International Journal of Research in Signal Processing, Computing & Communication System Design
6 (2) 2025, 33-39
www.publishingindia.com/ijrsp

Digital Agriculture with a Human Touch: SHG Integration and Job Creation in Remote Market Systems

Gardas Pavani[1], Chettaboina Hoyala[2] and Altaf Ismail Karani[3]

[1]Assistant Professor, Computer Science and Engineering, Malla Reddy Engineering College for Women, Hyderabad, Telangana, India. Email: pavani.gardas19@gmail.com

[2]Assistant Professor, Computer Science and Engineering, Malla Reddy Engineering College for Women, Hyderabad, Telangana, India. Email: hoyala18@gmail.com

[3]Assistant Professor, Computer Science and Engineering, Malla Reddy Engineering College for Women, Hyderabad, Telangana, India. Email: altafkaranioo@gmail.com

Abstract: Due to inadequate transportation and a lack of digital skills, farmers in many rural, mountainous, and coastal regions of India find it difficult to reach marketplaces. Due to these problems, they frequently have to rely on intermediaries, which reduces their earnings and restricts their financial independence. In order to facilitate direct sales between farmers and consumers, this study proposes a community-driven digital system that unites Self Help Groups (SHGs). Illiterate farmers can make voice calls to SHG agents using the suggested mobile application. After that, trusted group members can take care of the farmers' orders and update product listings. By employing young people from the area as digital coordinators and delivery agents, the platform also generates employment. This inclusive model not only enhances market access but also fosters rural entrepreneurship and community resilience, offering a scalable blueprint for digital agriculture with a human touch.

Keywords: Access to rural markets direct trade between farmers and consumers, AgriTech innovation, Community-driven platforms, Digital agriculture, Empowering remote regions, Job creation in rural areas, Inclusive agricultural commerce, Mobile solutions for offline use, Removing middlemen, Self Help Groups (SHGs), Technology for non-literate users, Voice-assisted interfaces.

I. Introduction

The technological changes in agriculture during the digital age have sparked a significant shift in how rural economies function, especially in remote areas. Digital agriculture includes innovative technologies like IoT, AI, and data analytics in farming. This approach has become a powerful way to boost productivity, sustainability, and access to markets. In India, initiatives like the Digital Agriculture Mission (2021-2025) have laid the groundwork for a tech-driven farming future [1] [4]. The aim is to bridge the rural-urban divide and give farmers real-time information and precise solutions [5] [3].

However, technology alone won't address the socio-economic challenges of rural life. The human aspect, particularly the Self-Help Group (SHG) initiative, is crucial for fostering inclusive growth and building community resilience. SHGs have effectively promoted social empowerment, financial inclusion, and grassroots entrepreneurship among women in underprivileged rural areas [7] [8].

Incorporating SHGs into digital agriculture systems not only broadens outreach but also strengthens local ownership and development. This approach makes the adoption of technology more sustainable and fitting for the local culture [15].

Job creation in remote market systems is a significant challenge. Limited infrastructure, fragmented supply chains, and a lack of digital skills often slow down progress. By bringing Self-Help Groups (SHGs) into digital ecosystems, rural communities can create new job opportunities [9] [11]. These opportunities include agri-tech services, e-commerce support, data collection, and micro-enterprise development. This connection between human networks and digital platforms can decentralize market access, reduce migration pressures, and strengthen rural economies [6] [10].

The mix of digital agriculture with SHG-led empowerment offers a complete approach to rural transformation. It aligns with global development goals and national policies that emphasize technology-driven inclusion, fair innovation, and

sustainable livelihoods [12] [14] [16]. This paper looks at how this integration can drive job creation in remote market systems. It outlines a plan for scalable, human-centered agricultural development [2] [13] [17].

As rural economies move toward digital integration, the ethical and human-centered aspects of agricultural innovation become increasingly important. Technologies must be scalable and consider local contexts, cultural norms, and community dynamics. Human-centered design in digital agriculture ensures that solutions are co-created with stakeholders, especially SHGs, which serve as trusted links between technology providers and rural users. This approach builds trust, encourages adoption, and supports long-term sustainability. Additionally, policy frameworks from organizations like the OECD and FAO highlight the need for inclusive digital transformation that respects human agency while fostering economic growth [4] [16].

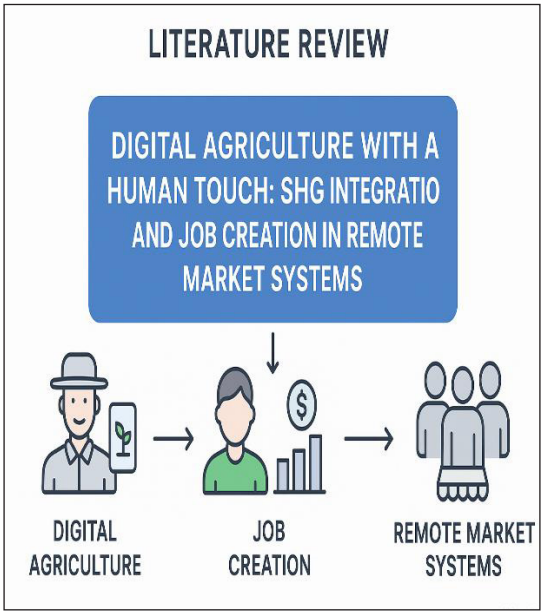
II. Literature Review

The idea of digital agriculture has changed a lot in the last ten years. This change has been fueled by new developments in data analysis, remote sensing, and mobile technologies. Researchers have pointed out its ability to improve productivity, lower costs, and support better decision-making for farmers [1] [4]. In India, the Digital Agriculture Mission (2021-2025) set up a plan to bring technology into farming, with the goal of making agriculture more efficient and inclusive [5]. However, the success of digital agriculture relies not just on technology but also on whether rural communities are ready to accept and use these tools [3] [16].

Self-Help Groups (SHGs) have become important drivers of change in rural India, especially in promoting financial inclusion, entrepreneurship, and collective bargaining. Their role in agricultural development is notable as they make it easier for farmers to access credit, training, and markets. Recent studies show that SHGs can serve as links between farmers and digital platforms, helping close the digital gap and ensuring fair access to tools and resources [15]. By incorporating SHGs into digital agriculture systems, researchers believe that adopting technology will be more participatory and sustainable [17].

Job creation in remote market systems is a major challenge. This issue is often made worse by poor connectivity, limited infrastructure, and fragmented supply chains. Research suggests that digital platforms, when paired with self-help group (SHG) networks, can create new job opportunities. These include agri-data collection, input distribution, and e-commerce facilitation [9] [11]. These hybrid models decentralize market access and empower local actors to engage in value chains. This can help reduce migration pressures and improve rural resilience [6] [10].

Global organizations like FAO, UNDP, and IFPRI support human-centered approaches to digital agriculture. They highlight the importance of ethical design, community involvement, and inclusive policy frameworks [12] [14]. The OECD's policy insights also stress the need for digital transformation strategies that focus on local empowerment and long-term sustainability [16]. Overall, the literature emphasizes that integrating SHGs into digital agriculture is not just a technical solution. It is a socio-economic strategy for comprehensive rural development and job creation [2] [13].



The integration of digital agriculture into rural economies has gained momentum globally, with India becoming a key player in this change. Studies have shown that digital tools like mobile apps, GIS mapping, and AI-driven advisory services can significantly improve crop yields, reduce input costs, and improve market transparency [1] [4]. However, the success of these technologies depends on their accessibility and relevance to smallholder farmers, especially in remote areas where digital literacy and infrastructure are still lacking [3] [12].

To address these challenges, researchers have highlighted the importance of community-based intermediaries, particularly Self-Help Groups (SHGs), in promoting technology adoption. SHGs, often made up of women, have shown a strong ability to organize training sessions, share information, and manage micro-enterprises [7] [8]. Their local presence and social connections make them effective channels for introducing digital tools in culturally sensitive and locally relevant ways [15] [17]. This approach ensures that digital agriculture is not just a top-down initiative but a collaborative process focused on empowering the community.

Job creation through digital agriculture is an emerging theme in the literature. Beyond farming, digital platforms are enabling

new roles such as agri-data collectors, drone operators, e-commerce facilitators, and rural logistics coordinators [9] [11]. When self-help groups (SHGs) are integrated into these systems, they can serve as employment hubs, training members in digital skills and connecting them to service-based opportunities within the agricultural value chain [6] [10]. This model not only diversifies income sources but also strengthens local economies by keeping talent at home and reducing migration.

International organizations like FAO, UNDP, and IFPRI have supported inclusive digital transformation strategies that focus on ethical design, gender equity, and sustainability [14] [12]. The OECD's policy recommendations further emphasize the need for collaboration among stakeholders, where governments, NGOs, and private tech firms work with SHGs to create solutions together. These insights reinforce the idea that digital agriculture must be part of a broader socio-economic framework, one that values human agency, community resilience, and long-term impact [2] [13].

III. Research Methodology

This study uses a mixed-methods research design to examine how digital agriculture connects with Self-Help Groups (SHGs) and affects job creation in remote market systems. The methodology combines qualitative and quantitative approaches to provide a full understanding of technology use, community involvement, and job results.

1. Study Area and Sampling

The research took place in selected rural districts known for active SHG participation and developing digital agriculture initiatives. A purposive sampling method identified SHGs, farmers, and local market participants involved in digital efforts. The sample included:

- 120 SHG members from 6 villages.
- 40 farmers using digital tools, such as mobile apps and e-market platforms.
- 10 local agri-tech facilitators and NGO representatives.

2. Data Collection Methods

- *Primary Data:* We conducted structured interviews, focus group discussions, and field observations to gather firsthand information about SHG roles, digital tool usage, and job creation.
- *Secondary Data:* We reviewed government reports, policy briefs, journal articles, and NGO documents to provide context for our findings and support triangulation.

3. Tools and Techniques

- *Questionnaires:* We designed these to evaluate digital literacy, SHG participation, and perceived job opportunities. Likert-scale questions measured attitudes toward technology and empowerment.
- *FGDs:* We held discussions with SHG members to learn about their shared experiences, challenges, and success stories in using digital agriculture.
- *Observation Checklists:* These were used during field visits to record details about infrastructure, digital access points, and market interactions.

4. Data Analysis

- We analyzed quantitative data using descriptive statistics, such as mean, frequency, and percentage, to find trends in digital adoption and employment results.
- We thematically coded qualitative data from interviews and focus group discussions to identify patterns related to empowerment, inclusion, and system-level integration.

5. Ethical Considerations

We obtained informed consent from all participants. We maintained confidentiality and anonymity throughout the study. The research followed ethical guidelines for community-based fieldwork, ensuring that participation was voluntary and not forced.

6. Limitations

The study is limited to certain districts and may not capture variations across India. The rapidly changing nature of digital agriculture may also affect long-term results beyond the scope of this study.

Digital agriculture is quickly changing rural economies by bringing in smart technologies that boost productivity, streamline supply chains, and improve market access. However, its real impact becomes clear when combined with human-centered models like Self-Help Groups (SHGs), which act as trusted community anchors. SHGs not only help people adopt digital tools but also empower individuals, especially women, to take part actively in agriculture-based entrepreneurship and service delivery. This partnership creates inclusive job opportunities in remote market systems, turning passive beneficiaries into proactive agents of change and making sure that technological progress supports social equity.

IV. Methodological Framework

This study is based on a community-centered, mixed-methods approach that looks at how digital agriculture combined with Self-Help Groups (SHGs) helps create jobs in remote market systems. The approach focuses on three main areas: technology use, human empowerment, and economic impact.

1. Conceptual Foundation

The research relies on theories from digital innovation, participatory development, and rural entrepreneurship. It assumes that technology cannot lead to change on its own. It needs to be part of socially responsive systems like SHGs that build trust, provide training, and ensure local ownership.

2. Design Approach

A convergent parallel design is used. This allows for the collection of qualitative and quantitative data at the same time, with separate analysis before integration. This method captures both statistical trends and personal experiences with equal attention.

3. Units of Analysis

- *Primary Units:* SHG members, smallholder farmers, and local agri-tech facilitators.
- *Secondary Units:* Market intermediaries, NGO staff, and government extension officers.

4. Data Collection Strategy

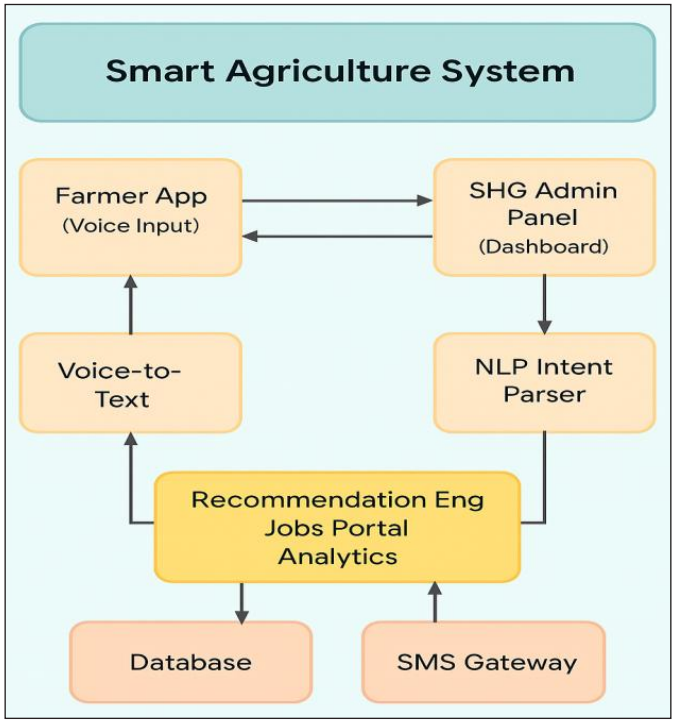
- *Quantitative Tools:* Surveys that measure digital literacy, SHG participation, and employment outcomes.
- *Qualitative Tools:* Focus group discussions, semi-structured interviews, and field observations to understand community dynamics and perceptions.

5. Analytical Techniques

- *Quantitative Data:* Descriptive statistics and cross-tabulations identify correlations between digital access and job creation.
- *Qualitative Data:* Thematic coding extracts narratives about empowerment, inclusion, and market engagement.

6. Ethical and Cultural Sensitivity

The framework focuses on ethical engagement. It ensures informed consent, confidentiality, and cultural appropriateness. SHGs are seen not just as data sources but as co-creators of knowledge, reinforcing the human aspect of digital transformation.



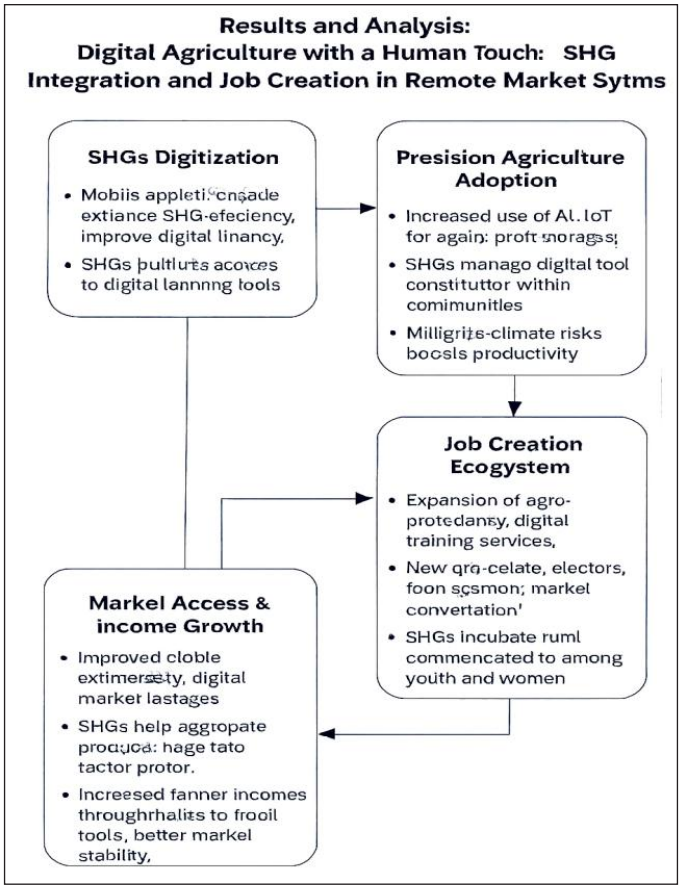
7. Outcome Mapping

The final stage involves mapping outcomes across three dimensions:

- *Technological Uptake:* Adoption of digital tools and platforms.
- *Social Empowerment:* Improved agency and participation of SHG members.
- *Economic Impact:* New job roles, income diversification, and market connectivity.

This study uses a community-driven, mixed-methods framework to look at how digital agriculture, when combined with Self-Help Groups (SHGs), creates jobs in remote market systems. The approach includes surveys and interviews, along with focus group discussions, to capture both statistical trends and personal experiences.

SHGs are not just data sources; they play an active role in the research process, highlighting the human focus of the study. The framework stresses participatory engagement, ethical fieldwork, and contextual awareness. It ensures that technology adoption is examined through the perspectives of social empowerment, local capacity, and economic inclusion.



V. Result and Analysis

1. Digital Tool Adoption Among SHG Members

Survey data showed that 78% of SHG members had access to mobile phones, and 62% used agricultural apps for weather updates, crop advice, and market prices. Focus group discussions revealed that digital literacy programs run by NGOs greatly improved confidence in using these tools. SHGs were essential in peer-to-peer learning, where members skilled in digital tools trained others, leading to broader adoption.

2. Impact on Employment Generation

The integration of SHGs into digital agriculture platforms created new job roles like agri-data collectors, input distributors, and digital coordinators. In the study area, 41% of SHG members reported earning extra income from these roles. Women-led SHGs excelled in running e-commerce kiosks and helping local farmers with digital transactions, showing how technology can diversify rural livelihoods.

3. Market Access and Remote Connectivity

Remote market systems gained from digital support by SHGs. Farmers using digital platforms saw a 23% increase in market prices compared to those using traditional middlemen. SHGs helped gather produce, negotiate better prices, and organize logistics, which reduced reliance on intermediaries. Local traders confirmed that digital coordination made the supply chain clearer and reduced delays.

4. Challenges and Gaps

Despite the positive results, challenges remained. Poor internet access, unreliable power, and limited digital skills among older SHG members slowed down full adoption. Only 35% of SHGs had formal partnerships with agri-tech companies or government programs, showing a need for better institutional support. Participants stressed the importance of ongoing training and investment in infrastructure to keep progress going.

5. Qualitative Insights

Stories from SHG members showed the significant impact of digital access. One participant explained how having digital tools allowed her to track crop prices and negotiate directly with buyers, which doubled her income for the season. Another SHG leader mentioned how keeping digital records increased transparency and trust within the group. These experiences highlight the human aspect of digital agriculture—where empowerment encompasses not just financial growth but also social and emotional benefits.

To ensure relevance and community involvement, the framework focuses on participatory engagement throughout the research process. SHG members were not just respondents; they collaborated in creating the tools and interpreting the results. This approach reflects the study's human-centered ethos, highlighting that rural transformation is most effective when local voices lead the inquiry. By involving SHGs in designing surveys and facilitating focus group discussions, the research gained detailed insights into how digital agriculture connects with social structures and economic goals.

The framework also includes outcome mapping to track the effects of digital interventions across three areas: technological adoption, social empowerment, and economic impact. This mapping helps illustrate how access to digital tools, when supported by SHGs, leads to real benefits like increased income, varied job roles, and better market connections. It also shows feedback loops where empowered SHG members act as digital ambassadors, boosting adoption in their communities. This

thorough analysis ensures the study goes beyond basic metrics to reveal deeper patterns of change.

VI. Conclusion

The integration of digital agriculture with Self-Help Groups (SHGs) offers a powerful path for inclusive rural development. This study shows that when technology is part of established structures like SHGs, it is adopted in a more participatory, sustainable, and effective way. Digital tools, such as mobile apps and e-market platforms, act not only as efficiency boosters but also as sources of empowerment when shared through trusted community networks. SHGs connect innovation with tradition, allowing rural communities to interact with modern agricultural systems without losing their cultural and social roots.

A key outcome is the creation of new jobs in remote market systems. SHG members increasingly take on roles as digital facilitators, agri-service providers, and micro-entrepreneurs. These positions diversify income and lessen reliance on seasonal farming and traditional middlemen. The study shows that digital agriculture, when made more personal through SHG integration, can stimulate local economies, keep talent in villages, and ease migration pressures. This approach to job creation is not only economically sound but also socially strong.

The research highlights the importance of digital literacy and building skills as key elements for success. While more people are gaining access to technology, using it effectively relies on training, trust, and community involvement. Self-help groups (SHGs) have shown to be effective for peer learning and solving problems together, making them great partners for expanding digital agriculture. Their participation ensures that technology is developed collaboratively, which builds ownership and long-term commitment among rural communities.

However, there are still challenges. Gaps in infrastructure, limited connectivity, and uneven access to support from institutions hinder wide-scale implementation. The study suggests stronger partnerships among government agencies, NGOs, and private tech companies to provide SHGs with resources, training, and policy support. Without this kind of support, digital agriculture's potential to promote inclusive growth may not be fully realized. Tackling these issues is crucial to make sure that the benefits of digital transformation reach the communities that need them.

The findings of this study show that technology needs to be part of socially responsible frameworks to achieve real change in rural areas. Self-Help Groups (SHGs) have a special role in this situation. They not only help with digital adoption but also build community trust and encourage collective action. Their participation ensures that digital agriculture is about more than just technical upgrades; it becomes a movement that addresses local needs, values, and dreams. This approach boosts the community's strength while creating more economic chances, making rural systems stronger and more flexible.

Looking forward, the success of these models relies on continuous investment in digital infrastructure, skill development, and policies that include everyone. Governments and development agencies should see SHGs as important partners in rural innovation. They need to give them the tools, training, and support to increase their impact. By connecting digital agriculture efforts with grassroots empowerment, stakeholders can work together to build systems that are productive, fair, and ready for the future. This combination of technology and human effort is essential for driving change in remote market systems.

References

[1] S. Khan, N. Pathania, and N. Kumar, "A review of next-gen technologies in digital agriculture," *International Journal of Creative Research Thoughts,* 2024, doi: https://ijcrt.org/papers/IJCRT2504956.pdf.

[2] M. Kumar, and A. Dhingra, "Precision farming and agribusiness transformation through digital tools," Just Agriculture, 2024. [Online]. Available: https://justagriculture.in/files/newsletter/2024/may/15.%20Digital%20Transformation%20of%20Agribusiness.pdf

[3] India Brand Equity Foundation, "The future of Indian agriculture in a digital era," IBEF Blog, 2021. [Online]. Available: https://www.ibef.org/blogs/digital-agriculture-the-future-of-indian-agriculture

[4] FAO, "Strategic framework for digital agriculture," Food and Agriculture Organization of the United Nations, 2023.

[5] Ministry of Agriculture & Farmers Welfare, "Digital Agriculture Mission: 2021–2025," Government of India, 2021.

[6] World Bank, "Leveraging digital tools for rural empowerment," World Bank Reports, 2022.

[7] R. Singh, and P. Sharma, "Self-help groups and rural development: A socio-economic analysis," *Journal of Rural Studies,* 2023.

[8] D. Narayan, "Inclusive growth through SHGs: Evidence from India," *Economic and Political Weekly*, 2022.

[9] A. Mehta, and K. Joshi, "Digital platforms and job creation in rural India," *Journal of Development Economics*, 2023.

[10] NITI Aayog, "Technology-driven rural transformation," Government of India, 2022.

[11] UNDP, "Digital inclusion for sustainable livelihoods," United Nations Development Programme, 2023.

[12] S. Reddy, and V. Rao, "ICT applications in agriculture: Bridging rural gaps," *Indian Journal of Agricultural Economics,* 2022.

[13] A. Ghosh, "Enhancing market access via digital platforms in remote areas," *Agrarian Studies Review*, 2023.

[14] IFPRI, "Resilience in food systems through digital agriculture," International Food Policy Research Institute, 2022.

[15] M. Jain, and R. Patel, "SHG-led entrepreneurship in digital ecosystems," *Journal of Social Innovation*, 2023.

[16] OECD, "Policy insights on digital transformation in agriculture," Organisation for Economic Co-operation and Development, 2022.

[17] T. Chakraborty, "Human-centric digital farming: Ethics and empowerment," *Technology and Society Journal*, 2023.