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# ECONOMIC CHALLENGES TO ADOPTION OF SUSTAINABLEAGRICULTURE IN INDIA

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## ABSTRACT

Sustainable agriculture, the agronomic practices promoting consistent food security and environmental conservation, has extremely low adoption rates in developing countries. This conundrum may be resolved by identifying the barriers faced by farmers in adopting various SAPs which make them inaccessible and reduce their backing significantly in a lower-middle-incomecountry like India.

A literature review was conducted for (1) Understanding the concept of sustainable agriculture (2) Identifying and reviewing the principal challenges in wide-scale adoption of SAPs in India (3) Critical analysis of existing initiatives by the government and possible solutions.

The foremost challenges include: decreased productivity and profits, lack of awareness and guidance, lack of technology and infrastructure and the question of long-term generation of employment. It is felt that appropriate information dissemination, technological and infrastructural advancements along with schemes distinctly catered to states should be devised in order to encourage and expedite the adoption process.

## INTRODUCTION

This study was initiated with the objective to understand the multitude of challenges faced by Indian farmers in adopting Sustainable Agricultural Practices (SAPs) and to ascertain its feasibility in the country.

It is a verity that agriculture is a preeminent sector of the Indian economy which helps sustain almost two-thirds of the workforce still residing in rural areas. (Singh and Parihar, 2015). It is also a major contributor to the nation's economic development. India, being an agrarian country, made huge strides in boosting food grain production. It remains the 'backbone' of the Indian economy, with the agricultural sector yielding an impressive growth of 3.4% at constant prices between 2020-21 despite the wide-ranging effects of covid-19 on the world economy. The share of agriculture in India's GDP reached almost 20% in the year 2020-21 (Economic Survey, 2021). The maintenance of this outstanding performance, however, has been accompanied by the exploitation of natural resources as well as destruction of the environment in many regions of India.

We have seen an impressive growth of agriculture in the last few decades. The Green Revolution gained much attention as it transformed India from a food grain deficit to a food production surplus country. On the one hand, the Green Revolution was a blessing as it improved the socio-economic situation of Indian farmers by lowering production costs and providing high returns; however, these traditional agricultural practices also impacted the

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environment adversely by giving rise to issues like climate change, deforestation, biodiversity loss and soil degradation. (Saidur, 2015)

In recent times, much attention has been paid to the unfavourable impact of commercial as well as industrial agriculture on the environment and the people alike. It has been reported that NASA's satellite sensors have observed that the levels of agricultural fire activity are extremely high (net
~60%) post the harvest season which results in an almost 43% increase in aerosol emissions found inthe Indo-Gangetic Plain. Also, the concentration of the air pollutant, $PM_{2.5}$ over New Delhi was at a net 60% and rising. (Jethva et al., 2019).

The conventional agricultural practices adopted under the Green Revolution were found to be deficient in terms of their environmental impact, and contributed significantly to climate change, water scarcity, land degradation, deforestation, etc. This gave rise to the demand for an alternative to the conventional practices that comprise our usual agronomic methods, and thus the idea of sustainable agriculture, which combines the idea of sustainability with agriculture in order to ensure both food security and food safety, was born. Sustainable agriculture not only addresses numerous environmental and social problems, but it also provides innovative, environmentally non-degrading, technically adequate, economically viable, and socially acceptable options for the farmers and entire food producing system.

(Gupta et al., 2021) provides a testament to the popularity of these terms by citing how organic farming has about 18.8 million search results, while sustainable agriculture stands at 9.9 million around the world, and both have remained consistently the most popular for the last 16 years. However, according to a recent study by the Council on Energy, Environment and Water (CEEW), the number of farmers that have adopted these SAPs remains at a discouraging less than 4%, despite the efforts of several individuals, groups and non-governmental organisations (Economic Times, n.d.).

While such a response to this much needed initiative might seem perplexing upon the first look, looking beneath these surface issues has revealed a host of other legitimate concerns.

The foremost issues responsible for the apprehension in adoption of sustainable agriculture lie in the decreased productivity as compared to conventional agriculture, spiralling costs on inputs, lack of availability of water and irrigation facilities, huge power requirements, lack of knowledge, problem of weed management, negative impact of climatic variability, uncertainty about its ability to produce a steady source of income for the financially weaker section of the society as well as the question of the long term generation of employment etc (Singh and Parihar, 2015).

Thus, in order to develop a deeper understanding into the state of the agricultural community of Indiaas well as the major issues that impede the adoption of SAPs on a wider scale, we seek to undertake this study with the following objectives:

1. To understand the concept of sustainable agriculture in its entirety.
2. To identify and analyse the principal challenges in the wide-scale adoption of sustainableagricultural practices in India, from an economic viewpoint.
3. To critically analyse existing initiatives by the government and suggest possible policysolutions.

The application of economics was made in order to deepen our understanding of the problem at hand.Microeconomics, concerned with analysing the behaviour of smaller farms or areas was crucial to understanding the key factors affecting their decisions, while the macro

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elements such as the government policies and schemes for the given issue helped us analyse and comment on their efficiency.

For ease of reference, some of the recurring abbreviations are listed as under:

- SAPs: Sustainable Agricultural Practices
- SDGs: Sustainable Development Goals
- SAUs: Sustainable Agriculture Universities
- MSP: Minimum Support Price
- GDP: Gross Domestic Product

The study includes an extensive and thorough survey of the existing literature. It also uses secondary data on the topic of sustainable agriculture in India including but not limited to Economic Survey and Budget documents, reports published by government institutions like NITI Aayog and Ministry of Agriculture, newspaper readings etc. The publications searched were in the English language and focused mainly on the subject area of social sciences and humanities, rather than pure sciences, owingto our primary focus on economics.

**Sustainable Agriculture: Concepts and Dimensions**

The term 'sustainable agriculture' does not have a concrete definition, rather it is a flexible umbrella term that can refer to a host of divergent methods and practices. Depending upon the objectives of the person or group using these methods, one goal might hold more importance and be prioritised in place of another i.e a tradeoff exists. For example: One might emphasise the continuation of conventional methods while farming while for another group sustainable agriculture might be centered around the maintenance of ecological integrity (Eswaran, n.d.).

In this analysis, we have limited the term to refer to a collection of various agronomic practices that are environment- friendly, economically feasible, promote a consistent level of food security (by increasing output and affordability) and minimise waste generation, for the sake of simplicity and maintaining consistency.

It might be useful to note however, that not all countries or regions are referring to the achievement offood security when they talk about sustainable agriculture. China, for example, has abandoned the goal of self-sufficiency due to droughts (Rao, n.d., p. 3). Thus, it is essential that we look at and recognise the goals of a nation to understand what sustainable agriculture means to them.

The course of our study has helped us see sustainable agriculture as a dynamic collection of agricultural methods utilizing a combination of conventional practices, newer methods as well as technological advancements which allows the adopters to reap several benefits in the form of achievement of the goals of food security, minimisation of waste, better nutritional quality and food security, social and economic sustainability, poverty reduction etc. These qualities make SAPs extremely instrumental in combating the problems of pollution, overfertilization, huge input costs inter alia that the agricultural sector is presently experiencing. This has further been elaborated in the subsequent discussion.

Sustainable agriculture often encompasses a plethora of practices that enable farmers to meet society's present food demand which involve the amalgamation of traditionally-adapted techniques (using fewer external inputs) and modern development of agricultural systems. It often enhances quality and

nutritional worth of food, provides a wider range of items through the time, is more economicallyviable and comparatively risk-free in the long run (Singh and Parihar 2015).

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It is concerned with the two-fold objective of achieving both economic sustainability as well as social sustainability, i.e., it aims to promote long term financial well-being without harming the environment by reducing poverty along with the stigma and social injustice that often accompanies it.

Another primary goal of sustainability, namely food security, is also essential as rising prices of food grains and other staple food items can often manifest themselves in form of inflationary impact on other sectors such as industrial and infrastructural commodities as well (Sengupta & Mukhopadhyay,n.d.).

An expansion in food security can often reduce poverty, and even fertility rates, which can help solve the population problem of India. Decline in the infant mortality rates and survival of more offspring often pushes people to invest more in their health and education, thus improving the quality of life of each child. (Food and Agriculture Organization of the United Nations, n.d.).

Sustainable agriculture also puts a great emphasis on the preservation as well as the strengthening of the various ecological structures, natural and common property resources in order to support itself. Recent exploitation however has mandated that actions for their safeguard be taken at the earliest in order to protect our already scarce resource base from further wastage and depletion (Sudhakar, 2016,p. 294).

Under the Global Goals defined by the United Nations Development Programme, The SDGs 2 (zerohunger) and 12 (responsible consumption and production) are concerned directly with sustainable agriculture. (Department of Agriculture Welfare and Framer's Cooperation, n.d., p. 2) also states that8 other SDGs namely 1(No poverty), 3 (Good health and well-being for people), 4 (Quality education), 5 (Gender equality), 13 (Climate action), 14 (Life below water), 15 (Life on land), 17 (Partnerships for sustainable development) are also largely concerned with the well-being of farmersand growth of agriculture sector as a whole.

Sustainable agriculture is an ever-changing concept, comprising of some pivotal features such as:

- It offers some major advantages over traditional practices like improving soil fertility, retains and stores rainwater, increasing the diversity of crops, helps in declining health problems by reducing the usage of chemicals and pests, avoiding overexploitation of land, improving climatic conditions, etc.
- It also helps promote both economic and social equality, and thus is an excellent initiative in apredominantly agricultural nation like India to subtly combat the underlying problems of the various deep-seated prejudices, preconceived notions and discrimination that still prevail.
- The thirty most promising SAPs and systems followed in India are permaculture, organic farming, natural farming, system of rice intensification, biodynamic agriculture, conservation agriculture, integrated pest management, precision farming, silvipastoral systems, vertical farming, hydroponics, crop-livestock-fisheries farming system, vermicompost, drip irrigation, crop rotation, intercropping, cover crops, mulching, contour farming, rainwater harvesting, floating farming, plastic mulching, shade net house, alternative wet and drying techniques, saguna rice technique, farm pond lined with plastic film, direct seeding of rice, canopy management and mangrove and non-mangrove bio shields. (Gupta et al.,2021)

It is also important to note the temporal aspects of sustainability. Attempts to historicize the conceptthas brought to light that defining sustainable agriculture as an ideal that

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societies hope to achieve should mean that with changes in structure and requirements of societies with time or even between two different societies existing at the same time, the concept of sustainable agriculture could hold entirely different meanings. This issue of a lack of concrete definition, as mentioned before, also makes it hard to categorise the various agronomic activities as being fully sustainable or unsustainable, and most fall in a grey area in between, where they fulfill only some conditions of sustainability (Ivey, 2013, p. 131).

One such case is the distinction between the words 'organic' and 'sustainable'. Contrary to popular perception, the two terms are not interchangeable. While sustainable agriculture is a broader term comprising several practices including organic farming, the term organic farming itself simply refers to a system which eliminates the usage of chemical inputs for the the safety of the flora and fauna of the area as well as the end consumer of the product. Other methods of sustainable agriculture such as crop rotation, hydroponics, permaculture etc. may or may not use synthetic inputs in order to fulfill their personal objectives relating to achievement of economic or social sustainability.

Organic farming essentially reduces environmental degradation caused by the chemical fertilisers and insecticides only by causing higher levels of greenhouse gas emissions due to needing more land for growing the same amount of produce. Also, the lessened productivity and a higher cost of inputs, characteristic of organic farming, makes it unsustainable from an economic perspective. The problem of the unequal distribution of the benefits from organic farming is also concerning. Especially true for a country like India, where the income disparities are so massive, it is felt that a large population might not be able to afford the expensive organic produce, which further raises the question of it isfair for the masses to suffer (in form of increased global warming) due to the wants of the few that occupy the status of 'wealthy class.' (Jacob, 2020).

Thus, the choice of opting for organic farming over the conventional methods creates a trade-off due to the abandonment of synthetic chemicals that aid in increasing productivity. The advantages of two goals of sustainable agriculture, namely food security and environment conservation, must be carefully assessed in this situation as choosing organic methods will result in release of more greenhouse gases. Thus, even though the produce grown might be considered safer for the consumer, it contributes to greater levels of global warming, and thus organic farming is not considered fully sustainable.

The above study also cited an example of India's all organic state, Sikkim, which compares official data to provide evidence on how the production of Sikkim Mandarin declined 22% since the adoption of sustainable agriculture, without any substantial increase in the production of any other product.

This helps bring to light a tradeoff where a greater availability of food was sacrificed for thepurposes of environmental conservation and food safety.

Thus, organic farming might be the most favoured as compared to other SAPs, yet the high input costs, low awareness of proper techniques, limited pest control options, low shelf life leading to wastage etc. have made it inaccessible for many Indians farmers. This makes the knowledge and promotion of other SAPs which do not bear similar limitations imperative to achieving the goal offood security that India seeks to achieve.

## The Principal Challenges in Wide-Scale Adoption of SAPs in India

This section examines the numerous problems and challenges that plague the Indian agricultural sector, making sustainable agriculture unprofitable as well as unfeasible. This makes it extremelydifficult for India's agricultural sector to adopt these practices.

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There is a vast corpus of literature examining the reasons for the low adoption rates of SAPs in India. Given the constraints of space and time, we have limited our focus to the economic reasons, and narrowed the problems to include the categories that we feel are primary contributors to low adoptionrates of SAPs in context of the Indian economy.

The various key factors affecting the wide scale adoption of sustainable agriculture can be dividedinto two broad headings namely:

1. Natural Problems which include problems like water scarcity, management of weeds and small and fragmented rural land holdings and (2) Human made problems include difference in public perception, creation of trade-offs between different wants, lack of knowledge among the farmers, drudgery and capacity building, huge input costs, high dependence on traditional methods, yield gaps, wastage of food and marketing challenges.

**An in-depth analysis of the above-mentioned challenges is provided as follows:**

**1. Natural Problems**

They are characterised by the lack of natural resources such as land, water, soil etc that hinder theagricultural process. Some of the key problems are elaborated as under:

**Water scarcity:** In agriculture, water is frequently wasted, misused, and inefficiently used which often exacerbates this issue. At the same time, as the demand for water gradually rises with each passing day, shortage of water and droughts have become major obstacles to agricultural growth and development. Due to the problem of drought and water shortage, the country lacks in adopting new technologies and adopting new techniques (Shalaby et al., 2011).

**Weed management:** It is one of the key issues. Weeds can be said to be a serious threat to farming as they reduce agricultural yields by absorbing water, sunlight, and essential nutrients, and thus act as a host for pests and diseases. Therefore, its management is of prime importance. The importance of proper weed management must be emphasized, and farmers must be educated for the adoption of various organic weed control strategies in contrast to using herbicides directly. (Muthuprakash et al., 2020).

**Small and fragmented rural land holdings:** Due to inheritance regulations, the size of the arableland shrinks with each generation inherited land gets divided into smaller pieces.

This declines agricultural productivity, reduces economic opportunities, and restricts crop diversity.Also practicing cultivation methods such as livestock farming, intercropping etc. requires a large space and is not impossible for smaller farmers.

**2. Human-made Problems**

They are influenced directly or indirectly by humans' actions, knowledge, behaviour, workingsystem, etc that hinders the agricultural process The major ones are as follows:

**Public perception:** (Muthuprakash et al., 2020 p. 45) used the method of Roger's Diffusion of Innovation (DOI) theory to understand the spread and perception of various groups about the idea of sustainable agriculture, and though the study was unsuccessful in acquiring concrete data to support any conclusions due to the small sample size, another study (Tomaš-Simin & Jankovic, 2014, p. 526) successfully concluded how the essential characteristics of an innovation in the given model, namely relative advantage, complexity, compatibility, trialability, observability are usually lacking in systems like organic agriculture. More generally, we feel that the same principle applies to sustainable agriculture as well, which has a high complexity and relatively low relative advantage, compatibility and observability as

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compared to conventional agriculture.

**Creation of tradeoffs between different wants:** We have already observed that adopting SAPs creates a trade-off between environment conservation and productivity (and overall profit), i.e a gain in productivity comes at the cost of making the environment worse off and vice versa, which makes the task of convincing people to adopt sustainable agriculture an increasingly difficult one.

Another tradeoff is seen between fulfilling the two conditions of food security i.e food safety and productivity/ affordability i.e., enormous amounts of chemicals can be used to increase the yield and achieve the food security target or keeping the productivity low but ensuring the safety of food produced.

An example would be the choice of the crop during crop diversification. Decision between sowing either wheat or bajra that a farmer might face is a case of environment-profit trade off, where while wheat offers better price incentives, bajra is more resilient to adverse weather conditions and requires a lower amount of chemical fertilisers which makes it better for the environment.

**Lack of knowledge among farmers** is one of the difficulties that prevents farmers in India from adopting sustainable agricultural practises. Most Sustainable agriculture practises require knowledge, and their successful adoption involves farmer education.The attitude of Indian farmers toward sustainability differs by location.

**Drudgery and Capacity building:** Sustainable agriculture in India is currently extremely labor-intensive, which may prevent medium- to large-scale farmers from adopting it. This is largely due to the absence of efforts in the arena of capacity building in the form of mechanization of the involved inputs.

**Huge input costs:** This is another problem associated with the adoption of sustainable agriculture as organic inputs are often much more expensive as compared to their conventional alternatives. Organic manures such as groundnut cake, neem seed and cake, vermi-compost, silt, cow dung, and other manures are getting increasingly expensive, making them unaffordable for small producers. Also, organic manures are more difficult to access for small and marginal farmers than chemical fertilisers, which are readily available in marketplaces.

**High dependence on traditional methods:** Another problem within the Indian agriculture system is its lowered productivity, which is caused due to the high dependence that the farmers have shown on the now outmoded methods borrowed from the green revolution as well as due to the absence of advanced technology.

**Yield gaps:** Elimination of synthetic inputs, high dependence on rain fed agriculture and lowered productivity further cause yield gaps, which are defined as the difference between the harvest that could be achieved and the actual crop produced. This is because restoration of full biological activity in terms of beneficial insect population increase, legume nitrogen fixation, pest reduction, and fertility issues take time.

(Pradhan et al., 2015) states how managing yield gaps could help many countries become self-sufficient by 2050 accounting for population growth and dietary pattern changes. However, the study further suggests an increase of 70% in N, 50% in $P_2O_5$, and 300% in $K_2O$ fertilizers, compared to 2010, if one hopes to achieve this goal, which when used in such great amounts could be detrimental to the health of the environment as well as the humans who consume it.

**Food wastage:** Merely reaching the desired production levels is not enough to reach our goal of food security for all, by stating the figures from a UN report according to which a third of

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all food produced is wasted (Department of Agriculture Cooperation and Farmers Welfare, n.d.). This helps us realise that there is also a need for proper storage and transportation techniques from areas with excess to areas with a shortage.

**Marketing Challenges:** The growing development of agriculture production has posed a new challenge for the agricultural industry in terms of finding markets for the increased outputs. Farmers in certain rural locations are unable to sell their produce due to a lack of markets. Also lack of institutional support (eg. adequate support and schemes by the government in terms of infrastructural/knowledge/others, irrigation facilities), issue of price realisation, access to credit, water scarcity, SAPs are too complex to understand and/or are too specific to a particular region, social and cultural constraints).

All these problems have helped us gain a deeper insight into the various challenges faced by the Indian farmers on a daily basis. According to the Ministry of Agriculture, the Indian government intends for the agricultural sector to grow sustainably at a rate of 4% annually to 2020, yet the aforementioned issues have proved to be huge obstacles in the accomplishment of this goal (Rao,n.d., p. 1).

It is also important to note that one problem cannot be declared as holding more importance. A study by (Muthuprakash et al., 2020 p. 45) surveyed 620 trained farmers across 11 Indian states, to find that while Assam, Jharkhand, Odisha and Sikkim (Eastern states) primarily struggled due to the lack of knowledge, access to organic inputs and irrigation constraints, the states of Andhra Pradesh, Gujarat, Himachal Pradesh, Maharashtra, Punjab and Tamil Nadu (remaining states) were plagued by marketing challenges and drudgery, which made adoption of sustainable agriculture cumbersome.

Other state-level disparities in both productivity and production have also been noticed ever since the advent of the green revolution. These are caused both due to the disparity in the availability and usageof available facilities and schemes as well as due to natural reasons such as difference in theenvironmental conditions and availability of natural resources such as land for agriculture or water forirrigation purposes.

(Singh, 2020) notes how the promotional price policies undertaken by the government to boost sales of cash crops such as coffee, tea, sugarcane etc. are also often detrimental to the performance of other crops in the market. And since different areas and regions often specialise in production of certain crops or produce, it is felt that such a move by a particular state might also negatively affect theperformance of another one.

Integrating the concept of sustainability into research, education, project planning, various schemes etc. is proving problematic as sustainability necessitates dealing with interconnections between technology, society, and the environment and the various stakeholders. Thus, effective promotion oforganic agriculture warrants the development of an adequate agriculture policy that takes these complications into account.

**Initiatives Undertaken by the Government**

The Indian government has recognized and initiated manifold programmes for attainment of the twin objectives of increasing the adaptability, and reducing the carbon emissions from the agricultural sector.

Historically, movements such as the green revolutions have helped yield greater produce and increase food security, but in the present the need for an ‘evergreen revolution’ has been emphasised. Such a movement aimed at increasing production without compromising the safety of the environment would be instrumental in promotion of sustainability in

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agriculture. Gradually some farmers are also looking for alternatives due to the harmful long-term effects of conventional agriculture. Furthermore, farmers in resource-constrained regions that do not rely heavily on external inputs are willing to undertake the gradual transition to sustainable agriculture.

Indian agriculture confronts numerous constraints but optimum utilisation of natural resources, human resources and capital resources is essential to accomplish sustainable agriculture development.However, for long term sustainability the wider spread and adaptation of various sustainable agricultural practices by all sections of society is needed.

In order to promote and encourage farmers to adopt SAPs, the Indian government has launched various schemes, both at national and state levels, in order to provide financial help, insurance
coverage, availability of materials, assistance with setting up organic farm models, providing guidance about certification, and other practices relevant to organizing conferences, extending subsidies and providing training etc.

From the multitude of schemes proposed by the government in order to encourage the adoption of SAPs, all the schemes may be categorised under two broad heads namely the National Mission for Sustainable Agriculture (NMSA) and the National Programme for Organic Production (NPOP), have been discussed as follows:

**1. National Mission for Sustainable Agriculture**

It aims to promote sustainable agriculture through a series of policy interventions focusing on major aspects of Indian agriculture, including improved crop seeds, livestock, fish cultures, water management, pest management, farm practice techniques, nutrient management, agricultural insurance, credit support, access to market and livelihood diversification.

According to the Press Information Bureau (PIB) report, the National Mission for Sustainable Agriculture (NMSA), uses several supporting programs to aid its objective of promoting region specific SAPs to maximise productivity. The schemes along with relevant details as stated by (Department of Agriculture Cooperation and Farmers Welfare, n.d., p. 4-8) are as follows:

- Paramparagat Krishi Vikas Yojana (PKVY)
  Encourages cluster based organic farming, and helps fund establishment, training, certification, market access etc. Over 3 years, a sum of Rs. 50,000/ hectare is contributed to asole cultivator, of which 62% (Rs. 31,000) is meant to be a stimulant for the use and purchaseof organic inputs.
- Rainfed Area Development (RAD)
  Aims to make rainfed agriculture more productive and sustainable through the use of Integrated and Composting Farming Systems along with the preservation of the precious natural resources of the area.
- Mission Organic Value Chain Development (MOVCD)
  The scheme was initiated by The Ministry of Agriculture and Farmers Welfare, Government of India plans to improve certified organic production in a value chain mode in order to create a bridge between farmers and consumers and to support the long-term development of the entire value chain, beginning by providing various inputs, planting materials and certification of quality. They also provide last-mile assistance by providing services like collection, management of harvest, processing, and marketing.
- National Mission on Oilseeds and Oil Palms (NMOOP)
  This scheme was initiated to promote the growth of oil seeds. It provides quality and efficient materials to plant oil seeds and oil palms. Under this scheme, the government assists by providing 50 % subsidy on biofertilizers, vermicompost etc., minimum of

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Rs.300 per acre.

- Capital Investment Subsidy Scheme (CISS)
  This scheme was initiated in order to increase agricultural productivity by maintaining soil health. Therefore, under this scheme the government promotes organic farming by making available various organic inputs and to reduce the dependency on harmful fertilizers and pesticides based on chemicals.

However, the Ministry of Agriculture and Farmers Welfare (MoAFW) allocates barely 0.8 % of its budget to NMSA. The Central government pays INR 71,309 crore (USD 10 billion) on fertiliser subsidies each year, in addition to the MoAFW's budget of INR 142,000 crores. (Gupta et al.,2021)

## 2. National Programme for Organic Production

The Ministry of Industries and Commerce, Government of India initiated this program which aims mainly at developing organic farming and processing, as well as providing evaluation of certification programmes for organic produce as per the approved criteria in order to determine their credibility.

Its basic objective is to provide a method for evaluating the certification programme for organic agriculture and goods against predetermined criteria. It makes the task easier to certify organic products in accordance with the required requirements. Also, it facilitates certifying organic products that meet the organic criteria of the importing country, based on an equivalence agreement between the two countries or importing country requirements.

Apart from these programs, the government has also invested in several other schemes and plans to encourage the agriculture community to adopt sustainable agriculture. Some of them are as under:

- (Ministry of Agriculture & Farmers Welfare, 2021) According to the central government expended a total of Rs. 1726.67 crore in the period between 2018- 2021 in order to support thegovernments of Haryana, Uttar Pradesh, Punjab, NCT of Delhi to help achieve their primary objectives of combating air pollution, subsidizing the machinery needed for in-situ crop residue management, raising awareness among the farmers and establishing Custom Hiring Centres (CHCs).
  This has also helped reduce pollution levels by limiting paddy residue burning, which have now successfully been reduced by 29.5% in Haryana, 24.5% in Uttar Pradesh, 11% in Punjab, as compared to 2017.
- The Government also ensures provision of financial support, incentive of approximately US$228 (Rs.10, 000) per hectare, to any organic farmers during the period of conversion (3 years) and for a period beyond.
- Provision of subsidies by the government that enable people to upgrade to better technology and become more efficient is also a huge step. It is reported that our government has allocated $160 million for a subsidy scheme offering to cover up to 80% (50% for individuals, 80% for cooperatives) cost of the ‘happy seeder machine’, usually costing about $ 4915 per unit, which helps in reducing stubble burning by converting it into mulch and depositing it over the planted crop (Business Times, 2019).

The total support cost to India in this regard is now well over US$ 80 000 (Rs.3.5 million) per year (until 2006-2007). Financial support is to compensate for any potential losses, promotion
of organic agriculture, developing and further supporting infrastructure, for conducting research and preparing for guidelines.

The farmers and cooperatives, however, were far from happy due to numerous gaps in

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the implementation of this scheme, the same study suggests. With farmers already on the fence about buying such an expensive machine that only has use of about 15-20 days in the whole year, the excessive formalities and paperwork required to apply for these subsidies paired with the lack of help available by concerned authorities for the same has exacerbated the matter further, by making it difficult for uneducated farmers to avail these benefits. Also, there have been concerns about the need to pay upfront and complaints about the excessive time taken to process these documents and for initialising the imbursement process have been plenty.

Newspaper reports like (Vasdev, n.d.) have also talked about claims by farmers in Punjab alleging that upon investigation these subsidised machines were found to be more expensive than the ones being sold in markets, which were a significant 10%- 30% cheaper. It was reported a private firm was selling the machine for Rs 60,000, while the government approved firms set the price of the same at Rs 1.5 lakh, which meant that despite the subsidy an individual farmer would still have to buy it for an additional Rs 15,000 if he buys it under this scheme; and this made people question this initiative and the associated intentions of the state government which itself procures these machines at a 100% subsidy from the state. However, the state government and concerned dealers have remained united in their stand and maintained that the additional costs are due to the superior quality of the imported product.

Other studies report that the farmers have often expressed having to resort to methods like residue burning, despite not wanting to, due to the exorbitant costs of servicing and maintaining a machine, attracting about 12% of the goods and services tax, that is used so infrequently. It was further stated that the 14,000 Happy Seeders and the 6,000 combines fitted with S-SMS that are already distributed can only cover an average area of 24.5-33.6 lakh acres and 18-22.5 lakh acres in the next 25-30 days respectively out of the 75 lakh acres under cultivation in Punjab, which is clearly not enough to stop the problem of stubble burning (Chaba, n.d.).

In another district of Punjab called Muktsar, having 144 cooperative societies, it was reported that most did not have funds to buy the machinery despite 80% subsidy, and had to rely on loans for a purchase. A demand for a mere 96 of the same was placed in 2018, and the delivery was reported to be extremely slow, which was attributed to technical issues (Watts, 2018).

- Another very direct and probably one of the most well-known initiatives by the government isthe provision of MSP by the government, which acts as a safeguard in case of extremely low prices. The recent farmer's protest in India over the dissatisfaction caused by exclusion of MSP from the farm bills also serves as a testament to its importance for our cultivator community (India Today, 2020). However, the same article also highlights how MSP is not enforceable by law, and provided only for 22 crops (+sugarcane under FRP or Fair and Remunerative Price).
- At the household and individual level, the advent of the Public Distribution System (PDS) through rations shops has helped increase accessibility. It further states that the retail price of staples has increased slower than per capita income, which has helped increase the purchasing power of consumers as the proportion of income required to buy these goods actually declined. The study also states an example of the price of 100 kg wheat as a proportion of annual per capita income in rural areas declined from 15.4 % in 1973-74 to 4% in January 2008. Relative economic poverty has also decreased and improved availability of staple food i.e more supply has caused "declining real prices has contributed to improvednutritional-security."

(Acharya, n.d., p. 4-6) emphasises the appreciable growth in food security levels at both macro and micro levels. Higher crop yields per hectare have aided cereal production to grow continuously while easily being able to accommodate the demands of the growing

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population, which has enabled us to reduce instability as well as dependence on imports.

(Rao, n.d., p. 3) further reports that with the latest developments in the fields of biotechnology, genetics, information and communication technologies, have had a huge impact on the management of agricultural production systems. Also, the realisation that some of the conventional can also be
used Another dimension is added by the recent realization of the gains that can be obtained by the inclusion of ancient wisdom and knowledge acquired by generations of local farmers in sustainable management of resources.

**The Way Forward: Some Recommendations**

In light of the conducted research, it has been observed that the gaps between the planning and the actual implementation of these initiatives are a huge barrier in the sustainable agriculture being accepted more widely. In order to bridge this gap and ensure greater levels of sustainability, we recommend the following:

1. There is an urgent need for increased spending in the areas of research related to the study of sustainable agriculture in India, as well as the creation of Sustainable Agriculture Universities (SAU's) in the various Indian states. (Rao, n.d.)
2. We feel that in order to ensure maximum benefit and efficiency, the various policy initiatives must be developed in accordance with the needs and aims of a particular state. The SAU's should focus on the specific issues in their area, and the state governments should be given complete autonomy on matters relating to their particular states.
3. There is also a need to diversify crops to include commercial and cash crops by the incorporation of horticulture and animal husbandry which would help farmers get better returns. (Committee for "Agricultural Policies and Action Plan for a Secure and Sustainable Agriculture", n.d., p.8)
4. The various government schemes and programs should also have subsidies under various slabs that are decided on the the basis of the applicant's financial standing, which would ensure more equitable distribution of the already scarce resources.
5. Combining technology to facilitate growth along with infrastructural development is also imperative to the success of such government schemes. Two suggestions made by ("Report onPolicies and Action Plan for a Secure and Sustainable Agriculture", 2019) in this regard are asunder:
    - Inclusion of the private sector in this area might help increase efficiency. Strengthening of institutions like the SAUs, Krishi Vigyan Kendras (KVKs), Self-Help Groups (SHGs), Cooperative Banks, Agri- business Centres, Farmer Producer Organizations (FPOs), Custom Hire Centres (CHC), etc.
6. (Acharya, n.d., p.6) elaborates on how the reduction in the absolute number of under-nourished population has reduced significantly, yet, it is important to note the distribution of population as around 48% of children (under 3 years) and about 39% of women fall prey to malnutrition and energy deficiency respectively. Thus, we also suggest the creation of special schemes and programs specifically tailored to understand and meet the needs of this demographic and to curb their excessive mortality rates.
7. (Ehrlich, 1993, p.4) talked at length about the maldistribution and states that a study by Kates,Chen and colleagues at the Brown University suggested that "present food supply is not as abundant to needs as is often assumed" and even further goes on to announce that a diet consisting of about 30% animal sources could only be given to about half of the population in 1992. Thus, we suggest that appropriate ways for the transport from areas of excess to areas ofshortage must be developed at the earliest. There is also a need for an extensive network of transportation and storage facilities, such as cold storages.

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8. We feel it might also be of help to India to lead by the example of China, the most populous country of the world, which followed simple methods like eco labelling (organic, green or
   hazard free) to make their consumers more aware and promote sustainability (Cook &Buckley, 2015, p.2).
9. Focusing on a 'farm-to-table' approach which includes the careful growth and handling of your food through all stages of a food chain, in order to provide the consumers with assurance about the sustainability and the quality of the produce should be encouraged (Sudhakar, 2016, p.294).
10. (Department of Agriculture and Cooperation Ministry of Agriculture (New Delhi), 2010, p.
    46) states some effective measures for integrated pest management, site-specific predictive models, utilisation of biotechnology and bioinformatics, usage of semiochemicals in creation of bio pesticides, reducing response time between detection and management of pests and diseases, strengthening immunisation, improving infrastructure and storage facilities.
11. There needs to be awareness about the use of fertilisers in sustainable agriculture, which are useful for providing the elements necessary for conversion of energy from solar to chemical form (food), and are harmful only when used in excessive quantities (Prasad, 1999, p. 38).
    - Traditional alternatives to chemical fertilisers include vermicompost, slurry, seaweed, guano, peat, green manure etc. However, it must be noted that even they should be used in controlled amounts.
    - Knowledge and access to fertilisers like BIOTA, an entirely plant-based organic fertiliser, synthesised from waste nitrogen sources and uses 90 % less CO2 and energy (The Community Research and Development Information Service (CORDIS), n.d.). More research into this specific area to help initialise and fund such projects could alsobe beneficial and should be encouraged.
12. (Tomaš-Simin & Jankovic, 2014, p. 523) talked about how social appeal, or the use of ideological reasons, is often chosen when asking people to change to organic farming, and
    how a change in motivation might influence the characteristics of this group and affect adoption rates. We feel that similar principles can also be applied to sustainable agriculture, in general, and more rational appeals, detailing the personal benefit such as higher profits due to growing market for safer products with spread of consumer awareness, would be more instrumental in positively influencing people's personal motivation and encouragingparticipation by the youth of the country.

## CONCLUSION

A thorough analysis of both the challenges as well as the measures taken in order to combat them by the government has helped solidify the long-established gap between the ends and means that needs to be traversed through the judicious use of the existing technology and resources (natural and human) as well as the initiation and employment of newer schemes and advancements.

We believe that creation of novel solutions supported by advanced technology, increased research, appropriate use of resources, improved infrastructure as well as region-specific government initiatives would surely prove to be instrumental in increasing the adoption rates of sustainable agriculture throughout India by eliminating disparity of results between states and ensuring the success is not concentrated on a few beneficiaries.

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Maintaining the present level of agricultural productivity while also attempting to manage the host of associated environmental concerns is indeed extremely difficult, but it is felt that viewing agriculture as ecological and not purely economic systems and acknowledging the existence of the associated trade-offs will empower people with the knowledge they need to make prudent decisions about the future.

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