



# Agro-Communicative Networks Rural Sociology Perspectives on Knowledge Sharing and Innovation Diffusion in Sustainable Agriculture

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## Abstract

Sustainable agricultural transformation depends not only on technology but also on communication, trust, and collective participation. This study develops a conceptual framework of Agro-Communicative Networks by integrating insights from rural sociology and development communication. Drawing upon secondary data from the article "Communication and Social Capital in Community-Supported Agriculture" (JAFSCD, 2022) and supporting literature from 2015–2025, the study explores how communication processes contribute to the formation of social capital and the diffusion of innovation in rural agricultural systems. The analysis reveals that communication builds social capital through three interrelated mechanisms: bonding (trust and solidarity within groups), bridging (horizontal collaboration among communities), and linking (vertical connections with institutions). These communicative relationships generate collective learning and shared decision-making, which accelerate innovation diffusion and strengthen the sustainability of agricultural practices. The proposed Agro-Communicative Network Framework conceptualizes this dynamic as a continuous cycle in which dialogue fosters trust, trust builds social capital, and social capital enhances the quality and depth of future communication. The findings suggest that agricultural innovation should be understood as a socially negotiated process rather than a unidirectional transfer of knowledge. Strengthening participatory communication through local media, farmer cooperatives, and digital platforms can enhance community resilience, inclusivity, and long-term sustainability. The study concludes that communication is not only a medium of coordination but also a strategic driver of social innovation in the rural agribusiness ecosystem.

**Keywords:** communication networks; social capital; rural sociology; innovation diffusion; sustainable agriculture; participatory communication

## 1. Introduction

Agriculture is entering a new era where productivity and sustainability must coexist. The global transition toward sustainable food systems has shifted the focus from purely technological innovation to social innovation in how communities learn, share, and adapt knowledge. In rural contexts, particularly in developing countries such as Indonesia, agricultural innovation cannot be separated from the dynamics of communication and social interaction. Farmers' decisions to adopt new practices such as biofertilizers, integrated pest management, or digital marketing of agricultural products are not made in isolation but within networks of relationships that define trust, influence, and legitimacy [1]. Consequently, the diffusion of innovation in agriculture is as much a communicative process as it is a technical one [2].

Over the past two decades, the Green Revolution model, characterized by top-down transfer of technology and dependency on chemical inputs, has been increasingly questioned. While it succeeded in increasing production, it also generated social inequality, environmental degradation, and dependency on external inputs. Recent research in sustainable agriculture emphasizes participatory communication, social learning, and network collaboration as crucial mechanisms to restore balance between productivity and ecological integrity [3]. The new challenge is not only to produce more but to produce smarter, through collective intelligence and knowledge-sharing mechanisms embedded within rural societies. In this transformation, rural communication systems both traditional and digital become the backbone of innovation diffusion [4].

Rural sociology offers an analytical lens to understand this shift. It posits that rural transformation is not simply an outcome of economic modernization but a product of changing social relations, institutional trust, and communicative practices [5]. Communities are not passive recipients of innovation but active participants in knowledge construction [6]. In many rural areas, social interactions within farmer groups, cooperatives, and kinship networks determine which technologies are trusted, adapted, or rejected [7]. The flow of agricultural knowledge whether through extension services, demonstration plots, or peer learning is mediated by social structures, values, and power relations. Thus, understanding agricultural innovation requires examining the social architecture of communication, not just its technological content.

Within this context, the concept of agro-communicative networks emerges as a critical framework. It refers to the web of interpersonal, institutional, and media-based relationships that connect rural actors in processes of learning and innovation. These networks link farmers with extension officers, researchers, local entrepreneurs, and digital platforms, forming what can be described as rural knowledge ecosystems. In these ecosystems, communication is not linear but interactive, allowing for negotiation, adaptation, and co-creation of knowledge [8]. Rather than viewing farmers as “end users,” this perspective recognizes them as knowledge producers who continuously experiment, share experiences, and modify innovations according to local conditions.

The diffusion of innovation theory (Rogers, 2003) provides a foundational understanding of how new ideas spread within social systems. However, contemporary studies have extended the theory by emphasizing the relational and participatory nature of innovation [8]. Factors such as social capital, trust, and collective identity have been shown to accelerate or hinder adoption. In the context of rural agriculture, the effectiveness of communication depends not merely on access to information but on the density, reciprocity, and inclusivity of social networks. Information delivered through trusted peers or respected local leaders carries more weight than that from external institutions [9]. Therefore, building resilient communication networks becomes a prerequisite for sustainable innovation.

At the same time, the digital transformation of rural life adds another layer to this process. The rapid diffusion of smartphones, WhatsApp groups, community radio, and social media has redefined how agricultural knowledge circulates. Farmers exchange tips, prices, and weather updates in real time, blurring the boundary between formal extension and informal peer communication [10]. Yet, digital tools alone do not guarantee effective learning. Without social cohesion and trust, digital platforms can amplify misinformation or reinforce existing inequalities. Hence, technological infrastructure must be accompanied by communicative capacity and the ability of rural communities to engage, interpret, and contextualize information collectively [11].

In Indonesia, these dynamics are particularly relevant. The country's rural population spread across thousands of islands faces diverse ecological and socio-economic challenges. While national programs such as the Kawasan Rumah Pangan Lestari and Program Desa Cerdas aim to modernize rural agriculture, their success largely depends on the communication linkages between stakeholders [12]. Studies on local agricultural innovation, such as microbial-based fertilizers and small-scale agroindustry (e.g., instant ginger products), reveal that innovation adoption rates are highly uneven. Villages with strong farmer groups and cooperative communication networks adopt new technologies more quickly, while isolated communities lag. These findings suggest that social connectivity may be a stronger predictor of innovation diffusion than resource availability alone [13].



Rural sociology identifies several mechanisms through which communication networks influence innovation. First, bonding social capital the strong tie within a community facilitates collective decision-making and risk sharing. Farmers are more likely to adopt new technology if their peers have tried and endorsed it. Second, bridging social capital, or connections across groups and institutions, allows new ideas to enter local systems and be adapted to local needs. Third, linking social capital relationships with higher-level actors such as government agencies or NGOs provides legitimacy and resources. Communication networks that balance these three forms of social capital are better equipped to sustain innovation over time [14].

Moreover, the quality of communication its clarity, inclusiveness, and cultural resonance determines how knowledge is interpreted. Participatory communication approaches, which emphasize dialogue, feedback, and joint problem-solving, outperform one-way dissemination strategies. For instance, farmer field schools and community radio programs that incorporate local dialects, and interactive formats tend to generate higher engagement. From a sociological standpoint, these platforms function not merely as channels of information but as arenas of social negotiation where meanings and norms surrounding innovation are collectively constructed.

The concept of agro-communicative networks thus integrates three analytical dimensions. The structural dimension concerns how actors are connected (who communicates with whom). The relational dimension examines the quality of those ties (trust, reciprocity, shared norms). The functional dimension explores what flows through the network (knowledge, support, innovation). Together, these dimensions explain how communication processes shape rural innovation systems. By mapping and analyzing these interactions, researchers can identify bottlenecks, influential nodes, and potential interventions to strengthen sustainability transitions [15].

Despite growing recognition of the role of communication, empirical studies often treat it as an auxiliary factor rather than a central determinant of agricultural success. Most agricultural extension models still follow a “knowledge transfer” paradigm, if innovation flows unidirectionally from experts to farmers. This linear model fails to account for the complex social dynamics of rural communities, where authority, tradition, and collective experience often outweigh formal expertise. Consequently, many top-down interventions struggle to achieve behavioral change because they neglect the communicative dimension of trust and participation.

This research responds to that gap by framing agricultural innovation through the lens of rural sociology and communication theory. It seeks to understand how knowledge and innovation flow within agro-communicative networks, and how these flows influence the adoption of sustainable practices. Specifically, it asks: What forms of communication facilitate knowledge sharing among rural actors? How do social relations and trust mediate innovation diffusion? And what are the implications for building sustainable agricultural systems?

The significance of this inquiry extends beyond academic discourse. As global food systems face challenges from climate change, resource scarcity, and market volatility, fostering resilient communication networks among farmers becomes a strategic necessity. Knowledge sharing, when embedded in trusted social relations, can accelerate adaptation to environmental stress and market change [16], [17]. Moreover, it enhances collective problem-solving capacity, a vital attribute for community resilience.

In summary, this study positions agro-communicative networks as both a theoretical and practical framework for understanding rural innovation. It bridges the analytical traditions of rural sociology (which focuses on structure and power) and communication studies (which focuses on meaning and interaction) to explain how innovation truly spreads. By doing so, it contributes to the broader goal of transforming agriculture from a technology-driven sector into a socially connected, communicatively empowered, and sustainability-oriented system.

## 2. Methods

### 2.1 Research Design

This study adopts a qualitative conceptual research design, positioned within the disciplines of rural sociology and development communication. Rather than relying on field data or surveys,



this research is built upon interpretive synthesis integrating insights from existing literature to develop a theoretical understanding of how communication processes and social relationships influence innovation diffusion in rural agricultural systems. The conceptual approach was selected for two reasons: First, because rural communication and innovation are inherently socially constructed processes, requiring interpretive rather than purely quantitative understanding. Second, because the integration of communication theory and rural sociology remains underexplored in agribusiness and agricultural development studies. Accordingly, this research uses literature-based reasoning to bridge existing empirical findings with theoretical reflection. It focuses on identifying how communication networks facilitate the building of social capital and, in turn, how both contribute to sustainable agricultural transformation [18].

The study follows three analytical orientations:

- Descriptive: Identifying and summarizing how communication practices shape social interactions in rural agricultural systems.
- Comparative: Examining how the communication–social capital relationship observed in Community-Supported Agriculture (CSA) contexts can be generalized to broader rural settings.
- Integrative: Synthesizing theories and empirical insights to construct the Agro-Communicative Network Framework, which conceptualizes how information flow and trust jointly drive innovation diffusion and sustainability in agriculture.

The guiding assumption is that agricultural innovation is not only technological but also communicative and relational. Hence, understanding how communities communicate, collaborate, and build trust provides a pathway to strengthening sustainable food systems at the grassroots level.

## 2.2 Data Source

The analysis in this study is based entirely on secondary data, primarily derived from the peer-reviewed article: “Communication and Social Capital in Community-Supported Agriculture” published in the *Journal of Agriculture, Food Systems, and Community Development (JAFSCD)* in November 2022. This publication was selected because it provides a strong empirical and theoretical foundation for understanding how communication practices contribute to social capital formation within community-based agricultural systems. The JAFSCD article investigates how farmers and consumers engaged in CSA use dialogue, shared learning, and mutual trust to sustain cooperation processes that are conceptually parallel to rural agricultural innovation systems.

- The study’s dataset and interpretations highlight three central elements [19]:
- Communication as a tool for building trust and reciprocity.
- Social capital as a mechanism linking individual engagement to collective action.
- The co-evolution of knowledge exchange and community resilience as key to agricultural sustainability.

These insights were extracted and contextualized through a literature-based interpretive review, in which conceptual linkages between communication, social capital, and innovation diffusion were analyzed. The JAFSCD study was treated not merely as a case, but as a theoretical mirror to frame how rural communities more broadly organize communicative action around agricultural change. Additional supporting references were consulted from FAO, IFAD, and scholarly databases (Scopus and ScienceDirect, 2015–2025) to enrich contextual understanding. However, the JAFSCD paper remains the anchor source and conceptual backbone for this study’s argumentation [19].

## 2.3 Analytical Approach

The analytical process followed three interpretive stages:

- Conceptual Abstraction extracting theoretical constructs from the JAFSCD article, such as trust-building, dialogue, participation, and reciprocity, and categorizing them under the three dimensions of social capital: bonding, bridging, and linking.
- Analytical Generalization connecting these constructs to broader rural contexts where farmer



groups, cooperatives, and agro-communities interact in innovative processes. The focus was to examine how the communicative mechanisms identified in CSA could inform sustainable agriculture more broadly.

- Framework Development integrating findings into a conceptual model (Agro-Communicative Network Framework) that links communication patterns, social capital strength, and innovation outcomes. The framework aims to illustrate how trust-based communication accelerates the diffusion of innovation in rural areas.

## 2.4 Limitations

As a conceptual synthesis, this research does not include empirical testing or field-based validation. The interpretations are derived from secondary data and literature, which limits the ability to measure or compare quantitative effects. However, the approach offers a strategic theoretical contribution, forming a basis for future empirical work using survey or social network analysis to test the model proposed in this study.

## 3. Results and Proposed Model

The analysis of the JAFSCD (2022) article on Communication and Social Capital in Community-Supported Agriculture (CSA) provides a strong foundation for understanding how communication serves as the social infrastructure of agricultural innovation [19]. The study highlights that in CSA systems, communication is not merely a tool for coordination but a process of relationship-building that enables trust, reciprocity, and collective responsibility between farmers and consumers. These communicative relationships form the building blocks of social capital, which in turn sustains participation, mutual learning, and long-term commitment to sustainable agricultural practices.

This insight has broader implications for rural agricultural systems beyond CSA. The same communicative logic dialogue, feedback, and co-creation can be applied to the interaction among farmers, cooperatives, extension officers, and local institutions in rural settings. In other words, communication builds the social foundation upon which innovation can diffuse and take root.

### 3.1 Communication as a Foundation of Trust and Reciprocity

According to the JAFSCD study, communication practices that emphasize transparency, regular dialogue, and shared values strengthen interpersonal trust within CSA communities. Members who communicate frequently and openly are more likely to share information about farming practices, market challenges, and product quality, which reinforces mutual understanding. This trust is not transactional, it is relational, cultivated over time through continuous engagement and empathy.

In rural innovation systems, this dynamic operates similarly. Farmers' desire to adopt new technologies or management practices often depends on who delivers the message and how it is communicated. Trust in local leaders, peer farmers, or extension workers significantly shapes adoption behavior. When communication is framed as participatory rather than instructional, it fosters a sense of ownership among rural actors. Dialogue-based communication transforms knowledge transfer into knowledge exchange, allowing farmers to adapt innovations to their local contexts rather than simply receiving external directives.

The key finding from the JAFSCD article that communication and trust are mutually reinforcing thus provides a conceptual bridge to understanding rural innovation diffusion. Trust built through communication reduces perceived risks, encourages experimentation, and supports collective problem-solving, all of which are crucial in sustaining innovation in agriculture.

### 3.2 Communication and the Formation of Social Capital

The JAFSCD study identifies three interrelated forms of social capital emerging from



communication processes: bonding, bridging, and linking. Each operates at different social scales but collectively sustains community resilience. Bonding social capital arises from strong ties within a group shared experiences, emotional connections, and collective identity. In CSA, this is reflected in the solidarity among members and farmers. In rural innovation systems, bonding capital strengthens cooperation within farmer groups or cooperatives, allowing them to coordinate production, share inputs, and collectively manage risks.

Bridging social capital refers to horizontal connections across different groups or communities. Effective communication channels such as farmer field schools, inter-village meetings, or digital networks facilitate this exchange. Bridging capital enables farmers to learn from other communities, spread successful practices, and gain access to diverse knowledge sources.

Linking social capital involves vertical connections with institutions such as government agencies, research centers, and NGOs. The JAFSCD study shows that communication with external partners increases access to information, legitimacy, and support. In rural innovation systems, linking capital allows communities to participate in broader policy dialogues, access subsidies, or collaborate in pilot projects for sustainable agriculture.

Thus, communication is not only the medium through which social capital forms but also the mechanism that connects social capital across levels—from micro (interpersonal) to macro (institutional). In the absence of effective communication, these forms of capital remain fragmented and underutilized.

### 3.3 Expanding the Logic to Rural Innovation Systems

When extended to rural innovation systems, the communication–social capital relationship observed in CSA provides a powerful explanatory model. Rural innovation does not occur in isolation; it is embedded in social relationships and communication flows. Farmers rarely adopt innovations based solely on technical merit. Instead, they respond to social signals of trust, endorsement, and peer experience that circulate within their communication networks.

This suggests that the diffusion of innovation depends less on technology itself and more on the quality of social communication surrounding it. Communities with dense, trust-based communication networks tend to adopt and sustain innovations faster because information travels efficiently and resistance to change is lower. Conversely, fragmented or hierarchical communication systems can hinder innovation, regardless of access to resources or technology.

Furthermore, communication contributes to collective learning process where communities interpret, test, and adapt innovations through shared experiences. This collaborative learning transforms individual behavior into collective capacity. For example, when farmers collectively discuss the benefits and challenges of microbial fertilizers, they refine their understanding and co-develop local solutions. This process mirrors the participatory learning observed in CSA communities, where knowledge co-creation replaces top-down instruction.

In this light, communication becomes the invisible infrastructure of innovation. It connects actors, aligns values, and cultivates mutual trust—all necessary ingredients for building resilient and adaptive rural systems. The more open, inclusive, and dialogic the communication process, the stronger the foundation for sustainable transformation.

### 3.4 Implications for Sustainable Agriculture and Policy

The conceptual synthesis reveals that communication should be viewed not merely as a channel for information transfer but as a strategic resource for community empowerment. For policymakers and development practitioners, this means that efforts to promote agricultural innovation must go beyond providing technology or training. They must invest in communicative capacity the ability of communities to engage in meaningful dialogue, share experiences, and build trust networks.

In practice, this could include strengthening farmer communication platforms (e.g., local radio, WhatsApp groups, or village knowledge centers), training facilitators in participatory



communication, and integrating social capital assessment into agricultural extension programs. Such initiatives enhance not only the efficiency of knowledge dissemination but also the social inclusivity and legitimacy of innovative processes.

Theoretically, this integration also challenges the traditional “transfer of technology” paradigm. It suggests that sustainable agricultural transformation is fundamentally a social communication process, where innovation is diffused not through command, but through conversation, not through authority, but through trust.

### 3.5 Conceptual Model: The Agro-Communicative Network Framework

Based on the synthesis of the JAFSCD (2022) study and its application to rural systems, the Agro-Communicative Network Framework (Figure 1) can be described as follows:

- Communication processes (dialogue, feedback, transparency) → build trust and reciprocity.
- Trust and shared meaning → generate social capital (bonding, bridging, linking).
- Social capital → enhances collective learning and participation.
- Collective learning → accelerates innovation, diffusion and sustainability.

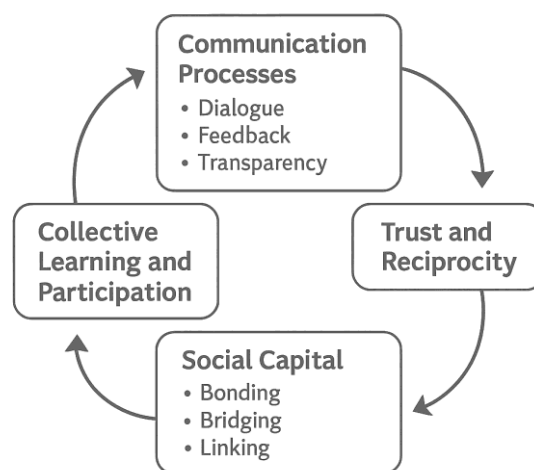


Figure 1. Agro-Communicative Network Framework

This cyclical relationship forms a self-reinforcing system where communication and social capital continually interact to produce innovation outcomes. Stronger communication leads to higher social capital, which further enhances communication quality and a virtuous cycle of social learning and innovation. Figure 1 illustrates the Agro-Communicative Network Framework, a conceptual model describing the cyclical relationship between communication, trust, social capital, and innovation diffusion within rural agricultural systems. The framework begins with communication processes, dialogue, feedback, and transparency that serve as the foundation for interaction among farmers, cooperatives, and supporting institutions. Through continuous communication, communities build trust and reciprocity, reducing uncertainty and encouraging participation in collective activities. Trust then evolves into social capital, expressed through bonding (within-group solidarity), bridging (horizontal collaboration across groups), and linking (vertical ties with formal institutions).

As social capital strengthens, it fosters collective learning and participation, allowing farmers and stakeholders to share experiences, adapt technologies, and co-create solutions to agricultural challenges. This collective learning accelerates innovation diffusion and supports the sustainability of agricultural systems by embedding innovation within the social and cultural fabric of rural life. The final loop of the model, an arrow returning to communication, emphasizes that the process is continuous and self-reinforcing: effective communication produces trust; trust builds social capital; and social capital, in turn, enhances the depth and quality of future communication. Together, these dynamics illustrate that sustainable agricultural transformation depends as much on communicative relationships as on technological advancement.



#### 4. Discussion

The findings from the JAFSCD [19] study reinforce the central premise that communication is a critical determinant of social capital formation in community-based agricultural systems. In the context of Community-Supported Agriculture (CSA), the researchers found that diverse and frequent communication, whether face-to-face at collection points, through volunteering, or via digital tools such as WhatsApp and newsletters plays a pivotal role in creating both bonding and bridging social capital. Bonding capital emerges through strong interpersonal ties and emotional connections within a group, while bridging capital arises when communication extends beyond the immediate circle, fostering collaboration across communities [20]. This dual process mirrors the dynamics found in broader rural contexts, where agricultural innovation and sustainability rely on similar patterns of dialogue and trust-building.

The study's conclusion that communication directly cultivates social capital provides a conceptual bridge to understanding how rural innovation systems function socially. In smallholder-based agroecosystems, effective communication aligns diverse actors' farmers, cooperatives, extension agents, and local entrepreneurs around shared objectives. Through regular interactions, communities collectively interpret agricultural knowledge, adapt technologies, and coordinate market access. This mirrors the CSA model's relational logic, where communication is not transactional but transformational; it binds communities through shared narratives of sustainability, risk-sharing, and mutual benefit. As a result, communication becomes both the medium and the message of innovation.

Furthermore, the distinction between bonding, bridging, and linking capital offers practical insight into strengthening rural agricultural networks. Bonding capital supports solidarity within farmer groups, essential for organizing collective actions such as input procurement or shared labor. Bridging capital enhances learning across communities through peer-to-peer exchanges, farm field schools, or social media networks that connect geographically dispersed actors [21]. Linking capital, meanwhile, provides institutional leverage connecting rural actors to government programs, financial services, or research institutions [22]. The JAFSCD findings demonstrate that the deliberate use of multiple communication media digital and physical can optimize all three forms of capital simultaneously, leading to more resilient and adaptable agricultural systems.

However, as Furness et al. (2022) emphasize, efficient communication and social capital do not automatically result in systemic transformation. The purpose and vision of communication strategies determine their long-term impact [23]. In rural innovation systems, communication that merely circulates information may sustain participation, but communication that fosters critical reflection and co-creation can drive transformative learning where communities redefine their relationship with technology, nature, and institutions [24]. This distinction highlights the need for reflexive communication frameworks that empower rural actors not only to receive innovations but to reinterpret and reshape them according to local knowledge and values.

In applying this to the Indonesian agro-sector, particularly within smallholder and cooperative models, the lesson is clear: innovation diffusion must be designed as a communicative process rooted in trust, reciprocity, and collective meaning-making. Programs that invest in participatory communication community radio, WhatsApp farmer groups, or storytelling-based extension are more likely to generate enduring behavioral change than those relying solely on top-down instruction. By embedding communication as the foundation of agricultural development, rural communities can build a virtuous cycle in which dialogue fosters trust, trust reinforces collaboration, and collaboration fuels innovation and sustainability.

#### 5. Conclusion

The synthesis of evidence from Community-Supported Agriculture (CSA) systems demonstrates that communication is the foundation upon which social capital is built in rural and



community-based agricultural networks. Frequent, transparent, and multidirectional communication cultivates trust, reciprocity, and shared identity among participants. These interpersonal and inter-group connections translate into social capital bonding within groups, bridging across networks, and linking to institutions which together reinforce community resilience and participation in innovation.

In the broader rural sociology perspective, these communicative processes form the soft infrastructure of sustainable agriculture. When communication channels are inclusive and reflexive, they enable not only the exchange of information but also the co-creation of meaning, collective learning, and adaptive behavior. Consequently, innovation diffusion becomes less a top-down transfer of technology and more a socially negotiated process that respects local knowledge and values.

The study concludes that investing in communication through both traditional forums and digital tools can significantly enhance the capacity of rural communities to generate and sustain innovation. Programs promoting sustainable agriculture should therefore integrate communicative strategies that strengthen social capital, foster dialogue between stakeholders, and connect grassroots initiatives with institutional support. In doing so, the agricultural sector can move toward a model of collaborative transformation, where communication is not only a means of coordination but also a driver of social innovation and long-term sustainability.

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