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Short Review Paper

Sustainable Agriculture in India

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Abstract

Agriculture is the backbone of Indian economy as well as society. Green Revolution has played a vital role in Indian agriculture leaving behind positive and negative implications. Despite of this agricultures share in GDP has declined rapidly in the recent past. Indian farmers are suffering from multiple issues such as high input cost, low profitability, land degradation, depleting water table and risks related to climate change. Sustainable agriculture has the potential to tackle most of the socio-economic and environmental problems originated out of unsustainable farm practices. Agricultural growth can be sustained by promoting conservation and sustainable use of these scarce natural resources through appropriate location specific measures. Sustainable management of land, water and natural resources while ensuring food security must be developed with sustainable agriculture. Government of India has launched numerous polices and schemes which cater the needs for key inputs in a sustainable manner. In the present paper the need for sustainable agriculture, Sustainable agriculture practices has been emphasized.

Keywords: Agriculture, Food security, Problems, Sustainable agriculture, Policies.

Introduction

India is a unique country from agricultural point of view due to vast geographical diversity. The physical factors such as of plain area, rich soils, wide climatic condition and long growing season provide a solid base to Indian Agriculture. The biggest challenge of post-independent India has been to produce enough food to sustain the increasing population. Hence, the Green Revolution began in the 1960s to increase food production. Green Revolution has played a vital role in Indian agriculture leaving behind positive and negative implications. Along with surplus food grain production, it has left deep impacts on regional development and environmental conditions[1].

Green revolution leads to infertile soil, depletion of water table, deterioration of water quality, Pollution with toxic chemicals from the agrochemicals, Imbalance in social and economic status. Sustainable Agriculture' is based on the principle of sustainability which means fulfilling the needs of the present without harming the ability of future generations to meet their own needs. It is essential to conserve natural resources, not only for the agricultural industry but also for all life on Earth. Sustainable agriculture involves production of food, fibre, plant or animal products with the farming methods that protect the environment, public health, wellbeing of human and animal life. It includes various environmentally friendly agricultural practices that are less toxic and use less energy and maintain productivity and profitability[2].

Examples of such practices include organic farming, mixed cropping or diverse cropping, crop rotation, mixed farming, strip farming etc. Among these, organic farming is being considered as the most effective and popular practice. Sustainable agriculture seeks to integrate three main objectives into their work: a healthy environment, economic profitability, and social and economic equity. Everyone involved in the food system including farmers, food processors, distributors, retailers, consumers, and waste managers has a role to play in ensuring a sustainable agricultural system.

Review of Literature

Several researchers have studied the concept, importance, and challenges of sustainable agriculture in India and globally. Studies on sustainable agricultural development highlight that excessive dependence on chemical fertilizers and pesticides has led to soil degradation, reduced productivity, and environmental imbalance. A study by Asokan R. & Murugan D.[3] emphasized that sustainable agriculture and organic farming can improve soil health, enhance biodiversity, and ensure long-term agricultural productivity. The study also pointed out that organic practices reduce environmental damage while maintaining farm profitability.

Another study by Singh, Y. V.[4] examined the role of organic farming in promoting sustainability in India. The findings revealed that organic farming not only improves soil fertility but also reduces health risks associated with chemical inputs. However, the study noted challenges such as lower initial yields and lack of awareness among farmers.

Lichtfouse et al.[5] highlighted the importance of integrating modern technologies with sustainable practices. It concluded that techniques like precision farming, efficient irrigation, and integrated pest management can significantly improve productivity while conserving natural resources.

A study from Gupta et al.[6] focused on sustainable agricultural practices in India. It found that practices such as crop rotation, agroforestry, and reduced tillage play a crucial role in maintaining soil fertility and reducing environmental degradation. The study also emphasized the importance of government support in promoting these practices.

Similarly, Singh B. and Yadav J. P.[7] discussed the relationship between sustainable agriculture and rural development. It concluded that sustainable practices not only protect the environment but also improve farmers' income and livelihood through diversification and value addition.

Singh S. K. and Parihar P.[8] analyzed the challenges in achieving sustainable agriculture in India. The study identified major issues such as lack of policy implementation, inadequate farmer awareness, financial constraints, and climate change impacts. It suggested that strong government policies and farmer education programs are essential for successful adoption.

Overall, the literature indicates that sustainable agriculture is essential for ensuring food security, environmental protection, and economic stability. While various practices and policies exist, their successful implementation depends on awareness, technological support, and effective government intervention.

Objectives: To understand the concept of sustainable Agriculture, to study sustainable agricultural practices, to study approach adopted by Government of India for development of sustainable agriculture

Methodology

The present study is descriptive and analytical in nature and is based entirely on secondary data. The data has been collected from various reliable sources such as research journals, published articles, government reports, books, and authentic online portals.

The study focuses on understanding the concept, need, practices, and policies related to sustainable agriculture in India. Relevant information was analyzed and interpreted to draw meaningful conclusions about the role of sustainable agriculture in addressing environmental and socio-economic issues.

Concept of Sustainable Agriculture

The Need for Sustainable Agriculture[9]: India's rapidly increasing population and changing consumption patterns have created major challenges for country's agricultural sector, requiring a shift towards sustainable farming practices. Overuse of natural resources, excessive use of chemical fertilizers and pesticides, and poor water management practices have caused soil degradation, groundwater depletion, and environmental pollution. The livestock sector alone is responsible for 18% of all global greenhouse gas emissions. Some farmers use machinery; others burn their fields to prepare them for planting a new crop. These farming practices lead to greenhouse gas emissions. Agriculture will continue to consume excessive amounts of water which harm freshwater systems across the globe. Therefore, it is essential to make agriculture more environmentally friendly by making it sustainable.

Principles of Sustainable agriculture: Key principles of sustainable agriculture outlined by FAO: Boost food chain productivity - Produce more with less, and make sure small farmers aren't left out. Integrated pest management, and precision techniques must be encouraged. Protect the environmental resources especially soil, water, and biodiversity - Soil conservation, Water management and Biodiversity conservation should be encouraged. Improve people's wellbeing and economic growth - Social protection for vulnerable farmers during droughts or price crashes. Make farming economically viable so the next generation stays in it. Foster ecosystems and communities' resilience-Agriculture must withstand shocks such as climate, pests, market volatility. Support with governmental initiatives and regulations - Governments, policies, and institutions need to support the shift. Policies should incentivize sustainable practices and Regulations must protect soil and water by enforcing pesticide laws, managing groundwater[10].

Goals of Sustainable Agriculture[11]: Food and fibre security-Sustainable agriculture aims to produce enough food and fibre for current and future generations without depleting the base resources. Ensuring soil fertility and encouraging biodiversity-It include maintaining organic matter, nutrient cycling, and microbial activity through compost, green manure, and reduced tillage. Improving the ecological conditions and preventing pollution- The goal is to minimize negative impact such as pesticide runoff into rivers, nitrate leaching into groundwater, and air pollution from stubble burning. Eg. Practices like integrated pest management, using organic fertilizers. Consuming less non-renewable resources- Sustainable agriculture aims to cut this by: using drip irrigation instead of flood irrigation to cut electricity use, promoting biofertilizers and natural pest control instead of chemical inputs, using solar-powered pumps and farm equipment where possible, Supporting rural economic development- The goal is to create viable rural economies through value addition, diversified income and better market linkages. Enhancing the quality of farmers' health, rights, and life in general-Reduced exposure to toxic pesticides improves farmer and farmworker health and Programs like Soil Health Card and organic farming clusters aim to empower farmers with knowledge and safer practices. Raising people's environmental awareness and responsibility-Awareness

programs, school curricular, and farmer field schools aim to build a culture where people understand the link between how food is grown and the health of ecosystems.

Sustainable agriculture practices[12]: The following farming practices have proven effective in achieving sustainability, especially when used in combination: Crop Rotation: Crop rotation is the practice of planting different types of crops in a planned order. This method promotes agricultural diversity and is a more logical and sustainable way of farming compared to growing only one type of crop. It offers several benefits such as better soil health and enhanced control over pests. Irrigation Techniques: The growth of crops heavily relies on irrigation, which uses water and energy resources. Sustainable farming focuses on efficient use of water and energy resources. This is achieved by growing crops that need less water and using smart irrigation methods. Planting cover crops: Farmers can protect their fields from soil erosion by planting cover crops during off-seasons. When cover crops are used as green manure, they increase the amount of organic matter in the soil, reducing the need for chemical fertilizers. They also help suppress weeds and keep the soil moist. Additionally, flowering cover crops naturally support the habitats of bees and other pollinators. Pest Control and Integrated Pest Management: The role of IPM in sustainable agriculture is to reduce risk for humans and non-target species as well as nature. A variety of approaches, including mechanical and biological controls, can be applied systematically to keep pest populations under control while minimizing use of chemical pesticides. Biological measures include using predators like ladybugs to kill aphids or poultry to eat up pests, their larvae, and eggs (e.g., ants, bugs, flies, woodlice, etc.). Integrated Weed Management: Sustainable weed control methods aim to protect natural resources by eliminating chemicals and introducing environment-friendly practices. These include using more resilient crop types, cover crops, insects and birds to destroy weeds, manual and mechanical weeding, allelopathic plants, crop rotation, and other organic farming measures of control. Reducing or eliminating tillage: No-till or reduced-till methods, which involve inserting seeds directly into undisturbed soil, can minimize erosion and improve soil health. Integrating livestock and crops: Data shows that a smart integration of crop and animal production increases efficiency and profitability. Adopting agroforestry practices: Integrating trees or shrubs into agricultural operations enables farmers to provide shade and shelter that protect plants, animals, and water resources and potentially offering additional income from fruit or nut crops. Managing whole systems and landscapes: Sustainable agriculture treats natural, uncultivated or less intensity land as an integral part to the farm's productivity.

Some Indian Policies and Initiatives for Sustainable Agriculture[13]: Paramparagat Krishi Vikas Yojana (PKVY): Launched between November and October 2023, this central government program aims to label and endorse organic farming practices by improving the market access of certified organic products. Rashtriya Krishi Vikas Yojana (RKVY): This initiative provides financial support for the implementation of eco-friendly technologies, the advancement of sustainable farming practices, and the enhancement of farmers' skills and knowledge. National Mission on Sustainable Agriculture (NMSA): This mission concentrates on climate-resilient farming methods such as water conservation and integrated practices. Soil Health Card Scheme: A Soil Health Card is used to report the current status of the health of the soil and, when used from different periods, compare the change in the health of the soil due to land management. Per Drop More Crop (PDMC): A component of Pradhan Mantri Krishi Sinchayee Yojana focusing on water use efficiency through micro-irrigation.

Opportunities to sustainable agriculture and food security[14]: Policy Reform: Many issues can be addressed by modifying agricultural policies to focus on adaptability and sustainability. It is crucial to implement policies that support smallholder farmers, encourage the adoption of sustainable practices, and optimize water use. Sustainable Farming Practices: Implementing sustainable methods such as agro forestry, integrated pest management, and organic farming can boost biodiversity, conserve water, and improve soil quality. Technological Innovations: Advancements in technology offer significant opportunities to enhance food security and promote sustainable agriculture in India. Precision farming utilizes technologies like GPS and remote sensing to optimize the use of resources such as water, fertilizers, and pesticides, thereby improving productivity and sustainability. Education and Training: It is vital to invest in the education and training of farmers concerning sustainable agricultural practices and food security. Agricultural universities and extension services can play a pivotal role in providing farmers with the necessary knowledge and skills. Diversification and Value Addition: Encouraging farmers to cultivate a variety of crops, particularly those that are nutrient-dense and high-value, can lead to a more varied diet and increased income. Furthermore, farmers can unlock additional revenue streams through processing, packaging, and marketing their product.

Conclusion

India's agricultural industry is a critical component of the nation's GDP and an essential provider of food, but it also has some major issues that arise from changes in climatic conditions, shortage of water, degrading soil quality, and the dependence on chemical fertilizers.

It has been noted that sustainable agriculture is very important for a developing nation like India, as it increases productivity, efficiency, and employment while offering guidance on how to cut back on practices that degrade other natural resources and the quality of the soil and water resources.

Its main goals are to increase output levels while preserving the environment and protecting it by embracing specialization and

environmentally friendly technologies.

Government initiation such as National Mission for Sustainable Agriculture (NMSA), Paramparagat Krishi Vikas Yojana (PKVY), Soil Health Card scheme and the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) aim to increase the resilience of agriculture to climate change practices, increase water use efficiency, reduce reliance on chemical inputs including chemical fertilizers besides improving the health of the soil.

The agriculture sector in India has performed significantly better over the years, demonstrating substantial progress in agricultural development.

However, the adoption of sustainable farming practices remains limited, highlighting the need to increase farmers' awareness, knowledge, and access to resources that promote environmentally friendly agricultural practices.

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