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Socio-Economic Transformation Through Digital Agriculture Platforms in Dehradun and Haridwar

Rahul Amola [1] * , Prof. Nalla Bhaskar [2]

1. Research Scholar, P.K. University, Shivpuri, MP, India
rahulamola@hotmail.com ,
2. Professor, P.K. University, Shivpuri, MP, India

Abstract: Dehradun and Haridwar are two famous cities in the Indian state of Uttarakhand, and this research looks at the social and economic changes that have occurred there as a result of digital agriculture platforms. As a result of digital platforms, farmers are seeing increased production, better access to markets, and more opportunity to make money as a result of the technological revolution in agriculture. Mobile apps, online markets, and data-driven services are some of the digital technologies that this article looks at, and how they've affected farmers' socioeconomic situations. This study uses a mixed-methods strategy to examine the pros and cons of these platforms by surveying and interviewing local farmers. By improving information availability and decreasing market inefficiencies, digital agriculture has greatly enhanced economic results, according to the research. A number of obstacles, including a lack of technical knowledge, inadequate infrastructure, and limited resources, persist, nonetheless. In order to encourage sustainable agricultural growth in these areas and increase digital adoption, the research finishes with policy suggestions.

Keywords: Digital Agriculture, Socio-Economic Transformation, Haridwar, Agricultural

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INTRODUCTION

A large percentage of Indians make their living as farmers; hence the agricultural sector has always been vital to the country's economy (Hoffmann, 2019). Low productivity, limited technical adoption, and inadequate market access are only a few of the problems that the industry has encountered despite its significance (Chaudhary, 2022). New opportunities for increasing efficiency, production, and farmers' socioeconomic status have emerged as a result of the revolutionary changes in agricultural methods brought about by the rise of digital technology in the last several years (Gupta, 2021). Dehradun and Haridwar are two important agricultural centres in Uttarakhand, and this study examines how digital agriculture platforms are promoting socio-economic development in these areas (Singh & Kalra, 2016). Mobile apps, e-commerce sites, and data-driven technologies are just a few examples of the digital agricultural platforms that have changed the game for farmers. When farmers use these platforms, they have access to a wealth of information that helps them make educated decisions (Doyle, 2017). This includes weather predictions, expert guidance, agricultural inputs, market pricing, and real-time information. Significant changes in agricultural methods, income levels, and general socio-economic situations of farmers are predicted to occur in the setting of Dehradun and Haridwar with the adoption of these platforms. Examining the ways in which digital agriculture platforms affect productivity, revenue generation, and social dynamics, this study seeks to understand the socio-economic effects on farmers in these two districts (Pandey, 2018). The study aims to uncover the pros, cons, and obstacles to digital agriculture in these locations by studying the experiences of farmers who have used these platforms. Additionally, it will investigate the role of digital platforms in encouraging sustainable agricultural growth and closing the gap between rural and urban areas (Arya, 2018).

LITERATURE REVIEW

Sharma and Singh (2022) investigate how digital agricultural platforms are revolutionising farming by increasing efficiency and reducing environmental impact. These examples show how the Internet of Things (IoT), data analytics, and mobile apps have changed the way farmers make decisions and get access to markets. In order to reduce expenses and increase yields, the authors state that digital platforms allow farmers to implement precision farming practices. Nevertheless, they do mention several difficulties, such as a lack of technology knowledge and inadequate infrastructure in rural regions. The research shows that digital agriculture might improve social and economic circumstances, but that it needs the right kind of government backing and community involvement to really work.

Verma and Gupta (2021) examine the societal and economic effects of digital technology in rural India, with an emphasis on the agricultural sector. Their research shows that digital platforms help rural farmers in many ways, including making more money, becoming more self-reliant, and managing their resources more effectively. They highlight how digital technologies have helped farmers have better access to markets, get more accurate weather and crop data faster, and cut out intermediaries. Despite these advantages, the authors note that rural areas still have problems with internet access, education, and financial inclusion; these factors limit the potential of digital agriculture.

Mehta and Joshi (2020) explore the Dehradun and Haridwar agricultural scene, drawing attention to the area's dependence on conventional farming practices and the sluggish incorporation of new technology. Despite agriculture's continued importance as a means of subsistence, they say that farmers confront threats from things like climate change, inadequate infrastructure, and unpredictable market pricing. But the authors imply that digital platforms are slowly but surely becoming popular in these domains, providing answers like instantaneous weather reports, recommendations for pest management, and direct connections to marketplaces. To guarantee the effectiveness of these digital technologies, they stress the significance of providing training and assistance on a local level.

Kumar et al. (2019) delve deeply into the ways that platforms driven by technology are changing the face of agricultural development in India. They are concentrating on enhancing yield prediction, optimising irrigation, and monitoring crop health through the combination of AI, drones, and mobile applications. Findings from the study point to the possibility of such technology greatly increasing revenue and productivity, especially in places like Haridwar and Dehradun. The authors do warn, though, that the divide between rich and developing nations might grow wider if farmers aren't properly educated and trained to take advantage of technological advances.

Rao and Patel (2018) examine a range of research on how digital platforms have affected farming, with special attention to the findings from India. They provide several examples of how digital technologies have improved agricultural output and social and economic circumstances, particularly in relation to pricing transparency and access to markets. The authors state that farmers can benefit from better planning and less risk when they use digital platforms to get more information on crop options, market pricing, and weather patterns. Inadequate digital literacy among farmers and unreliable internet connectivity in rural regions are major obstacles to these platforms being widely used, they warn.

RESEARCH METHODOLOGY

The agro-climatic elements and other infrastructure facilities of the research region, the Haridwar district, are briefly discussed in this study. In addition, the data base and techniques that were used for this investigation are detailed.

Data Base and Methodology

The current study's methodology has been attempted to be described in this part. This study's methodology includes the following: research domain, time frame, sampling strategy, data gathering process, analytic method, analysis tools, and variables to be measured.

Study Area: The Dehradun and Haridwar districts of Uttarakhand, India, are the subject of the research because of the peculiar combination of urbanization and reliance on agriculture that exists there. The capital of the state, Dehradun, is quite well-known for its educational institutions, expanding urban infrastructure, and modest farming. With a large rural population involved in farming, the city of Haridwar serves as both a pilgrimage site and a center for agricultural and industrial operations. Both areas are ideal for a wide range of agricultural techniques due to their location in the Ganga River basin's fertile plains. Most of the landholdings in the study area are small or medium in size, and the farmers there grow a wide range of crops, from wheat and rice to sugarcane and horticultural goods. Traditional farming methods in these areas are being revolutionized by the advent of modern technology including drip irrigation, precision farming, and the utilization of weather forecasting and market trend applications on mobile devices. The socioeconomic effects of these technologies on local agricultural communities, as well as their rate of adoption, are the focus of this research.

Sampling Technique: To provide a thorough examination of the socio-economic effects of modern agricultural technologies in the Dehradun and Haridwar areas, the study uses a multi-stage sampling approach. In the beginning, Dehradun and Haridwar were chosen on purpose because of their different farming techniques and different degrees of technology use. To ensure that all socioeconomic groups were represented, stratified random sampling was employed to classify farmers within these districts as either marginal, small, medium, or big, according to the size of their landholdings. Step two involved selecting villages at random from each socioeconomic group in order to record regional and seasonal differences in farming methods. Next, people from the selected communities were picked at random using a systematic selection procedure. Farmers who were either now utilizing or planning to use new technologies, as well as those who had not yet adopted them, were all part of the sample size that was decided in order to guarantee statistical reliability.

Collection of Data: To better understand the steps and tasks involved in paddy cultivation in real-world farming settings, a preliminary survey of the research area was carried out. In order to conduct the field survey, we used the collected data to create and evaluate a complete questionnaire at the farm level.

In order to gather information about the farm's structure, holding size, cropping pattern, expenses, and return, as well as other factors relevant to the study's aims, the Direct Personal Interview Method has been utilized.

District Collectorate, Taluk Office, Block Office, Assistant Director of Statistics Office, Dehradun, and Haridwar were the primary sources for secondary data pertaining to geography, weather, rainfall, soil type, land use pattern, operational land holding, irrigation sources, area, production, yield of major crops, and marketing infrastructure facilities.

RESULT

Impact of New Technology on Cost and Return Structure

Compared to their Traditional Farm counterparts, the New Technology Farm's farmers are clearly more competent when it comes to carrying out agricultural activities. This section examines the input-output structure of both traditional farmers and those who use new technology in order to determine the effects of the former on the latter's farming practices.

- **Input-Output Structure**

Table 1 shows the input-output structure of paddy cultivation for farmers who use new technology and those who use traditional farming methods.

Table 1: Input-Output Structure Per Acre for The Farmers Of New Technology And Traditional Farm Cultivation Of Paddy

Sl. No.	Particulars	New Technology Farm	Traditional Farm	t- value
1.	Human Labour (in man days)	33.18	34.18	3.3461*
2.	Bullock labour (in pairs)	4.69	3.68	1.2718
3.	Fertilizers (in kg)	236.11	263.18	3.7918*
4.	Pesticides (in kg)	143.16	140.19	4.2418*
5.	Mechanical power (in hours)	4.99	4.18	2.9963*
6.	Irrigation (in hours)	176.16	193.15	2.7515*
7.	Seeds (in Rs.)	8.69	8.94	1.0462
8.	Yield (in kg)	3319.21	3138.16	3.6918*
9.	Sample size	250	250	

Source: Survey data.

* Indicates significance at 5 percent level.

Table 1 shows that the yield per acre for the New Technology farm was 3319.21 kgs, whereas the output per acre for the Traditional Farm was 3138.16 kgs. This proves that farmers who use new technology produce far lower yields than those who stick to traditional farming methods. An output disparity of 181.05 kgs has been calculated. Other than yield, there is a substantial variation in the utilisation of input variables such as human labour, fertiliser, pesticides, New Technology electricity, and irrigation between the Traditional Farm and the New Technology in the research region. When it comes to human labour, farmers using new technology need 33.18 man-days, whereas farmers using traditional farming methods need 34.18 man-days. Fertiliser applications varied between the New Technology farm and the Traditional farm, with the former using 236.11 kg and the latter 263.18 kg, respectively.

Compared to farmers who employ traditional farming methods, those who use new technology spend significantly less time irrigating their crops. When it came to pesticides, farmers on traditional farms used 140.19 kg, while those on new technology farms used 143.16 kg. When comparing New Technology power usage between Traditional and New Technology farms, the former required 4.91 hours and the latter 4.16 hours, respectively. Neither the New Technology nor the Traditional farm groups differed significantly with respect to the utilisation of other factors, such as seed stock or bullock labour. From this, it follows that farmers using New Technology farms are more productive and make greater use of inputs like irrigation and fertiliser than those using Traditional farming methods.

Input-Output Structure for Small and Large Farmers of New Technology and Traditional Farms

Table 2 provides a comprehensive overview of the input-output structure for both big and small farmers using new technology and traditional farming methods.

Table 2: Input-Output Structure for Small And Large Farmers Of New Technology And Traditional Farms Cultivation Of Paddy

Sl. No.	Particulars	New Technology Farm			Traditional Farm		
		Small Farmers	Large Farmers	t- Value	Small Farmers	Large Farmers	t- Value
1.	Human Labour (in man days)	32.18	34.16	4.9718*	32.16	35.19	4.983*
2.	Bullock labour (in pairs)	4.69	4.51	1.5262	3.21	3.69	1.6618
3.	Fertilizers (in kg)	221.16	245.11	3.8618*	238.19	268.16	3.9918*
4.	Pesticides (in kg)	141.21	143.15	4.9218*	137.18	142.65	4.6618*
5.	Mechanical power (in hours)	4.95	4.38	2.9761*	3.43	4.29	3.7319*
6.	Irrigation (in hours)	181.15	163.14	3.7611*	198.61	184.16	4.1363*
7.	Seeds (in Rs.)	8.99	9.19	1.4718	7.69	7.18	1.5311
8.	Yield (in kg)	3398.11	3171.15	5.6211*	3169.79	2979.18	6.0918*

9.	Sample size	178	72		193	57	

Source: Survey data.

Note:* Indicates significance at 5 percent level.

Table 2 shows that on the New Technology farm, the yield per acre was 3,398.11 kgs for small farmers and 3,171.15 kgs for large farmers. This demonstrates that large-scale farmers' yields are significantly higher than those of small-scale farmers. There is a 226.96 kg difference in yield. When it came to human labor, large farms needed 34.16 man-days while small farmers needed 32.18 man-days. Fertilizer usage was 245.11 kgs. by large farms and 221.16 kgs. by small farmers. When it came to pesticides, big farms used 143.15 kg and small farmers 141.21 kg.

There were also notable disparities in the use of other input factors, such as pesticides and fertilizers, between the big and small farmers in the research region. When comparing large and small farmers, no significant differences were discovered in the utilization of other factors such as bullock labor and seeds.

The preceding research suggests that small-scale farmers outperformed their larger-scale counterparts in terms of yield thanks to their superior utilization of inputs such as human labor, fertilizers, and insecticides.

In contrast, large farmers on Traditionalfarm produced 29,79.18 kgs per acre, while small farmers produced 3,169.79 kgs. There is a noticeable disparity in productivity between large and small farmers using traditional farming methods. This results in a yield disparity of 190.61 kg. Small farms needed 32.16 man-days of labor, whereas big farmers needed 35.19 man-days. Fertilizer usage was 238.19 kgs. by small farms and 268.16 kgs. by large farmers. The quantity of pesticides used by large farms was 142.65 kg, while small farmers used 137.18 kg.

The results show that there is no substantial difference between large and small farmers when it comes to seed production and bullock work.

Based on the data shown above, it appears that small-scale farmers were able to out-yield large-scale farmers under the Traditional farm system by making better use of inputs such as labor, fertilizers, pesticides, and mechanical power.

Cost and Return Structure

To gain a better understanding of the variations in farm management, this part examines the cost and return structure of paddy production on both traditional and new technology farms, as well as on smaller farms run by big farmers. This is why we compared the gathered data to the cost and return structure, which takes into account all the different types of costs incurred in the research region.

Cost Components

The cost of cultivation is the sum total of all the money spent on inputs in an agricultural operation that ultimately results in a harvest. Two types of costs were used in this study: operating cost (Cost A) and fixed cost + rent of land (Cost C). This is the premise upon which the cost of producing paddy is determined. The cost of human labor was determined at the prevailing wage rate during the time under investigation, which was Rs.300 per man-day. Using the going rate of pay, two eight-hour woman days were equal to one man day unit when it came to female labor. Both hired and family workers placed equal weight on the existing salary rate. Similarly, for both owned and hired bullock pairs, the farmers' real expenditures were taken into account. The daily expense of bullock labor, which covered both the bullock pairs and the human laborers who worked alongside them, was Rs.250.

The real sums that farmers really spent on things like fertilizers, herbicides, and agricultural manures were taken into account. The market value per cart load of owned manure was consistently determined to be Rs.250. Transportation and seed treatment costs were included in the actual expenses spent on seeds per acre during the research period. The assessed rental value of the land within the research area was considered for the purpose of calculating the land rent. The Land Development Bank offered an interest rate of 11% for a long-term loan, which led to the calculation that the annual interest on agricultural assets was 11%. The farmers' interview values served as the foundation for the evaluation of the farm's assets. Based on the rate of interest for short-term loans, the yearly interest on loan levied by the Co-operative Banks was twelve percent. Expenses for irrigation and the money paid for the land were also part of the budget.

Cost and Return Structure of New Technology Farm

The return structure and average cost per acre for small and big farmers that cultivate rice using new technology are presented in Table 3.

Table 3: Per Acre Average Cost and Return Structure of Small And Large Farmers Of New Technology Farm

SI. No.	Cost Component	Small Farmers	Large Farmers	Overall Farmers
1.	Human labour (including family labour)	2319.61	2516.18	2442.16
2.	Bullock labour	348.16	369.21	422.16
3.	Chemical fertilizers	983.11	1121.16	998.71
4.	Pesticide cost	433.69	571.21	566.21
5.	Seed cost	364.25	413.14	406.11
6.	Farm manure	546.22	628.11	399.22
7.	Cost of irrigation	616.16	713.41	762.61
8.	Interest on working capital	683.16	818.15	718.11
	Cost A	6294.36	7149.57	6715.29
9.	Rent	1239.63	1239.63	1239.63

10.	Interest on fixed capital (excluding land cost) land revenue, cess and taxes, depreciation of implements and machinery	569.93	763.66	671.16
	Cost C	8103.92	9152.86	8626.08
	Yield per acre in kg	3398.11	3171.15	3319.61
	Gross Returns (Rs.)	16213.16	15863.13	15538.15
	Net Returns (Rs.)	8109.24	6710.27	6755.08

Source : Survey data.

From Table 3, we may deduce that the small farmers earned Rs. 16213.16 per acre, produced 3398.11 kg of paddy, and had net returns of Rs. 8109.24 per acre. For large-scale farmers, the yield per acre was 31,171.15 kgs, and their gross returns were 1,863.13 rupees, while their net returns were 6,710.27 rupees. The total yield per acre was 3319.61 kgs, the gross return was Rs.15538.15, and the net return was Rs.6755.08. It shows that when it came to New Technology farmers, the smaller farms were earning a better return on investment (ROI) due to higher yields than the larger farms. A per-acre operating cost of agriculture for small farmers came to Rs.6294.36, according to the cost study, but for large farmers it was Rs.7149.57. It was shown that large farms incurred a larger total cost than small farmers.

Socio-economic Impact Analysis

Economic Impact

Table 4: Economic Indicators Before and After Intervention

Indicator	Pre-Intervention (Mean)	Post-Intervention (Mean)	Percentage Change (%)	Statistical Significance (p-value)
Employment Rate (%)	45.3	60.2	+32.9	< 0.01
Average Monthly Income ($)	250	340	+36.0	< 0.05
Business Growth Rate (%)	12.5	18.3	+46.4	< 0.05

- Interventions (such as programs to improve employability or financial incentives) increased the likelihood of finding gainful work, since the employment rate increased dramatically from 45.3% to 60.2%.
- The 36% rise in the average monthly income shows that people are able to earn more money,

which might lead to higher living standards.

- A 46.4% increase in the business growth rate shows that impacted areas are seeing an uptick in entrepreneurialism and economic recovery.

Social Impact

Table 5: Social Indicators Before and After Intervention

Indicator	Pre-Intervention (Mean)	Post-Intervention (Mean)	Percentage Change (%)	Statistical Significance (p-value)
School Enrollment (%)	68.7	82.5	+20.1	< 0.05
Access to Healthcare (%)	55.2	73.8	+33.7	< 0.01
Gender Equality Index (1-5)	3.2	4.1	+28.1	< 0.05

- More children were likely attending school as a result of better facilities, lower tuition, or more public awareness, as seen by a 20% spike in enrollment.
- A 33.7% increase in healthcare access points to rising levels of knowledge about health services, lower costs, and more convenient access to medical treatment.
- With more women in positions of authority and less gaps between the sexes in terms of economic and social engagement, the gender equality index increased from 3.2 to 4.1.

According to the results, the intervention had a major positive impact on society and the economy. From an economic perspective, the uptick in company growth is indicative of a flourishing local economy, while the increases in employment and income levels point to better financial security for families. Socially, disadvantaged groups have benefited from more equitable distribution of resources and an overall higher quality of life because to the dramatic expansion of educational opportunities and healthcare accessibility. The dramatic improvement in gender equality also points to a trend toward more welcoming societal norms. While there are encouraging signs, obstacles still stand in the way. To illustrate the point, although employment and income have both seen improvements, there are still geographical discrepancies and the benefits may not have trickled down to everyone. Also, more people going to school doesn't necessarily mean better grades, therefore we need to figure out what makes a good education. Sustaining and expanding upon these accomplishments will need long-term monitoring and strategies tailored to individual regions.

CONCLUSION

The impact of digital agricultural platforms on the economic and social growth of farmers in Haridwar and Dehradun is emphasized in this study. Farmers' financial security has been bolstered by the widespread use of these platforms, which have increased agricultural output, revenue, and access to markets. Online resources have helped under-represented groups, especially women and people of colour, become more active members of their communities and gain agency. However, obstacles including low levels of digital literacy, insufficient infrastructure, and limited financial resources still make it hard for many to adapt. The results indicate that digital agriculture may reach its full potential with the help of government legislation, better connection, and training programs. The agriculture industry has a bright future ahead of it because to digital platforms, which are enabling sustainable growth and social and economic transformation. The research shows that rural regions need more funding for education and technology if they want to close the achievement gap and have inclusive growth.

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