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Examining the Relationship Between Farmer Profiles and Performance Outcomes in Soybean Digital Farmer Field Schools

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Abstract

This study examines the relationship between farmer profiles and performance outcomes among participants and non-participants of Digital Farmer Field Schools (DFFS) in soybean cultivation in Maharashtra, India. Using an ex-post facto research design, data were collected from 150 respondents (75 participants and 75 non-participants) through personal interviews during 2023-2024 across three talukas in Ahilyanagar district. The study analyzed four performance dimensions: knowledge, adoption, productivity, and economic performance in relation to farmer profile characteristics. Results revealed distinct patterns between groups. For DFFS participants, scientific orientation, social media viewing behavior, and techno-savviness emerged as strong predictors across all performance dimensions, showing highly significant positive relationships at the 0.01 level. Education, land holding, annual income, and cosmopoliteness demonstrated significant relationships at the 0.05 level. Non-participant farmers showed fewer significant relationships, with only scientific orientation consistently demonstrating strong associations with knowledge and adoption levels. Notably, demographic factors such as age and gender showed no significant relationship with performance dimensions in both groups, suggesting DFFS programs can be equally effective across diverse demographic segments. The findings underscore the importance of digital literacy and technological engagement in modern agriculture. The significant impact of social media viewing behavior and techno-savviness on participant farmers' performance highlights the need for targeted interventions to enhance digital skills among farming communities. The study recommends prioritizing digital literacy training, leveraging social media platforms for agricultural extension, and ensuring DFFS program accessibility regardless of demographic characteristics to achieve sustainable and productive soybean cultivation systems in Maharashtra.

Key words : Digital Farmer Field School (DFFS), soybean cultivation, farmer profile, knowledge adoption, productivity, economic performance, scientific orientation, techno-savviness, social media viewing behaviour.

Soybean (*Glycine max* L.), commonly known as the "golden bean," stands as a globally important oilseed and pulse crop, valued for its rich protein content and essential contributions to food, feed, and industrial applications (Pachpute *et al*., 2023). In recent decades, worldwide soybean production has witnessed tremendous growth, achieving approximately 371.18 million tonnes from 136.91 million hectares in 2023 (Agricultural Market Intelligence Centre, PJTAU, 2025). Brazil dominates global production with 152.14 million tonnes, while the United States produces 113.34 million tonnes, Argentina 25.04 million tonnes, China 19.50 million tonnes, and India 14.98 million tonnes, representing 41%, 31%, 7%, 5%, and 4% of worldwide production, respectively (Agricultural Market Intelligence Centre, PJTAU, 2025).

Within India, soybean cultivation is concentrated in Madhya Pradesh, Maharashtra, and Rajasthan, with Maharashtra serving as a significant producer. During 2023-24, India's soybean coverage spanned approximately 118.32 lakh hectares, yielding around 126 lakh tonnes, while Maharashtra contributed 45 lakh hectares and generated an estimated 50.17 lakh tonnes during the current *kharif* season (Economic Times, 2024). Nevertheless, current

patterns show a declining trend in Maharashtra's soybean cultivation area, with projections indicating a reduction of two lakh hectares in 2024-25 attributed to inadequate returns, market volatility, and policy-related difficulties (Times of India, 2025).

Regardless of its economic significance, soybean cultivation in India and Maharashtra encounters numerous obstacles. Primary production difficulties encompass unpredictable and inadequate rainfall, insufficient irrigation infrastructure, elevated input expenses (particularly fertilizers and plant protection chemicals), and workforce scarcity (Channe & Maurya, 2023). Environmental factors, especially rainfall unpredictability, have been recognized as the primary limiting element, followed by unfavorable weather conditions and insufficient irrigation systems (Singh *et al*., 2022). Technical limitations including unavailability of superior seeds, delayed fertilizer access, and challenges in pest and disease control additionally restrict productivity (Channe & Maurya, 2023). Financial and market-related problems, such as low and fluctuating market prices, delayed procurement at minimum support price (MSP), and illegal deductions during marketing, intensify farmer hardships (Economic Times, 2025).

Resolving these obstacles is vital for improving soybean productivity and maintaining the viability of soybean-dependent livelihoods in India and Maharashtra. Strategic measures emphasizing enhanced irrigation, prompt input provision, improved price realization, and farmer education on modern cultivation techniques are necessary for addressing these ongoing challenges (Jaybhay *et al*., 2017).

The evolution from conventional Farmer Field Schools (FFS) to Digital Farmer Field Schools (DFFS) marks a substantial advancement in agricultural extension and education. Although FFS has historically empowered farmers through participatory, hands-on learning in group environments, its coverage has frequently been restricted by logistical, financial, and geographical barriers (Davis *et al*., 2012; FAO, 2016). The incorporation of digital technologies within the FFS structure overcomes these restrictions by utilizing mobile applications, online platforms, and social media to expand knowledge sharing and real-time assistance to a wider population (Lwasa *et al*., 2021). This digital evolution not only improves accessibility and scalability but also facilitates prompt, data-informed decision-making, collaborative problem-solving, and ongoing interaction between farmers and specialists. Consequently, DFFS offers the potential to make agricultural education more comprehensive, effective, and meaningful, especially in resource-limited and remote regions, thus supporting sustainable agricultural progress in the digital era.

The Digital Sheti Shaala (Digital Farmers Field School, DFFS), initiated by PAANI Foundation in Maharashtra, constitutes an innovative, farmer-focused program aimed at closing the knowledge divide in sustainable agriculture through digital approaches. Created in partnership with Mahatma Phule Krishi Vidyapeeth and other State Agricultural Universities, the DFFS offers thorough, scientifically validated instruction on soybean and various other crops through weekly videos, interactive live sessions, and real-time Q&A platforms. Through the utilization of WhatsApp groups and YouTube, the program guarantees broad accessibility and direct interaction with agricultural specialists. During 2023-24, approximately 35,000 farmers across 3,027 groups in 18 districts actively engaged, collectively implementing best practices and standard operating procedures customized to local requirements. The DFFS prioritizes collective action, social inclusion, and the

application of modern technology to empower farmers, decrease cultivation expenses, and tackle the substantial yield difference between Indian and global soybean producers, ultimately seeking to transform rural livelihoods and agricultural sustainability in Maharashtra.

Notwithstanding the extensive coverage and beneficial effects of the Digital Farmers Field School (DFFS) program, a considerable number of soybean farmers in Ahilyanagar, Maharashtra continue to be non-participants. These non-participating farmers frequently encounter ongoing limitations in soybean production, including restricted access to current scientific knowledge, insufficient exposure to best practices, and absence of timely, expert advisory assistance. Conversely, farmers who engaged in the DFFS gained from organized training modules, real-time exchanges with agricultural specialists, and access to carefully developed standard operating procedures for soybean cultivation. This direct involvement allowed participating farmers to implement enhanced agronomic practices, tackle challenges efficiently, and increase their productivity. Therefore, the difference in access to information and advisory services has resulted in a notable disparity in soybean production results between participating and non-participating farmers, emphasizing the significance of comprehensive and accessible agricultural extension programs.

Methodology

The present study investigates the "Examining the Relationship Between Farmer Profiles and Performance Outcomes in Soybean Digital Farmer Field Schools" using an ex-post facto research design, as the researcher has no control over the independent variables, which have already occurred. The methodological procedure consisted identification of the problem, research design, sources of data, area of study, sampling procedure, selection and measurement of variables, tools and methods of data collection and statistical framework for analysis of data. The study was conducted in 3 talukas *viz*. Ahilyanagar, Sangamner and Parner were selected purposely for the present study, which are located in Ahilyanagar district of Maharashtra state. Suitable and appropriate tools were used for the measurement in light of the derived objective. In total 150 respondents (75 participant and 75 non-participant farmers) were selected for present study. The data were collected through personal interview and then after it is compiled, tabulated and analyzed to get proper answer for the specific objectives of the study with the help of various appropriate statistical tools.

The present investigation was based on the primary data. The data on various aspects of the study were collected from personal interviewed with the help of specially designed scheduled. The data pertains to the year 2023-2024. The data collected were tabulated and analysed using appropriate statistical tools like frequency, percentage, mean, standard deviation, correlation.

Result and discussion

Relationship between profile of participant farmers and non-participant farmers of soybean Digital Farmer Field School with their Performance : The Coefficient of correlation between the profile of participant farmers and non-participant farmers with their performance dimension namely knowledge, adoption, productivity and economic performance have been presented in this section.

The coefficient of correlation of each of the independent variables with their performance dimension has been furnished in Table 1.

A. Relationship between profile of participant farmers with their knowledge level : It was noted from the Table 1 that scientific orientation, social media viewing behaviour and techno-savviness of the participant farmers had positive and highly significant relationship with knowledge at 0.01 level of probability whereas education, land holding and cosmopolitness had positive and significant relationship with knowledge level at 0.05 level of probability. Thus, null hypothesis (H_0) in case of these variables was rejected. Age, gender, area under soybean cultivation, farming experience and annual income had no significant relationship with knowledge level. Thus, null hypothesis (H_0) in case of these variables was accepted.

The study of participant farmers in digital farmer field schools revealed interesting correlations between profile and knowledge levels. Age, gender, area under soybean cultivation, farming experience, and annual income showed no significant relationship with knowledge levels, suggesting that the digital format was equally effective across diverse demographic and economic groups. Education, land holding, and cosmopoliteness demonstrated positive and significant relationships at the 0.05 level of probability, indicating that farmers with higher education, larger land holdings, and more openness to external ideas tended to gain more knowledge from the digital programs. Notably, scientific orientation, social media viewing behaviour, and techno-savviness exhibited positive and highly significant relationships with knowledge at the 0.01 level of probability. This implies that farmers who approach farming with a more analytical mindset, actively engage with agricultural content on social platforms, and are comfortable with technology were better equipped to absorb and apply new information from digital farmer field school.

B. Relationship between profile of non-participant farmers with their knowledge level : In case of non-participant

Table 1. Coefficient of correlation between profile of participant farmers and non-participant farmers Digital Farmer Field School with their Performance dimensions

Characteristics	Correlation coefficient (r) value							
	Knowledge level		Adoption level		Productivity level		Economic performance	
	PF	NPF	PF	NPF	PF	NPF	PF	NPF
Age	-0.043^{NS}	0.142^{NS}	-0.037^{NS}	0.194^{NS}	-0.046^{NS}	0.153^{NS}	-0.059^{NS}	0.142^{NS}
Education	0.608*	0.679*	0.520*	0.556*	0.546*	0.556*	0.616*	0.215*
Gender	0.175^{NS}	-0.243*	0.053 ^{NS}	-0.321*	0.107 ^{NS}	-0.343*	0.167^{NS}	-0.243*
Land Holding	0.374*	0.277*	0.234*	0.277*	0.356*	0.101^{NS}	0.421*	0.136^{NS}
Area Under Soybean Cultivation	0.113^{NS}	0.250*	0.075^{NS}	0.345*	0.121^{NS}	0.345*	0.102^{NS}	0.449*
Farming experience	0.99^{NS}	0.209*	0.135^{NS}	0.397*	0.163^{NS}	0.397*	0.187^{NS}	0.287*
Annual Income	0.156^{NS}	0.305*	0.468*	0.574*	0.451*	0.159^{NS}	0.478*	0.269*
Scientific Orientation	0.421**	0.378**	0.399**	0.421**	0.263*	0.175^{NS}	0.225*	0.175^{NS}
Social media viewing behaviour	0.366**	0.264*	0.347**	0.234*	0.298**	0.129^{NS}	0.305**	0.129^{NS}
Techno-savviness	0.474**	0.236*	0.561**	0.241*	0.387**	0.207*	0.589**	0.317*
Cosmopoliteness	0.313*	0.276*	0.256*	0.224*	0.279*	0.267*	0.355*	0.224*

**Significant of 0.01 level of probability, *Significant of 0.05 level of probability, NS - Non-Significant, PF-Participant farmers, NPF- non-participant farmers.

farmers, it could be seen that only scientific orientation, had positive and highly significant relationship with knowledge level at 0.01 level of probability then education, land holding, cosmopolitness, area under soybean cultivation, farming experience and annual income having significant relation at 0.05 level of probability. Thus, null hypothesis (H0) in case of these variables was rejected. Age and Gender had no significant relationship with knowledge level. Thus, null hypothesis (H0) in case of these variables was accepted.

The results for non-participant farmers of Digital Farmer Field Schools reveal interesting patterns in knowledge acquisition. Scientific orientation emerges as the most influential factor, showing a highly significant positive relationship with knowledge levels at the 0.01 probability level. This suggests that farmers with a more analytical and evidence-based approach to agriculture tend to seek out and retain information more effectively, even without formal participation in digital programs. Education, land holding, cosmopoliteness, area under soybean cultivation, farming experience, and annual income also demonstrate significant relationships at the 0.05 level, indicating that these variables contribute to knowledge accumulation through various channels outside of digital FFS. Notably, age and gender show no significant relationship with knowledge levels, implying that traditional demographic factors may not be barriers to informal agricultural learning.

C. Relationship between profile of participant farmers with their Adoption level : It was noted from the Table 1 that scientific orientation, social media viewing behaviour and techno-savviness of the participant farmers had positive and highly significant relationship with adoption level at 0.01 level of probability whereas education, land holding, annual income and cosmopolitness had positive and significant relationship with adoption level at 0.05 level of probability. Thus, null hypothesis (H_0) in case of these variables was rejected. Age, gender, area under soybean cultivation and farming experience had no significant relationship with adoption level. Thus, null hypothesis (H_0) in case of these variables was accepted.

The results indicate that farmers' scientific orientation, social media viewing behavior, and techno-savviness strongly influence their adoption of digital farmer field school (DFFS) practices. This is likely because scientifically-inclined farmers are more receptive to new agricultural information, while those active on social media and comfortable with technology can better engage with digital FFS content. Education, land holding, annual income, and cosmopoliteness also positively affect adoption, albeit to a lesser degree. Higher education levels typically correlate with greater information processing abilities, while larger land holdings and higher incomes provide more resources for implementing new practices. Cosmopolitan farmers are generally more open to external ideas. Interestingly, age, gender, area under soybean cultivation, and farming experience do not significantly impact adoption levels. This suggests that the digital FFS format may be equally effective across different demographic groups and farm sizes, potentially bridging traditional gaps in agricultural knowledge dissemination.

D. Relationship between profile of non-participant farmers with their Adoption level : In case of non-participant farmers, it could be seen that only scientific orientation, had positive and highly significant relationship with adoption level at 0.01 level of probability then education, land holding, cosmopolitness, area under soybean cultivation, farming experience and annual income having significant relation at 0.05 level of probability.

Thus, null hypothesis (H_0) in case of these variables was rejected. Age and Gender had no significant relationship with adoption level. Thus, null hypothesis (H_0) in case of these variables was accepted.

The results for non-participant farmers of Digital Farmer Field Schools reveal interesting patterns in adoption levels. Scientific orientation emerges as the most influential factor, showing a highly significant positive relationship with adoption at the 0.01 probability level. This suggests that farmers with a more scientific approach are more likely to adopt new practices, even without formal participation in digital FFS. Education, land holding, cosmopoliteness, area under soybean cultivation, farming experience, and annual income also demonstrate significant relationships at the 0.05 level, indicating their moderate influence on adoption. These factors likely contribute to a farmer's capacity and willingness to implement new techniques. The significance of area under soybean cultivation and farming experience implies that more experienced farmers with larger soybean areas are more inclined to adopt new practices. Notably, age and gender show no significant relationship with adoption levels, suggesting that these demographic factors do not play a crucial role in determining a non-participant farmer's likelihood of adopting new agricultural practices.

E. Relationship between profile of participant farmers with their productivity level : It was noted from the Table 1 that social media viewing behaviour and techno-savviness of the participant farmers had positive and highly significant relationship with productivity level at 0.01 level of probability whereas education, land holding, annual income, scientific orientation and cosmopolitness had positive and significant relationship with productivity level at 0.05 level of probability. Thus, null hypothesis (H_0) in case of these variables was rejected. Age, gender, area under soybean cultivation and farming experience had no significant relationship with productivity level. Thus, null hypothesis (H_0) in case of these variables was accepted.

The results from Table 1 reveal important relationships between various variables and crop productivity levels among participants of Digital Farmer Field Schools. Social media viewing behaviour and techno-savviness showed a highly significant positive correlation with productivity at the 0.01 level, indicating that farmers who are more active on social media and comfortable with technology tend to achieve higher crop yields. This suggests that digital platforms and technological aptitude play a crucial role in modern farming success. Education, land holding, annual income, scientific orientation, and cosmopoliteness also demonstrated significant positive relationships with productivity at the 0.05 level. These variables likely contribute to farmers' ability to access and implement advanced agricultural practices. Higher education and scientific orientation may enable better understanding and application of new techniques, while larger land holdings and higher incomes could provide more resources for productivity-enhancing investments. Interestingly, age, gender, area under soybean cultivation, and farming experience showed no significant relationship with productivity, suggesting that the benefits of digital farming methods may be accessible across demographic groups and farm sizes.

F. Relationship between profile of non-participant farmers with their productivity level : In case of non-participant farmers, it could be seen that no independent variable had positive and highly significant relationship with productivity level at 0.01 level of probability then education, cosmopolitness, area under soybean cultivation, farming experience and techno-savviness having

significant relation at 0.05 level of probability. Thus, null hypothesis (H_0) in case of these variables was rejected. Age, gender, land holding, scientific orientation, annual income and social media viewing behaviour had no significant relationship with productivity level. Thus, null hypothesis (H_0) in case of these variables was accepted.

The results for non-participant farmers in digital farmer field schools reveal interesting patterns in variables influencing productivity levels. While no variables showed a highly significant relationship at the 0.01 level, several variables demonstrated significant correlations at the 0.05 level. Education, cosmopoliteness, area under soybean cultivation, farming experience, and techno-savviness all had positive significant relationships with productivity. This suggests that non-participants with higher education levels, greater exposure to external ideas, larger soybean cultivation areas, more farming experience, and better technological skills tend to achieve higher productivity levels. The significance of these variables indicates their importance in enhancing agricultural productivity even without formal participation in digital farmer field schools. Interestingly, variables such as age, gender, land holding, scientific orientation, annual income, and social media viewing behaviour showed no significant relationship with productivity levels for non-participants. This lack of correlation might imply that these variables play a less crucial role in determining productivity among farmers not engaged in digital FFS programs, highlighting the potential benefits of such programs in leveraging these attributes for improved agricultural outcomes.

G. Relationship between profile of participant farmers with their economic performance : It was noted from the Table 1 that social media viewing behaviour and techno-savviness of the participant farmers had positive and highly significant relationship with economic performance at 0.01 level of probability whereas education, land holding, annual income, scientific orientation and cosmopolitness had positive and significant relationship with economic performance at 0.05 level of probability. Thus, null hypothesis (H_0) in case of these variables was rejected. Age, gender, area under soybean cultivation and farming experience had no significant relationship with economic performance. Thus, null hypothesis (H_0) in case of these variables was accepted.

The results indicate that social media viewing behaviour and techno-savviness of participant farmers in Digital Farmer Field Schools (DFFS) have a highly significant positive relationship with economic performance at the 0.01 probability level. This suggests increased access to information, market opportunities, and innovative farming practices these technologies provide, farmers who actively engage with social media and are comfortable with technology are better positioned to leverage digital resources, connect with experts, and make informed decisions about their agricultural practices. Education, land holding, annual income, scientific orientation, and cosmopoliteness also show a positive significant relationship with economic performance at the 0.05 level. These factors likely contribute to farmers' ability to adopt and implement new practices learned through DFFS. Higher education levels, larger land holdings, and greater income provide more resources and capacity for innovation. Scientific orientation and cosmopoliteness indicate openness to new ideas and practices. The lack of significant relationship between age, gender, area under soybean cultivation, and farming experience with economic performance suggests that the digital format of the farmer field school may be equalizing opportunities across these demographic factors, making the

program's benefits accessible to a wide range of participants.

H. Relationship between profile of non-participant farmers with their economic performance : In case of non-participant farmers, it could be seen that no independent variable had positive and highly significant relationship with economic performance at 0.01 level of probability then education, cosmopolitness, area under soybean cultivation, farming experience and techno-savviness having significant relation at 0.05 level of probability. Thus, null hypothesis (H_0) in case of these variables was rejected. Age, gender, land holding, scientific orientation and social media viewing behaviour had no significant relationship with economic performance. Thus, null hypothesis (H_0) in case of these variables was accepted.

The results for non-participant farmers of Digital Farmer Field Schools (DFFS) reveal interesting patterns in the relationship between profile and economic performance. Notably, no independent variable showed a highly significant positive relationship at the 0.01 level, suggesting that the variables typically associated with improved economic outcomes in FFS participants may not have the same impact on non-participants. However, several variables demonstrated significant relationships at the 0.05 level, including education, cosmopoliteness, area under soybean cultivation, farming experience, and techno-savviness. This indicates that these variables still play a role in economic performance, albeit to a lesser degree than for DFFS participants. The significance of education and techno-savviness suggests that even without DFFS participation, farmers with higher education levels and technological aptitude may be better positioned to improve their economic outcomes. The importance of land holding and area under soybean cultivation points to the continued relevance of resource availability. Interestingly, age, gender, land holding, scientific orientation, and social media viewing behaviour showed no significant relationship with economic performance, suggesting that these variables may be less influential for non-participants compared to DFFS participants.

Conclusion

This study examined the relationship between farmer profiles and performance dimensions (knowledge, adoption, productivity, and economic performance) among participants and non-participants of Digital Farmer Field Schools (DFFS) in soybean cultivation. The findings reveal distinct patterns between the two groups, highlighting the transformative potential of digital agricultural extension programs.

For DFFS participants, scientific orientation, social media viewing behavior, and techno-savviness emerged as consistently strong predictors across all performance dimensions, demonstrating highly significant positive relationships at the 0.01 level. This suggests that farmers who embrace scientific approaches, actively engage with digital platforms, and possess technological skills are better positioned to maximize the benefits of digital agricultural education. Education, land holding, annual income, and cosmopoliteness also showed significant positive relationships, indicating their supportive role in enhancing farmer performance.

In contrast, non-participant farmers showed fewer highly significant relationships, with only scientific orientation consistently demonstrating strong associations with knowledge and adoption levels. While education, cosmopoliteness, farming experience, and area under soybean cultivation maintained significant relationships at the 0.05 level, the overall pattern suggests that non-participants may be

missing opportunities to leverage their profile characteristics for improved agricultural outcomes.

The study's most striking finding is that demographic factors such as age and gender consistently showed no significant relationship with performance dimensions in both groups, indicating that DFFS programs can be equally effective across diverse demographic segments. This suggests that digital agricultural extension has the potential to bridge traditional knowledge gaps and create more inclusive learning environments.

The results underscore the importance of digital literacy and technological engagement in modern agriculture. The significant impact of social media viewing behavior and techno-savviness on participant farmers' performance highlights the need for targeted interventions to enhance digital skills among farming communities. Furthermore, the differences between participants and non-participants emphasize the value of structured digital agricultural education programs in translating farmer characteristics into improved agricultural outcomes.

These findings provide valuable insights for policymakers and extension agencies seeking to design inclusive and effective digital agricultural programs. The study recommends prioritizing digital literacy training, leveraging social media platforms for agricultural extension, and ensuring that DFFS programs are accessible to farmers regardless of their demographic characteristics. By addressing the constraints faced by non-participants and building on the success factors identified among participants, Maharashtra can work toward more sustainable and productive soybean cultivation systems.

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