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Embracing Sustainable Agriculture in Maharashtra

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Abstract

Agriculture is the main occupation of the majority of the country's population. Even today, more than 48 percent of the citizens are associated with agriculture and allied businesses. We can see that this business has adopted the invention of today's 'hi-tech' technology from the traditional era. Various stages like Green Revolution, Blue Revolution, and White Revolution have taken place in the agricultural sector so far. Many options have come forward as complementary businesses to agriculture. Among these, animal husbandry is a business that has been going on for a long time. Dairy farming has given farmers good financial stability. Changes in businesses like goat farming are eye-catching. New experiments, new fields are being cultivated and awakened with hope. Farmers are getting financial support from nurseries. Many good experiments are seen happening in agriculture in the areas where there are nurseries and nurseries. Vegetables, orchards, flowers, ornamental trees; also, sugarcane nursery business opportunities have been provided by this business. Modern technology is being used in agriculture.

Key Word: Sustainable Agriculture, Agriculture in Maharashtra

Introduction:

Sustainable agriculture, agro ecology, regenerative agriculture, organic farming, natural farming are some of the most common terms used to describe various sustainable agriculture approaches. One might ask why so many different terminologies refer to these respective but related concepts. Perhaps it is not essential to bother about the various terms as long as we know what we mean conceptually. However, in the absence of universally accepted definitions of each of these terms, everyone has their interpretation of them. It also means that two different individuals may interpret or even apply the underlying philosophy or concept differently while using the same term. Sustainable agriculture was addressed by Congress in the Food, Agriculture, Conservation, and Trade Act of 1990. Under that law, the Term sustainable agriculture means "an integrated system of plant and animal production practices having a site-specific application that will, over the long term: satisfy human food and fiber needs enhance environmental quality and the natural resource base upon which the agricultural economy depends make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls sustain the economic viability of farm operations enhance the quality of life for farmers and society as a whole."

The term started gaining prominence in the US in the 1980s, with a formal mention in US legislation for the first time in 1985. This led to a programme on Low Input Sustainable Agriculture (LISA). In 1990, the US Congress formally addressed and defined 'sustainable agriculture under the law. Over the years, civil society, the private sector, multilateral institutions, and various national and sub-national governments have used the term 'sustainable agriculture.' In India, the national government initiated the National Mission for Sustainable Agriculture (NMSA) in 2014-15, which formally defines sustainable agriculture in the Indian context and has identified ten underlying dimensions.

Maharashtra is renowned for its diverse agricultural output, which includes a variety of cash crops, food grains, and horticultural products. The state's agricultural landscape is characterized by its adaptability to different agro-climatic zones, ranging from the fertile Konkan coast to the arid regions of Marathwada. One of the most notable crops is sugarcane, which forms the backbone of Maharashtra's agro-industry. The state is among the top producers of sugarcane in India, supporting a vast network of sugar mills and related industries. This crop not only contributes significantly to the economy but also provides employment to millions.

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In addition to sugarcane, Maharashtra is famous for its grapes and onions, both of which are major export commodities. The Nashik region, often called the "Wine Capital of India," is particularly well-known for its vineyards and wine production. The cultivation of these crops has benefited immensely from the adoption of modern irrigation and eco-friendly farming techniques. Other important agricultural products include cotton, pulses, and oilseeds. The state's farmers have also embraced horticulture, cultivating mangoes, bananas, and pomegranates, which have gained national and international recognition for their quality.

Research Objective:

- Study the concept of sustainable agriculture.
- To study sustainable agriculture in Maharashtra and suggest action plans.
- Studying policies for sustainable agriculture.
- **Research Methodology:** Descriptive and analytical research methods have been used for this research. The research is based on secondary data.

Organic Farming

Organic farming eliminates synthetic chemicals and relies on natural inputs such as compost, bio fertilizers, and bio pesticides. Maharashtra has witnessed a growing number of farmers transitioning to organic cultivation, especially for crops like cotton, sugarcane, and vegetables. This shift not only improves soil health but also opens up premium markets for organic produce.

Agroforestry

Integrating trees with crops and livestock creates a diversified farming system that enhances biodiversity and soil stability. Agroforestry practices in Maharashtra include planting fruit trees alongside staple crops, which provides additional income sources and improves microclimates.

Crop Diversification and Rotation

Rotating crops and diversifying plant species help break pest cycles and improve soil fertility. Farmers in Maharashtra are increasingly adopting this practice to reduce risks associated with monoculture and to maintain balanced nutrient levels in the soil.

Water-Smart Agriculture

Techniques such as drip and sprinkler irrigation, mulching, and rainwater harvesting are crucial in Maharashtra's semi-arid regions. These methods conserve water, reduce evaporation, and ensure efficient water delivery to crops.

Integrated Pest Management (IPM)

IPM combines biological, cultural, and mechanical control methods to manage pests sustainably. Maharashtra's farmers use natural predators, pheromone traps, and resistant crop varieties to minimize pesticide use, protecting both crops and the environment.

Sustainable agriculture's impact evidence in India

Income: The evidence around SAPSs' impact on farmers' incomes remains insufficient, both in terms

of geographical coverage as well as the number of long-term assessments. Notwithstanding this critical limitation, the literature indicates the potential of a few SAPSs to enhance income through a reduction in production costs (CA, natural farming), diversification of agricultural production (IFS, intercropping), and premium prices (organic produce).

Yields: Notwithstanding the conceptual limitations to adequately estimate farm productivity, we find some emerging patterns for yields under a few SAPSs. For organic farming, at least in the short-term (2-3 years), yields are lower than conventional farming. Beyond this period, some studies show equal and even higher yields for some crops, particularly once the soil form and structure evolve after a few years of applying biological inputs. The short-duration studies of natural farming indicate no statistically significant changes in yields for most crops. For SRI, yield impacts are well documented, showing a statistically significant increase in various paddy varieties. Resource-conserving practices, such as vermicomposting, agroforestry, and crop diversification, have positively impacted yields. However, the lack of studies documenting the long-term impacts of SAPSs on yields makes it difficult to generalize results.

Water-use: Several studies in literature capture the impact of various SAPSs on water-use efficiency. In particular, SRI, CA, precision farming, rainwater harvesting, contour farming, cover crops, mulching, crop rotation, and agroforestry have positively impacted water conservation. Rainwater harvesting and SRI appeal to smallholder farmers because of their ease of adoption. Pre-monsoon dry sowing in natural farming is considered a breakthrough in the drought-prone regions of Andhra Pradesh, warranting further assessments.

GHG emissions: Among SAPSs, agroforestry, SRI, and CA have the most evidence for climate mitigation. Evidence associated with agroforestry's carbon-sequestering abilities (above and below ground) is well established. A growing body of evidence suggests that the SRI promotes aerobic soil conditions reducing methane emissions. However, intermittent irrigation, an intrinsic component of SRI, can increase nitrous oxide emissions. Overall, long-term carbon sequestration impacts of the SAPSs need evaluation in India.

Biodiversity:

Several SAPSs like agroforestry, IFS, permaculture, natural farming, organic farming, conservation agriculture, and crop diversification strategies (rotation, intercropping, mixed) tend to increase the spatial, vertical, and temporal diversity of species at a farm (and landscape) level. While research articles mention the impact on biodiversity, studies offering substantive empirical evidence are missing.

Health: We only find anecdotal evidence mentioning positive health impacts of various SAPSs, mainly through dietary diversity and less exposure to harmful chemicals such as pesticides. Empirical studies comparing SAPSs with conventional agriculture for

health outcomes are missing. Crop-diversification through inter-cropping or multi-cropping is common under various SAPSs. A few SAPSs can enhance income through a reduction in production costs (CA, natural farming), diversification of agricultural production (IFS, intercropping), and premium prices (organic produce) Executive summary.

Gender: Women contribute more than 70 per cent of the labour force in Indian agriculture. However,

research studies focusing on gender outcomes of SAPSs are minimal. A few practices like vermicomposting, organic farming, IFS, and rainwater harvesting define women's roles, but the evidence on women's impact is missing. We need further research to understand the impact of various SAPSs on women's workloads, income, empowerment, and employment.



Agroforestry and system of rice intensification (SRI) are the most popular among researchers studying the impact of SAPSs on economic, environmental, and social outcomes. Evidence for the impact of practices such as biodynamic agriculture, permaculture and floating farming are either very limited or non-existent.

The existing literature critically lacks long-term assessments of SAPSs across all three sustainability dimensions (economic, environmental and social). Other research limitations include a research gap concerning landscape, regional or agroecological-zone level assessments and a relative lack of focus on evaluation criteria such as biodiversity, health and gender.

The budget outlay for the National Mission for Sustainable Agriculture (NMSA) is only 0.8 per cent of the Ministry of Agriculture and Farmers' Welfare's total budget - INR 142,000 crore (excluding INR

71,309 crore spent annually on fertiliser subsidies by the Centre).

Eight of the 16 practices identified by the study receive some budgetary support under various central government schemes. Of these, organic farming has received the most policy attention as Indian states, too, have formulated exclusive organic farming policies.

Most Civil Society Organizations (CSOs) involved in SAPSs were active in Maharashtra, Rajasthan and Madhya Pradesh. Organic farming, natural farming and vermicomposting get the most interest from CSOs.

Key emerging themes in India's sustainable agriculture

Executive summary this section discusses the key cross-cutting themes that emerged during our research and are central to the discussion on sustainable agriculture in India.

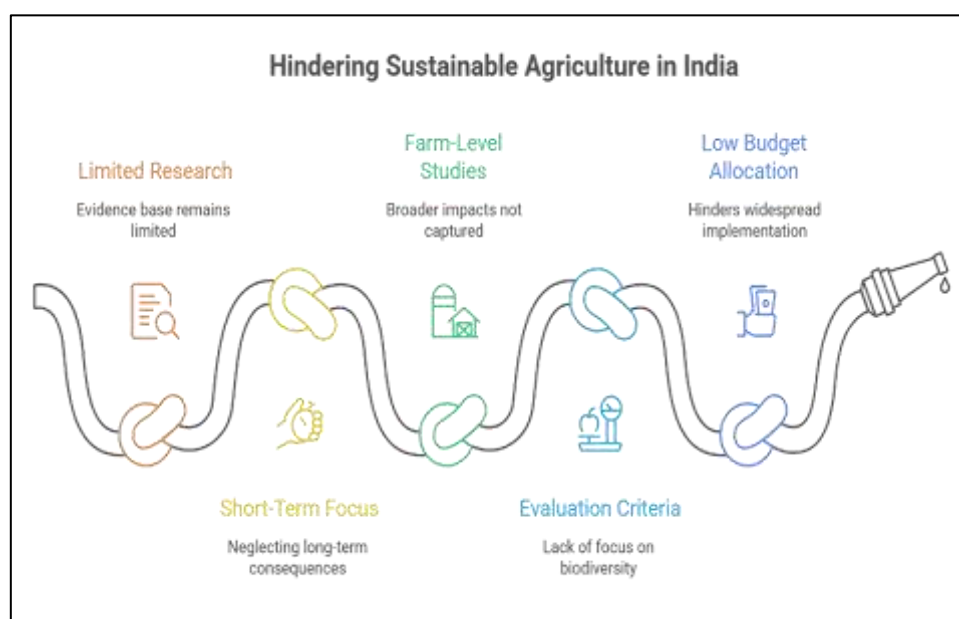
The role of knowledge: Most SAPSs are knowledge-intensive and need knowledge exchange and capacity building among farmers to enable their successful adoption.

The reliance on farm-labour: Given the practices are niche, the mechanization for various input preparations, weed removal, or even harvesting in a mixed cropping field is not mainstream yet – increasing the reliance on labour for various on-field activities. Labourintensiveness may pose a barrier to the adoption of some of the SAPSs among medium to large farmers.

Motivation to adopt SAPSs: First, conventional agriculture's long-term negative impacts are pushing farmers to look for alternatives. Second, where

farmers are in a resource constrained environment, such as rain-fed areas, and not using significant external inputs, anyway, and hence are willing to make the incremental shift to adopt SAPSs.

SAPSs' role in food and nutrition security: Most SAPSs promote crop and food diversity through intercropping, mixed cropping, crop rotation, agroforestry, or IFS. One, it improves the farmer's food security by diversifying their food and income sources. Secondly, by improving the diversity of available nutrition, it enhances the nutrition security for agriculture families which could possibly solve the country's underlying malnutrition problems. However, both these aspects are hardly studied in the available literature and thus warrant future research.



Goals:

The goal of sustainable agriculture is to minimize adverse impacts to the immediate and off-farm environments while providing a sustained level of production and profit. Inherent to this goal is the understanding that sustainability must be extended not only globally, but indefinitely in time, and to all living organisms including humans. Simply stated, sustainable agriculture refers to the ability of a farm to produce food indefinitely, without causing irreversible damage to ecosystem health.

In all, we identified 30 sustainable agriculture practices (SAPs) prevalent in India. Some are focused only on one aspect of agriculture (we call them practices). In contrast, others are more holistic concerning the overall agriculture or most aspects of it (we call them systems). We collectively refer to them as sustainable agriculture practices and systems (SAPSs). Many practices have overlaps among themselves, and some individual practices are also advocated under a few systems

Conclusions

Conventional agriculture has accomplished much along the time, but there are still many problems to solve, both old and new. Sustainable

agriculture is about trying to solve these problems created by the conventional agriculture- without creating new ones. There are many specific practices that can be incorporated into a sustainable farm, but often farmers are not willing to introduce such practices in their activity. This is due mainly to the critics that claim that sustainable agriculture practices results in lower crops yields. But the practice proved that over time, the land managed in sustainable manner can be as productive as conventional farmland, but choosing and adapting properly the system for each farm and in a different timeframe. . As the positive results at scale would emerge, farmers in irrigated areas will follow suit. At the budgetary level, significantly increase allocation to sustainable agriculture enabling its evidence-backed scale-up across the country. At the tactical level, focus on region- and practice-wise priorities, which span a wide variety: from technological innovation to help mechanize labour- intensive processes to farmers' capacity building in knowledge-intensive practices. Finally, broaden the national policy focus from food security to nutrition security and yield to total farm productivity. It would help recognize the critical role that sustainable agriculture could play to ensure

India's nutrition security in a climate-constrained world.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper

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