



Review Article

A Review of Information Dissemination System on Small-Holder Farmers: Role and Challenges

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Abstract

Small-scale farmers are central to rural economies and sustainable agriculture, contributing to community development, food security, and the preservation of indigenous knowledge. However, many smallholder farmers struggle to access real-time agricultural information across the pre-planting to post-harvest stages. Traditional channels such as radio, television, and extension services often fail to deliver timely and context-specific guidance. Digital information systems also face limitations due to low digital literacy, limited ICT skills, high data costs, and inadequate internet and electricity access in rural areas. This study systematically reviews information dissemination systems (IDSs) to examine their role in supporting smallholder farmers and the barriers that hinder effective information flow. Relevant literature from 2020 to 2024 was analyzed to understand farmers' information needs and the challenges affecting their productivity. Findings reveal that smallholder farmers contribute significantly to national food production, yet language barriers, technical complexities of ICT tools, poor network coverage, limited electricity, high costs, and a lack of localized content reduce the effectiveness of IDSs. Many systems also function as one-way communication channels, offering minimal opportunities for interaction or feedback. The study concludes that strengthening IDSs through ICT literacy training, user-friendly platforms in local languages, and improved rural digital infrastructure is essential to enhance information access and boost agricultural productivity.

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I. INTRODUCTION

Agricultural information dissemination systems are considered essential components that interact with other production variables. Relevant, reliable, and useful information can significantly improve the productivity of factors such as capital, land, labour, and managerial competence. Information from agricultural organizations, extension services, research, and education benefits farmers. Therefore, to manage and enhance a particular agricultural information system, one must understand how it operates [1]. According to [2], several strategies have been used, with varying degrees of success, to provide farmers with the information needed to support their farming operations.

These strategies include a variety of extension programs designed to overcome barriers to the adoption of new technologies and traditional public-sector extension services. In this regard, modern information and communication technologies (ICTs) with significant potential benefits are urgently needed in rural development and agriculture. Achieving enhanced and sustained agricultural productivity depends on agricultural research and its successful application in farmers' fields through the transfer of improved technologies and innovations. Information dissemination systems (IDSs) have enormous potential as tools in the global fight against hunger and in feeding billions of people worldwide [3]. Despite the widespread use of ICTs in Nigeria, farmers—particularly those in rural areas—

appear to have limited access to and use of these technologies [4]. According to [5], as cited in [6], of Nigeria's 98.3 million hectares of land, 74 million are suitable for agriculture; however, crops and livestock are not cultivated on nearly half of this fertile land. As noted by [7], from a growth perspective, enormous opportunities exist in Nigeria's agricultural sector, with smallholder farmers serving as the primary producers and suppliers of food in the country. This implies that farmers should have timely access to agricultural information, such as the type of seed to plant, the appropriate fertilizer to apply, and suitable soil types. This information should be delivered by agricultural extension workers through IDSs or by physically meeting and training smallholder farmers at appropriate times [7]. This paper presents a systematic review of information dissemination systems, their roles, and the challenges associated with the efficient production of tangible farm produce for consumption. The objective was achieved by adopting a systematic review approach.

II. LITERATURE REVIEW

Information dissemination systems are mechanisms designed to distribute information to a specific audience or across a network. They involve communicating information through defined channels and media to reach target groups, such as smallholder farmers in rural communities [2]. IDSs play a crucial role in agriculture, especially at a time when factors such as population growth and climate change threaten food security. Technological advancements in agriculture offer farmers, entrepreneurs, and investors opportunities to enhance production and efficiency [8]. These systems may range from simple methods, such as printed materials, to advanced electronic platforms that filter and deliver information based on user preferences. However, despite the proliferation of IDS-based agricultural information services, smallholder farmers continue to exhibit low utilization and derive limited value from available agricultural information [9]. The authors of [10] critically examine how information dissemination systems can transform smallholder farming from subsistence operations into profitable and sustainable agribusinesses in developing countries. A major issue identified is that many IDS models assume an average level of literacy and digital competence, which does not reflect the realities of smallholder communities in low-resource settings.

Similarly, [11] explores how agricultural information access and use influence the decision-making processes of smallholder farmers in Oyugis, Kenya. The study highlights that although farmers make numerous strategic and operational decisions, limited, unreliable, or irrelevant information often undermines decision quality, leading to low productivity and income. In [12], the authors investigate the role of IDSs in improving agricultural sustainability among smallholder farmers in rural Kenya. They found that limited extension services, weak integration of IDSs into rural farming systems, and restricted access to timely and useful agricultural information pose major barriers to climate

adaptation, market access, and the adoption of improved farming practices. The study by [13] addresses gender- and age-based disparities in access to digital agricultural extension and advisory services (EAS) in Uganda. It highlights how young rural women are excluded or underserved due to socio-cultural norms, low digital literacy, affordability constraints, and gender-insensitive content design, thereby undermining gender equity and the productivity potential of digital agriculture. Furthermore, [14] and [15] examine how digital technologies can support youth agripreneurship in Kenya as a pathway toward sustainable agricultural transformation. The central challenges include youth unemployment, low agricultural productivity, digital illiteracy, and unequal ICT access. These barriers limit both youth empowerment and broader digital inclusion efforts in agriculture. Addressing these issues requires action from community leaders and government stakeholders to empower young individuals interested in agribusiness for improved national food production.

III. RESEARCH METHODS

This research was conducted by following the guidelines outlined by [16]. The steps include:

A. Search Strategy

A systematic literature search was performed in online databases such as IEEE Xplore, Google Scholar, Elsevier, and ResearchGate for studies published between 2020 and 2024. Search terms included "Information Systems," "Information Dissemination Systems," "Agricultural Innovation," "Design and Implementation of an Information Dissemination System," and "Agricultural Information Dissemination Systems."

B. Selection Criteria

Only papers meeting the following criteria were included:

1. Journal and conference papers only;
2. Papers published between 2020 and 2024;
3. Paper titles indicating relevance to information dissemination systems;
4. Papers written in English.

A total of 22 relevant articles were identified and analyzed regarding the roles of IDSs, their impacts on smallholder farmers, associated challenges, and potential solutions.

IV. RESULTS AND DISCUSSION

The review identified 22 relevant articles. These were analyzed based on the roles and impacts of IDSs on smallholder farmers, the challenges encountered, and the possible way forward. Table I summarizes the reviewed studies.

A. Role of Smallholder Farmers in South West Nigeria

Smallholder farmers play a vital role in sustainable agriculture and rural economies. They are the primary

contributors to rural food production, custodians of local agricultural knowledge, drivers of socioeconomic transformation, and contributors to national and global food

security. Furthermore, [22] posited that smallholder farmers contribute to food security enhancement, poverty reduction, and sustainable rural employment.

TABLE 1 SUMMARY OF PAERS REVIEWED

S.No	Author and year	Title	Problem Addressed	Methods	Results	Strength	Weakness
1	Ileri, <i>et al.</i> (2021) [2]	Role of ICT in the Dissemination and Access of Agricultural Information by Smallholder Farmers in Southeastern Kenya	Limited access to agricultural information by smallholder farmers reduces productivity	Mixed method (survey, interviews, thematic analysis) in Kenya	High use of radio/TV; limited internet use; multiple information needs; positive productivity outcomes.	Rich data, theory-driven, wide context comparison	Lacks ICT intervention testing, low internet/mobile adoption, no gender-specific insights, and infrastructure issues unaddressed.
2	Gambo <i>et al.</i> (2020) [17]	Design and implementation of an information dissemination App for University Communities	The study examined the issues that university communities currently face with the conventional method of disseminating information. .	Using the Unified Modeling Language (UML), Gambo et al created an information dissemination App.	The system provided administrators with the most user-friendly real-time updates.	The web app would make information distribution more convenient and accessible to the academic community	The study still needs to verify the stability and scalability of the implemented app
3	Luo, <i>et al.</i> (2022) [18]	A Dissemination Model Based on Psychological Theories in Complex Social Networks.	A dynamic analysis was performed to investigate the impact of network structure.	Created a resistant linear threshold (RLT) diffusion model based on psychological theories and empirical data.	The results show that the RLT model successfully matched the patterns of information dissemination on social media.	The RLT model can identify social media information patterns, offering insights for marketing, rumor control, and public opinion analysis.	The study's model recall accuracy prediction of information diffusion trends should have been optimized.
4	Huang (2021) [19]	Information dissemination control algorithm of ecological changes in the new media communication environment.	The study addressed a problem in social networks by establishing a path for knowledge transmission through the application of social influence mechanisms.	A fuzzy control method combines real-time network data with dissemination models to improve information control.	The proposed method complies with the new media transmission of information's ecological information control standards.	Simulation results confirm the algorithm's effectiveness in controlling information spread in the evolving new media environment.	Only social media networks have the potential to regulate successful information transmission.
5	Muhanguzi & Ngubiri (2022) [9]	Challenges Smallholder Farmers Face in Extracting Value from Agricultural Information	Smallholder farmers are unable to gain value from agricultural information despite advances in ICT.	Convergent parallel mixed methods; interviews; FGDs; survey; SPSS + NVivo	Major barriers: low education, poor info quality, poor design of ICT channels, high info cost, preference for informal sources	Strong empirical base and theoretical grounding	Narrow scope (Uganda only), no longitudinal or experimental testing, excludes info providers,

					like peers, low use of the internet, and NGOs		lacks gendered analysis.
6	Mkhize (2024) [10]	Information Systems (IS) and Smallholder Farming in Developing Countries: A Systematic Literature Review	Addresses the issue of the disconnect between IS theory (assumes literacy) and the reality of smallholder farmers in the developing world	Systematic Literature Review; ATLAS.ti coding; thematic analysis	He identified 5 key themes (knowledge-sharing, supply chains, food security, tech use); found mobile tech + social platforms to be key enablers	The author rigorously conducted a cross-disciplinary study and focused on literacy gaps and mobile ICTs	No primary data, lacks experimental IS model testing, light.
7	Shitaye <i>et al.</i> , (2024) [20]	Sources and Intensity of Access to Agricultural Information Technologies by Smallholder Farmers	Limited access to agricultural information and its impact on productivity among smallholder farmers	A Cross-sectional survey, Ordered Probit Model, sample of 403 households were carried out.	Key sources: radio, extension services, and agriculture offices; key factors: farm size, media exposure, extension access, and market proximity.	Rigorous large-sample analysis with a robust model, alongside comprehensive socio-economic and institutional factors.	Generalizability limited to East Gojjam; findings may not hold in other contexts without further validation.
8	Cavan, <i>et al.</i> (2021) [21]	Development of Rice-Based Information and Support System with Simulation Model for Rice Diseases	Addressed creating an online community to create a network of information and assistance for rice-based cultivation.	The authors created an Android application and a website that covered information and a support system.	It was concluded that the system performed as planned.	The platform has two (2) facilities: information and support	To avoid rice diseases, it is necessary to further create a simulation model
9	Babu (2023) [22]	Small-Scale Farming: A Review of Challenges and Potential	The research was based on Multifaceted challenges faced by smallholders' farmers globally	The methods were based on a narrative literature review	The Key issues are land fragmentation, low-tech access, climate vulnerability; potentials: food security, rural development, employment	The research was based on a holistic treatment of smallholders' farming's socio-economic dimensions.	Digital agriculture and information dissemination tools are mentioned but not deeply evaluated.
10	Owino, Onyango & Osiru (2022) [14]	The Role of Agricultural Information in Farmers' Decision-Making: A Case Study of Smallholder Farmers in Oyugis, Homa Bay County, Kenya	Smallholder farmers face decision-making problems due to lack of reliable agricultural information	Case study, 127 farmers surveyed, interviews, SPSS analysis	Use focuses on crop selection, pest control, and timing; barriers include cost, access, literacy, and gender; trust is higher in peers than online sources.	The study is a context-rich, gender-sensitive study focused on decision-making.	But, a small sample, no information system trial, or longitudinal data, lacks provider-side insight, excludes interactive ICT innovations
11	Wanyonyi, Ochieng & Okoth (2023) [12]	Empowering Smallholder Farmers through ICT: The Case of Agricultural	Smallholder farmers lack access to timely agricultural information,	Authors, used a Mixed-methods approach; 200 farmers; SPSS, and interviews	Improved productivity, market access, and climate adaptation; major barriers:	The research is well-grounded research in sustainability; rich data; and	But, no ICT trials; generalizability limited; no deep age/gender

		Sustainability in Rural Kenya	weakening sustainability and adaptation	then lastly, focus group discussions (FGDs)	digital illiteracy, cost, infrastructure, local content	an actionable insight.	impact analysis.
12	Byamukama <i>et al.</i> , (2022) [23]	The Use of ICT and the Challenges Faced by Ugandan Smallholder Farmers	The ICT use in agriculture and the constraints rural farmers face in Uganda	Theoretical review based on the ICT4D framework was used by the researchers.	ICT improves market access, adoption of tech, and communication; challenges include poor infrastructure, limited skills, and fragmented ICT efforts.	The paper presents a comprehensive review of existing literature and ICT initiatives in Uganda	The work underexplores the frameworks for ICT design tailored to rural users' experience.
13	Bhusal, <i>et al.</i> , (2021) [24]	A review article on role of information and communication technology in agriculture and factors affecting dissemination in Nepal	Limited ICT use by smallholder farmers due to socio-economic, infrastructural, and cultural barriers.	Literature review and secondary data analysis	ICT can improve productivity, reduce risk, and enhance market access; adoption is still low due to awareness, cost, education, and geographic constraints.	The research is a Field-based data collection with solid empirical grounding.	But lacks an analytical model for the relationship between information access and productivity.
14	Yusuf <i>et al.</i> , (2021) [25]	Information Sources and Services by Farmers in Edu Local Government Area of Kwara State.	Challenges preventing smallholder farmers in Nigeria's Edu LGA from obtaining essential agricultural information.	The researcher used Survey; Questionnaire, and a Descriptive stat.	Major challenges are poor communication, lack of libraries and extension services, low credit access; key needs: irrigation, improved techniques, and seed prices.	It includes a broad range of information needs and dissemination barriers.	No digital focus or model. Also lacks cross-sectional depth and gendered analysis.
15	Ugwu <i>et al.</i> , (2022) [26]	A Farmers' Digital Information System (FDIS) for Sustainable Agro-preneurship and Food Security in Nigeria.	Lack of structured, real-time digital information systems for Nigerian farmers is impeding agro-preneurship and food security.	The method used was a System design using UML and OOAD; Conceptual FDIS model.	The result shows a conceptual web platform to deliver real-time, decision-oriented agricultural data to farmers and other stakeholders.	It is a Strong system design and architecture. It aligns well with digital transformation and smart agriculture goals.	But no implementation or empirical validation. Digital divided issues and inclusivity concerns are not fully addressed.
16	Yegbeney <i>et al.</i> , (2021) [27]	Reaching out to Smallholder Farmers in Developing Countries with Climate Information: The Role of ICTs.	The smallholder farmers lack access to actionable climate information; ICTs could bridge the information divide.	The research was conceptual and literature-based with a secondary data review.	ICTs (phones, radio, TV) enhance climate information access and support adaptation, but cost, literacy, and gender gaps remain barriers.	The research had a strong emphasis on ICT as a climate resilience tool for smallholder farmers.	Research lacks discussion of the user experience or interface design of ICT platforms.

17	Owusu-Sekyere., <i>et al</i> (2021) [28]	Targeting Smallholder Farmers for Climate Information Services Adoption in Ghana.	Despite the availability of CIS adoption by smallholder farmers, CIS usage remains low, and there is a need to identify influencing factors.	The researchers carried out a Survey of 540 farmers with binary logistic regression and multistage sampling.	Education, extension, and mobile use boost adoption, while women and older smallholders lag—calling for inclusive ICT policies.	The research was robust with quantitative analysis and statistically significant results.	The research findings were limited to Ghana and may not generalize to other developing countries.
18	Egwuonwu., <i>et al</i> (2024) [29]	Agricultural Information Generation and Dissemination by Agric Extension Workers in Anambra State Agricultural Development Program, Awka.	Research addresses the information gaps in rural farming communities and the weak dissemination of agricultural research findings by extension workers.	The methodology used was a descriptive survey with 25 extension workers and a questionnaire with an observation checklist.	Extension workers share diverse information via social media, NGOs, and journals, but face funding, communication, and policy barriers.	Real-world data from extension practitioners, with clear problem–solution links and actionable recommendations.	Only extension workers’ views were used, with no farmer data; ICT tools weren’t tested, and the single-state focus limits generalizability.
19	Van Campenhout, (2021) [30]	The Role of Information in Agricultural Technology Adoption: A Literature Review.	The paper addresses poor agricultural technology adoption due to cognitive and informational constraints among smallholder farmers.	Systematic review of 100+ studies, focusing on sub-Saharan Africa and South Asia.	About 80% of smallholders have imperfect information; risk aversion and low digital literacy limit ICT adoption (SMS, call centers, radio) despite their potential.	Provides a comprehensive, up-to-date synthesis and highlights emerging areas like misinformation and digital service design.	Calls for design thinking but lacks implementation guidance and comparative ICT performance metrics.
20	Hamad <i>et al.</i> , (2023) [31]	Access and Use of Agricultural Market Information by Smallholder Farmers in Unguja Island, Tanzania	The research addressed that the Limited and inefficient use of agricultural market information hinders productivity and income among farmers.	A Survey of 200 farmers with logistic regression and a structured questionnaire were carried out.	Results show that with the present education on ICTs usage, like mobile phones, and extension services, their fellow farmers were their most preferred access for information.	The study identifies real-world barriers to ICT-based information systems. It’s an empirical study with statistically tested relationships.	The research does not explore longitudinal outcomes or how consistent usage affects profitability. Does not address content customization or feedback mechanisms.
21	Megesa <i>et al.</i> , (2020) [32]	Access and Use of Agricultural Market Information by Smallholder Farmers in Kilosa District, Morogoro Region, Tanzania	Smallholder farmers lack sufficient access and utilization of market information critical to marketing success	The methodology used was a Survey of 120 farmers with descriptive stats and logistic regression.	Farmers relied on peers, radio, phones, traders, and extension agents; 75% accessed market information, but only 56% used it for marketing decisions.	Field-based data provide empirical evidence linking ICT access to market behavior.	Research only focuses on the demand side of the information system. There was no ICT platform evaluation, e.g., usability, content effectiveness.
22	Nyoni <i>et al.</i> , (2024) [33]	Targeting Smallholder Farmers for Climate	The study addressed low adoption of CIS by	The study utilized quantitative survey-based	The result found three (3) farmer types with different CIS	Uses multi-country data for broader generalizability	The study examines adoption only, not behavior or

		Information Services Adoption: Implications for Climate Risk Communication	smallholders due to untargeted delivery and structural barriers	research of Regional Agricultural Survey data (2018) from Malawi, Zimbabwe, and Zambia	needs, with adoption linked to ICT, education, gender, and social capital	y, integrating ICT use, access, and demographics	outcomes, and does not assess CIS platforms (usability, trust, feedback).
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According to [27], [29], and [33], smallholder farmers play multiple roles: they are producers and stewards of food security, recipients and users of climate and agricultural information, and potential adopters of ICT-enabled services, meaning that with proper support they can use digital tools to enhance productivity and resilience. They are also targets of policy and extension systems, whose feedback is crucial for designing effective and scalable agricultural and climate communication systems. In addition, [16] emphasizes that smallholder farmers significantly contribute to food security by increasing crop diversity, improving employment stability, and promoting self-sufficiency. They also provide direct and indirect environmental, cultural, social, and economic benefits.

Furthermore, [20] highlights that smallholder farmers are essential to Ethiopia’s food production and rural economy, and their role includes adopting improved technologies, utilizing information systems, and participating in extension programs to enhance productivity and sustainability. In developing countries such as Nigeria, IDSs hold immense potential by improving access to information, technical guidance, and markets. Nigeria is predominantly agrarian, with agriculture supporting the livelihoods of more than 70% of the population and contributing 23% to the national GDP [34].

Despite its importance, the Nigerian agricultural sector has been slow in adopting digital technologies. The sector continues to rely on outdated practices, suffers from weak rural development policies, poor implementation strategies, limited extension services, and inadequate market access [35]. These challenges have led to Nigeria being classified as an “information-poor” country in terms of farming practices [36].

B. The Role of IDSs in Disseminating Information to Smallholder Farmers

Information Dissemination Systems (IDSs) are among the most promising technologies for agricultural development. According to [24], IDSs include all digital technologies that enable the electronic capture, processing, storage, and sharing of information. These technologies range from satellite systems and computers to radio, television, mobile phones, and associated network hardware and software. They also include digital services such as remote learning and video conferencing [37].

IDSs enhance farmers’ access to market information and improve communication between farmers and extension

agents. As noted in [38], the value of IDSs is increasingly apparent as they are now widely used to deliver agricultural production and crop-safety information. For individuals to engage effectively with IDSs, access to a computing device such as a smartphone is essential. According to [2], IDSs have significantly impacted developing nations because they facilitate digital knowledge-sharing in food and agriculture. They promote the adoption of agricultural technologies and support information exchange on markets, prices, weather conditions, transportation, and farming practices. IDSs also improve market efficiency by increasing farmers’ selling power through mobile and internet-based applications. Mobile technologies, in particular, reduce search costs and provide timely information critical for decision-making.

Furthermore, IDSs support better planting and harvesting practices by providing farmers, researchers, and extension agents with timely and accurate agricultural information such as weather forecasts, market prices, and agronomic recommendations [40]. With such systems, farmers no longer need to depend on middlemen for price information, reducing the risk of exploitation. However, inaccurate or delayed information—especially regarding seeds and market prices—can cause substantial financial losses [39].

Additionally, farmers with limited IDS awareness may fall victim to fraud or misinformation when overly dependent on traders or extension workers. Evidence from countries like Kenya, Ghana, Uganda, and Morocco shows that IDS adoption for price information has raised trader earnings by 7–10% and farmer earnings by up to 36% [41]. These gains stem from improved communication, reduced costs, and more efficient market operations [40]. Therefore, access to technological devices and digital literacy is crucial, especially in rural communities. As noted in [8], researchers increasingly acknowledge the importance of understanding both the potential and limitations of IDSs.

C. Challenges Hindering Smallholder Farmers from Using IDSs

Despite their benefits, smallholder farmers face several constraints affecting their ability to adopt IDSs. According to [27] and [29], these challenges include:

1. Limited access to ICT tools such as mobile phones, radios, and internet services
2. Low digital literacy, making it difficult to interpret weather forecasts or use mobile applications
3. Gender and geographical disparities, where women, older farmers, and remote communities receive less timely information

4. Poor information quality and timing, which reduces usefulness
5. Dependence on traditional communication sources, such as word-of-mouth
6. Exclusion from system design, leaving farmers as passive recipients rather than co-creators

Similarly, [24] highlights cultural and economic barriers, high ICT costs, language issues, and traditional practices. Yusuf et al. [25] further identify inadequate communication infrastructure, lack of information centers, few extension agents, limited credit facilities, and insufficient awareness of government initiatives as critical challenges. Another study [9] reports low education levels, poor information quality, weak dissemination channels, and high information costs. Financial constraints also limit productivity for smallholder farmers [42], while technology costs remain a significant barrier [43]. High illiteracy rates further exacerbate these issues.

V. RECOMMENDATIONS AND CONCLUSION

To address these challenges, short training programs should be organized for extension agents and smallholder farmers to strengthen their ability to use IDS tools such as smartphones and computers. Over 90% of farmers already possess smartphones but lack the skills to apply them effectively for agricultural purposes. Information dissemination platforms should also be designed in local languages to ensure comprehension. Content should include seed selection, appropriate chemicals and herbicides, market prices, and other essential agricultural information. Governments should make key information resources publicly accessible and provide subsidies for internet, mobile phones, and related technologies to promote IDS adoption. In conclusion, this study comprehensively reviewed the role and challenges of IDSs among smallholder farmers. Smallholder farmers are central to rural food production, custodians of indigenous agricultural knowledge, and key contributors to national and global food security. To ensure timely and effective information dissemination, farmers must first be trained to use the digital tools they already possess, and information platforms should be accessible in local languages. The study concludes that harnessing the full potential of IDSs requires governments to provide technology access, digital services, and supportive policies that empower smallholder farmers to enhance productivity, sustain livelihoods, and remain competitive in evolving global markets.

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