Jurnal
Manajemen
Teknologi

Jurnal Manajemen Teknologi, 23(3), 2024,237-151
Available online at http://journal.sbm.itb.ac.id

Innovation Platforms as a Strategy to Support the Agricultural Innovation System in Indonesia (Case study on the Implementation of Jajar Legowo Super*)*

Indah Purwaningsih, Winda Anestya Ayunda*, and Lutfah Ariana
National Research and Innovation Agency Republic of Indonesia (BRIN)

Abstract. *The strategy for utilizing research results through collaboration between stakeholders is crucial in developing agricultural innovation system. This study examines the multi-stakeholders collaboration on the scaling process of the Jajar Legowo (Jarwo) Super technological package as the research result of the Agricultural Research and Development Agency (Balitbangtan), Ministry of Agriculture (MoA), Indonesia. Employing the innovation platform framework, this study explores the multi-stakeholders' perspectives by conducting semi-structured interview with related stakeholders: researchers, policy makers, disseminators, and local governments. The innovation platform framework is applied to map the actors, roles and functions that support the scaling process along the value chain from the problem identification, towards technology development through experimentation and the upscaling process in the system. The study finds that the innovation platform succesfully improve the rice productivity in some regions despite some challenges. Instead of full technology application, farmers prefer integratge them with indigenous practice due to the limited absorptive capacity, socio-economic background and natural conditions of the region. Also, the findings highlight the gap in multistakeholder relation despite the central role of the central government that not only act as a policy maker but also technlogy developer, disseminator, and logistic providers. The goverment is suggested to enhance the institutional arrangements by engaging industry in input logistic system to provide farmers' access on technology supply and integrate policies/programs with the local government and other related stakeholders to accelerate the upscaling process.*

Keywords: *Agricultural innovation system; Innovation platform; Jajar legowo super; Multi-stakeholders collaboration, sclaing process*

Abstrak . *Strategi pemanfaatan hasil riset melalui kolaborasi antar pemangku kepentingan memiliki peran penting dalam pengembangan sistem inovasi pertanian. Penelitian ini mengkaji kolaborasi multipihak dalam proses penskalaan (*scaling*) teknologi Jajar Legowo (Jarwo) Super yang merupakan hasil riset Badan Penelitian dan Pengembangan Pertanian (Balitbangtan), Kementerian Pertanian (Kementan), Indonesia. Dengan menggunakan kerangka platform inovasi, penelitian ini memetakan aktor, peran, dan fungsi yang mendukung proses penskalaan di sepanjang rantai nilai, mulai dari identifikasi masalah, riset dan pengembangan teknologi, uji coba, dan peningkatan skala di dalam sistem. Data dikumpulkan melalui wawancara semiterstruktur dengan pemangku kepentingan terkait, termasuk peneliti, pembuat kebijakan, penyuluh, dan pemerintah daerah. Hasil penelitian menunjukkan bahwa platform inovasi berhasil meningkatkan produktivitas padi di beberapa daerah, meskipun penerapannya masih menghadapi tantangan, seperti keterbatasan daya serap petani, latar belakang sosial ekonomi, dan kondisi alam. Komponen teknologi baru tidak sepenuhnya diterapkan, namun petani cenderung mengintegrasikan teknologi dengan praktik lokal. Selain itu, masih ditemukan juga kesenjangan dalam koordinasi antar pemangku kepentingan, meskipun pemerintah pusat memainkan peran utama sebagai pembuat kebijakan, pengembang teknologi, penyebar, dan penyedia logistik. Oleh karena itu, pemerintah dirahapkan dapat memperkuat kerangka kelembagaan dengan melibatkan sektor industri dalam sistem logistik input sehingga dapat meningkatkan akses petani terhadap komponen teknologi, serta mengintegrasikan kebijakan/program dengan pemerintah daerah dan pemangku kepentingan lainnya untuk meningkatkan keberhasilan proses penskalaan teknologi.*

Keywords*: Sistem inovasi pertanian; Platform inovasi; Jajar legowo super; Kolaborasi, Proses penskalaan*

*Corresponding author. Email: windaanestya@gmail.com
Received: May 30th, 2024; Revision: October 31th, 2024; Accepted: December 17th, 2024
Print ISSN: 1412-1700; Online ISSN: 2089-7928. DOI: http://dx.doi.org/ 10.12695/jmt.2024.23.3.5

Published by Unit Research and Knowledge- School of Business and Management-Institut Teknologi Bandung
How to cite: *Purwaningsih, I., Ayunda, W. A., & Ariana, L. Innovation Platforms as A Strategy to Support the Agricultural Innovation System in Indonesia: Case study on The Implementation of Jajar Legowo Super. Jurnal Manajemen Teknologi, 23(3). https://doi.org/10.12695/jmt.2024.23.3.5*

Introduction

Agricultural innovation has evolved into the Agricultural Innovation System (AIS), which has shifted from linear towards a non-linear scheme (Islam et al., 2013). The AIS seeks to understand the multi-stakeholder interaction in an innovation system, the role of innovation policies, and the supporting structures including research and development R&D units, both at the national, sectoral and technological levels (Klerkx dkk, 2012).

Agricultural R&D in Indonesia is highly managed by public sector as well as its utilization that involves public research organization (PROs), universities and industries. The agricultural R&D is not only conducted to examine the input sides, but also the output and the institution in order to increase the added-value, productivity, and cost efficiency of the products. However, these efforts still experience many multi-dimensional challenges and problems, especially in the aspect of synergy between technology providers and the relevance of user needs (Lakitan, 2012). Meanwhile, how big the economic and social impact of new inventions and ideas depends on the diffusion and utilization of these innovations (OECD/Eurostat, 2018).

The process of accelerating the diffusion of R&D results in an agricultural innovation system can be done through an innovation platform approach. Innovation platform is built as a common forum in seeking innovative solutions by utilizing R&D result that prioritizes the collaboration of relevant stakeholders (Schut et al., 2016). The innovation platform approach is used to solve a specific problem involving multiple stakeholders (farmers, industry, researchers, government, and others) (Schut et al., 2016) through a shared learning scheme (Klerkx et al., 2012). According to Schut et al (2016), the innovation platform is able to integrate knowledge with local wisdom so that it will have a broad impact (Sartas et al, 2018), not only limited to the platform (Duncan et al, 2015).

The innovation platform is also built to strengthen the AIS, encourages institutional and policy changes, and effectively utilizes resources and opportunities in finding solutions to the problems (Davies et al, 2018). This is driven by the alignment of innovation platform activities with government policies or a broader political agenda so as to facilitate the process of scaling innovation and its utilization on a wider scale (Totin et al, 2020), both across regions (scaling out) and being institutionalized to bring a systemic impact (scaling up) (Schut et al, 2016). In addition, innovation platforms can be developed and work at one level, for example a village community, regional, national, or in a value chain, depending on the problems faced (Schut et al, 2016).

Klerkx et al., (2012) stated that a standard model has yet to be found to explain the innovation platform. The practices on innovation platforms are mostly initiated and practiced in agricultural areas in the Southern Africa, with the support of international institutions such as the Consultative Group for International Agricultural Research (CGIAR). A study that applied action research resulted that the argued that innovation platform is considered an effective medium in strengthening the AIS and quite successful in solving the problems faced by farmers in the area (Davies et al., 2018).

Ayunda et al. (2021) states that Cassava Innovation Platforms/KIAS, Rwanda, which has limited resources and land, has succeded to boost food production by up to 600% in Sub-Saharan Africa. Under the CGIAR Research Program on Integrated Systems for the Humid Tropics (Humidtropics), IPs are located in five countries: Burundi, Rwanda, DR Congo, Ethiopia, and Burkina Faso. By carrying out systems-oriented Research for Development (R4D) through IPs, the program seeks to empower women and youth, increase farm productivity, improve nutrition and income for rural households, and improve innovation capacity (Adam et al., 2018).

Onumah et al., (2023) maps the roles and actors linkage to for the establishement of Cacao IP in Ghana and highlights the siginificance role of extensions and policy actors in connecting the networks. Also, Seifu et al., (2022) by using the Social Network Analysis, emphasizes the importance of a proportional representatiom of all stakeholders to succeed the capacity building to be impactful for inclusive AIS in a State-facilitated multistakeholder IP in Ethiopia.

Whilst the studies explain IPs as a strategic instrument to improve capacity and achieve inclusive AIS, they overlooked the required functions in each phase of the process that need to be addressed by IPs. This study tries to fill the gap by mapping the role of actors and required functions along the value chain from problem identification, technology development to application in order to succeed the scaling process of PRO led-IP to enhance the AIS in Indonesia.

Collaboration efforts as an important element in increasing the impact (scaling) of innovation platforms can contribute to sustainable agriculture. The scaling process can be interpreted as the proliferation of new technologies, dissemination of knowledge, collaboration between stakeholders, market access and others outside of both geographic areas and initial targets (World Bank, 2012). In the agricultural innovation system, the scaling process can be divided into outscaling and upscaling. Outscaling is the process of horizontal diffusion of innovations within the same level (for example, more and more areas are using diffused innovations). Meanwhile, upscaling innovation shows a technology or process that is diffused at a higher level, for example being institutionalized as a new agricultural management in government policy (Schut et al, 2016). Schut, et al, (2016) explain that there are three components that influence the success of the innovation platform in achieving the impact of agricultural development, including:

1. *Aspects of the problem (Content matter)*
   Agricultural issues and problems that become the focus of the innovation platform include productivity innovation, natural resource management (Natural Resource Management), environmental innovation, climate change and institutional innovation (land, financial and market).
2. *The Process Of Interaction Between Stakeholders (multi-stakeholder Process)*
   This process includes the main interactions through collaboration and communication between different group of actors in finding solutions to achieve development targets. This process involves stakeholders from diverse backgrounds (i.e. politicians, policy makers, researcher, society, private sector, etc.) and inclusive member participation can encourage the process of scaling innovation.
3. *Platform Support Functions*
   Functions that connect processes between stakeholders with specific problems that encourage multi-stakeholders to form an innovation platform through a learning process, negotiation and problem identification.

Innovation platform framework is used to map the involved actors, roles, and the multi-stakeholders process along the value chain in scaling up the Jarwo Super technology as a National Program. It eventually examines the critical factors that affect the scaling process of the technology. In detail, the research questions of this study are formulated as the following:

1. What innovation platform should be developed to scale up the PROs' research result?
2. What are the determinants that affect the innovation platforms in scaling up the PROs' research results?

This paper is divided into four section. The introduction explains the background and objective of the study as well as the supporting literature review to fill the research gap. Next, research methodology will explain the research methods. Results and Discussion section will explicate the important findings and the analysis. Finally, the last section will conclude the study and share the further recommendation and limitation of the study.

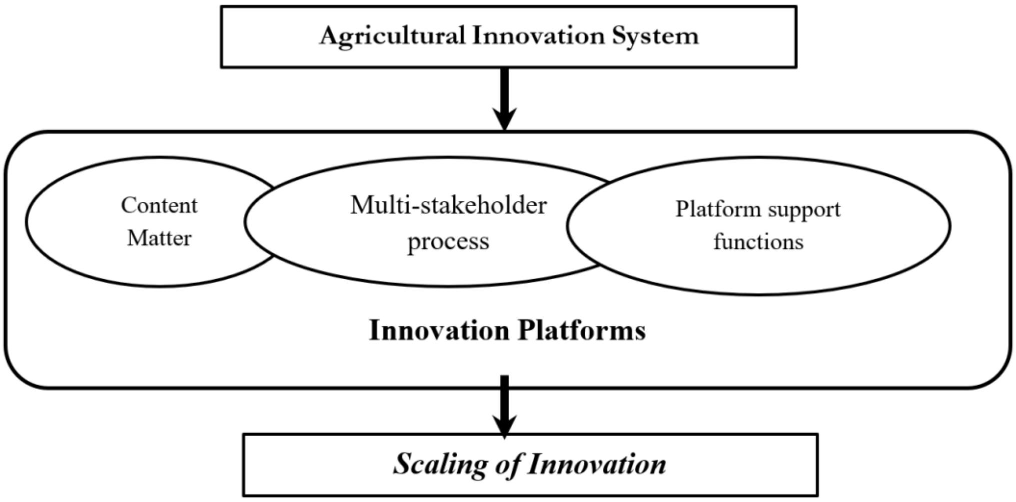

Figure 1.
Analytical framework of Innovation Platforms in scaling PRO's research results (Modified by authors based on Schut, et.al.2016)

Research Methodology

This study employed qualitative case study method to undertsand the complex phenomena of the scaling process of Jarwo Super technological package and to allow the investigators to retain the holistic and meaningful characteristics of the event (Yin, 2009).

1. *Case Selection*
   This study focuses to examine one of R&D policies of the MoA, the development of the Jarwo Super technological package which has been implemented in 2016 – 2019 as a national program. This technological package has become the flagship program of Balitbangtan to increase national food productivity, especially in irrigated lowland paddy field. This study involves the practice of Jarwo Super technology application in two districts in West Java Province: Cianjur Regency and Indramayu Regency, based on several regional success indicators of Balitbangtan's dissemination program. The experience of Balitbangtan is assumed to be sufficient to represent the innovation activities of a PRO. Regarding its major role in the Indonesian AIS, it is then considered as the most neutral organization to appropriately initiate the formation of an innovation platform (Hendrickx, S. et al, 2015).
2. *Data Collection*
   Data collection began with literature study exploring the concept of AIS, innovation platform, and innovation scaling. Taking into account the conditions of the Covid-19 pandemic, primary data collection activities through semi-structured interviews and Focus Group Discussions (FGD) were conducted online during the period of February – November 2020. The first key informants were determined purposively who represent the main actors in the Jarwo Super IPs based on document analysis, i.e. policymakers (central government - MoA), technology producers/researchers (PRO), and the others were snowballed, i.e. policy makers in central and local governments and disseminators at the central and regional levels, especially agencies and extension workers who were involved in the Jarwo Super IPs. The total number of the interviewees was 20 people. The interviews were conducted based on the guidelines that had been developed from the conceptual framework of the innovation platform. The duration of the interview

was about 1-2 hours per activity. In addition, secondary data collection was carried out through document analysis: reports, strategic plan documents, regulations, and scientific papers from other researchers that present empirical data related to Jarwo Super technology.

3. *Data Analysis*

   The interview results were transcibed and coded based on initial framework (Figure 1.) by mapping the actors, roles and activities of the Jarwo Super IP from problem identification, technological development through experimentation and upscaling at the national scale. Data was then triangulated with secondary data and the results were reviewed by key informants from Balitbangtan (policy makers) to ensure construct validity (Yin, 2009).

Results and Discussion

Content Matter

Jarwo Super Technological Package To Increase National Rice Productivity

The application of the *Jarwo Super* program by the MoA is a response to the government's national target to increase rice production following the population growth. As a staple food, rice has a strategic role in maintaining both food resilience and economic stability. Programs to increase rice production includes: (i) intensification through the application of cultivation technology, and (ii) extensification through increasing planting area. These two practices have been implemented while improving technology that has been developed previously (BPTP Banten, 2020).

Balitbangtan integrates technological components as R&D results from research centers under its authority whose utilization is not yet optimal. One of the previous approaches to increase rice productivity is Integrated Crop Management (PTT). PTT has become a national program and has been massively developed through the PTT Field School (SL-PTT) Program (BPTP Banten, 2020).

The technology components in PTT can be grouped as basic technology components and optional technology components. The basic technology components include high quality seeds, superior varieties, *jajar legowo* planting system (Figure 2), balanced fertilization, integrated pest control, weed control, and proper harvest handling. Optional technology components include intermittent sowing, weeding and harvesting by using traditional tools or machines.

The PTT is further developed into the *Jarwo Super* technological package in which the technology components are strived to be applied holistically while still taking site-specific aspects into account. The technoloical package includes site-specific based new superior varieties (VUB), *jajar legowo* planting system, balanced fertilization and the use of organic fertilizer (POH), biodecomposers, integrated pest control, and the use of machinery for planting (transplanter) and harvesting (combined harvester). These components are expected to be applied holistically.

The *Jarwo Super* technological package is designed to increase rice productivity by up to 10 tons/ha per year. The potential of this technology is generated from the increase in plant population by adjusting the space using a curved type. In practice, the curved space technique provides several advantages such as easier light interception to optimize photosynthesis, regulates temperature humidity, and facilitates the management.

"*the support for these aspects will spur population increase, increase growth, and facilitate microclimate engineering through legowo space, that ultimately impact on the productivity increase to 10 tons/ha,*" *(the Indonesian Center for Rice Research - BB Padi)*

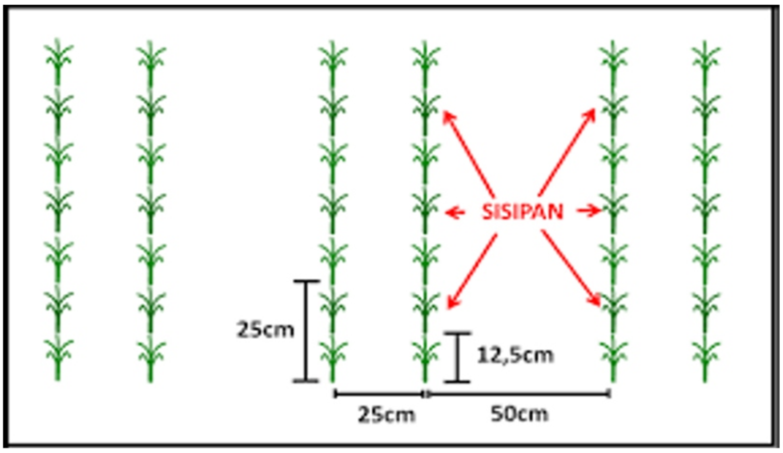

Figure 2.
Intermittent Cropping Pattern In *Jajar Legowo* Technique (BB padi, 2020)

Upon the development, *Jarwo Super* was piloted through a demonstration plot (*demplot*) program of 10 ha in Aceh and a demonstration area (*demarea)* of 50 ha in Indramayu Regency in 2016. Based on the results of these two practices, the Balitbangtan expanded the dissemination of this technological package in 2017 through coordination and collaboration with the Directorate of Food Crops, MoA, as a National Program.

The application of The Jarwo Super Technological Package in Indramayu Regency

The application of *Jarwo Super* in Indramayu was carried out in 2017 following the success in Subang Regency. The demonstration farm (*demfarm)* program was carried out in 8 villages covering of 25 Ha/area. The *Jarwo Super* technology *demfarm* has succeeded in increasing rice productivity in Indramayu Regency by 45% with a yield of 8.2 tons to 9.7 tons GKG/ha (GKG: milled dry grain).

The adoption of technology components by farmers shows varying degrees of adoption with site-specific adjustments. The use of site-specific-VUBs is adjusted to the preferences of farmers from a number of VUBs that have been introduced. Inpari 30, which is an improvement from Ciherang, has become one of the VUBs that farmers have continuously adopted until 2018.

The use of biodecomposers for soil processing has proven to accelerate the straw composting process. Likewise, the provision of biological fertilizers as seed treatment has also been proven to produce phytohormones (plant growth boosters). Nitrogen fixers and phosphate solvents have also been shown to improve soil fertility and health. The use of bio- pesticides are also effective in controlling rice plant pests such as brown planthoppers. However, the continued adoption of technology components to accelerate the scaling process is constrained due to the limited product availability at the market.

The application of the *jajar legowo* planting technique during the *demfarm* program has increased production yields. However, the additional cost of planting labor for the application of the *jajar legowo* insertion planting pattern is one of the obstacles to the sustainability of the application of this technique. This planting technique is considered costly as the planting workers prefer to carry out a wholesale planting technique in order to get a lot of planting area in one day. Therefore, adjustment to the *jajar legowo* technique is carried out according to the preferences and capacity of the farmers to support the scaling process.

The modification is made by changing the rowing *legowo* planting system from 2:1 and 4:1 to 5:1 and 6:1. In addition, the use of agricultural machinery (transplanter and combined harvester) to save labor costs and to reduce the risk of crop loss also gives positive impact for farmers in Indramayu. However, the adoption of the two technologies is still constrained due to the absorptive capacity of the farmers, the topography of the land and the socio-economic background of the community. The use of transplanters requires special skills in which the farmers feel uneasy. Also, the muddy rice fields make a lot of land uncultivable by using transplanter. Fear of farm laborers to be replaced by machinery for harvesting is also an obstacle in adopting the combined harvester, thus requiring understanding and employment options for them.

Application of The Jarwo Super Technological Package in Cianjur Regency

The *Jarwo Super* technology demonstration program was implemented in 2017 in Cianjur Regency based on recommendations from the MoA through the West Java Agricultural Technology Study Center (BPTP). The *demfarm* for the adoption of Jarwo Super technology is around 200 hectares in 5 districts involving 368 farmers. The Jarwo Super demonstration program has increased the productivity of rice to 65 kw with a total production of around 130 tons from 200 ha of land. Nevertheless, the increase in productivity from the adoption of Jarwo Super technology is still below 10%, or an average of 5.3% to 6.5% per year.

The application of *Jarwo Super* in Cianjur Regency indicates a different result, in which not all technology components can be adopted properly by farmers. The application of the *jajar legowo* planting techniques that has been used since PTT has become a common practice among farmers. So has been the use of site-specific VUB (Inpari 30, 32, and 33), the use of POH, biodecomposers, and pest control. However, the condition of agricultural facilities and infrastructure in the Cianjur area which is quite unequal between conditions in the north and south leads to challenges in the scaling process of the *Jarwo Super* technology. Several damaged roads Cianjur in the southern and central parts of Cianjur have poorly supported the farming and production access. The distribution of utilities is also more accessible in the northern region. Nonetheless, the availability of existing utilities is still unable to meet the needs of the whole production facilities of the Cianjur farming community.

In addition, the hilly topography of the southern Cianjur area hinders the use of machinery (transplanter for planting and a combined harvester for harvesting). The low absorptive capacity of farmers is also an obstacle in the adoption of the machinery. Therefore, the process of planting and harvesting is mostly conducted manually, excluding in a few areas that can adopt the machinery.

Another factor that determines technology adoption is the inadequate number of human resources. The limited number of extension workers is one of the obstacles in the process of dissemination and scaling of *Jarwo Super* technology in Cianjur Regency, in which those of 182 people manage and handle 360 villages. From 182 extension workers, only 65 are public officers (ASN). The status of extension workers, most of whom are not ASN.

The scaling of Jarwo Super technology in both Cianjur and Indramayu has successfully increased rice productivity, despite facing several challenges (Table 1). In Indramayu, the adoption of the technology led to a 45% increase in rice yields, supported by the use of site-specific varieties, biological fertilizers, and improved planting techniques. However, challenges such as limited market availability of technology components and the need for better farmer skills in using machinery slowed broader adoption.

Table 1.
Comparison of Jarwo Super Technology Adoption: Successes and Challenges in Cianjur and Indramayu

Category	Indramayu	Cianjur
Area coverage	- 8 villages (200Ha)	- 5 districts (200 Ha)
Productivity increase	- 45% with a yield of 8.2 tons to 9.7 tons GKG/ha (GKG: milled dry grain)	- 130 tons from 200 ha (6. ton/ha) of land. Nevertheles the increase in productivi from the adoption of Jarw Super technology is still belo 10%, or an average of 5.3% t 6.5% per year.
Technology Adoptionof Jarwo Super	- VUB (inpari 30) - POH - Biodecomposer	- VUB (Inpari 30, 32, and 33) - POH - Biodecomposer
Human Resource	- Farmers' reluctance to adopt machinery due to lack of skills.	- Shortage of extension worke hinders the dissemination c technology.
Socio-culture/topography condition	- Fear of job loss among farm laborers slows combined harvester adoption. - Muddy rice fields make land uncultivable for transplanters, limiting their use.	- Poorly maintained roads i southern and central parts lim access to farming areas. - Hilly topography in souther Cianjur hinders the use c machinery for planting an harvesting
Institutional arrangements	- Limited availability of technology components in the market - Lack of policy/program integration central-local government	- Unequal agricultur infrastructure developme between northern and souther Cianjur. - Limited availability of technolog components in the market - Lack of policy/progra integration central-loca government
Modified Technology	- Changing the rowing *legowo* planting system from 2;1 and 4:1 into 5:1 and 6:1 - Most processes are still manual, with machinery use in a few areas.	- The process of planting an harvesting is mostly conducte manually, excluding in a few area that can adopt the machinery.

The scaling of Jarwo Super technology in both Cianjur and Indramayu has successfully increased rice productivity, despite facing several challenges (Table 1). In Indramayu, the adoption of the technology led to a 45% increase in rice yields, supported by the use of site-specific varieties, biological fertilizers, and improved planting techniques. However, challenges such as limited market availability of technology components and the need for better farmer skills in using machinery slowed broader adoption.

In Cianjur, while there are significant efforts to implement Jarwo Super, infrastructure issues, difficult topography, and limited human resources hinder the widespread adoption of the whole technology despite the effective use of inputs i.e. biodecomposers, bio-pesticides, and improved rice varieties. In addition, most of the farmers in Cianjur are traditional farmers, who need assistance to master new methods. After the mentoring program carried out by BPTP and extension workers for one season has been completed, the new technology is still hardly mastered., the Further development program is carried out by local government. The District Agriculture Office is responsible for the program, with the support from the MoA and the Province government. They provide subsidized seeds and fertilizers through the allocation of the national and provincial budget. The local government also cooperate with local bank to provide soft loan for seed breeder. The support from the community through their farmer group is unneglectable too.

Multi-stakeholders' collaboration in the Jarwo Super Innovation Platform

One of important aspects of the innovation platform framework is the multi-stakeholders element. The actors observed are from upstream (technology oducers) to downstream side (application of R&D results).

Table 2.
Multi-stakeholders' collaboration in the *Jarwo Super* Innovation Platform (source: Author)

Innovation Platform Actor	Roles	Involved actor
Policy maker	Program planning and coordination	MoA; localgovernment
Research organization	R&D on VUBs, POH, agricultural machinery, biodecomposer	Balitbangtan- MoA
Public extension agency	• Study of community preferences • Extension/capacity building of farmers	MoA; BPTP (speciali extension agency); fiel extension agency at district lev
Logistics agency	Provider of source seed, spread seed, POH, and Biodecomposer	MoA; Seed Center; loc government; seed breeders
Industry/ agribusiness	provider of seed	Seed cultivator, seed shc (SMEs)
Framer organization	Jarwo Super technology users	Framer community/group
Financial institutions	Financing/credit support for seed breeders	Local bank
User/society	• Jarwo Super technology users • Rice preference response that influences the use and development of VUBs	• Farmers • society

Identification of actors emphasizes the diversity of characteristics, motivations, expected goals, physical and social environment by each actor (Mardikanto, 1993). Each actor has strategic duties and plays a key role in carrying out the implementation of programs and activities in a synergistic manner. Multi-stakeholder identification is also needed to see if the value chain formed is in accordance with the needs and required functions (Table 2). Within the innovation platform framework, actors mapping is important to identify if there is a double burden, or overlapping tasks carried out by each actor. And it is needed to find out if therare vacancies of actors to fill in any required functions.

By identifying the structure of actors systematically, the process of escalating the impact/output of research can be enhanced. Furthermore, the multi-stakeholders collaboration in the application of *Jarwo Super* can be illustrated according to the functions developed through the innovation platform (Figure 3). This multi-stakeholder collaboration agrees to Sanyang (2016) that it is a long learning process to accumulate in a knowledge hub.

First, it starts from the demand articulation for the development of a relevant innovation platform to increase national rice production. At this stage, there are program initiators, including policy makers such as Balitbangtan and local government; R&D actors of research centers under Balitbangtan, public extension agency, and farmers. Following this matter, the provision of technological are designed in accordance to the problem and user needs, especially technology to strengthen the cropping patterns and rice quality. Through coordination and interaction between Balitbangtan and research centers such as BB Padi, the implementation of the R&D results were then applied for experimental learning (*demplot* and *demarea*) at specific locations in 2016.

The experimentation in IPs context provides learning process and the success of the pilot project for approximately 2 years become the basis for the MoA to replicate as a National Program on a wider scale (Seifu et al., 2020).

In 2017, the *Jarwo Super* technological package was scaled up into a National Program to be massively applied in ten provinces of rice production centers in Indonesia with a total area of 10,000 ha of irrigated land. This scaling process is carried out through a dissemination scheme with the assistance of production facilities (VUB, machineries, biodecomposers, and POH) from the MoA. Dissemination of Jarwo Super technology in the West Java, especially in Indramayu and Cianjur regencies are carried out in demonstration farms (demfarm).

Dissemination of Jarwo Super technology involves coordination between West Java BPTP and local governments, both the Province (Food Crops Agriculture Office of West Java Province) and the respective District Agriculture Offices. The dissemination process is carried out linearly. West Java BPTP as the extension agency provides counseling to field extension workers at the District Agriculture Office. Furthermore, the Food Crops Agriculture Service of West Java Province and the Indramayu Regency Agriculture Service educates farmers group about information, knowledge and activity plans as well as understanding related to technological innovations of *jarwo super* rice cultivation in the form of farm demonstrations (farming demonstration plots).

This activity is also addressed to agricultural extension officers, observers of plant-disturbing organisms (POPT), Mainstay Farmers and Fishermen Contacts (KTNA) at the district and sub-district levels and farmer groups as the candidates for program benificieries. Dissemination activities in the form of training are carried out through technical guidance, both theoretical and practical, directly related to the technology components that will be applied in the *Jarwo Super demfarm*.

Innovation Platforms support functions for Jarwo Super scaling process

The innovation platform approach for technology scaling requires institutional support in the form of government policy interventions (Totin et al., 2020). In the case of Jarwo Super technology, scaling up was carried out through the MoA on irrigated land of 10,000 ha/10 provinces in 2017 to support the achievement of the national rice production target. The escalation of dissemination into top-down based national programs opens up opportunities for farmers (technology users) to learn and to adopt new technologies.

During the application in Indramayu and Cianjur regencies, this program is coordinated with the local government through BPTP as the extension agency. The multi-stakeholder collaboration is conducted through resource sharing scheme which leads to to the successful application of Jarwo super technology in this one-season mentoring program. The functions carried out by each actor on the platform are based on the embedded institutional functions. The Central Government (MoA), holds heterogenous function, in addition to being a policy maker, also provides assistance for production facilities / technology components (Onumah et al., 2023). Local governments provide access to farmers and provide field extension resources. BPTP becomes a bridge for technology transfer from technology developers to field extension workers for further transfer to farmers. BPTP and local governments also evaluate the process of technology absorption by farmers and the challenges they face. Although not all components of Jarwo Super's technology can be applied by farmers, the increase of rice production in both areas is quite significant during the program.

However, the adoption of the Jarwo Super package technology still faces many challenges both in Indramayu and Cianjur. The process of technology adoption by farmers in the two regions shows differences, which are not only influenced by the absorptive capacity of farmers, but also the socio-economic and natural conditions of the community. At the Cianjur Regency the technology has not been fully adopted by the farmers because the application of machinery is constrained by the suitability the technology with the land topography.

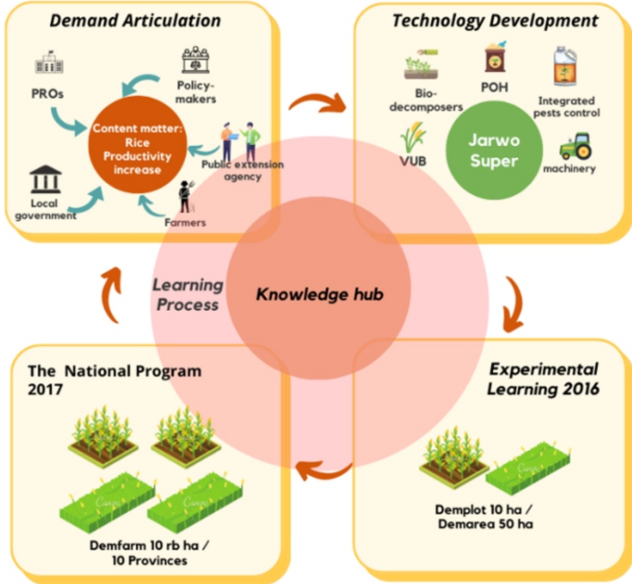

Figure 3.
The Functions Developed Through The Innovation Platform (source: Author)

Another problem relates to institutional problem. Farmers' access to *Jarwo Super* technology components is a challenge to support sustainable adoption of *Jarwo Super* technology. The limited access of farmers to VUB in seed shops is one of the obstacles in adopting VUB. The insufficient availability of bioproducts, especially those available at farmers' stalls, and the limited supply of fertilizers to meet farmers' needs/demands are other challenges.

This issue also highlights social innovation needs to be considered. Social innovation is ultimately key in driving technology adoption (de Roo et al., 2019). This social innovation can be exemplified by farmers' access to land, knowledge and skills regarding agronomy, farmers' rights that should be obtained in technology supply sources.

This condition requires synergy between institutions within the system so that the scaling process can be successful. The institutional arrangements should have been developed to facilitate the process (Seifu et al., 2022). When the demfarm mentoring program takes place, the technology component is provided in the form of assistance. However, the expected target through the scaling process is the sustainability of technology adoption in which there is a continuous change process that requires adjustment and reflection (Sanyang et al., 2016). The production facilities assistance program (technology component) will not be sustainable. The government who holds a central role in the Jarwo Super IP should have been able to connect more actors including industry to succeed the programs (Onumah et al., 2023) such as through development of input logistics system.

In addition, in the case of *Jarwo Super* technology application, the Central Government (MoA) has scaled it up as a National Program. The program should have been integrated with the regional program at the local level. The synergy between central and local program is demanded to support the achievement of rice productivity target both at the regional and national levels. Unfortunately, after the mentoring program completes, the decision on the sustainability of technology adoption is left entirely to the farmers' decision amidst the limitations of the existing system.

Implication: The required value chain in Jarwo Super Innovation Platforms

The innovation platform is built to solve problems that arise along the value chain in a system. Based on the experience of *Jarwo Super* technology application, especially in the application in Indramayu and Cianjur Regency, it is found that there are two innovation platforms that have been built to support technology adoption to achieve the rice productivity increase target. Figure 4. describe the value chain from technology development to scaling process required to achieve the goal of *Jarwo Super* application to increase rice productivity. Each chain represents a platform to solve a specific problem with an appropriate entry point and key actors. This value chain analysis is conducted to identify critical determinants needed to accomplish the final goal (Sanyang et al., 2016).

The problem solving process starts from the innovation platform (IP) 1 through the development of Jarwo Super technology to meet the users' needs, followed by the dissemination process on IP 2 to support the technology application. However, there are still obstacles and challenges in achieving the target. More IPs (IP 3 and IP 4) need to be built to solve the problems in in the value chain by considering issues, related to actors and functions to facilitate the scaling process (Figure 4).

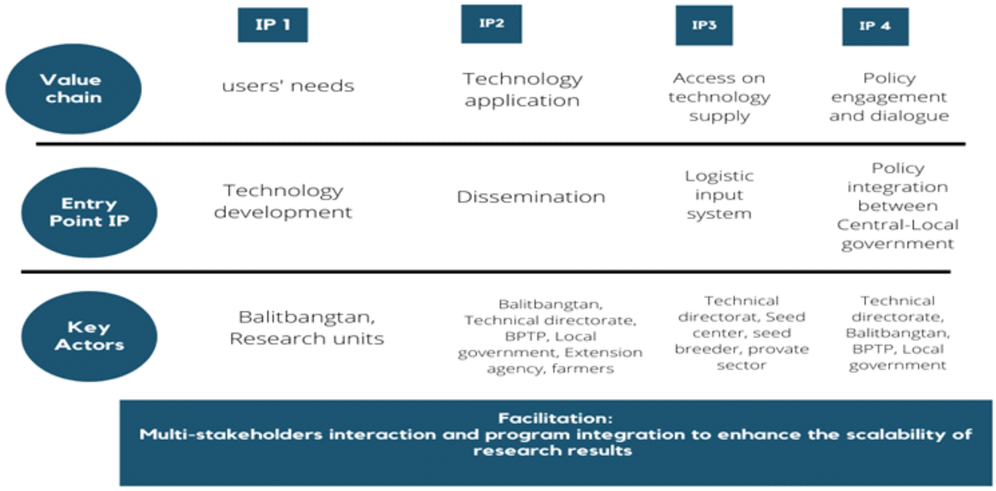

Figure 4.
The Required Value Chain In Jarwo Super Innovation Platform (modified from Sanyang et al, 2016)

Farmers' access to the availability of technology needs to be facilitated through IP 3 by building an input logistics system. Eventually, there is a need for policy integration between the Central and the Local Governments which will be facilitated by IP 4 to support the scaling process, such as by synchronizing the technical program at the central to local government level. Thus, the goal of increasing rice productivity in a sustainable manner through *Jarwo Super* application can be achieved.

Conclusion

Innovation platform has become a startegic instrument to address problems and and strengthen AIS. This study applies innovation platform perspective to learn the scaling process of Jarwo Super technological package, as developed by Balitbangtan (PRO) from the problem identification, technology development, expemerimentation, and application at the national scale.

In the Jarwo Super IP, the Central government plays the central role not only as policy maker but also technlogy developer, disseminator, and logistic providers. Extension connects the central and local government to disseminate the technology implemented by the farmer groups. Despite the implementation of technological package has substantially improve rice productivity in some regions, there are some challenges. The absorptive capacity of farmers, socio-economic background and natural conditions of the region hinder the the full technology application by the farmers. However, modification in the technology adoption is also done by the farmers by integrating with indigenous practice. Morever, institutional arrangements have yet facilitated the scaling process. The involvement of industry in input logistic system to provide farmers' access on technology supply has not been developed. In addition, there is a need for policy/program engagement between the Central and the Local Government to support the success of technology scaling at the farm level.

To improve rice productivity in Indonesia and similar regions, the Jarwo Super application can serve as a benchmark for boosting agricultural output by focusing on several critical areas. First, developing an efficient input logistics system is essential to ensure timely and affordable access to key agricultural resources such as seeds, fertilizers, and technology—this is crucial for supporting widespread adoption of the application.

Additionally, addressing structural barriers, such as land access and farmers' rights, through social innovation initiatives will help create an enabling environment that encourages long-term adoption of agricultural technologies. Finally, improving coordination among stakeholders, including policymakers, local governments, and private sector players and farmers will ensure that resources, knowledge, and policies are effectively aligned to support the scaling of these technologies. Together, these actions will foster more sustainable and inclusive agricultural technology adoption, driving increased productivity and resilience in Indonesia and similar regions.

There are some limitation of this study. The data are gathered from multistakeholders' perspective mainly the policy makers, technology developers and extension agency. We have not included farmers' perspective due to limitted resources. Despite data triangulation has been conducted, the missing of farmers as key informant might be potential to data bias. A more robust research are nedeed in the future. In the next stage, the results of this analysis are expected to be developed into approaches, concepts as well as tools to develop appropriate innovation scaling strategies and to determine value criteria in measuring the effectiveness of each strategy to be implemented.

Declarations

Author contribution

All authors contributed equally as the main contributors of this paper. All authors read and approved the final paper.

Funding statement

This research received funding from the Indonesian Institute of Science, 2021.

Competing interest

The authors declare that they have no conflicts of interest to report regarding the present study

References

Ayunda, W. A., Purwaningsih, I., Ariana, L., & Akil, H. A. (2021). Innovation Platforms Practices for Improving Sustainable Intensification in Several Countries and Its Implication to Indonesia: An Integrative Review of Agricultural Innovation Systems. *STI Policy and Management Journal*, *6*(1). doi: 10.14203/stipm.2021.296

Davies, J, Maru Y, Hall, A., Abdourhamane, I.K., Adegbidi, A., Carberry, P., Dorai, K.,Ennin, S.A., Etwire, P.M., McMillan, L., 2018. *Understanding innovation platform effectiveness through experiences from west and central Africa. Agric.* Syst. 165,321–334.

De Roo, N., Almekinders, C., Leeuwis, C., Tefera, T., (2019). *Scaling modern technology or scaling exclusion? The socio-political dynamics of accessing in malt barley innovation in two highland communities in southern Ethiopia.* Agric. Syst. 174, 52–62.

Duncan, A. J., Teufel, N., Ravichandran, T., Hendrickx, S. and Ballantyne, P. G. (2015). *Innovation platforms to improve smallholder dairying at scale: Experiences from the MilkIT project in India and Tanzania. ILRI ProjectReport.* Nairobi, Kenya: International Livestock Research Institute (ILRI). Available at: https://cgspace.cgiar.org/handle/10568/67890.

Hendrickx, S., Ballantyne, P., Duncan, A., Teufel, N., Ravichandran, T. (2015). *Scaling and innovation platforms. Innovation platforms practice brief 13*. https://cgspace.cgiar.org/bitstream/handle/10568/67884/Brief13.pdf?sequence=3&isAllowed=y. Diakses pada 21 Februari 2020.

Islam, M. M., Renwick, A., Lamprinopoulou, C., & Klerkx, L. (2013). *Innovation in Livestock Genetic Improvement.* April. doi: 10.1111/1746-692x.12019.

Klerkx, L., Schut, M., Leeuwis, C. and Kilelu, C. (2012). Advances in knowledge brokering in the agricultural sector: Towards innovation system facilitation. *IDS Bulletin* 43(5):53–60.

Lakitan, Benyamin (2013). Connecting all the dots: Identifying the “actor level” challenges in establishing effective innovation system in Indonesia. *Technology in Society* 35, 41–54. doi: 10.1016/j.techsoc.2013.03.002

Mardiana, G.B., Yohanes, B, Irianto. (2011). *Peran kelembagaan dalam penyebaran teknologi produksi benih kedelai di NTB*. Prosiding Seminar Hasil Penelitian Tanaman Aneka Kacang dan Umbi 2011: 428-437.

Musyafak, A., Ibrahim, T.M. (2005). Strategi Percepatan Adopsi dan Difusi Inovasi Pertanian Mendukung Prima Tani. *Analisis Kebijakan Pertanian* 3(1): 20-37

Sanyang, S., Taonda, S. J. B., Kuiseu, J., Coulibaly, N., & Konaté, L. (2016). A paradigm shift in African agricultural research for development: the role of innovation platforms. *International Journal of Agricultural Sustainability*, *14*(2), 187–213. doi: 10.1080/14735903.2015.1070065

Sartas, M., Schut, M., Hermans, F., Van Asten, P.J.A., Leeuwis, C. (2018). Effects of multistakeholder platforms on multi-stakeholder innovation networks: Implications for research for development interventions targeting innovations at scale. *Plos One 13* (6), e0197993.

Schut, M., Cadilhon, J. J., Misiko, M., & Dror, I. (2016). *Do mature innovation platforms make a difference in agricultural research for development? a meta-analysis of case*

Seifu, M., van Paassen, A., Klerkx, L., & Leeuwis, C. (2020). Anchoring innovation methodologies to 'go-to-scale'; a framework to guide agricultural research for development. *Agricultural Systems*, *182*. doi: 10.1016/j.agsy.2020.102810

Seifu, M., van Paassen, A., Klerkx, L., & Leeuwis, C. (2022). A state-initiated multi-stakeholder platform as an instrument to build agricultural innovation system capacity: a case study from Ethiopia. *Innovation and Development*. doi: 10.1080/2157930X.2022.2064959

Totin,E., van Mierlo, B. and Klerkx, L. (2020). Scaling practices within agricultural innovation platforms: Between pushing and pulling. *Agricultural Systems* 179, 102764. doi: 10.1016/j.agsy.2019.102764

Mardikanto, Totok. 1993. *Penyuluhan Pembangunan Pertanian. Surakarta :* UNS Press

OECD (2013). Agricultural Innovation Systems: A Framework for Analyzing the Role of the Government. *OECD Publishing*. doi:10.1787/9789264200593-en

Onumah, J. A., Asante, F. A., & Osei, R. D. (2023). Actor roles and linkages in the agricultural innovation system: options for establishing a cocoa innovation platform in Ghana. *Innovation and Development*, *13*(2), 301–322. doi: 10.1080/2157930X.2021.1965752

World Bank (2012). *Thinking systematically about scaling up: Developing guidance for scaling up World Bank supported agriculture and rural development operations the case of competitive grant schemes for agricultural research and extension*. In Agriculture and Rural Development Discussion Paper 53, Washington DC, USA: World

Yin, R. K. (2009). *Case Study Researc: Design and Methods Fourth Edition* (4th ed.). SAGE Publication , Inc.