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The Identification of Challenges in Innovation Ecosystem of West Java, Indonesia Using a Systematic Literature Review

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Abstract. The objective of this literature review was to identify the challenges in the innovation ecosystem of West Java, Indonesia. Using a systematic literature review (SLR) and qualitative method, over 100 works from 2012 to 2022 were analyzed. The focus was then narrowed to 67 articles, significantly contributing to this review paper's discussions. Additional relevant references were included based on keywords such as Higher Education Institutions (HEIs), Intellectual Property, and Innovation Ecosystem. The literature review area was West Java, chosen due to the abundance of articles circulating within the region. West Java had the highest patent and intellectual property registrations, attributed to the presence of reputable universities. The main issue identified was the lack of synergy among the actors and limited youth participation, thereby worsening challenges in sustaining the funding. The analysis underscored the potential to enhance youth participation through government initiatives. To validate such results and formulate tailored recommendations for each actor in innovation ecosystem, further reviews were recommended. This aimed to enhance innovation productivity emanating from HEIs and other important actors.

Keywords: Challenges; Collaboration; Engagement; Ecosystem; Innovation

1. Introduction

Indonesia, classified as a low-and-middle-income country (LMIC), is showing considerable potential for economic development, evident in the proliferation of startups established over the past five years (Harsanto, 2021). The annual gross domestic product (GDP) data remained stable, fluctuating between 5% to 6% over the past five years. However, it experienced a decline with the onset of COVID-19 in 2020, rebounding in 2021. The progress in the economy of Indonesia has garnered attention globally, with the country being part of the G20. According to the 2020 Global Innovation Index, the Indonesian innovation performance is in line with the expectations for LMIC. When compared to fellow LMICs in Southeast Asia, particularly Vietnam (Suketi *et al*., 2014) and the Philippines (INSEAD, 2022; Widiawati and Nugroho, 2021), the country lags significantly. The decline from the 74th position in 2019 shows a shortage of research and development innovation. This deficiency is attributed to the Indonesian inadequate investment in research and

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development. The country lags in terms of scientific journal publications, patent applications, research and development funding, and excellent research institutions (Nitia, 2020).

Research shows that actors who are engaged in innovation activities often operate independently. These actors, including HEIs, government entities, and private industries, tend to function in isolation. The segregation results in gaps between funding, research activities, and output, hindering the generation of innovative ideas (Lawrence *et al*., 2020). Education serves as a crucial factor in enhancing sustainability in innovation. Previous reviews showed that a well-educated workforce was fundamental for fostering innovation in an organization.

In the Philippines, efforts to enhance the quality of HEIs incorporate incentivizing research and focusing on total university development (Ortiga, 2017). Similarly, Vietnam aims to increase capacity, quality, and efficiency by granting HEIs greater autonomy (Lawrence *et al*., 2020). The country has established a National Innovation Capacity to enhance research productivity through university-industry linkages (Do *et al*., 2021; Nguyen, Nguyen, and Doan, 2013). In Malaysia, a different approach emphasizes the quality of the analysts, their commitment, and financial support as crucial elements ensuring the success of University-Industry Collaboration (UIC). Industrial partners prioritize teamwork and frequent communication as key components for successful UIC project integration. This symbiotic relationship between local analysts in Malaysian university and industry professionals advances based on important success factors, including leadership ability, commitment, short-term results, impact on industry and university, government and management support, and the research environment (Hanid, *et al*., 2019).

Beyond fostering collaboration in agriculture, it is necessary to identify and engage actors from each sector to ensure innovative practices. Engagement refers to the extent to which actors feel engaged in the organization and its objectives. Naruetharadhol *et al*. (2021) emphasized that the commitment and engagement of actors play an intermediary role in realizing the organizational objectives.

In Indonesia, numerous innovation ecosystem are found in the agricultural sector. The connection is intricately linked to intellectual property arising from innovation by actors in HEIs and their collaborative efforts with, the government and the private sector. In this literature review, the focal point of the innovation ecosystem is West Java. This is attributable, among other factors, to the concentration of major university, particularly in agriculture in West Java compared to other regions. The substantial population and extensive land support of the region further accentuate its prominence in agriculture. The aspect is exemplified in the research conducted by Hidayat and Suciaty (2019), showcasing how agricultural innovation in West Java contributed to an increase in rice production.

To comprehensively understand the challenges within the innovation ecosystem, this review paper uses a systematic literature review. The investigation focuses on agricultural innovation in West Java, a context frequently featured in publications. The identified gaps center on the comprehension of the innovation ecosystem, the engagement of actors, and their contributions to innovation. Therefore, this review paper aims to address the gaps through an assessment of the literature using keywords. The subsequent discussion will examine the greater detail concerning the definition of an innovation ecosystem, the engagement of actors, and the challenges encountered in such an ecosystem.

2. Methods

This literature review adopted a systematic literature review coupled with a qualitative method using article search platforms, such as Web of Science, Scopus,

Copernicus, and Google Scholar. Literature was sourced from various types of articles, including peer review, research and/or policy briefs, and newspapers, spanning from 2012 to 2022. The search used main keywords, such as innovation ecosystem and agriculture innovation in West Java. Initially, more than 100 articles were reviewed at the commencement of the literature review. The sources were then narrowed down to 67 articles, which played a substantial role in shaping the discussions in this paper, complemented by additional relevant references (Figure 1). The articles were subjected to evaluation to identify challenges or main issues within the innovation ecosystem, particularly in West Java.

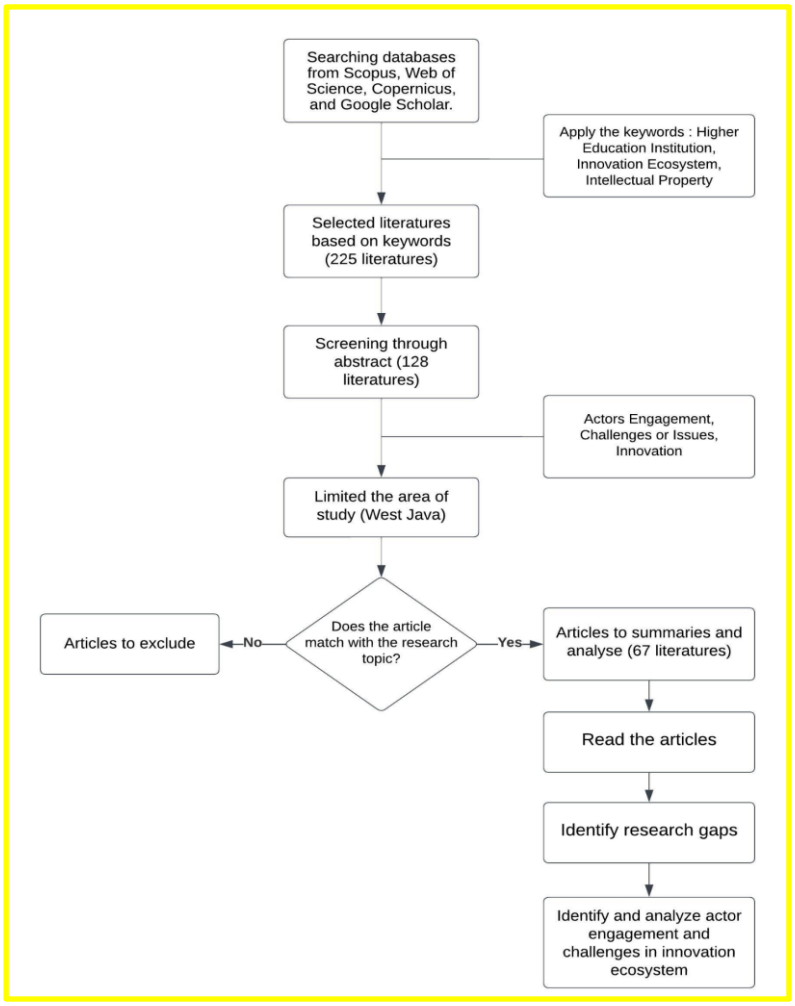

Figure 1 Research Design

The article collection process began with sourcing literature based on specified keywords, followed by screening abstracts to shortlist 67 papers. The selection comprised 55 peer-reviewed articles, 2 reports from NGOs/Development Agencies, 3 conference papers, and 7 policy briefs and documents. The selection criteria were based on the engagement of actors, particularly HEIs, within the broader innovation ecosystem. The focus was then narrowed to the agricultural innovation ecosystem, supporting the national priorities in government policies. The literature review area was limited to West Java, given the abundance of relevant articles circulating within the region. West Java holds the highest patent and intellectual property registrations, attributed to the concentration of the reputable university. After the article selection, the review paper identified collaboration within the development of innovation ecosystem and elucidated the occurring challenges.

3. Results and Discussion

The assessment of 67 literature sources adopted a rapid network and systematic approach to discern both engagement and challenges within the innovation ecosystem. The discussion evolved from the definition of the innovation, particularly its connection to agriculture, a topic extensively explored in the literature of West Java. Actors engagement within the innovation ecosystem, particularly HEIs, and challenges were key focal points.

3.1. Innovation Ecosystem Definition

An innovation ecosystem was a collaborative network comprising an organization and individuals aiming to cultivate ideas for positive societal and economic impacts (Lawrence *et al*., 2020). The strength of the ecosystem relied on the quality and frequency of the interactions within the communities, an organization, and institutions. A 'strong' innovation ecosystem comprised both element and functional attributes. Element attributes pertained to actors fulfilling specific roles, a robust market system, and abundant resources, including infrastructure, financing, and social capital. Functional attributes consisted of communication networks and independence in financial and human resources. In essence, the actor-centric innovation ecosystem model was predominant (Hoffecker, 2019).

This literature review specifically focused on understanding the relationships among all actors within the innovation ecosystem. Actors were primarily characterized by their roles, such as innovators, knowledge sharers, connectors, conveners and facilitators, advocators, trainers, and funders (Figure 2). Poor connections could result in unfulfilled essential roles, and without organizational focus on strengthening the coordination between actors, the ecosystem risks disconnection. Additionally, actors were described by their institutional type, including government, donors, businesses, start-ups, civil society organizations (CSOs), and HEIs (Hoffecker, 2019). The actors collaborated around the center of the ecosystem with shared missions and visions, embedded in an enabling environment shaped by cultural, regulator/policy, and market contexts. Some elements or functional attributes might not be sufficient to sustain innovation activity without robust, prolonged engagement with other actors.

From the literature review, Science Techno Park (STP) became the government-led initiative to foster innovative products within HEIs (Tricahyono *et al.*, 2018). Recognized as a catalyst for innovation-based economic growth within regional and national innovation systems (Soenarso, Nugraha, and Listyaningrum, 2013), STP became an innovation center within HEIs, leveraging their role to be knowledge sharers (Mukhlish, 2018; Soenarso, Nugraha, and Listyaningrum, 2013). Effective collaboration was necessary for HEIs, incorporating partnerships with the private sector known to be distributors, and the government as regulators. To navigate the complex and dynamic environment, the participation of consumers and communities in innovation process was crucial (Mukhlish, 2018).

To support this, several universities have established business incubators. Research by Gozali *et al*. (2016) defined a university-based business incubator as an entity streamlining the development of successful new businesses through a range of integrated services. The performance of a successful business incubator relied on essential factors, including information technology, government protection and support, funding, mentoring networks, and adherence to university regulations (Gozali *et al*., 2020).

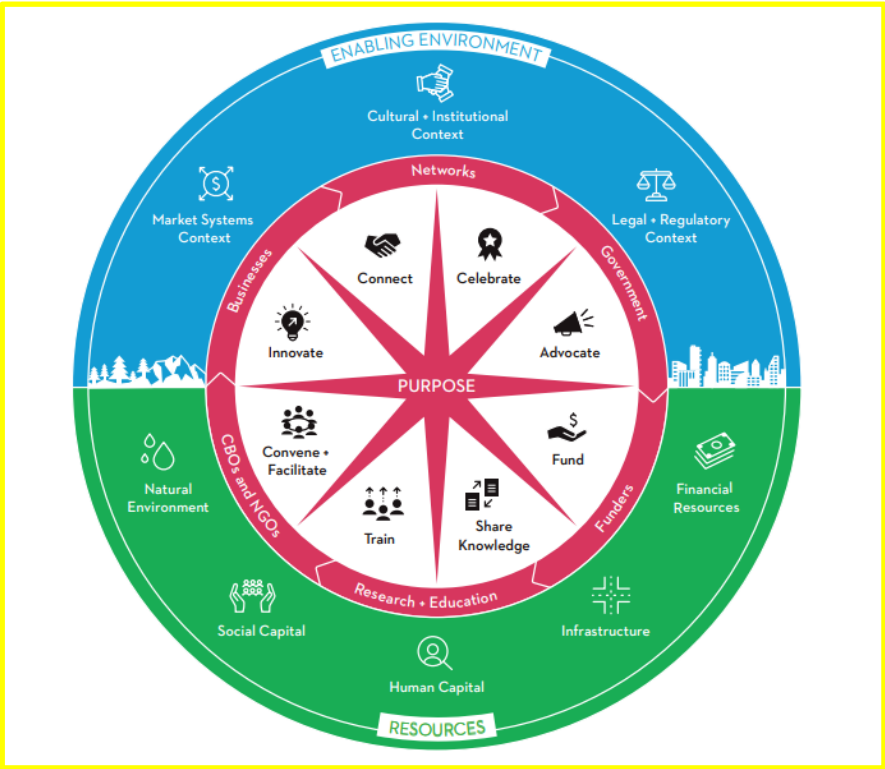

Figure 2 The model of innovation ecosystem derived from Hoffecker (2019) pg 5: Understanding Innovation Ecosystem: A Framework for Joint Analysis and Action. The model identified three main categories of ecosystem elements, including actors (red color), resources (green color), and enabling environment (blue color).

As an agricultural country, Indonesia prioritized agricultural innovation, with HEIs and government literature centers spearheading developments. Despite this, collaboration remained limited, posing challenges in sustaining innovation (Harsanto, 2021). The aspect would be further explored in the next section, focusing on the engagement of actors in innovation collaboration, including HEIs.

3.2. Collaboration in innovation ecosystem

Research showed that, in most cases, innovators operated independently in their endeavors. An example was the case of Papaya Calina, which was distributed through Bogor Life Science and Technology (BLST), a Holding Company from Bogor Agricultural University (IPB). IPB took on the role of researching and distributing the product across Indonesian regions (Suketi *et al.*, 2014). Another example was the Organic-based Controlled Aerobic Rice Intensification technology (IPAT-BO) from Padjadjaran University (UNPAD). The technology was designed to conserve water and reduce input requirements (seeds, organic fertilizers, and pesticides). Furthermore, it has the potential to enhance rice production yields by 25-300% (Sutrisna and Surdianto, 2017). All research and development endeavors were carried out by universities with support from the Ministry of Research and Technology. However, instances existed where innovators from research and educational institutions collaborated with other actors.

A significant example was the case of allowing an educational institution to work alongside the government and other actors, including the Value Chain Center (VCC). The collaboration aimed to eliminate loan shark middlemen, empowering farmers to market their products at fair prices and generate better profits. This innovative approach restored the agricultural supply chain through a triple-helix partnership incorporating UNPAD, the

West Java Governor, and Fresh Fruit and Vegetable (FFV) farmers (Perdana and Kusnandar, 2012). The collaborative effort reduced risks and transactional costs while increasing the export rate of FFV. Another instance of collaboration was the Agricultural Techno Park (ATP), similar to the functionality of STP, developed by IPB, the Ministry of Agriculture, and the Bogor Regency government (Mardiharini, Indrawanto, and Rohaeni, 2021). The ATP was geared toward market-oriented businesses with adequate facilities and activity inputs aimed at enhancing the productivity of farmers. The objective of the ATP was to evolve into a business-oriented educational institution.

As previously mentioned, the majority of the innovation originated in the university with government funding, often without the participation of the private sector. To address this issue, the government initiated programs to foster collaboration and create a more dynamic innovation ecosystem, such as the matching fund *Kedaireka*. The *Kedaireka* was a grant that facilitated the collaboration between the university and the private sector. Additional incentives, including tax deductions for the private sector participating in research with the university, were regulated (Lawrence *et al*., 2020).

The absence of collaboration between HEIs and other actors, specifically private sectors, arose from various reasons. A significant challenge was maintaining engagement in collaboration, often limited by funding durations of 1 to 2 years (Harsanto, 2021; Mukhlish, 2018). The sustainability of research became challenging when the funding expired while the work was ongoing. Beyond funding sustainability, additional challenges were explored in the following sections.

3.3. Challenges in innovation Ecosystem

The evolution of technology drove innovation toward digital transformations, including smart farming, precision farming, the application of remote sensing and unmanned aerial vehicles (UAV) for agriculture, and the integration of the Internet of Things (IoT) (Harsanto, 2020). Technological integration provided easier access to high-quality data, facilitating research when adequate funds were available (Khofiyah, Sutopo, and Hisjam, 2020). Despite improved access to data, the lack of collaboration in research persisted. The literature identified key issues within the Indonesian innovation ecosystem, including (1) the lack of synergies between ecosystem actors, (2) research products misaligned with industry and consumer needs, (3) low adoption of agricultural technology innovation, and (4) lack of youth participation.

3.3.1. Lack of Synergies Between Ecosystem Actors

Synergies manifested when actors collaborated around the center of ecosystem with shared missions and visions embedded in an enabling environment that comprised cultural, regulator/policy, and market contexts, exemplified by the triple helix formation (Mukhlish, 2018; Perdana and Kusnandar, 2012). The triple helix formation created a more robust supply chain for agricultural markets in West Java, particularly for FFV farmers (Perdana and Kusnandar, 2012), enhancing export commodities and creating a more resilient market. However, collaboration was not consistently maintained, resulting in disconnection. It was limited to research funding, lacking follow-up after the completion of funding (Mukhlish, 2018). The lack of synergies between the university, local governments, and adopters (users) in innovation ecosystem was a crucial issue. The lack of synergies between actors also introduced another challenge. In scenarios where the private sector failed to engage adequately with the university, the research, and innovation that was developed struggled to meet the market demand.

3.3.2. Research Products that Do Not Meet Industry and Consumer Needs

Innovation represented a means to fulfill consumer demand, exemplified by the West Java Innovation Valley, a collaborative initiative between IPB and the West Java Government. The area was envisioned to become a hub for agricultural innovation, addressing food security and serving as a center for modern agriculture (Satria, Santosa, and Abdullah, 2021; Khumaida, Ardie, and Purwanto, 2019). Sudarman emphasized that government-supported research should be in line with industrial demand (Sudarman, Sawitri, and Budiono, 2013). Therefore, ongoing collaboration and discussion were crucial to ensure that innovative solutions, generated or translated, met the industry perspectives and end-user demands. The demand for innovative products was expected to increase as end-users were compelled to embrace technologies, offering income-generating opportunities for the university. In this context, the engagement of the private sector being a conduit to consumers, became indispensable (Choeriyah and Noviaristanti, 2021; Khumaida, Ardie, and Purwanto, 2019).

As discussed in the previous subsection, certain innovation did not progress beyond the funding period. Engaging the private sector simplified the process of connecting the dots and sustaining innovation. However, challenges persisted not only from the private sector but also from end-users, including slow adoption due to complex or irrelevant innovation for the target market. It was crucial for the proposed innovation to be user-friendly (Harsanto, 2020).

3.3.3. Low Uptake of Innovation

The government acknowledged the need for technology adoption in agriculture and initiated programs including the Smart Farming program by local government institutions in Lembang. Using IoT and smart farming applications, Indonesian farmers could control their fields through smartphones (Awaliyah, 2018), enabling tasks such as watering and fertilization with a simple press on the application (Flor *et al*., 2021).

A considerable number of traditional farmers belonged to the old generation rather than the youth, lacking a transitional generation that readily comprehended technological developments. Therefore, even with government efforts to train farmers in the latest technology, a distinct method was required to facilitate their proper use of the learning. This resulted in a sluggish adoption of technology, contributing to widening gaps in innovation (Flor *et al*., 2021; Harsanto, 2020; Guntoro, Rakhman, and Suranindyah, 2016). To bridge the gap in digital technology across various sectors, including agriculture, the government advocated for the establishment of STP. By integrating technology into agriculture, youth participation was anticipated to increase (Sari and Retnaningsih, 2020). The increased participation of youth in agri-technology aimed to contribute to innovation ecosystem, reducing the disparities between innovators and end-users.

3.3.4. Lack of Youth Participation

The sluggish technology adoption rate was partly attributed to the limited participation of youth in agriculture. Research suggested that youth engagement could enhance agricultural productivity through the adoption of new technology and innovation (Widaningsih *et al*., 2021). Recognizing the need to engage millennials in the digital era 4.0, Dhawan (2020) emphasized the importance of inviting them to contribute to solving agricultural challenges through technology. Government encouragement was crucial to engage youth in managing various aspects of modern agriculture (Yunus *et al.*, 2021). Experts emphasized the crucial role of digital technology across all sectors, including agriculture in rural areas. To attract more youth to engage in agriculture technology-based

initiatives and foster innovation in ecosystem, it was essential to establish improved regulations and training programs.

A program called Petani Millennials (Millennials Farmers) was created to enhance youth participation and was outlined in the Regulation of The Governor of West Java Number 25/2021 (West Java Government of Indonesia, 2021). The program provided various incentives, with a particular focus on technology support, to Millennials interested in the agricultural sector. As part of the initiatives of West Java, Petani Millennials aspired to increase the presence of millennials in HEIs and contribute to agriculture through technology development. The program aimed to increase youth participation, particularly among university graduates, in line with the food security objective outlined in the 2045 National Long-Term Development Plan.

4. Conclusions

In conclusion, it was evident that the innovation ecosystem in West Java, Indonesia still faced several challenges. The innovation landscape, particularly in agriculture, required enhanced collaboration and synergy among the government, HEIs, and other actors. Both government and donor funding played a crucial role in supporting innovation and fostering collaboration. The active engagement of youth and millennials was also important. Millennials in Indonesia are driving the transformation of traditional agricultural practices toward digital technology such as smart farming. To achieve this, integrating improved regulations and training programs became necessary to attract more youth to engage in agriculture technology-based initiatives, thereby fostering innovation in the agricultural ecosystem. Future investigations could investigate more specialized innovation ecosystems, such as agri-technology, and explore the innovation ecosystem of HEIs to validate the analysis results. The exploration could be aimed at formulating recommendations fostering a more engaging innovation ecosystem and increasing its productivity.

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