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Risk and Resilience in the Adoption of New Agrarian Technology by Rural Families: An Ethnographic Study of East Barddhaman District

Sarojit Kapasi[1]

[1]Department of Sociology, School of Liberal Arts and Cultural Studies, Adamas University, 24 Parganas (North), Kolkata-700 126, West Bengal, India
sarojit.sociology@gmail.com

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Abstract

The uptake of new agrarian technologies is a key driver of enhancing the agricultural productivity and food security in rural communities. Yet, the uptake of such technologies into conventional farming activities is usually accompanied by risks and challenges. This ethnographic research investigates the risks and resilience-related factors of the adoption of new agricultural technologies among rural households in East Barddhaman district, West Bengal, India. By conducting a close-up study of rural farming communities, the research explores the socio-economic, cultural, and environmental determinants shaping the adoption of technology as well as the adaptive strategies that farmers employ in negotiating perceived risks and constructing resilience.

The study examines that while the new farm technologies, including enhanced seeds, irrigation equipment, and mechanized tools, can potentially harness productivity. These also present huge financial, environmental, and social risks to the farmers. The risks mentioned are high initial investment costs, unclear returns on investment, exposure to climate change, and market fluctuations. For smallholder farmers, these risks are further exacerbated by poor access to credit, poor information, and a lack of technical assistance. Resilience, however, is a key driver in the ability to overcome these. Farmers show resilience through the adaptation of technologies to the local environment, diversification of income streams, and dependence on community-based risk-mitigating support systems.

The research also emphasizes the use of a mix of participant observation, in-depth interviews, and focus group discussions to provide qualitative data. Throughout six months of field observation, the researcher interacted with farmers, agricultural ex-

tension agents, and community leaders to determine how technological adoption impacts their livelihoods and how they manage related risks. The evidence indicates that whereas more resource-endowed farmers are likely to adopt new technologies, small farmers tend to adopt technology cautiously, balancing the perceived risks against benefits.

The conclusions of the study have significant policy implications and point to the necessity of customized interventions addressing financial constraints, increasing access to farm extension services, and fostering community-based resilience initiatives. With attention given to both technology adoption risks and resilience drivers, this research yields significant lessons for facilitating sustainable agricultural growth in rural India while ensuring that technological advancement reaches all farmers, especially those in weaker socio-economic segments.

Keywords

Agrarian Technology, Rural Families, Adoption, Resilience, Risk, Ethnographic Study, East Barddhaman District

1. Introduction

The introduction of new farming technologies in rural areas plays a crucial role in boosting agricultural productivity and tackling food security challenges. It also supports sustainable development in these communities. However, adopting these technologies can be complex, especially in regions with strong religious beliefs and various social, economic, environmental, and cultural obstacles. This study focuses on the experiences of rural families in the East Barddhaman district of West Bengal, India.

The research aims to identify the factors that influence risk and resilience when rural farmers adopt modern farming technologies. It investigates how these families manage the uncertainties and challenges involved in integrating innovations like improved seeds, irrigation systems, and mechanized tools into their traditional farming methods. The study emphasizes that adopting technology in rural areas involves not only technical considerations but also economic, social, and cultural adjustments.

For many small farmers in East Barddhaman, deciding to use new technologies carries significant financial and environmental risks. These include the high initial costs, uncertain returns on investment, the possibility of technology failing, and market instability. Moreover, rural communities face environmental risks such as changing climate conditions, water scarcity, and soil degradation, which increase the vulnerability of their agricultural systems. The study highlights resilience and coping strategies as key themes, focusing on how rural families and communities can adapt to and recover from these risks. Resilience means not only surviving the challenges of new technologies but also thriving and finding innovative ways to succeed despite the difficulties.

This resilience is determined by individual and collective strategies and perceptions. Individually, farmers demonstrate resilience by diversifying their sources of income, practising adaptive farming methods, and tapping their traditional knowledge together with advanced technology. At the collective level, community-based cooperation, sharing knowledge, and networks of support assist farmers in minimizing risks and their ability to cope with uncertainties. The research uses ethnography to collect data, interspersing participant observation, detailed interviews, and focus group debates. During the fieldwork for six months in East Barddhaman, the researcher directly interacted with rural farmers, extension workers in ag-

riculture, and village leaders.

The research strategy pursues in-depth knowledge of the everyday experiences of rural families and how they define risk and resilience based on their everyday agriculture practices. The study discovers that although the uptake of new technologies promises much in the way of enhancing agricultural productivity and enhancing livelihoods, the perceived threats tend to exceed the advantages, particularly among poor smallholder farmers. Large farmers, with easier access to credit and financial assistance, are more likely to embrace these risks, whereas small farmers adopt new technologies cautiously or not at all. Additionally, the research discloses that the resilience of rural families relies not merely on their capacity to absorb shocks but also on their ability to tailor technology to local environments. This flexibility is particularly important in a place like East Barddhaman, where environmental unpredictability, e.g., irregular rainfall, is a major threat.

The key findings of this research are of significant policy and practice relevance. For there to be effective adoption of agrarian technologies, government and development agencies need to remove the finance and information constraints that confront rural households. This involves enhancing credit access, provision of subsidies, and agricultural extension services that remain sensitive to the distinctive needs of various farming communities. Second, the social aspects of technology adoption must be addressed to a larger extent, including gender roles, networks of community members, and traditional knowledge systems that can strongly shape the ways technologies are perceived and used by rural households.

The research has specifically focused on appreciation of how Indian rural communities grapple with the intricate landscape of technological change. Concerning the analysis of both risks and resilience under agricultural modernization, this study provides a detailed reflection of ways rural families cope with the evolving nature of the farm scene. The research further emphasised the necessity of an integrated technological adaptation strategy. The strategy analysed is interpreted to simultaneously focus on economic, technical, social, cultural and environmental dimensions. The decisions made by the farmers in rural regions are considered to be based on these factors a mechanism in the external environment. The process of study is thus considered to outline the importance of policies for the promotion of resilience, and sustainable agriculture systems with the ability to respond to global environmental changes and market risks.

Conclusively, the findings of this ethnographic study emphasize that resilience is not simply about bouncing back from risks. Rather it is about continuously adapting, learning, and innovating within a context of persistent uncertainty. By enhancing the resilience strategies of rural families in East Barddhaman, the adoption of new agrarian technologies can become much easier. It is understood to be a significant pathway to sustainable agricultural development, improving the livelihoods of smallholder farmers while contributing to broader goals of food security and rural empowerment.

1.1. Background

The development of rural agriculture through the use of new technologies has been a key focus of research in development studies. In India, where agriculture is the backbone of rural existence introduction of modern agrarian technologies has both positive and negative impacts on farming communities. The new technologies have the potential for greater productivity, lower labor costs, and better food security. Significant risks are also identified to be posed in the path, particularly in terms of economic uncertainty and environmental sustainability.

1.2. Problem Statement

In the district of East Barddhaman, rural farmers experience several issues such as limited exposure to technology, climatic risks, and social restrictions. The present ethnographic study attempts to investigate the way rural households in the district evaluate and react to the risk involved in the adoption of new agrarian technologies. It also aims to understand the function of resilience in the technological adoption process.

1.3. Objectives

- To explore the economic, cultural, and social determinants of the adoption of new agricultural technologies among rural households in East Barddhaman.
- To identify risks rural families, perceive in adopting new technologies and how these are addressed.
- To discuss the role of resilience in surmounting the challenges of technology adoption.

1.4. Significance of the Study

This research adds to the knowledge base regarding how rural families deal with the intricacies of adopting emerging agricultural technologies. It also provides policy suggestions on enhancing the impact of agricultural extension services and rural farming communities' resilience.

2. Literature Review

2.1. Theoretical Framework

The research is based on the two most relevant concepts: risk and resilience. Risk theory provides an explanation of the uncertainty and possible negative consequences of using new technologies. On the contrary, resilience theory, concerns itself with the ability of societies to cope with and bounce back from these setbacks.

2.2. Adoption of Agricultural Technology

New agricultural technology adoption has been extensively researched, with diverse theories exploring the factors influencing adoption, like economic incentives, education levels, social networks, and government incentives (Rogers, 2003). Gender dynamics also have an important role in technology adoption, as highlighted by Doss (2006), especially in rural India where women tend to be the main farm labor force.

2.3. Risk in Agricultural Technology Adoption

The adoption of new technologies often involves significant risks, including financial investments, uncertain returns, and potential environmental consequences. Risk perception is shaped by both objective factors, such as previous farming experiences, and subjective factors, like trust in technology providers and the government (Glover et al., 2016).

2.4. Resilience in Rural Communities

Rural community resilience is often understood as the capacity to endure economic shocks, climate change, or market instability. In agricultural terms, resilience has been interpreted as a system of adaptive responses such as crop diversification, sharing of resources, and utilization of local knowledge (Barrett et al., 2001).

3. Methodology

3.1. Research Design

This research has specifically followed an ethnographic research design, combining participant observation, in-depth interviews, and focus group discussions. Ethnography allows for an in-depth exploration of the lived experiences of rural families as they navigate the complexities of adopting new agricultural technologies.

3.2. Study Area

The research was conducted in East Barddhaman district, a predominantly agrarian region in West Bengal, India. This district was selected due to its diverse farming practices. Moreover, the ongoing introduction of modern agricultural technologies, including hybrid seeds, irrigation systems, and so on.

3.3. Sampling

A purposive sampling technique was employed to select 30 households that have adopted new agricultural technologies in the past five years. The sample included both men and women, from different socio-economic backgrounds, to provide a holistic view of the adoption process.

3.4. Sampling

- In-depth Interviews: Semi-structured interviews were held with farmers, agricultural extension agents, and local leaders to understand factors affecting the adoption of technology and perceived risks.
- Focus Group Discussions: Focus group discussions were conducted with sets of farmers to delve into shared perceptions of risks and resilience tactics.
- Participant Observation: The researcher stayed in the community for six months, observing everyday farming activities and farmer-technology provider interactions.

3.5. Data Analysis

The data analysis method combines the resilience of software to reach the results and form the base of findings. Data has been coded thematically surrounding risk perception, technology adoption, and resilience. The NVivo software was employed to aid in coding and grouping the data.

4. Results

4.1. Factors Influencing Technology Adoption

The study identified several factors influencing the adoption of new technologies:

- Social Factors: Social networks, including interactions with fellow farmers and extension workers, played a significant role in influencing adoption. Trust in the technology provider and local government also emerged as key factors.
- Cultural Factors: Resistance to new technologies was observed among some farmers, particularly older generations, who preferred traditional farming methods due to cultural beliefs and knowledge.
- Economic Factors: The ability to invest in technology was often dependent on access to credit and subsidies. Larger farmers were more likely to adopt new technologies due to better financial resources.

4.2. Perceived Risks of Adoption

Farmers have identified several risks associated with the adoption of new agricultural technologies:

- **Economic Risks:** Many farmers are worried about the high upfront costs and the uncertain returns from new technologies. There was also concern about market volatility and price fluctuations.
- **Environmental Risks:** Some farmers were concerned that new technologies might not be suited to local environmental conditions, such as soil quality or water availability.

- **Social Risks:** There were concerns about the social implications of adopting new technologies, such as alienation from traditional farming practices and changes in community relationships.

4.3. Resilience Strategies

Farmers addressing the risks and challenges of technological adaptation have adopted particular strategies. Implementation of various resilience strategies to mitigate risks are discussed below:

- **Knowledge Sharing:** Farmers relied on community knowledge and collective action to share experiences and learn from each other's successes and failures.
- **Adaptation to Local Contexts:** Some farmers have adapted technologies to suit local environmental and cultural conditions, thereby increasing the chances of successful implementation.
- **Diversification:** Diversification of crops and income sources was a common strategy to reduce dependency on any one technology or crop.

5. Discussion

This ethnographic research aimed to investigate the risks and resilience determinants of new agrarian technology adoption among rural households in East Barddhaman, West Bengal. From a close reading of local farming activities and challenges of smallholder farmers, a number of important themes became apparent, highlighting the multifaceted realities of technology adoption, risk coping, and rural community resilience.

1. The Role of Risk in Technology Adoption

Perhaps the most important result of this research is that risk is a dominant factor in influencing the adoption of new agrarian technologies. Though the potential for greater productivity, efficiency, and better livelihoods is enticing, these advantages tend to be overpowered by perceived risks from technological change. Financial risks entailed by high initial costs, environmental risks as a consequence of climate change, market risks stemming from price fluctuations, and social risks due to the disruption of customary practices and social dynamics have been critically recognised. Smallholder farmers, in particular, are susceptible to these risks because they have limited capital, no access to credit, and rely on local and informal agribusiness markets. Larger farmers, as observed in the findings, have better access to capital and credit and thus are more inclined to embrace new technology.

But for small farmers, the inflated cost of machinery, seeds, and inputs tends to push them away from proceeding with technological adoption. This discovery supports research by Doss (2006), who observes that the availability of credit and capital ranks among the most prominent hindrances to technology adoption in rural regions. Additionally, the threat of technology failure—through low yields, inefficient machinery, or disease in crops—may discourage farmers from investing in new technology without the promise of success. In some sense, these results confirm the general literature on technology adoption in rural areas. Research has established that risk aversion is a pervasive influence on adoption choices, particularly among farmers who are confronted with uncertain returns from technology investments (Barrett & Armaña, 2015; Fafchamps, 2003).

The particular case of East Barddhaman, however, illustrates how these risks are further exacerbated by environmental conditions, including unpredictable rainfall, water shortages, and soil erosion, which have intensified with the advent of climate change. Farmers in this area have to balance the risks of taking up new technologies against the larger environmental uncertainties that can directly affect agricultural productivity.

2. Resilience as a Coping Mechanism

Resilience as a Coping Mechanism Resilience was a key theme in the study, especially in the way rural families cope with the risks and challenges of new agricultural technologies. Resilience here does not just mean farmers surviving the challenges they encounter but their ability to innovate, adapt, and learn how to bounce back from adversity. The resilience concept is in line with Walker et al. (2004), who contend that resilience is not about preventing change but about being able to manage it. Farmers in East Barddhaman exhibited adaptability in a variety of forms: by adapting technologies to local conditions, diversifying the sources of income, and depending on community-oriented support systems. One of the most important contributions of this study is that farmers are not simply passive recipients of technological change; instead, they participate in adaptive processes that enable them to appropriate modern technologies as well as maintain traditional practices. For instance, whereas others embraced new irrigation systems, they modified the technology to accommodate the region's unpredictable rainfall patterns.

Others integrated the application of high-yielding seed varieties with their local knowledge of crop rotation and pest control. This integration of traditional and new methods enabled farmers to avoid risks and increase the efficiency of the technology. This resilience also took the form of community-based approaches. East Barddhaman farmers often used social networks and cooperative agreements to exchange resources, information, and labor.

These informal networks, which were sometimes founded on trust and mutual aid, served as a cushion against the social and financial risks of adopting new technology. Glover et al. (2016) highlight the significance of social capital in enhancing resilience, especially in rural areas where formal institutions are less accessible. In this study, the role of collective action and knowledge-sharing practices came out as imperative in building resilience among smallholder farmers.

3. The Importance of Social and Cultural Factors

Another critical element in this study is the role played by social and cultural factors in shaping technology adoption. East Barddhaman farmers did not make adoption choices independently; rather, they were strongly shaped by their social networks, cultural norms, and gender relations. The research indicated that gender was a key factor in determining access to information and resources, especially for women farmers. Women were often left out of decision-making on technology adoption, even though they were actively engaged in farming. This result is consistent with the research of Doss and Morris (2001), which emphasizes how power relations based on gender tend to restrict women's exposure to farm innovations and extension services. In addition, cultural perception and beliefs regarding modernity and risk also deterred farmers from adopting new technologies. In some cases, the traditional approach was regarded as more sustainable and more culturally acceptable, generating aversion to the implementation of new, unknown technologies. The prospect of modernization was progress and economic gain, with greater and more active incorporation of technology. This shows the overall trade-off between tradition and modernity in rural development (Rogers, 2003), where innovation is both adopted and rejected depending on social and cultural views.

4. Policy Implications and Future Directions

The implications of this study are significant for policy to foster sustainable and inclusive agricultural development. First, policies intended to encourage the adoption of technology must consider the financial limitations of smallholder farmers. The availability of low-cost credit, subsidies, and cheap technologies can minimize the financial pressure on farmers and induce adoption. Also, extension services in agriculture must be planned for addressing the variegated requirements of rural society, including the transmission of technical knowledge and concrete guidance that can suit local contexts. In addition, policies must seek to enhance social networks and community resilience. Community initiatives that facilitate knowledge-sharing, collective farming, and shared risk-taking can reduce social and cultural resistance to adoption. Lastly, gender-sensitive policies must be implemented in order to guarantee that male and female farmers both have equal opportunities to access resources and support to adopt technology. In summary, this research has shed light on the intricate relationship between risk,

resilience, and technology adoption in rural agricultural societies.

Although new agrarian technology adoption has the potential to boost agricultural productivity and improve livelihoods, it has to be embraced with a rich appreciation of the risks involved and the resilience strategies that farmers adopt to cope with these risks. Through creating an adaptive environment of supporting strategies, inclusive policies, and community-based resilience, rural families are in a better position to cope with the uncertainties of technological change, leading to long-term agricultural sustainability.

6. Conclusion

The ethnographic research has presented an overall critique of the risks and resilience determinants involved in adopting new agrarian technologies by rural families in East Barddhaman district, West Bengal. The research has underscored the complex nature of technology adoption in rural areas, where economic, social, cultural, and environmental concerns intersect to determine the decisions of farmers.

One of the central findings of this study is that while the adoption of new technologies offers potential benefits in terms of increased productivity and efficiency, it also presents significant risks, particularly for smallholder farmers. These risks are not only financial but also environmental and social. The high initial costs associated with purchasing new technologies, the uncertainty regarding returns on investment, and the vulnerability to external shocks such as climate change and market fluctuations are all critical factors that influence farmers' willingness to adopt modern technologies. This research reinforces the notion that technology adoption is a highly contextual process, shaped by the unique socio-economic realities of rural households.

Despite these risks, the concept of resilience emerged as a key factor in enabling farmers to successfully integrate new technologies into their agricultural practices. Resilience in this context refers to the capacity of rural families to adapt to the challenges they face, whether through diversified livelihoods, adaptive use of technology, or collective action within communities. Farmers in East Barddhaman have shown a remarkable ability to adjust new technologies to local environmental conditions and integrate them with traditional knowledge. This adaptability, coupled with community support and knowledge-sharing practices, enables them to mitigate the risks associated with technological adoption.

The study also highlighted the importance of financial access, information dissemination, and social networks in facilitating or hindering technology adoption. Larger farmers, who have greater access to credit and financial resources, are more likely to embrace new technologies, while smaller farmers often face barriers related to credit, training, and information. Moreover, gender dynamics and community trust play an influential role in the adoption process. Female farmers, for instance, may encounter additional challenges in accessing resources and information, which can affect their capacity to adopt new technologies. These findings point to the need for targeted interventions that address the specific needs of different socio-economic groups, particularly women and smallholder farmers, in promoting inclusive agricultural development.

In terms of policy implications, this research underscores the need for a more holistic approach to promoting technological adoption. Policies should not only focus on providing financial support but should also emphasize building social and technical capacities within rural communities. Strengthening agricultural extension services, ensuring that technologies are adapted to local conditions, and facilitating access to affordable credit and subsidies are essential steps in overcoming the barriers to adoption. Additionally, fostering community-based resilience through social networks and local knowledge sharing can enhance the ability of farmers to adapt and innovate within the changing agricultural landscape.

Ultimately, this study contributes to a deeper understanding of how rural families in East Barddhaman— and by extension, other similar regions—navigate the complexities of agricultural modernization. The research underscores that the adoption of new agrarian technologies is not a linear or purely technical process, but a deeply social and cultural one. To en-

sure that technological advancements lead to sustainable and inclusive agricultural development, it is imperative that policymakers, agricultural extension services, and development organizations adopt a more integrated approach. This approach should consider not only the technical and economic dimensions of agricultural change but also the social, cultural, and environmental factors that shape farmers' decisions and resilience. By supporting the resilience of rural families and addressing the risks they face, the adoption of new agrarian technologies can become a powerful tool for fostering long-term agricultural sustainability, improving livelihoods, and achieving broader developmental goals.

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