

Sustainable Agriculture and Smallholders

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Sustainable Agriculture: Defined

Sustainable agriculture integrates environmental stewardship, farm profitability and prosperous farming community. It enables farms to produce food on a sustainable basis without damaging soils and eco-systems or human and social capital. It aims to maintain soil health while reducing reliance on external inputs (fertilizers, pesticides, herbicides) by

- Recycling crop wastes and livestock manure as nutrients
- Avoiding monocropping with better crop rotation involving a legume in the system
- Integrating crop-livestock-tree and natural pest control on individual farms

Sustainable agriculture emphasizes on

- The use of locally-adopted improved seeds and breeds
- Participatory technology development
- Spreading knowledge through farmer-to-farmer methods
- Community based management in pest control, irrigation, forest and credit management, besides watersheds

Thus sustainable agriculture relies on locally renewable resources and locally-based innovations.

Preamble

Earth resources are finite. Every use of resources has impacts. Agriculture is not an exemption. Farming and grazing have the largest negative environmental impact and remain unacceptably high. Further those effects are cumulative both spatially and temporally. So we need to continuously improve.

Let us realize (based on ISRIC data from 1983 to 2003), our country is losing 4.9 ha/minute due to degradation. The common causes are loss of soil organic matter (SOM) and consequent soil erosion (wind and water). In the process we are also losing agricultural biodiversity, the life-line of the poor and smallholders.

Agricultural Development

Agricultural development is at cross-roads. In spite of five decades of green revolution, *a la* chemical agriculture, over 320 million people are not having two square meals a day from early seventies onwards as per the Planning Commission. The gap between the rich and the poor has widened as per sponsored study done by the Institute of Applied Manpower Research. Also investments on agricultural development by the government, international lenders and foundations are at a HISTORIC low. Global trends indicate even agricultural extension services are reduced.

Green Revolution (GR)

The ecological crisis and technology fatigue in the case of GR is established. In 1968 itself, Prof. Swaminathan cautioned for proper understanding of GR so as to avoid a disaster than one of prosperity. Now he points out that GR lead to a greed revolution. Globally it is seen that not all segments of the population are benefited equally with GR. Added to this are newer problems. First is changing food habits with increasing demand for animal protein, fruits, vegetables and legumes and oils. Second is the loss in biodiversity since rice, wheat and maize (thanks to GR) constitute 60% of the world food. The “orphan” food crops that have high nutritive value and that are adaptive to varying environmental conditions need a revisit / attention, more so in the present context of climate change. Third is the migration of the rural poor to cities. Globally it is estimated that 70% of the estimated 9.1 billion would migrate to cities by 2050. In our country it could be at least 50%. Then as Timberlake said “starve the city dwellers and they riot; starve the peasants and they die. If you are a politician, which would you choose”. So the government ensures food security for urban residents to reduce urban unrest and political instability most likely at the expense of the rural and politically marginal populations.

The Wild Cards for Government

The wild cards for government on the next few decades are likely to be climate change (CC) and water. Both affect food production. And the strides made in food production are in a way based on “fossil fuel” economy. If the supply of inexpensive fossil fuel becomes unreliable in the future, increasing food production may become severely limited. Food sector accounts for 30% of world’s total energy consumption (mechanization, fertilizers, pesticides, harvesting, processing and transportation). About 10 calories are needed to produce 1.0

calorie of agricultural product. At least two aspects need immediate attention. First is considering renewable energy *in lieu* of fossil fuel. Second is avoiding wastages of food at post-harvest and storage levels. UN declared 2012 as the energy-smart production year. Let us have matching efforts. Presently 60% of the rural energy is from biomass. We must augment this approach.

Water is for people, food production, industry, power generation and environment. So business as usual is no answer. If water use, particularly groundwater exploitation continues the same way, the present 29% groundwater blocks that are critical / semi-critical or overexploited would be 60% by 2025. Unfortunately the government is allowing such a trend by spending over Rs 750 crores / annum on rainwater harvesting for groundwater recharge. Instead efforts could have been to improve SOM for optimized use of rainwater in rainfed agriculture so that more of it moves into soil and becomes part of the soil water sustaining rainfed agriculture in the 85 Mha out of 141 Mha of net cultivated area.

Input Management

Insofar as the inputs are concerned, their use efficiency has to improve or alternative systems have to be encouraged. Water use efficiency has to increase at least by 20% from the present level. Pressurized systems are efficient but are expensive with considerable subsidy component (unviable) and associated problems in efficient management. So at least in rainfed areas use of systems like deficit irrigation in *kharif* and come-up irrigation in *rabi* could be one example. The other is participatory groundwater irrigation management by creating more awareness on hydrology and available water from different sources for use by the Community. Already several case examples prove the feasibility of such an approach.

Nutrient Management

The goal for fertilizer use efficiency is to triple from the present level. By improving SOM, much can be achieved. The present average response to fertilizer of 6.5 kg/kg NPK can easily be improved to 20-25 kg. But let us also realize the costs of fertilizers are bouncing. Nitrogen fertilizer is based on fossil fuel energy system while phosphorus and potassium are from phosphate rock and muriate of potash. But they have their own peaks. If we consider phosphates in the recent past the costs of rock phosphate increased by 7 fold in a matter of 13 months. The present costs of fertilizers are as follows.

Commodity	Year	Price / tone (US \$)	Year	Price / tone (US \$)	Year	Price / tone (US \$)
Urea	1998	70	Jan 2008	404	Aug 2008	815
DAP	1993	110	Jan 2008	802	Aug 2008	1330
MOP	1993	80	Jan 2008	328	Aug 2008	945

FAO states that there is a 8-fold increase in the use of fertilizers from 1961 – 2006 with only a 1.5 times increase in grain yields.

Added to these, the problem of pollution and other effects are serious. Overuse of N leads to NO₃ – pollution of groundwater or N₂O emissions (a pernicious GHG). Similarly with excess phosphorus secondary problems like P-induced Zinc deficiency can occur. All these lead to unhealthy soils.

As a solution at least two options are available. First is to produce more biomass to meet the Nitrogen requirement of crops and use phosphorus and if needed potassium to a limited extent. The second is to move to **greener revolution** which lies in locally adapted knowledge which incidentally is also climate-smart agriculture. Among others it includes

- Mulching
- Intercropping
- Conservation tillage
- Crop rotation
- Integrated crop-livestock management
- Agroforestry
- Improved grazing
- Improved water management

Sustainable Agriculture (non-chemical farming)

Rhodale Institute compared chemical and no-chemical farming over 30 years and found the latter improved quality of food and improved soil health and water quality creating more jobs using 45% less energy over the former system and with 40% low GHG – emissions, producing comparable yields. So the main benefits are health of soil, crops, livestock and people with reduced costs in production.

Then, the adage should be increase productivity of crops without damaging the natural resources and leading to resilience and that is sustainable agriculture.

So the issues concerning future agricultural production have to be

- (i) Enhance organic fertilization (Enhanced C-sequestration: Need be paid as environmental service)
 - a. Biomass
 - b. Composting
 - c. Caring for humus
- (ii) Rehabilitate soils with low-nutrient status
 - a. N-fixation (Legumes)
 - b. Use of mycorrhizae
 - c. Improving SOM
 - i. Resultant earthworm activity (ecological engineers to mitigate CC effects)
 - ii. Improved physical, chemical, biological and hydrological parameters
- (iii) Optimized use of water in rainfed agriculture
 - a. Enhancing turnover of biomass
 - i. Enhanced infiltration
 - ii. Improved soil water
 - b. Location specific minimal irrigation
 - i. Deficit irrigation in *kharif*
 - ii. Come-up irrigation in *rabi*
- (iv) Agro-biodiversity
 - a. Consider orphan crops
 - i. Resilience even under CC
 - ii. Better nutrition
 - b. Use genetic biodiversity
 - c. Animal breeding
 - i. Protect genetic variability
 - ii. Use ability to stand variability with CC
 - d. Reducing GHG emissions
 - i. N₂O emission in relation to N-use by efficient use
 - ii. CH₄ emission with SRI and breeding ruminants for low emission

Smallholders in sustainable agriculture

Small farms are an integral part of Asian agriculture. They are characterized by the preponderance and emphasis on mixed crop-animal systems across a variety of agroecological zones. They are models of diversification, efficiency and resilience.

About 85% of our 166 million rural households are smallholders. FAO estimates that about 40% of foodgrains and 50% of fruits and vegetable are produced by them. Generally their farms are more productive, with 30% increase in economic efficiency compared to large-holders. However they need more skills to improve their technical efficiency.

The small farmers show lower per capita income and incidence of poverty is widespread. About 4/5 of their expenses is on farming operations that include land, water, equipment and inputs. Smallholders continue to largely depend on professional money lenders at high interest rates. Input costs are on increase. So low cost credit and alternate sources of income through off-farm employment are needed to protect them from the debt trap. Further they need institutional innovations in accessing inputs and services. The smallholders are mostly in hinterlands and so need better basic infrastructure facilities for their habitations.

Efforts of Government of India

The Government of India in their National Policy on Agriculture (2007) realized the need for separate dispensation to smallholders.

Since smallholdings are non-viable two steps have been suggested viz. (1) Increasing productivity and (2) Provide multiple livelihood opportunities through crop-livestock based systems and marketing (Processing, value addition). Further aims of government include (i) farming through groups, (ii) cooperative farming, (iii) group farming through SHGs, (iv) smallholder estates (e.g. cotton, horticulture, aquaculture, high value crops, poultry), (v) contract farming (e.g. organic production) and (vi) farmer companies (e.g. seed production, bio-pesticides). Government wants smallholders to be stakeholders and not shareholders in these ventures.

UK Hunger Free for Campaign

The Hunger Free for Campaign of UK suggested the following farming systems for smallholders.

- Small scale produces include family farmers, herders, gardeners, fisher folk, hunters and gatherers (NTFPs). Women are the majority of the workforce in agriculture
- Sustainable agriculture was found to increase yields by 79% in 286 projects covering 37 Mha in 57 countries. The technologies included IPM, conservation agriculture, agroforestry, water harvesting in rainfed areas and introducing aquaculture and livestock into farming system
- Such systems lead to
 - o An increase in food availability
 - o Increase in household income
 - o Increase in education, skills and health
 - o Formation of CBOs for community based management
 - o Improvement in infrastructure
 - o Benefits to natural environment
- Sustainable agriculture sequesters more carbon with increasing SOM
- UNEP advocates a switch to sustainable agriculture

Benefits of Sustainable Agriculture

Let us recapitulate the benefits of sustainable agriculture for smallholders as enunciated by IAASTD.

- Economic stability
- Improved health and nutrition
- More social resilience
- Increased ecological resilience
- Conservation of natural resources
- Climate change mitigation

In any case, the soil quality which is as important as water and air quality improves. Then we would have healthy and nutrition food as well.

Epilogue

The Government of India has realized that the future increases in agricultural production lie in rainfed agriculture and with smallholders. Rainfed areas are predominantly farmed by the smallholders. They constitute over 85% of the farmers and contribute upto 40% for the national foodgrain basket and about 50% to the fruits and vegetable kitty. They are economically efficient producers. They can further enhance their productivity if technical skills are provided.

With the ever-increasing costs in inputs (including labour), limited supplies of fertilizers in the years to come and the present ecological crisis with inefficient use of the production inputs, there is a need for looking for alternatives. Sustainable agriculture that can produce food without damaging soils and ecosystems or human and social capital is one option. It calls for internalized production systems that are both energy and climate-smart.

Sustainable agriculture also calls for community based management of the natural resources, production systems, peripheral forests and credit. The system relies on locally renewable systems and locally based innovations.

The concerned of IFPRI on “Tackling the Agriculture-Nutrition in India (TANDI)” indicates that due to pronounced slow down in the income growth of small and marginal farmers and wage labour, the malnutrition is pervasive. Sustainable agriculture partly can alleviate this problem with the ecological access of nutritious and healthy food.

Sustainable agriculture cools the climate and the practitioners must be paid for their ecological protection service. Further it leads healthy soils, healthy crops and livestock and a healthy NATION.

Post Script

The paper draws inspiration from several of the documents and research papers of different national and international agencies and individuals.