"ENHANCING FARM PROFITABILITY THROUGH SMART EQUIPMENT AND GOVERNMENT SUBSIDY SCHEMES: A STUDY ON SUSTAINABLE AGRICULTURAL TRANSFORMATION"

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ABSTRACT

In the face of mounting challenges in agriculture rising input costs, labor shortages, and growing demand for sustainability. Farmers are increasingly turning to smart technologies and government subsidies to enhance productivity and profitability. This study explores how the integration of advanced agricultural equipment and targeted subsidy schemes is transforming the agricultural sector in India. Using secondary data from government reports, scholarly sources, and reliable online platforms, the research assesses the impact of technologies such as GPS- enabled tractors, AI-driven monitoring systems, and automated irrigation, supported by subsidy programs like PM-KISAN, RKVY, and SMAM. The findings suggest that the convergence of smart farming practices and supportive public policy is not only driving higher yields and reduced costs but also improving rural livelihoods and ecological risk, such as monoculture, groundwater depletion, and pollution, stemming from the overuse of subsidized resources. The paper emphasizes the need for balanced implementation strategies to ensure long-term sustainability.

KEYWORDS: *Agriculture, Government Schemes, Subsides, Sustainability, Profit.*

I. INTRODUCTION:

Smart equipment and government subsidies can significantly increase profits in agriculture by improving efficiency and reducing costs. Subsides help farmers adopt new technologies and practices. In today's rapidly evolving agricultural landscape, farmers are finding new ways to boost profitability of production, not by working harder, but by working smarter. The combination of smart farming equipment and targeted government subsidies is revolutionizing how crops are grown and harvested. This article explores how technology and public policy are coming together to unlock hidden potential in the agricultural sector, especially for small and mid- sized farmers looking to scale their operations efficiently. Precision agriculture technologies, like GPS- guided tractors, drones, and AI-powered systems enhance yields and optimize resource use. Allow for efficient input application and timely interventions, while government subsidies, and help farmers afford these technologies. This combination can lead to higher yields, lower input costs, and better management of resources like water and fertilizers, and improved overall farm income.

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II. REVIEW OF LITERATURE:

Tankha, Fernandes, and Narayanan (2019) the present study focused on encouraging climate-smart agriculture in the form of improved irrigation methods in India can subsidize both climate change mitigation and version goals by improving source-use efficiency. Researchers have used three complementary methods sociological, institutional, and technical. 50 samples are used in this study. The analysis offers guidance on developing effective climate change strategies under hostile institutional environments.

Singh, Keshava, and Roy, et..al. (2020) In this paper main objective is farm mechanization in the purview of shortage of farm labour and increasing demand from the land for higher productivity. In this paper main benefits to farmers and the implementation of this scheme with a focus on power tiller purchase and uses. This paper was conducted in selected 23 districts in India. And use the primary method and secondary method. These authors' opinion is Tripura district has the highest farmers' use cost of power tiller and subsidy amount. This paper concludes is 89.01 percent of the beneficiates farmers are satisfied with the quality of power tillers under this scheme. This paper focused on only one equipment but farmers need much equipment for improving production this is the research gap in this paper.

Robert, Pricilla, & Clare,et..al. (2024) According to these authors, Breeders of common beans aim to produce varieties that are highly valued by farmers and consumers, and that are suitably tailored to various production settings, evolving markets, and intended applications. Using choice experiment data collected from 1152 urban and rural bean-consuming families, this study examined the preferences and willingness to pay for shortened cooking times and other specific attributes in the Ugandan bean markets. To analyze a latent class model was used to assess preferences and willingness to pay for reduced cooking times.

III. OBJECTIVES OF THE STUDY:
1. To assess the Impact of smart agricultural equipment on crop productivity and cost reduction.
2. To evaluate the effectiveness of government subsidy schemes in supporting technology adoption among farmers.

IV. RESEARCH METHODOLOGY:

This study adopts a descriptive and analytical research design based on secondary data to examine the role of smart technology and public policy in enhancing agricultural profitability and reducing the cost of production in India. The study is entirely based on secondary data collected from the following credible sources Government reports, Academic Sources relevant books, research papers, and peer-reviewed journal articles related on smart farming and agricultural economics. Online databases authentic websites of government and non-government agencies, agricultural technology companies, and news portals.

V. PROFIT IN AGRICULTURE WITH SMART EQUIPMENT AND GOVERNMENT SUBSIDIES:
➢ The Rise of Smart Equipment

As the nation's oldest occupation, farming has advanced significantly from the days of using hand tools to the use of sophisticated machinery in the present day. Smart farming has changed Indian agriculture, from personally inspecting fields to researching crops using remote sensors.

However, India's agriculture is dealing with a number of issues, such as a lack of workers, rising prices, and shifting customer preferences. Consumers today want openness and sustainability in everything they purchase. Therefore, using smart farming becomes even more important. Agri- tech firms like leads connect are striving to offer AI- focused farming solutions like automation, biotechnology, smart irrigation, and precision agriculture in order to address these issues. For examples Robotics, Drones, IOT sensors, GPS and Automated Machinery.

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Table1: Number of Government Subsidies Schemes and Achievement

Sl.No	Name of the Scheme	Purpose and Achievement
I	**Central Sector Schemes**	
1	Pradhan Mantri Kisan Samman Nidhi (PM-KISAN)	Under the scheme, financial benefit of Rs.6000/- per year is transferred in three equal four-monthly installments into the bank accounts of farmer's families across the country, through Direct Benefit Transfer (DBT) mode. Till now, RS.2.81 lakh cores have been transferred through DBT to more than 11 crores beneficiaries through various installments.
2	Pradhan Manthri Fasal Bima Yojana (PMFBY)	The scheme is demand driven and available for all farmers A total of 5549.49 lakh farmer applications were insured under the scheme since 2016-17 and Rs 150589.10 crore has been paid as claim.
3	Namo Drone Didi	The govt has recently approved a central Sector Scheme for providing drones to the Women Self help Group (SHGs) for the period from 2024-25 to 2025-26 with an outlay of RS. 1261 crores. The scheme aims to provide drones to 15000 selected women SHG's for providing rental services to farmers for agriculture purpose . Under this scheme upto a maximum of Rs. 8.0 Laks will be provided to the women SHG's for purchase of Drones.
II	**Centrally Sponsored Scheme**	
4	Rastriya Krishi Vikas Yojan – Detailed Project Report based schemes (RKVY-DPR)	Under RKVY Agri-Startup Programme, since 2019-20, 1524 Start-ups have been selected and Rs. 106.25 crore released as grants-in aid for funding the Start-ups.
5	Sub-Mission on Agriculture Mechanization (SMAM)	Till date Rs. 6748.78 Crore have been released to State Governments, distributed more than 15,75,719 agricultural machinery & equipment's including Tractors, Power Tillers, Self-Propelled Machineries and Plant Protection Equipment and also supply of 1595 drones to the CHCs for providing drone services to the farmers on rental basis.
6	Crop Residue Management	This scheme effective utilization and management of crop residue. Rs.3333.17 crore has been released under the scheme since inception and distributed more than 2,95,845 CRM machinery. CRM is now merged with SMAM.

Source: Ministry of Agriculture & Farmers Welfare on 02 Feb 2024 by PIB Delhi.

On this table the Government of India, along with State Governments, implements a range of agricultural subsidy schemes to boost farm productivity and reduce the cost of cultivation. Key Programs include PM-KISAN, which provides direct income support to farmers, RKVY this progarmme aimed at holistic agricultural development, SMAM which subsidizes equipment and machinery, CRM to promote eco-friendly practices, and Drone subsidy Schemes to modernize precision farming, Subsidies are also provided for fertilizers, quality seeds, credit support, irrigation systems, and farm machinery, enabling farmers to adopt improved practices. Collectively, these initiatives have significantly increased crop production while minimizing input cost, contributing to rural income growth and food security.

Table 2: Allocation of fund under department of agriculture, cooperation and Farmer's welfare (Rs. crore)

Schemes	Actual allocation for 2020-21	Budget allocation for 2021-22	Revised for 2021-22	Budget allocation for 2022-23	Percentage change in BE 2022-23 over RE 2021-22
RKVY	9748	13408	8889	17616	98%
PM-KISAN	60990	65000	67500	68000	1%
Pradhan kantri Krishi Sinchai Yojana	2562	4000	2000	-	-
Agriculture Infrastructure fund	22	900	200	500	150%
Pradhan Mantri Fasal Bima Yojana	14161	16000	15989	15500	-3%
Market Intervention Scheme & Price Support Scheme (MIS-PSS)	1358	1501	3596	1500	-58%
Total	108273	123018	118294	124000	4%

Source: Demand for Grants 2022-23 Analysis

In this table Shows Major Agricultural Schemes Budget Allocation (2020-21 to 2022- 23) the total budget allocation for key agricultural schemes increased modestly by 4% in 2022-23 (1,24,000 crore) compared to the revised estimate of 2021-22 (Rs. 1,18,294). The Rashtriya Krishi Vikas Yojana (RKVY) saw the highest percentage increase of 98%, indicating a strong push towards agricultural development projects. PM-KISAN, the largest income support scheme, remained largely stable with a minor 1% rise. The Agriculture Infrastructure Fund allocation rose significantly by 150%, highlighting a focus on post-harvest infrastructure. However, Pradhan mantra Fasal Bima Yojana swa a slight decrease of 3%, and MIS-PSS allocations were slashed by 58%, indicating shifting policy priorities. Notably, data for Pradhan Manthri Krishi Sinchai Yojana for 2022-23 in not available.

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<p style="text-align:center">**Table 3: Distribution of subsidies & Gross Cropped Area in India (2000 to 20204)**</p>

Year	Fertilizer (Rs.Crore)	Electricity (Rs.Crore)	Irrigation (Rs. Crore)	Total Subsidies (Rs.Crore)	Gross Cropped Ares (in Million hectares)
2000-01	13800 (24.88)	26950 (48.59)	14711.71 (26.53)	55461.71 (100.00)	185.34
2005-06	18460 (45.15)	12490.6 (30.55)	9933.09 (9.19)	40883.69 (100.00)	192.74
2010-11	62301 (61.07)	30332 (29.73)	9374.54 (9.19)	102007.54 (100.00)	197.68
2015-16	72415 (39.55)	91000 (49.79)	19330.44 (10.57)	182745 (100.00)	197.05
2020-21	133947 (53.35)	100754 (40.13)	16344.07 (6.51)	251045.07 (100.00)	196.5
2023-24	175103 (43.22)	190005.1 (46.90)	40048.48 (9.88)	405156.58 (100.00)	-

Source: 1) Fertilizer association of India, various Issues
2) Ministry of Agriculture & Farmers Welfare, GOI, PIB,
3) Agricultural Statistics at a Glance, 2021,
4) Central Electricity Authority, GOI, various years,
5) Central Water Commission, 2021

➢ **Impact of smart agricultural equipment on crop production and cost reduction:**
▪ **Enhanced Agricultural Output**

Subsidies play a crucial role in boosting agricultural production, thereby contributing to food security, especially in populous nations like India. These increases in productivity can help mitigate the need to convert natural habitats into farmland, preserving ecosystems. Subsidies can improve farm productivity, output, and export potential.

▪ **Encouraging Technological Progress**

Certain subsidies are designed to facilitate the adoption of advanced and environmentally friendly agricultural technologies, such as improved seed varieties and water- saving irrigation systems. These innovations can lead to increased efficiency and higher yields with reduced resource consumption.

▪ **Support for Rural Incomes**

Financial aid through subsidies assists in sustaining farmer livelihoods, thereby discouraging rural- to-urban migration and easing the resulting pressures of urban expansion and environmental degradation that while such support mechanisms can enhance food availability and reduce poverty, they may also generate unintended negative consequences.

▪ **Monocropping and Ecological Risk**

Financial incentives favoring high-yield varieties often promote monoculture, which undermines crop diversity. This lack of biodiversity increases vulnerability to pests, disease, and climate variability, negatively affecting long-term sustainability.

▪ **Excessive Water Extraction**

Subsidies access to irrigation systems encourages farmers to over-exploit groundwater resources, leading to falling water table and future water scarcity an issue particularly severe in areas

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with high levels of agricultural subsidies. Electricity subsidies have also contributed to this groundwater overdependence.

VI. CONCLUSION:

Smart agricultural technologies, when supported by well-structured government subsides, offer a powerful pathway to increase profitability in farming. This synergy has enabled farmers, particularly small and mid-sized producers, to adopt precision agriculture tools, reduce input costs and increase crop yields. Program such as PM-KISAN and RKVY have played a crucial role in improving financial access to modern equipment and practices. The rising investment in agriculture infrastructure and smart machinery subsidies reflects a strong policy push toward innovation-led growth in the sector. However, the overuse of inputs like fertilizers, electricity and water under subsidies regimes poses environmental risks such as soil degradation, groundwater depletion, and biodiversity loss. Therefore, while the impact of these initiatives is largely positive, a more sustainable and regulated approach is essential to maximize benefits while minimizing adverse ecological effects. Moving forward technology adoption should be complemented by education, resource management training, and data-driven policy making to ensure a resilient and profitable agricultural future.

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