SUSTAINABLE AGRICULTURE

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Abstract:

Sustainable Agriculture in simple words means agriculture which could sustain for a longer period of time on a particular land area.

The paper concentrates on the ill- effects of introduction of chemical inputs and output fortifying techniques on climate change, land and water pollution and introduction of sustainability in agriculture through complex agro- ecosystems. The various problems related to the development of Sustainable Agriculture are also taken into consideration. There are various suggestions to improve sustainability in agriculture are given at the end.

1. Introduction:

Developing countries like India are in the Second Stage of Demographic Transition characterized by Population Explosion. Such overpopulated countries are in a Malthusian Under-Employment Equilibrium position based on a subsistence structure. Unplanned population growth tends to impose severe stress on any nation's agricultural lands.

India as a developing country has so far seriously pursued only the high energy input pathway for agriculture, in order to attain self-sufficiency in food for its increasing population pressure. Whilst we

have achieved a lot in this direction, the technology based agricultural development which was designed more to suit the socio-ecological conditions prevailing in the developed countries, though not sustainable even there, is showing its negative impact through soil degradation, leading to decline in potential productivity from the land.(Ramakrishnan P.S.-2008).

While the environmental implications of economic growth have been widely noted in the engineering and economic literature for at least the past fifty years or even more, global concerns relating to energy and environmental conservation, climate change, and ecosystems in general became crystallized after the Earth Summit held in Rio De Janerio in 1992(D.M. Nachane-2011). India has achieved notable economic growth during the last six decades. However, as the country enters the new millennium poised to attain gross domestic product (GDP) growth in excess of 8 per cent per annum, it is confronted with the spectre of environmental pollution and natural resource degradation.(Puran Mongia-2010). Degradation witnessed on land and water resources due to intense use of fertilizers are mentioned below.

2. Land Degradation:

2.1. Land Pollution:

India's total geographical area is just over 328 million hectares. But far, the most serious environmental crisis facing poor countries like India is the wholesale degradation of their productive land resources on which most of their people depend directly for their basic survival. (Uma Devi and Reddy- 2007). The path of food self-sufficiency through green revolution did cost highly both social and

economical. The negative impact of over production on land are witnessed through organic carbon depletion, soil salinity, drastic change in soil- water regimes, pesticide poisoning. The north- western parts of the Indo- Gangatic plains has started showing signs of declining agricultural productivity.

With a richer accumulation and slowly decomposing soil carbon pool, under lower soil temperature conditions, the temperate soil of India is more responsive to fertilizer application, over a much longer period of time. (Ramakrishnan P.S. -2008). Just as all vegetative matter depends on the land for its survival, the survival of land also depends on plants. India is estimated to be losing annually, 6000 million tons soil in this manner. Both water logging and salinity severely affect crop yields. If they are left unchecked, once fertile soils soon become totally unproductive, salty wastes. (Uma Devi and Reddy- 2007).

2.2. Soil Erosion:

Warmer soil temperature in the tropics, compounded by highly seasonal monsoonal rainfall, as in India and many parts in Asia, accelerate Soil degradation. (Ramakrishnan P.S. -2008).

3. Climate Change:

Changes in average temperature, shifting patterns of rainfall and changes in the frequency and intensity of extreme weather events can affect agriculture in ways that are unpredictable. It is likely that water availability for agriculture and other uses, including drinking and ecosystem services will considerably decrease in semi-arid and arid areas, thus affecting food security and rural livelihoods (Fraiture et al 2010).

Being large sources of greenhouse gas emissions, the agricultural sectors in these countries will have to be reoriented through climate-resilient farming practices. Trends as of 2005 reveal that agricultural methane (CH4) emissions contributed about 65% of the greenhouse gas emissions in India. (P K Viswanathan, Thapa, Routray, Ahmad-2012)

4. Pesticide Poisoning:

Pesticide Poisoning in India led a 100 deaths in Kerela and 250 deaths in Uttar Pradesh due to pesticide contamination of stored wheat. Pesticide contamination in food is growing at such an alarming rate that an Indian may be taking 0.665 mg. of DDT along with every meal. This DDT is contaminating the breast milk of mothers also. Indian farmers, being not informed, are unaware of the dangers and effects of prolonged pesticide usage. (Uma Devi and Reddy- 2007). Economically viable pest management strategies need to be put in place so as to meet present and future requirement of food.

5. Agrarian Transition:

However, agricultural transition in Asia brings out a major con-tradiction. While a handful of countries, particularly Japan and South Korea, have achieved rapid rural transformation and become advanced industrial economies, a majority of the countries, especially in south and south-east Asia, still remain predominantly agrarian.(P K Viswanathan, Thapa, Routray, Ahmad-2012)Though empirical literature on the economic benefits of growing GM crops is available, very little is known from the food and ecological security perspectives about the risks of growing more and more of them. There has been relatively little biosafety research on the health and environmental

effects of GM crops (UNESCAP 2009). The problems in the adoption of GM crops7 are also a matter of serious debate, needing systematic and long-term studies specific to these crops across countries. The greatest challenge posed by GM technology is that unlike the GR, R&D and technological innovations are largely owned and exploited by Multinational Companies (Lipton 2010). Not surprisingly, many countries do not have strong regulatory systems and rural institutions that facilitate an informed choice of GM crops by resource-poor farmers (Tripp 2009).

At present, watershed programmes, especially, in the semi-arid regions, have adopted two rather extreme approaches of concentrating either on first water harvesting structures and thereby promoting irrigation intensive crops. Or, second these resort mainly to in-situ conservation of rainwater without significantly increasing irrigation facilities for a large number of farms and households. As a result, one often observes that increased availability of irrigation is used intensively by a smaller number of farms and households. This apparently, results in favourable benefit-cost ratios despite the fact that the remaining land continues with low productivity and scanty vegetative cover (Shah, 2000). Moreover, with increased irrigation on a selective area under cultivation, there is always a tendency to shift towards more water-intensive crops like cotton, spices or vegetables. This kind of selective benefit however, may neither be conducive for stabilizing yields nor be effective for regeneration of land.

5.1. Green Revolution:

The ‘green revolution’ in Haryana which was a part of an inter-Academy sponsored inter-disciplinary studies. The Haryana case study

is a typical example of the impact of high input agriculture on the ecological and economic front. No doubt it has become a major bread-basket of India, playing a crucial role in the food security of the nation.(Ramakrishnan P.S. -2008) However the success is build on receding water resources, with sharp drop in the groundwater table in some areas, and water logging in others. The excessive use of fertilizers and pesticides has led to a deterioration of land and soil quality.

5.2. Problems of Small Land Holders:

A substantial section of the rural population of about 60%, working outside the green revolution sector struggle with their traditional monoculture production systems. Green revolution technologies and a vigorous smallholder sector have seen Asian agriculture make giant strides in the last five decades. But agricultural transition has not been uniform across Asia and the future of smallholder agriculture faces several challenges arising from a range of socio-economic, demographic, structural and institutional factors that could adversely affect its sustainability. The significance of the Asian smallholder sector is that it produces 80% of the food consumed in the developing world and feeds one-third of the global population (FAO 2011). Smallholder agriculture in Asia faces several challenges arising from a range of socio-economic, demographic, structural and institutional factors that could adversely affect its sustainability. The challenges include (a) the shrinking size of farms; (b) distress-induced rural-urban migration that has led to an increasing number of women and old people in agriculture; (c) persistent technological and institutional constraints; (d) climate change and its adverse impacts; and (e) the emergence of genetically modified (GM) crops and

problems to do with their adoption. . (P K Viswanathan, Thapa, Routray, Ahmad-2012)

5.3. Organic Farming:

To reduce the burden of chemical fertilizers, to insure effective utilization of farm resources and to cater domestic and internationally growing Organic Food Market, a national project on Organic farming was launched during 10th Plan with an outlay of Rs. 115.00 crore. This scheme is being continued in 11th Plan with an outlay of Rs. 101 crore. Its main objectives were to build Capacity through Service Providers, Financial and Technical support for setting up of organic input production unit such as Fruits and Vegetable market waste compost, Biofertilisers and biopesticides and vermiculture hatcheries, Human resource development through training and demonstration, Awareness creation and market development, Quality control of Organic Inputs, Biological assessment of Soil Health.

6. Complex Agro-ecosystems:

According to P. S. Ramakrishnan complex agricultural systems can be classified loosely on the intensity of land. There exist a wide range of complex agro- ecosystem types with biodiversity comparable to that of the natural ecosystems in tropics.

6.1. Shifting Agriculture:

This is also called the Jhum agriculture in India is the basic alteration of short-crop phases with phases of natural or slightly

modified vegetation fallow. This system maintains diversity in the cropping phase through mixed cropping. Here agricultural ecosystem functions such as nutrient cycling and pest population dynamics are controlled both through the complex cropping and the fallow phases. During the fallow phase that soil fertility recovery occurs, which in turn determines economic yield. In the north-east Indian hill areas, where shifting agriculture is the major land use, a minimum of 10- year (now 5- years) cycle was found to be necessary for its sustainability.

6.2. Rotational Fallow:

In north- eastern India where the shifting agricultural cycle has fallen to 5- years, long fallow systems have been replaced by shorter fallow systems. Very often leguminous crops may form part of the mixed cropping system (3-10 crop species), involving traditional crops such as rice or maize along with lesser known crops of food value.

6.3. Traditional sedentary cropping system:

With increase in population pressure, the fallow system may be replaced by fully sedentary systems that may still remain mixed cropping, but where the weed biomass between two successive cropping phases is ploughed in, supplemented by some organic and/or inorganic fertilizer input.

6.4. Home Gardens:

It is prevalent in regions such as north- east India and Kerala. These are small plots, usually of ½- 2 hectares, located close to the habitation and fertilized with household wastes. They are rich in plant species diversity, dominated by woody perennials, structurally stratified, and with a mixture of annuals and perennials of varied

habits- herbs, shrubs, trees and vines as well as more conventional annual food crops. This self- sustaining system are ecologically and economically efficient, but fast disappearing.

6.5. Compound Farms:

A mixture of the land use systems under the control of the same household are not usually found. The sub-systems may range from the home gardens through shifting agriculture to fully sedentary and relatively specialized fields.

6.6. Mixed arable- livestock farming:

Shifting cultivation being a characteristic of the humid tropics, agriculture in the drier savanna zones has traditionally been centered on livestock production. Cattle provide a resource for arable production in terms of draft power for ploughing and cartage and a source of manure for fertilization. Thus, nutrients are harvested from pastures during grazing, and transferred and concentrated on the crop fields.

6.7. Traditional agro- forestry system:

In this system, trees are common components either retained selectively from the natural vegetation or deliberately planted.

6.8. Agri- silviculture:

This land use involves the use of crops and trees, including shrubs or vines on the same land. Multipurpose trees, including fruit trees and shrubs are mixed with arable crops on farmland. Trees are used as windbreaks, contour barriers or boundary makers here.

6.9. Silvi-pastoralism:

It is a combination of pastures and trees. It includes grazing systems for livestock in the form of grass-legume mixtures as well as fences of fodder trees and hedges, and scattered trees and shrubs on pasture lands.

6.10. Agri-silvi-pastoralism:

It combines food crops, pastures for livestock and trees. Often, woody hedges may provide browse, mulch, green manure, erosion control and riverbank stabilization.

6.11. Specialised cash crop system:

In the tropics 'high value' crops form part of traditional economies, being bartered for other products. These crops also become important components of the cash economy. Many of these systems also continue to emphasis recycling of organic residues, with minimal dependence upon inorganic fertilizers and the specialized crops are commonly inter spread with other plants.

6.12. Intercropping and crop rotation:

It is a practice whereby more than one crop is cultivated in the same land area, through time. This represents a good anti-risk investment for farmer, both in terms of range of potential products as well as the ecological strategies it can embrace.

6.13. Alley Cropping:

Trees are planted closely in rows to form hedgerows and the crops are grown in the 'alleys' between them. The trees are regularly pruned to reduce above-ground competition effect with crops.

6.14. Modern Monocropping Agriculture:

It is based on the use of high-yielding varieties of a particular ideotype replacing biodiversity in agriculture. Intensively managed fruit plantations and orchards, vegetable crops and intensive cereal production system are some examples.

7. Remedies and Suggestions:

- Farmers should be informed about the long-term control methods instead of relying on toxic chemicals.
- Proper use of equipments and safety measures needed in handling pesticides should be taught to the farmers.
- The production of economically valuable timber management of soil quality crucial for long term sustainability of Green Revolution should be taken into consideration in agro-forestry practices.
- Various techniques that could help sustainability in small land holdings should be developed.
- Better Land Acquisition Policies should be made.
- Agricultural Finance Institutions should play its role properly.
- Certification of seeds and use of genetically modified organisms (GMO) are yet other dimensions that need greater attention from the viewpoint of environmental governance.

8. Conclusion:

Agricultural Productivity should be enhanced preventing the negative externalities such as soil salinity, water logging, soil erosion, and pesticides pollution etc., created by them. This would ensure long term benefits in agricultural productivity. Today growth in production continues to be the main thrust leading to faulty use of inputs. Effective policy implementation is needed with a lot of transparency in order to Feed the Masses Without Starving the Environment.

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