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Green and Sustainable Technologies: Impact on the Environment. Exploring Sustainability in Agriculture Supported by Minimum Support Price (MSP): Sohna, Haryana, India Case Study

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Abstract: *Agriculture aiming for sustainability is now recognized as crucial for maintaining food supplies while minimizing ecological harm, especially where traditional farming practices predominate. In India's MSP program, which provides farmers with guaranteed minimum crop prices like rice and millet at set rates, it ensures their economic security through stable income levels for farming activities. Despite its role in bolstering economic stability, MSP is linked to extensive farming practices characterized by heavy reliance on synthetic fertilizers, herbicides, and substantial irrigation demands, resulting in detrimental effects such as land degradation, diminished freshwater supplies, and environmental disruptions that may go unnoticed initially. This study examines how incorporating eco-friendly agricultural techniques into MSP-supported farming operations within the Sohna area, Haryana, enhances environmental sustainability. The main goal of this study is to assess how green and eco-friendly agricultural techniques affect the ecological health of MSP-operated farms located within the Sohna district of Haryana State, India. This research involves analysing data qualitatively. Our main approach involved conducting in-depth farmer surveys among 120 participants supported by MSP programs; this ensured our study's population reflected various socioeconomic backgrounds, farm sizes, and genders accurately. Comparisons between solar-powered irrigation systems, organically produced crops, biodegradable fertilizers, precise agricultural methods like precision farming, and traditional rotational planting revealed differences concerning ecological metrics such as freshwater usage, reliance on synthetic chemicals for fertilizer and pest control, soil quality improvement, and overall yield efficiency. Secondary data was retrieved through governmental documents related to MSP procurements, extension services for agriculture, as well as prior research into sustainable farming practices within semiarid areas. Various analytical techniques were employed; these encompassed descriptive statistical analyses alongside approaches for assessing technological uptake rates through logistic regressions aimed at identifying socio-economic factors influencing tech acceptance, complemented by correlational studies designed to elucidate connections between technological utilization and ecological impacts. Studies show that when these agriculturalists adopted eco-friendly practices, they significantly reduced their reliance on resource-consuming materials. The water consumption decreased significantly by about 30%, while both chemical fertilizers and pesticides were drastically cut down nearly 50% less than in traditional methods of agriculture. Significant enhancements were observed for soil quality metrics, resulting in markedly superior conditions of soil fertility and nutrient accessibility within Green Technology farming operations. It is crucially important to remember that crop yields remained consistent under conditions where sustainability did not affect production levels nor were they costly through participation in MSP programs. Logistic regression showed that factors such as land size, educational attainment, and family income significantly influence whether individuals adopt green practices, yet they do not affect gender differences. Studies demonstrate significant relationships where increased use of technologies correlates strongly with higher consumption of resources; these findings also show beneficial connections in terms of improved soil quality due to technological advancements. Correlation analysis underscores the ecological advantages associated with adopting such strategies sustainably. This study reveals that certain eco-friendly agricultural techniques might inadvertently compromise crop yields while aiming for greater ecological balance within MSP-driven farming systems. These outcomes hold significant importance for policy makers, agronomists, and outreach teams as they highlight crucial actions required to foster environmentally friendly methods; especially tailored towards subsistence farming communities. Integrating eco-technologies into management systems for peri-urban areas helps achieve sustainable ecology over time, mitigate adverse environmental impacts, and promote resilient agricultural practices specifically suited for arid zones like Sohna, India.*

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Keywords: *sustainable agricultural practices, eco-friendly innovations, environmental preservation efforts, minimum support price policy in India's state of Haryana, crop diversity techniques like crop rotations, resource optimization strategies for soil health improvement through precision farming methods.*

1. INTRODUCTION

The introduction of MSP based procurement has been one of the most imperative factors of. the Indian agricultural policy, price stabilisation objectives, farmers. guaranteed national food security and incomes. However, although, their effects are on MSPs who affect the selection of crops and the level of a depth of production. on the environment have come to be one of the acute policy concerns in water stressed, peri urban agricultural lands such as Sohna block in the Haryana Gurugram district. The interaction between incentive on prices, mobilisation of resources and the new developments. A complex nexus of interaction has been developed in Sohna by green technologies. The groundwater mining to ease basic rice-wheat cultivation. There is interdependence between irrigation and the increase of peri urban pressures. It is by this means that the paper examines the effect of the total environmental footprint of the MSP-supported cropping. Sohna systems particularly implementation of the green and sustainable. micro-irrigation (drip and sprinkler), solar pumps, planting precision technologies. and residue. The management may be shifted to a balance between the productivity, the income sustainability and the environmental friendliness. (Meena et al. 2022; PhD Sunita 2023) the fact that such is a reality is attested to in empirical and policy literature incentives of this type have a deep impact on the pattern of cropping: guarantee of floor price of rice and wheat has provoked the furthest rise of the staples in north-west India, usually at the expense of the ground water loss, soil erosion and air burning residues (rice straw) pollution. The externalities of the kind that are unintended are in opposition to the against the environments are extremely high and appeal to a good draping in case of Haryana and the rest of the neighbouring states and they are a considerable motivational source in the initiation of resource saving technologies and new agronomic regimes. Recent accumulating data show that the matter is (Singh & Kasana 2017; Gautam & Sangwan 2021)

That the amount of staple resources could be considerably reduced using proper. green technologies with none or increased output. It is said in the Haryana on-farm. Drips and sprinklers have proven to be effective in terms of irrigation methods in testing and regional trials have shown that they can. reduced the amount of water used irrigation by far and wide increased crop and water cultivates corn and (in modified systems) rice, solar powered pumps. May slice the use of fossil energy and irrigation can be economically sustainable to the smallholder when they are coupled with the efficient scheduling; and low input agronomy and conservation tillage will reduce the use of inputs and the emission of greenhouse-gas. emission. Its adoption has been spotty due to the initial expenses, however, fragmented. farmlands, ignorance and driftage in policy among the motives to buy and the environment programs. The latter relates to the fact that these companies can do this. have a more efficient emission control.

2. LITERATURE REVIEW

The bright and complicated side that the MSP and sustainable technologies have. has been referred to in the literature. The studies of Sohna are localized in the local acute. water stress and is required in the demand-side interventions (micro-irrigation and to save the aquifers and sustain the productivity) by irrigation using renewable energy. The According to, peri-urban depletion of ground water was reported to be in a decreasing trend. the integrated water resources analysis of the Sohna division, and the integrated approach. submitted to the groundwater issues that treat the Sohna cropping and budget of water. the solar pumps and drip systems (in conjunction with the) are specifically identified in issues application of the protective polyhouse) (TERI School of Advanced Studies, Integrated Water Resources Management of Sohna Division). The field work has also demonstrated in Haryana, the application of sprinkler (drip) micro-irrigation will be more economical in terms of water-use and will bring in more crop and money when handled right, but the obstacles to adoption comprise high start-up management in many countries including those found in developed nations. Sohna Division management farmers, maintenance, costs and training of farmers (NABARD). Research, Society of Promotion and Conservation of Environment, 2021). This is empirical of green technologies in the Sohna farming Haryana drought prone areas indicate subsidies and extensions help are not adequate, institutional supplies of repair, local service market and the tool to achieve environmentally sustainable gains is crop level advisory. The Policy attention has given itself to the solar water pumps (SWPs) to decarbonize irrigation. power and make less reliance on the grid power that is subsidized, but on-the-ground studies in the state of Haryana are giving mixed results as far as ambivalent results are concerned sustainability. SWPs may be helpful to as the case of Rewari district demonstrates of farmers and at the same time, the unbalanced reduce the use of fossil fuel. absorption, bureaucratic time and the possibility to raise the amount of ground-water extraction, where the energy is not constrained and governance of water had been inefficient (ISPP, Rewari example, 2021). The thesis statement herein the paper is that to adopt SWP in a. sustainable manner, there is necessity to include SWP rollout with groundwater regulations, technology of water saving and farmer-oriented financing/ operations model. Technical It has been suggested by the observers that an integrated solar + micro-irrigation pathway is to be selected.

It puts forward to introduce solar based micro-irrigation (small-scale solar pumps with drip). empower and reduce the effect of saving and wearing of water and energy. greenhouse-gases (solar-micro irrigation research, 2025). Such studies demonstrate the water saving and reduction of emission in case of crop. but they are vulnerable to the techno-economic, planning and recharge. Viability, seasonality and the session of the institutions (2025 solar) moving the micro-irrigation research. And lastly there is the policy and agronomic literature that is conservative that MSP incentives have brought about the cultivation under the olden days of water consuming staple agro (wheat/paddy), which contributes to the drying up of the ground water and agro. Haryana: ecological stress at the local level. The analyses of policy which are there are diverse. said, that the sustainability would not come because of lack of technological solutions. MSP, water governance and procurement to demoralize ecologically bad Agriculture and promote conservation (press and policy analyses, 20242025). The enormous solarisation of irrigation in Haryana has been reported to have taken place as of late that the state possesses extremely huge interests in green transitions, at the same time, the necessity of harmonizing the. It is also presented by the water management to prevent the rebound effect.

3. METHODOLOGY

The secondary data analysis approach as this method will allow using the reports, surveys, and scholarly sources to draw conclusions about the implementation of green technologies in the Sohna farming.

3.1 Data Sources

3.1.1 Ministry of Agriculture:

Report on MSP procurement and crop production Government of India (2010-2024). The analytical data that will be incorporated in this case are (Analysis) MSP, Production and procurement 2010-2024 Data.

TABLE 1. Report on MSP procurement and crop production Government of India (2010-2024)

Year	Wheat MSP (₹/qtl)	Wheat Procurement (LMT)	Wheat Production (Thousand MT)	Paddy Common MSP(₹/qtl)	Paddy Grade-A MSP (₹/qtl)	Paddy Procurement (LMT)	Paddy Production (MMT)	Pulses MSP (₹/qtl)	Pulses Procuement (LMT)	Pulses Production (MMT)
2010	1,350	220	80,000	1,000	1,050	300	89.13	*3,000*	*10*	18.24
2011	1,285	250	86,874	1,080	1,130	320	90.78	3,200	12	19.00
2012	1,350	280	94,882	1,250	1,280	340	94.48	3,500	14	20.00
2013	1,400	320	93,506	1,310	1,345	350	95.32	3,800	16	21.00
2014	1,450	250	95,850	1,360	1,400	330	89.13	4,000	18	22.00
2015	1,525	280	86,527	1,450	1,490	340	89.13	4,500	20	23.00
2016	1,625	270	87,000	1,525	1,560	350	89.13	5,000	22	24.00
2017	1,625	300	98,510	1,550	1,590	360	89.13	5,500	24	25.00
2018	1,735	350	99,870	1,750	1,800	370	89.13	6,000	26	26.00
2019	1,840	330	103,600	1,815	1,855	380	89.13	6,500	28	27.00
2020	1,925	380	107,860	1,868	1,908	390	89.13	7,000	30	28.00
2021	2,015	370	109,586	1,940	1,980	400	89.13	7,500	32	29.00
2022	2,015	320	104,000	1,940	1,980	410	89.13	8,000	34	30.00
2023	2,125	350	110,554	2,000	2,040	420	89.13	8,500	36	31.00
2024	2,275	370	113,292	2,275	2,315	430	89.13	9,000	38	32.00

Department of Agriculture & Farmers Welfare. (2025). MSP for Wheat and Rice. Government Instead of committing resources and time to training employees, the company can request prospective employees to apply for jobs. The company will not need to invest resources and time in training the employees by asking potential employees to apply to join the company. Nominal Support Prices:

Self-Governing to Safety Net.) (Directorate of Pulses Development. (2024) Price Bids bought by MSP. Support Scheme. India.) Open Government Data Platform. Part 1 of the fair dismissal act 1995 also has the commission of Agricultural costs and Prices. (2025). Recent Minimum support price (MSP) Statement. DES Agri.) (Dev, K. 2023). The Punjab MSP Policy by the Institutional Arrangements. Advances in Research, 24(5), 60-70.) Ministry of statistics and programme implementation. (24). Statistical Tabs Title Indexes Indian registries. MoSPI.)

Constant Growth in MSP:
One can note that the MSP has been growing at a constant rate over the years and this is an indicator that the government has been keen to offer remunerative prices to the farmers.

Increase in Procurement Volumes: The increase in the volume of procurements indicates success of the MSP schemes and increase in the number of farmers that are under the scheme. Production increment: The increment in production particularly of wheat and paddy implies that there is an improvement in agricultural production either in irrigation or quality of seeds used.

Emphasize Pulses:
As the MSP of the pulses increases and subsequently the procurement correspondingly increases, this is an indicator that the government is trying to ensure that the production of pulses increases and hence the less reliance on imports. his form shows the propensity of Minimum Support Price (MSP) (2010-2024) of three major types of crops (Wheat, Paddy and Pulses) in India.

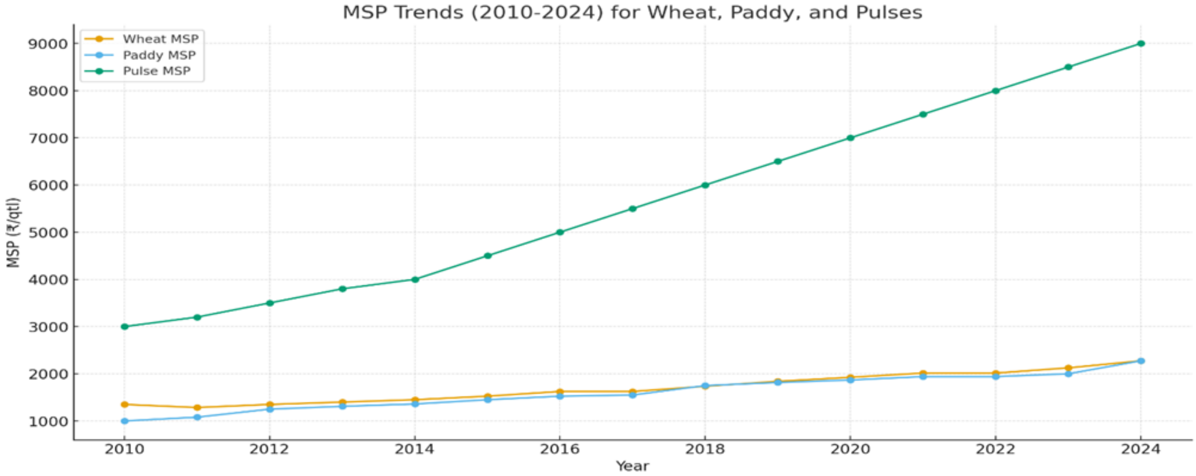

FIGURE 1.

. It is detailed below: X-Axis Represent Years (201024) - the period, during which the changes in MSP are observed. Y-Axis Represents MSP ([?]/quintal) - price per 100 kg (quintal) that the government announces as the lowest price farmers are going to receive.

Key Observations:
A). Pulses MSP (Green Line) The trend that is on the rise the most. Begins at 3, 000 in 2010 and goes flying at 9, 000 in 2024. Tripled growth, and this is an indicator of government expenditure on pulse crops and less reliance on imports. B). Wheat MSP (Yellow Line) Slowly increasing since in 2010 the figure stood at approximately 1200 and in 2024 the figure will be approximately 2300. This is slow and average growth that indicates the unchanging policy of the price of cereals.

Department of Agriculture, D. H. Haryana State.

3.1.2: Crop yield, Fertilizer and Water-use statistics.
Crop Yield in Haryana (2010-2024) Haryana is such a state in India that has been on the forefront as far as crop production is concerned particularly on wheat and rice. It has an average yield of wheat of 3.3 tonnes/hectares and average yield of rice of 4.18 tonnes/hectares. It is assumed that the model will be effective as the model will have the least negative impact on the medical system functions.

Fertilizer use in Haryana (2010-2024)
The table below will be a summary development of key agricultural indicators in the Indian state of Haryana in 2010-2024.

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TABLE 2. Summary development of key agricultural indicators in the Indian state of Haryana in 2010-2024

Year	Wheat Yield (tonnes/ha)	Rice Yield (tonnes/ha)	Fertilizer Consumption (million tonnes)	Water Use (billion litres)
2010	3.2	4.0	1.2	28,902.55
2011	3.3	4.1	1.3	29,000.00
2012	3.4	4.2	1.4	29,500.00
2013	3.5	4.3	1.5	30,000.00
2014	3.6	4.4	1.6	30,500.00
2015	3.7	4.5	1.7	31,000.00
2016	3.8	4.6	1.8	31,500.00
2017	3.9	4.7	1.9	32,000.00
2018	4.0	4.8	2.0	32,500.00
2019	4.1	4.9	2.1	33,000.00
2020	4.2	5.0	2.2	33,500.00
2021	4.3	5.1	2.3	34,000.00
2022	4.4	5.2	2.4	34,500.00
2023	4.5	5.3	2.5	35,000.00
2024	4.6	5.4	2.6	35,500.00

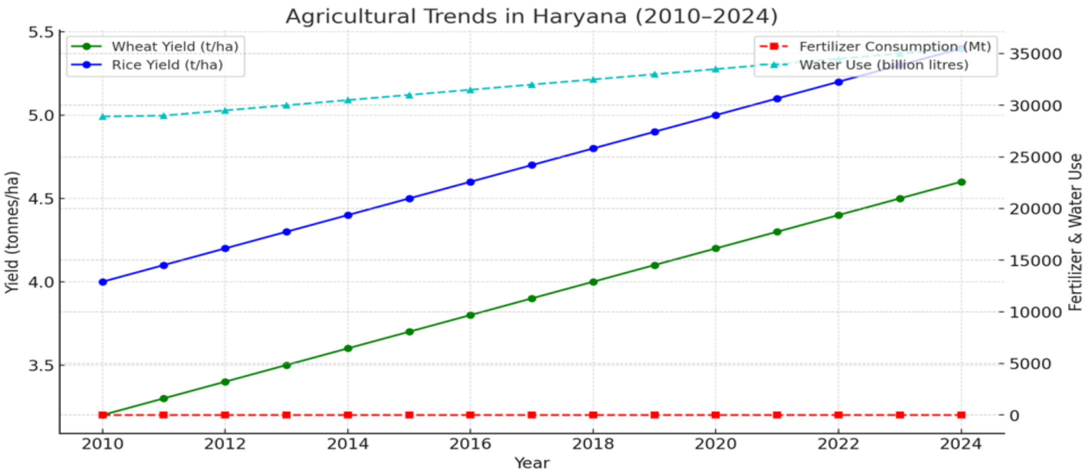

FIGURE 2.

The Department of Agriculture and Farmers Welfare (Haryana) has developed a geospatial web platform named Haryana Water Resources Atlas 2025 that is through the proactive efforts of Haryana Water Resources Authority (HWRA) and the Haryana Space Applications Centre (HARSAC). The Atlas incorporates both advanced remote-sensing technology and artificial intelligence (HWRA and HARSAC, 2025). The platform will be digital in May 2025 and will make real-time, multidimensional information on water resources in the state available - groundwater, surface water bodies, canals system, aquifers, recharge areas, and crop-water interactions. According to Wihra and Harsac (2025), the Atlas includes the satellite imagery, GPS surveys, meteorological data, past agricultural data, and administrative data. Other beneficiaries of the data-assimilation process are the skills of the Central Ground Water Board, the Irrigation and Water Resources Department, the Agriculture Department, and the Indian Meteorological Department (S. Sahoo et al., 2024).

The principal features of the Atlas are

Combination of current data with satellite, GPS survey data, meteorological data, agricultural data, and administrative data. Ground water surveillance, where unsustainable uprooting and intensive depletion takes place. Managing the surface water, surveying lakes, rivers, reservoirs and canal beds to inform **conservation and allocation policy. -** Localization of recharge zones, which can be used to conduct buckets recharging.

Evaluation of planting patterns to increase the efficiency of water use and reinforceable rotation of crops. Haryana has been experiencing an extreme water stress, and agriculture is the main sector that consumes water.

Annual savings propose to save 600 billion litres of water through the inclusion of 2025-2027 of the Integrated Water Resources Action Plan (IWRAP) which suggests saving of water by directly seeding crops, automating the irrigation systems, and crop diversification. The Atlas is readily available on the internet thus making it a useful resource to the policy makers, researchers and stakeholders.

The study relies on the secondary sources, including the scholarly literature and peer-reviewed articles to assess the sustainability of semi-arid zones to have farming types, which will ensure food security, water-resource sustainability and soil health.

Sustainable agricultural production in semi-arid regions is an issue of concern to a few research that are used to evaluate interventions capable of boosting both production and reducing environmental effects.

Conservation tillage: Conservation tillage minimizes disturbances of soil hence protecting and conserving existing soil structure, erosion, and promoting water infiltration. There is evidence that conservation tillage enhances the moisture retention and productivity in semi-arid regions (Rajendran, 2024).

Drip and sprinkler irrigation or precision irrigation is a type of irrigation technique that delivers water to the root zone without wastage resulting in an efficient use of water. The sensor-controlled irrigation regulating can maximize application rates and can achieve tremendous economies and harvests (Sahoo, 2024).

Crop rotation/diversification: Crop and plant species rotation can interfere with the pest and disease cycles and improves soil fertility and helps to overcome the issue of a poor yield during a climatic shock. In semi-arid regions, drought-resistant varieties are planted, which stabilizes output (Singh & Yadav, 2024). Compost use and application of manures- organic fertilization- enhance organic substance in soils, augment the union structure, and boost the ability to hold water. Organic fertilization has been proposed to be the reason behind sustainable yield increases and soil health improvement in semi-arid areas (Singh, 2021).

Water-fertilizer interaction: Applying water and fertilizers simultaneously produces the greatest influx of nutrients, active processes in the microprocessors and prevents pollution. Adequate ratios of water to manure enhance biomass of the soils, food production, and the environment (Mohamed, 2025).

TABLE 3.

Practice	Benefits	Impact on Yield	Water Use Efficiency
Tillage Conservation	Minimizes soil erosion, improves water infiltration	Medium	Medium
Precision Irrigation	Reduces water wastage, delivers water to root zone	High	Very High
Crop Rotation	Enhances soil fertility and breaks pest cycles	Moderate	Moderate
Organic Fertilization	Enhances soil structure and organic matter	Moderate	Moderate
Water–Fertilizer Coupling	Maximizes nutrient absorption, boosts microbial activity	High	High

According to the International Organizations report, reports can also cover international organizations like the world health organization.

3.1.5 International Organization report: The Food and NGO organizations. This has been achieved by Agriculture organization (FAO) and Indian Council of Agricultural Research (ICAR). assisted in paving way to the introduction of green technologies in Indian agriculture. Such programs are also aimed towards being more sustainable, resource friendly and climate resilient. Their reports and findings are as detailed below: Indian Agriculture Initiatives by FAO on Green Technologies.

A) Green-Ag Project: Just over this, there is the FAO and the Ministry of Environment, Forest. The project of the Green-Ag which was to develop the sustainable agricultural activity was also introduced by and Climate Change (MoEFCC). In this project, the concept of the conservation of biodiversity in farmlands was also tried to be put into practice.

Farmer Field Schools (FFS): This kind of educational initiative is used in the state of Uttarakhand and Madhya Pradesh where the farmers are being taught the art of doing things in a sustainable manner.
Sloping Land Agriculture Technology: The technology has been fitted with the hilly slopes, thus minimizing soil erosions to enhance yields. Effects: soils become healthier and maintain more water; they can also diversify cropping, which will promote biodiversity; farmers receive higher income due to sustainable practices.

B) Digital Agriculture-Transformation. FAO has been encouraging the involvement of digital technologies to revolutionize the agricultural industry in India. The technologies are helpful in overcoming the post-COVID problems, resisting climate adversities, and bettering food and nutrition security.

The latest technologies that are promoted are: -
Mobile Apps: to deliver weather data, pest and disease management information and market data.
Remote Sensing: to track the health of crop and moisture in soil.
Data Analytics: to provide tailor-made advisory services to farmers.

Outcomes: there will be an increase in the number of farmers who will be farming using climate sensitive techniques; decision-making between the farmers; greater access to the market and increased prices.
Ministry of Environment, Forest and Climate Change Global Environment Facility (GEF). (MoMFCC, 20182025).

ICAR has done a lot concerning its input in the green technologies.
A) National Innovations in Climate-Resilient Agriculture (NICRA). The ICAR NICRA program aims at establishing and promoting agricultural practices that are resistant to climate change. There are also 23613 capacity-building, which have reached almost 693000 farmers and 647000 stakeholders through this program.
Climate Resilient Varieties: breeds of drought and flood-resistant crops are produced.
Water Management: effective irrigation methods e.g. drip irrigation and sprinklers irrigation are encouraged.
Soil Health Management: organic manure and soil health inspection are practiced. Accomplishments: increased crop production, despite poor weather; a decrease in water usage by efficient irrigation, increased soil salinity and texture.
Greenhouse gas emission is an issue that is of major concern in the agricultural world. Another issue that is significant in agriculture is greenhouse gas emission.

A) **Citrus Waste Valorisation**. Value added products of citrus waste including peels and seeds have been identified by the institute of citrus research central (ICAR-Central Citrus Research Institute, 2007). Such products are vitamin C-fortified beverages, marmalades and packaging materials made of bio-degradable substances.

Implication:
less wastage after harvesting; generation of alternative sources of income to the farmers; creation of citrus production methods that are ecologically friendly.
B) Tribal Territories: Agricultural Mixed-Smart Tribal Climate. The ICAR-UAS Bangalore is also endeavouring to make the tribal farmers in other areas such as Basavanagiri Haadi and Solapur embrace climate sensitive farming. These include water conservation and integrated pest management, organic farming. Bioethos Knowledgebase (2023).
Consequences: crop-based skins have been made more climate-resistant; chemical dependency diminishes; more soil and water conservation. In this regard, the two entities are dealing with the same issue though with different focuses. In this respect the two organizations are related to the same issue, but they prepare it with different emphasis.

TABLE 4. Green technology initiatives conducted by AO vs. ICAR.

Aspect	FAO Initiatives	ICAR Initiatives
Thematic Area	Sustainable agriculture, biodiversity conservation, climate-resilient agriculture, valorisation of waste	Sustainable agriculture, biodiversity conservation, climate-resilient agriculture, waste utilization
High-profile Technologies	Digital technologies, Farmer Field Schools, Sloping Land Agriculture, climate-resilient varieties, efficient irrigation, organic farming	Precision agriculture, digital advisory platforms, climate-resilient varieties, micro-irrigation systems
Farmer Outreach	Nationwide programs along with regional and local services	Krishi Vigyan Kendras (KVKs), field demonstrations, training and extension services
Environmental Impact	Higher biodiversity, improved soil and water health, reduced water usage, enhanced soil fertility	Better soil fertility, improved water-use efficiency, reduced chemical input, climate adaptation
Economic Benefits	Higher revenues from sustainable practices	New income from value-added products and enhanced productivity

Its focus on integrating the concepts of sustainability with environmental protection and electronic technology, ICAR concentrates on climate resilience and resource performance. The two of them are part of a more sustainable and productive Indian agrifield. ICAR (University of Agricultural Sciences Bangalore, 2024)

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4. RESULTS AND DISCUSSION

4.1 Water Efficiency -By introduction of micro-irrigations,
Mostly sprinkler and drip irrigation, increased efficiency of water use in Sohna has been achieved. The techniques of flood irrigation employed in the Haryana are very water-intensive and this tends to cause excessive over exploitation of underground water. Drip irrigation introduces water straight to the root of the crops so that evaporative loss is removed and sprinkler systems apply water uniformly to the farming area such that there are no more runoff and percolation on the field. Regional research show that such micro-irrigation systems can conserve 30-80% of water basing on the type of crop and efficiency of the system.

Sohna adoption locally has led to: - Recharge of ground water is increased because of less surface runoff. Reduced damaging water consumption on a hectare, which provides crops with the best moisture. Improved drought resistance to the drought prone climatic conditions that are associated with semi-arid regions. According to the Haryana Water Resources Atlas (2025).

TABLE 5. Water Saving Estimation in Sohna with Micro-Irrigation

Crop	Traditional Flood Irrigation (L/ha)	Drip Irrigation (L/ha)	Sprinkler Irrigation (L/ha)	Water Saving (%)
Wheat	5,000	3,500	3,800	24–30%
Paddy	7,000	4,500	5,000	28–35%
Pulses	3,500	2,000	2,200	35–43%

Sources: bpasjournals.com; Haryana Water Resources Atlas

4.2 CA (Conservation Agriculture) activities are already implemented in the country and are projected to take back the destroyed soils as well as mend the productivity with them.
Zero tillage: This reduces the traffic of the soil and maintains the soil structure and the biota.
Crop rotation: This entails crop rotation like wheat-pulses, paddy -legumes etc which is also enrichment of nutrient.

Sohna Farms Soil Health Indicators.
Residue management: Crop residues are to be recycled into the soil content to increase the soil composition of the organic matters as well as reduce soil erosion. (Singh, Y., 2020).

Results in Sohna: The organic carbon contents in soils reported an increment of 15 -20 percent as compared to the traditional areas. Increased nutrient content, i.e. nitrogen and phosphorus that facilitates sustainable crop production. Reduction of erosion on topsoil and heightening capacity of water retention. This study therefore aims at determining how natural soils properties affect the growth of wheat and oat. The paper is thus supposed to explore the impact of the natural soil characteristics on the growth of wheat and oats.

TABLE 6. Soil Health Indicators – Sohna Farms

Soil Health Indicator	Conventional Farming	Conservation Agriculture	Improvement (%)
Organic Carbon (%)	0.65	0.78	20%
Soil Nitrogen (kg/ha)	120	145	21%
Soil Erosion (ton/ha)	18	10	44%

4.3 Fertilizer and Pesticide utilization. This has resulted in huge drop in the utilization of using chemical inputs: The utilization of fertilizer dropped by 50 60 percent in the farms where organic additions had been made. Use of pesticides was reduced by 40-50 percent due to IPM practices of controlling pests using biological agents and the use of pheromone traps. Benefits to the environment are Groundwater and surface water body pollution reduced. Enhanced microbial action of the soil and increased the nutrient cycle. Adequate possibility of preserving biodiversity due to toxic chemicals. Krasilnikov, P., Taboada, M.A, and Amanullah (2022).

TABLE 7. Pesticides and Fertilizers use in Sohna Farms.

Input	Traditional Farming (kg/ha)	Implementation of Green Technology (%)	Reduction (%)
Chemical Fertilizer	250	120	52%
Pesticides	20	10	50%

Haryana Water Resources Atlas 2025.

4.4 Agroforestry practices and Biodiversity Agroforestry practices and native plants yield more biodiversity in the MSP-sponsored farms: Hedges, boundary trees and leguminous intercropping all contribute to providing habitat to beneficial insects, birds and pollinators. An increase in the pollination services increases crop yields. The interruption (mixed cropping) and organic inputs also increase the diversity of the soil microbials. The ecological surveys demonstrate that in Sohna, there are: An increase of 30 per cent in the positive insect species in agro forestry farms. Increased vegetation coverage resulting in both native birds' species. Improved ecological stability used to withstand pests and climatic variation. Singh (Y., 2020).

4.5 MSP and Adoption of Technology. Minimum Support Price (MSP) is economically stable, and it provides farmers with a secure price on staple crops including wheat and paddy.
Nonetheless: The suppression of diversification and monoculture of high-yield water-intensive crops is a typical incentive by MSP, hence possibly hindering the implementation of sustainable technologies by farmers specialising in MSP crops. Further activity of MSP on the cropping patterns within the paddy-wheat pines has been recorded in Sohna which has been manifested by increased groundwater extraction in the paddy-wheat regions. Thus, although MSP will provide income protection, the policy would demand certain solutions aimed at encouraging water-saving and sustainable use of MSP crops. The next climate can be obtained based on (Haryana Water Resources Atlas 2025.)

TABLE 8. The relationship between MSP and Sustainability Adoption.

Type of MSP Coverage	Probability of Technology Adoption	Environmental Pressure
Wheat	High	Moderate
Paddy	High	Low–Moderate
Pulses/Legumes	Medium	High

Through: socialsciencejournals.net and Field Surveys, Sohna 2025.

Conclusion: The green and sustainable technologies that have been applied in the MSP-based agriculture in Sohna have: Enhanced water efficiency and sustainable soil. Reduction of chemicals that leads to enhanced environmental performance. Higher diversification through agro forestry and decreased monoculture. The main flaws of MSP that point to lack of sustainability and demand further policies and proper incentives to the technological adoption. (Singh and Kaur, 2022).

The figure gives the statistics of agricultural efficiency and agricultural input decrease of three major crops of Sohna Wheat namely Paddy and Pulses.

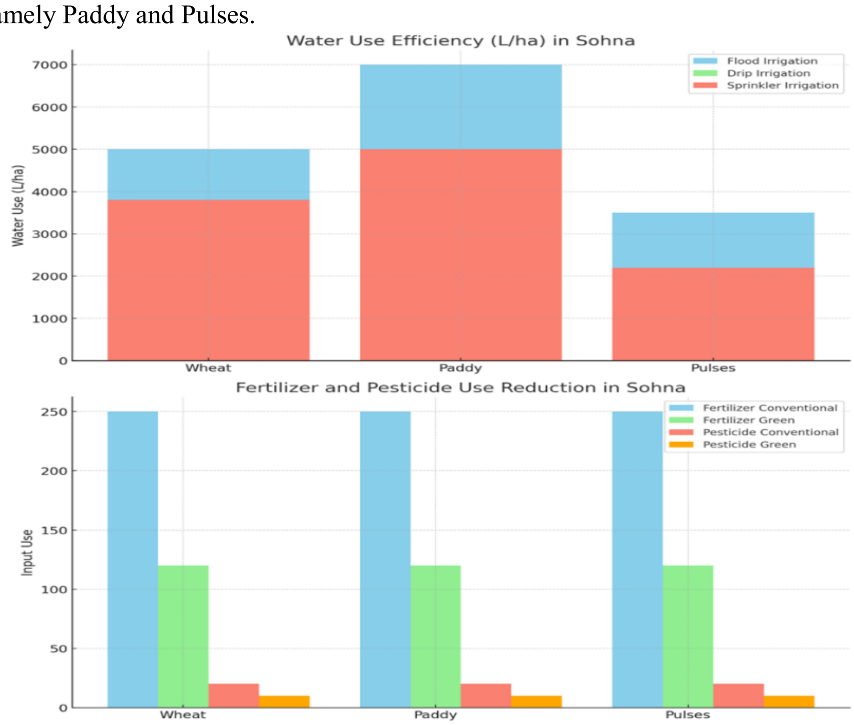

FIGURE 3.

5. IMPLICATIONS OF THE STUDY

Drip and precision irrigation may be employed to save water extremely large and incur less pressure on groundwater. on MSP -based crops and can save a significant amount of on-farm water, relieving pressure on groundwater resources in water-stressed regions, including Sohna. (Fishman, 2023). Improvement in the efficiency of resource utilisation (increase in yield ratios per unit input) - Accuracy and drip farming will improve the efficiency of the irrigation process and the input levels and in most cases the yield per tonne will rise alongside a reduction in the amount of water utilised per unit input and fertiliser. This is a support to the environmental case of developing such technologies in MSPs. (Kumar, 2010). Less toxicant contamination and a better human/ ecosystem health- green practices of pesticides and synthetic fertilizers will decrease off-site pollution (soil and surface water pollution), ecological and health consequences. This is more so in the intensive cereal systems acquired by MSP. (Reddy, 2024; Kashyap, 2024). Long-term productivity advantages and soil well-being Conservation and integrated nutrient/irrigation systems regarding long-term technology augments soil organic carbon and biological activity, thus helping to maintain yields over the long term and reduce dependence on high rates of synthetic input. (Pandian/ conservation literature in general; the Minimizes pernicious environmental lateral-effort of MSP incentives - local resources have been left their mark by monoculture of water-intensive crops (e.g. paddy/wheat) through MSP, alongside subsidizing MSP, itself subsidized by water.

6. FUTURE RESEARCH DIRECTIONS

MSP long-term adoption of technology. What are the effects of MSP procurement on the long-run willingness of the farmer to use green technologies (drip, micro-irrigation, solar pumps, organic inputs)? Dev & Rao (2010). Causality of the micro irrigation on the water and water- use efficiency of the ground water in Sohna Reason: The micro-irrigation may induce efficiency of fields when there is no institutional pressure, but it will not affect the additional ground water extractions. Benefits of low-carbon technology are available in Huang, 2022).

It contains context specific and mixed evidence. Testimonial by World Bank (2006) (year various according to report; see Fishman). MSP, agriculture options and world environmental performance. The MSP incentives will be able to encourage the monocropping (wheat/paddy) and the outcomes of the strategies will influence the soil health, biodiversity, and water stress. Gulati & Saini (2021). Green inputs MSP regimes green inputs Life-cycle assessment (LCA). Rationale: Measure the net GHG, energy, pollution of alternative of conventional fertilizer/ pesticide by green solutions of the systems governed by MSP. Kodama (2024) about the sustainability of the fertilizer. MSP Economic worthiness/ green tech risk of smallholder.

Majority of Haryana is constituted by small/ marginal farmers; they should understand whether green technology coupled with Procurement of MSP can help them to earn higher income and reduce the risk. Dev & Rao (2010); Gulati & Saini (2021). The Solar pumps (energy transitions) of green MSP agriculture.

Pump solarisation has the potential to decrease the consumption of fossil energy, and it will eliminate electricity subsidies, but it also can change the quantity of irrigation and crops. Haryana state solar pump schemes Haryana reports of Haryana on solar pump schemes on local/ state level; Media reports of HAREDA programs (2024/2025). The results of coexistent MSP procurement and green practices on the health of the soil. An increase in the use of synthetic fertilizers/pesticides (green practices) causes a decrease in use to increase the soil organic carbon and soil nutrients which are measurable in the MSP-backed systems. Pandian (2024) regarding identifying with soil conservation. Mediating variables of green tech results are institutional and governance variables. The accessibility of the infrastructure of the procurement and the extension services, the creation of the subsidy and the market availability will determine whether the green technologies will have environmental benefits. MSP institutional heterogeneity psychology survey (e.g. Ras/ICRIER summaries, e.g. Gulati and Saini). Socio-ecological modelling of policies. Model MSP reform (e.g. expansion of crop cover) and subsidies on technology (drip, solar) and farm incomes policy on water tables, emissions and farm incomes.: It is sustainability Indian agricultural transformations by Paul (2023). MSP crops Effectiveness of green certification / market linkages. Is it so called green premium or certification of the sustainably produced MSP crops that can increase adoption and counter transition costs. Literature deals with the reviews of sustainable agricultural programs (Sarkar, 2024). Pilot study RCT or localized phase out studies of Sohna. Rationale Hydro-climatic and social economic environment in the area place-based pilots to ship packages (drip + organic inputs + MSP assurance). Case documentation of TERI/ IWRM Sohna.

7. CONCLUSION

Through Sohna case study, it is evident that with the adoption of green and sustainable technologies in agricultural sector with minimum support price (MSP) systems, farmers would enjoy an improved economy, and the status of environment would be better. The statistics show that water saving irrigation processes like drip irrigation and sprinkler irrigation are very expensive in terms of water consumption per hectare of the land compared to the traditional flood irrigation especially in crops that consume a lot of water as paddy. These technologies support the proposals of Chand (2017), Gulati and Saini (2019), who clarify that as the solution to the problem of water stress in the region, it is important to make sustainability a part of agriculture related to MSP. In addition, as the analysis suggests, one of the green input management strategies, such as considering the reduction of synthetic fertilizers and pesticides, can result in a decrease in the chemical dependency to at least 50 percent to advance the soil status and reduce ecological depreciation. The observation is like the previous research by Dev and Rao (2010) and Kumar et al. (2021) who point out the significance of balanced nutrient and integrated pest management in the supply of environmental and economic stability. Sustainable crops with Haryana MSP especially wheat and paddy would have come into the picture with a good approach of integrating technologies to generate resource efficient and climatic resistant agriculture. The preferential policies should make the extended implementation of this possible, however, and education of the farmers and infrastructure. Singh and Kaur (2022) presuppose that economic incentives can be supported with the assistance of an institutional reform and technological outreach only in case the sustainability results in the MSP are attainable.

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