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Integrating Local Knowledge and Social Capital for Socio-Economic Adaptation: Pathways to Sustainable Agronomic Systems

Erwin Nugraha Purnama[1,*], Samel W. Ririhena[2], Inez Cara Alexander Phoek[3]

[1,2]Department of Public Administration Science, Faculty of Social and Political Science, Musamus University, Merauke, South Papua, Indonesia.
[3]Faculty of Business and Accountancy, Saint Theresa School of Economics, Merauke, South Papua, Indonesia.
erwin92@unmus.ac.id[1], samel_ririhena@unmus.ac.id[2], inez@saintttheresa.ac.id[3]

*Corresponding author

Abstract: Sustainable agronomic systems require not only technological innovations but also the integration of local knowledge and social capital, particularly in frontier regions with unique ecological and socio-economic conditions. This study investigates how farming communities in South Papua Province, Indonesia, leverage local knowledge and social networks to adapt socio-economically and enhance agronomic sustainability. Using a mixed-methods approach, data were collected through household surveys, in-depth interviews, focus group discussions, and field observations. The findings indicate that locally adapted crop selection, planting calendars based on ecological indicators, rotational land use, and livestock integration are central practices, while strong bonding, bridging, and linking social capital facilitate knowledge sharing, collective action, and risk management. These strategies improve system resilience, diversify livelihoods, and reduce dependency on external inputs. The study contributes empirical evidence from an underrepresented frontier region, emphasising the critical role of socio-ecological integration in agronomic development. Implications for theory and practice include recognising local knowledge in agricultural extension, reinforcing farmer institutions, and designing adaptive development programs. Future research should explore longitudinal impacts and comparative analyses across similar frontier contexts.

Keywords: Local Knowledge; Social Capital; Socio-Economic Adaptation; Sustainable Agronomic Systems; Technological Innovations; Socio-Economic Conditions; Food Security; Climate Risks.

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1. Introduction

Global food security currently faces increasingly complex, multidimensional pressures, particularly from climate change, natural resource degradation, economic volatility, and social inequality in rural areas. Several international reports confirm that conventional agronomic systems, which rely on chemical input intensification and solely technocratic approaches, are increasingly showing their limitations in addressing long-term sustainability challenges [1]. In this context, the transition towards sustainable agronomic systems has become a global agenda that emphasises not only productivity, but also ecological resilience and the socio-economic sustainability of farming communities [14]. Many modern agronomic policies and

interventions remain dominated by a top-down approach that positions farmers as objects of technology adoption rather than as knowledge actors. This approach tends to ignore local social, cultural, and institutional dimensions that play a crucial role in farmers' adaptation to climate risks and economic uncertainty. Several studies have shown that failing to integrate social factors, such as local knowledge and social capital, can hinder the effectiveness of agronomic innovation and weaken the resilience of agricultural systems in vulnerable areas [12].

Contemporary discourse on sustainable agronomy increasingly emphasises the importance of an integrative approach that links the technical dimensions of agronomy with socio-economic adaptation, particularly in smallholder farming communities in developing and frontier regions. This approach positions farmers as adaptive agents who actively combine local knowledge, social networks, and agronomic practices to sustain their livelihoods [8]. Although the literature on agronomy and rural development continues to grow, there remains a significant gap in integrating local knowledge, social capital, and socio-economic adaptation frameworks into sustainable agronomic systems. Most agronomic studies still focus on biophysical aspects such as land efficiency, crop productivity, and emissions mitigation, without deeply linking them to farmers' socio-economic adaptation strategies [13]. On the other hand, studies on climate change adaptation often address social aspects separately from agronomic systems, thus failing to capture the dynamic interactions between agricultural practices, local institutions, and farm household livelihood strategies. Yet recent research confirms that local knowledge and social capital serve as adaptive assets, enabling farmers to navigate environmental and economic uncertainty more flexibly [6]. Another prominent gap is the lack of empirical evidence from regions with unique ecological characteristics and that have been historically marginalised in the global literature. Regions like Papua, with their high biodiversity and distinctive socio-cultural systems, remain relatively underrepresented in agronomy and development journals. Consequently, knowledge contributions from this region have not fully enriched the global discourse on sustainable agronomy and rural development.

South Papua Province offers a highly relevant context for examining the interrelationships between local knowledge, social capital, and socio-economic adaptation within sustainable agronomic systems. This region can be viewed as a socio-ecological laboratory, where interactions between humans and the environment are intense under sensitive, dynamic ecological conditions. High biodiversity, the dominance of traditional agricultural systems, and the community's dependence on local natural resources make agronomic practices in South Papua highly context-specific and rooted in inherited experience [4]. The farming communities in South Papua are dominated by indigenous peoples who possess rich local knowledge systems, including in land management, crop rotation, the use of local species, and adaptation mechanisms to climate variability. This knowledge is not only technical, but also embedded in social structures, cultural values, and community solidarity networks. Social capital—such as collective work, trust, and norms of reciprocity—is a crucial foundation for maintaining the resilience of farming households [5]. South Papua also faces increasing development pressures, including large-scale agricultural expansion, land-use change, and integration into the market economy. These conditions create both challenges and opportunities for local farmers to adapt their agronomic and livelihood strategies [9]. Therefore, this region provides a strategic empirical context for understanding how local knowledge and social capital interact to shape farmers' socio-economic adaptation.

Based on the global dynamics and knowledge gaps that have been identified, this study focuses on analyzing how farming communities utilize local knowledge in managing agronomic resources in South Papua Province, how social capital influences farmers' socio-economic adaptive capacity in responding to environmental changes and economic pressures, and how the integration between local knowledge and social capital contributes to the sustainability of agronomic systems and the resilience of farmers' livelihoods. This study aims to analyse in depth the interactions among local knowledge, social capital, and socio-economic adaptation within the context of sustainable agronomic systems in South Papua Province. Specifically, the study seeks to identify farmers' adaptation strategies derived from local practices and social networks and assess their implications for farm household income and livelihoods. The main contribution of this research is multidisciplinary. First, it enriches the literature on sustainable agronomy by incorporating socio-economic dimensions that have received little attention. Second, it provides empirical evidence from a frontier region rarely explored in international journals, thus broadening the geographic scope of rural development discourse. Third, the findings are expected to yield policy implications for designing more inclusive, context-specific, and sustainable agronomic interventions in Indonesia and other developing regions.

2. Literature Review and Conceptual Framework

The concept of sustainable agronomic systems emerged as a response to the limitations of conventional agricultural systems, which emphasise increasing production without considering environmental carrying capacity and social sustainability [7]. In contemporary agronomic literature, sustainable agronomic systems are understood as agricultural production systems capable of maintaining long-term productivity while preserving ecological integrity, resource efficiency, and the social well-being of farmers. This approach positions sustainability not merely as a technical issue but also as a social process influenced by local actors, institutions, and contexts. Many studies confirm that agronomic sustainability cannot be achieved through technological innovation alone, but rather through integration between agronomic practices, environmental management, and the social dynamics of rural communities. The reciprocal relationship among agronomy, the environment, and society lies at the heart of

sustainable agricultural systems, in which farmers' agronomic decisions are influenced by ecological factors, as well as socio-economic and cultural conditions [3]. Thus, sustainable agronomic systems are understood as socio-ecological systems that are adaptive and contextual. Mainstream agronomic approaches still tend to position farmers as recipients of technology, rather than producers of knowledge. This creates a gap between the design of sustainable agronomic systems and the social realities of farmers on the ground, particularly in developing and frontier regions. Therefore, integrating the social dimension is a crucial prerequisite for developing truly sustainable agronomic systems.

2.1. Local Knowledge in Agronomic Practices

Local knowledge has long been recognised as a crucial component of traditional agronomic practices, particularly in smallholder and indigenous farming communities. This knowledge is formed through intergenerational experiences and long-term interactions between humans and the environment [2]. In the context of agronomy, local knowledge encompasses farmers' understanding of crop selection, planting calendars, and land management adapted to local agroecological conditions. In crop selection, farmers often rely on local knowledge to determine varieties that are resistant to certain environmental conditions, such as rainfall variability, soil fertility, and pest attacks [17]. Traditional planting calendars, often linked to natural indicators and local cosmological knowledge, serve as adaptation mechanisms to climate uncertainty. Meanwhile, land management based on local knowledge, such as crop rotation, fallow systems, and the use of local species, helps maintain soil fertility and biodiversity. The literature shows that local knowledge is dynamic and adaptive. Challenges arise when this knowledge is dichotomously separated from modern agronomy. Recent studies emphasise the importance of integrating local knowledge and modern agronomy to improve the sustainability of agricultural systems. This integration enables agronomic innovations to be more context-specific, socially acceptable, and relevant to farmers' needs, especially in areas with high ecological diversity, such as South Papua.

2.2. Social Capital in Farming Communities

Social capital is a key concept in understanding how farming communities organise themselves and respond to socio-economic challenges. In the rural development literature, social capital is generally defined as the social networks, trust levels, and shared norms that facilitate cooperation and collective action [10]. Social capital acts as a non-material resource that can strengthen the adaptive capacity of farming households. In farming communities, social networks enable the exchange of information, knowledge, and resources, including access to seeds, labour, and markets. Trust and norms of reciprocity strengthen the stability of social relationships and reduce transaction costs in agricultural activities. Social capital also underpins collective action, such as cooperation, shared land management, and the formation of local agricultural institutions. Several studies have shown that strong social capital can increase community resilience to external shocks, including climate change and commodity price fluctuations. However, social capital is often overlooked in formal agricultural policy design, which tends to focus more on individual- and market-based interventions. In this context, understanding the role of social capital is crucial for explaining variations in farmers' adaptive capacity, even within relatively similar agroecological conditions.

2.3. Socio-Economic Adaptation of Farming Communities

Farmers' socio-economic adaptation refers to the ability of individual and farming households to adjust their livelihood strategies in response to environmental, economic, and social changes. Adaptation theory emphasises adaptive capacity, namely the ability of social systems to learn, innovate, and transform in response to external pressures. In the agricultural context, adaptation includes not only changes in production practices but also livelihood diversification, risk management, and strengthening social networks [11]. The sustainable livelihood framework is widely used to analyse farmers' socio-economic adaptation. This framework positions livelihoods as the result of interactions between various assets, including natural, human, physical, financial, and social assets. Within this framework, local knowledge and social capital are viewed as strategic assets that influence the choice and success of farmers' adaptation strategies. Adaptation studies still separate socio-economic analysis from substantive agronomic systems. Consequently, the relationship between agronomic practices, local knowledge, and economic adaptation outcomes is often not analysed in an integrative manner. This gap presents a crucial opportunity for this research to connect socio-economic adaptation with sustainable agronomic systems.

2.4. Research Gaps and Conceptual Frameworks

Based on the literature synthesis above, it can be concluded that although numerous studies examine sustainable agronomy, local knowledge, social capital, and socio-economic adaptation, conceptual integration among these elements remains limited. Specifically, there is a lack of empirical studies that simultaneously analyse how local knowledge and social capital interact to shape farmers' socio-economic adaptation within the context of sustainable agronomic systems. This research fills this gap by proposing an integrative conceptual framework that positions local knowledge and social capital as key determinants of farmers' socio-economic adaptation. Within this framework, local knowledge influences agronomic practices, while social capital

strengthens collective capacity and access to resources. The interaction of the two contributes to the sustainability of agronomic systems and increases the income and livelihoods of farming households. Conceptually, this research framework positions local knowledge and social capital as the main social inputs, socio-economic adaptation as the mediating process, and sustainable agronomic systems as the long-term outcome, as depicted in Figure 1.

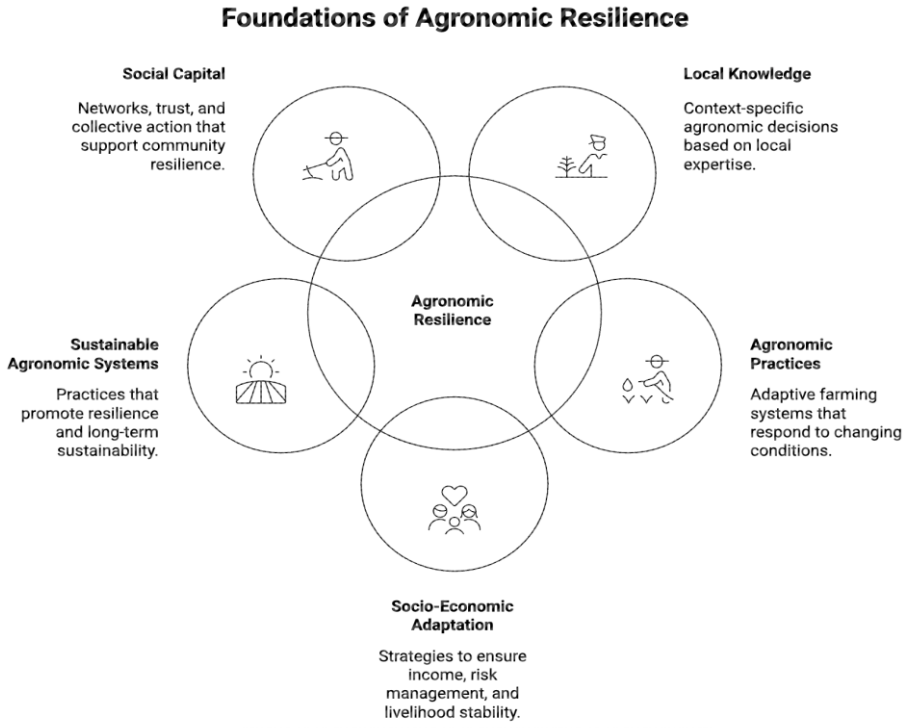

Figure 1: Conceptual framework linking local knowledge and social capital to socio-economic

This conceptual framework highlights that agronomic sustainability is not solely the outcome of technical or biophysical interventions but an adaptive process shaped by interactions among local knowledge, social capital, and farmers' socio-economic capacities. By positioning these social dimensions as key enablers, the framework explains how agronomic systems sustain productivity and resilience under complex pressures, while contributing to Agronomy for Sustainable Development by strengthening social-process perspectives, particularly in frontier regions such as South Papua.

3. Materials and Methods

This research employs a qualitative approach with a systemic, interdisciplinary perspective that integrates agronomy, rural sociology, and sustainable development. The goal is not to statistically measure causal relationships, but rather to understand the socio-ecological mechanisms linking local knowledge, social capital, and socio-economic adaptation within sustainable agronomic systems. This approach allows exploration of community practices, values, and adaptation strategies that are often overlooked by quantitative methods. The research is contextual, adapting to the characteristics of the frontier region and indigenous communities in South Papua's wetlands, with traditional agricultural systems grounded in local knowledge and social capital. Analysis was conducted thematically through open, axial, and selective coding. The research procedure upholds ethics through informed consent, data anonymisation, methodological reflexivity, and triangulation to ensure the validity of interpretations and to produce analytical generalisations in the form of conceptual contributions to agronomic sustainability in frontier regions with limited technology and market access. Informants were selected through purposive sampling with clearly defined criteria to ensure the agronomic and social relevance of the data. Key informants consisted of active farmers who: (i) had at least five years of farming experience, (ii) were directly involved in local knowledge-based land management practices, and (iii) were part of local agricultural social or institutional networks.

Data collection was conducted through in-depth interviews to explore local knowledge related to crop selection, planting calendars, land management, and adaptation strategies to environmental and economic changes; Focus group discussions (FGDs) were used to capture collective dynamics, social capital, and joint decision-making mechanisms within the farming community; Field observations were conducted to verify actual agronomic practices and social interactions occurring at the local level. Analysis is conducted using an iterative, theory-informed thematic analysis across three coding stages: open coding

to identify patterns, axial coding to link themes to research dimensions, and selective coding to synthesise an integrative narrative on socio-ecological adaptation. All analytical processes are explicitly mapped onto a conceptual framework to ensure findings explain underlying mechanisms rather than remaining purely descriptive. Ethical principles are strictly upheld by obtaining informed consent from all participants and ensuring anonymity through de-identification. Sensitive local knowledge is protected and not published without community approval. To ensure validity, methodological reflexivity is applied, with interpretative bias minimised through triangulation and academic discussion. While the contextual and qualitative nature of this study precludes statistical generalisation, it offers analytical generalisation. The conceptual contributions apply to other regions with similar socio-ecological characteristics, particularly within frontier areas and traditional farming communities.

4. Results and Discussion

The research findings show that local knowledge plays a fundamental role in shaping adaptive agronomic practices in South Papua Province. Farmers utilise inherited knowledge to select crop varieties suited to wetland conditions, rainfall patterns, and local soil characteristics. Traditional planting calendars, adapted to ecological indicators such as vegetation changes and water cycles, serve as key instruments for anticipating climate uncertainty and reducing the risk of crop failure. These findings reinforce the sustainable agronomy literature, which emphasises that local knowledge is not merely a traditional practice but a context-specific form of agronomic intelligence that has been shown to increase the resilience of agricultural systems [15]. In this context, local knowledge serves as an adaptation mechanism that complements, and in some cases even replaces, limited access to modern agricultural technology. These findings align with international studies showing that agronomic systems that integrate local knowledge tend to be more adaptive to environmental pressures than uniform technocratic approaches.

4.1. Social Capital and Collective Action in Farming Communities

In addition to local knowledge, this study found that social capital—reflected in social networks, trust levels, and collective norms—is a key factor in strengthening farmers' adaptive capacity. Agricultural practices in South Papua are not carried out individually, but rather through mechanisms of collective work, labour exchange, and resource sharing [16]. Social capital enables farmers to collectively manage production risks, particularly in the face of crop failure or environmental disturbances (Table 1).

Table 1: Socio-economic and agronomic characteristics of farming households

Characteristics	Description
Age of farmers	Mean age 43.7 years (range 25–68 years)
Education level	No formal education (28%); Primary education (46%); Secondary education (26%)
Farm size	Small-scale to medium-scale farms ranging from 0.5 to 3.0 hectares
Dominant cropping system	Traditional subsistence-based systems (41%); Mixed systems combining traditional and semi-commercial practices (39%); Semi-commercial systems (20%)
Main source of income	Agriculture as primary income source (62%); Agriculture combined with non-farm activities such as forest product collection and casual labour (38%)

Notes: *The characteristics reflect the socio-economic diversity and predominantly smallholder-based agronomic systems in South Papua Province. Percentages are based on household-level observations.*
Source: *Field survey, in-depth interviews, and authors' analysis.*

The international analysis demonstrates that these findings are consistent with a collective action approach to rural development, where the strength of informal institutions at the community level heavily influences the success of agronomic adaptation. However, this study also extends this literature by demonstrating that in frontier regions like South Papua, social capital functions not only as an economic instrument but also as a socio-cultural mechanism that sustains locally based agronomic practices.

4.2. Interaction Between Local Knowledge and Social Capital

The interaction between local knowledge and social capital forms the primary foundation for the sustainability of indigenous agronomic systems. Local knowledge is not passed down individually, but through social mechanisms such as kinship networks, rituals, and collective activities that bind communities together. This process creates a shared learning space where agronomic values, norms, and skills are reinforced through hands-on practice and cross-generational experience. Thus, local knowledge functions not only as a source of technical information but also as a social system that maintains harmony between humans and the environment. Social capital strengthens the sustainability of this knowledge through trust, solidarity, and social cohesion. The existence of norms of mutual assistance and mechanisms of cooperation enables communities to maintain traditional

agronomic practices amidst social and ecological changes. It provides legitimacy to local practices, ensuring that knowledge transfer remains continuous and relevant to the local ecological context. The reciprocal relationship between local knowledge and social capital is the key to socio-ecological resilience in sustainable agricultural systems, as summarised in Table 2.

Table 2: Local knowledge applied in agronomic practices

Dimension of local knowledge	Examples of practices	Adaptive function
Crop selection	Selection and preservation of locally adapted crop varieties (eg, flood-tolerant tubers, resilient local rice and sago species); use of mixed cropping to reduce crop failure risks	Enhancing tolerance to climate variability, flooding, and soil heterogeneity; reducing dependence on external inputs
Planting calendar	Determination of planting and harvesting periods based on ecological indicators such as rainfall patterns, river water levels, vegetation phenology, and animal behaviour	Improving the timing of cultivation under uncertain climatic conditions and minimising yield losses due to irregular rainfall.
Land management	Rotational cultivation, fallowing practices, and integration of agroforestry systems combining food crops and perennial species	Maintaining soil fertility, controlling pests naturally, and sustaining long-term land productivity
Water management	Utilisation of natural drainage patterns, raised beds in wetland areas, and adaptive field layouts to manage excess water	Preventing waterlogging, improving root aeration, and enhancing crop survival in wet environments
Knowledge transmission	Intergenerational transfer of agronomic knowledge through family-based learning, communal labour, and customary practices	Ensuring continuity of adaptive practices and strengthening community-based learning systems.

Notes: *Local knowledge refers to context-specific agronomic practices shaped by long-term interactions between farming communities and their environment and sustained through intergenerational transmission. Based on interviews, focus groups, field observations, and prior studies, this research shows that local knowledge and social capital are inseparable. Its effectiveness depends on the social structures that support it, suggesting that agronomic adaptation is an integrated socio-ecological process rather than a purely technical intervention.*

4.3. Socio-Economic Adaptation and Livelihood Resilience

The integration of local knowledge and social capital forms the basis for socio-economic adaptation in agrarian communities. Local knowledge passed down across generations enables farmers to adapt agricultural practices to environmental conditions, such as seasonal cropping patterns and natural resource management. This strategy increases resilience to climate change and maintains stable production and household incomes. Social capital enhances the effectiveness of knowledge application through networks of trust, cooperation, and risk-sharing. The interaction of these two creates a resilient system of adaptation to market and ecological pressures, while also serving as a foundation for agronomic sustainability in frontier regions with limited access to technology and markets (Table 3).

Table 3: Socio-economic adaptation strategies and agronomic outcomes

Adaptation strategies	Socio-economic outcomes	Agronomic outcomes
Crop diversification	Income stability and reduced vulnerability	Increased system resilience
Livestock integration	Improved household resource efficiency	Nutrient recycling and soil fertility
Utilisation of non-timber forest products	Livelihood diversification	Reduced pressure on agricultural land

These results align with the Sustainable Livelihood Framework, which places social assets and knowledge as key components of adaptive capacity. However, this study adds a more robust agronomic dimension by demonstrating how locally based agricultural practices bridge the gap between social assets and economic outcomes. Thus, socio-economic adaptation is influenced not only by external factors such as policies or markets, but also by the community's ability to sustainably manage agronomic systems.

4.4. Implications for Sustainable Agronomic Systems

The findings show that agricultural development strategies prioritising modern technology while neglecting social context and local knowledge are often ineffective, especially in frontier areas with limited formal infrastructure. In contrast, strengthening

social capital—bonding, bridging, and linking—along with recognising local knowledge, enhances the resilience of agronomic systems. This integrated approach sustains agricultural practices and reinforces community livelihoods, enabling adaptive and sustainable agronomic development in South Papua amid environmental and socio-economic challenges. Empirically, adaptation strategies implemented by farming communities demonstrate a close link between locally based knowledge and sustainable agronomic outcomes. Crop diversification based on local knowledge, for example, increases the resilience of agronomic systems by reducing dependence on a single crop and external inputs, while challenging the technology-based development model alone. The integration of crops and livestock through community management improves resource efficiency, nutrient cycling, and soil fertility in smallholder farming systems, highlighting the importance of integrated farming approaches mediated by social capital. Furthermore, the use of non-timber forest products as a supplementary livelihood source reduces pressure on agricultural land. It extends the concept of agronomic sustainability from the individual farm level to the broader landscape. The bonding and bridging dimensions of social capital support collective action, knowledge sharing, and risk mitigation, enabling communities to respond effectively to socio-economic and environmental pressures. Constraints in formal infrastructure strengthen reliance on local knowledge and informal institutions as adaptive strategies. In this context, South Papua emerges as a strategic frontier that provides empirical insights into agronomic innovation and sustainability from an underrepresented region. Beyond serving as a research site, it functions as a socio-ecological laboratory, offering transferable lessons for resilient, adaptive, and community-oriented agronomic development in other frontier areas (Table 4).

Table 4: Implications of local knowledge and social capital for sustainable agronomic systems

Key empirical findings	Implications for sustainable agronomic systems	Contribution to agronomic development discourse
Crop diversification based on local knowledge	Enhances resilience of agronomic systems by reducing dependency on single crops and external inputs	Demonstrates the adaptive value of locally embedded practices; challenges technology-centric models.
Integration of crops and livestock through community-based management	Improves nutrient cycling, soil fertility, and resource efficiency within smallholder systems	Reinforces the role of integrated farming systems as socially mediated sustainability pathways
Utilisation of non-timber forest products as complementary livelihoods	Reduces pressure on agricultural land while strengthening household livelihood security	Expands agronomic sustainability beyond farm plots to broader landscape and livelihood systems
Strong bonding and bridging social capital among farmers	Facilitates collective action, knowledge sharing, and risk management in agronomic practices	Highlights social capital as a critical enabler of sustainable agronomic transitions
Limited access to formal infrastructure and agricultural services	Encourages reliance on local knowledge systems and informal institutions	Positions frontier regions as innovation spaces rather than development laggards

Notes: *The implications reflect the fact that agronomic sustainability emerges from the interaction among ecological conditions, local knowledge, and social institutions rather than from technological adoption alone.*
Source: *Household survey data, qualitative field evidence, and authors' synthesis.*

These tabulated results enrich the discourse on Agronomy for Sustainable Development by providing empirical evidence from a relatively underrepresented region. South Papua serves not only as a case study site but also as a socio-ecological laboratory, offering important lessons for the development of sustainable agronomic systems in other frontier regions. These findings underscore the importance of integrating local knowledge and social capital into adaptive, sustainable agronomic development strategies. These results and the discussion confirm that the sustainability of agronomic systems depends on integrating technical, social, and economic dimensions. The main contribution of this research is the development of a conceptual framework for understanding how local knowledge and social capital shape socio-economic adaptation mechanisms in sustainable agronomic systems. By linking empirical findings with international agronomy and rural development literature, this research broadens the scope of agronomic analysis beyond productivity to resilience and long-term sustainability.

5. Conclusion

Research shows that local knowledge-based practices such as crop diversification, ecological planting calendars, land rotation, and livestock integration are supported by strong social capital (bonding, bridging, and linking), enabling farming communities to adapt to climate pressures, infrastructure limitations, and market uncertainty. These findings confirm that agronomic sustainability is not simply the result of adopting modern technology, but rather a product of complex interactions between local practices, social networks, and ecological conditions:

- Contribution to the Literature lies in providing empirical evidence from an underrepresented frontier region, namely South Papua. This study enriches the global discourse on sustainable agronomic systems by demonstrating how a community-based socio-ecological approach can enhance agronomic resilience, while also providing a reference model for similarly situated regions in other frontier regions.
- Theoretical Implications include strengthening the concepts of socio-ecological resilience and ethno-agronomy, emphasising that integrating local knowledge and social capital is a crucial pillar of sustainable agronomic adaptation. Practical implications include the need for formal recognition of local knowledge in agricultural extension programs, strengthening farmers' institutional capacity to leverage social capital, and designing agricultural development schemes that are adaptive and responsive to local socio-ecological contexts.
- The Future Research Agenda recommends longitudinal studies to evaluate the long-term impact of integrating local knowledge and social capital on agronomic sustainability; exploration of inclusive business models based on local resources; and comparative analysis across frontier regions to identify best adaptation practices that can be replicated in a global agronomic context.

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