

STAKEHOLDER CHARACTERISTICS IN THE PENTAHHELIX MODEL FOR DIGITAL INTEGRATED FARMING COMMUNITIES KOPER-TANI



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ABSTRACT

The agricultural sector in Indonesia still faces various individual challenges with multiple roles, limited market access, low supply chain transparency, and minimal adoption of digital technology that can improve the efficiency of farming businesses. Digitalization of integrated farming communities is a potential solution to overcome these challenges. This study aims to analyze the characteristics and roles of stakeholders in the pentahelix model for the development of digital farming communities. The research method employs a qualitative descriptive approach, utilizing hybrid survey techniques (online and offline) to collect data from 60 respondents across various regions. Data were analyzed using qualitative descriptive methods with data visualization techniques. The analysis stages consist of: reduction (selection of relevant data), visualization by grouping each component of the question interpreted in the form of a percentage, drawing conclusions to state the dominant factors and implications based on stakeholder characteristics, and determining their roles in the form of a pentahelix model. The study's results showed that the majority of stakeholders possess characteristics that are ready to adopt digital technology, with the primary needs being market access, increasing farmer capacity, and environmental sustainability. The characteristics of the pentahelix model involve Farmer Business Actors, Consumer Society, Academics and/or Agricultural Practitioners, Government, and the Koper-Tani Media Platform, which plays a crucial role in supporting the development of integrated digital farming communities.

Keywords: community; digitalization; integrated farming; stakeholders.

INTRODUCTION

The agricultural sector in Indonesia remains dominated by conventional farming patterns, which face various challenges, including limited resources, suboptimal market access, and dependence on traditional distribution systems (Silfia, 2021). Dependence on collectors leads to unstable prices for agricultural products, making it difficult for farmers to accurately project their production and profits (Septiadi & Mundiya, 2020). Additionally, increasing production costs, including the need for fertilizers, seeds, and pest control, are becoming a growing burden for farmers in managing their farming businesses (Andrew, 2022). On the other hand, consumers are increasingly showing a preference for healthier and more sustainable agricultural products, such as organic products. However, access to these products remains limited, while relatively high prices pose an obstacle for most consumers (AOI, 2023). However, consumer loyalty to sustainable agricultural products remains high, mainly due to health and environmental sustainability factors. This suggests a substantial market opportunity for more innovative and affordable integrated agricultural products.

The challenges for farmers are not only limited to production and distribution aspects, but also limitations in building collaborative networks that can support innovation and efficiency in their farming businesses. Time constraints, distance, and minimal access to information and technology are obstacles in creating a more adaptive and competitive farming system (Kumbara & Putri, 2023). The community can be supported by one of these approaches, such as the pentahelix approach, which integrates the roles of five main stakeholder elements: the government, academics, business actors,



communities/society, and the media, in its development (Setyara et al., 2024). According to Nugroho et al. (2024), the development of an agribusiness system with a pentahelix approach plays a crucial role in supporting the improvement of established agencies or communities.

The pentahelix approach can be strengthened by utilizing digital collaboration as a synergy solution that effectively connects stakeholder elements, providing flexible media that can be accessed at any time (Firdaus & Cahyani, 2023). As time passes, the digitalization trend is being increasingly adopted, especially among farmers. The increasing adoption of digital technology by farmers, such as the use of internet-connected gadgets, is becoming increasingly relevant and in line with their daily needs. Based on the increasing penetration of digital technology in the agricultural sector, around 46.84% of the 28.19 million farmers in Indonesia have adopted digital technology in their farming practices (BPS, 2023). The millennial farmer group, which numbers 6.18 million people or approximately 21.93% of the total farmers, is increasingly active in utilizing digital technology to enhance efficiency and expand market access. However, digital initiatives in the agricultural sector are still not fully integrated with the needs of farmers and other stakeholders. Of the 55 identified digital agricultural technologies, most are still in the early stages of development and have not been able to provide a broad and sustainable impact because they have not fully understood the characteristics of the needs and problems faced by stakeholders (Setiawan, 2021; Upland Kementerian Pertanian, 2022).

Digital-based agricultural communities play a crucial role in enhancing farmer capacity through collaboration with academics, practitioners, and consumer communities. The role of academics and practitioners as companions can help farmers access technology, innovation, and broader resources (Nurida et al., 2024; Sulistyowati et al., 2023). However, existing communities are still limited to local networks and do not fully optimize their potential for cross-regional collaboration (Kumbara & Silfia, 2024). Therefore, a strong understanding of the characteristics of farmers, consumer communities, and agricultural academics/practitioners is needed to align the solutions provided with the needs and problems of related stakeholders. Of course, by understanding the characteristics between parties, regions, collaboration, and information exchange, it can increase community system access to easy adoption of technology and market information. Thus, efforts to find a solution in this study have led to the proposal of a model, summarized in the Koper-Tani brand (Komunitas Pertanian Terpadu). Koper-Tani is an idea that provides a digital collaboration framework, based on the urgency of overcoming the limitations of cross-regional collaboration, accelerating the spread of knowledge, technology, and market access, and optimizing the potential of digital agricultural technology.

Based on the above problems, it is emphasized that there are still limited studies that comprehensively explore the characteristics of stakeholders in the pentahelix approach to integrated agricultural digitalization in Indonesia. In addition, previous studies still have gaps, underscoring the need for this research topic to be studied in greater depth. Research by Uneze et al. (2024) highlights the role of digitalization in agricultural cooperatives, especially in the rice value chain, as well as the obstacles to its adoption, which include individual, institutional, and technological factors. However, this study focuses more on the technical and institutional aspects of digitalization without specifically discussing the involvement of multi-stakeholders in the digital-based agricultural cooperative ecosystem. Meanwhile, research by Maria et al. (2022) also examines the level of community participation in the development of community-based agriculture in urban areas, emphasizing the importance of leadership and driving factors in encouraging community involvement. However, this study is limited to the context of urban farming and does not directly integrate a multi-actor approach in the digital-based agricultural model. The primary gap between these two studies is the lack of a comprehensive analysis of the characteristics and roles of stakeholders in the development of digital agricultural communities using the pentahelix approach. This approach involves the government, academics, business, communities, and the media as the leading actors in the innovation ecosystem. Therefore, the research study proposed by the author is crucial for filling this gap, with a focus on how each element of the pentahelix contributes to forming a sustainable and inclusive digital agricultural community.

Koper-Tani is a virtual community design model that can bridge farmers and related stakeholders, ranging from governments and practitioners/academics to the consumer society. The Koper-Tani community acts as a starting point, encouraging joint innovation, providing supply chain information, managing and guiding (coaching) agricultural activities, facilitating access to production resources, accessing marketing opportunities, and accumulating profits to be distributed fairly. Based on the identified problems, this study aims to analyze the characteristics and roles of stakeholder elements using pentahelix analysis in the development of digitally integrated agricultural communities.

This study aims to analyze the characteristics and roles of stakeholders in the pentahelix model for the development of digital farming communities.

MATERIALS AND METHODS

This research was conducted in a hybrid online and offline manner in the area of the Payakumbuh State Agricultural Polytechnic located on Jalan Raya Negara, Tanjung Pati, Harau District, Limapuluh Kota Regency, West Sumatra Province. The online survey was conducted by distributing survey questionnaires to respondents in various research locations. The offline study was conducted by visiting respondents directly and collecting data through survey forms in the Payakumbuh City and Agam Regency areas of West Sumatra. Research was conducted from December 2024 to March 2025.

The descriptive qualitative method was used in this study because it aims to provide a detailed description of the characteristics of stakeholders, namely farmers, consumers, and academics/practitioners, in the development of a community based on the Koper-Tani digital platform. Analytical descriptive research is particularly suitable for this topic because it is designed to understand specific phenomena in detail and utilize qualitative data to support the conclusions drawn. This descriptive, qualitative approach was employed by analyzing categorized responses from each stakeholder group (farmers, consumers, and academics/practitioners) using predetermined indicators that identify needs, challenges, and roles in developing a digital agricultural community platform (Nazir, 2020).

The subjects of this study consisted of three main respondent groups, namely farmers, consumer communities, and academics or practitioners in the field of agriculture. The research object focuses on the characteristics of needs, preferences, and challenges faced by the subjects. This object includes elements such as access to market information, organic cultivation guides, community interaction media, and relevant digital community features. Respondents in this study were obtained through a quota sampling technique of 60 respondents. Quota Sampling is the selection of respondents whose population is unclear or infinite, so it is necessary to consider the sample quota that needs to be set. However, this quota must meet the quality and criteria that follow the research objectives (Fauzy, 2019). The reason for choosing quota sampling rather than the non-probability method is to ensure that each element in the pentahelix is represented proportionally and to avoid the dominance of one particular group, as not all stakeholders have an equal opportunity to be included in this research.

The selection of 20 respondents per group was based on a purposive sampling approach, which emphasizes the importance of adequately representing each subgroup for a comprehensive analysis (Bryman, 2012). Thus, a total of 60 respondents from three primary groups — farmers, consumer communities, and academics/practitioners — was deemed sufficient to explore the preferences and challenges faced by each group in the context of developing a digital agricultural community. In addition, this number took into account the limitations of research resources, thus making for in-depth data collection without sacrificing operational efficiency.

Data analysis techniques using secondary and primary data sources. The validation strategy was carried out through the triangulation method, namely, synergizing data obtained from various literature sources with data collection techniques that have been systematically reduced. The data obtained were analyzed using a quantitative descriptive analysis approach, as described by Syatori (2023). Raw data was identified based on the characteristics of respondents, as determined by predetermined indicators. For agricultural business actors, these characteristics can be identified through experience, technological needs, and the type of training required (Hamdani, 2020; Sugiantara & Utama, 2019; Elsiana et al., 2018). Consumer communities can be identified based on the level of awareness, consumer behavior, and factors that influence product quality standards in purchasing decisions (Sari, 2017; Fajarani et al., 2021; Swardinata et al., 2021). Finally, academics and/or agricultural practitioners can be identified based on their place of work, mentoring experience, the simple technology that can be provided to farmers, challenges, standards, and community models that are considered effective (Bakhtiar, 2020; Undang-Undang No. 17 of 2013; Sugiantara & Utama, 2019). The indicator answers are used as categories and then classified into predetermined subcategories.

Furthermore, the identified data focuses on the most significant percentage in each category of characteristics. Therefore, if the category characteristics have the most significant percentage of subcategories, then this will be the dominant factor for further discussion (Kumbara et al., 2024). This percentage is calculated by dividing the number of specific responses in a category by the total

number of respondents, and then converted into a visualization (graph/table) to describe the distribution pattern.

Finally, the characteristics of the respondents that have been found are further analyzed by mapping the pentahelix model. The pentahelix concept is based on the guidelines outlined in Regulation No. 14 of the Kementerian Pariwisata (2016), which serves as the foundation for sustainable development. In this regulation, sustainable development, as outlined in the pentahelix concept, must involve collaboration among the five elements of stakeholders or subjects. The five elements are: Academician, Business, Community, Government, and Media. Although its regulations aim to promote sustainable development through the pentahelix concept, which focuses on developing tourism communities, it remains relevant for the agricultural sector, whose basis also emphasizes community involvement while encompassing five key elements or stakeholders. Pentahelix mapping is based on research by Firdaus & Cahyani (2023), which involves interpreting data collected on the characteristics of respondents regarding community development to determine the role of the five stakeholder elements involved.

RESULTS AND DISCUSSION

Distribution of Regions and Respondent Identity

Figure 1 illustrates the regional distributions of 60 respondents. Respondents came from 16 different provinces, with a predominance from West Sumatra (26.67%), indicating that the region has a strong connection with sustainable agricultural practices or participation in integrated farming systems. The relatively large proportion of respondents from West Java and Riau also indicates the interest or involvement of people from the two regions in modern community-based farming systems. This finding is consistent with Uneze et al. (2024), who found that respondents who were actively involved in the integrated farming platform came from areas that already had access to organic certification institutions and organized farming systems. A similar observation was also made by Maria et al. (2022), who noted that the participation of small towns and rural communities, such as Banjarbaru, in organic farming was higher than in metropolitan areas, due to the encouragement of local communities and the role of local agricultural institutions.

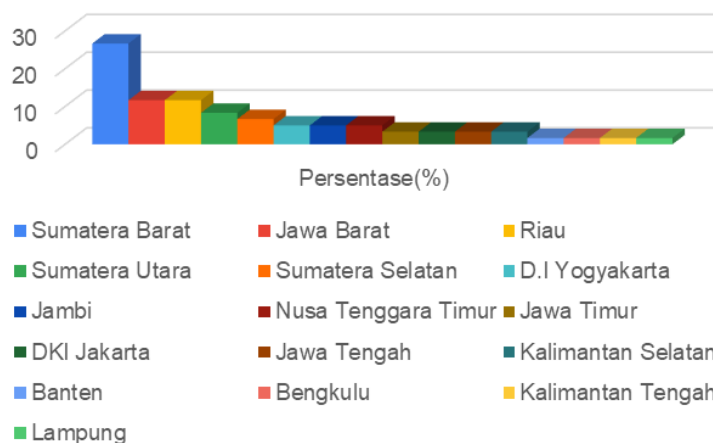


Figure 1 Distribution of respondent acquisition areas

What are the various characteristics of these regions, and what kind of community model can be created to accommodate the diversity of perspectives and needs of stakeholders from different geographic and social backgrounds? According to Nailly (2015), the development of Community-Based Research (CBR) emphasizes the importance of involving various stakeholders from diverse geographic and social backgrounds to understand their needs and perspectives. This approach enables the design of a community model that is more inclusive and responsive to local needs, leveraging the social capital of the parties involved. Social capital in the development of agricultural communities emphasizes the importance of understanding the social and cultural characteristics of various regions through social networks, norms, and beliefs that are formed in society, thereby building a sustainable system (Indah et al., 2024). Therefore, it is essential for Koper-Tani platform developers to expand their reach and collaboration to areas where participation is still low, and to utilize this data for regionally based policy making, particularly in strengthening the role of local communities and providing digital access in the agricultural sector.

Table 1. Demographic distribution of respondents based on gender, age, education, and position in the agricultural ecosystem

No	Category	Subcategory	Total	Percentage (%)
1	Gender	Male (M)	38	63.33
		Female (F)	22	36.67
2	Respondent Age	18-25 Years	20	33.33
		26-35 Years	19	31.67
		36-45 Years	16	26.67
		45-55 Years	3	5.00
		>55 Years	2	3.33
3	Education	Junior High School	2	3.33
		Senior High School	5	8.33
		Diploma/Bachelor	41	68.33
		Master	8	13.33
		Doctor	4	6.67
4	Position	Farming Business Actors	20	33.33
		Consumer Society	20	33.33
		Agricultural Academic/Practitioner	20	33.33

Source: Data processed by the author (2025)

Table 1 shows that the majority of respondents are young males with a high level of education, indicating their readiness to adopt digital technologies in the agricultural sector. The three groups (farmers, consumers, academics/practitioners) are also proportionally represented, allowing this study to capture views from various sides of the digital agriculture ecosystem. This finding aligns with Uneze et al. (2024), who stated that the majority of cooperative members in the Nigerian rice value chain are also predominantly of productive age and possess basic skills in using digital tools. Meanwhile, this result also supports the research of Mari et al. (2022), which found that age factors and direct involvement in the agricultural process influence the level of education and community participation in urban agricultural development. So the implications for farmers, young people, and higher education open up great opportunities in digital literacy training programs. Meanwhile, for governments and technology providers, this data highlights the importance of developing an inclusive digital approach while also considering the skills challenges faced by individuals over 45 years of age.

Respondent Characteristics Regarding Digital Agricultural Community Trends

a. General Characteristic Trends

The survey results revealed general characteristics that became the primary focus in identifying the deepening of the integrated agricultural digitalization trend. Here are the data findings.

Table 2. General characteristics of respondents regarding digital agricultural community trends

No	Category	Subcategory	Percentage (%)
1	Experience in integrated farming in practice, consumption of its products, or knowledge about it	a. Have experience	78.3
		b. Have no experience	21.7
2	Information/support needed to improve access to integrated farming	a. Organic farming cultivation guide	25.0
		b. Market and marketing information.	30.0
		c. Agricultural expert consultation.	20.0
		d. Latest agricultural technology.	20.0
		e. Other.	5.0
3	Access that can combine Various parties to collaborate	a. Mobile application.	40.0
		b. Website.	15.0
		c. Online Seminar.	6.7
		d. Online Discussion Group.	38.3
4	Language preference or communication format	a. Indonesian.	20.0
		b. Video tutorials.	40.0
		c. Images and infographics.	30.0
		d. Other.	10.0

Source: Data processed by the author (2025)

The data in Table 2 show that out of a total of 60 respondents, the majority (78.3%) have experience in integrated farming and are highly involved in digital communities, either through mobile apps (40%) or online discussion groups (38.3%). This finding aligns with the research of Maria et al. (2022), which also found that community participation in urban agriculture is high, particularly in decision-making and evaluation. However, the main difference lies in the stage of "enjoying the benefits," which, in the research of Maria et al. (2022), is still low, while in this study, respondents are more oriented towards the need for marketing information (30%) and the latest technology (20%). This suggests that digital community participation tends to be informational and transactional, as opposed to the direct, economic benefit-based participation model. Meanwhile, the results of this study also found that market access (40%) and limited digital literacy are the main obstacles to the development of digital farming communities. This finding differs from that of Uneze et al. (2024), which identified the main challenges in the digitalization of agricultural cooperatives in Nigeria as being more closely related to the democratic control of members and the adoption of technology in cooperative institutional governance. This difference may indicate that in Indonesia, the digitalization of agricultural cooperatives is still in the early stages of adoption, with the main problems still focused on market access and technology, rather than aspects of institutional governance.

The results of verification through open-ended questions to respondents regarding the question " Preference for certain features from other platforms that can be useful if adopted ?" obtained various descriptions of answers, the main point of which is that farmers' needs in adopting digital technology reflect general trends in the development of information technology-based agribusiness platforms. The existence of features such as video tutorials, live streaming, marketplaces, discussion communities, the use of Artificial Intelligence (AI), and real-time agricultural information reflects farmers' needs for more interactive, educational, and practical, solution-based information access. The integration with popular social media-based communication patterns that exist today (TikTok, Instagram, Facebook, and YouTube) and the need for e-commerce underscore the importance of digitalizing the supply chain and agricultural marketing, which aligns with various studies on digital transformation in the agribusiness sector. Understanding this general trend, there is a need for a user-centered design approach to be more effective in increasing productivity, collaboration, and community welfare digitally.

The problems that have been mapped to the general characteristics of dominant stakeholders are the need for market and marketing information, access via mobile applications, and communication (via video, images and infographics), so with the existence of Koper-Tani as a container for an integrated agricultural community, it provides a community platform that can provide market access through an integrated agricultural product marketplace. In addition, its use is integrated into a mobile application that can be accessed through the main Koper-Tani website. This application provides a platform for sharing information related to integrated agriculture through social media, featuring various posts in the form of interactive videos, images, and infographics. The existence of Koper-Tani can serve as a strategic solution to overcome the main problems faced by stakeholders, providing wider market access, ease of use through a mobile system, and a more effective and interactive communication system. This platform enables farmers, consumers, and other stakeholders to connect directly, access relevant information, and enhance the efficiency of marketing and distributing agricultural products.

b. Characteristics of Farmers.

Characteristics of farming actors are an important aspect to understand the actual conditions in the field and determine the direction of integrated farming community development strategies. Based on the survey results, data were obtained regarding farmers' experiences in carrying out farming activities, the main obstacles they faced, their experiences with receiving assistance, and their views on the use of supporting technology for sustainable agriculture. This information serves as the basis for designing an empowerment model that is adaptable to the real needs and challenges faced by farming actors. Details of these characteristics are presented in Table 3 below.

Table 3. Characteristics of agricultural business actors based on their needs and challenges

No	Category	Subcategory	Percentage (%)
1	Experience in conducting farming activities	a. Less than 1 year	10
		b. 1 year	5
		c. 2 years	15
		d. More than 2 Years	70

Table 3. Characteristics of agricultural business actors based on their needs and challenges

No	Category	Subcategory	Percentage (%)
2	The main obstacles faced	a. Limited resources.	10
		b. Market access and selling prices are not yet guaranteed.	30
		c. Constraints on technology application (procurement of agricultural facilities and infrastructure, from production to post-harvest).	15
		d. Climate change and environmental conditions.	40
		e. Limited productive land.	5
3	Experience in getting mentoring	a. Once.	75
		b. Never.	25
4	Technologies to be used to support sustainable integrated farming systems	a. Technology that can ensure optimal use of resources.	45
		b. Use of technology for crop monitoring.	15
		c. Integrated pest management.	5
		d. An Internet-based innovative irrigation system to monitor soil moisture and weather conditions.	20
		e. A hydroponic farming system to grow more plants.	15
5	Mentoring or training required	a. Training in carrying out various components of agriculture, such as crops, livestock, and fisheries, in one system.	30
		b. Training in utilizing waste into organic fertilizer and pesticides.	25
		c. Providing skills in managing land by combining trees, food crops, and livestock according to the culture of the local community.	10
		d. Teaching the use of digital technologies improves resource use.	20
		e. Provides comprehensive guidance on the sustainable use of natural resources.	15
6	Expected standards of mentoring in the community	a. Agricultural practices are carried out safely and sustainably, covering aspects such as land management, pesticide use, and worker safety.	30
		b. Focusing on post-harvest handling of agricultural products to maintain product quality and safety until they reach consumers.	25
		c. The processing of agricultural products is carried out following established hygienic and quality standards.	10
		d. Combining various agricultural components, such as crops, livestock, and fisheries, into one system.	35
		e. The existence of a farmer institution that protects farmers.	0

Source: Data processed by the author (2025)

The data obtained in Table 3 show that the majority of agricultural business actors (70%) have had more than two years of experience in integrated farming. This reflects that most business actors have a reasonably good basic understanding of sustainable agricultural practices, but still face

various operational constraints. In the study by Maria et al. (2022), it was found that community involvement in urban agriculture is also quite high; however, the main challenge faced is the lack of direct economic benefits that community members experience. The findings in Table 3 indicate that the main obstacles faced by agricultural business actors are not only limited economic benefits, but also market access (30%) and the impact of climate change (40%). These obstacles are likely caused by farmers' dependence on conventional distribution chains, where intermediaries still have control over prices and distribution networks of agricultural products.

Additionally, the lack of digital infrastructure in rural areas exacerbates the technological gap between farmers and other stakeholders. Suppose the study by Maria et al. (2022) emphasizes the importance of increasing economic benefits for urban farming communities, thereby encouraging their continued engagement in sustainable farming systems. In that case, the results of this study indicate that in the field of integrated agriculture, market access and environmental uncertainty are more critical factors than short-term economic considerations alone. The group leadership factor significantly determines the sustainability of community participation; however, in this study, the main challenges are more closely related to external factors, such as climate change and market uncertainty. This suggests that in a digitally integrated farming community, a more systematic approach is needed to build farmer resilience to environmental change and market uncertainty.

The results of verification through open-ended questions to respondents regarding the question "Special needs or challenges in integrated farming?" Provided various answers that can be described as follows: there are various challenges and special needs that need to be overcome so that this system can run optimally. One of the main obstacles is the limited availability of human resources (HR) and infrastructure, particularly in terms of farmers' knowledge of integrated farming and their ability to adopt digital technology. Many farmers remain technology illiterate, while internet access in various regions remains uneven, resulting in gaps in technology adoption. Additionally, differences in geographical conditions across regions mean that not all agricultural knowledge and practices can be applied uniformly. As conveyed by respondents with the following statements:

"So far, young farmers who are tech-savvy are still relatively few, so one of the challenges of developing a digital farming community is that farmers are not tech-savvy. Additionally, internet access in each region varies, presenting its unique challenges. The digital community also brings together farmers from various regions with different geographical conditions, thus raising the possibility that the knowledge given by A is not relevant to the conditions in B's area " (Respondent 1 Farmers, Quote 1, 2025).

Challenges related to technology and digital literacy, as well as limited funds, are also inhibiting factors in implementing an integrated farming system. Farmers require support in the form of technology training, adequate internet infrastructure, and user-friendly applications to manage their farming businesses more efficiently. The internet-based documentation process is also a crucial need to help farmers record and organize their farming activities from the pre-harvest stage to the post-harvest stage, ensuring more structured management.

"Internet-based documentation process to make it easier for farmers to manage and organize agricultural activities to become products so that all activities carried out can be controlled in detail " (Respondent 2 Farming Business Actors, Quote 2, 2025).

Sustainability, monitoring, and evaluation are the primary concerns in the development of digital farming communities. Often, agricultural business assistance is only provided at the beginning without clear sustainability, making it difficult for farmers to develop their businesses consistently. In addition, the minimal involvement of young farmers who are tech-savvy adds to the challenges in building an integrated digital-based agricultural ecosystem. Post-harvest management and market penetration strategies are also crucial for increasing the added value of agricultural products. Farmers also need to gain literacy related to marketing through social media in order to market their products more effectively and consistently. This must, of course, be supported by the shelf life factor of agricultural products, and their processing is a crucial concern that requires innovative solutions to enable agricultural products to last longer and remain competitive in the market.

The dominant problems faced by agricultural business actors can be addressed through the existence of Koper-Tani as an integrated agricultural community platform. This platform offers solutions by providing a digital ecosystem that connects farmers with a broader market through a technology-based marketing system, accelerating the distribution of agricultural products, and supporting a deeper understanding of supply chain efficiency. In addition, this platform can serve as a

means of education and ongoing support by offering digital training modules, interactive webinars, and mentorship from agricultural and business experts, thereby enhancing technological literacy and agricultural business management. With the internet-based digital documentation feature, farmers can record and manage agricultural activities systematically, support transaction recording, and increase business transparency and efficiency.

c. Characteristics of Consumer Society

To design a market-oriented, integrated agricultural community development strategy, it is essential to understand consumers' attitudes towards sustainable agricultural products. The results of a survey of consumer communities reveal the level of awareness regarding the importance of sustainable agricultural products, the frequency of purchase, the main criteria used in making purchasing decisions, and the expected quality of these products. This information is the basis for identifying market preferences and developing community-based marketing strategies that are relevant to today's consumer needs. Details of these consumer characteristics are presented in Table 4 below.

Table 1 Characteristics of consumer society in sustainable agricultural products

No	Category	Subcategory	Percentage (%)
1	Awareness of the importance of sustainable agricultural products	a. Understand.	60
		b. A little understanding.	40
		c. Do not understand.	0
2	Frequency of purchasing sustainable agricultural products in 1 week	a. Never.	0
		b. 1-3 times.	60
		c. 4-6 times.	40
		d. More than 7 times.	0
3	The most important criteria to consider when purchasing a product	a. Confidence in food safety.	55
		b. Quality of service.	5
		c. Price.	25
		d. Product availability and access.	15
4	Desired product quality standards	a. Product packaging.	0
		b. Physical and sensory qualities.	30
		c. Nutrient content.	40
		d. There is already certification and labeling.	25
		e. Durability and shelf life.	5
5	Main obstacles to gaining product access	a. Lack of market access.	40
		b. Infrastructure constraints.	0
		c. Higher prices.	10
		d. Does not have certification and labeling yet.	25
		e. Lack of knowledge.	25
6	Experience of buying food products through online media	a. Always.	10
		b. Seldom.	45
		c. Never.	45

Source: Data processed by the author (2025)

Table 4 presents survey data from 20 groups of respondents specifically targeting the consumer community, indicating that the study's findings reveal a high level of consumer awareness of sustainable agricultural products, as reflected in the frequency of purchases and attention to food safety aspects. This aligns with Uneze et al. (2024), who emphasized the importance of digital literacy and sustainability awareness in agricultural cooperatives in Nigeria. However, as Mari et al. (2022) found, the main constraints remain in the distribution and market access aspects. This indicates that, despite high consumer awareness, there are still structural barriers that need to be addressed by stakeholders. According to Khanal et al. (2021), digitalization in agriculture enhances transparency and consumer involvement in the agricultural value chain, enabling small farmers to adapt to changing consumer demand preferences. Of course, the level of productivity and technical efficiency can be higher in production, allowing for the provision of food with guaranteed quality. Therefore, as an implication, it is crucial to strengthen marketing infrastructure and encourage digitalization programs, while producers should focus on improving product quality and affordability to reach a broader consumer market.

The findings on the characteristics of the consumer community surveyed align with the study by Triwahyuni et al. (2024) on urban farming communities, which highlights internal and external factors influencing the development of agricultural communities, particularly in terms of access to information and community participation. Although consumer awareness of sustainable agricultural products is relatively high, limited market access, a lack of community literacy, and low utilization of digital platforms continue to be significant obstacles to product distribution and marketing. If land limitations are the main challenge in urban farming, then in sustainable agriculture, the roles of education, quality assurance, and digital market optimization are crucial factors that must be considered to increase the competitiveness of local agricultural products.

The dominance of characteristic data obtained from the main problems faced by consumer society, the existence of Koper-Tani as an integrated agricultural community platform, provides solutions that can be offered, including strengthening digital market access through a special marketplace for sustainable agricultural products that connects farmers directly with consumers, ensuring transparency and trust in product quality. In addition, community education and literacy can be strengthened through information features related to food safety, certification, and the benefits of sustainable products, thereby improving consumer understanding. Koper-Tani can also develop a community-based membership system that provides incentives for consumers who actively support sustainable agriculture, such as through a points system or discounts for loyal customers. With this approach, the platform not only expands market access for farmers but also increases consumer awareness and involvement in the sustainable agricultural ecosystem.

d. Characteristics of Academics/Practitioners in the Field of Agriculture

To develop a digital-based integrated farming community model, the views and contributions of academics and agricultural practitioners are essential. This group not only serves as a provider of knowledge and technology, but also as a facilitator in the integration process between agricultural actors. Therefore, it is essential to describe the characteristics of academics/practitioners, including their workplace background, experience in providing assistance, effective empowerment models, challenges, and simple technologies that can support community activities. This information provides an important basis for formulating the strategic role of academics/practitioners in supporting the sustainability of the Koper-Tani system. The full details are presented in Table 5 below.

Table 5. Characteristics of academics/practitioners in the agricultural sector

No	Category	Subcategory	Percentage (%)
1	Work place	a. Government agencies.	65
		b. Private companies.	30
		c. Businessman.	5
2	Experience in Mentoring	a. Once.	100
		b. Never.	0
3	agricultural community development models are considered effective	a. Integration of all Sub-agricultural components.	20
		b. Organic fertilizer production management.	5
		c. MSME cluster approach.	10
		d. Effective planting planning.	0
		e. Integrating agricultural components With management practices.	65
4	Simple technology that can support community activities	a. Organic waste processing.	25
		b. Efficient use of irrigation.	25
		c. Waste management for feed.	25
		d. Effective composting.	20
		e. Creating an aquaponics system.	5
5	Challenges that hinder integrated farming systems	a. Capital limitations.	25
		b. Limited market access.	5
		c. Fluctuations in agricultural product prices.	10
		d. Lack of knowledge and skills.	50
		e. Land limitations.	10
6	Community standards that must be met	a. A sustainable environment is maintained.	35
		b. Optimal production efficiency.	10
		c. Empowering farmers through efficient education and training.	20
		d. Ability to maintain Food security.	5

No	Category	Subcategory	Percentage (%)
	e.	There is an increase in farmers' income and Quality of life.	30

Source: Data processed by the author (2025)

The results of a survey of 20 specific respondent groups from academics and practitioners in the agricultural sector, as shown in Table 5, indicate that the majority of historians and practitioners in the sector come from government agencies (65%), with 100% of them having experience in assisting agricultural communities. Most respondents believe that the most effective agricultural community model is the integration of agricultural components with good management practices (65%), which allows for increased efficiency and drainage in an integrated agricultural system. In terms of infrastructure, limited internet access and communication networks in agricultural areas continue to be significant obstacles to the development of digital farming communities. Although the majority of academics and practitioners support the application of digital technology in integrated farming systems, only a small proportion of farmers have access to the technology. This gap highlights a notable disparity in perspective between academics and farmers regarding their understanding of the challenges of digital farming. This finding aligns with research by Maria et al. (2022), which demonstrates that in urban areas, community success is significantly influenced by the role of group leaders and a robust management system. However, the main differences are seen in the scale and challenges faced. Previous research has found that the main challenge in urban agricultural communities is the low direct economic benefits for community members. This study, however, found that the biggest obstacle to integrated agricultural communities lies in the lack of knowledge and skills among farmers (50%).

The biggest challenges for practitioners in building integrated agricultural communities are the lack of knowledge and skills among farmers (50%), followed by limited capital (25%), and the need to strengthen agricultural product prices (10%). This finding differs from the research of Uneze et al. (2024), which found that in Nigeria, the main challenge in digitalizing cooperative agriculture is not in farmer literacy, but instead in the aspects of cooperative governance and democratic control by members. In the research by Uneze et al. (2024), digital agricultural cooperatives have faced challenges in managing democratic control among their members, indicating that the digital agricultural community in Nigeria has become more mature in adopting digitalization. Meanwhile, in this study, the issue of cooperative governance has not been a primary focus because limited farmer skills and inadequate digital infrastructure support remain significant obstacles. Therefore, assistants, such as extension workers who can be considered academics or practitioners, play an important role as facilitators in developing farmers' potential (Verionice et al., 2015).

The results of verification through open-ended questions to respondents regarding the question "Special needs or challenges in integrated farming that must be considered?" obtained various descriptive answers from respondents, so that several main themes that are crucial factors in the implementation of digital-based integrated farming can be identified from the perspective of academics/practitioners in the field of agriculture.

1. Education and Changing Farmers' Mindsets. One of the biggest challenges revealed by respondents is the mindset of farmers who remain resistant to agricultural digitalization. Many farmers consider digital technology to be troublesome or irrelevant to their current practices. Therefore, education is a key element in increasing the adoption of agricultural technology. This education is not only in the form of technical training, but also requires a more persuasive approach by providing tangible evidence of the success of digitalization in increasing farmer efficiency and income.
2. Strengthening Farming Business Management and Economic Sustainability. Several respondents emphasized the importance of more structured farming management, ranging from creativity in farming to ensuring the certainty of harvest prices and guaranteeing the sustainability of agricultural businesses. This challenge is closely related to how farmers can manage their businesses more professionally and sustainably, encompassing production, distribution, and market access. The uncertainty of harvest prices and the dominance of intermediaries remain the primary obstacles to farmers achieving decent profits. Therefore, an integrated farming system is needed that not only focuses on production, but also on supply chain management and marketing.
3. Access to Technology and Digital Literacy. Respondents emphasized that access to the latest technology remains limited, particularly in rural areas where internet and electricity infrastructure are not evenly distributed. Farmers' low digital literacy is also a significant obstacle to the adoption of precision farming technology, e-commerce, and digital payment systems. Some of the solutions proposed from a practical perspective include increasing internet access in rural areas, digital

- training programs, and systems that are easier for farmers to use, allowing them to adapt gradually.
4. **Integrated Systems and Infrastructure Support.** The success of integrated farming depends not only on individual farmer factors but also requires an integrated system from upstream to downstream. Respondents emphasized the need for supporting facilities, such as agricultural infrastructure, clear market access, and policies that accommodate digital-based farming. The lack of data integration from various sources, including weather, market prices, soil fertility, and waste management, is also an obstacle to data-driven decision-making.
 5. **Government Policies and Incentives.** Some respondents also highlighted the importance of policies that support integrated farming, including easier access to capital, stable price policies, and regulations that support the digitalization of the agricultural sector. Without clear incentives from the government, many farmers continue to rely on conventional methods because they consider technology to be an expensive and risky investment.
 6. **Community Strengthening and Ongoing Mentoring.** Many respondents emphasized the importance of farmer involvement in communities that are active in sharing information and innovation. Farming communities, in theory, are based on both academic and practical perspectives. They play a role in assisting farmers, improving their skills, and serving as a forum for sharing experiences in implementing new technologies.

With Koper-Tani as an integrated agricultural community platform, it can be developed into a Smart Digital Community Hub model that integrates academics, practitioners, and government in a single collaborative ecosystem. Based on the survey results, the dominant characteristics of academics and agricultural practitioners have an important role in mentoring, educating, and implementing digital technology for farmers. With Koper-Tani, the development model applied can focus on three main aspects. Facilitating the sharing of research, training modules, and precision agricultural technology among academics and practitioners digitally, providing access to agricultural business mentoring, supply chain management, and financial literacy for farmers to strengthen aspects of economic sustainability. Koper-Tani can be a communication bridge between the agricultural community and government policies, including regulatory support, technology incentives, and access to financing. With direct involvement from government agencies such as State Universities, the Ministry of Agriculture, and the Agricultural Extension Center, Koper-Tani can function as a strategic forum in accelerating the adoption of digital technology while ensuring that the policies implemented are following the needs in the field, so that they can overcome the challenges of integrated agriculture more effectively and sustainably.

Pentahelix Model Based on Characteristic Respondents as Stakeholders

The development of the Koper-Tani model as an integrated digital agricultural community requires close collaboration between the five main elements in the Pentahelix model: Academic, Business, Community, Government, and Media. This collaboration creates effective synergy in advancing the agricultural development sector. Based on the characteristics and perceptions obtained from stakeholders, the following are the roles of each element in supporting the community's development efforts.

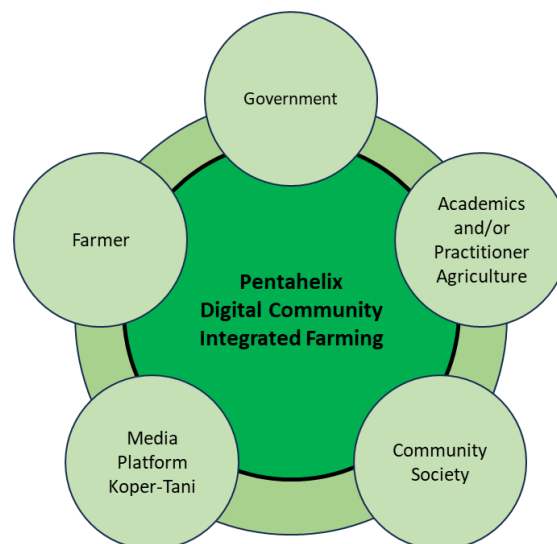


Figure 2. Pentahelix model from Koper-Tani

The pentahelix model of Koper-Tani, as shown in Figure 2, can be seen to be composed of five elements that are interconnected to form parties that support the existence of this community. In detail, the role of each element is explained in the following Table.

Table 6. Pentahelix model of stakeholder roles based on their characteristics.

Element	Characteristics	Role Strategy	A real challenge	Implications of Recommended Actions
Farmer	<ul style="list-style-type: none"> a. Assuming felt helped by regular assistance in terms of agricultural knowledge, marketing, and use of technology. b. The majority of agricultural entrepreneurs require support from the government or community institutions to enhance their business capacity. c. Tends to be participatory-responsive, but not yet fully independent in accessing innovation 	Key actors in field production and innovation	Minimal access to training and technology	Community-based digital agribusiness training program
Society	<ul style="list-style-type: none"> a. Have awareness of the importance of sustainable agricultural products. b. Dominance refers to the frequency of purchasing sustainable agricultural products online within one week. c. The primary criteria for purchasing a product should be a belief in food safety, with a focus on product standards that prioritize nutritional content. d. Lack of market access is a significant obstacle for consumers in obtaining products. 	Actively participate in direct purchasing, community education, and provide feedback to farmers through digital platforms.	Limited local product information	Digital platforms need to strengthen transparency and logistics features.
Academics and/or Practitioner Agriculture	<ul style="list-style-type: none"> a. Overall, most of them have experience in mentoring from both government and private agencies. b. Dominance focuses on mentoring that has environmental sustainability. c. Integrating agricultural components with management practices is a factor that is considered effective in supporting. 	Innovation driver, technology validation, public education	Minimal direct involvement in the community	Need for collaborative village-based applied research schemes
Government	<ul style="list-style-type: none"> a. Having bureaucracy, budget limitations, and requiring synergy between central/regional governments to optimize the digital ecosystem. b. More focused on incentive and regulatory policies, but requires strategic partners such as academics and digital platforms for more effective program execution. 	Policy makers and regulatory facilitators	Slow and not yet digital-ready bureaucracy	Preparation of affirmative policies based on community data

Table 6. Pentahelix model of stakeholder roles based on their characteristics.

Element	Characteristics	Role Strategy	A real challenge	Implications of Recommended Actions
Koper-Tani Platform Media	a. Potential to provide ease of access, user-friendly appearance, and interactive features such as discussion forums and online training. b. There are challenges in building user trust, increasing community engagement, and ensuring that the content presented is relevant to the needs of farmers and others. c. Has the potential to be an information center, marketplace, and advocacy tool for farmers to voice their aspirations and gain wider market access.	Community access providers in supporting information and advocacy bridges	Inadequate access, lack of engagement, and user trust	Optimization of educational features and reward-based user engagement

Source: Table processed by the author (2025)

Table 6 illustrates that the Pentahelix model in the digital agricultural community ecosystem demonstrates how various stakeholders have complementary strategic roles, although challenges remain to be overcome. Based on this, it can be stated that the concept emphasizes the importance of integrated cross-sector collaboration as a step that can serve as a recommendation for action. Each actor plays a complementary role in a synergistic ecosystem, not in a fragmented or sectoral manner. Farmers are the primary actors who still require ongoing support, both in enhancing their agribusiness skills and accessing technology and markets. They tend to be responsive to innovation, but are not yet fully independent in accessing digital solutions. Consumers contribute as end users who demand better product standards, especially in terms of food safety and sustainability, but are still constrained by limited product distribution. Academics and practitioners play a crucial role in developing data-driven solutions and best practices that can be applied on a broader scale. However, these efforts still require policy support and synergy with other stakeholders in order to be implemented effectively. The government has a role in creating a regulatory ecosystem that supports agricultural digitalization, although bureaucracy and limited resources are still challenges.

Findings from Silfia et al. (2020) on the development of community areas based on agricultural entrepreneurship show that the effectiveness of performance is greatly influenced by how collective synergy can be managed, particularly in innovation, supply chain management, access to economic resources, and profit sharing. With the availability of agricultural access to form a platform-based community, it turns out to provide a perspective that digital transformation of agriculture provides a new way to reduce the risks of conventional agricultural impacts through the use of integrated agricultural subsystems that can be implemented into various digital system features (Chen & Li, 2024). However, most farmer groups have not fully managed these dimensions socially and collectively, so the role of mentoring and facilitation from external actors, such as practitioners and the government, is crucial. This aligns with the Pentahelix approach, which emphasizes the complementary roles of stakeholders. In the context of digitalizing agricultural communities, as attempted by the Koper-Tani platform, strengthening farmers' capacity to access innovation and markets, as well as cross-sector collaboration based on data and policies, is key to improving the performance of community entrepreneurship as a whole. The Koper-Tani media platform serves as a liaison, bridging interactions between stakeholders and providing an educational space, advocacy, and digital-based market access for farmers. However, it is still necessary to build trust and increase user engagement so that this platform can develop optimally.

The findings from the development of the Pentahelix model by Koper-Tani still have limitations, especially in terms of the scope of respondents and the depth of interaction between actors, which means that the results obtained do not fully represent the complexity of the dynamics of cross-sector collaboration throughout Indonesia. However, this model makes an important contribution as an initial basis for formulating evidence-based policies that support the inclusive strengthening of the digital agricultural ecosystem. By integrating the strategic roles of farmers, consumers, academics/practitioners, government, and the media, these findings can be an initial

foothold for formulating policies that are responsive to local needs and adaptive to the challenges of digital transformation in the agricultural sector.

CONCLUSIONS AND SUGGESTIONS

This study reveals that the characteristics of digital farming community users are predominantly comprised of productive and highly educated age groups, who have the potential to adopt digital technology. The pentahelix-based digital farming community model addresses the specific needs of the five key stakeholders. Farmers need access to markets and technology, consumers demand transparency and ease of transactions, academics/practitioners play a role in innovation and education, the government supports regulation and collaboration, and Koper-Tani becomes a digital connector. These findings can serve as the basis for developing policies and models that foster more inclusive and synergistic digital farming communities in Indonesia. The primary suggestion to stakeholders is the importance of conducting in-depth mapping of the preferences, needs, and challenges faced by each stakeholder group (farmers, consumer society, and agricultural academics/practitioners) within the digital agricultural ecosystem. By understanding the characteristics of each party, the Koper-Tani platform can be designed more adaptively and responsively, ensuring that the features developed are truly in line with user needs, encourage active participation, and strengthen collaboration between stakeholders in support of the sustainability and efficiency of an integrated agricultural system.

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