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RESEARCH PAPER

Technology Adoption and Its Impact on Farm Income: A Study of Farmers in Dharwad District, Karnataka

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ABSTRACT

Agricultural modernization has transformed farming, enabling higher productivity, resource efficiency, and income generation. This study examines the socio-economic factors influencing the adoption of agricultural technologies and their impact on farm income in rural Karnataka, focusing on Surasettikoppa village. The analysis utilized primary data collected through structured surveys and interviews, covering demographics, landholding patterns, and adoption rates. Findings indicate weak correlations between technology adoption and factors like age, education, landholding size, family size, and income, suggesting that socio-economic characteristics alone are not primary determinants. Younger farmers showed slightly higher adoption rates, reflecting their openness to innovation, while education and income exhibited minimal positive influences. Despite these weak associations, the results underscore the critical role of technology in enhancing farm sustainability and income. Medium to high adoption levels among 70% of farmers reveal a positive trend, though barriers persist for others due to lack of awareness and financial constraints. The study emphasizes the need for targeted interventions, including extension services, community-based training, and improved access to a affordable technologies. Stakeholder collaboration and investment in agricultural innovation are essential to bridge adoption gaps, ensuring sustainable growth and resilience in rural farming communities.

HIGHLIGHTS

- Study the correlations between technology adoption and socio-economic factors.
- Identifying the barriers for targeted interventions such as community-based training and improved access to affordable technologies.

Keywords: Adoption, agriculture, correlation, socio-economic factors, technology

Agriculture has undergone significant transformations in recent decades, with technological advancements playing a pivotal role in improving productivity, efficiency, and sustainability (Pingali, 2012; Gebbers and Adamchuk, 2010). Modern technologies, such as advanced irrigation systems, protected cultivation technologies, adoption of proper cropping system and inputs management, precision farming tools, improved seed varieties, and mechanized equipment, have revolutionized farming practices, allowing farmers to enhance yields and reduce labor-intensive processes (Santosh *et al*. 2024; Maitra *et al*. 2023, 2024; Sairam *et al*. 2022, 2024; Mukesh *et al*. 2024; Ray *et al*. 2024). These advancements not only address the growing demand for food but also contribute to better resource management and environmental conservation (Maitra *et al*. 2000; Sarkar *et al*. 2000; Sairam *et al*. 2023). For small and marginal farmers, access to appropriate technologies can be a critical driver of socio-economic upliftment, helping them break out of the cycle of low productivity and income stagnation (Birthal *et al*. 2015; Santosh *et al*. 2024).

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Karnataka is one of India's agriculturally vibrant states, characterized by diverse cropping patterns and a significant contribution to the national agricultural output. However, the sector faces several challenges, particularly in rural areas. Farmers grapple with issues such as fragmented landholdings, erratic rainfall, limited access to modern inputs, and dependency on traditional methods (Hazell, 2011; Sharma, 2023). Credit constraints and inadequate knowledge about emerging technologies further hinder their ability to innovate (Meena *et al*. 2020). Bridging the digital divide is critical for empowering rural people in India, as they face multifaceted barriers to technology adoption, including cultural norms, limited mobility, and financial constraints (Saha *et al*. 2024b). Despite these challenges, Karnataka presents immense opportunities for technological integration in agriculture. The state's progressive policies, well-established agricultural extension networks, and growing awareness among farmers about modern methods create a conducive environment for adopting new technologies. Moreover, integrating these technologies can help bridge the gap between potential and actual productivity, boosting rural incomes and livelihoods (Darko *et al*. 2020; Saha *et al*. 2024a).

METHODOLOGY

The study was conducted during 2022-2023 in Surasettikoppa, a village in Karnataka known for its agricultural prominence and diverse cropping patterns. This region was selected as the focal area due to its blend of small, marginal, and medium-scale farmers who practice a variety of traditional and modern farming techniques. The village provides a representative setting to study the impact of technology adoption on agricultural income, given its challenges of limited resources and opportunities for growth through innovation. Primary data was collected through structured surveys and face-to-face interviews with farmers. The survey instrument included questions on demographic characteristics, landholding sizes, cropping patterns, educational levels, family sizes, and detailed information about the technologies they used in farming. Farmers were also asked about their income sources, reliance on credit, and subsidiary occupations, allowing for a comprehensive view of their socio-economic conditions. The interviews provided qualitative insights into their perceptions of modern agricultural tools and barriers to adoption. The sample comprised a diverse group of farmers varying in age, education, landholding size, and socio-economic backgrounds. This heterogeneity ensured a broader understanding of how different factors influence technology adoption. Most respondents were categorized as small and marginal farmers, with a significant proportion belonging to socially disadvantaged groups. The data analysis involved a combination of descriptive statistics and inferential methods. Correlation analysis was employed to explore the relationship between the level of technology adoption and farm income, while regression models were used to identify the key determinants of adoption. These statistical tools helped establish the extent to which modern agricultural technologies contribute to income levels, enabling robust conclusions and actionable recommendations.

RESULTS AND DISCUSSION

The Fig. 1 shows the age distribution among the studied farmers. The age distribution of farmers in the sample is diverse, ranging from below 40 years to over 70 years. The majority of farmers (48%) fall within the 40-70 years age group, indicating a significant presence of middle-aged and older farmers. A smaller proportion (16%) are younger than 40 years, suggesting potential for generational renewal in the future. Similar observations are observed by Prusty and Mohapatra (2021).

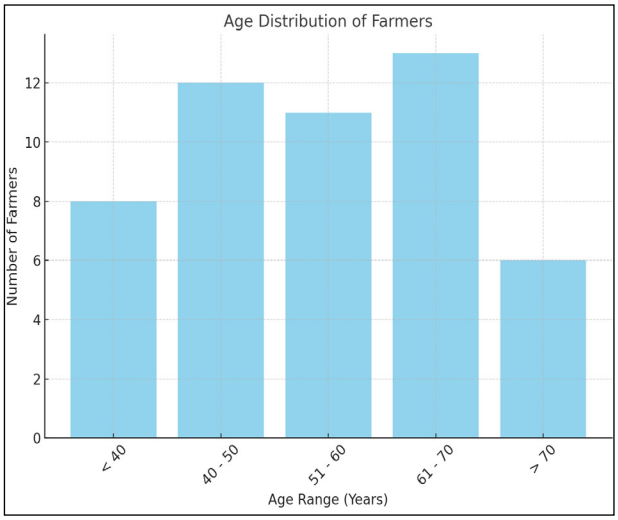

Fig. 1: Age distribution of respondent farmers

The age distribution of farmers has implications for agricultural practices, decision-making, and the future of farming. A significant proportion of older farmers may influence traditional farming methods and risk aversion. Younger farmers, on the other hand, may be more open to adopting new technologies and innovative approaches. Understanding the age distribution is crucial for designing targeted extension programs, policies, and support services that cater to the specific needs and challenges faced by different age groups.

The Fig. 2 shows the education level of the sample farmers of the study area. The educational level of farmers in the sample is varied, with a majority possessing primary or secondary education. Approximately 40% of the farmers have completed primary education, while 32% have attained secondary education. A smaller proportion (20%) have pursued higher education, and 8% are illiterate. The educational level of farmers can significantly influence their farming practices, decision-making abilities, and adoption of modern agricultural technologies. A higher level of education is often associated with better understanding of agricultural techniques, access to information, and ability to adopt innovative practices. The relatively high proportion of farmers with primary and secondary education suggests a need for targeted extension programs that can effectively communicate complex agricultural information in a simplified manner. Additionally, efforts to promote higher education among young farmers can contribute to a more skilled and knowledgeable farming community.

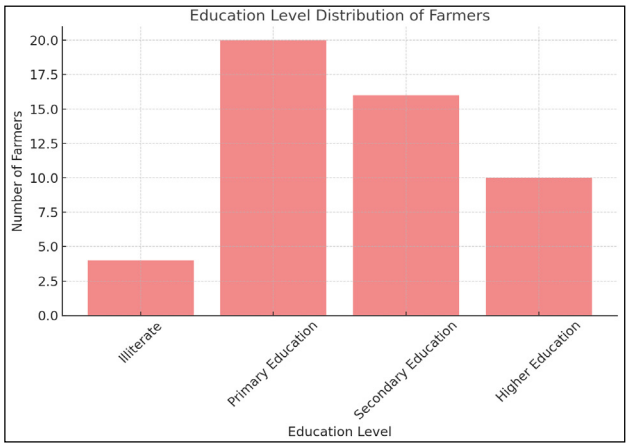

Fig. 2: Education level of respondent farmers

The Fig. 3 shows the land holding of the farmers in study area. The distribution of landholdings among farmers is skewed towards smaller landholdings. A significant proportion (44%) of farmers own less than 2 hectares of land. Only 12% of farmers possess landholdings larger than 5 hectares. Similar results were observed by Prusty *et al*. (2020b). The predominance of small landholdings poses challenges for agricultural productivity and economic viability. Small-scale farmers often face constraints in terms of access to resources, technology, and credit. To address these challenges, policy interventions may focus on promoting collective farming, land consolidation, and providing targeted support services to smallholders. Additionally, promoting sustainable agricultural practices that optimize resource use can help mitigate the impact of small landholdings on agricultural productivity.

Fig. 4 shows the family size of the farmers of study area. The majority of farmers in the sample have relatively large families. Over half (56%) of the farmers have families with 7 or more members. Only 14% have families with fewer than 5 members. Larger family sizes can have implications for labour availability on farms, particularly during peak seasons. However, it can also lead to increased dependency on agricultural income, potentially straining household resources. To optimize the benefits of family labour, policies and programs that promote education, skill development, and diversification of income sources can be considered.

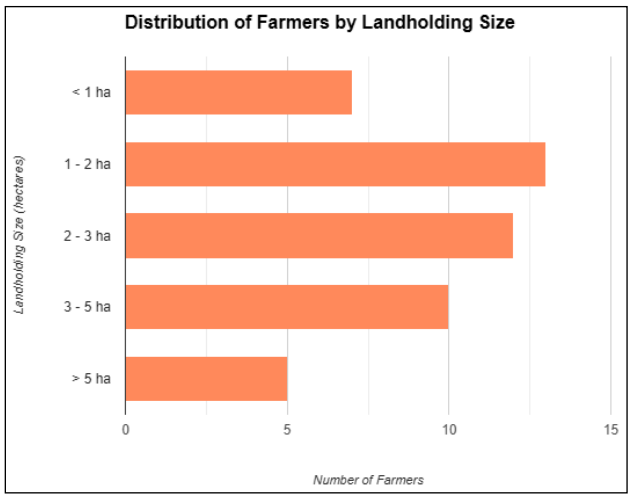

Fig. 3: Land holding of respondent farmers

The Table 1 show the analysis of technology adoption by the farmers in study area. The analysis of technology adoption among farmers in the Surasettikoppa region reveals a significant number

of farmers (70%) adopting technology at a medium to high level. This indicates a positive trend towards the adoption of modern agricultural practices. However, a considerable proportion of farmers (30%) still rely on traditional methods, falling under the low technology adoption category. The relatively high level of technology adoption is encouraging and suggests that farmers are receptive to new technologies and practices. This could be attributed to various factors such as government extension services, agricultural training programs, and exposure to innovative farming techniques. However, the persistence of low technology adoption among a significant portion of farmers highlights the need for targeted interventions. Factors such as lack of awareness, financial constraints, and inadequate infrastructure may hinder technology adoption.

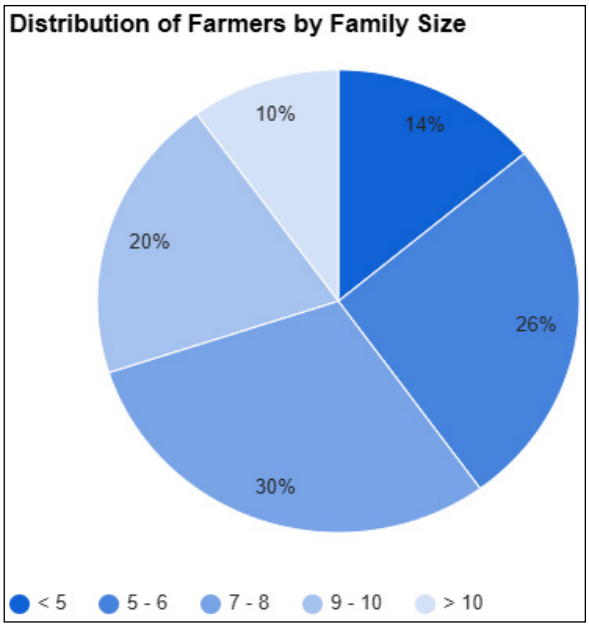

Fig. 4: Family size distribution of respondent farmers

Table 1: Adoption of technology by the farmers

Sl. No.	Technology Adoption Category	Number of Farmers
1	Low (0-50%)	20
2	Medium (51-75%)	45
3	High (76-100%)	35

Fig. 5 presents the correlation analysis of factors affecting the technology adoption. The correlation analysis reveals interesting insights into the relationship between socio-economic factors and the adoption of agricultural technologies. Among the variables considered—age, education, landholding, family size, and annual income—the relationships with adoption are generally weak, indicating that these factors might not be the primary drivers of technology uptake.

A weak negative correlation (r = −0.20) was observed between age and adoption, suggesting that younger farmers tend to adopt technologies slightly more readily than older ones. This trend may be attributed to the openness of younger individuals to innovation and experimentation, as well as their greater exposure to modern farming methods through digital media or training programs. Conversely, older farmers may rely more on traditional practices, potentially due to risk aversion or lower adaptability to change. Education displayed a negligible positive correlation (r = 0.03) with adoption. This finding implies that the level of formal education has little influence on the adoption of agricultural technologies among the sampled farmers. While education is generally believed to enhance awareness and decision-making, the absence of a strong relationship may indicate that other factors, such as access to extension services or community influence, outweigh the role of formal education.

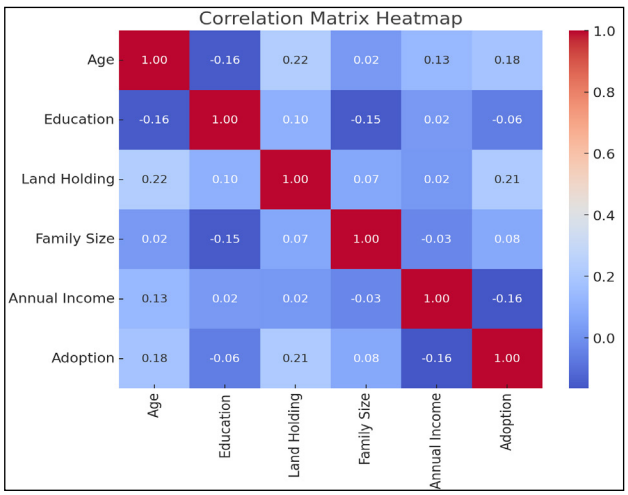

Fig. 5: Correlation matrix of socio-economic variables with adoption

The relationship between landholding size and adoption was also minimal (r = −0.02), indicating that the size of land owned by farmers does not significantly impact their willingness to adopt new technologies. This suggests that both small-scale and large-scale farmers may face similar opportunities and challenges when it comes to adoption, possibly

shaped by shared socio-economic contexts, access to markets, or policy environments. Similarly, family size showed a weak negative correlation (r = −0.05) with adoption, hinting that larger families might slightly hinder the adoption of technologies. This could be due to financial constraints in larger households or traditional family dynamics that prioritize established practices. However, the effect is minor and does not strongly influence adoption rates.

Annual income exhibited a weak positive correlation (r = 0.07) with adoption, suggesting that wealthier farmers might be slightly more inclined to adopt new technologies. This trend, while not strong, aligns with the idea that financial capacity can ease the burden of upfront costs associated with adopting new practices. However, the low correlation value indicates that other barriers, such as perceived risks or lack of awareness, may still limit adoption among higher-income farmers.

The results emphasize that socio-economic factors alone do not substantially influence technology adoption. Other variables, such as institutional support, access to information, peer networks, and cultural attitudes, may play a more significant role. To enhance adoption rates, policymakers and extension services should prioritize inclusive strategies that address these broader challenges. The similar findings were reported by Prusty *et al*. (2020a). Targeted training programs, especially for older and less-educated farmers, along with community-based initiatives to foster peer-to-peer learning, could prove effective. Additionally, efforts to reduce non-financial barriers, such as trust in institutions and access to quality inputs, are essential for improving technology uptake across diverse farmer profiles.

CONCLUSION

The analysis highlights several important findings regarding the adoption of agricultural technologies. Despite weak correlations between socio-economic factors like age, education, landholding, family size, and annual income with adoption rates, it is evident that these variables alone do not significantly influence farmers' willingness to embrace new technologies. Younger farmers were slightly more likely to adopt technologies, suggesting the importance of targeting youth in agricultural interventions. Similarly, although education and income exhibited only minimal positive relationships with adoption, they underline the potential of informed decision-making and financial stability in promoting new practices. The results reinforce the critical role of technology in enhancing farm productivity, increasing income, and ensuring long-term agricultural sustainability. Adoption of modern technologies not only optimizes resource use but also strengthens farmers' resilience to market and climatic uncertainties. Bridging the gap between technological availability and farmer adoption requires a multi-stakeholder approach. Extension services, policymakers, researchers, and private players must work collaboratively to ensure access, affordability, and awareness of technological solutions. A call to action is necessary for stakeholders to prioritize investments in agricultural technology development and dissemination. Programs aimed at reducing knowledge barriers, improving credit access, and creating farmer-friendly policies can significantly boost adoption rates. By doing so, the agricultural sector can achieve sustainable growth, secure food systems, and uplift rural livelihoods in the long run.

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