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Strengthening Partnership Ecosystems to Foster Innovation and Empower Farmers Based on Regional Potential in Riau Province

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Abstract: In the face of rapid economic and technological change, building a robust partnership ecosystem is essential to ensure inclusive and sustainable development, particularly in regions with strong resource-based economies such as Riau Province, Indonesia. As the largest palm oil–producing region in the country, Riau plays a pivotal role in Indonesia's agricultural landscape. However, its significant economic growth—mainly driven by the palm oil industry—has not translated into equitable outcomes for rural communities, especially smallholder farmers and the sustainability of education for farmers' children. This study aims to develop an integrated framework that strengthens multi-stakeholder partnerships to foster innovation and empower farmers based on regional potential. The research adopts foresight methodology and system dynamics to model strategic scenarios. Data were analyzed through horizon scanning, focus group discussions, and simulation techniques. The results highlight persistent gaps in employment absorption, rural unemployment, and limited access to innovation and vocational training. Over half of surveyed enterprises indicated plans to enhance digital infrastructure and adopt artificial intelligence (AI). The study concludes that inclusive partnerships, vocational education aligned with industrial needs, and technology adoption are key to empowering farmers, diversifying the economy, and enhancing regional resilience.

Keywords: Empower Farmers**;** Inovation; Partnership ecosystems; Regional potential; Sustainability of Education

Introduction

In today's global context, economic expansion alone is no longer a sufficient measure of development success. The pursuit of inclusive and sustainable development requires ensuring that growth benefits all segments of society, particularly rural communities that are often left behind. Across the world, regions with abundant natural resources face challenges in translating their economic potential into equitable welfare. This calls for integrated approaches that combine economic, social, and technological dimensions of development, enabling local populations—especially smallholder farmers—to become active participants in regional transformation. Riau Province continues to be one of the main destinations for investment in Indonesia, particularly in the sectors of plantation, processing industries, logistics, tourism, fisheries, and agriculture. These sectors serve as the main pillars of the provincial economy, which, according to Statistics Indonesia (BPS),

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recorded a Gross Regional Domestic Product (GRDP) in 2023 of IDR 1,026.47 trillion at current prices and IDR 551.83 trillion at constant 2010 prices, with an economic growth rate of 4.21%—slightly lower than the 4.55% growth in 2022 (BPS Riau, 2024). Riau contributes 5.00% to the national economy, making it the sixth largest contributor nationally and the second largest outside Java.

Despite these achievements, labor absorption has not kept pace with economic growth. The open unemployment rate in February 2024 was 4.23%, placing Riau as the seventh highest province in (BPS Riau, 2024). Employment remains concentrated in manufacturing (27.55%), agriculture (26.30%), and wholesale/retail trade (19.78%), indicating a structural gap between economic development and the capacity of the regional workforce to access productive jobs. This gap is even more evident in rural communities, where smallholder farmers face systemic limitations in accessing innovation, markets, and quality education for their children.

To address this, the Provincial Government of Riau has outlined a long-term vision for 2025–2045: "Riau Maju, Berbudaya Melayu, Agamis, dan Berkelanjutan." This vision aims to create a competitive and equitable society grounded in cultural and religious values, supported by sustainable economic growth (RPJPD Riau 2025–2045). One of the core missions includes transforming human resources through access to quality vocational and higher education, especially in underdeveloped regions such as Pelalawan, Indragiri Hulu, and Indragiri Hilir (Paman et al., 2023). Strategic steps include strengthening vocational education and polytechnic specializations tailored to Riau's economic base (palm oil, oil and gas, and forestry), as well as boosting research and innovation in downstream industries (Brilliant Asmit et al., 2020).

In this context, strengthening partnership ecosystems becomes a strategic necessity to ensure that economic growth is inclusive, sustainable, and responsive to regional needs. Multi-stakeholder collaboration—among government agencies, industry players, universities, and farming communities—can serve as the foundation for fostering innovation and empowering farmers (Esengulova et al., 2023). This includes expanding access to digital infrastructure, integrating artificial intelligence (AI) technologies in agriculture, and ensuring the sustainability of education for farmers' children as part of long-term human capital development.

In line with the draft RPJPD 2025–2029, Riau is also positioned as a strategic gateway for the Indonesia–ASEAN economic corridor and a future hub for bioindustry in Sumatra. Regional development will be focused on key urban centers like Pekanbaru and Dumai as growth poles, with supporting corridors such as Medan–Dumai–Pekanbaru(Irewati, 2020) . These efforts are supported by planned infrastructure development in logistics, transportation, and digital connectivity.

Nonetheless, significant challenges remain in aligning economic opportunities with labor readiness and innovation capacity (Guth, 2005). Therefore, an integrated planning approach—particularly in workforce development and regional innovation systems—is required to ensure that investment growth translates into inclusive development and increased competitiveness (Grobbelaar et al., 2016). This study seeks to contribute to that agenda by proposing a model that strengthens partnership ecosystems to accelerate innovation and improve farmers' socioeconomic resilience based on Riau's regional potential.

A strategic response to this challenge lies in building partnership ecosystems—multi-stakeholder collaboration frameworks involving government, industry, academia, and communities. These ecosystems help strengthen innovation capabilities, promote inclusive governance, and support the implementation of sustainable economic models tailored to local strengths. In resource-based regions like Riau Province, such frameworks are especially relevant. Riau's economy is driven by plantations, agro-industries, and logistics, yet its future resilience will depend on how effectively it integrates vocational education, digital technologies, and value chain innovation into its development strategies.

Economic Growth and Regional Development

Economic growth is a key indicator of a region's prosperity and its potential to contribute to national development (Cristina et al., 2021). Previous studies have shown that regions with diverse economic sectors, such as Riau, experience a growth trajectory driven by multiple pillars, such as agriculture, manufacturing, and services (Syahza et al., 2020). Riau, as the largest palm oil–producing region in Indonesia, holds a strategic position in the national agricultural economy, but this growth has not always translated into inclusive benefits for rural populations, particularly smallholder farmers.

The linkage between Gross Regional Domestic Product (GRDP) growth and social welfare is complex(Grover et al., 2022). While GRDP growth indicates overall economic expansion, it does not always lead to equitable benefits for local communities, especially when labor absorption fails to match growth (Hess, 2016). Therefore, inclusive economic policies must be sensitive to disparities across sectors and regions and should integrate mechanisms for farmer empowerment and rural development (Moldovan & Moldovan, 2023).

Labor Market Dynamics and Unemployment

The persistent mismatch between economic expansion and employment absorption remains a challenge in developing economies (Diao et al., 2019). In Riau, despite contributions from key sectors like manufacturing and agriculture, the open unemployment rate remains relatively high. Much of this is attributed to a lack of alignment between workforce capabilities and industrial needs.

Addressing this requires strategic partnerships between government, industries, educational institutions, and local communities. An inclusive labor market strategy must focus on integrating smallholder farmers into the formal economy, upskilling youth in rural areas, and expanding job opportunities within the agricultural value chain(Balestra et al., 2018) . Special attention should be given to improving access for the children of farmers to vocational education, ensuring intergenerational progress and sustainability.

Vocational Education and Workforce Development

Vocational education plays a critical role in bridging the skills gap and preparing the workforce for modern economic demands (Gadling & Bhosale, 2025). As noted by the World Economic Forum (2023), future employment will require both technical and adaptive skills. In Riau—where palm oil, forestry, and agriculture dominate—the alignment of vocational curricula with local industry needs is vital for enhancing employment and empowering local farmers. (Atchoarena & Esquieu, 2017) highlight that vocational education must be embedded in the local economic context to ensure relevance. Expanding access to polytechnic and technical training for farming communities and their children is a strategic step to breaking cycles of rural poverty while fostering inclusive innovation and entrepreneurship.

Regional Innovation and Technological Advancements

Innovation and technology are central to diversifying regional economies and improving competitiveness. In Riau, downstream development in agriculture and fisheries offers space for innovation-driven models. The adoption of smart technologies, such as IoT in palm oil processing and precision agriculture, can boost productivity and sustainability (Biazi & Marques, 2023).

However, effective technology adoption depends on the robustness of the regional innovation ecosystem. This includes R&D institutions, human resource development, digital infrastructure, and regulatory support (Matt et al., 2021). Collaborative innovation platforms that connect farmers, researchers, and agribusinesses can accelerate the transfer of technology to the field level, thus enabling inclusive and sustainable rural transformation.

Strategic Regional Planning and Policy Integration

Strategic planning is essential to synchronize economic, technological, and social policies. The Provincial Government of Riau's long-term vision (RPJPD Riau 2025–2045) focuses on building a "competitive and equitable society" through inclusive economic development rooted in cultural values. One of its missions is human capital transformation, particularly in underdeveloped regions such as Pelalawan and Indragiri Hilir, by expanding vocational and higher education (Fadhlan Yazid et al., 2019).

In line with the Pentahelix framework (Sabel & Saxenian, n.d.), regional policy must actively engage academia, business, government, communities, and the media to develop an innovation ecosystem. Emphasizes that digital connectivity is a critical enabler for economic modernization, especially for provinces like Riau positioned as future hubs of Indonesia's bioindustry.

Challenges and Opportunities in Diversifying the Economy

Riau's economic overdependence on oil and gas has made diversification an urgent priority. Although palm oil and agriculture offer promising alternatives, challenges persist—ranging from regulatory gaps to limited innovation linkages (Oviawe et al., 2017). Expanding the value-added processing of palm oil and renewable energy could transform rural economies and increase farmer incomes (Ahmadov, 2017).

Strengthening the partnership ecosystem is crucial to realize these potentials. Multi-stakeholder collaboration can support farmers in adopting sustainable practices, entering new markets, and participating in decision-making processes. This will not only improve livelihood outcomes but also ensure long-term resilience.

The Role of Horizon Scanning and Media Intelligence

Horizon scanning is essential for anticipating economic, environmental, and technological shifts (Ricciardi et al., 2017). In Riau, it can help local governments and stakeholders proactively respond to megatrends—such as climate change, digital disruption, and global commodity volatility—that affect rural livelihoods.

Media intelligence tools, including social media analytics, can further inform policy design by capturing community voices and emerging issues (Teti, 2024). By integrating this feedback loop into strategic planning, Riau can design more adaptive and inclusive development interventions, particularly for its farming population.

Despite being one of Indonesia's top investment destinations and contributing 5% to the national economy, Riau Province faces a structural disconnect between economic growth and labor absorption. In 2023, the province recorded a GRDP of over IDR 1,000 trillion, but the open unemployment rate remained high at 4.23%. Employment is concentrated in a few sectors, with rural communities—particularly smallholder farmers—struggling to access innovation, market integration, and quality education. Although the provincial government has outlined a long-term vision of "Riau Maju, Berbudaya Melayu, Agamis, dan Berkelanjutan," the implementation of human capital transformation through vocational education and inclusive regional planning remains fragmented and insufficiently responsive to these structural challenges.

While numerous studies have explored economic diversification and inclusive growth in rural regions, limited research integrates foresight methodology and system dynamics modeling to project and simulate partnership-based development pathways. This study fills that gap by offering a novel framework for strengthening multi-stakeholder partnerships that empower farmers, accelerate innovation, and increase socio-economic resilience. It builds on regional potential and uses scenario analysis to model future-oriented policy options. Given Riau's strategic position in the Indonesia–ASEAN economic corridor and its role in national palm oil production, the urgency to establish inclusive, adaptive, and evidence-based planning is critical to achieving long-term sustainable development and social equity.

Method

Tool and Materials

This study used both qualitative and quantitative resources. The key tools included: Vensim PLE: software for system dynamics modeling and simulation and Microsoft Excel: for data entry, trend analysis, and scenario mapping.

The materials included:

a. Regional planning documents: RPJPD Riau 2025–2045, and other strategic policies relevant to innovation and workforce development.
b. Official statistics from Badan Pusat Statistik (BPS) Riau (2020–2024).
c. Results of Focus Group Discussions (FGDs) with stakeholders from government, academia, industry, and farming communities.

Research Methods

The research applied an integrated methodology combining: Foresight Approach: Selected for its strength in capturing long-term qualitative insights and constructing future-oriented strategic scenarios (Acemoglu, 2002). It enables the identification of trends, drivers, and plausible developments in workforce and innovation planning (Kanzola & Petrakis, 2024). System Dynamics: Used to validate foresight insights by modeling causal relationships and feedback loops within the socio-economic systems of Riau (Hines et al., 2019). It supports simulation of complex interdependencies across variables like labor, education, and technology

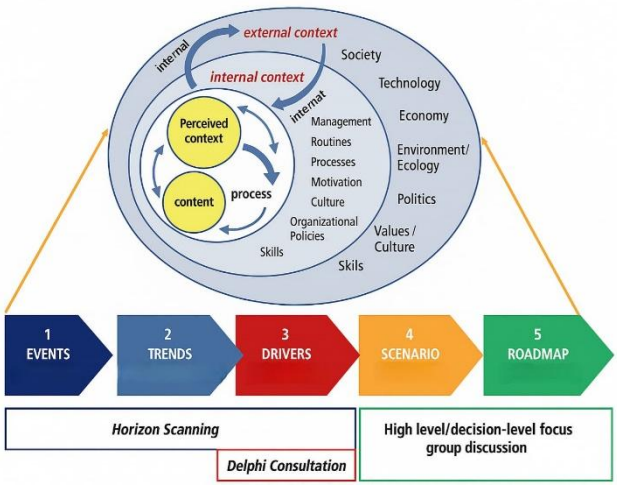

Figure 1. Foresight System Methodology

According to the diagram, the foresight process consists of five main stages: Events, Trends, Drivers, Scenarios, and finally the Roadmap stage. While Foresight is powerful in capturing long-term qualitative insights, it also has inherent limitations—particularly in its susceptibility to cognitive biases and subjectivity, especially during the Horizon Scanning phase, which is typically conducted through Focus Group Discussions (FGDs).

As a method, System Dynamics is well-suited to model the interdependencies and dynamic behaviors of complex systems over time (Nursubiyantoro et al., 2020). In this study, insights from horizon scanning and FGDs serve as initial inputs for building a dynamic simulation model. This model is then used to test scenarios and evaluate the projected impacts of key drivers within the workforce and economic systems of Riau Province.

Both Foresight and System Dynamics emphasize the importance of stakeholder participation, which strengthens the validity and societal acceptance of the outcomes. This participatory, cross-sectoral engagement enhances the legitimacy and effectiveness of evidence-based public policy. Given the high complexity of data integration and analysis, the study adopts an iterative and collaborative approach, involving experts from diverse disciplines to ensure methodological rigor and practical relevance.

By applying this integrated method, the study underscores the importance of adaptive planning in navigating the uncertainties brought by digital transformation, reinforcing the Riau Provincial Government's commitment to formulating data-driven, future-ready policies. Research design and method should be clearly defined.

Research Stages

The study followed a five-stage framework adapted from Foresight System Methodology:

a. Event Identification: Collection of key regional events affecting economic transformation and labor transitions.
b. Trend Analysis: Detection of long-term trends in digitalization, education, employment, and agriculture.
c. Driver Mapping: Using FGDs to identify and validate main drivers of change—technological, institutional, and demographic.
d. Scenario Development: Formulating multiple future scenarios to explore policy implications and strategic options.
e. Roadmap Construction: Integrating simulation results and foresight outcomes into a strategic planning roadmap for Riau Province.

The process was iterative and collaborative, involving domain experts from economics, education, agriculture, and regional planning.

Data Analysis

Qualitative data from FGDs and document analysis were processed using horizon scanning techniques to extract strategic drivers. These drivers were ranked and validated through expert consensus using the Delphi method. The system dynamics simulation used a conceptual model incorporating labor supply, vocational education capacity, digital readiness, and technological adoption.

Result and Discussion

Socio-Economic Landscape of Riau: Implications for Farmer Resilience and Inclusive Development

Riau Province holds considerable economic potential, particularly in the agricultural and palm oil plantation sectors. However, despite a steady Gross Regional Domestic Product (GRDP) growth of 4.21% in 2023, the distribution of economic benefits remains uneven, especially among smallholder farmers. This indicates that economic growth has not yet translated into broad-based improvements in rural livelihoods.

The increase in the Human Development Index (HDI)—from 72.94 in 2021 to 74.04 in 2023—signals progress in human development. However, this advancement has not yet strengthened the competitiveness and autonomy of smallholder farmers. Furthermore, the open unemployment rate of 4.23% highlights persistent structural challenges, including limited access to innovation, technology, and stable markets for rural communities.

Strategic Issue Identification through Horizon Scanning

A horizon scanning approach was employed to identify emerging issues that directly affect the agricultural sector and the empowerment of farming communities in Riau. Several critical challenges were identified: Climate Vulnerability and Agricultural Risk: Shifts in rainfall patterns and the rising frequency of natural disasters, such as floods and forest fires, threaten the productivity and sustainability of smallholder agriculture. Limited Access to Innovation and Appropriate Technology: The majority of smallholder farmers continue to rely on traditional farming knowledge, with a low level of adoption of modern tools and practices. Weak Farmer Institutional Capacity and Partnership Governance: Farmer groups, cooperatives, and local institutions are not yet optimally integrated into the value chain and lack bargaining power in the distribution of agricultural value-added.

Fragmented Regulatory and Policy Support: Inconsistent and disjointed agricultural policies between national and regional levels impede coordinated interventions, particularly in the facilitation of farmer empowerment and partnership development.

Media Discourse and Public Perception on Vocational and Agricultural Innovation

Media and social media monitoring during 2022–2023 revealed increasing public discourse on human capital development and vocational education in Riau. These topics—frequently shared across Twitter, Facebook, TikTok, and Instagram—often intersect with themes of farmer training, agricultural digitalization, and rural entrepreneurship. This demonstrates growing societal awareness of the role of innovation and capacity building in improving agricultural livelihoods.

Nevertheless, dominant media narratives continue to be shaped by political scandals and bureaucratic inefficiencies, which may reduce public trust in regional institutions. Strengthening media narratives that highlight successful farmer partnerships, local innovations, and institutional best practices is therefore essential for shifting public attention towards inclusive rural transformation.

System Dynamics of Innovation, Labor, and Agriculture

A system dynamics framework was developed to examine how capital, labor, and technology interact in shaping the economic and agricultural development of

Riau. Using a Cobb-Douglas production function, the model emphasizes that Total Factor Productivity (TFP)—which includes innovation and knowledge transfer—is critical in achieving sustainable growth.

In the agricultural sector, innovation is not solely about increasing yields but also about reducing risks, improving resilience, and enhancing farmer-market linkages. The model also includes projections of labor supply and demand in vocational and agricultural fields, showing the importance of aligning training capacity with real sector needs.

Scenario Planning and Regional Pathways

Using the Delphi method, four future scenarios were developed. Among these, Riau currently aligns most closely with the "Untapped Potential" scenario, characterized by emerging downstream industries in agriculture and plantations, but constrained by slow institutional reforms and fragmented innovation systems.

Tabel 1. regional innovation clusters

Region	Main Cluster Focus
Pekanbaru	Manufacturing, energy, and oil & gas industries around Tenayan Industrial Zone
Kampar	Freshwater catfish (patin) aquaculture and its downstream processing industry
Kepulauan Meranti	Sago-based industries, contributing 90% of national sago production with export potential
Rokan Hilir	Capture fisheries and fish-based processed products (e.g., dried fish, fish floss, fish nuggets)
Bengkalis	Marine aquaculture and shrimp farming in coastal areas
Dumai	Marine fisheries in the Strait of Malacca; key horticultural crops such as chilies and pineapples
Siak	Palm oil and rubber processing; cassava and sweet potato cultivation
Indragiri Hilir	Coconut-based economy with extensive plantations and derivative product industries
Kuantan Singingi	Mining cluster (coal, gold, manganese); potential for broader regional economic development
Rokan Hulu	Agriculture, forestry, and fisheries; opportunities for electricity and gas supply development
Pelalawan	Pulp and paper industry based on industrial forest plantations (acacia and eucalyptus)

This position underscores the urgency of strengthening regional innovation clusters and partnership models that enable the integration of smallholder farmers into modern value chains. Without targeted interventions, such as inclusive financing, extension services, and digital market access, these potentials may remain underexploited.

Strengthening Regional Innovation Clusters through Applied Research

The regional roadmap for 2024–2029 emphasizes cluster-based innovation, where each district focuses on its comparative advantage. For example: Kampar: Digital freshwater aquaculture using IoT systems. Meranti Islands: Advanced sago processing technologies. Indragiri Hilir: Biofloc-based marine aquaculture with environmental sensors. Siak: Smart palm oil plantations integrating precision agriculture tools. Bengkalis: Low-cost sonar fish detection for traditional fishermen.

These initiatives demonstrate that applied research—when aligned with local contexts—can address productivity gaps while promoting ecological sustainability and farmer welfare. However, such efforts require long-term policy commitment, multi-stakeholder coordination (Pentahelix), and robust knowledge dissemination mechanisms.

Vocational Education as a Catalyst for Agricultural Transformation

To match future labor demands, vocational education institutions must realign their curricula with emerging skill sets in agriculture, digital innovation, and green economy. The simulation results suggest that without this realignment, mismatches between supply and demand in the agricultural labor market will persist.

Capacity planning for vocational institutions must therefore be evidence-based and region-specific—targeting the unique needs of each agricultural cluster and empowering youth in rural areas with adaptive and entrepreneurial competencies.

Conclusion

In conclusion, although Riau Province has experienced steady economic growth in recent years, this progress has not been accompanied by equitable improvements in employment opportunities or rural welfare. The persistently high open unemployment rate of 4.23% as of August 2023 highlights a structural disconnect between economic performance and labor market inclusiveness—particularly for smallholder farmers and youth in rural areas.

This gap underscores the need for a strategic transition from a predominantly extractive economy, reliant on oil and gas, to a diversified and innovation-driven agricultural economy. Central to this shift is the development of human capital through contextualized vocational education, tailored to the specific needs of agro-industrial value chains and supported by robust public–private–community partnerships.

The digital ambitions of local enterprises—79% targeting improved digital access and 38% planning to

integrate artificial intelligence by 2030—signal readiness for technological transformation. However, to ensure that these shifts benefit rural populations and agricultural stakeholders, innovation must be democratized through inclusive digital infrastructure and capacity-building mechanisms.

To achieve this, four strategic imperatives are proposed: Strengthen downstream commodity policies to add value locally and enhance employment through inclusive agricultural processing and agro-industry clusters. Reform vocational education systems to produce digitally literate, technically skilled graduates who can lead innovation in farming, agri-entrepreneurship, and green technologies. Expand digital and physical infrastructure to connect rural communities with broader markets, services, and innovation ecosystems. Institutionalize ESG principles (Environmental, Social, and Governance) in agricultural and regional development planning to ensure sustainability and social justice.

These strategies align with Riau's 2024–2045 long-term vision of becoming "Advanced, Culturally Malay, Religious, and Sustainable." Achieving this vision requires not only policy coherence and inter-sectoral synergy but also the strengthening of a collaborative partnership ecosystem that empowers farmers, accelerates innovation, and fosters inclusive regional prosperity.

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Author Contributions

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Conflicts of Interest

The authors declare no conflict of interest.

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