

SUSTAINABLE AGRICULTURE IN INDIA – OPPORTUNITIES AHEAD

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Abstract

Agriculture in India plays a central role in the economy of the country and employs more than half of the workforce of the country. Modern agricultural practices impact global warming. The continued use of chemical fertilizers and pesticides is destroying the environment. Sustainable agriculture reduces harm to the environment through the reduction or elimination of polluting substances such as pesticides and nitrogen fertilizers, water conservative practices, soil conservative practices, restoration of soil fertility, and maintenance of agricultural biodiversity. Agroforestry, ecological agriculture, regenerating agriculture, natural farming, and biological agriculture are a few processes by which the use of chemicals and chemical fertilizers is reduced and the target of sustainable agriculture may be obtained.

Reference to this paper
should be made as follows:

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INDIA – OPPORTUNITIES
AHEAD*

*Vol. XIII, Special Issue
pp.102-106
Article No.20*

Similarity Check: 0%

Online available at:
<http://jgv.anubooks.com>

DOI: [https://doi.org/10.31995/
jgv.2022v13iS.020](https://doi.org/10.31995/jgv.2022v13iS.020)

Agriculture in India plays a central role in the economy of the country and employs more than half of the workforce of the country. The green revolution has transformed our country from a food scarce to a food secure nation by applying an input-intensive and technology focussed approach. Long-term uses of chemical fertilizers have degraded our topsoil, contaminated water bodies, and reduced bio-diversities. Does not everyone know that modern agricultural practices impact global warming? The production of agrochemical substances is an important source of greenhouse gas emissions (GHG). Chemical fertilizers production is energy-intensive and accounted for 0.6-1.2 percent of the world's total greenhouse gas (GHG). These fertilizers have degraded soil and destroyed resources that are useful for storing carbon, such as forests and other vegetation. Farm operations with heavy machines, inorganic fertilizers, cross animal breeding, and burning of the straw decline in carbon organic content in soil are blamed to increase the greenhouse gas emission by about 20 percent. Lime is often applied in agricultural fields to increase the soil pH, leading to the net emission of carbon-di-oxide. Fertilized agricultural soils contribute a substantial amount of nitrous oxide to the atmosphere. Recent studies have made it evident that this input-intensive agriculture is a contributor as well as a victim of climate change.

Sustainable agricultural approaches can be in many forms, such as agro-ecology, organic agriculture, ecological agriculture, regenerating agriculture, natural farming, and biological agriculture. Its main components are – making the best use of nature's goods and services by integrating natural and regenerating processes like nitrogen fixation, and soil regeneration; minimizing non-renewable inputs like pesticides and fertilizers; improving self-reliance and skill of the farmers, depending on locally adopted practices to innovate in the face of uncertainty; promoting and protecting farmers capacities to work together to solve problems; being multifunctional and contributing to public goods such as clean water, wildlife protection, carbon sequestration in soils, flood protection and landscape quality. Sustainable agriculture reduces harm to the environment through the reduction or elimination of polluting substances such as pesticides and nitrogen fertilizers, water conservative practices, soil conservative practices, restoration of soil fertility, and maintenance of agricultural biodiversity. Sustainable agriculture approaches allow the farmers to improve their food production with low-cost, readily available inputs without causing environmental damage. As per an estimate by the UN Food and Agricultural Organisation (FAO), approximately 70% more food will be required than that of today to feed the entire population of the world by 2050. The continued use of chemical fertilizers and pesticides further destroys the environment.

The term sustainable agriculture was first used in the United States in the 1980s for a program of low-input agriculture. In our country, the central government initiated the National Mission for Sustainable Agriculture (NMSA) in 2014-15. Sustainable agriculture is the form of farming in which the agricultural outputs are maximized without compromising environmental and ecosystem issues. The main components of sustainable farming are soil management, water management, pest management, and waste management, the same required for our conventional farming but the methods used in sustainable agriculture are quite different from conventional farming. Sustainable farming integrates three main objectives- environment conservation, economic viability, and social issues. Its main principle is to meet the need of the present without compromising the ability of future generations to meet their own needs, Hence, the National Mission for Sustainable Agriculture has the following objectives –

1. To make Indian Agriculture more productive, remunerative, sustainable, and climate-resilient by promoting location-specific Integrated/Composite Farming Systems;
2. To adopt comprehensive soil health management practices based on soil fertility maps, soil test-based application of macro & micro nutrients, judicious use of fertilizers, etc.;
3. To optimize utilization of water resources through efficient water management to expand coverage for achieving '*more crop per drop*';
4. To optimize utilization of water resources through efficient water management to expand coverage for achieving '*more crop per drop*';

National Mission on Agriculture Extension and Technology, Nation Food Security Mission, and National Initiative for Climate Resilient Agriculture (NICRA) are given the responsibility to develop the capacity of farmers to adopt the measures of climate change. High level of Co-ordination Committee is formed for accomplishing key deliverables of the National Mission of Sustainable Agricultural under the aegis of the National Action Plan for Climate Change (NAPCC).

The Strategy adopted by NMSA is to promote the integrated farming system covering various crops, livestock, and fisheries, pasture-based composite farming for enhancing livelihood opportunities and popularising resources conservative technologies (on-farm and off-farm), introducing practices that support mitigation efforts in times of extreme climate events or disasters like prolonged dry spell and floods, etc. NMSA promotes effective management of water resources and enhances water use efficiency through the application of technology. It also encourages improved agronomics practices for higher farm productivity, improves soil treatment, increased water holding capacity, judicious use of chemicals, and enhances soil carbon storage. NMSA also involves institutions and professionals in developing climate change adaption and mitigation strategies for specific agro-climate situations.

In agriculture, the idea of sustainability is a complex issue because it involves many facets- social, economic, and environmental. The social issue involves a fair deal with the owners of the land and workers; the economic issue means sustainable agriculture should be a profitable phenomenon that should contribute to the growth of the economy, and the environmental issue concerns the air, water, and climate pollution that includes building and maintaining the healthy soil, manage water efficiently and promote bio-diversity. To fulfill these objectives, we have to move with nature instead of going against it.

Sustainable land use Management

Sustainable agriculture moves with sustainable land use management. The land is used to mean soil, forms of terrain, climate, vegetation, and fauna. The land quality may differ with respect to the availability of water resources and nutrient value yet the management of the land have the same principles all over the world. The following principles should be kept in mind to maintain or enhance the productivity of land:

- 1) Irreversible changes of the land such as erosion of land should be avoided;
- 2) Reduce the level of production risk e.g. security;
- 3) Minimum use of natural resources water, energy, soil, plants, animals, and ecosystem should be ensured;
- 4) The concept of 3R (Reduce, Recycle, and Reuse) should be applied to make the farming economy viable;
- 5) Choosing polyculture over monoculture (e.g., multi-year crop rotation, inter-cropping, mixed cropping, etc.);
- 6) Growing cover crops during the off-season when soils might otherwise be left bare,
- 7) Planting trees around the farm (e.g., agroforestry practices) that will act as windbreaks and also provide habitat for local birds (which can prey on insects that prey on crops);
- 8) 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 that spread diseases to crops).

Sustainable land use management plays a crucial role in soil and water conservation. Water is a scarce natural resource that is depleting day by day. Effective land use reduces water run-off and soil loss. The trees act as a barrier to soil erosion by checking run-off water and suspended sediments, so the trees should be planted near farms and fields.

Agroforestry

The concept of Agroforestry is not new; it has been practiced for as long as humans have been farming. Realizing the full benefits of integrating the commercially managed trees into the farming system is not far behind. Growing tree crops with farming has numerous benefits for humans as well as animals. We may define Agroforestry in simple words 'farming with trees'. Agroforestry can provide additional sources

of farm revenues by providing wood-fuel, and timber to replace plastics, fruits, and nuts. Trees can moderate the climate conditions and are a good source of carbon both above ground and below the ground and decrease the rate of greenhouse gas emissions. Trees also help water management by slowing down the flow of rainwater run-off from the farms and soil erosion. The roots of the trees help to minimize the leaching of nitrogen contents from the soil.

It is evident that there are many environmental benefits from agroforestry, relative to agriculture alone on farms or forestry alone in the forest by increased biodiversity. The benefits of agroforestry may be experienced by arable farmers, livestock farmers, horticulturists, foresters, and householders. The agroforestry system may be operated on the smallest farm to big farms as the demand for energy, machines, and irrigation is less in comparison to simple farming and it is far from damaging the environment. It conserves soil, water, and the atmosphere. The role of trees on a farm has a direct productive role. The crop seasons are short but the productivity of the trees remains for a longer period of several years coupled with low demands for efficient uptake of nutrients. The multi-species composition of agroforestry lowers the risk of crop failure and the multiple roles of trees may allow for adjustments in production according to needs.

Any form of diversification is not easy, it is a challenge for farmers. Managing and garnering the benefits of agroforestry is also a challenge if the farmers have no clarity of purpose and economic benefits in their minds. The purposes of agroforestry should be clear such as, increase profit but keep growing crops on the farm, increase the income from woodlands and develop a medicinal plant business, increase the income from orchards and provide more social benefit, and make hedgerows a profit center rather than a cost center without major capital cost, maintain the same level of food production on the farm, maintain profit on the farm and reduce the need for labour. There are some other important factors for the success of the agroforestry system. These include efficiency, effectiveness, and impact. The benefits are not part of the initial plan, they emerge after a time interval and so, adopting effective management is crucial.

Organic Farming

The concept of organic farming is not new for Indian farmers. In fact, in the initial stage farming was mainly organic farming worldwide. It is after the introduction of chemical fertilizers and pesticides, that the farmers adopt the present form of farming. As per the definition of USDA “Organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives, etc) and to the maximum extent feasible rely upon rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives, and biological system of nutrient mobilization and plant protection”.

Organic agriculture is a production system that promotes maximum use of organic materials like crop residues, animal excreta, legumes, on and off-term organic wastes, and bio-pesticides. It promotes and enhances agro-ecosystem health, bio-diversity, biological cycle, and biological activity.

There is one new concept of integrated farming that includes characteristics of both conventional farming and organic farming. Integrated farming involves the utilization of organic materials like crop residue and animal excreta etc to the maximum extent possible for nourishing the soil and simultaneously use of synthetic chemical fertilizers and pesticides to the limited extent possible. The basic principle of organic farming is to avoid all forms of pollution and to protect plant and animal habitats. The live stocks are kept with organic concepts and make them an integral part of the entire ecosystem.

There are four principles of organic farming-

1. Principle of health- Maintenance of health of soil, plant, animal, humans, and the planet as a whole is the first principle of organic farming. All living creatures depend on the soil and so the health of the soil is of utmost importance. Healthy soil means healthy crops and healthy crops mean a healthy ecosystem.
2. Principle of ecological cycles- It means that the production of the crops should be based on ecological processes and recycling using local inputs and conditions. Inputs should be reduced by reuse, recycling, and efficient management.

3. Principle of fair relationship with the environment- Organic farming should adopt the practice of fair relationship with the environment and life opportunities. Natural and environmental resources are used in such a way that they will not harm the balance between humans and nature.
4. Principle of responsibility- It's our prime responsibility that we should protect the health of the environment for our future generations. Our agriculture should be managed in such a way that our living ecosystem should not be destroyed.

It is observed that the food grown organically is superior in vitamin, mineral, and nutritional value, and it is free from the poisonous effects of pesticides and chemical fertilizers. Organically grown food tastes better than that conventionally grown. As a result, organically grown foods can be stored longer and do not show the latter's susceptibility to rapid rotting. Due to these inherent qualities, the market rates are more than the conventional food. The lower growing cost and higher market rate are beneficial for the farmers. Though organic farming output is lower than that of conventional, it keeps biodiversity and reduces environmental pollution. It creates the best possible relationship between the earth and the men.

Despite the fact that sustainable agriculture has long-term and widespread benefits, sustainable agriculture is far from mainstream in India. Very few farmers are adopting the practices of sustainable agriculture. Crop rotation is most popular across the country, covering about 30 million hectares and approximately 15 million farmers. The government is popularising agroforestry and rainwater harvesting on a large scale, but these practices are popular among large farmers and adopted on large farms. There is no documentary data available but it is estimated that it covers an area of about 20 million hectares of land. Over the years, micro-irrigation is promoted in the country through the National Mission on Micro Irrigation Mission and about 9 million hectares of the land area are covered under micro-irrigation.

To encourage organic farming on a large scale with the view to declaring the state as an Organic State, the Department of Agriculture has prepared a five-year road map for the promotion of organic farming in the State. Priority was given to the declared organic village in each district for providing vermicompost units to all eligible farmers who applied for assistance. Subsequently, Bio-gas plant units were also included in RKVY in 2011-12. Farmers are encouraged to establish a 2cft/3cft bio-gas unit to promote vermicompost units assuming that the by-product of the biogas plant will be used in vermicompost units. (SFAC coffee table book 18.04.2012)

Intercropping is more common in the country's southern and western regions. Organic Farming is popularised by the government and private agencies, but it covers only 2 percent of the total net sown area of the country. Biodynamic agriculture, a variant of organic farming has meagre coverage of 0.1 million hectares. The Government of Sikkim stepped into the Organic Mission process in 2003, the year when it stopped imports of chemical fertilizers in the State. Since then, the cultivatable land in Sikkim are practically organic and also farmers of Sikkim are traditional users of organic manure. During the financial year 2021, Madhya Pradesh had the highest organic agriculture area with approximately 1.6 million hectares across India. Followed by Rajasthan with over 481 thousand hectares of organic farming land.

No doubt, there is a long path to mitigating climate change and reversing the damages done by conventional agricultural methods, sustainable farming practices may reduce the negative effects of conventional agriculture by increasing the organic matter in the soil and thus lowering the water and air pollution.

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