rotating crops.
5 Income that is generated from the farming is also very limited due to sparingly use of land.

- Advantages of eco sustaining agriculture

1 Contributes to environmental conservation.
2 Prevents pollutions.
3 Reduces costs.
4 Keep biodiversity.

5 Preserves social equality.
6 Achieves the integration of natural biological cycles and controls.
7 Protects and renews soil fertility and the natural resource base.
8 Optimize the management and use of farm resources.
9 Reduces the use of non-renewable resources and purchased production inputs.
10 It does not advocate for the use of chemicals and commercial fertilizers.
11 This reduces certain harmful effects on the environment that can pollute it.
12 This preserves the natural ecosystem, thus, healthy produce.
13 It promotes the culture of raising animals through feeding on natural feeds.
14 There is better protection of animal species, creating a natural balance in the ecosystem.

- Benefits of Sustainable Farming: The Future of Agriculture

The benefits of sustainable farming can be found from producing healthy food for humans and animals, to conserving the environment and empowering farmers economically. Sustainable farming, which simply means producing crops and livestock using practices that have minimal effects on the environment, has a wealth of benefits. Unlike industrialized farming that focuses on mass production for maximum profits, impact on ecosystem notwithstanding, sustainable farming is a balanced type of agriculture that seeks to protect public health, animal welfare, environment and human communities.

- Benefits of Sustainable Farming

Health
The first benefit that comes out of sustainable farming discourages the use of inorganic resources in production. As a result, animal and human health is enhanced as more chemical-free food is made available.

Environment
Environmental benefits of sustainable farming are numerous. From lowering greenhouse gas emission (we are seeing the result now) to keeping the soil rich with organic matter, this method of farming enhance a pollution-free environment.

In sustainable agriculture there is a decreased use of synthetic chemicals and non-renewable resources. Reduction in soil contaminants contributes not only to soil health (enhancing future productivity) but also, decreasing the chances of having consumer's bio-accumulating heavy metals like lead (Pb) and arsenic (Ar).

Notable also, is the drastic reduction in soil erosion, which is achieved through practices like mulching, reduction of runoff through managed irrigation and elimination of tillage.

Economical
Sustainable farming leads to a reduction in the use of expensive synthetic fertilizers and other inorganic resources in livestock and crop production thus, farmers are able to save on inputs. In addition, urban farming which is a type of sustainable farming, cuts on transportation costs leading to lower food prices.

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