

Collaborative Governance Model in the Development of Coconut Shell Charcoal Downstreaming in Banyuasin Regency

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Abstract. *This study examines the collaborative governance model for the downstream development of coconut shell charcoal in Banyuasin Regency from a Quadruple Helix perspective. It explores how government, academia, business, and the community collaborate to promote sustainable industrial development based on local resources. A descriptive qualitative approach was employed using secondary data from scientific literature, institutional documents, previous studies, and collaborative governance frameworks related to coconut shell charcoal downstreaming and the Quadruple Helix model. The findings indicate that effective downstream development depends on strong collaboration among multiple stakeholders with complementary roles. The government serves as a regulator, facilitator, and coordinator through policy support, institutional strengthening, and MSME empowerment. Academia contributes through research, technological innovation, training, and human resource development to enhance product quality and competitiveness. Businesses play a strategic role in production, product diversification, distribution, and market expansion, while local communities and farmer groups ensure a sustainable supply of raw materials and strengthen community-based economic activities. The study also highlights participation, communication, trust, transparency, and accountability as essential principles of successful collaboration. Furthermore, downstream processing increases the economic value of coconut waste, generates employment, improves local incomes, and supports environmental sustainability. These findings emphasize the importance of strengthening cross-sector collaboration, institutional coordination, innovation, and market access to accelerate green economic transformation and sustainable local industrial development in Banyuasin Regency.*

Keywords: *Collaborative Governance, Quadruple Helix, Downstream, Coconut Shell Charcoal, Sustainable Development, Banyuasin Regency*

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INTRODUCTION

Sustainable development has become Indonesia's strategic foundation in realizing the vision of Golden Indonesia 2045 by prioritizing inclusive, competitive, and environmentally sustainable economic growth (Maqfirah & Laba, 2025; Zahira et al., 2024; Syavitra, 2025; Pangestika et al., 2026; Setyari et al., 2026). In this context, the development of local resource-based industries through the downstream processing of coconut shell charcoal possesses

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significant potential to increase community economic value while simultaneously supporting the transition toward a green economy. Indonesia, as one of the world's largest coconut-producing countries, has abundant coconut shell waste resources that can be transformed into high-value industrial products such as activated carbon, briquettes, and renewable energy materials (Vieira et al., 2024; Divate et al., 2026; Stelte et al., 2023).

Therefore, the downstreaming of coconut shell charcoal not only represents an alternative economic opportunity but also constitutes a strategic approach to optimizing local natural resources in a sustainable manner. From an empirical perspective, the development of coconut shell charcoal downstreaming continues to encounter numerous challenges. One of the primary issues is the low level of utilization of coconut shell waste, which remains largely underdeveloped despite its substantial economic potential (D'Almeida & de, 2025; Mim et al., 2026; Abuzar et al., 2026). In many regions, coconut shell waste is still discarded or burned conventionally without further processing into value-added products. In addition, the production process is frequently constrained by limited technological capacity and inadequate industrial infrastructure. Traditional production methods often result in inconsistent product quality, low productivity, and inefficiency in resource utilization. Consequently, locally produced charcoal products frequently struggle to compete in both domestic and international markets (Mensah et al., 2022; Irawan et al., 2025).

Another significant empirical problem concerns limited market access and investment opportunities. Small-scale producers and local communities often face difficulties in accessing broader distribution networks, export markets, and financial support mechanisms. The absence of integrated industrial ecosystems further weakens the competitiveness of coconut shell charcoal downstream industries (Hamid et al., 2026; Putri et al., 2024). Moreover, environmental pollution arising from traditional combustion processes remains a critical concern. Inefficient carbonization methods contribute to air pollution, greenhouse gas emissions, and environmental degradation, thereby contradicting the principles of sustainable industrial development and green economic transformation. From a theoretical perspective, existing studies on coconut shell charcoal downstreaming have predominantly concentrated on economic and production-oriented dimensions, including productivity improvement, market expansion, and industrial efficiency.

Nevertheless, there remains limited scholarly attention toward integrating collaborative governance and the Quadruple Helix approach in developing an innovative and sustainable governance framework for this industry (Wahyudi, 2026; Wirtz & Müller, 2023; Lepore & Spigarelli, 2018). The Quadruple Helix model emphasizes the synergistic interaction among four key actors: government, business sector, academia, and society. This approach is highly relevant because sustainable industrial development requires not only technological advancement and economic growth but also social participation, institutional coordination, and environmental responsibility. Therefore, the lack of comprehensive studies examining the role of collaborative governance in strengthening intersectoral cooperation constitutes a significant theoretical gap within the current literature (Sholeh et al., 2025; Such et al., 2022; Aivalli et al., 2025).

In terms of regulatory issues, the downstream development of coconut shell charcoal also faces several institutional and policy-related constraints. Existing technical regulations regarding waste management and environmentally friendly production standards remain insufficiently implemented. Furthermore, legal certainty concerning investment in downstream industries is still relatively weak, reducing investor confidence and limiting industrial expansion. Government policies supporting environmentally based industries have not yet been fully optimized, particularly in relation to incentives for green technology adoption, financing schemes for small and medium enterprises, and export facilitation programs. In addition, weak coordination among governmental institutions frequently results in fragmented policy implementation and overlapping administrative procedures, thereby reducing the effectiveness of downstream industrial development programs (Puspaningtyas, 2023; Whitfield & Buur, 2014).

The critical issue underlying this research lies in the absence of a collaborative governance model capable of effectively integrating the roles of government institutions, business actors, academic institutions, and local communities in supporting technological innovation, investment strengthening, community empowerment, and environmental management. Without effective collaboration among these stakeholders, the downstreaming of coconut shell charcoal risks remaining fragmented, inefficient, and environmentally unsustainable. In many cases, local communities lack adequate technical knowledge and financial capacity, while industries encounter obstacles in scaling production and ensuring environmental compliance (Mokhtar et al., 2024; Hajam et al., 2025). Simultaneously, academic institutions often possess research and technological innovations that are not optimally connected to industrial and community needs. This disconnect highlights the urgent necessity for an integrated governance framework capable of fostering cross-sectoral cooperation and collective problem-solving (Pranatayana et al., 2026).

Furthermore, collaborative governance based on the Quadruple Helix approach offers a strategic framework for promoting innovation-driven and sustainable industrial development. Through collaborative mechanisms, government institutions can formulate supportive regulations and facilitate investment opportunities; businesses can contribute capital, market access, and industrial expertise; academic institutions can provide research-based technological innovation and capacity building; while communities can actively participate in resource management and local economic empowerment. Such collaboration is essential for establishing a sustainable industrial ecosystem that balances economic productivity, social welfare, and environmental sustainability (Niu et al., 2023; Ghobakhloo et al., 2021; Camarinha-Matos et al., 2024).

Therefore, this study aims to analyze the Quadruple Helix-based collaborative governance model in the development of coconut shell charcoal downstreaming in order to create a competitive, sustainable, and environmentally oriented local industrial system capable of supporting green economic development at both regional and national levels. This research is expected to contribute theoretically by enriching the discourse on collaborative governance and sustainable industrial development, while practically providing policy recommendations for strengthening local resource-based industries in Indonesia (Dwiartama et al., 2018).

According to Maksum et al. (2020) and Wittman & Blesh (2017) collaborative governance in the development of coconut shell charcoal downstreaming refers to a collaborative process involving government institutions, the business sector, academia, and society in the formulation, implementation, and supervision of policies and programs aimed at increasing product added value and improving community welfare sustainably. This approach is important in strengthening local resource-based industries through environmentally sustainable industrial development. This research is motivated by several empirical problems in the downstream development of coconut shell charcoal, including the low optimization of coconut shell waste utilization, limited processing technology, weak investment access, low product competitiveness, and environmental pollution resulting from traditional production methods.

Although Indonesia possesses abundant coconut resources, the economic potential of coconut shell waste has not been maximally utilized to support sustainable local economic development. From a theoretical perspective, studies on collaborative governance in coconut shell charcoal downstreaming remain limited and are still dominated by discussions on cooperation between government and society. Previous research has not comprehensively integrated the Quadruple Helix approach, which emphasizes synergy among government, business, academia, and society in supporting sustainable industrial development. Therefore, this study aims to analyze collaborative governance based on the Quadruple Helix approach in the development of coconut shell charcoal downstreaming. The study is expected to provide a comprehensive understanding of cross-sector collaboration in strengthening environmentally

sustainable downstream industries while contributing to regional economic growth and community welfare improvement.

Theoretical Framework

The Triple Helix Theory was first proposed by Henry Etzkowitz and Loet Leydesdorff, emphasizing the relationship among government, business, and academia in fostering innovation and economic development. Over time, this theory evolved into the Quadruple Helix Theory by incorporating society as the fourth actor in the process of development and innovation. According to this model, the success of sustainable development is not solely determined by government institutions and economic sectors; rather, society and academia must also actively participate in establishing a collaborative, adaptive, and participatory system (Rianse et al., 2025).

The Quadruple Helix concept positions the government as the actor responsible for formulating regulations, developing policies, facilitating development programs, and supervising implementation processes. Meanwhile, the business sector plays a significant role in promoting investment, production, distribution, and market expansion through sectoral innovation aimed at increasing economic added value. Academia contributes to industrial sustainability through research activities, technological innovation, knowledge transfer, and human resource development. In addition, society functions as implementers, users, and social supervisors within the development process, thereby strengthening public participation and community-based economic empowerment. Through the integration of these four actors, the Quadruple Helix model seeks to create a sustainable governance system capable of encouraging innovation, strengthening economic competitiveness, and supporting environmentally sustainable development.

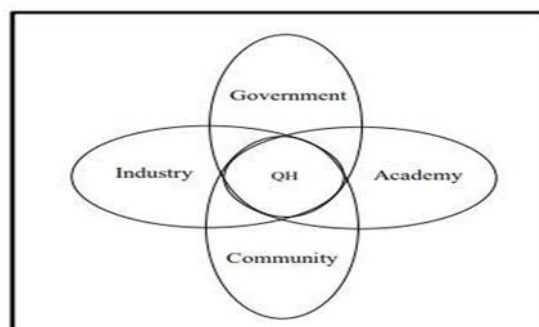


Figure 1. Teori Quadruple Helix

In the downstream development process of coconut shell charcoal in Banyuasin Regency, the Quadruple Helix Theory is utilized to examine the synergy among various stakeholders contributing to the growth of local resource-based industries. The development of coconut shell charcoal downstreaming is expected to create an innovative, competitive, and environmentally sustainable industry through collaboration among multiple actors. In this context, the government plays a role in supporting downstream industrialization policies and environmental control mechanisms, while the business sector contributes through investment activities, production processes, and market development. Academia supports the industry through technological innovation, research activities, and the development of human resources related to coconut shell charcoal processing technologies.

The Quadruple Helix Theory in this study is analyzed through four main indicators: (1) the role of government in regulation, facilitation, and supervision; (2) the role of the business sector in investment, production, and marketing; (3) the role of academia in innovation, research, and human resource development; and (4) the role of society in participation, economic empowerment, and social supervision. These indicators are employed to evaluate the effectiveness of coconut shell charcoal downstream development in Banyuasin Regency. Through

the integration of these four dimensions, the study seeks to assess the extent to which collaborative governance based on the Quadruple Helix approach can strengthen sustainable industrial development, improve local economic competitiveness, and encourage environmentally friendly industrial transformation in Banyuasin Regency (Alfadri, 2023).

Meanwhile, from the regulatory perspective, the implementation of coconut shell charcoal downstreaming continues to face several challenges, including weak technical regulations, limited certainty regarding investment policies, insufficient support for environmentally sustainable industrial development, and the lack of optimal inter-agency coordination in supporting integrated downstream industrialization. Furthermore, the critical issue underlying this research lies in the absence of an effective collaborative governance model capable of integrating the interests of multiple stakeholders. As a result, the downstreaming process has not yet been able to generate sustainable innovation, improve the local community's economy, or strengthen the competitiveness of the coconut shell charcoal industry at both national and international levels. The production and combustion activities of coconut shell charcoal in Banyuasin Regency have developed in areas with strategic access to distribution routes and port connectivity.

Several production centers are located in the Sungsang area and Karang Anyar Village, which are integrated with transportation access leading to Tanjung Api-API Port. This geographical position provides logistical advantages in supporting the distribution of coconut shell charcoal products for both regional markets and export-oriented maritime trade routes. Moreover, the existence of Tanjung Api-API Port as a strategic industrial and distribution area in South Sumatra further strengthens the potential development of coconut shell charcoal downstreaming through increased supply chain efficiency, expanded market access, and enhanced connectivity of local resource-based industries. Therefore, the proximity of production locations to port areas becomes a significant factor in supporting the competitiveness and sustainability of the coconut shell charcoal industry in Banyuasin Regency.

Meanwhile, from the regulatory perspective, the implementation of coconut shell charcoal downstreaming continues to encounter several challenges, including weak technical regulations, limited certainty regarding investment policies, insufficient support for environmentally sustainable industrial development, and suboptimal coordination among governmental institutions in supporting integrated downstream industrialization. These regulatory limitations have hindered the effectiveness of industrial development and reduced the capacity of local industries to compete in broader markets. Furthermore, the critical issue underlying this research lies in the absence of an effective collaborative governance model capable of integrating the interests and roles of multiple stakeholders. Consequently, the downstreaming process has not yet been able to generate sustainable innovation, enhance the local community's economic welfare, or strengthen the competitiveness of the coconut shell charcoal industry at both national and international levels (Mulyono et al., 2025).

The production and combustion activities of coconut shell charcoal in Banyuasin Regency have developed in areas with strategic access to distribution routes and port connectivity. Several production centers are located in the Sungsang area and Karang Anyar Village, which are integrated with transportation access leading to Tanjung Api-API Port. This geographical advantage provides significant logistical benefits in supporting the distribution of coconut shell charcoal products for regional markets as well as export-oriented maritime trade. Moreover, the existence of Tanjung Api-API Port as a strategic industrial and distribution hub in South Sumatra further strengthens the potential for downstream industrial development through improved supply chain efficiency, expanded market accessibility, and enhanced industrial connectivity based on local natural resources. Therefore, the proximity of production locations to port infrastructure constitutes an important factor in strengthening the competitiveness, distribution efficiency, and long-term sustainability of the coconut shell charcoal industry in Banyuasin Regency (Novitasari et al., 2025).

The downstream development of coconut shell charcoal in Banyuasin Regency is in line with the direction of the National bureaucratic reform policy which emphasizes the strengthening of collaborative governance and the development of national priority programs based on downstream industries. This is as stipulated in PANRB Ministerial Regulation Number 19 of 2023 concerning changes in the Bureaucratic Reform Road Map 2020-2024, especially in Article 1 Paragraph (2), which confirms that bureaucratic reform is directed at general bureaucratic reform and thematic bureaucratic reform to support the national strategic agenda, including downstream industries.

In addition, PANRB Ministerial Regulation Number 7 of 2022 concerning the Work System in government agencies also emphasizes the importance of strengthening cross-sector coordination, collaboration between agencies, and flexibility of the work system in improving the effectiveness of governance. In this context, the downstream development of coconut shell charcoal is not only oriented towards increasing the added economic value and competitiveness of local products, but also becomes part of an adaptive, collaborative, and sustainable governance transformation effort through synergies between the government, business actors, academics, and the community (Peraturan Menteri PANRB Nomor 19 Tahun 2023, 2025)

METHODS

This study employs a qualitative approach with a descriptive method to analyze the implementation of collaborative governance in the development of coconut shell charcoal downstreaming in Banyuasin Regency. A qualitative approach was selected because this research aims to obtain an in-depth understanding of inter-actor collaboration processes, governance dynamics, and various challenges emerging in the development of coconut shell charcoal downstream industries. This research applies the Quadruple Helix Theory as the analytical framework to examine the synergy among government, the business sector, academia, and society in supporting the development of sustainable local resource-based industries. The indicators within the Quadruple Helix model consist of: (1) the role of government, including regulation, policy facilitation, and industrial supervision; (2) the role of academia, encompassing research activities, technological innovation, and human resource development; (3) the role of the business sector, including investment, production development, and product marketing; and (4) the role of society, involving participation in production activities, economic empowerment, and environmental supervision. Data collection techniques were conducted through in-depth interviews, field observations, and documentation involving stakeholders engaged in coconut shell charcoal production activities, including local government institutions, business actors, academics, and communities within production areas. The collected data were analyzed using an interactive analysis technique consisting of data reduction, data presentation, and conclusion drawing in order to obtain a comprehensive understanding of the implementation of collaborative governance in the development of coconut shell charcoal downstreaming in Banyuasin Regency.

RESULTS AND DISCUSSION

Strengthening local economies and promoting innovation-based development require collaboration among multiple stakeholders within an integrated governance system. According to the Quadruple Helix Theory, the synergistic relationship among government, academia, business or industry, and society plays a crucial role in generating innovation, enhancing regional competitiveness, and encouraging sustainable development. This collaborative process is essential in ensuring that development not only emphasizes economic growth but also considers social, environmental, and community empowerment aspects (Kartika, 2026). The Quadruple Helix approach is particularly relevant to the development of coconut shell charcoal downstreaming in Banyuasin Regency because the downstreaming process requires support from various actors with different roles and interests. The downstream development of coconut shell charcoal is not limited to transforming waste into economically valuable products; it also

involves policy support, technological advancement, community empowerment, industrial strengthening, and market expansion.

Therefore, the success of coconut shell charcoal downstreaming is strongly influenced by how stakeholders collaborate in establishing an inclusive and sustainable governance system. This study examines how government institutions, academia, business actors, and local communities contribute to supporting coconut shell charcoal downstreaming in Banyuasin Regency. Each stakeholder performs strategic and complementary functions within the development process. The government acts as a regulator and facilitator by formulating policies and providing institutional support. Academia contributes through research activities, technological innovation, and knowledge development. The business sector plays a role in production, investment, and industrialization processes, while society is directly involved in utilizing local resources and strengthening community-based economic activities. Through the integration of these four actors, the Quadruple Helix-based collaborative governance model is expected to establish a sustainable and competitive coconut shell charcoal downstream industry capable of improving local economic welfare and strengthening regional industrial competitiveness in Banyuasin Regency (Mulyono, 2024)

Government

The government holds a significant responsibility in establishing regulations, policies, and coordination systems capable of supporting innovation-based regional development and the optimization of local potential. In the context of coconut shell charcoal downstreaming in Banyuasin Regency, the government serves as a strategic actor in creating an institutional environment that supports the development of industries transforming coconut shell waste into high-value economic products. This role is implemented through the formulation of integrated waste management policies, the empowerment of Micro, Small, and Medium Enterprises (MSMEs), and the development of local resource-based industries aimed at improving community welfare. In addition to functioning as a regulator, the government also acts as a facilitator in strengthening the capacity of coconut shell charcoal business actors. Such support may include the provision of production facilities and infrastructure, technical skills training, business assistance programs, as well as support for product legality and certification to enhance competitiveness in national and international markets. Furthermore, local governments are responsible for expanding investment opportunities, strengthening marketing networks, and encouraging the digitalization of coconut shell charcoal product marketing to improve the productivity and competitiveness of local industries.

From the perspective of collaborative governance, the government also functions as a connector among stakeholders involved in the downstreaming process, including academia, the business sector, financial institutions, and local communities. Through effective coordination and collaboration, the government can establish an industrial ecosystem that supports innovation development, technology transfer, and business capital strengthening. The government's success in building such synergy constitutes a crucial factor in improving the efficiency and sustainability of the coconut shell charcoal industry in Banyuasin Regency. Moreover, government involvement is directed toward ensuring that the downstreaming process not only generates economic benefits but also creates positive social and environmental impacts. Through policies that support sustainable waste management, coconut shell waste can be transformed into a new economic resource capable of increasing community income, creating employment opportunities, and strengthening sustainable local economic development in Banyuasin Regency (Suraya et al., 2026).

Akademisi

Within the Quadruple Helix Theory, academia is positioned as a key actor responsible for technology transfer, innovation, and the advancement of knowledge to support regional development. Academics play a crucial role in developing research and innovations that can

improve the quality and efficiency of coconut shell charcoal production in the downstream process in Banyuasin Regency. Universities and research institutions possess the capacity to provide scientific solutions to various challenges faced by industry actors, particularly those related to production technology, waste management, and the development of value-added coconut shell charcoal products. Furthermore, the contribution of academia can be observed in efforts to develop more advanced and environmentally sustainable carbonization technologies. Through research and technological innovation, academics are able to improve the quality of charcoal products, thereby enhancing their competitiveness in both domestic and international markets. Academic institutions also contribute to the development of downstream products such as activated carbon, charcoal briquettes, and alternative energy products derived from coconut waste (Abubakar et al., 2024).

In addition, academia plays an important role in strengthening human resources through training programs, technical assistance, and community empowerment initiatives. Business actors and local communities require adequate knowledge and technological support in order to establish more efficient and sustainable production systems. Through education, research dissemination, and technology transfer, academics contribute to increasing the capacity and competitiveness of local industries. Therefore, the involvement of academia is expected to encourage the development of an innovative and sustainable coconut shell charcoal downstream industry in Banyuasin Regency. Through effective collaboration among academic institutions, government, business actors, and society, the downstreaming process can generate not only economic benefits but also technological advancement, environmental sustainability, and long-term community welfare.

Business/Industry

Within the Quadruple Helix Theory, the business sector functions as the primary driver of economic activities as well as the main actor in implementing industrial innovation. In the development of coconut shell charcoal downstreaming in Banyuasin Regency, the business sector plays a central role in the processes of production, processing, distribution, and marketing of coconut shell charcoal products. The involvement of business actors is highly significant because this sector has the capacity to transform coconut shell waste, which previously possessed limited economic value, into commercially valuable products with strong competitiveness in both domestic and international markets. Through organized industrial activities, business actors can create a more productive and sustainable value chain for local communities (Attamimi et al., 2026).

Coconut shell charcoal entrepreneurs contribute to maintaining product quality, increasing production capacity, and developing effective marketing strategies to expand market access. These efforts are carried out through the implementation of product quality standards, modern packaging systems, and the utilization of information technology and digital marketing strategies in promotional activities. Furthermore, the business sector also holds responsibility for adopting innovative production technologies to ensure that charcoal processing becomes more efficient, cost-effective, and environmentally sustainable. The use of modern technologies, such as efficient combustion furnaces and waste management systems, constitutes an important component in supporting the sustainability of the coconut shell charcoal industry. In the context of downstream industrialization, the business sector is not solely oriented toward economic profit but also contributes significantly to the surrounding community.

The presence of the coconut shell charcoal industry creates new employment opportunities, increases local community income, and encourages the growth of micro and small enterprises associated with the charcoal production chain. Consequently, business activities within the coconut shell charcoal downstream industry contribute to reducing unemployment and improving community welfare in Banyuasin Regency. In addition, the business sector plays a strategic role in strengthening the competitiveness of Banyuasin's coconut shell charcoal

products. Extensive distribution and marketing networks enable these products to reach national and export markets. Business actors also serve as intermediaries connecting local producers with the continuously growing demands of the global market, particularly for high-quality and environmentally friendly charcoal products. Therefore, within the collaborative governance model based on the Quadruple Helix approach, the business sector occupies a highly strategic position in supporting the sustainable, innovative, and competitive development of coconut shell charcoal downstreaming.

Civil Society/Community

Within the Quadruple Helix Theory, society is regarded as an essential element because it is positioned as an actor directly involved in the processes of innovation, development, and local economic strengthening. Society does not merely function as the recipient of development outcomes but also serves as an active participant that determines the success of regional development programs. In the context of coconut shell charcoal downstreaming in Banyuasin Regency, local communities play a strategic role in supplying raw materials, supporting production processes, and strengthening the sustainability of the coconut shell charcoal industry. Community involvement demonstrates that the downstreaming process is not solely implemented through a top-down approach but also requires active participation from local communities within a collaborative governance system. Coconut farmers and community groups serve as key actors in maintaining the availability of coconut shell raw materials used in charcoal production. They contribute to the processes of collecting, sorting, and distributing coconut shells to charcoal processing industries.

In addition, local communities are directly involved in production activities, including combustion processes, packaging, and the marketing of coconut shell charcoal products. Such involvement generates positive impacts on increasing community income and promoting local economic empowerment in Banyuasin Regency. From the perspective of the Quadruple Helix approach, society not only benefits from development programs but also holds responsibility for ensuring the sustainability of downstream industrialization initiatives. Active community participation is a crucial factor in establishing harmonious cooperation among stakeholders, including government institutions, academia, business actors, and local communities. With strong community support, the development process of coconut shell charcoal downstreaming can become more inclusive, adaptive, and responsive to local needs.

Furthermore, communities can serve as valuable sources of information regarding regional potential, production challenges, and opportunities for local resource-based business development. In addition to contributing to economic development, communities also play an important role in environmental sustainability through the utilization of coconut shell waste as economically valuable products. The management of previously underutilized waste can help reduce environmental pollution while simultaneously creating new sources of income for local communities. This activity demonstrates that coconut shell charcoal downstreaming not only provides economic benefits but also supports the concept of sustainable development by integrating social and environmental considerations. Therefore, community involvement within the Quadruple Helix-based collaborative governance model constitutes a highly important factor in supporting the success of coconut shell charcoal downstreaming development in Banyuasin Regency. Community participation can strengthen inter-actor synergy, improve program sustainability, and promote a more inclusive, independent, and competitive local economic development process (Sumbogo, 2026).

Collaborative Governance Model in Coconut Shell Charcoal Downstreaming in Banyuasin Regency Based on the Quadruple Helix Perspective

The development of coconut shell charcoal downstreaming in Banyuasin Regency represents one form of local economic transformation focused on increasing added value through the utilization of natural resources and waste management. In the context of regional

development, downstream industrialization does not merely refer to the process of transforming raw materials into products with higher economic value, but also constitutes an effort to establish an economic system capable of improving community welfare, creating employment opportunities, and supporting sustainable development. Therefore, the downstream development of coconut shell charcoal requires a collaborative governance system involving multiple stakeholders in an integrated manner (Permana, 2024).

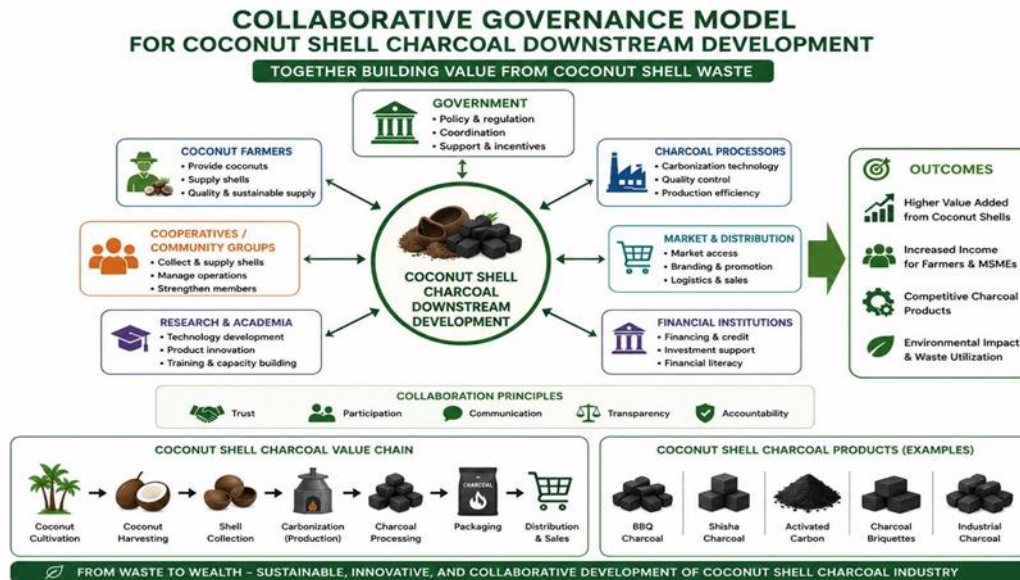


Figure 2. Collaborative Downstream

In explaining the dynamics of inter-actor collaboration within the development of coconut shell charcoal downstreaming in Banyuasin Regency, the Quadruple Helix approach becomes highly relevant. This theory emphasizes that innovation and collaborative development can be achieved through synergy among government, academia, the business or industrial sector, and civil society. These four actors perform strategic and complementary functions in supporting the downstreaming process, including policy formulation, technological advancement, industrial strengthening, and local community empowerment. Consequently, the success of coconut shell charcoal downstreaming is strongly influenced by the effectiveness of relationships and cooperation among stakeholders in establishing an inclusive and participatory governance system.

Government

Within the collaborative governance model of coconut shell charcoal downstreaming, the government functions as a regulator, facilitator, and coordinator. Based on secondary data derived from the collaborative governance model, the government supports and promotes the development of coconut shell charcoal businesses through the formulation of policies and regulations, institutional coordination, and the provision of incentives. This role demonstrates that the government plays a significant part in creating an institutional environment capable of supporting the sustainability of downstream industries based on local resources. From the perspective of the Quadruple Helix Theory, government involvement is essential because the government is responsible for maintaining governance stability and ensuring the sustainability of cooperation among stakeholders. One of the responsibilities of the Banyuasin Regency government is to formulate policies that support the development of Micro, Small, and Medium Enterprises (MSMEs), business legality, access to training programs, and the improvement of production infrastructure.

Furthermore, the government also serves as a connector among academics, investors, business actors, and local communities in establishing a more competitive downstream industrial

system. Secondary data findings indicate that the government's ability to build cross-sectoral coordination significantly influences the success of coconut shell charcoal downstream development. In addition to administrative functions, government support also includes efforts to create an investment climate that encourages the growth of the coconut shell charcoal industry in Banyuasin Regency. This support may involve facilitating investment access, strengthening industrial policies, and promoting sustainable industrial development. Therefore, the role of government is highly important in strengthening the collaborative governance system based on the Quadruple Helix approach and ensuring the sustainability and competitiveness of coconut shell charcoal downstreaming in Banyuasin Regency (Masaguni et al., 2025).

The Role of Farmers

Coconut farmers play a crucial role in the downstream value chain of coconut shell charcoal because they provide the primary raw materials, namely coconut shells and husks. Based on secondary data from the collaborative governance model, farmers contribute through supplying coconuts, providing coconut shells as raw materials, and maintaining the quality and sustainability of the supply chain. This demonstrates that the sustainability of the coconut shell charcoal industry is highly dependent on the stability of coconut production within local communities. Within the perspective of the Quadruple Helix Theory, local communities are positioned as participatory actors who directly contribute to local economic development and production processes while simultaneously benefiting from development outcomes. The involvement of coconut farmers in the downstream development of coconut shell charcoal reflects the utilization of local resources capable of generating economic added value for the people of Banyuasin Regency. Furthermore, the presence of coconut farmers indicates that the downstreaming process is closely connected to rural economic activities and the agricultural sector. As demand for coconut shells as raw materials for charcoal production continues to increase, coconut farmers occupy a strategic position in maintaining the sustainability of the industrial supply chain. Their role is not limited to supplying raw materials but also includes ensuring the continuity, quality, and availability of coconut resources required for industrial production. Therefore, the participation of coconut farmers becomes an important component in supporting the sustainability, productivity, and competitiveness of the coconut shell charcoal downstream industry in Banyuasin Regency (Stevani et al., 2026).

The Role of Community Groups

Based on secondary data derived from the collaborative governance model, cooperatives and community groups function as collective institutions that assist members in improving their capacities and managing coconut shell charcoal businesses. Their roles include the collection and provision of coconut shells as raw materials, operational management, and the strengthening of group members' capacities and economic positions. The existence of cooperatives and community groups reflects the importance of social participation in supporting the success of coconut shell charcoal downstreaming in Banyuasin Regency. From the perspective of the Quadruple Helix Theory, community groups are considered part of civil society and play an essential role in strengthening collaboration among stakeholders. Cooperatives and community-based business groups contribute to building economic solidarity, improving the bargaining position of small-scale entrepreneurs, and increasing access to government assistance programs and investment partnerships. Through collective cooperation mechanisms, these groups also contribute to maintaining the sustainability and stability of coconut shell charcoal business activities. Furthermore, community groups and cooperatives play an important role in empowering local communities by facilitating knowledge sharing, production coordination, and collective marketing strategies. Strengthening the capacity of these groups is crucial in enabling communities to improve production quality, expand market access, and enhance the competitiveness of coconut shell charcoal products. In addition, community-based organizations can serve as intermediaries between local producers and external stakeholders, including government institutions, academic institutions, and private investors. Therefore, community

groups and cooperatives constitute important components in establishing an inclusive and participatory collaborative governance system. Their involvement not only supports economic empowerment and local industrial sustainability but also strengthens social cohesion and community participation in the development of coconut shell charcoal downstreaming in Banyuasin Regency (Ilimu et al., 2025)

Academia and Research

Based on the secondary data model, educational and research institutions are responsible for technology development, product innovation, and training and capacity building activities. This demonstrates that academics play a significant role in advancing innovation and scientific knowledge that support the downstreaming process of coconut shell charcoal. Within the perspective of the Quadruple Helix Theory, academia functions as a center for knowledge creation and innovation that enables local industries to become more competitive and sustainable. Academic involvement in the development of coconut shell charcoal downstreaming can be observed through research on environmentally friendly carbonization methods, the development of value-added charcoal derivative products, and the dissemination of knowledge to communities and business actors. Through scientific research and technological innovation, academic institutions are capable of providing solutions to challenges related to production efficiency, environmental sustainability, and product competitiveness.

Furthermore, the development of downstream products such as charcoal briquettes, activated carbon, and alternative energy products derived from coconut waste demonstrates the strategic contribution of academia in strengthening industrial diversification. In addition, academics play an important role in improving human resources through training programs, technical assistance, and business mentoring initiatives. Such support is essential for business actors to gain a better understanding of modern production techniques, marketing strategies, and more professional business management practices. Through continuous education and capacity-building programs, local entrepreneurs are expected to improve production quality, expand market access, and strengthen the competitiveness of their products in domestic and international markets. Therefore, academia holds a strategic position in encouraging innovation, knowledge transfer, and the sustainability of coconut shell charcoal downstreaming in Banyuasin Regency. Through collaboration with government institutions, the business sector, and local communities, academic institutions contribute significantly to the establishment of an innovative, competitive, and sustainable local industrial ecosystem (Yuniasih et al., 2025).

Charcoal Processors

The processing of coconut shells into commercially valuable charcoal products is carried out by the charcoal processing industry. Based on the secondary data within the collaborative governance model, charcoal processors are responsible for the implementation of carbonization technology, quality control, and the improvement of production efficiency. Since they are directly involved in producing market-ready products, the industrial sector plays a crucial role in the downstreaming process of coconut shell charcoal. From the perspective of the Quadruple Helix Theory, the business sector functions as the center of economic activity and innovation within the production process. Charcoal processors are responsible for ensuring that their products meet high-quality standards in order to compete effectively in both domestic and international markets. In addition, the business sector contributes significantly to increasing local income and creating employment opportunities for surrounding communities.

The presence of charcoal processing industries enables coconut shell waste to be transformed into a variety of economically valuable products, including BBQ charcoal, shisha charcoal, activated carbon, charcoal briquettes, and industrial charcoal products. This diversification of products is highly important in strengthening the competitiveness and economic added value of the coconut shell charcoal industry in Banyuasin Regency. Furthermore, the adoption of improved carbonization technologies and efficient production systems can

enhance product quality, production capacity, and environmental sustainability within the industry. Therefore, charcoal processors occupy a strategic position in supporting the sustainability and competitiveness of coconut shell charcoal downstreaming. Through innovation, product diversification, and industrial development, the charcoal processing industry contributes to strengthening local economic growth and promoting sustainable industrial transformation in Banyuasin Regency (Zulkarnaini et al., 2023).

Market and Distribution Sector

The downstream development of coconut shell charcoal is highly dependent on market access and distribution networks. In the secondary data model, the market and distribution sectors are responsible for branding and promotion, expanding market access, and enhancing logistics and sales performance. This indicates that the ability of entrepreneurs to broaden their marketing networks significantly influences the success of coconut shell charcoal production. Within the Quadruple Helix framework, the involvement of the market sector reflects the interconnection between community needs, global market demands, and business activities. Broad market access can enhance the commercial value of the product and strengthen the competitive position of Banyuasin's coconut shell charcoal industry in both regional and international markets. Furthermore, branding and promotional strategies play a crucial role in establishing a strong local product identity with high competitive value. In the secondary data model, financial institutions are responsible for financing and credit provision, investment support, and financial literacy development. Financial institutions play a vital role because the growth of downstream industries requires adequate capital support and access to financing. According to the Quadruple Helix theory, financial institutions function as part of an economic ecosystem that supports sustainable business growth and innovation. Through financial support, businesses are able to increase their production capacity, improve production technology, and gain access to broader markets. In addition, enhancing the community's capacity to manage businesses in a professional and sustainable manner constitutes an essential component of financial literacy.

Financial Institutions

In the secondary data model, financial institutions are responsible for financing and credit provision, investment support, and the enhancement of financial literacy. In the development of coconut shell charcoal downstreaming in Banyuasin Regency, the presence of financial institutions is highly important because the growth of downstream industries requires adequate capital support, access to financing, and well-established investment systems. Such support is essential to enable business actors to carry out production processes optimally and to expand their enterprises sustainably. According to the Quadruple Helix theory, financial institutions function as part of an economic ecosystem that supports business growth, business innovation, and the strengthening of industrial competitiveness. Through business credit facilities, working capital loans, and investment support, financial institutions can assist entrepreneurs in increasing production capacity, expanding distribution networks, and developing more efficient and environmentally friendly production technologies. Financial support also enables coconut shell charcoal entrepreneurs to improve product quality in order to compete in both national and international markets. In addition to providing capital support, financial institutions also play a significant role in enhancing the financial literacy of communities and business actors. Knowledge related to financial management, business bookkeeping, investment management, and risk management constitutes an important factor in maintaining the sustainability of downstream business activities. With adequate financial literacy, communities are better equipped to manage their businesses in a more professional, independent, and sustainable manner, thereby contributing to the improvement of local economic welfare in Banyuasin Regency.

Collaborative Principles and Expected Outcomes

Based on secondary data derived from the collaborative model, the downstream development of coconut shell charcoal provides various economic, social, and environmental benefits for communities in Banyuasin Regency. These benefits include increasing the added value of coconut shell waste, improving the income of farmers and MSME actors, developing competitive charcoal products, and supporting environmental sustainability through the productive utilization of waste materials. Coconut shell waste, which was previously underutilized, can be processed into charcoal products with high economic value, thereby creating new business opportunities and strengthening the local economy. Within the collaborative governance model based on the Quadruple Helix framework, the successful development of coconut shell charcoal downstreaming is supported by the implementation of collaborative principles such as trust, participation, communication, transparency, and accountability. These principles serve as an essential foundation for building harmonious relationships among stakeholders, namely government institutions, academics, the business sector, and the community.

Trust among stakeholders enables the establishment of sustainable cooperation, while the active participation of all parties strengthens decision-making processes and promotes a more inclusive implementation of downstream development programs. Furthermore, effective communication among stakeholders plays a crucial role in disseminating information, resolving problems, and fostering innovation in the coconut shell charcoal production process. Transparency and accountability are also necessary to ensure that program implementation is conducted openly, systematically, and in accordance with regional development objectives. Through effective governance, each stakeholder can perform its roles and responsibilities optimally, thereby ensuring the sustainability of downstream industrial development. Overall, the secondary data indicate that the collaborative governance model for coconut shell charcoal downstreaming in Banyuasin Regency has significant potential to promote community empowerment and local economic growth based on natural resources. Through the transformation of coconut shell waste into high-value economic products, synergy among stakeholders within the Quadruple Helix model can foster innovation, enhance production capacity, expand employment opportunities, improve community welfare, and support sustainable and environmentally friendly economic development (Maulana, 2018).

CONCLUSION

The development of coconut shell charcoal downstreaming in Banyuasin Regency demonstrates that collaborative governance based on the Quadruple Helix approach plays a strategic role in strengthening sustainable local resource-based industries. This study found that synergy among government institutions, academia, the business sector, and society contributes significantly to the development of a more innovative, competitive, and environmentally sustainable coconut shell charcoal industry. The downstreaming process is not merely focused on transforming coconut shell waste into products with higher economic value, but also on establishing an integrated industrial ecosystem capable of improving community welfare, strengthening local economic resilience, and supporting green economic development. The research results indicate that each actor within the Quadruple Helix framework performs complementary and interconnected functions. The government acts as a regulator, facilitator, and coordinator through the formulation of policies, institutional support, MSME empowerment programs, investment facilitation, and industrial supervision. Government involvement is essential in creating a conducive environment for industrial development and strengthening cooperation among stakeholders. Meanwhile, academia contributes through research, technological innovation, human resource development, and technology transfer activities. Academic institutions support the improvement of production efficiency and product quality through environmentally friendly carbonization technologies and the development of value-added products such as activated carbon and charcoal briquettes. Furthermore, the business and

industrial sector serves as the primary driver of production, processing, distribution, and marketing activities. Business actors contribute to increasing production capacity, adopting modern technology, expanding market access, and strengthening product competitiveness in domestic and international markets. The development of branding strategies, digital marketing, and product diversification further strengthens the economic value of coconut shell charcoal downstream industries in Banyuasin Regency. In addition, the study reveals that local communities and farmer groups play a crucial role in supplying raw materials, supporting production processes, and participating in community-based economic activities. Community participation not only strengthens local empowerment but also supports environmental sustainability through the productive utilization of coconut shell waste.

SUGGESTION

The findings also show that collaborative principles such as participation, communication, trust, transparency, and accountability are fundamental factors supporting the success of collaborative governance in coconut shell charcoal downstreaming. Effective collaboration among stakeholders enables the establishment of an inclusive and adaptive governance system capable of addressing industrial challenges, including limited technology, weak investment access, low product competitiveness, and environmental pollution resulting from traditional production methods. In addition, the strategic location of production centers near Tanjung Api-API Port strengthens distribution efficiency, logistics accessibility, and export potential for coconut shell charcoal products. However, this study also identifies several challenges that continue to hinder downstream industrial development, including weak technical regulations, limited financial support, insufficient inter-agency coordination, and the absence of an integrated governance framework capable of fully connecting stakeholder interests. Therefore, strengthening policy implementation, improving institutional coordination, supporting green technology adoption, and expanding investment opportunities remain essential priorities for future development. The Quadruple Helix-based collaborative governance model possesses substantial potential to support sustainable coconut shell charcoal downstreaming in Banyuasin Regency. Through synergy among government, academia, business actors, and society, the downstreaming process can enhance local economic competitiveness, create employment opportunities, improve community welfare, encourage technological innovation, and support environmentally sustainable industrial transformation. This study contributes theoretically to the discourse on collaborative governance and sustainable industrial development while also providing practical recommendations for strengthening local resource-based industries in Indonesia as part of achieving sustainable development and green economic transformation.

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