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Sustainable Agriculture for Food

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Agriculture is the world's largest industry. It employs more than one billion people and generates over $1.3 trillion dollars-worth of food annually. Pasture and cropland occupy around 50 percent of the Earth's habitable land and provide habitat and food for a multitude of species. When agricultural operations are sustainably managed, they can preserve and restore critical habitats, help protect watersheds, and improve soil health and water quality. But unsustainable practices have serious impacts on people and the environment. The need for sustainable resource management is increasingly urgent. Demand for agricultural commodities is rising rapidly as the world's population grows. Agriculture's deep connections to the world economy, human societies and biodiversity make it one of the most important frontiers for conservation around the globe.

Defination of Sustainable agriculture

• A sustainable Agriculture is a system of agriculture that is committed to maintain and preserve the agriculture base of soil, water, and atmosphere ensuring future generations the capacity to feed themselves with an adequate supply of safe and wholesome food '
- (Gracet, 1990)

A broad and commonly accepted definition of sustainable Agriculture is as follows:

- Sustainable Agriculture refers to an agricultural production and distribution system that
- Achieves the integration of natural biological cycles and controls • Protects and renews soil fertility and the natural resource base
- Reduces the use of non-renewable resources and purchased (external or off - farm) production inputs
- Optimizes the management and use of on- farm inputs
- Provides on adequate and dependable farm income
- Promotes opportunity in family farming and farm communities, and Minimum adverse impact on health, safety, wildlife, water quality and the environment
- The ultimate goal or the ends of sustainable agriculture is to develop farming systems that are productive and profitable, conserve the natural resource base, protect the environment, and enhance health and safety, and to do so over the long - term.
- The means of achieving this is low input methods and skilled management, which seek to optimize the management and use of internal production inputs (i.e., on - farm resources) in ways that provide acceptable levels of sustainable crop yields and livestock production and result in economically profitable returns.

- This approach emphasizes such cultural and management practices as crop rotations, recycling of animal manures, and conservation tillage to control soil erosion and nutrient losses and to maintain or enhance soil productivity.

Elements of sustainability

A. Soil conservation- Many soil conservation methods, including contour cultivates contour bun-strip cropping cover cropping, reduced tillage etc help prevent loss of soil due to wind and water erosion.

B. Crop diversity- Growing a greater variety of crops on a farm can help reduce risks from extremes in weather, market conditions or crop pests. Increased diversity crops and other plants, such as trees and shrubs, also can contribute to soil conservation, wildlife habitat and increased populations of beneficial insects.

C. Nutrient management: Proper management of nitrogen and other plant nutrients con improve the soil and protect environment. Icreased use of farm nutrient sources such as manure and leguminous cover crops, also reduces purchased fertilizer costs.

D. Integrated pest management (IPM)- IPM is a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in way that minimizes economic, health and environmental risks.

- Marketing: Farmers across the country are finding that improved marketing way to enhance profitability, agricultural product from farmers to consumers is becoming much more common, including through marketing yard road side stands.
- Status of sustainable Agriculture in India: Suitable Development of India demands access to state of are ‘clean’ technologies and have as strategic role in increasing the capabilities of the country both of the environment as well as to provide thrust towards conservation and sustainable agriculture.
- Current research programmes towards sustainable agriculture are as follows:

1. Resistant crop varieties to soil, climatic and biotic stresses
2. Multiple cropping system for irrigated areas and tree-based farming system rainfall area.
3. Integrated nutrient management
4. Integrated pest management
5. Soil and water conservation

Factors Affecting Sustanability of Agricultural Resources

a) Land/soil related problems:

- Soil degradatiom
- Deforestation
- Accelerated soil erosion
- Siltation of reserves
- Wind erosion

b) Irrigation related problems:

- Rise in groundwater table & water logging
- Soil salinization & alkalization
- Over- exploitation of groundwater

c) Indiscriminate use of agro-chemicals:

- Fertilizer pollution
- Pesticide pollution

d) Environmental pollution

- Greenhouse effect

Sustainable agriculture - the challenges

The challenges for agriculture with regard to a more efficient and environmentally friendly method of cultivation will be growing significantly in the coming years:

Growing enough food

While the world population is increasing, the amount of arable land per capita is diminishing. Each person currently has 0.21 hectares at his or her disposal; this will rise to 0.15 hectares of basic food resource per capita in 2050. Our machines enable us to help ensure that yields per hectare, e.g.for wheat and feed grain, continue to rise. After all, a large proportion of the world's crop production comes from the targeted use of fertilisers and plant protection.

The current world population will grow to an estimated 9.7 billion people in 2050. In this respect, arable farming is a cornerstone of food security. Agriculture and agricultural technology are therefore systemically important.

Loss of usable land

Around 60 hectares of usable agricultural land are lost every day to alternative uses for industrial and residential development in Germany. The remaining land must therefore be used more efficiently.

Energy

Agriculture is playing an increasingly important role as a producer of renewable energy. Bioenergy for electricity, heat and fuel can save significant amounts of emissions from agriculture.

Climate change

Climate change can lead to weather extremes worldwide. In some regions, lower rainfall will lead to longer periods of drought, meaning that the amount of land which was previously adequately supplied with water is reduced.

Resources

Climate protection, soil protection and water conservation form part of sustainable agricultural practices. CO2, methane and nitrous oxide emissions should therefore be reduced, ground water and bodies of surface water protected and erosion and harmful compaction avoided.

Political and legal requirements

Increasing political requirements for a reduction in the use of plant protection agents and fertilisers as well as the abandonment of certain plant protection agents necessitate modified cultivation methods in crop production.

Cost and efficiency pressure

Cost and efficiency pressures for farms will continue to increase in many regions due to falling product prices, stricter environmental regulations, reduced public subsidies and rising costs for rents and wages.

Economic Sustainability

Economic sustainability is vital component of sustainable agriculture. Green revolution in Asia has substantially enhanced the agriculture production through improved provision and use of inputs (new cultivars, chemical fertilizers and pesticides). The advancement of agriculture technology boosted the grain yield in Asia by 3.57% annually during 1965–1982. The yield of rice and wheat has increased from 150% to 250% respectively in sub- continent and Indonesia (FAO 2014). This rise in agricultural crop yields lead to many fold increase in per capita income of farmers. For instance, in two provinces of India (Haryana and Punjab) the poverty declined from 35.2% to 8.1% and 28.1–8.4% in 2004/2005. In Pakistan, post green revolution has improved the food security situation as per capita caloric intake has increased from 2462 in 2000 to 1748 in early 1960s. Moreover, population density, agriculture credit facilities, market situation, food habits are also key determinants of economic sustainability.

The green revolution has resulted in improved economic sustainability of agriculture production system in South Asia. During past few decades, the increase cost of production due to high prices of seed, fertilizer, labor and machinery and yield stagnation has led to economic unsustainability. Recently, Zulfiqar and Thapa (2017) studied the economic, environmental and social sustainability of Agriculture of Pakistan. To study the economic sustainability, they used overall crop production and stability of crop production as indicators, while environmental indicators were crop diversification, soil salinization, fertilizer use (organic and inorganic) and pesticide usage. Moreover, food security and employment of rural labor force were social sustainability indicators. They found regional differences for agriculture sustainability across Pakistan. Their findings revealed the tendency of unsustainable production in all provinces (Punjab, Sindh, Balouchistan and KPK) as the farmers in Sindh and Punjab are using more chemical fertilizers, pesticide and pumping ground water for irrigation purposes. The lack of sustainability in Balochistan and KPK was due to low use of fertilizer and pesticides and even no application in some areas. Furthermore, groundwater pumping for irrigation in coastal areas further increases the unsustainability of agriculture.

Arable landholding and soil fertility also influence the economic sustainability of agriculture. In a study, Wasąg and Parafiniuk (2015) assessed the ecological and social sustainability in Roztocze Region of Poland. They found that bigger holdings 70 ha UAA (utilized agricultural area) have ecological stability due to high organic matter in soil. Although these holdings have high organic matter decomposition but the balance remained positive due to increased addition of manure as these holdings have large scale of animal production. Similarly, social sustainability was also observed in holding >30 ha due to increased mechanization which reduced the workload i.e. <100man hours per ha. Niemmanee et al. (2015) studied the existing agricultural systems cover on the environmental, economic and social condition of Samut Sakhonn Province, Thailand and suggested suitable pattern for sustainable agriculture. The major characteristics of this sustainable agriculture system were use of mixed cropping systems with string bean (most supplementary plants) and chili, less use of pesticides and chemical fertilizers and more use of manures, crop residues and application of knowledge gained through training and its dissemination.

In conclusion; the higher use of chemical fertilizers, pesticides and other inputs along with fluctuating agricultural markets has resulted in increased agricultural production over

the years however, there is also indication of economic unsustainability due to increased use of inputs and its high input costs.

References

1. Haugen-Kozyra K, Goddard TM (2009) Conservation agriculture protocols for green-house gas offsets in a working carbon market. In: Paper presented at the IV World Congress on Conservation Agriculture, 3–7 February 2009, New Delhi, India
2. Resource conservation and environmental sustainability. Indian Res J Ext Educ 2:49–54
3. CM (2019) Cost-effective opportunities for climate change mitigation in Indian agriculture. Sci Total Environ 655:1342–1354
4. Wikipedia: Amazon - https://amazone.net/en/company/sustainability