

Social Engineering and Agrarian Empowerment among Coconut Farming Communities in Coastal Sumatra

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ABSTRACT

The main economic support for the coconut sector on the coast of Sumatra is challenged by low productivity and weak institutions and dependence on middlemen. This study aims to analyse the potential of social engineering based on community empowerment and the sociological factors that influence the sustainability of coconut farming in Indragiri Hilir, Asahan, Sabang and Aceh Besar. This research uses a qualitative approach with case study method. Data were collected through observation, documentation and in-depth interviews with 13 key informants (farmers, extension workers and government) and analysed using the Miles and Huberman interactive model. The results show structural barriers in terms of low technological literacy and poor institutional coordination. However, there is a strong social capital that can be revived through the kepala parit system in Indragiri Hilir, the tradition of gotong royong in Asahan and the innovation of superior varieties of Lampanah in Aceh. The sustainability of coconut business is very much dependent on the synergy between social capital, institutional capacity and strengthening farmer agencies. The "inside-out" social engineering model helps transform the farmers' habitus from "subsistence" to "agripreneur" via the transformation of cultural and social capital into a competitive economic force for sustainable community resilience.

Keywords: social engineering, agrarian empowerment, coconut farmers, social capital, agripreneur

INTRODUCTION

Most rural communities in Indonesia depend on people's agricultural commodities for their livelihoods. The main problem that is often faced by the people's agricultural sector is the low productivity of agriculture and the quality of the commodities produced. These issues stem from the advancement of agricultural technology and innovation. According to P. et al. (2019), farmers struggle to select the appropriate tools and machines due to their limited understanding of mechanization. Research by Nurhanifa & Budiasih (2023) revealed that the agricultural sector's productivity level remains relatively low due to its inability to achieve maximum and efficient production levels. According to Kurniawan (2013), the obstacles in empowering the farmer community are caused by the limited budget and the number of extension workers available to assist the farmers.

The solutions include empowering farmer communities (Astuti & Wijaya, 2020), developing community institutions (Abidin, 2021), reorienting fertilizer subsidies (Kariyasa, 2005), implementing the People's Business Credit Program (Afnani et al., 2020), and advancing agricultural technology and innovation (Karouw et al., 2019). In fact, the solutions to address the issues with agricultural commodities often do not align with the plans. Despite numerous policy initiatives, the implementation of solutions for agricultural commodity development frequently falls short of planned objectives due to

fragmented governance, bureaucratic complexity, and weak coordination between central and subnational governments (de Boon et al., 2022; OECD, 2025). In some cases, Government policies and private investment have historically concentrated on a number of strategic plantation commodities, particularly oil palm, while coconut has received comparatively less policy attention, investment, and institutional support despite its important contribution to rural livelihoods (Putri et al., 2022).

Talking about coconut commodities, data from Bappenas (2024) shows Indonesia is the second largest coconut-producing country in the world, with more than 5.6 million farming households managing 98.95% of the coconut plantation areas. These plantations cover an area of 3.34 million hectares and produce approximately 2.87 million tons of coconut meat, which accounts for about 24% of global production. Over the past four decades, since 1980, the Philippines, Indonesia, and India have become the three largest coconut-producing countries in the world, accounting for 71% of global coconut production in 2022. At the same time, Brazil recorded the highest growth in coconut production from 1980 to 2022, an increase of 67%, or 482 thousand tons, in more than four decades, followed by Thailand and Sri Lanka.

The centralization of coconut agricultural commodities in Indonesia is concentrated on the east coast of the island of Sumatra. The focus of this research covers three main areas, precisely located along the coast of East Sumatra, namely Indragiri Hilir Regency in Riau, Asahan Regency in North Sumatra, and Sabang City and Aceh Besar Regency in Aceh. The largest potential for coconut plantation commodities is precisely in Riau Province, with coconut producers contributing around 15% to Indonesia's total production. Data from Badan Pusat Statistik Kabupaten Indragiri Hilir (2022) shows that this region is the largest production center, with a total yield (local and hybrid coconut) of 310,699 thousand ton from a total land area of 341.196 hectares, translating to a productivity rate of 0.91 tons/ha while Asahan Regency has enormous potential for the development of people's coconuts thanks to its strategic location near Malaysia and Singapore, with a production of 22,293.11 tons from 22,882.44 hectares of land or 0.97 tons/ha (Badan Pusat Statistik Kabupaten Asahan, 2022). In Aceh, especially in Sabang and Aceh Besar, the growth of coconuts is not steady. The area has shrunk from 104,800 hectares in 2021 to 102,601 hectares in 2023, and production has dropped from 66,434 tons to 63,071 tons or 0.61 tons/ha. When compared to the national average coconut productivity standard in Indonesia of approximately 1.1–1.2 tons/ha/year—and far below the optimal potential at 3 research location—these figures highlight a systemic productivity gap across East Sumatra. This stark disparity between land allocation and low productivity underscores the acute vulnerability and sustainability challenges faced by local smallholder farmers who remain heavily dependent on this sector.

Coconut is one of Indonesia's strategic plantation commodities, supporting the livelihoods of millions of smallholder households and contributing substantially to rural economies, particularly in coastal regions where coconut farming remains the primary source of income. Despite Indonesia being among the world's largest coconut producers, the sector has experienced relatively slow development due to fragmented value chains, weak institutional coordination, limited downstream processing, and unequal market access, all of which reduce farmers' bargaining power and income. Recent studies have shown that smallholders often remain disconnected from higher-value markets because of limited value chain integration and weak institutional support, constraining the competitiveness of coconut-based agrifood systems (Hidayati et al., 2023).

Several studies have documented these challenges from different perspectives. Trimerani et al. (2024) found three categories of coconut sugar artisans in Pacitan and designed four social engineering designs based on empowerment, social interaction, institutional strengthening, and techno-social technology. Dahlan et al. (2021) identified three categories of coconut sugar artisans in Pacitan and noted that the coconut downstream industry in South Sumatra was hampered by poor marketing chains and weak institutional linkages. The authors suggest an integrated social engineering framework to tackle these structural issues. The framework consists of four interrelated strategies: (1) community empowerment, (2) social interaction strengthening, (3) institutional strengthening and (4) techno-social innovation. The framework aims at building community capacity, improving value chain integration and promoting sustainable rural economic transformation. Ikhwan et al. (2023) highlight gender inequality in the food estate region of Central Kalimantan and encourage gender-retributive policies to strengthen gender equality. While Khusnul & Widodo (2023) found that coconut downstream in South Sumatra has not been optimal due to trade chain inefficiencies, while Raho (2013) found that the potential of social engineering arises from the gap between ideal conditions and social reality, which for coconut farmers

appears through the inequality of market access and selling prices. The capacity of human resources to utilize modern technology is low.

This institutional aspect has been also emphasized in earlier studies. According to Jamaludin (2016), farmer organizations are still weak, which limits their collective bargaining power, access to production inputs and coordination among farming communities. Afnani et al. (2020) also reported that limited access to capital, lack of enabling infrastructure and low exploitation of coconut plantations were hindrances to productivity and barriers to the growth of value-added coconut industries. Such structural constraints are also apparent at national level. The coconut sector in Indonesia is still experiencing low productivity due to old plantations, slow replanting programs, limited downstream industrial development, weak institutional support and inefficient marketing systems Bappenas (2024). Collectively, these studies show that the sustainability of coconut farming depends on the improvement of agricultural production, strengthening of farmers' institutions, increasing the access to resources and integrating upstream and downstream value chains.

Beyond these structural constraints, coconut-producing communities possess important social assets that provide opportunities for transformation. Strong social capital, mutual cooperation *gotong royong*, and community participation remain valuable institutional resources that can facilitate collective action and strengthen local governance (Putnam, 2000). Therefore, enhancing the competitiveness and sustainability of Indonesia's coconut sector requires not only technical and market interventions but also well-designed social engineering that integrates institutional strengthening, collaborative governance, and community empowerment to improve the resilience of coconut farming systems.

Borrowing thoughts Anthony Giddens (in Wirawan, 2015, pp. 275–276) from a sociological perspective, social engineering is the result of a dynamic interaction between agency and structure. Individuals act as reflective actors who are able to create change through institutional strengthening and the use of technology. Social structures function as well as limit and facilitate action, making social engineering a conscious process to reorganize the relationship between the two for inclusive social change. The development of issues within the coconut farming community is closely related to the interdependent interaction between social structures and individual actions. According to Giddens, the social actions of coconut farmers are not only influenced by social structures but at the same time participating in creating and maintaining these structures through daily habits and activities (Firmando et al., 2025). A. Kinseng (2017) also states that structures and agencies have a dualistic relationship, which influences the behaviour of people in social spaces in the same way.

Meanwhile, within the framework of Bourdieu, the social behaviour of farmers can be analysed through the relationship between habitus and capital (which includes economic, social, and cultural aspects) as well as the arena that influences strategies for survival as well as the process of resource accumulation Miharja et al. (2017) Habitus signifies established patterns of thought and behaviour, whereas economic, social, and cultural capital serve as catalysts for transformation within the social domain. Within this study, social engineering refers to a deliberate and participatory process of designing social change by strengthening institutional arrangements, improving collaboration among actors, and enhancing community capacities to address structural constraints and achieve sustainable development. In the context of coconut farming, social engineering is intended to transform existing social relations and institutional practices so that farmers are better able to mobilize resources, strengthen collective action, and improve their adaptive capacity. This understanding is consistent with Jatnika et al., (2024) and Sambodo et al., (2023), who defines social engineering as an intentional effort to empower individuals while simultaneously reforming social structures to become more equitable and sustainable.

Research by Firda et al. (2020) also confirms that the excellence of actors in managing village resources is largely influenced by the uneven distribution of capital, which then impacts the limited participation of the community at large. These findings indicate that unequal access to different forms of capital shapes the capacity of rural actors to participate in development processes and to utilize available resources effectively. In Bourdieu's perspective, the interaction between habitus, capital, and social arena ultimately determines how actors respond to structural constraints and pursue livelihood strategies. Consequently, the productivity and sustainability of coconut farming cannot be understood solely as technical or economic issues. Rather, they are socially embedded processes influenced by existing social structures and by farmers' ability to mobilize economic, social, and cultural capital, including social networks, local knowledge, and collective institutions, to strengthen resource management and community participation.

Based on these phenomena, this study aims to analyze the potential application of community-based social engineering in coconut farming communities along the east coast of Sumatra and to examine the sociological factors influencing the sustainability of smallholder coconut farming in improving household welfare. This study particularly focuses on the role of community institutions, social capital, economic practices, technological adaptation and farmers' knowledge capacity along the upstream and downstream coconut value chain. The study also evaluates the existing social engineering practices in coconut farming communities to determine their strengths and weaknesses. Based on the comparative analysis of the three study areas, the study proposes a community-based social engineering model adapted to the socio-cultural characteristics and institutional contexts of the study sites. Instead of implementing an intervention program, the present study develops an analytical model based on empirical findings to explain how social capital, institutional capacity, technological adaptation and community empowerment interact in supporting the sustainability of coconut farming communities.

RESEARCH METHODS

This study uses a qualitative approach with a case study method as described by Creswell, who states that case studies are a form of qualitative research that focuses on providing detailed data to obtain a complete and in-depth description of an entity. The fieldwork for this study was conducted between May and September 2025. The object of this research covers three main areas, namely Indragiri Hilir Regency, Riau Province, precisely in Tembilahan City, Teluk Pinang Village, Pantai Seberang Makmur Village, Palas Island Village, and Sungai Nyiur Village. Asahan Regency, North Sumatra Province, precisely in Sei Kepayang Tengah Village, Sei Kepayang District, Silo Lama Village, and Silo Bonto Village, Silau Laut District. Additionally, the research includes the Aceh Province area, specifically Sabang City in Anoe Itam Village, Suka Jaya District, and Ujong Keupula Village in Aceh Besar Regency. These three provincial regions were chosen as a representation of the social, cultural, and economic dynamics of the coconut farming community in the eastern coastal area of Sumatra Island.

The subjects of this study were determined by the purposive sampling technique of thirteen informants, which included coconut farmers, institutional administrators (farmer groups/cooperatives/extension workers), value chain actors (middlemen/traders/MSMEs), government/private institutions/NGOs, and community/customary leaders. Specifically, the informants were five smallholder coconut farmers, two institutional representatives (farmer groups/cooperatives), two value-chain actors (middlemen and MSME processors), two government representatives (agricultural extension officers and plantation officials), one representative of a local NGO and one customary/community leader. Also joining the participants were women and young community members actively involved in coconut farming and downstream coconut processing activities. The informants in this study have characteristics as independent coconut farmers or members of the coconut farming community who own their land, depend on natural resources, and carry out traditional agricultural lifestyles and systems.

We collected the data for this study through observation, in-depth interviews, and documentation. Interviews were conducted using a semi-structured interview guide and lasted generally between 60 and 120 minutes. The interview themes were on coconut cultivation practices, institutional dynamics, market access, technology adaptation, local knowledge, community empowerment and sustainability of coconut farming businesses. All interviews were audio-recorded with the consent of the participants and transcribed verbatim to allow for coding and thematic analysis. We then analyzed the obtained data using the Miles and Huberman model, which encompassed data reduction, data presentation, and the repeated conclusion drawing model, which included data reduction, data presentation, and repeated drawing of conclusions (Sugiyono, 2013). All participants were informed about the purposes of the research before data collection and had voluntarily agreed to participate by giving informed consent. During the analysis and reporting, all informants were anonymised and assigned identification codes to ensure confidentiality. The research was conducted with the approval of the respective village authorities, local government institutions and community leaders at each research site.

The validity of the data is strengthened through triangulation techniques so that the results of the study are expected to produce a comprehensive picture of the social, cultural, economic, and institutional practices of coconut farmers that have the potential to be developed as a social engineering model based on independent and sustainable community empowerment (Nurfajriani et al., 2016). Data collection stopped when theoretical saturation was reached; that is, when no new relevant themes or categories emerged from further interviews. Thirteen informants were considered sufficient as they represented all major stakeholder groups in the coconut farming system in the three study regions and provided

convergent information on institutional conditions, community empowerment practices, technological adoption, and business sustainability.

RESULTS AND DISCUSSION

Geographical and Socio-Economic Conditions of Smallholder Coconut Plantations in East Sumatra

Figure 1 shows the geographical distribution of the study area and the detailed locations of field observations made by researchers using the SW Maps Application during their field work in 2025. The study was conducted in three major small-scale coconut producing areas along the east coast of Sumatra, namely Indragiri Hilir Regency (Riau Province), Asahan Regency (North Sumatra Province) and Sabang City together with Aceh Besar Regency (Aceh Province) as presented in Figure 1A. These sites were chosen purposefully because they differ in terms of ecological characteristics, socio-economic conditions and institutional arrangements of coconut farming communities which serve as basis for comparison for the analysis of community-based social engineering. Figure 1. Geographic Distribution of Study Areas in Community-Based Coconut Farming along the East Coast of Sumatra Explanation: Overview Map of the Study Area in Sumatra Island; Research Locations in Indragiri Hilir Regency, Riau Province; Research Locations in Asahan Regency, North Sumatra Province; Research Locations in Sabang City and Aceh Besar Regency, Aceh Province.

The geographical and socio-economic conditions of the coast of East coast of Sumatra show the vital role of coconut farming as the primary livelihood and socio-cultural foundation of coastal agrarian communities. “*Negeri Seribu Parit*” has a distinctive geographical character in the form of swampy lowlands with a wide network of rivers and canals. This ecological condition makes coconut plantations not only a superior commodity but also a social and economic identity of the local community. Based on the data (Badan Pusat Statistik, 2025), the area of deep coconut plantations in this area reached 303,906 hectares with a production of 265,068.61 tons, while hybrid coconuts reached 38,044 hectares with a production of 48,465.96 tons. Researchers conducted direct observations in four main sub-districts, namely Gaung Anak Serka (Teluk Pinang Village), Tembilahan Hulu (Palas Island Village), Tanah Merah (Sungai Nyiur Village), and Enok (Pantai Seberang Makmur Village), which represent the geographical and socio-economic diversity of coconut farmers. These villages represent the geographical and socio-economic diversity of coconut farmers, where the canal (parit) system remains the foundation of agricultural production, transportation, and collective community.

As shown in Figure 1C, Asahan Regency is known as one of the strategic coconut-producing areas on the east coast of North Sumatra, with fertile lowland geographical conditions and a tropical climate that is very supportive for the growth of coconut plants. Based on K. A. Badan Pusat Statistik (2025), coconut production in 2024 will reach 19,327.81 tons from a land area of 20,820.19 hectares, with Sei Kepayang, East Sei Kepayang, and Tanjung Balai Districts as the main centers. The results of field research in Silau Laut District (Silau Lama Village and Silo Bonto Village) and Sei Kepayang District (Central Sei Kepayang Village) show that these two areas have great agrarian potential, where Silau Laut recorded the largest area of community coconut plantations (6,623 ha) and Sei Kepayang has the highest copra productivity (3,978 tons). Socio-economically, the village community has depended on the cultivation and processing of coconuts for generations with a collective work system. Coconut commodities play a role as a support for the economy as well as the socio-cultural identity of the coastal communities of Asahan, which are agrarian, independent, and adhere to the values of solidarity and local wisdom.

Figure 1D presents the research in Aceh Province focuses on Sabang City and Aceh Besar Regency, which represent the socio-economic character of rural communities in coastal areas. Based on data from the Badan Pusat Statistik (2025), the plantation sector is dominated by clove and coconut crops, with the area of smallholder coconuts tending to decrease from 2,099 hectares in 2020 to around 2,080 hectares in 2023, while coconut production is relatively stable in the range of 575–634 tons per year. The research was conducted in Anoe Itam Village, Suka Jaya District, a coastal area with a wet tropical climate with around 1,840 smallholder coconut farmers who depend on coconut cultivation and its derivative products such as young coconuts and crested coconuts. Meanwhile, in Ujong Keupula Village, Seulimeum District, Aceh Besar Regency, there is a certified mother coconut plantation center



a



b



c



d

Figure 1. Geographical Distribution of the Study Areas in Community-Based Coconut Farming along the East Coast of Sumatra: (a) Overview of the Study Areas on Sumatra Island; (b) Field Observation Sites in Indragiri Hilir Regency; (c) Field Observation Sites in Asahan Regency; and (d) Field Observation Sites in Sabang City and Aceh Besar Regency (Field survey Desky et. al using SW Maps application, 2025)

supervised by the Plantation Seed Supervision and Certification Center under the Ministry of Agriculture. Based on data from Badan Pusat Statistik (2024), the area of coconut plantations decreased from 14,809 hectares in 2020 to 12,462 hectares in 2023, with smallholder coconut production also falling from 7,764 tons to 5,469 tons.

These results indicate ongoing difficulties in plantation regeneration and sustainable management, although coconut farming remains the backbone of rural livelihoods and a vital part of the socio-cultural identity of coastal communities in Aceh. Besides a technological constraint, the persistence of traditional farming practices is a matter of coconut cultivation since it is an integral part of traditional farming, local ecological knowledge and family identity; production choices are strongly shaped by community norms and intergenerational learning. Thus, farmers tend to adopt technological innovations in a phased manner through trusted local institutions, extension officers and respected community leaders and not solely through market-driven considerations.

The spatial distribution (Figure 1) shows that the selected study sites represent different ecological settings, institutional arrangements and socio-economic characteristics of smallholder coconut farming communities. These geographical differences constitute the empirical basis for the comparative analysis carried out in this study to identify the context-specific patterns of community empowerment and to develop a community-based social engineering model to improve the sustainability of coconut farming in the east coast of Sumatra.

Overall, the three study regions show different geographic and socio-economic characteristics, and the sustainability of coconut farming is influenced by the structural constraints and agency of farmers. Limited market access, weak farmer organisations and unequal control over economic resources have reinforced dependence on middlemen, but at the same time social capital, kinship and local institutions offer mechanisms through which farmers negotiate these constraints. From the perspective of Giddens' structuration theory, farmers are continuously reproducing and transforming these social relations through their daily practices. In the same vein, Bourdieu's notion of economic, social and cultural capital is useful in explaining how differential access to resources creates unequal bargaining positions among coconut farming households. These findings imply that establishing farmer institutions and collective marketing mechanisms is not only an economic intervention but also a process of transforming rural social relations by empowering communities.

The Potential of Coconut Cultivation in the Upstream Sector and Coconut Diversification in the Downstream Sector

In Indonesia, there are three main types of coconuts, namely deep coconut, genjah coconut, and hybrid coconut, with around 50 varieties that have been developed and commercialized, opening up investment opportunities in the downstream sector through the use of the characteristics of each variety (Bappenas, 2024). Information about coconut varieties is important for land conservation, production sustainability, and increased productivity. Deep coconut has thick flesh and high water, suitable for oil, coconut milk, copra, and VCO; coconut genjah bears fruit quickly, ideal for coconut sugar production; while hybrid coconuts from crosses offer high-quality fruit and greater productivity. Guidelines for coconut cultivation are regulated by the Regulation of the Minister of Agriculture number 130 of 2013, covering climate and land standards, the use of SNI seeds, tree rejuvenation, and the implementation of polyculture systems to improve land efficiency and farmers' incomes.

Field observation, in-depth interviews with coconut farmers, farmer group leaders, extension officers and local government officials, and document analysis showed different patterns of upstream coconut cultivation across the three study sites. The management of coconut nurseries in Indragiri Hilir Regency is a combination of traditional practices and institutional support through Selected Parent Trees (SPT), community-based replanting programs, and technical assistance from private companies, which together help to create a more independent and sustainable seed production system. In Asahan Regency, the management of nurseries is still mostly traditional and household-based, while the dissemination of improved seedlings is hampered by weak farmer institutions, land conversion into oil palm plantations, and limited market coordination. But the government's training program and the availability of certified superior seedlings are opportunities to increase community empowerment. In the meantime, with the collaboration of the farming communities, the local government and the agricultural extension agency, Sabang City and Aceh Besar Regency have developed Lampanah coconut as a certified local superior variety. The institutional support has resulted in better seed quality and enhanced the relevance of

coconut cultivation to sustain local livelihoods. The empirical findings suggest that the success of upstream coconut development is not only dependent on biophysical conditions but also on the interaction of local knowledge, institutional capacity, and multi-stakeholder collaboration which improves community empowerment and sustainability of coconut farming systems (Jatnika et al., 2024; Sambodo et al., 2023).

In the downstream sector, almost all parts of coconut have useful value, although utilization in Indonesia is still dominant in basic products such as copra and crude oil. Diversification of derivative products, ranging from oil, shell charcoal, and briquettes to coconut flour, has the potential to increase farmers' incomes, create jobs, and strengthen agriculture's contribution to national GDP (Bappenas, 2024). Optimizing the coconut sector requires the collaboration of farmers, the government, and the private sector through training, technology access, incentive policies, and sustainable product research and innovation so that coconuts can become a leading commodity that supports the local economy and strengthens Indonesia's position in the global market.

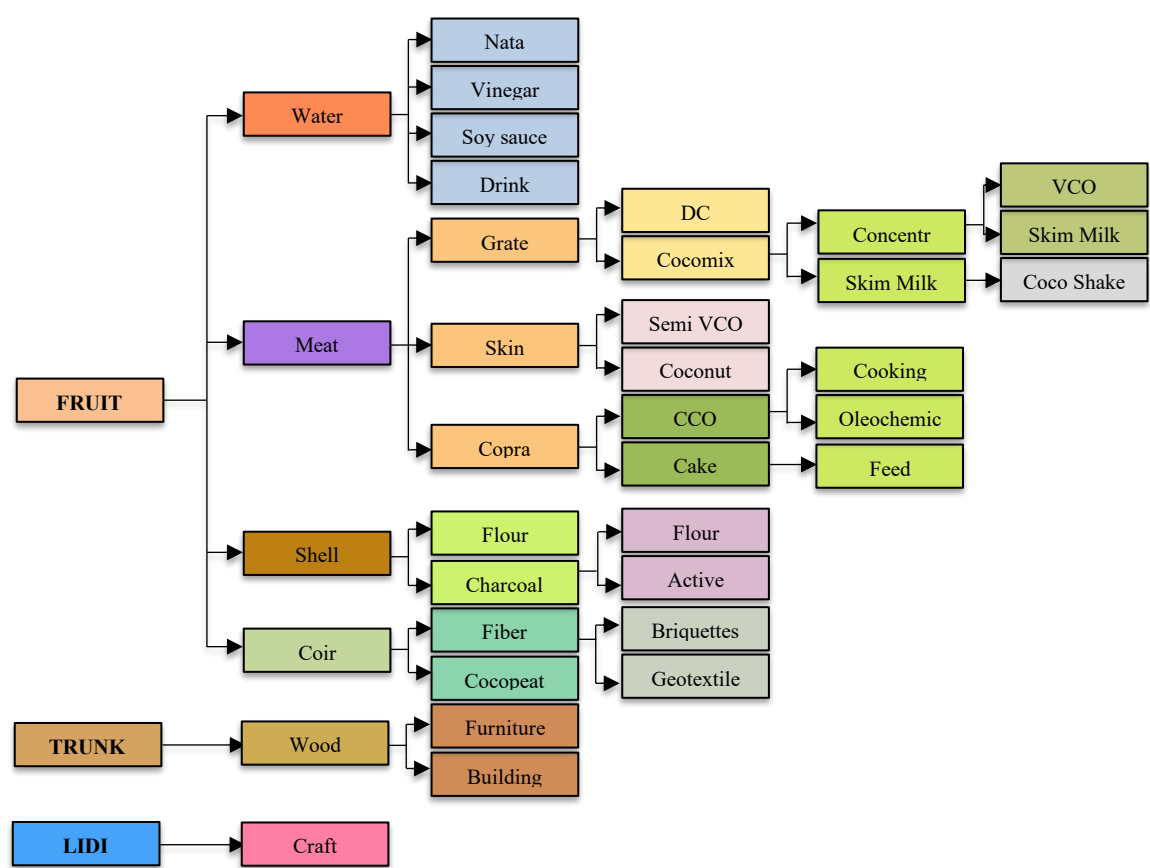


Figure 2. Coconut Diversification Products (Dai, 2018)

Figure 2 shows the entire chain of coconut product diversification with the use of almost all parts of the tree, ranging from fruits to stems to skewers. Thus, almost all parts of the coconut tree have the opportunity to increase significant added value. The researcher's visit to three regions of East Sumatra in the downstream sector revealed that coconut diversification varies according to local characteristics. In Indragiri Hilir, coconuts are used for a range of purposes, from fresh fruit to copra, which focuses on round coconuts, crest coconuts, dried copra processing, and other processed products that are distributed on a large scale, such as “*tokeh besar*,” private companies for export. In Asahan, diversification is wider, including round fruits, wet copra, coal, and fibres for MSME handicrafts, with the involvement of various levels of society in the value chain. Meanwhile, in Aceh, the prominent coconut diversification is young coconuts, Lampanah coconut seeds, and MSME products such as Coco's Chips Sabang that are connected to the tourism sector. All three locations show variations in coconut utilization from direct consumption to value-added processed products, marking different opportunities in local economic empowerment.

Potential for Community-Based Social Engineering in Coconut Farming Communities along the East Coast of Sumatra

The section examines the potential for developing a community-based social engineering model among coconut farming communities in three coastal areas of eastern Sumatra: Indragiri Hilir Regency in Riau, Asahan Regency in North Sumatra, and Sabang City and Aceh Besar Regency in Aceh. Rather than treating the three sites as directly comparable cases, the analysis identifies context-specific patterns of social relations, institutional conditions, community capabilities, and adaptive practices that may provide the basis for collective socio-economic transformation and sustainability of coconut farming. The proposed model is grounded in the lived experiences of coconut farmers who continuously negotiate structural constraints in production, marketing, institutional participation, and access to technology. In Indragiri Hilir, for example, farmers described their dependence on local traders not simply as an economic relationship but also as a form of social and financial interdependence:

“We sell our coconuts to the tokeh because they are the only ones who come to the village regularly and give us loans when our families are in urgent need of money. Even if the market price somewhere else is higher, we are often stuck with them due to debts from the past and long-standing relationships.” (WAG, Farmer Indragiri Hilir, 13/09/2025)

In this study, social engineering refers to a participatory process through which existing social relations, local institutions, knowledge systems, and community capacities are reorganized into collective arrangements that enable farmers to address structural constraints and strengthen the sustainability of coconut-based livelihoods. Thus, social engineering does not imply replacing existing community practices but rather transforming and institutionalizing locally embedded capacities to support more collective, participatory, and economically empowering arrangements.

The analysis subsequently synthesizes the empirical findings into five analytically interconnected dimensions that underpin the proposed community-based social engineering model: social capital, institutional capacity, human capital, technological capacity, and community empowerment. These dimensions represent the broader domains through which the empirical patterns identified across the study sites can be organized and interpreted. Social capital encompasses trust, social networks, reciprocity, and collective norms; institutional capacity concerns the effectiveness of farmer groups, cooperatives, extension services, and government support; human capital refers to farmers' knowledge, technical skills, leadership, and capacity for innovation; technological capacity encompasses technology adoption, access to information, digital literacy, and post-harvest innovation; and community empowerment concerns participation, collective decision-making, capacity building, and self-reliance. These dimensions are understood as mutually reinforcing conditions that may support product diversification, household welfare, and the long-term sustainability of coconut farming. This framework is consistent with recent studies on community-based rural development that emphasize social capital, institutional strengthening, and community empowerment in sustainable rural transformation (Sambodo et al., 2023).

Analytical Framework on Social Engineering Development

To avoid purely descriptive comparison between study sites, an analytical framework was developed to identify the empirical dimensions underlying the potential for community-based social engineering. The ten analytical aspects presented in Table 1 were not treated as predetermined variables. Rather, they emerged from an iterative analysis of the empirical data and were used to capture how social engineering potential was manifested in the different study contexts. The analysis involved three interconnected stages: open coding, axial coding, and selective coding, drawing on constructivist grounded theory principles (Charmaz, 2017).

First, interview transcripts, field observations, and focus group discussions were coded line by line to identify recurring concepts related to community empowerment, institutional conditions, technological adaptation, social relations, and socio-economic transformation. Similar codes were then grouped into broader categories through axial coding by examining their relationships and patterns across the empirical material. Through selective coding, these recurring categories were integrated into ten analytical aspects that capture the principal areas in which the potential for community-based social engineering was expressed across the three study sites.

Table 1. Analysis of the Social Engineering Potential of Coconut Farmers in Three Regions of East Sumatra

Analysis Aspect	Indragiri Hilir Regency (Riau)	Asahan Regency (North Sumatra)	Sabang City and Aceh Besar Regency (Aceh)
Socio-Ecological Context	The ecology of swamps and peatlands with a " <i>trench system</i> " forms a solid agrarian and coastal culture and cooperation, but it is weakened due to modernization and dependence on middlemen.	Lowlands with traditional agrarian patterns with the value of cooperation are still strong but have not been formally institutionalized.	Coastal areas, which rely on traditional systems, experience unstable production due to a lack of replanting and technology.
Main Problems	The primary issues include the deterioration of social institutions due to the loss of the <i>Kepala Parit</i> function, reliance on intermediaries, and a low level of digital and financial literacy.	Farmer groups are weak, knowledge of agricultural technology is limited, and there is a lack of innovation and collaboration between parties.	Dependence on traditional planting patterns, weak institutions, limited capital and innovation, and coordination between government agencies and coconut farmers is limited.
Social Engineering Focus	Social engineering focuses on revitalizing institutions, integrating local wisdom with technology, and bolstering cooperative-based economies.	The focus is on modernizing traditional agriculture, establishing farmer institutions, and enhancing the economy through BUMDes/cooperatives.	The strategy involves the integration of superior seeds, diversification of coconut products, and the strengthening of government institutions and policies.
Key Enablement Strategies	The key strategies include the establishment of participatory agrarian cooperatives, the establishment of coconut tree schools, and the digitalization of marketing.	The strategies include the formation of village farmer groups, the implementation of modern agricultural training, and the diversification of coconut products.	The efforts are focused on strengthening the access to certified superior planting material, providing training in coconut processing, integrating replanting policies, and digitalizing marketing.
The Role of Local Social and Cultural Capital	Social capital, mutual cooperation, and solidarity "trenches" are the foundation of institutional revitalization and collective work.	The value of togetherness, along with the tradition of planting coconuts passed down through generations, serves as the foundation for social engineering rooted in local wisdom.	The synergy of local knowledge (seed selection, planting patterns) and modern techniques strengthens the agrarian social identity.
Economic and Institutional Aspects	Diversification of coconut businesses based on the circular economy strengthens the bargaining position of farmers against middlemen.	The strategy involves diversifying coconut products, establishing BUMDes or coconut commodity cooperatives, and enhancing access to capital and entrepreneurship training for village communities.	The downstream sector should focus on diversifying coconut products, collaborating with agritourism, and receiving government support for seeds and market access in the upstream sector.
Education and Technology Dimension	The education and technology dimension prioritizes digital-financial literacy and the recording of production and marketing activities.	Young farmers receive agribusiness education and counselling, which is based on simple agricultural technology.	Entrepreneurship technical education is integrated with field data-based research and empowerment.
Forms of Social Engineering Innovation	Tradition-based socio-economic system and participatory modernization; Collective Ecological Ditch Management Forum.	The forum facilitates the transformation of collective awareness, fosters collaboration between farmers and the government, and promotes village-based innovations.	Upstream and downstream integrative models through strengthening superior seeds, product innovation, and multi-actor coordination of regional policies.
Implications for the Welfare of Farmer Families	This approach leads to an increase in independence, economic stability, and ecological sustainability, all of which are founded on social solidarity.	Local economic independence is formed, young farmers are regenerated, and collective income is increased.	This initiative aims to boost farmers' productivity, enhance their product quality, uphold family values, and fortify the socio-economic identity of coconut farmers.
Sustainability Orientation	Empowerment based on community collaboration and ecological adaptation.	The focus is on strengthening social institutions and transforming agricultural culture.	The integration of technology, policy, and innovation is crucial for the development of sustainable coconut systems.

Source: Primary Data (2025)

The identified analytical aspects are: (1) socio-ecological context, (2) main problems, (3) social engineering focus, (4) key enablement strategies, (5) role of local social and cultural capital, (6) economic and institutional aspects, (7) education and technology dimensions, (8) forms of social engineering innovation, (9) implications for household welfare, and (10) sustainability orientation. These aspects were identified across the three study sites, although their empirical manifestations varied according to local socio-ecological conditions, institutional arrangements, and community capacities. They were subsequently empowerment theory, social capital theory, and literature on rural institutional development (Brown & Westaway, 2011; Jatnika et al., 2024; Sambodo et al., 2023). Table 1 therefore represents an analytical synthesis based on the empirical field rather pre-established classification.

The findings presented in Table 1 indicate that the potential for community-based social engineering is manifested differently across the three study sites, reflecting variations in socio-ecological conditions, institutional arrangements, and community capacities. Rather than representing three directly comparable cases, each site reveals particular social relations, institutional practices, and adaptive capacities that shape the possibilities for collective transformation in coconut farming.

In Indragiri Hilir, the potential of social engineering is strongly linked to the revitalization of local institutions and the restructuring of farmers' relationships with traders. Each community has its own *Kepala Parit*, which is the actor who leads a community of coconut farmers historically considered capable of nurturing, organizing and responsible collective activities as well as maintaining social relations between coconut farmers. However, its institutional function has weakened while farmers remain dependent on local traders for marketing and short-term financial support. This dependence suggests that the relationship between farmers and traders is not solely economic but also embedded in social and financial relationships. A trader further explains how this local network operates in practice:

"If there are coconuts, we first call the farmers. Sometimes we pick up a lot of coconuts. If the location is far away, we use pompong to transport it." (TA, Coconut Trader Indragiri Hilir, 14/09/2025).

This finding suggests that strengthening farmer institutions in Indragiri Hilir cannot focus solely on market access. It also needs to consider the social and financial functions currently provided by traders. The potential for social engineering therefore lies in strengthening collective institutions that can provide alternative mechanisms for marketing, information exchange, and mutual support while retaining locally embedded social relations.

In Asahan, the findings indicate that the potential for social engineering lies in strengthening existing social cohesion and translating it into more institutionalized forms of collective action. Coconut farming is closely embedded in local livelihood practices and community relations. One farmer explained:

"Even though I have retired from my job as a civil servant, I still choose to be a coconut farmer. Most of our neighbours here are also coconut farmers." (AGS, Farmer Asahan, 22/09/2025)

This statement illustrates that coconut farming is not merely an economic activity but is also embedded in local social relations and continuity of livelihood practices. However, social proximity does not automatically translate into strong collective institutions. Farmer groups and village institutions such as BUMDes may therefore provide mechanisms for converting existing social cohesion into collective economic activities, including joint marketing, knowledge exchange, and capacity development.

The technological dimension in Asahan further demonstrates the importance of gradual and socially embedded innovation. Farmers expressed willingness to adopt new technologies when they were affordable, accessible, and supported by continuous assistance:

"We are willing to try new techniques if they are easy and cheap and have been successful with other farmers. Training alone is not enough, we need regular support until we are confident to use the technology by ourselves." (UM, Toke is also a coconut farmer, Asahan, 23/09/2025).

This evidence indicates that technology adoption is influenced not only by the availability of technology but also by trust, demonstration effects, affordability, and sustained institutional support. Technological capacity therefore needs to be developed together with human capital and social capital rather than treated as an isolated intervention.

In Sabang and Aceh Besar, the potential for social engineering is more strongly associated with improving productivity, strengthening the coconut value chain, developing superior planting materials, and enhancing coordination between farmers and government institutions. Farmers identified limitations in government support, particularly the absence of continuous assistance after the distribution of planting materials. As one farmer stated:

“The government usually only provides seeds. In fact, we also need fences, extension assistance, and continuous supervision because young plants are often damaged by wild boars.” (KPL, Farmer Aceh Besar, 27/09/2025).

The statement highlights that access to inputs alone may be insufficient to strengthen farmers' productive capacity. Institutional support needs to extend beyond the provision of seedlings to include technical assistance, monitoring, and locally appropriate infrastructure. The importance of institutional coordination is also evident in the process of obtaining certified planting materials:

“I selected the seedlings myself, then the officers came to the garden to check and assess before getting the certification.” (KPL, Farmer Aceh Besar, 27/09/2025)

This experience indicates that farmers can participate actively in institutional processes when appropriate mechanisms for interaction and verification are available. Such practices provide a potential basis for strengthening human capital, technological capacity, and institutional capacity simultaneously. Across the three study sites, the thematic analysis reveals several common patterns despite their contextual differences.

First, all three areas face structural constraints related to weak farmer institutions, limited technological adoption, and dependence on established marketing systems. However, the specific expression of these constraints differs across locations: institutional decline in Indragiri Hilir is associated with the weakening of the *Kepala Parit* system and dependence on traders; in Asahan, the central challenge concerns the weak institutionalization of existing social cohesion; while in Sabang and Aceh Besar, productivity and value-chain development are constrained by technological limitations, limited productive support, and weak coordination between government institutions and farmers.

Second, community empowerment consistently emerged as an important mechanism for strengthening the potential for social engineering. Across the three sites, empowerment was manifested through collective participation, institutional renewal, farmer capacity building, and co-innovation. This finding supports recent research emphasizing the relationship between community empowerment, social capital, and sustainable rural transformation (Jatnika et al., 2024; Sambodo et al., 2023).

Third, social capital emerged as an enabling foundation for social engineering. Trust, reciprocity, local knowledge, and social networks provide important resources for strengthening institutions, adapting technologies, and developing diversified economic activities. This finding is consistent with rural development research highlighting the role of social capital in strengthening the adaptive capacity and collective resilience of agricultural communities (Sambodo et al., 2023).

Taken together, these findings indicate that the potential for community-based social engineering cannot be understood as the result of technological intervention or government programs alone. Rather, it is shaped by the interaction of social capital, institutional capacity, human capital, technological capacity, and community empowerment. The empirical findings therefore provide a basis for synthesizing these five dimensions as the broader conceptual foundation of the proposed Community-Based Social Engineering Model. In this framework, the ten analytical aspects presented in Table 1 represent the empirical domains through which these five dimensions become visible across the study sites. The proposed model consequently conceptualizes social engineering as a continuing process of strengthening and reorganizing existing community capacities into more collective, participatory, and institutionally supported arrangements for sustaining coconut-based livelihoods.

Analysis of the Sustainability of Coconut Farmers' Businesses in Three Regions of East Sumatra

Coconut farming families face complex dynamics ranging from price fluctuations and limited market access to dependence on traditional business patterns. However, social forces emerged, including community solidarity, the role of women, and social innovations that strengthened the socio-economic resilience of coconut farming families. To gain a more profound understanding, the researcher will present the results of the analysis of the three regions of East Sumatra as follows.

Business Sustainability and Welfare of Farmer Families in Indragiri Hilir Regency. The table below will describe the findings of the research that highlight the key aspects in the sustainability of the smallholder coconut business in Indragiri Hilir Regency.

Table 2. Business Sustainability and Welfare of Coconut Farmers in Indragiri Hilir Regency

Aspects	Key Findings	Implications for Farmer Welfare
Regional Conditions	Peatland ecosystem; high dependence on water management.	Livelihood depend on ecological adaptation.
Nursery and Production	Combination of traditional nurseries and certified seed programmes.	Higher productivity and production sustainability.
Social Institutions	Weak farmer organisations; declining collective action.	Institutional strengthening improves bargaining power.
Economic Structure	Dependence on middlemen; unequal profit distribution.	Cooperatives can increase farmers' income.
Technology and Market Access	Limited mechanisation and digital marketing..	Technology adoption creates higher value-added products.
Government Support	Training, certified seeds, and institutional collaboration..	Expands economic opportunities and business sustainability.

Source: Primary Data (2025)

Based on Table 2, the sustainability of the people's coconut business in Indragiri Hilir Regency not only focuses on increasing productivity but also reflects socio-economic transformation that relies on local adaptation and institutional innovation. The researcher designed a social engineering model in Indragiri Hilir Regency to enhance the welfare of the coconut ecosystem, which can be applied across both upstream and downstream sectors.

In the upstream sector, this model is divided into two aspects, namely the aspect of activities that are directly related to agricultural production on the land (on-farm) and the aspect of activities related to agricultural products but carried out off-farm. The on-farm aspect includes cultivation assistance, garden management, mechanization, plant rejuvenation, and farmer and government collaboration. The off-farm aspect includes strengthening the value of cross-generational management, support for young farmers, access to finance, land law assistance, and strengthening coconut farmer groups.

In the downstream sector, strengthening small- and medium-sized agribusinesses is carried out through technical, managerial, and financial training; increasing access to financing; developing a young business ecosystem; and advocating for regional regulations. This synergy between sectors forms a development model that encourages independence, innovation, and sustainability of the coconut ecosystem at the local and national levels.

Social Engineering in the Sustainability of People's Coconut Business: A Case Study in Asahan Regency. The Table 3 presents unique field findings, highlighting the presence of women and child workers who contribute to their family's survival strategy as participants in the coconut value chain, illustrating the social and moral dimensions of sustainability in smallholder coconut plantation businesses.

Based on the findings in Table 3, the sustainability of the smallholder coconut business in Asahan Regency has an important role in supporting the rural economy and the welfare of farmer families. However, the abundant natural potential has not been supported by an efficient and fair production system. Based on the table, the researcher designed a social engineering model in Asahan Regency aimed at improving the welfare of the coconut ecosystem, which can be applied to both upstream and downstream sectors.

In the upstream sector, the on-farm aspect includes assistance in the cultivation and management of coconut plantations, collective replanting of old trees based on mutual cooperation, maintenance of garden infrastructure with the government, application of local technology such as beko trenches, organic fertilizers, and intercropping, as well as advocacy for regional policies to prioritize the coconut sector. The off-farm aspect emphasizes changing the mindset of farmers to become entrepreneurs, the role of local leaders and youth as agents of innovation, a family work system without child labor, and strengthening solidarity through farmer groups and cooperatives. In the downstream sector, strengthening agribusiness is achieved through cooperatives or BUMDes, the regeneration of young farmers based on agripreneurship, product diversification, collaboration among various parties, women's empowerment, and the elimination of child labor.

Table 3. Business Sustainability and Welfare of Coconut Farmers in Asahan Regency

Key Aspects	Field Findings	Research Analysis	Implications for the Welfare of Farmer Families
Regional Conditions	Fertile land and climate are supportive, but management is still traditional.	The enormous potential has not been utilized optimally due to limited technology and capital.	Family income is not stable; welfare is low.
Cultivation System	The cultivation system is plagued by numerous old coconut trees that lack replanting or scientific care.	Productivity decreases due to limited agricultural knowledge.	Income decreased, triggering family economic dependence.
Minor Workers	Children help with the harvesting and processing of copra.	The family's economic strategy is to reduce costs, but it violates social principles.	This approach comes at the cost of children's education and exacerbates structural poverty.
Farmer Institutions	There are no active farmer cooperatives or groups.	The weakness of social capital lowers the bargaining position of farmers.	Access to capital and training is minimal, and collective welfare does not increase.
Government Policy	The government focuses on palm oil and rice, while coconut has received less attention.	There is a policy gap between potential and government support.	Farmers find it difficult to develop, and economic inequality is increasing.
Farmer Regeneration	Younger generations are hesitant to cultivate coconuts, and they are converting a significant portion of land to palm oil.	It shows the crisis of regeneration and the declining attractiveness of agriculture.	This situation poses a threat to both the sustainability of the village economy and the stability of farmer families.

Source: Primary Data (2025)

Business Sustainability and Welfare of Farmer Families in Sabang City and Aceh Besar Regency. Table 4 analyses aspects of field findings, key findings, research interpretation, and their impact on the welfare of farmer families to gain a comprehensive understanding of how sustainable coconut plantation businesses improve the welfare of farmer families.

Table 4. Business Sustainability and Welfare of Coconut Farmers in Sabang City and Aceh Besar Regency

Aspects of the Findings	Key Findings	Research Analysis	Implications for Family Well-Being
Regional Conditions	The land is suitable for coconut, but production fluctuates.	Management is not yet optimal and still depends on the season.	Family income is unstable; a sustainable management strategy is needed.
Traditional Management Systems	Farmers still use the hereditary planting method.	Low innovation reduces productivity.	Welfare is stagnant; it is necessary to adopt simple technology.
Lampanah Coconut Varieties	Superior varieties with high demand.	Great potential for the development of certified seedlings.	It is a new source of stable income for farming families.
Production and Ecological Challenges	Pests, extreme weather, and water limitations pose significant challenges.	Ecological resilience is weak; adaptive innovation is needed.	The decline in crop yields has a direct impact on the family economy.
Market Access and Distribution	The sale of seeds depends on the government.	Market attachment is high; the bargaining position of farmers is weak.	If managed by a cooperative, income can be more stable and independent.
Local Wisdom and Social Adaptation	Farmers still rely on local knowledge.	The value of tradition is the social capital of sustainability.	This strengthens the social and economic resilience of farmer families.

Source: Primary Data (2025)

Table 4 shows that the sustainability of coconut farming is not only determined by land productivity and crop yields but also by farmers' social capacity, economic innovation, and ecological adaptation. The researcher designed a social engineering model in Sabang City and Aceh Besar Regency to improve the welfare of coconut ecosystems from upstream to downstream. The on-farm aspect includes adaptive cultivation, superior varieties of Lampanah, simple technology, institutional strengthening, local wisdom, pest control, farmer regeneration, and digital recording. Off-farm aspects include capacity building, group independence, innovative mindsets, local-modern knowledge integration, market expansion, regeneration of young farmers, and social rewards for outstanding farmers.

Meanwhile, in the downstream sector, the engineering model is based on strengthening the small/medium-scale agribusiness sector through the formation of cooperatives, the development of value-added processed products, the certification and branding of local varieties, the use of e-commerce, the revitalization of cooperation, family agribusiness management training, and cross-party socio-ecological partnerships for sustainability. Thus, the coconut socio-economic engineering model in Sabang City and Aceh Besar Regency strengthens the economic independence of farmers and creates a sustainable socio-ecological system.

Sociological Analysis of Business Sustainability and Farmers' Welfare

Through a cross-case comparison of the three study areas, the study presents that sustainability of coconut farming is driven by different socio-ecological contexts but facilitated by similar social mechanisms. In Indragiri Hilir, sustainability is improved through the revival of the traditional *Kepala Parit* institution and collective trench management that improve farmers' bargaining power and cooperative action. While strong communal values remain an important social asset in Asahan, weak farmer organizations and limited technological capacity reduce opportunities for collective economic transformation. On the other hand, the presence of certified Lampanah coconut varieties, government-backed extension programs, and a stronger integration of coconut production with tourism provide Sabang and Aceh Besar with more opportunities for product diversification and market expansion. The three regions similarly show that social capital, institutional capacity and community empowerment are the main drivers of business sustainability and farmers' welfare, despite the differences in context.

The empirical differences found in the three study areas can be explained by Giddens' structuration theory, which takes into account the constant negotiation of the agency and structural conditions by farmers in the production of sustainable livelihood strategies. The practice of economic transformation among coconut farmers is the result of a structuring process, namely a dynamic relationship between agency (farmers as reflective actors) and structure (rules and resources). In Anthony Giddens' conception, this transformation takes place through three domains: significance (meaning), dominance (control of resources), and legitimacy (norms). The duality of structure is seen when farmers in Indragiri Hilir reinterpret the identity of the "Negeri Seribu Parit" as the basis of economic independence, in Asahan they convert cultural heritage into collective agribusiness, and in Aceh they make Lampanah coconut a symbol of future resilience. The dominance structure can be seen from the mastery of technology such as the *Trio Tata Air* (embankments, ditches, valve doors) in Indragiri Hilir, the mechanization of beko/punggu in Asahan, and the control of certified seeds in Aceh Besar, which increases the bargaining position of farmers. The legitimacy structure has transitioned from informal rules, such as the *Kepala Parit*, to formal institutions like agrarian cooperatives, BUMDes, and national certification standards. This evolution has validated modern economic practices among farmers.

From Pierre Bourdieu's perspective, this transformation represents a redistribution of capital and a shift in habitus concerning coconut production. There has been a shift from the habitus of "subsistence farmers" to "agripreneurs" through the conversion of cultural capital (local knowledge) and social capital *gotong royong* into economic capital through product diversification and digital marketing. In Indragiri Hilir, the social capital of the ditch was revitalized into an institutional strength; in Asahan, economic capital is accumulated through the diversification of charcoal and white copra; while in Aceh, symbolic capital in the form of Lampanah variety certification is used to penetrate the national market. Thus, farmers are no longer passive but active in negotiating positions in the economic realm to reduce dependence on patrons or middlemen. Such differences indicate that the differences in farmers' welfare are not dependent on their economic assets but on the ability of the communities to mobilize social, cultural, economic and symbolic capital based on their local contexts.

The results are in general consistent with previous research that emphasizes the interdependencies of social capital, institutional capacity and community empowerment for the sustainable rural

transformation. Sambodo et al. (2023) argue that community-based rural development requires better institutions and collective action at the local level. Similarly, A. Kinseng (2017) also considers social change as the result of interaction between agency and structure (structurgency). Firmando et al. (2025) demonstrate how adaptive cultural strategies enable rural communities to reconfigure structural constraints. Moreover, Ikhwan et al. (2023) and Trimerani et al. (2024) highlight the importance of incorporating technological innovation, gender-responsive empowerment and institutional collaboration to improve livelihoods in rural areas. But this paper, through a comparison of three coconut-producing regions, shows that efficient social engineering is highly context dependent, while having common sociological mechanisms. This is different from the previous studies.

The sustainability of businesses and the welfare of farmers depend on the harmonization of family, institutional, and market functions. Community-based participatory institutions (bottom-up) have demonstrated greater effectiveness than bureaucratic methods in enhancing farmers' bargaining positions. They promote increased trust and collaboration among community members, which leads to better negotiation outcomes and improved access to resources. Bourdieu's framework illustrates how social capital, expressed through trust and mutual cooperation, becomes a symbolic force that enables access to economic opportunities. The transformation of cultural values also strengthens women's role in financial management and marketing, which is the key to family economic sustainability (Ikhwan et al. 2023), as it enables them to make informed decisions and contribute significantly to household income and resource allocation.

Business sustainability is the result of recursive interaction between agencies and structures. Farmers, acting as reflective agents, can negotiate structural boundaries by strengthening institutions and utilizing appropriate technology. This adaptability enables them to respond to changing market conditions and enhances their economic outcomes. Social structures, including community norms and profit-sharing systems, serve both as a medium and a result of social practices that can either limit or enable transformational actions. The welfare of farmers is attained through what is known as “embedded agency.” This concept involves the strategic use of cultural and social capital within the current structural framework. The use of certified seeds and participation in agrarian cooperatives reflect the use of authoritative and allocative resources to increase productivity and competitiveness. Thus, ensuring the sustainability of the coconut business involves a continuous and socially driven process.

Finally, this study shows that sustainability of coconut farming cannot be achieved by a top-down development approach but requires an inside-out transformation driven by local innovation, product diversification and adoption of appropriate digital technologies. More importantly, this study contributes to rural sociology by showing that sustainability of coconut cultivation is not only a technical or agricultural issue but a socially embedded process influenced by local institutions, patron-client relations, ecological adaptation, and transformation of social and cultural capital into economic capacity. Therefore, the well-being of farmers should be understood not only in terms of increased income, but also in terms of broader social outcomes, such as educational opportunities for children, stronger community resilience and collective capacity to respond to changing economic and environmental conditions. These findings add weight to the conclusion that agrarian sustainability is fundamentally based on empowerment, solidarity, institutional cooperation and adaptive social relations that enhance the autonomy and competitiveness of rural farming communities.

Cross-Sectoral Strategic Recommendations for Strengthening Social Empowerment of Coconut Farming Communities

The strategic recommendations in this section are based on the cross-case findings and sociological analysis presented in previous sections. Rather than general policy recommendations, the recommendations are a synthesis of empirical evidence from Indragiri Hilir, Asahan, and Sabang – Aceh Besar to strengthen community-based social engineering across the upstream and downstream coconut value chain. The recommendations are drawn from the inputs of five key actors: coconut farmers, farmer organizations, value-chain actors, government and private institutions, and community leaders.

The proposed recommendations are directly based on the empirical findings obtained across the three case studies as presented in Table 5. The revival of the traditional *Kepala Parit* and cooperative water management in Indragiri Hilir shows the need for strengthening local institutions as the main upstream strategy. Considering the weak farmer organization and limited technological capacity, in Asahan, institutional restructuring, entrepreneurship training and downstream product diversification are more

pressing than technological interventions alone. At the same time, the case of Sabang and Aceh Besar demonstrates how certified seed systems, government extension services, and tourism-oriented coconut processing can greatly enhance farmers' market opportunities. Hence, even if the recommendations vary from one region to another, they are always based on the empirical evidence generated by the three case studies and not on generic policy prescriptions.

Table 5. Strategic Recommendations Derived from Cross-case Findings on Community-based Social Engineering

Actor	Upstream Sector Recommendations	Downstream Sector Recommendations
Coconut Farmers	1) Developing local superior coconut seeds (such as Lamangan coconut) with technical assistance. 2) Apply adaptive replanting and simple technology for productivity. 3) Improve digital and financial literacy for recording results and market information.	1) Diversify coconut derivative products (copra, VCO, coconut flour, shell charcoal, coir). 2) Developing family microbusinesses based on processed coconut. 3) We are leveraging digital platforms to expand our marketing and distribution network.
Institutional (Farmer Group/ Cooperative/ Extension Officer)	1) Involved in the formation and strengthening of farmer groups or participatory agrarian cooperatives. 2) Organizing community-based training and counselling such as the "Coconut Tree School." 3) Manage certified breeding and breeding certifications.	1) Develop joint business units for product processing and collective marketing. 2) Become a facilitator of the distribution and export of farmers' products. 3) Implementing digital cooperatives that prioritize price and production transparency.
Value Chain Actors (Middlemen/ Traders/MSMEs)	1) Implement fair trade partnerships and transparent contracts with farmers. 2) Provide access to capital and logistics for partner farmers. 3) Invest in local breeding and sustainable replanting programs.	1) Encourage the development of MSMEs in local coconut processing. 2) Develop branding and packaging of local products (e.g., the coconut chips brand "Coco's Chips Sabang"). 3) Forming a cooperative partnership model between market participants and farmer groups.
Government/ Private Institutions/ NGOs	1) Develop community-based replanting policies with the participation of farmers. 2) Provide incentives and access to microfinance for cooperatives and smallholders. 3) Encourage collaborative research and innovation of local superior varieties.	1) Building post-harvest infrastructure and village logistics. 2) The process of drafting regulations for certification and digital marketing. 3) Organizing entrepreneurship training and facilitating access to export opportunities.
Community/ Customary Leaders	1) Revive traditional social functions such as the <i>kepala parit</i> and the cooperation system. 2) They are responsible for upholding the principles of community solidarity and serving as local ecological managers. 3) Encourage the regeneration of young farmers through the inheritance of local values and knowledge.	1) Initiating a cross-actor village social forum, which includes farmers, the government, and MSMEs as participants. 2) Promoting the incorporation of cultural identity in the branding of local coconut products. 3) The initiative aims to instil the values of social justice and moral economy into local trade practices.

Source: Primary Data (2025)

Based on the cross-case synthesis and sociological interpretation of the Results and Discussion, this study presents the Community-Based Social Engineering Model as an analytical model, not a universal policy model. The model was developed by combining empirical findings from the three study sites and the theoretical views of Giddens' Structuration Theory and Bourdieu's Theory of Capital. This model positions farmers as independent and innovative agents of social change through four sustainable stages: socialization and community participation to build critical awareness and social cohesion; strengthening

institutions and social capacity through the formation of farmer groups, cooperatives, and training; economic transformation through appropriate technology, product diversification, and marketing innovation; as well as the sustainability stage that emphasizes the regeneration of young farmers, the role of women, and environmentally friendly principles. Conceptually, this model is a participatory and adaptive social transformation process with a focus on institutions in Indragiri Hilir, economic diversification in Asahan, and innovation and sustainability in Sabang and Aceh Besar.

All the components of the proposed model are derived from the empirical results. The participation stage shows the high social cohesion and collective action that is evident in Indragiri Hilir through revitalization of the *Kepala Parit* institution. In Asahan, the need to strengthen institutions is reflected in improved farmer organizations, cooperative governance and entrepreneurship capacity. The main source of information for the economic transformation is downstream product diversification, particularly MSME development in Asahan and tourism-based coconut processing in Sabang. Finally, the sustainability stage is supported by evidence from Aceh on certified seed systems, youth regeneration, women's participation, and environmentally adaptive farming practices. Thus the model is not an abstract normative framework, but a synthesis of the three case studies.

CONCLUSION

The study indicates that local social and cultural capital can be converted into adaptable economic strength through the application of social engineering and community-based agrarian empowerment (an insider approach), resulting in a restructuring of farmers' habitus and transforming their subsistence mentality into an agripreneur. But this model is a kind of analytical framework, which is very dependent on the details of local ecological and sociological contexts. Efforts to revive local wisdom, such as the *Kepala Parit* system in Indragiri Hilir, the tradition of *gotong royong* in Asahan, and the Lampanah variety certification in Aceh, have succeeded in strengthening the role of farmers. However, fundamental structural barriers still constrain the sustainability of small-scale farming. These barriers include the community's historical reliance on middlemen due to debt bondage, low levels of digital and financial literacy, lack of post-harvest support infrastructure, and imbalances in macro policies that have given priority to other agricultural commodities over smallholder coconuts. Therefore, future studies need to evaluate the advantages and disadvantages of potential social engineering and empowerment strategies by considering how sociological factors such as the role of community institutions, social capital, economic practices, technological adaptation, and the knowledge capacity of coconut farmers affect the sustainability of coconut farming and enhance household welfare in both the upstream and downstream sectors. The major objective is to assess to what extent community-based social engineering is able to improve farmers' bargaining position in the face of market chain inequalities.

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