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ARTICLE

Enhancing the Institutional Resilience of Farmer Corporations through Stakeholder Communication Networks and Digital Integration in Indonesia

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ABSTRACT

This study aims to analyze the centrality structure of communication networks and the level of fragmentation among stakeholders involved in the development of farmer corporations, focusing on the implications for institutional sustainability. A mixed-methods approach was employed, combining a survey of 281 farmers with in-depth interviews of key actors from the government, private sector, financial institutions, universities, and extension change agents. Social network analysis (SNA) using UCINET was applied to measure degree, closeness, and betweenness centrality indicators to capture the relational dynamics among stakeholders. The findings reveal that farmer corporation networks in Jayakerta District remain highly centralised in civil servant extension workers and the Ministry of Agriculture. This centralization enhances coordination but creates risks of institutional dependency. Voluntary extension workers demonstrate an important brokerage function by connecting marginalised farmers to

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central actors and facilitating more inclusive information flows. In contrast, financial institutions and universities remain poorly integrated, reflecting persistent gaps in cross-sector collaboration. To address these challenges, strengthening digital literacy and providing continuous digital mentoring have been identified as key strategies for enhancing inclusivity, reducing fragmentation, and improving institutional resilience. The study recommends that rural development strategies integrate multi-stakeholder collaboration with phased digital adoption, carefully calibrated to the diverse capacities and readiness of local communities. This approach aims to contribute to more sustainable and adaptive institutional arrangements in the long run.

Keywords: Digital Integration; Farmer Corporation; Institutional Resilience; Social Network Analysis; Stakeholders Communication

1. Introduction

Global agricultural development faces the complex challenge of achieving food and nutrition security for the world's growing population. These challenges are in the form of climate change, degradation of natural resources, farmer regeneration crisis, inequality of access to technology, land, financing, markets, and weak institutions [1–3]. In this context, the crucial role of stakeholders, ranging from the government, private sector, and academia to the community, is in formulating and implementing innovative solutions to increase the productivity, efficiency, and sustainability of the food system [4,5]. The issue of food security is not only a production issue but also involves aspects of access, distribution, and utilization of resources, all of which require cross-sectoral coordination and collaboration on a global and local scale [6,7].

The agricultural sector plays a crucial role in Indonesia's economy, but it still faces significant structural challenges, especially those related to the condition of smallholders [8,9]. Data show that the number of smallholders or gourmet farmers in Indonesia continues to increase, from 14.2 million in 2013 to 16.89 million in 2023, indicating an increase of 18.5% [10]. This condition leads to low incomes for farmers and limits their access to essential resources such as technology, information, markets, and capital [11]. This vulnerability does not always have a direct impact on poverty; rather, it is more appropriately positioned as a predisposing factor that increases the risk of economic insecurity. Therefore, adaptive institutional support is required to strengthen farmers' resilience to market dynamics and climate change.

In response to this problem, the Indonesian government has implemented various policies, including the establishment of farmer corporations. This institutional model is designed to organize farmers in an agribusiness-based collective enterprise system, aiming to consolidate smallholders into a larger business entity. This is stipulated in the Strategic Plan of the Ministry of Agriculture through Regulation of the Minister of Agriculture No. 18 of 2018 concerning the Guidelines for the Development of Agricultural Areas Based on Farmer Corporations. Through this collective approach, it is hoped that smallholders can achieve more optimal economies of scale, strengthen their bargaining positions in the market, and facilitate easier access to capital, technology, and markets that were previously difficult to reach individually [12,13]. Collective agriculture also plays an important role in strengthening social capital, improving coordination, and encouraging cooperation among various actors, including social learning through engagement in both formal and informal networks [14].

Although farmer corporations have great potential, their development in Indonesia still faces various obstacles, especially in terms of communication and multi-stakeholder engagement. Ineffective communication can hinder coordination, information exchange, and access to the resources farmers need to increase productivity and competitiveness [15]. Effective communication is an important prerequisite for the adoption of innovation, driving social change, accelerating rural development, creating solid governance, and preventing conflict [16,17]. The lack of coordination between corporate members and stakeholders, caused by limited capacity and farmer performance, further exacerbates the situation and high-

lights the need for strategic measures to strengthen communication networks [18,19].

An effective communication network is essential for the dissemination of agricultural technologies, agribusiness innovations, market access, and capital management [20]. Farmers embedded in broader networks are more likely to adopt innovations and enhance their agribusiness capacities [21]. However, in Indonesia, the development of such networks is often constrained by limited stakeholder support, which tends to focus narrowly on technical assistance while neglecting strategic dimensions such as market integration, digital infrastructure, and social capital [22]. This gap highlights the urgent need for stronger cross-sectoral coordination, as poor collaboration can inhibit innovation transfer and knowledge diffusion [23,24]. Empirical evidence shows that stakeholder collaboration enhances program effectiveness, strengthens participation, and accelerates development outcomes [25,26]. Despite its importance, research on how stakeholder engagement contributes to communication networks in farmer corporations remains limited. This underscores the relevance of stakeholder theory, which posits that organizational success is contingent on the ability to identify, involve, and align the interests of all relevant actors in pursuit of shared goals [27]. Within the framework of Social Systems Theory (Parsons, 1961), farmer corporations are viewed as institutional systems that must be capable of controlling entropy (disorganization) while simultaneously reinforcing negentropy (stability and sustainability). Stakeholder communication networks are critical for maintaining organizational order and ensuring institutional resilience.

Based on this background, this study aims to analyze how stakeholder support strengthens communication networks in the development of farmer corporations in Indonesia. Specifically, this study examines the influence of stakeholders' roles (government, universities, private sector, financial institutions, and extension change agents) on communication networks within farmer corporations. Through a better understanding of the role of external stakeholders, this study is expected to provide more effective strategic recommendations for supporting the growth of smallholder corporations and improving the welfare of smallholders. The theoretical contribution of this study is to enrich the literature on the role of multistakeholder communication and collaboration in collective agricultural development, particularly in the context of developing countries. Practically, the results of this study are expected to serve as a guide for policymakers and related stakeholders to design more integrative and sustainable interventions to optimize multi-stakeholder coordination and support more inclusive agricultural development in Indonesia. This research directly contributes to the achievement of Sustainable Development Goals (SDGs) 1 (No Poverty) and 2 (No Hunger) by increasing the income and food security of smallholders, as well as SDGs 17 (Partnerships for the Goals) by strengthening collaboration between stakeholders.

2. Materials and Methods

This study used a mixed-methods approach to analyze the dynamics of communication and stakeholder support in strengthening farmer corporations in Jayakerta District, Karawang Regency. A quantitative approach was used to measure communication patterns and the level of involvement of actors, while a qualitative approach was used to explore contextual aspects and social barriers that are not reached by statistical data. This combination allows for data triangulation, which reinforces the validity of the findings and generates evidence-based recommendations.

Data was collected through a survey of 281 corporate farmers, who were randomly selected from a total population of 984 farmers. The sample was calculated using the Slovin formula at an error rate of 5% to ensure the representation of farmer business groups, namely, 264 rice farmers, 8 horticultural farmers, and 6 duck farmers. The inclusion criteria were experience in corporate training, ownership of communication tools, and assistance from the Ministry of Agriculture or other stakeholders. Quantitative data were collected using a structured questionnaire based on the Likert scale to measure perceptions of communication networks and stakeholder support, which were analyzed descriptively using the scoring method [28].

The qualitative approach was carried out through in-depth interviews with agricultural extension workers, related agencies, academics, and private actors. The interview guide focused on policies, coordination barriers, and collaborative strategies for strengthening farmer institutions. The analysis was carried out thematically to identify central patterns and issues in communication between actors. In addition, interpersonal media are defined as direct face-to-face communication among actors, whereas hybrid media represent a combination of face-to-face communication and digital media. Meanwhile, assistance is defined as various forms of new agricultural technology innovations, institutional agribusiness support practices, and digital communication patterns. The extent of assistance is assessed based on the type of support provided and the number of farmers receiving it, and is subsequently described descriptively. The questionnaire instrument was developed based on indicators of institutional communication and literature on social network analysis. The structured questions cover communication frequency, interaction intensity, and the types of information exchanged (production, technology, training, financing, and marketing). The data were systematized in matrix form for analysis using UCINET.

The validity of the data was tested through triangulation of methods by comparing the results of interviews, surveys, and policy documents. Communication network data were analyzed using UCINET version 6 to describe the network structure, position of actors, and patterns of connectivity between stakeholders [29]. A sociogram was constructed from a one-mode adjacency matrix based on farmer and stakeholder affiliation data. Survey variables on training, communication tools, and assistance were transformed into directed ties to represent the actual flows of communication and support, ensuring that the centrality measures accurately reflected the interaction patterns within the network. In the sociogram, the node size indicates degree centrality, while the node colours distinguish stakeholder categories and highlight betweenness roles. The direction, thickness, frequency, and number of arrows represent the intensity and flow of communication. A radial layout was manually configured to improve readability, with the narrative aligned with the visualisation. This analysis provides a visual and numerical representation of the strategic roles of actors in the institutional communication system of farmer corporations. In this study, degree centrality reflects actors' direct ties in exchanging agricultural information, training, and production support; closeness centrality indicates their accessibility and speed of information flow; and betweenness centrality captures their brokerage roles in bridging the gap between disconnected stakeholders.

3. Results

3.1. Centrality and Communication Patterns among Stakeholders

To examine the communication structure within farmer corporations, a centrality analysis was conducted on stakeholders involved in the farmer corporation program in Jayakerta District, Karawang Regency. Three key indicators were employed: degree centrality, which measures the number of direct connections an actor has; closeness centrality, which reflects how quickly an actor can access others within the network; and betweenness centrality, which captures the actor's role as an intermediary in bridging disconnected nodes.

The analysis reveals that Civil Servant Extension Workers occupy the most central position in the network, with a high degree of centrality (31) and the highest betweenness value (27.167). This indicates that they are not only highly connected but also play a vital role in facilitating the flow of information across otherwise disconnected actors. Their position aligns with Scott's (2000) social network theory, which highlights the power and influence of highly connected nodes in shaping communication and decision-making within institutional systems [30].

Following this, Voluntary Agricultural Extension Workers also held a significant position, with a degree centrality of 26 and a betweenness score of 18.167. Although they are not structurally at the core of the network, their intermediary role is essential for connecting peripheral actors, particularly farmer groups, to the central information flow of the network. The high degree and betweenness scores of Civil Servant Extension

Workers (31 and 27.167, respectively) confirm their dominance in coordinating inter-stakeholder communication. Meanwhile, the brokerage role of Voluntary Extension Workers (betweenness 18.167) highlights the importance of informal actors in engaging marginalised farmers. Conversely, the very low centrality scores of private banks (degree 4.0, betweenness 0.0) and savings cooperatives (degree 0.0, betweenness 0.0) underline the structural weaknesses in integrating financial institutions into farmer cooperatives. Node size shows degree centrality, while node colours represent stakeholders categories: Green= government (Karawang Regency Cooperatives and MSMEs Office, the Ministry of Agriculture, the Karawang Regency Agriculture and Food Security Office), Orange= agent of change (civil servant extension workers, private extension workers, voluntary agricultural extension workers) Black= universities (University of Singaperbangsa, the Bogor Agriculture Development Polytechnic), Blue= financial institutions (Private banks, Savings and Loan Cooperatives), Purple: private sector (ACT and the Taiwan Technical Mission (TTM)).

The Ministry of Agriculture demonstrates a stable coordinating role with a degree centrality of 21, closeness of 14, and betweenness of 13.333. These values reflect its function as a vertical linkage node, especially in connecting central government policies to local-level actors, including technical institutions such as Taiwan Technical Mission (TTM), a development agency under ICDF that supports agricultural capacity building in Indonesia and Bogor Agriculture Development Polytechnic.

TTM and the Karawang Regency Agriculture and Food Security Office display moderate levels of degree centrality, indicating that they function as institutional supporters in the coordination process. Conversely, stakeholders such as the Savings and Loan Cooperatives, Private Banks, and University of Singaperbangsa exhibit very low centrality and betweenness values. This suggests their limited involvement in the core communication flow and weak integration into the institutional network, an issue that merits further attention in designing more inclusive communication strategies.

The centrality analysis indicates a hierarchical and formalized communication structure, where government-affiliated civil servant extension workers dominate the information flow. Non-governmental actors, while present, are still marginal in terms of network influence, which may inhibit knowledge dissemination, innovation adoption, and multi-stakeholder collaboration.

To complement the centrality analysis, **Figure 1** presents a sociogram that visualizes the structure, intensity, and roles of actors within the stakeholder communication network in farmer corporations. The sociogram illustrates a radial-centralized pattern, where key actors occupy central positions and serve as information hubs, while other stakeholders are located on the periphery with minimal linkages. The color and size attributes of the nodes represent the level of centrality, the intensity of relationships, and the role of brokers. This visualization is consistent with the numerical values presented in **Table 1**, which confirm that the network structure remains hierarchical with the dominance of government actors.

Table 1. Centrality Metrics of Stakeholder Communication Networks in Farmer Corporations (Jayakerta District, Karawang Regency).

No.	Stakeholders	Centrality	Closeness	Betweeness
1	Ministry of Agriculture	21.000	14.000	13.333
2	Karawang Regency Cooperatives and MSMEs Office	11.000	18.000	10.000
3	Karawang Regency Agriculture and Food Security Office	19.000	15.000	2.333
4	Bogor Agriculture Development Polytechnic	12.000	19.000	0.000
5	University of Singaperbangsa	7.000	20.000	0.000
6	Private banks	4.000	21.000	0.000
7	Savings and Loan Cooperatives	0.000	44.000	0.000
8	ACT	7.000	22.000	0.000
9	TTM	20.000	15.000	0.000
10	Voluntary agricultural extension workers	26.000	14.000	18.167
11	Private extension workers	7.000	21.000	0.000
12	Civil servant extension workers	31.000	13.000	27.167

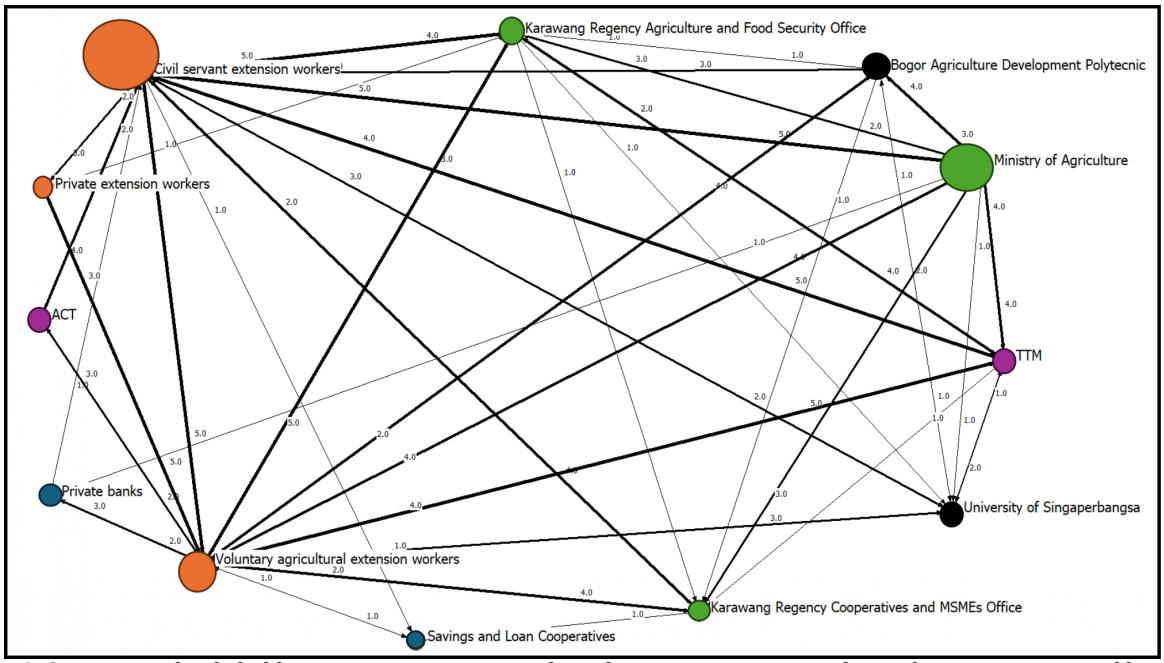

Figure 1. Sociogram of stakeholder communication networks in farmer corporations: relationships, intensities, and key roles.

Civil Servant Extension Workers emerge as the most central nodes in the network, showing strong linkages with strategic actors such as the Ministry of Agriculture, local government offices, independent extension workers, and financial and academic institutions. Their frequent and intensive interactions position them as the primary liaisons for cross-sectoral coordination and knowledge dissemination.

In contrast, Voluntary Agricultural Extension Workers, although not located at the structural center of the network, demonstrate a significant brokerage role, with a high betweenness centrality score of 18.167. This indicates their capacity to connect otherwise unlinked actors. Their strong social proximity and cultural legitimacy enable them to engage marginalized farmer groups and promote inclusivity in the information network.

The Ministry of Agriculture also plays a pivotal role, primarily by establishing vertical linkages with technical institutions such as TTM and Bogor Agriculture Development Polytechnic. Their function emphasizes top-down coordination, particularly in delivering programs from national to local levels.

Meanwhile, stakeholders such as Savings and Loan Cooperatives, Private Banks, and the University of Singaperbangsa occupy peripheral positions with thin, limited communication ties. Despite their potential to support institutional capacity through financial access and knowledge transfer, their current involvement in the network remains minimal.

3.2. Communication Media and Interaction

The mentoring process carried out by external stakeholders in the farmer corporation program in Karawang faced several challenges, including the underdevelopment of farmer cooperatives and unequal stakeholder capacity. Despite these constraints, assistance continued through 2022–2023, during which the program entered a transition phase before being handed over to the Karawang Regency Government. Although initial coordination between stakeholders was relatively effective, differences in capacity and lack of sustained engagement among external actors limited the continuity and depth of collaboration. In some cases, stakeholders worked in isolation without proper synchronization in the field. To address these gaps, communication media became essential in maintaining coordination and delivering guidance, as shown in **Table 2.**

Table 2. Media used in communicating with Farmers Corporations.

Stakeholders	Media Type	Frequency	Percentage (%)
Ministry of Agriculture	Media Interpersonal	269	95.73
	Hybrid Media	12	4.27
Karawang regency agriculture and food security office	Media Interpersonal	109	38.79
	Hybrid Media	14	4.98
Karawang regency cooperatives and MSMES office	Media Interpersonal	24	8.54
Bogor Agriculture Development Polytechnic	Media Interpersonal	9	3.2
University of Singaperbangsa	Media Interpersonal	4	1.42
Private banks	Media Interpersonal	37	13.17
	Hybrid Media	5	1.78
Savings and loan cooperatives	Media Interpersonal	5	1.78
	Hybrid Media	5	1.78
TTM	Media Interpersonal	15	5.34
	Hybrid Media	4	1.07
ACT	Media Interpersonal	6	2.14
	Hybrid Media	4	0.36
Civil servant extension worker	Media Interpersonal	190	67.26
	Hybrid Media	51	18.15
Private extension worker	Media Interpersonal	92	32.74
	Hybrid Media	8	2.85
Voluntary agricultural extension workers	Media Interpersonal	189	67.26
	Hybrid Media	90	32.03

The findings show that stakeholder communication with farmers was dominated by interpersonal channels. The Ministry of Agriculture had the highest frequency of face-to-face communication (95.73%), followed by Civil Servant Extension Workers and Voluntary Extension Workers (both at 67.26%). These results reflect the central role of government-affiliated actors in providing direct training, disseminating information, and maintaining institutional presence at the local level.

Private Extension Workers engaged moderately (32.74%), often through demonstration activities and product promotion. In contrast, communication from financial institutions, cooperatives, universities, and private sector actors (such as TTM and ACT) remained minimal in both interpersonal and hybrid forms. For example, the University of Singaperbangsa and Bogor Agricultural Polytechnic recorded interaction rates of only 1.42% and 3.2%, respectively, while banks and cooperatives showed frequencies around 1.78% for each communication mode.

The use of hybrid communication media, which combines face-to-face and digital tools (e.g., WhatsApp, Zoom), was generally limited. Only Voluntary Extension Workers (32.03%) and Civil Servant Extension Workers (18.15%) demonstrated relatively high adoption. Other stakeholders, including the Ministry of Agriculture (4.27%) and financial institutions (1.78%), used hybrid media at a much lower rate.

3.3. Type and Distribution of Stakeholder Support

This section outlines the scope and nature of support provided by various stakeholders involved in the farmer corporation program in Karawang Regency, focusing on their contributions to production, technology, financing, training, and institutional strengthening.

Table 3 presents the types and distribution of assistance offered by each stakeholder. The Ministry of Agriculture emerged as the most comprehensive and equitable contributor, reaching 100% of farmers with a combination of production inputs such as seeds, fertilizers, and pesticides, along with access to capital, business mentoring, technical training, and leadership development. This underscores the central government's strong role in supporting agricultural production systems.

In addition, Civil Servant Extension Workers and Voluntary Extension Workers provided widespread support, reaching 85.77% and 99.29% of farmers, respectively. Their assistance primarily involved technical training, production guidance, and facilitation of market access, indicating their significant role in extending government programs to the grassroots level. By contrast, the Karawang Agriculture and Food Security Office played a more limited role, focusing primarily on technical training (44.13%), while the Karawang Cooperatives and MSMEs Office served only 2.85% of farmers

through cooperative institutional management training. These figures reflect a relatively narrow engagement of regional agencies in the farmer corporation system.

Support from the education sector, namely the Bogor Agriculture Development Polytechnic and the University of Singaperbangsa, was also modest. These institutions reached 3.20% and 1.42% of farmers, respectively, primarily through student internship programs. While valuable, their impact remains limited in terms of institutional capacity building. Financial institutions demonstrated minimal involvement. Private banks provided individual capital loans to 14.95% of farmers, while savings and loan cooperatives supported only 3.56%. These services were not integrated into the broader farmer corporation framework and were delivered independently, limiting their potential impact on collective financing structures. Among private sector actors, TTM supported 3.91% of farmers through horticultural inputs, training, capital, and marketing assistance, while ACT reached 3.20% of farmers via organic farming support. However, both institutions operated outside the institutional framework of farmer corporations, making their involvement more incidental than structural. Lastly, Private Extension Workers engaged with 35.59% of farmers, largely through the promotion of agricultural inputs and field demonstrations. These activities, often aligned with commercial interests, were not systematically integrated with farmer corporation initiatives. In this study, degree centrality reflects actors' direct ties in exchanging agricultural information, training, and production support; closeness centrality indicates their accessibility and speed of information flow; and betweenness centrality captures their brokerage roles in bridging disconnected stakeholders.

Table 3. The type of assistance provided by stakeholders in the activities of the Farmer Corporation.

Stakeholders	Types of Assistance	Frequency	Percentage (%)
Ministry of Agriculture	Production support, access to capital, business assistance, and technical training (farming, financial management, and leadership)	281	100.00
Karawang regency agriculture and food security office	Technical Training for Agricultural Workers	124	44.13
Karawang regency cooperatives and MSMES office	Technical training in cooperative institutional management	8	2.85
Bogor Agriculture Development Polytechnic	Technical Training, Mentoring of Student Interns	9	3.20
University of Singaperbangsa	Mentoring Student Interns	4	1.42
Private banks	Individual capital loans	42	14.95
Savings and loan cooperatives	Individual capital loans	10	3.56
TTM	Production support, horticultural farming technical training, access to capital, and marketing	19	3.91
ACT	Production support, access to capital, and technical training for organic farming	9	3.20
Civil servant extension worker	Production support, technical training (farming, financial management, leadership), marketing	241	85.77
Private extension worker	Production support (pesticides), agricultural technical training (plot demonstration)	100	35.59
Voluntary agricultural extension workers	Production support, technical training (farming, leadership), marketing	279	99.29

4. Discussion

4.1. Communication Network Structure: Hierarchy, Brokers, and Gaps

The sociogram (**Figure 1**) illustrates a radial-centralized pattern, in which key actors occupy central positions. The color and size attributes of the nodes represent the level of centrality, the intensity of relationships, and the role of intermediaries or brokers. This visualization is consistent with the numerical values in **Table 1**, which confirm that the network structure is hierarchical and dominated by government actors. Civil ser-

vant extension workers are the most structurally central actors, maintaining strong connections with key institutional nodes such as local agencies, private extension workers, and both financial and academic stakeholders. This strategic position underscores their pivotal role in coordinating inter-agency communication and disseminating technical information.

In addition, voluntary agricultural extension workers, although not positioned centrally, exhibit a significant brokerage role. Their high betweenness centrality (18.167) highlights their function as social connectors, capable of bridging disconnected actors within the network. Their proximity to grassroots communities enhances the inclusivity of information flow and supports innovation uptake at the local level. This reflects Scott's (2000) assertion that highly connected or intermediary actors hold influence over institutional coordination and behavior, and is consistent with those who emphasize the role of brokers in enabling bottom-up institutional transformation [31].

From the perspective of Social Systems Theory, the hierarchical and government-centric communication structure indicates a tendency toward entropy, manifested in limited cross-sectoral collaboration, the marginal involvement of financial institutions and universities, and weak digital integration. Simultaneously, elements of negentropy are evident in the strong coordinating role of civil servant extension workers, the brokerage function of voluntary extension workers, and vertical linkages established by the Ministry of Agriculture, which collectively reduce fragmentation and enhance institutional stability. These dynamics highlight that the resilience of farmer corporations depends on balancing entropic pressures with negentropic mechanisms within the stakeholder communication networks.

Conversely, non-government stakeholders, notably private banks, savings and loan cooperatives, and Singaperbangsa University, occupy peripheral positions with limited linkages, indicating low levels of engagement in institutional communication. Despite their potential to contribute through access to finance and knowledge transfer, their minimal involvement reflects persistent fragmentation and weak cross-sector collaboration, which may hinder the adaptability and resilience of farmer corporations.

Overall, the network remains hierarchical and government-centric, with insufficient integration of informal and non-state actors. Addressing these structural gaps requires deliberate strategies to promote cross-cluster communication, strengthen linkages between formal and non-formal actors, and create a more inclusive, participatory, and resilient institutional communication system.

The lack of involvement of all supporting stakeholders centralizes interactions within farmer organizations on certain actors, resulting in uneven information flows and limited member participation. This hierarchical communication pattern weakens cross-sectoral collaboration, hinders the diffusion of innovation, and reduces access to strategic resources. From the perspective of social systems theory, such conditions diminish the organization's capacity to perform its functions of adaptation, integration, and goal attainment. Meanwhile, within the framework of stakeholder theory, the absence of key actors' engagement restricts the organization's ability to accommodate the interests of relevant parties, thereby undermining the legitimacy, effectiveness, and sustainability of farmer institutions.

4.2. Stakeholder Participation and Interaction Media

The dominance of face-to-face communication among central actors highlights the traditional and hierarchical nature of institutional interaction within farmer corporations. While interpersonal engagement remains effective for training and information delivery, the limited use of digital tools underscores a missed opportunity for expanding communication reach, reducing transaction costs, and improving coordination. The moderate use of hybrid media by Voluntary and Civil Servant Extension Workers is notable, suggesting some degree of adaptation to digital technologies. However, the overall low engagement from financial institutions, universities, and cooperatives indicates poor cross-sectoral integration. This is especially concerning given these institutions' potential to provide critical resources such as financing, knowledge, and entrepreneurial training.

The findings reflect a broader issue of digital liter-

acy gaps among farmers, which may hinder the adoption of communication technologies. Furthermore, the lack of coordinated efforts among external stakeholders suggests weak institutional synergy in farmer support systems [32,33]. Without a deliberate strategy to improve communication infrastructure and digital adoption, especially by non-state actor farmer corporations, risk becoming overly dependent on traditional, centralized models of interaction. Some argue that fragmented communication and the absence of inclusive collaboration reduce the effectiveness and sustainability of institutional support in agricultural development [34]. Meanwhile, other studies have found that structured communication can facilitate the equitable adoption of innovations, accelerate the diffusion of agricultural technologies, and promote more responsive practices [35].

4.3. Institutional Support and Role Distribution

The findings demonstrate a significant concentration of institutional support among government-affiliated actors, notably the Ministry of Agriculture and civil servant extension services. This centralized model ensures wide coverage but highlights the limited involvement of non-government stakeholders, particularly those from the financial sector, higher education institutions, and private enterprises [36].

While the Ministry of Agriculture and national-level Civil servant extension workers play a dominant role in enhancing production capacity and coordination, the minimal participation of regional agencies such as the Karawang Agriculture Office and Cooperatives Office reveals a lack of vertical alignment between central policies and local implementation structures. Similarly, the weak engagement of academic institutions, such as Bogor Agricultural Polytechnic and the University of Singaperbangsa, limits the potential for knowledge transfer, innovation diffusion, and institutional learning factors essential for long-term resilience [37]. Bogor Agricultural Polytechnic assigns internship students to provide guidance and training to farmers in the application of rice and duck farming technologies. In contrast, Singaperbangsa University plays a more limited role, focusing primarily on supporting horticulture and premium rice production at the RMU, with a significantly smaller number of students involved compared to Bogor Agricultural Polytechnic.

Support from financial institutions remains fragmented and delivered on an individual basis, with no integration into collective agricultural financing mechanisms. This reflects a missed opportunity for inclusive financial services and business capacity development tailored to farmer corporations [38]. The private sector's involvement, particularly that of TTM, supports the horticulture sector comprehensively, ranging from the initial planting stage to the marketing process, and is integrated with farmer corporation activities. In contrast, ACT's role is far more limited, assisting in the form of production inputs only during the COVID-19 outbreak, without continuity. Their contributions, while beneficial, lack continuity and institutional anchoring. Institutional communication plays a pivotal role. Beyond coordination, it enhances market efficiency by reducing information asymmetry, improving access to agricultural inputs, and accelerating price negotiations. Structured communication also facilitates equitable innovation adoption, faster diffusion of agricultural technologies, and more responsive farming practices [37,38].

Support from financial institutions is not integrated into farmer corporation activities, as their interactions remain at the individual level. This unbalanced stakeholder engagement underscores the structural fragility of current support systems. Institutional resilience in agriculture is not solely about withstanding external shocks, but also about fostering adaptive, transformative capacities in response to dynamic environments. Achieving this requires inclusive, horizontally integrated collaboration across actors. Moreover, consistent with Stakeholder Theory, organizational sustainability depends on the active and equitable participation of all relevant entities: government, private sector, academia, financial institutions, and farming communities [39]. The peripheral roles of non-government actors observed in the network analysis suggest a deficit in collaborative governance, weakening institutional performance, and limiting collective impact [40]. However, the literature also notes that collectivization has the potential to suppress farmers' individual creativity and pro-

ductive skills [41]. Therefore, this study emphasizes the concept of adaptive collectivism, namely, a collective institutional arrangement that still provides space for individual innovation and community-based social learning.

4.4. Implications for Institutional Sustainability

The analysis of stakeholder communication networks reveals that farmer corporations remain heavily reliant on formal actors, particularly civil servant extension workers and the Ministry of Agriculture, for coordination and information flow. While this centralization contributes to efficiency and programmatic coherence, it also creates institutional dependency, which risks vulnerability during leadership transitions or policy shifts.

Conversely, non-government actors, such as cooperatives, private sector entities, financial institutions, and universities, occupy peripheral positions in the communication network. Their limited involvement reflects weak cross-sectoral integration, which restricts access to innovation, information exchange, and collaborative problem-solving. This condition signals underperformance in the integration and adaptation functions of the framework in social system theory, highlighting the need for more balanced and inclusive institutional arrangements.

To achieve long-term institutional sustainability, promoting equitable participation across all stakeholder groups is essential. Strengthening horizontal linkages among actors, including those outside government structures, fosters a more resilient institutional ecosystem. Digital communication tools, such as WhatsApp, Zoom, and social media, offer promising solutions by enhancing network connectivity, reducing transaction costs, and facilitating the faster dissemination of innovation. However, low digital literacy levels among smallholders remain a constraint that must be addressed through targeted training and localized digital extension services.

This finding supports the conclusion that strong stakeholder partnerships, particularly those embedded in communication networks, play a pivotal role in shaping farmers' institutional behavior, as also demonstrated in the sago agroindustry, where partnerships significantly influence attitudes, behavioral control, and agro-industrial actions [42]. In line with Stakeholder Theory, institutional success depends on an organization's ability to engage, harmonize, and sustain cooperation with diverse actors. The current overreliance on formal governmental actors, without sufficient engagement from private and community-based institutions, undermines the long-term resilience and adaptability of farmers' corporations. Therefore, moving towards a participatory, digitally integrated, and cross-sectoral model of institutional governance is essential to achieve sustainable and inclusive agribusiness development. Accordingly, the strategic recommendations of strengthening digital literacy, fostering cross-actor integration beyond government stakeholders, and promoting adaptive collectivism directly address the findings of the network analysis. Therefore, this study underscores the need for a more inclusive, participatory, and adaptive institutional model.

5. Conclusions

The findings indicate that the resilience of farmer corporations relies on balancing government-led coordination with broader stakeholder integration. In Jayakerta District, the communication network remains highly centralised in formal actors, particularly civil servant extension workers and the Ministry of Agriculture, whose dominance ensures effective information distribution but also creates the risk of overdependence and institutional vulnerability. The limited participation of private sector actors, financial institutions, and universities reflects the structural weaknesses that contribute to network fragmentation and hinder innovation diffusion. Nevertheless, voluntary agricultural extension workers play a critical brokerage role by linking marginalised farmer groups to central nodes, thereby promoting inclusivity in the program. Strengthening these linkages requires cross-sectoral collaboration supported by digital transformation, where tools such as WhatsApp, Zoom, and social media can expand the reach of information and accelerate innovation adoption, provided they are accompanied by enhanced digital literacy and continuous digital mentoring. Beyond improving coordination, digital communication reduces transaction costs and reinforces the value chains of local agribusinesses. Accord-

ingly, an integrative approach that combines network development, agricultural education, digital mentoring, and institutional digitalisation is essential for shaping inclusive and sustainable rural development strategies in the region. Future research should examine the effectiveness of this approach across different regions and commodities.

Author Contributions

Writing original draft preparation, S.A. Conceptualization of ideas, S.A. data collection, S.A. editing preparation, S. (Sumardjo) data curation, D.P.L. validation, S.A. supervisors of data collection, D.P.L. data analysis, S.A. reviewed the manuscript, D.P.L. review of the manuscript, S. (Sumardjo) supervision, S. (Syahyuti) visualization, S. (Syahyuti) supervisor of data collection, S. (Syahyuti) All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted and approved by the Muhammadiyah University of Jakarta, protocol code 134/PE/KE/FKK-UMJ/VIII/2024; date of approval: August 26, 2024.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data supporting the findings of this study are not publicly available due to considerations of privacy, ethical restrictions, and the informed consent provided by the respondents.

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Conflicts of Interest

The authors declare no conflict of interest.

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