Defining social sustainability through social capital in the small-scale coconut plantation ecosystem in Indragiri Hilir, Indonesia: A preliminary study

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Abstract. The study explores the role of social capital in promoting social sustainability within small-scale coconut plantations in Indragiri Hilir, Indonesia. Employing a qualitative approach, this preliminary research engaged 65 farmers and 15 middlemen through extensive in-depth interviews and group discussions. Spanning diverse rural landscapes across the coastal areas of Indragiri Hilir—including Pulau Burung, Kateman, Tanah Merah, Teluk Belengkong, Pelangiran, Tembilahan, Enok, Sungai Batang, and Reteh Districts, covering 15 villages—the study addresses specific challenges and opportunities for sustainable practices unique to each locality. Through a nuanced examination of bonding, bridging, and linking forms of social capital, the findings underscore the pivotal role of social capital in fostering social sustainability. This encompasses aspects such as agricultural finance, supply chain dynamics, agricultural regeneration, and sustainable land management, facilitated by knowledge exchange, resource sharing, and collective action. The research highlights that the relationships among farmers, characterized as "bonding social capital," constitute the fundamental basis for coconut ecosystem sustainability. However, addressing more complex challenges and meeting advanced needs requires expanding relationships beyond homogeneous groups of farmers. Therefore, fostering connections among actors at different levels and scales, represented by "bridging and linking social capital," becomes crucial because vertical connections serve as a conduit to enhance bonding capital through interactions with external stakeholders.

1 Introduction

The social dimension of sustainable agriculture frequently becomes the focal point of intricate debates or is neglected altogether from the difficulties in operationalizing and

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quantifying social impacts, in contrast to the more readily measurable environmental and economic aspects [1–4]. Discussions about sustainability commonly grapple with the trade-offs between socioeconomic welfare and environmental conservation [5]. Whereas, the widely cited definition of sustainability by World Commission on Environment and Development in 1987 states, "Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs," highlighting the necessity of considering socioeconomic aspects alongside ecological ones, thereby underscoring the interconnectedness of these three aspects [6].

Awareness of the importance of evaluating social sustainability in the context of agriculture and food security is increasing, leading to ongoing debates debates among researchers and practitioners [7]. The examination of social sustainability constructs becomes increasingly complex in the context of small-scale farming, which is typically managed by local communities. This complexity arises due to the numerous obstacles that must be overcome to make small-scale farming sustainable and profitable [8,9]. Unlike larger farms that are usually owned by corporations or individuals and follow strict regulations, small farms run by decentralized groups risk falling apart without adequate oversight.

Small-scale farmers often have inherent disadvantages compared to larger operational entities [10]. Decision-making in small-scale farming tends to emerge from a complex framework due to the absence of a single governing institution. As a result, individual decisions are influenced not only by personal preferences but also by collective dynamics within the community structure [11,12].

The role of social capital in agriculture sets a complex stage for analysis. Some researchers suggest that social capital is vital for boosting agricultural productivity, adopting new technologies, reducing information gaps, and enhancing links with formal institutions [13–16]. However, social capital's effects are also subject to debate. For example, social capital can sometimes foster nepotism, thereby limiting opportunities to close family members [17].

Social capital is increasingly recognized as a vital element of social sustainability [18–20]. By examining the definitions of social capital provided by [21–23], social capital plays a key role in promoting social well-being through fostering cooperation and mutual support [24]. Consequently, the development of social capital is considered an essential strategy for shaping and assessing the processes of sustainable social development [20,25].

Research in sustainability measurement has identified geography as a critical factor affecting the sustainability of a region [26]. Although there is a growing amount of evidence showing that social capital positively influences social sustainability [19,20], few studies have explored its impact on social sustainability in small-scale plantations with distinct geographic features. Small-scale plantations on peatlands, which are often geographically isolated, introduce additional complexity to our understanding of social sustainability. This issue becomes even more complex in the context of coconut plantations, a crop with deep local roots that has been cultivated for centuries in the Indragiri Hilir Regency [27]. Furthermore, the lack of formal management systems in these small, community-owned plantations raises significant risks of fragmentation.

Building on the aforementioned background, this research aims to frame the role of social capital in shaping social sustainability in the small-scale coconut plantation ecosystem in the Indragiri Hilir Regency, a region where coconut agriculture has been a cornerstone of social, economic, and cultural life for generations. As a preliminary study, this research will exploratory address the question: "How does social capital contribute to achieving social sustainability in small-scale coconut plantations?"

2 A brief theoretical framework

2.1 Social sustainability in the plantation subsector

Research on social sustainability in various industries has highlighted several recurring themes. For instance, a study on the palm oil industry in developing countries identified key aspects such as governance, economics, infrastructure, health and safety, environment, education and training, and interpersonal relationships [3]. In a similar vein, research on the rubber industry in Sri Lanka underscored workers' rights, health and safety, human rights, and community sustainability [28]. Complementing these findings, investigations into industrial forest and palm oil plantations in Indonesia focused on equitable profit sharing, human resource management, and alignment with community needs [29].

However, the characteristics of plantations are shaped not only by industrial management but also by community or small-holder management. In both developing and developed countries with limited land resources, production is often still dominated by small-scale farmers [30]. This diversity in management styles can result in significant differences in the factors that influence social sustainability between industrial and community-managed plantations.

Studies on small-scale cocoa plantations in Indonesia emphasize the importance of partnerships and community relations, while crucial social assets for farmers, including associations and community groups, have been identified in broader agricultural contexts [31,32]. Market dynamics, such as price fluctuations and stability, impact the social sustainability of small-scale coffee and rubber sectors [33]. In community-managed palm oil plantations, key factors like farmer regeneration, empowerment, conflict resolution, education, group participation, financial access, and knowledge enhancement play critical roles in sustaining livelihoods. Similar characteristics have been observed across palm oil plantations in Ethiopia, Malawi, South Africa, and Tanzania, where well-being is shaped by access to credit, education, health services, technology, land ownership, and community-based farmer groups [34,35].

Another commodity extensively managed by small-scale farmers worldwide is coconut [36–39]. In Gorontalo, Indonesia, research has shown that farmer regeneration and knowledge are essential for sustaining coconut agriculture, with these factors identified as vital components of long-term social sustainability [40]. Studies in Halmahera have similarly highlighted that education, experience, worker status, and knowledge significantly enhance the social sustainability of coconut farmers [41]. Nevertheless, research comprehensively addressing social sustainability in coconut plantations remains limited, with a stronger emphasis placed on the environmental or biological aspects of cultivation in existing studies [42–44].

2.2 Social capital

The concept of social capital, being diverse and multidimensional, has been examined from numerous perspectives across different disciplines [45,46]. Rather than focusing on individual accomplishments, social capital underscores the importance of relationships as key resources for achieving success in various areas of life [23,47]. The cultural basis of social interactions is crucial in reducing opportunistic behaviors, highlighting the broader role of trust within communities. Additionally, empirical studies suggest that social capital is productive, aiding in the accomplishment of goals and enhancing collaborative outcomes [23].

Social capital is characterized by its relational nature, shaped by power dynamics within networks, as emphasized by its relational nature influenced by power dynamics within

networks, emphasizing how these dynamics impact social capital [21–23,48]. Trust, norms, and relationships that develop through sustained collaboration are foundational elements of social capital, underscoring its community-building potential [22]. These components have allowed social capital to be applied practically in diverse fields, helping to understand factors like economic growth and household income [1]. Additionally, social capital plays a role in advancing agricultural innovation [22], facilitating access to credit services, reducing transaction costs [49,50], and enhancing agricultural extension services [51].

Social capital can be divided into three main types: bonding social capital, which involves informal and strong relationships between individuals [1,52], bridging social capital, which refers to formal relationships between individuals with greater differences [52,53], and linking social capital, which denotes formal relationships between farmers and institutions that may have power differences [54].

2.3 The concept of social capital is intrinsically linked to social sustainability

Commodities managed by small-scale farmers often exhibit vulnerable characteristics in the context of sustainability. In such contexts, social capital is critical as strong social relationships help to mitigate the shortcomings of existing institutions [55,56]. Farming activities, particularly in remote areas, rely on social networks to reduce risk and boost resilience [57]. Farmers create norms and resource exchange mechanisms as strategies to cope with the risks they encounter [51,58]. These exchanges through relational networks are vital, indicating that the sustainability of farmers depends not only on their land but also on the social connections they establish [59].

The concept of social sustainability is a prominent topic in various studies, yet it often lacks a clear understanding [25,60]. Despite various interpretations and unclear policy objectives, there is a general agreement in the literature that social sustainability includes key elements such as social capital, human resources, and well-being [19,61,62]. In this context, social sustainability is seen as the result of effectively leveraging social capital, which is crucial for social development through support networks and the sharing of knowledge among individuals and groups. It focuses on achieving coherence, reinforcement, cohesion, and stability within populations [18]. While this research acknowledges the importance of social capital in sustainability, it also recognizes that a comprehensive understanding of sustainability may require consideration of other aspects or frameworks in addition to social capital. Forming a more complex framework by integrating social sustainability with other elements is a possibility.

Experts employ various methods to measure social capital, typically focusing on three main aspects: social networks, social reciprocity, social participation, and social trust [10,30,63]. In line with these dimensions, this study aims to assess social capital by examining its presence in contexts that involve social networks, participation, and trust among participants. However, as an initial study, it does not delve into each of these aspects in detail.

This research delineates the framework of social sustainability by selecting key aspects that form the foundational pillars for achieving long-term stability in the coconut plantation ecosystem, namely: 1) agricultural financing (Social Sustainability / SS 1), 2) supply chain continuity (SS 2), 3) household farming regeneration (SS 3), and 4) sustainable land management (SS 4). The absence of these aspects can lead to ecosystem utilization that is not aligned with socially accepted goals and may not contribute to long-term economic prosperity. Additionally, it can violate ecological stewardship principles in the context of peatland plantations.

This research adopts the social capital classification by [22], which divides social capital into three categories: bonding, bridging, and linking, in [54]. Bonding social capital involves

relationships between farmers, their families, and fellow farmers. Bridging social capital includes interactions between farmers and middlemen, Village Unit Cooperatives (*Koperasi Unit Desa* / KUD), as well as between farmer managers and farm laborers. Meanwhile, linking social capital encompasses relationships between farmers and coconut processing industries, local NGOs, and local government. The study explores how each group of social capital shapes aspects of social sustainability, spanning from SS 1 to SS 4.

3 Methods

3.1 Research locations

This study filters districts located from coastal areas to hills out of a total of 20 districts in the Indragiri Hilir. The hill districts are eleminated due to their increasing domination by oil palm plantations (*Elaeis guineensis* Jacq.). Among the coastal districts, the specific research locations were chosen based on additional geographical factors. This approach acknowledges that areas and localities are distinct spaces, where economic outcomes are shaped by complex interactions among individual actors, groups, and institutions within dynamic spatial boundaries [64,65].

First, accessibility. Finding adequate primary asphalt roads in regions predominantly made up of peatlands, such as Indragiri Hilir, is extremely challenging. Consequently, many areas in this region suffer from poor road access, which hampers efficient transportation, economic activities, and community mobility. In addition to roads, river and sea transport are vital in the Indragiri Hilir, given the limited land-based infrastructure. These constraints significantly hinder the distribution of harvest yields and other commodities to broader markets. In contrast, regions with well-developed infrastructure networks have better opportunities for accessing diverse markets and distributing harvests. Improved infrastructure also facilitates enhanced cooperation among farmers. Initial observations indicate that in areas with good accessibility, farmers tend to establish more advanced collaborative relationships. Thus, this research identifies roads and bridges as critical factors in selecting the research location.

Second, coconut plantation conditions. The geographical location of plantations greatly influences the risks and challenges encountered by farmers. Plantations situated in coastal areas are especially prone to tidal phenomena, facing greater risks than those near rivers. Frequent high tides can cause periodic flooding, submerging plantation lands and potentially reducing crop production significantly. Consequently, farmers in these areas need to adopt specific adaptation strategies to protect their crops and ensure operational sustainability. Therefore, this research takes into account the conditions of the plantations as a key factor in selecting the research location.

Third, agricultural management system. The diversity of regions allows for the adoption of various agricultural systems. In the Indragiri Hilir, two predominant systems are the KUD and the farmer-managed system. The KUD system is operational in ten villages within the Pulau Burung District, notable for being a transmigration area primarily populated by Javanese ethnic groups, which contrasts with the ethnic composition of most other villages in the Indragiri Hilir [66,67]. The farmer-managed system, commonly used in coconut plantations, typically involves a landowner, several farm workers, and a farmer-manager who may also double as a farm laborer. These agricultural management systems are key factors in selecting the research location due to the different dynamics of social capital they present within each system. Based on the three considerations above, the distribution of research locations is in Figure 1.

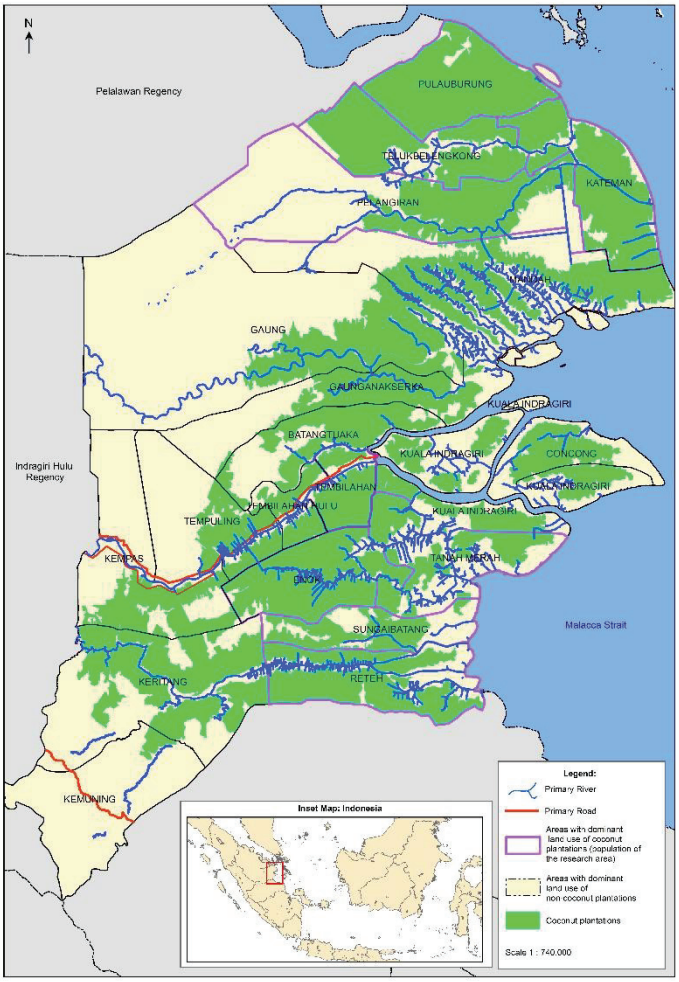

Fig. 1. Reseach location based on three consideration; accessibility, coconut plantation conditions and spreads, agricultural management system

3.2 Rapid Rural Appraisal (RRA)

RRA was employed to explore the research questions through in-depth interviews and group discussions. In-depth interviews were conducted to gain a detailed understanding of individuals' perspectives, experiences, and opinions on the management of social capital affecting coconut agriculture practices. Conversely, group discussions enabled researchers to observe interactions among participants, discuss their views, and assess group dynamics. Social capital is more prevalent within groups than individuals, differentiating it from human and physical capital [67,68].

RRA is crucial for capturing the nuances of rural conditions in real-time. Group discussions are effective for gathering collective insights on specific topics, gaining an in-depth understanding of social issues [69]. Moreover, RRA helps identify potential opportunities and challenges related to the study's focus. This approach is particularly valuable in studies that prioritize verbal interactions, allowing researchers not just to observe but also to actively participate in discussions and data collection [70].

3.3 Informant

The research focuses on coconut producers, namely coconut farmers (including laborers, landowners, and farm managers) and middlemen. The farming community and informal institutions are areas where social capital is easily observed [71]. Consistent with this perspective, the rationale for selecting these two actors lies in their operation within a flexible system structure, not tightly bound to a single entity, and significant autonomy in decision-making regarding their farming activities.

The sampling strategy used in this study was purposive sampling, where participants were selected based on specific criteria. For farmers, these criteria included their role in coconut agriculture, ownership of other businesses, size of land, duration of employment in the coconut plantation ecosystem, historical connections to Indragiri Hilir, and factors mentioned in section 3.1 Location. Middlemen were selected based on the size of their business operations (either large or small) and their tenure within the coconut plantation ecosystem. The sampling process adhered to saturation principles, meaning data collection stopped when no new information emerged during repeated interviews [72]. Selection of respondents and village locations was carefully planned with the help of village authorities or community leaders who had deep knowledge of their communities.

Group discussions involved 4-6 participants per group, a size determined through trial sessions to ensure effective discussions lasting between 60 to 120 minutes. This number was chosen to allow each participant ample opportunity to express their views without one individual dominating the conversation or others becoming passive [73]. All group discussions were audio-recorded with explicit permission from the participants, who were fully informed about the research goals and consented freely. The study used a questionnaire that was refined through several trials, making adjustments based on feedback from initial interviews. Data collection for group discussions is scheduled to conclude by the end of April 2024 with five farmers and two middlemen participating, while in-depth interviews are set to be completed by early June 2023. As a result, this study respondents included 65 farmers and 15 middlemen.

3.4 Data Analysis

The thematic analysis method, a common approach for analyzing data from group discussions, was selected as the analytical framework for this study [74]. This method involves two primary stages: coding and narrative formation, as outlined [75]. The process begins with an extensive literature review to develop research questions and establish initial codes for a thorough analysis [76]. It is important to recognize that group discussions can reveal new insights, which may necessitate modifying or enriching the initial codes derived from the literature review.

Following the data collection, transcriptions and simplifications are made. The data is then aligned with the pre-established codes from the literature review. These codes are categorized and developed into themes based on frequency, patterns of similarity and difference among participants, and their alignment with existing theories. These emerging themes are further validated and refined in consultation with other researchers, who act as supervisors and reviewers, to ensure their accuracy and relevance. The finalized themes will form the foundation for the discussions in the Results and Analysis section of the study.

4 Results and Discussions

The primary aim of this research is to explore how different forms of social capital—bridging, bonding, and linking—contribute to achieving social sustainability. The study

begins by examining the characteristics of each type of social capital and the support they offer, details of which are summarized in Table 1.

Table 1. Tabulation of levels of social capital and support provided in four categories of social sustainability

Social Capital / Social Sustainability	**SS 1: Agricultural financing**	**SS 2: Supply chain continuity**	**SS 3: Household farming regeneration**	**SS 4: Sustainable land management**
Bonding (Farmers with fellow farmers, family and their neighbors)	Financial support among coconut farmers is often provided to meet both agricultural and non-agricultural needs, although the amount is limited. Opportunities for job diversification are mostly available through fellow coconut farmers. This diversification typically includes jobs such as harvest laborers and coconut huskers, aimed at obtaining additional sources of income.	Coconut trading networks are often established among fellow coconut farmers. Typically, connections for new sales destinations are obtained when a farmer receives information about price fluctuations. This information then determines which middleman the farmer without debts will sell their harvest to.	Many coconut farmers primarily hope to pass on farm management to their biological children to ensure continuity. However, this expectation is often not embraced by the next generation. Labor assistance originating from core family members is common among coconut farmers. One of the goals is to save on labor costs and to provide family support. Support to remain a coconut farmer and maintain coconut farms does not only come from farming families. Most coconut farmers also support each other to continue their profession and maintain their farms.	Many coconut farmers still lack direct access to knowledge sources on sustainable coconut agriculture capacity building. Therefore, mutual support among coconut farmers is largely dominated by practical knowledge based on experience.
Bridging (Farmers with middlemen and KUD)	Middlemen play a central role in providing capital for many coconut farmers, both for agricultural and non-agricultural financing needs.	Market opportunities for most small-scale coconut farmers (2-4 ha) heavily rely on middlemen.	The relationship between farmers and middlemen is primarily based on buying and selling transactions. However, a small number of large-	Middlemen and KUD do not significantly contribute to the creation of new knowledge regarding sustainable coconut agriculture practices.

Social Capital / Social Sustainability	**SS 1: Agricultural financing**	**SS 2: Supply chain continuity**	**SS 3: Household farming regeneration**	**SS 4: Sustainable land management**
	Apart from middlemen, particularly in Pulau Burung District, KUD also plays a crucial role in supplying agricultural necessities for coconut farmers.	Information about market conditions is openly provided by many middlemen through WhatsApp contacts, allowing most coconut farmers to always stay informed, especially about prices. Besides middlemen, particularly in Pulau Burung District, KUD serves as a means for coconut farmers to sell their harvest, replacing the role of middlemen.	scale coconut farmers (those with farms 5 hectares or larger) view middlemen as akin to close relatives. These strong connections motivate the farmers to sustain and improve their plantations.	
Linking (Farmers with coconut processing industry, NGOs, and local goverenment)	Financial support is provided by the processing industry in the form of CSR, with most assistance focused on constructing embankments. Financial support for coconut ecosystem development from the Regional Government is limited, and most coconut farmers perceive the government's role in this area as minimal.	The presence of coconut processing industries in Indragiri Hilir serves as the primary destination for most middlemen to sell coconuts. This industry ensures that all coconuts from farmers are sold.	*Have not yet found the relationship among the indicators.*	The advancement of sustainable practices in coconut agriculture is primarily driven by the processing industry through research and diverse forms of farmer support. This support is delivered both via affiliated organizations, such as NGOs, and through the industry's own corporate social responsibility initiatives.

4.1 Horizontal relationships generate basic yet essential collaboration outcomes for social sustainability

This study considers three main aspects in selecting research locations: accessibility (land, river, and sea), plantation conditions, and plantation management systems. These elements

are examined to understand how variations in social capital can affect collaboration within the coconut plantation ecosystem. While location-specific factors do not necessarily diversify the forms and outcomes of social capital, the findings show that areas with better accessibility—such as certain subdistricts in Sungai Luar, Tembilahan District; Sungai Rukam and Enok in Enok District; and Pulau Kijang in Reteh District—tend to have more developed collaborative networks. These collaborations manifest as horizontal relationships among farmers and vertical relationships with middlemen and buyers outside the Indragiri Hilir region. The most prevalent form of cooperation involves the creation of informal groups, which help enhance collaboration in expanding coconut sales markets beyond local processors and in diversifying planting and sales strategies.

Although regions with better accessibility tend to exhibit more developed collaborative outcomes, the study finds that basic forms of cooperation are common across all areas, regardless of specific factors. At the smallholder level, trust among farmers is crucial for participation in agricultural development and is significantly influenced by their relationships with fellow farmers, neighbors, and family members [10,77].

This study highlights the crucial role of farmer relationships, facilitated through bonding social capital, in enabling efficient resource exchanges. In many study areas, informal farmer groups have been formed, allowing members to share the workload effectively. These groups operate on a rotational basis for various agricultural tasks such as farm cleaning, harvesting, transporting yields, and coconut husking on each other's land, according to predetermined schedules. Often, these group members are from the same family or are relatives, making these resource exchanges a form of close support within family or kinship networks. Additionally, initiatives like informal farmer cooperatives (*arisan petani*), which pool savings, are also present. For example, in Air Tawar Village, Kateman District, such cooperatives provide both financial and social support for coconut farmers. This aligns with findings that indicate social networks act as channels for reducing transaction costs in agricultural activitiesm [78].

Bonding social capital significantly supports small-scale farmers who typically use traditional methods and struggle to access development programs [79]. These farmers establish strong horizontal social ties through activities that facilitate the exchange of knowledge, the formation of lobby groups, and improved access to markets [80,81]. This study corroborates these findings, revealing that while most coconut farmers depend on middlemen for sales transactions, they still maintain active trading networks among themselves. They share information about price fluctuations, which helps them decide whether to sell their produce to middlemen or directly to processing industries, based on insights obtained from their peers (SS 2).

Unfortunately, bonding social capital often faces criticism for fostering overly strong ties among farmers that may inhibit the introduction of new ideas and slow the adaptation to changes [79,80]. This study reveals that sustainable land management efforts (SS 4) are particularly weak due to limited interactions fostered by bonding social capital. The knowledge shared within these groups tends to be basic and sometimes includes fundamental misconceptions about managing coconut cultivation on peatlands. However, an interesting finding is that all farmers involved in this study showed a readiness and strong willingness to embrace more reliable, scientifically validated information. This suggests that the existing information exchange networks among farmers about sustainable land management practices are underdeveloped, thereby offering a straightforward opportunity for introducing new interventions.

Fundamentally, this research underscores that relationships among coconut farmers provide the essential foundation for ecosystem sustainability. The collaboration among close peers fosters basic yet vital cooperative efforts. However, addressing complex challenges or significantly improving quality requires more than just farmer relationships. These alone are

not sufficiently effective because the interactions typically involve actors with homogeneous characteristics, which limits the diversity of ideas and approaches needed to tackle more complex issues effectively.

4.2 Vertical relationships play a role in bolstering social sustainability

Achieving development goals in rural areas depends significantly on the active participation of stakeholders in collective actions, such as forming communities or establishing multi-actor networks [65]. Some stakeholders invest time in these activities because building and maintaining relationships is crucial, especially within hierarchical contexts [82]. In the context of adapting to change, bridging social capital is seen as more effective than bonding social capital. These forms of social capital enhance the exchange of information, ideas, and innovations and help build consensus among groups with diverse interests [83].

Linking social capital, much like bridging social capital, involves relationships both within and between social groups across various levels of society. This type of capital offers opportunities for sustainable growth, equity, and participatory governance. While the understanding of linking social capital is still evolving, hierarchical relationships are acknowledged for providing access to essential resources for innovation [82]. Supporting this notion, various social networks involving actors at different operational scales facilitate change [71]. This study provides empirical evidence for these findings, indicating that hierarchical relationships established through linking social capital between coconut farmers and local NGOs foster avenues for innovation. For instance, in the context of sustainable land management (SS 4), practices such as intercropping or cultivating peat-friendly crops for income diversification and nutritional enhancement are promoted through research initiatives led by local NGOs. Additionally, establishing learning platforms for farmers through collaborative efforts between governmental and non-governmental organizations in rural areas would be highly beneficial [84].

Another hierarchical relationship is reflected in the relationship between farmers and middlemen (bridging social capital). The close ties between farmers and middlemen enhance opportunities for absorbing coconut harvests, with market priority given to those who maintain good relationships (SS 2). This maintained trust also opens opportunities for farmers to access agricultural capital under more flexible conditions regarding payment amounts, deadlines, and interest rates, regardless of the harvest volume. Bridging social capital positively influences agricultural financial support and marketing assistance [85]. In terms of farmer regeneration (SS 3), the sustained relationships between farmers and middlemen or processing industries foster a sense of kinship among farmers and the assurance of ongoing market access, which motivates them to continue their agricultural practices. This bond creates optimism for the continuation of coconut farming by future generations. However, this rationale applies only to a small minority of farmers, while the majority may disagree due to transactional reasons.

KUD and coconut farmers exhibit another unique vertical relationship through their involvement in cooperatives, which provide a more structured system compared to other group collaborations. Farmers in cooperatives tend to have high social capital, demonstrated through regular meetings that enhance their awareness of appropriate agricultural inputs [86]. This study finds that KUDs play a critical role in supporting social sustainability in coconut agriculture, serving as mediators between farmers and broader markets for both coconut and non-coconut products, as well as in savings and loan services (SS 1). Unlike middlemen, who often engage in more transactional interactions, cooperatives offer a more relational approach. However, this research has not yet found evidence that KUDs facilitate complex knowledge exchanges (SS 4).

Essentially, this study shows that vertical relationships provide farmers with access to broader opportunities, including agricultural financing, supply chain continuity, motivation for agricultural regeneration, and enhanced knowledge for managing environmentally friendly peatland plantations. Farmers frequently encounter barriers in accessing knowledge sources and other critical resources. Consequently, interconnected vertical connections among stakeholders are essential as they serve as vital channels for development [75,85,87,88].

As a preliminary study, this research acknowledges limitations, particularly in not thoroughly examining the role of local government in supporting social sustainability within the coconut plantation ecosystem. Initial findings suggest that local governments, especially at the district level, face significant challenges. While this warrants further investigation, it is disappointing since local governments could potentially improve farmers' adaptability through measures such as expanding equitable infrastructure and enhancing communication among farmers to foster a community culture [79,89].

Beyond local government, social entrepreneurs—represented in this study by middlemen, KUDs, and processing industries—play a pivotal role. They leverage community-level resources and establish relationships at the regime level, thereby creating broader environmental impacts [90]. Additionally, NGOs and development institutions are crucial for facilitating capacity building and improving access to production resources and markets. To maximize their effectiveness, local NGOs should operate within an open and flexible system that accommodates knowledge flows from various stakeholders, positively impacting farmers [91].

Despite the advantages of leveraging resources and information through interconnected relationships across different structures, it is crucial to acknowledge the potential drawbacks of vertical social capital, which can include nepotism, corruption, and oppression [5,92]. In this study, it was found that vertical relationships are weaker and less developed compared to horizontal ones within the same ecosystem. The inability to form strong vertical connections remains a major issue in this ecosystem. While the presence of vertical relationships can lead to negative outcomes, the primary issue remains the development and strengthening of these connections to support the overall sustainability and progress of the ecosystem.

5 Conclusion

Social capital is crucial for facilitating coordination and cooperation within and between groups, playing a key role in communities' ability to adapt to changes and shocks. Communities with strong networks and active participation in associations tend to be more resilient. In the context of the coconut plantation ecosystem in Indragiri Hilir, this study highlights that inter-farmer (horizontal) relationships, or "bonding social capital," are essential for maintaining ecosystem health. These relationships foster critical collaborations, such as forming informal groups that address labor and financial challenges (SS 1 & SS 3), and spreading market information (SS 2).

However, for addressing more complex challenges and broader needs, horizontal relationships alone are insufficient due to the limited resources available to actors with similar characteristics. To overcome this, building relationships among actors at various levels and scales is vital, facilitated by "bridging and linking social capital." Vertical relationships enhance both bonding and bridging social capital by connecting farmers with external entities such as NGOs, which can introduce innovations like sustainable coconut management on peatlands and intercropping strategies (SS 4).

The relationship between farmers and middlemen, for instance, improves market access for those who maintain strong connections, thus enhancing the absorption of coconut

harvests (SS 2). Trust between these parties also enables farmers to access more flexible agricultural financing terms (SS 1), irrespective of the harvest size. In terms of farmer regeneration (SS 3), the sustained relationships with middlemen or processing industries foster a sense of community among farmers, ensuring continuous market access and contributing to the sustainability of their plantations.

In short, the study ultimately underscores the critical role of social capital in achieving social sustainability within small-scale coconut plantations, particularly within the specific geographical context of Indragiri Hilir, Riau. The research findings and analysis unambiguously demonstrate this supports.

As a preliminary study, further research development holds great potential for contextual exploration. Currently, this study focuses solely on micro-level social capital using actor-based analysis units. The next steps could involve macro-level analysis, including its influence on the formation of social capital at the regional level. Additionally, deeper research into specific actors, such as local governments playing a central role, is crucial. Time framing is also an aspect to consider in future research; this study only explores current social capital without considering transformations over time, including future predictions. Lastly, given the broad scope of activities from upstream to downstream in coconut plantations, future studies might specialize in exploring in-depth aspects such as social capital within supply chains.

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