

**[Research Article]**



## Socioeconomic Outcome of Ecological Restoration Project: A Case Study of Ex-Oil and Gas Mining Areas

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Article Info:	Abstract
<p>Received: 10 August 2025</p> <p>Accepted: 9 September 2025</p> <p>Published: 11 September 2025</p> <p><b>Keywords:</b> socioeconomics; ecological; restoration; mining; oil and gas.</p>	<p><i>Ecological restoration in former oil and gas extraction sites plays a vital role in promoting sustainable development. This study examines the socio-economic impacts of community-based ecological restoration efforts in Riau Province. This research used a qualitative case study design with purposive sampling. Data were obtained through observation, interviews, and document analysis, then analyzed inductively to identify emerging patterns. The findings reveal that the revegetation program of PT Pertamina Hulu Rokan generated tangible benefits by employing 302 local workers and reducing conflicts through Local Business Development. A financial commitment of USD 1.4 million to local enterprises reflects the synergy between corporate environmental responsibility and community economic growth. The study underscores the importance of integrating corporate environmental initiatives with local economic strategies to foster sustainable development and enhance community well-being in post-extraction landscapes.</i></p>
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<p>Diterima: 10 Agustus 2025</p> <p>Disetujui: 9 September 2025</p> <p>Dipublikasi: 11 September 2025</p> <p><b>Kata kunci:</b> sosioekonomi; ekologi; pemulihan; pertambangan; minyak dan gas.</p>	<p><i>Pemulihan ekologi di bekas ekstraksi migas berperan penting dalam mendorong pembangunan berkelanjutan. Studi ini mengkaji dampak sosial-ekonomi dari upaya pemulihan ekologi berbasis masyarakat di Provinsi Riau. Penelitian ini menggunakan desain studi kasus kualitatif dengan sampling purposif. Data diperoleh melalui observasi, wawancara, dan analisis dokumen, kemudian dianalisis secara induktif guna mengidentifikasi pola-pola yang muncul. Temuan menunjukkan bahwa program revegetasi PT Pertamina Hulu Rokan memberikan manfaat nyata, menyerap 302 tenaga kerja lokal, serta mengurangi konflik melalui Pengembangan Bisnis Lokal. Komitmen dana USD 1,4 juta bagi perusahaan lokal mencerminkan sinergi antara tanggung jawab lingkungan korporasi dan pertumbuhan ekonomi masyarakat. Penelitian ini menegaskan pentingnya mengintegrasikan inisiatif lingkungan perusahaan dengan strategi ekonomi lokal untuk mendorong pembangunan berkelanjutan dan meningkatkan kesejahteraan komunitas pasca-ekstraksi.</i></p>

## INTRODUCTION

The oil and gas sector is a fundamental component in stimulating the economic development of a nation, as it encompasses various activities such as exploration, production, refining, and distribution of oil and gas resources, which are crucial for sustaining industrial processes, transportation, and energy generation, thus significantly contributing to the overall economic progress and stability of a country (Hamza et al., 2022). The oil and gas sectors contributed 2.72% to the Gross Domestic Product (GDP), an important measure of economic performance. This underscores their vital role in influencing the financial framework and promoting sustainable economic growth (Ariyanto et al., 2024). Oil and gas extraction operations foster economic development by providing employment opportunities, revenue, and energy supply. The contribution of Riau's oil and gas sector to Indonesia's GDP was 4.98% in the second quarter of 2025, making Riau the largest oil and gas producing province and an important contributor to the national economy.

However, it is essential to acknowledge that these activities also have significant consequences for society's natural environment, economy, and social fabric (Ngene et al., 2016; Negara et al., 2020). Oil and gas exploration has significant ecological impacts, including habitat destruction and fragmentation from infrastructure like well pads and roads, air and water pollution from emissions and spills, and the release of greenhouse gases like methane, which contribute to climate change (Mudumba et al., 2023) and this condition also occurs in other countries (Saputra, 2025).

PT Pertamina Hulu Rokan (PHR), an oil and gas company operating in the Riau region, has conducted post-mining land reclamation activities as a form of commitment to post-operation environmental improvement (Lbs & Suwondo, 2023; Lbs et al., 2024). PT Pertamina Hulu Rokan is mandated to undertake environmental restoration initiatives, including revegetation programs in decommissioned areas, in accordance with Law No. 32 of 2009 on Environmental Management Protection, Government Regulation No. 27 of 2012 on Environmental Permits, and relevant guidelines from the Minister of Energy and Mineral Resources and SKK MIGAS. These regulatory frameworks specify the protocols for

post-operation ecological restoration in the upstream oil and gas sector (Lbs et al., 2023). PT Pertamina Hulu Rokan has rehabilitated 300 hectares of post-operation land during the period of 2022-2023. The criteria for assessing the revegetation efforts in the Environmental Impact Assessment document include: a) achieving at least a 75% survival rate of the target revegetation area, and b) attaining a minimum of 75% plant growth rate with an average height of 100 cm within the designated revegetation zone.

In this project, the company engaged with local enterprises (Local Business Development/LBD) in a concerted attempt to uphold the sustainability of revegetation endeavours within the company's operational regions. Empowering local communities by collaborating with small-scale enterprises near their operational zones is anticipated to yield supplementary benefits to the local economy and workforce, thereby striving to mitigate social challenges in oil and gas operational territories. Khair et al. (2021) emphasized that community involvement is essential for effective ecological rehabilitation because restoration moves beyond a technical exercise toward a sustainable, holistic, and equitable process. A conceptual framework for community based ecological rehabilitation integrates social, ecological, and economic dimensions, recognizing that humans and ecosystems are intertwined in complex social-ecological systems.

Restoring mining-impacted areas is important for maintaining ecological balance and can help the community economy (Sutrisno et al., 2023). The involvement and oversight of the local community in the processes of mining restoration are vital for realizing improved results for local societies in landscapes following extraction activities (Dawson et al., 2021). Persistent surveillance of revegetation initiatives and collaboration with local communities are advocated to ensure the longevity of success and augment the benefits derived from these restoration endeavors (Suswadi et al., 2023).

Efforts to reestablish vegetation in landscapes affected by mining, especially within the oil and gas sector, have substantial socioeconomic consequences. These endeavors aim to reinstate ecological equilibrium and enhance the quality of land (Boulot & Collins,

2023). However, challenges persist, such as the need for greater engagement and control of local people in rehabilitation processes.

This study aims to examine the impact of community participation in revegetation initiatives on social and economic conditions, particularly to understand how community involvement affects community income, employment opportunities, and the post-operational landscape of PT Pertamina Hulu Rokan.

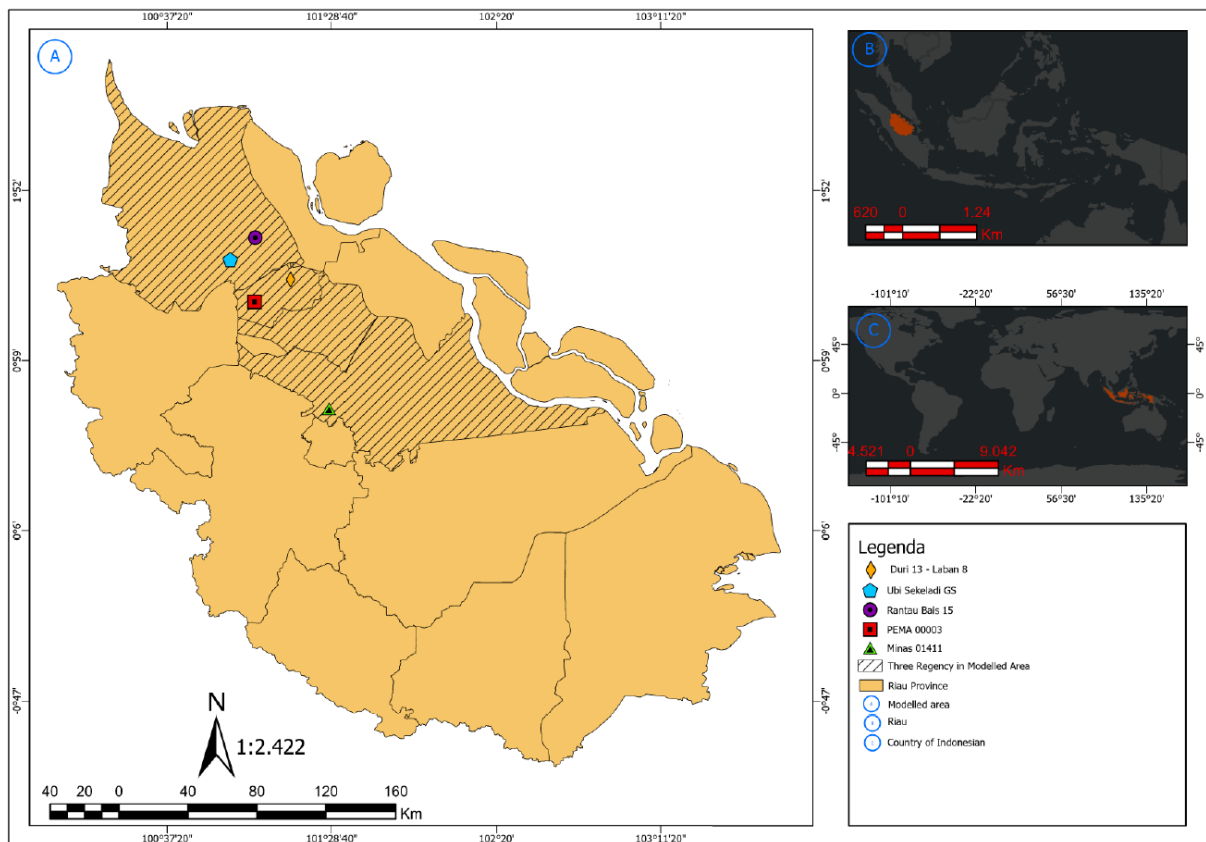
## METHOD

This research was exploratory (Syahza, 2016) and devoid of a hypothetical model. This allowed for a more flexible and open-ended approach to data collection, analysis, and interpretation, enabling researchers to uncover unexpected patterns and relationships within the research domain.

The research methodology used in this study involved the application of a case study approach that enabled an in-depth analysis of a specific phenomenon within its real-life context,

coupled with field research techniques that allowed the collection of primary data through direct observation and interaction with participants in their natural environment.

This research was conducted in multiple districts within Riau Province. The investigation focused on the post-operation land area of the PT Pertamina Hulu Rokan (Block Rokan), specifically at five sites selected to represent three distinct groups of post-operation areas. The five sites were selected based on a purposive sampling method with criteria: 1) areas of ex-well pad facilities where well plug & abandon (P&A) activities have been carried out, including the dismantling of related surface facilities, 2) areas of ex-production facilities that have been dismantled, and 3) areas of ex-borrow pits. These sites included Minas 01141 (7E-81-NI3), covering an area of 0.21 hectares, PEMA00003 with 0.19 hectares, Rantau Bais 15 with 0.04 hectares, Ubi Sekeladi GS with 1.97 hectares, and Duri 13 - Laban 8 with 14.56 hectares (Figure 1).



**Figure 1.** The research location is in a) Riau Province, b) Sumatra, c) Indonesia

The research design was meticulous and thorough, considering each revegetation site's specific characteristics and dimensions to ensure a comprehensive analysis of the post-operation areas in different districts within Riau Province. The investigation utilized diverse methods for gathering data, such as observations, in-depth interviews, and documents from local contractors and PHR's employees.

This study's data validity evaluation involved a thorough scrutiny of these criteria. Furthermore, the informants' data validity was verified by reconfirming the information gathered during previous interviews. Data analysis involves testing, grouping, tabling, and recombining evidence or data into conclusions. Data examining societal facets will be elucidated descriptively, whereas data concerning economic facets will be expounded

on utilizing the direct economic benefits received by the community. An inductive approach was employed to conduct the data analysis, which entailed identifying the patterns and themes from the collected data. In addition, the process included data interpretation and triangulation, resulting in thorough and dependable conclusions.

## RESULT AND DISCUSSION

### Landscape

This study analyzes post-operational landscape conditions at several locations previously used for oil and gas extraction. The analysis focuses on the physical and socio-ecological characteristics of each site, including topography, proximity to settlements, and surrounding land use. A summary description of each study site is presented in Table 1.

**Table 1.** Description of the Post-Operation Landscapes at Study Sites

Location	District	Description
Minas 01411 (7E-81NI3)	Siak District	Ex-wellpad; open area and close to community gardens and farms; flat, sloping, to slightly steep topography (15°)
PEMA 00003	Bengkalis District	Ex-wellpad; open area surrounded by community settlements; flat topography
Rantau Bais 15	Rokan Hulu District	Ex-wellpad; located in a floodplain area, flat topography
Ubi Sekeladi GS	Rokan Hulu District	Ex-oil storage production facility (ex-production facility); close to highway; mild topography
Duri 13 - Laban 8	Bengkalis District	Ex-borrow pit; open area; land erosion; location surrounded by community plantations; mild topography

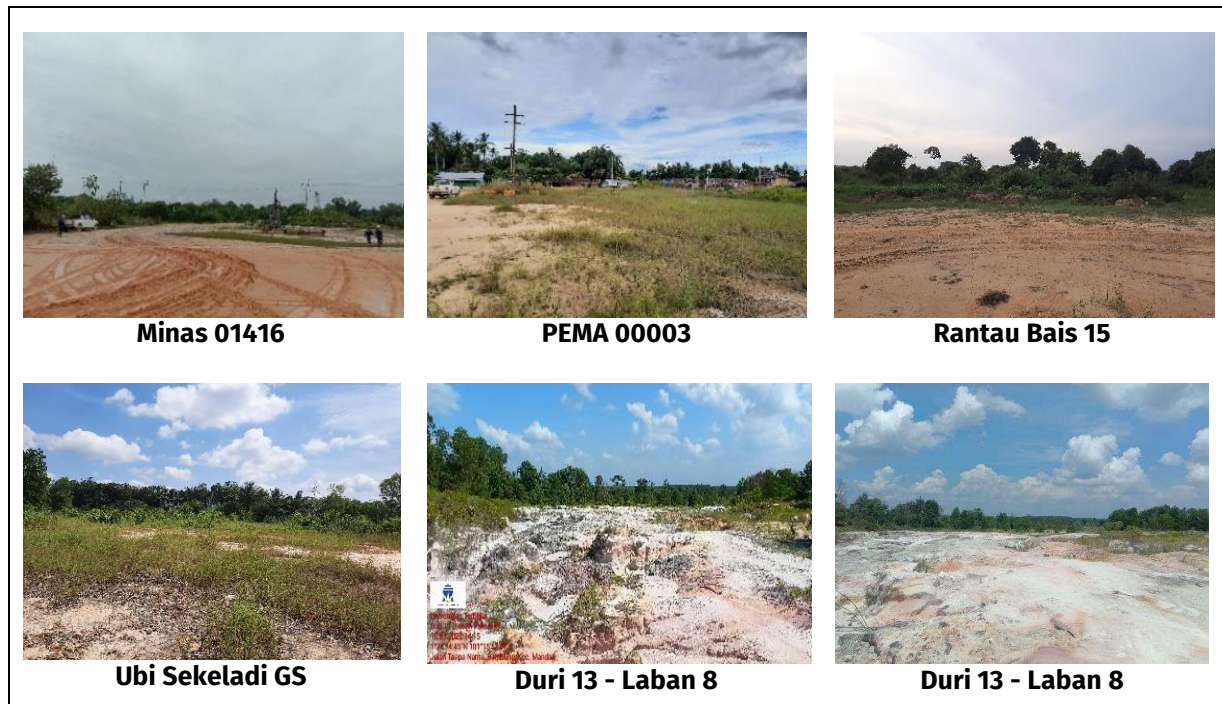
Diverse landscape conditions were observed based on observations at the site (Figure 1). Minas Site 01411 (7E-81NI3) is an ex-wellpad and operating facility that is an open area surrounded by oil palm plantations and community farms. The community farms were cassava and sweet potato farms mixed with shrubs and roadside banks overgrown with acacia. The topography of the area is flat, sloping, and slightly steep.

The PEMA 00003 is an ex-wellpad and an open area surrounded by residential areas with high community activities. The open area is approximately 0.5 ha in the form of a field area that is slightly waterlogged (due to the influence of the rainy season). The topography was flat, and the soil was compacted and filled. A few short grasses were observed in the open area. Taller grasses and shrubs are at the edge of this open area, and woody vegetation, mainly cultivated trees, is found only around community villages.

The Rantau Bais 15 site is an ex-wellpad area. An oil-drilling area in a floodplain experiences periodic inundation of water, particularly during the rainy season, owing to its low location with a flat topography and along the path of a large river. The revegetation area was close to the active drilling area. It is a compacted fill soil substrate that is different in structure from natural soil (inundated soil substrate). The vegetation covering the central area was grassland and shrubs with scattered woody trees submerged in water. Cultivated vegetation is rare (some spots have palms) because of the presumed deep submergence and proximity to oil refinery areas.

The Ubi Sekeladi GS site is a revegetated area near the Sintong station. This includes the roadside area that crosses the Sintong oil-gathering station in the shrub grassland and inside the station. The topography of the area gently slopes along the highway.





**Figure 2.** Ex-Oil and Gas Mining Operation

The Duri 13-Laban 8 site is an ex-borrowed pit area. The excavation activity was no longer visible. Several open areas had damaged roads. The signs of sheet and rill erosion are ubiquitous, particularly on roadsides and open spots. The vast landscape is surrounded by palm oil and rubber plantations. The topography is gentle, with mounds and small cliffs. The subsoil is pale brown clay interspersed with gray and red, indicating somewhat impeded drainage.

### Local Empowerment in the Revegetation Project

Ecological restoration projects in ex-oil and gas mining areas represent a significant step toward sustainable development. These initiatives aim to rehabilitate the environment and improve the socioeconomic conditions of the affected communities. Revegetation of ex-oil and gas sites represents a critical step toward ecological restoration. It involves reintroducing native plant species to restore habitats, increase biodiversity, and stabilize the soil (Ostermann et al., 2023). This process is essential in areas disturbed by extraction activities, where the removal of vegetation and soil compaction can lead to erosion and habitat loss (Gordon et al., 2023).

The PHR's revegetation program is spread across four districts in Riau Province:

Siak Regency, Bengkalis Regency, Rokan Hilir Regency, and Rokan Hulu Regency. This activity can cause social issues that hinder the implementation of work programs prepared by PHRs. This aspect of community involvement needs to be involved and empowered more intensively so that the community itself feels equal to other groups in post-mining area reclamation efforts (Table 2).

PT Pertamina Hulu Rokan involved 35 local companies in revegetation activities spread across three Rokan Block operating areas (Minas-Siak, Bekasap-Rokan, and Duri Steam Flood). This partnership program is a follow-up to the corporate strategy that cares about and grows with the environment in its operating area (Amrizal & Taufiqurrahman, 2014). This program provides business opportunities for small local companies to support PHR operations through partnerships.

Empowering local communities during the revegetation process ensures that restoration efforts are culturally relevant, economically beneficial, and ecologically appropriate (Hunt et al., 2023). Local knowledge of native species and traditional land management practices can significantly contribute to selecting appropriate plant species and the success of revegetation efforts. Local empowerment is pivotal for successful revegetation activities, particularly

**Table 2.** Companies Involved in the Program in the Rokan Block

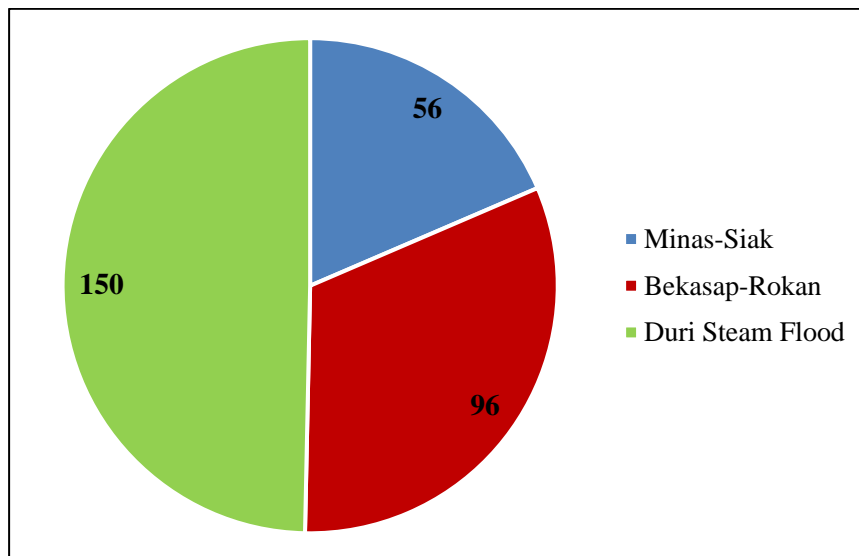
Minas-Siak	Bekasap Rokan	Duri Steam Flood
<ul style="list-style-type: none"> <li>- PT. Insan Tapung Mandiri</li> <li>- PT. Minas Citra Bersatu</li> <li>- PT. Minas Jaya Perkasa</li> <li>- PT. Minas Sakai Pusako</li> <li>- PT. Minas Maju Bersama</li> <li>- PT. Popah Joek Kijang</li> <li>- PT. Ada Harapan Muda Rejeki</li> </ul>	<ul style="list-style-type: none"> <li>- PT. Aka Mulia Sukses</li> <li>- Koperasi Bas Samo</li> <li>- PT. Gadies Sakai Mandiri</li> <li>- PT. Soluk Bungkal Sakai</li> <li>- PT. Efrian Bonai Utama</li> <li>- PT. Zhizhy Shidqia Villa</li> <li>- Koperasi Serba Usaha Tuah Sepakat</li> <li>- Koperasi Unit Desa Tuah Sekata</li> <li>- Koperasi Yudha Putra</li> <li>- Koperasi Berkah Saudara</li> <li>- PT. Limo Anak Botuah</li> <li>- PT. Jaya Putra Helindo</li> </ul>	<ul style="list-style-type: none"> <li>- PT. Abil Karya Mandiri</li> <li>- PT. Aditya Jaya Utama</li> <li>- PT. Agung Perkasa Semesta</li> <li>- PT. Althaf Mandiri Perkasa</li> <li>- PT. Amelia Putri Sulung</li> <li>- PT. Ananda Naila Amirah</li> <li>- PT. Andalan Pratama Global</li> <li>- PT. Aria Juanda Sejahtera</li> <li>- PT. Aryes Esa Nugraha</li> <li>- PT. Azzahwa Mulia Globalindo</li> <li>- PT. Bangsawan Bina Graha</li> <li>- PT Berkah Bunga Tanjung 1991</li> <li>- PT. Berkat Tuah Bumi</li> <li>- PT. Berkat Tuah Negeri</li> <li>- PT. Bumi Sakai Lestari</li> <li>- Koperasi Asa Bangun Negeri</li> <li>- Koperasi Talang Sundik</li> </ul>

in landscapes previously exploited for oil and gas extraction (Gutierrez et al., 2023). This process can restore ecological integrity and revitalize community engagement and economic development.

Souza-Alonso et al. (2023) emphasized that ecological restoration initiatives frequently require substantial community involvement. This active engagement cultivates a feeling of ownership and accountability among the local community, prompting the establishment of community-based organizations dedicated to environmental stewardship. The programs linked to these endeavors promote awareness of environmental concerns and sustainable methods, allowing communities to make

informed decisions regarding their natural surroundings.

One of the most tangible outcomes of ecological restoration is the creation of employment opportunities (Brancalion et al., 2022). Implementing the revegetation program positively contributes to the local ecosystem and significantly absorbs the local labour force. This impact on the labour force is exemplified by the program's capacity to provide employment opportunities to a total of 302 workers in the region. Detailed information regarding the number of workers engaged and absorbed within the framework of this program can be found in Figure 3 of the accompanying data analysis.

**Figure 3.** The Labour Involved in the Revegetation Program

Community involvement in the form of LBD significantly reduced conflicts during the revegetation program. This was shown by 77% of the 30 respondents who said that revegetation activities had never had conflicts. The remaining 23% experienced rejection because of the need for more socialisation by the company and contractors (LBD) in the surrounding community when revegetation activities were carried out.

Community involvement in ecological rehabilitation reduces conflict by building trust, ensuring project legitimacy through shared ownership, and fostering local buy-in by integrating local knowledge and values into project goals (Ardoin et al., 2020). This leads to enhanced project acceptance, smoother implementation, and long-term sustainability, while economic add-value benefits, such as job creation and access to new livelihood opportunities, further strengthen community support and commitment to the project's success (Palmer et al., 2022).

The results of the interviews with the surrounding community indicated that the community supported the revegetation activities carried out by PT. Pertamina Hulu Rokan. All stakeholders were responsible for environmental management. Mutual relations among a unity of interested parties are pivotal for fostering harmonious social relations among diverse interest groups in environmental management. This is primarily because environmental problems inherently involve conflicts of interest; however, cooperation among different actors and opposing coalitions is often essential for resolving these issues (Bodin et al., 2020).

### Impact on Local Economies

Revegetation in oil and gas areas impacts local livelihoods by creating job opportunities in ecological restoration, reducing resource conflicts through improved environmental conditions, and necessitating alternative livelihood development by communities and companies to compensate for lost revenue from unsustainable practices. Successful projects integrate livelihood revitalization with revegetation, offering training and support for new economic activities like LBD to ensure and promote long-term sustainability. These projects can provide significant economic and environmental benefits, particularly in previously used oil and gas extraction areas. Syahza et al. (2020) stated that approaches developed for the advancement of socioeconomic conditions within communities have concentrated on executing different initiatives and measures to enhance the overall well-being and prosperity of the population. These measures encompass a collection of planned actions and interventions to address crucial societal challenges and disparities and foster sustainable development and growth in the community.

Revegetation projects can stimulate local economies by creating jobs in plant nurseries, fieldwork, and monitoring (Galuszynski et al., 2022). These jobs provide income and help build skills within the community, fostering economic independence and resilience (Krypton, 2023). Participation in revegetation projects enhances the community's connection to land, increasing well-being and a sense of ownership (Syahza et al., 2021; Tan et al., 2023). This emotional investment can result in a more

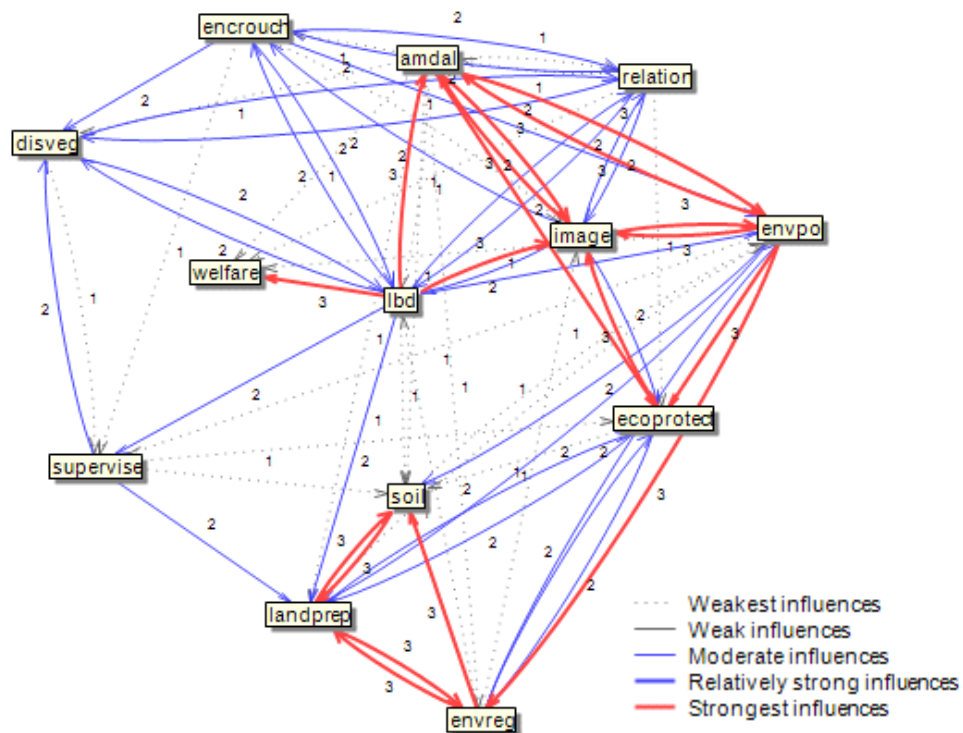


**Figure 4.** Cost of the Revegetation Program in USD

substantial commitment to maintaining and protecting restored areas. Involvement of LBD is a specific treatment in revegetation post-operation areas in the oil and gas industry.

The calculation of prevention expenditure costs in Figure 4 shows that Pertamina Hulu Rokan's commitment to restoring post-operation land was significant. They spent approximately USD 1,4 million on

revegetation activities in the oil and gas operation area. Local companies' participation in revegetation programs can significantly influence their economic landscapes (Franco et al., 2020). Involvement in environmental initiatives can also strengthen community bonds, leading to a more unified community that collaborates to enhance local economic conditions (Goedkoop et al., 2022).



**Figure 5.** Direct Influence Relationship between Sustainability Variables

The network analysis in Figure 5, conducted by Lbs et al. (2024) illustrates its strong influence (marked with a red line). It also emphasizes the role of local companies (LBD) in their involvement in revegetation programs, with the welfare of communities around the company. Furthermore, local companies could diversify their financial endeavors, reduce their dependence on a single industry, and bolster the resilience of the local economy against industry-specific downturns. Additionally, companies engaged in revegetation efforts can improve their reputation and fulfil corporate social responsibility (Baruah & Panda, 2022; Miranda & Miguel, 2022). Through these contributions, local companies can play a pivotal role in ensuring that economic growth is not achieved at environmental expense.

Campbell et al. (2023) emphasized that revegetation efforts contribute to an enhanced

quality of life for local communities. Green spaces provide health benefits, reduce pollution, and improve well-being (Revich, 2023). Moreover, a robust revegetation program can increase the resilience of local economies to environmental shocks, such as climate change and natural disasters, by stabilizing ecosystems and providing alternative income streams (Zamora-Pereira et al., 2023). A company's involvement in revegetation can positively influence its image (based on the network analysis shown in Figure 5) and consumer perception. Consumers are becoming increasingly aware of environmental issues and often make purchasing decisions based on a company's environmental records. By actively participating in revegetation, companies can enhance their brand reputation, leading to increased customer loyalty and potentially higher sales.



Despite these benefits, companies may need assistance in aligning their revegetation efforts with local economic development. Challenges include funding constraints, logistical issues, and the need for long-term commitment. To overcome these hurdles, companies must integrate their revegetation programs into their broader business strategies and continuously engage in dialogue with local stakeholders.

### Limitations and Future Directions

Limitations of revegetation projects include a lack of planning, poor soil preparation, and challenges posed by extreme weather and climate change, leading to uncertain outcomes. Future research should focus on long-term ecological monitoring, integrating socio-economic and environmental sustainability, developing climate-ready planting strategies, and improving stakeholder engagement to ensure projects meet both ecological goals and community needs, thereby creating a resilient, sustainable ecosystem.

### CONCLUSION

Local empowerment through re-vegetation activities is vital for restoring oil and gas landscapes. It brings ecological, economic, and social benefits, fostering a sense of community ownership and responsibility for land. Although challenges exist, integrating local knowledge with scientific guidelines can lead to successful and sustainable restoration. Thus, local empowerment should be the cornerstone of any ex-oil and gas landscape revegetation project.

Ecological restoration projects in ex-oil and gas mining areas significantly impact local economies and sustainable development. These projects can contribute to a more sustainable and equitable future by creating jobs, enhancing property values, developing renewable resources, strengthening community resilience, and promoting social equity. However, careful planning and community involvement are crucial for realizing these benefits and overcoming the associated challenges. The success of these projects ultimately depends on a collaborative approach that considers the needs and values of the local community while striving for environmental and economic sustainability.

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