

Research Paper



## OPEN INNOVATION FOR AGRO-SMES IN INDONESIA: ENHANCING COMPETITIVENESS THROUGH DIGITAL KNOWLEDGE EXCHANGE AND COLLABORATION

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**ABSTRACT.** Small and medium-sized enterprises (SMEs) are central role in economic resilience by contributing to regional development, and national output. Innovation is crucial for SME competitiveness rendering SME can survive in dynamic and digitally competitive markets. This study explores how digital technology enhances innovation performance through open innovation (OI) among agro-SMEs in Depok, Indonesia. Using a qualitative approach, data were collected through semi-structured interviews, field observations, and documentation from an AI-focused digital training program. Thematic analysis using NVivo revealed five main themes: digital collaboration, peer learning, knowledge sharing, innovation drivers, and competitiveness. Findings indicate that digital tools, such as social media, e-commerce platforms, and simple AI applications, facilitate knowledge exchange and co-creation with customers, suppliers, and peer SMEs. Peer-based learning and informal collaboration during community events and training significantly enhanced product improvements and branding innovations. However, barriers are still existing, such as limited digital skills, low confidence, and a lack of structured support, hinder the full adoption of digital OI practices. This study underscores the importance of localized innovation ecosystems and practical support mechanisms in enabling SMEs to engage in open innovation. A strategic framework linking digital knowledge flows and collaborative capabilities to innovation performance is proposed. The results offer practical guidance for institutions and policymakers seeking to strengthen SME competitiveness in the agricultural sector.

### INTRODUCTION

Small and medium-sized enterprises (SMEs) are pivotal central role in economic resilience by contributing to driving employment, regional development, and national output (Hossain and Kauranen, 2016; OECD, 2019). In Indonesia, SMEs constitute for over 99% of registered firms, contribute approximately 61% of GDP, and employ nearly 97% of the workforce (BPS, 2023; Tambunan, 2019), highlighting their strategic importance to national economic stability. Agro-based SMEs are particularly crucial because of their contributions to food security and rural livelihoods (FAO, 2017; Widyastuti and Hartono, 2024). Despite this role, many face persistent structural constraints, including limited capital, weak R&D capacity, informality, and fragmented innovation

ecosystems. This paradox renders agro-SMEs economically vital but vulnerable to sustaining innovation and competitiveness (Adu-Gyamfi and van der Meer, 2022; Chatterjee *et al.*, 2024; Setiawan *et al.*, 2025).

Innovation is crucial for SME competitiveness; however, most SMEs lack formal R&D structures, systematic knowledge management, and stable innovation networks. As a result, innovation often emerges informally through peer learning, supplier interactions, and trial-and-error processes, rendering SME vulnerable in dynamic and digitally competitive markets (van de Vrande *et al.*, 2009; Spithoven *et al.*, 2013; Brunswicker and Vanhaverbeke, 2015). Open innovation (OI), defined as the purposeful exchange of knowledge across organizational boundaries (Chesbrough, 2003; Chesbrough and Bogers, 2014),

offers a pathway for SMEs to overcome internal resource constraints by engaging external actors, such as customers, peers, and suppliers. Digital technologies amplify these opportunities by enabling low-cost experimentation and wider knowledge access, although adoption remains hindered by limited digital literacy and resources (Nambisan *et al.*, 2017; Bican and Brem, 2020; Scutto *et al.*, 2021). Prior studies on SME technology adoption indicate that technological complexity and limited human expertise remain key barriers, highlighting the need for open innovation mechanisms that support knowledge sharing and collaborative learning (Ari *et al.*, 2025).

Despite the extensive OI literature, significant gaps persist. Empirical studies have predominantly focused on manufacturing or high-technology sectors, whereas agro-processing SMEs—characterized by perishability, seasonality, and fragmented value chains—remain underexamined. Moreover, existing research emphasizes formal collaborations and R&D partnerships, often neglecting informal, community-based, and practice-driven innovation processes prevalent among resource-constrained SMEs. The role of digital tools and AI-enabled learning in strengthening open innovation capabilities within grassroots ecosystems is also insufficiently explored, particularly in developing-country contexts

In Indonesia, these challenges are compounded by uneven digital adoption and weak institutional support (Anshari and Almunawar, 2022). Community-based intermediaries, such as *Pusat Pelatihan Pertanian dan Pedesaan Swadaya* (P4S), play a bridging role by facilitating training, peer learning, and digital experimentation. However, limited research has examined how traditional and digital open innovation practices intersect within such ecosystems. This study addresses this gap by analyzing open innovation practices among agro-SMEs in the P4S *Trikarsa Inti Rakyat* network in Depok, focusing on digital knowledge exchange, AI-based learning, and community-embedded collaboration. Accordingly, this study aims to:

1. Identify traditional and digital open innovation practices adopted by agro-based SMEs within P4S *Trikarsa Inti Rakyat* Depok
2. Examine the open innovation capabilities developed through digital knowledge exchange and collaboration.
3. Analyze the role of AI-based training as a learning mechanism supporting SME innovation practices

Explore the implications of community-based open innovation ecosystems for enhancing agro-SME innovation performance and competitiveness

## RESEARCH AND METHODS

### Research Design

This study employed a qualitative case study to examine how agro-SMEs in Depok implement digital-based open innovation. A case study enables an in-depth exploration of contextual factors, tacit knowledge, and everyday interactions that shape innovation practices (Yin, 2018). Unlike survey designs, this approach captures socially embedded dynamics—such as trust, relationships, and community engagement—that inform both digital adoption and collaborative decision-making among resource-constrained agro-based SMEs.

### Research Site and Participants

Inti Rakyat, an agricultural training center coordinating more than 90 agro-SMEs known for their strong community-driven innovation (Etzkowitz and Zhou, 2017). Participants were selected purposively based on their involvement in agro-food production, operation for at least one year, engagement in innovation or collaboration efforts, and willingness to participate (Palinkas *et al.*, 2015). Six SME owners participated in semi-structured interviews. Additionally, over 30 participated in a digital innovation training program in December 2024, which served not only as a capacity-building activity but also as a contextual intervention and supplementary qualitative data source, covering AI introduction, hands-on platform use, and reflective discussions.

### AI-Based Training as a Contextual Intervention and Data Source

The AI-based digital innovation training introduced basic artificial intelligence tools for knowledge search, idea generation, content creation, and problem-solving related to daily operations, while functioning primarily as a reflective and interactive learning environment rather than an experimental treatment. Participant reflections, group discussions, facilitator field notes, and outputs from AI-assisted activities were treated as qualitative data, offering empirical insights into how SMEs perceive, experiment with, and begin to integrate digital tools into their open innovation practices, thereby complementing interview and observational findings.

### Data Collection Techniques

Data were collected through semi-structured interviews, field observations, and documentation from the AI-based innovation workshop to ensure triangulation and methodological robustness (Creswell and Plano Clark, 2018). Interviews (30–60 min) were recorded with consent and anonymized. Observations focused on peer learning, co-creation, and knowledge exchange during community events. Documentation included facilitator notes, participant reflections, and outputs generated from AI-assisted activities during the training sessions.

### Data Analysis

Data were analyzed using Braun and Clarke’s (2006) six-phase thematic analysis, with NVivo 15 utilized to organize codes, visualize patterns, and conduct cross-case comparisons. NVivo integrated interview transcripts, observational notes, and training-related documentation within a single analytical framework. A hybrid deductive–inductive strategy guided theme development, combining open innovation theory (Chesbrough and Bogers, 2014) with emergent context-specific insights. Trustworthiness was strengthened through triangulation, reflexive journaling, and thick description to maintain transparency and transferability.

### Interview Instrument

The semi-structured interviews were guided by themes including digitalization, collaboration, knowledge exchange, innovation, competitiveness, and policy needs. The questions explored external collaboration, strategies to sustaining competitive advantage, and institutional support requirements,

allowing for comparability while giving participants flexibility to elaborate on their experiences. (Table 1)

## RESULTS AND DISCUSSION

This section presents the qualitative findings on how Depok-based agro-SMEs engage in open innovation and the contextual factors shaping these practices. The analysis addresses two objectives: (1) to examine the current state of open innovation practices, and (2) to identify gaps and opportunities for strengthening SMEs’ innovation capability through digital knowledge exchange and collaboration.

### Profile of Respondents

Respondent characteristics provide essential context for interpreting open innovation behaviors among SMEs, as demographic and educational backgrounds often influence entrepreneurial decision-making and innovation adoption (Storey, 2016; Bruton *et al.*, 2021). The study involved 36 participants—six in-depth interviewees and 30 survey respondents—with variations in gender, age, education, and business type, as summarized in Table 2.

The profile shows that most respondents are female entrepreneurs (91.7%), aligning with the broader prevalence of women-led micro and small firms in Indonesia (Tambunan, 2019). A large share falls within the productive age range of 36–45 years (41.7%), and many have at least a senior high school education, indicating relatively strong human capital that can support digital adoption and collaborative innovation. Most businesses operate in the food and beverage sector (61.1%), reflecting both high market demand and the sector’s low entry barriers in urban areas such as Depok.

Table 1. Core interview questions

No	Theme	Questions
1	Digitalization	Have you ever used digital technology to support your business? (e.g., online marketing, bookkeeping, applications) What benefits or challenges have you experienced using these technologies?
2	Collaboration	Have you ever collaborated with external parties (customers, other SMEs, institutions)? What form did this take? Have you ever developed a product or marketing strategy jointly with a partner?
3	Knowledge exchange	How do you usually obtain or share ideas and information in your business? Do you document or store key business knowledge (e.g., recipes, processes)? Is this knowledge shared with others (staff/family)? In what form?
4	Innovation	Have you developed new products or processes in the last 1 – 2 years? What triggered them? What were the results or impacts of the innovation you implemented?
5	Competitiveness	What do you consider as your business’s competitive advantage over others? What strategy do you use to stay competitive in the current market?
6	Policy recommendation	What kind of support do you think SMEs need to be more innovative and competitive?

Table 2. Characteristic of respondents (N = 36)

Variable	Category	Frequency	Percentage (%)
<b>Gender</b>	Male	3	8.3
	Female	33	91.7
<b>Age</b>	17–25 years	2	5.6
	26–35 years	9	25.0
	36–45 years	15	41.7
	>45 years	10	27.7
<b>Education</b>	Junior High School (SMP)	2	5.6
	Senior High School (SMA)	17	47.2
	Diploma	5	13.9
	Bachelor (S1)	11	30.6
<b>Business Type</b>	Master (S2)	1	2.7
	Food & Beverages	22	61.1
	Handicraft	4	11.1
	Services	3	8.3
	Fashion & Accessories	5	13.9
	Digital/Creative	2	5.6

Table 3. NVivo coding summary for innovation triggers and knowledge sources

Theme	Most frequent codes/phrases	Frequency	Illustrative meaning
Innovation Triggers	Customer request, reseller suggestion, market demand, competitor product	54	Innovation often emerges reactively from external push
Knowledge Sources	WhatsApp groups, Instagram feedback, supplier input, peer advice	41	Knowledge is sourced informally from digital chats and peer interactions

### General Patterns of Open Innovation Among Agro-SMEs

NVivo analysis of interviews and training observations indicates that open innovation among Depok agro-SMEs is still in an *early-stage and largely informal*. Innovation emerges *reactively*, triggered by customer requests, reseller suggestions, market demand, or competitor moves, rather than through structured planning. This aligns with prior findings that SMEs in developing economies often lack the resources and systems to formalize innovation (Spithoven *et al.*, 2013; de Araújo Burcharth *et al.*, 2014). Table 3 summarizes the dominant innovation triggers and knowledge sources. Digital engagement is mainly limited to marketing and communication, with platforms such as WhatsApp, Instagram, and Shopee used for customer interaction, order processing, and feedback management. NVivo frequency patterns show that customer feedback and reseller input dominate innovation triggers, indicating a strongly reactive orientation. As one SME owner stated, “If a customer

asks for something new, I try to make it... but I don't really have a plan for innovation” (Interviewee 2).

This reactive pattern is reinforced by structural resource constraints. None of the SMEs reported having dedicated innovation budgets, personnel, or formal routines for innovation, resulting in limited absorptive capacity and weak knowledge integration. Collaboration with suppliers, resellers, and peers occurs mainly on an incidental and transactional basis rather than through sustained or strategic partnerships.

In summary, the general pattern of open innovation practices in these agro-SMEs can be summarized as follows:

1. Reactive rather than proactive, driven primarily by customer and market demands.
2. Informal and unstructured, without dedicated resources, budgets, or planning mechanisms.
3. Digitally limited, with technology functioning mainly as a marketing tool rather than as a driver of knowledge integration or process optimization.
4. Opportunistic in collaboration, relying on casual exchanges rather than sustained partnerships.

These practices reflect a combination of adaptive strengths and structural limitations. While informality and reactivity enable rapid market-driven adjustments, the absence of structured knowledge management and partnership mechanisms constrains scalability and long-term innovation sustainability. Strengthening absorptive capacity is therefore critical for enabling a shift from reactive innovation responses toward more intentional and resilient innovation pathways.

### Identified Best Practices in Open Innovation

Best practices among SMEs revolve around informal peer learning, rapid adaptation, and community-embedded knowledge exchange. For instance, entrepreneurs frequently adopted ideas observed at bazaars or during peer interactions: “We developed our product variants after hearing what worked for others in the bazaar” (Interviewee 1); “My packaging changed after I saw a friend using natural paper. It looked classy” (Interviewee 6). Such exchanges exemplify tacit knowledge transfer and collective experimentation, consistent with grassroots open innovation ecosystems (van de Vrande *et al.*, 2009).

The co-creation of with customers and peers strengthened innovation capacity through rapid feedback loops, such as testing packaging or branding options via social media, and bazaars and P4S training enabled real-time peer learning. These practices illustrate innovation as a socially embedded process shaped by networks and interactions rather than formal structures (Chesbrough and Bogers, 2014; Lichtenthaler, 2011; OECD, 2021).

The summary presented in Table 4 reinforces that open innovation in the agro-SME ecosystem of Depok

is highly relational and community-embedded. Instead of relying on formalized structures, SMEs depend on collaboration with suppliers and resellers, as well as knowledge sharing through peer networks and co-creation with customers. This supports the findings of previous studies (van de Vrande *et al.*, 2009; Lichtenthaler, 2011) that SMEs often innovate through external partnerships and informal knowledge flows rather than through internal R&D.

### Digital Open Innovation – Based Practices

Digital engagement among Depok-based agro-SMEs reflects a transitional stage of open innovation, with platforms such as WhatsApp, Instagram, Shopee, and GoFood mainly used for communication, promotion, and order processing rather than for knowledge creation or collaborative experimentation. As one jam producer noted, “Once I post a picture, the orders come through... I don’t really need anything else” (Interviewee 2), highlighting the predominantly transactional use of digital tools. This pattern aligns with prior studies showing that SMEs in developing economies adopt digital technologies primarily for sales, limiting their role in open innovation and knowledge exchange (Akpan *et al.*, 2022; Asare *et al.*, 2021).

Innovation decisions remain predominantly reactive, driven by customer and reseller requests, as indicated by the frequent co-occurrence of “customer request,” “market trend,” and “reseller advice” in the NVivo analysis. Although the 2024 AI training enabled the experimental use of tools such as ChatGPT, Gemini, and Perplexity for basic ideation, digital platforms remain weakly integrated into knowledge-sharing and collaborative learning processes (Table 5).

Table 4. Identified best practices of open innovation among Agro-SMEs in Depok

NVivo Theme	Practice	Representative Quote	Interpretation
Collaboration	Supplier collaboration	“My supplier suggested reducing the size of the bottle to make it more affordable for school canteens. It worked, and sales increased.” – Interviewee 4	Suppliers act as co-innovators, offering market-relevant adjustments beyond raw material provision
	Reseller-driven improvement	“I didn’t think of creating a sugar-free version until my reseller told me that customers were asking for it.” – Interviewee 5	Resellers provide valuable customer insights, functioning as feedback channels for continuous improvement.
Knowledge sharing	Peer learning at community events	“We developed our product variants after hearing what worked for others in the bazaar.” – Interviewee 1	Informal peer exchanges serve as substitutes for formal training and inspire product diversification
	Co-creation with customers	“I learned how to bundle products after joining a training event. Another participant shared her idea, and I tried it with my own products.” – Interviewee 6	Training and community events act as hubs for exchanging practical innovation strategies.
Collaboration & Knowledge Sharing			

Table 5. Comparative summary of digital open innovation practices

NVivo Theme	Practice Type	Tools Used	Observed Purpose	Limitations
Knowledge Sharing	Customer communication	WhatsApp	Quick updates, direct orders, reseller coordination	No structured customer database or analytics
	Digital documentation	Instagram, WhatsApp Business	Displaying product images	Minimal interaction, limited market insights
Collaboration	Online marketplaces	Shopee, GoFood	Expanding reach and fulfilling orders	Treated as transactional, not collaborative
Knowledge Sharing & Collaboration	Exploratory AI use	ChatGPT, Gemini, Perplexity (training only)	Drafting names, promotional texts, quick insights	Not integrated into business processes, perceived as complex

A clear gap persists between digital presence and digital open innovation. Viewed through the exploration–exploitation lens (March, 1991), SMEs rely heavily on exploitation—using digital tools to support existing operations—while exploration remains limited. Without structured integration, emerging AI use has yet to translate into sustained innovation capability. Capacity-building efforts that embed digital tools into feedback loops, co-creation, and learning processes are, therefore, essential for advancing digital open innovation among agro-SMEs.

### Barriers and Opportunities in Open Innovation

The analysis shows that agro-SMEs in Depok operate within a dual landscape of persistent barriers and emerging opportunities for open innovation. Structural constraints, particularly limited resources, low digital literacy, and weak institutional linkages, continue to inhibit systematic innovation. Digital tools, such as WhatsApp and Instagram, are mainly used for communication and marketing, whereas core functions, such as inventory, finance, and customer analytics, remain largely manual. This situates most SMEs at a “low digital maturity” stage, where technologies address immediate operational needs but are not yet integrated into strategic or innovative processes (Nambisan *et al.*, 2017).

Despite these limitations, SMEs adapt by leveraging accessible digital platforms (e.g., WhatsApp Business, Shopee, and GoFood) and strong interpersonal networks. Bazaars and community trainings facilitate peer learning and informal knowledge exchange, supporting inbound open innovation through socially embedded knowledge absorption rather than formal R&D structures (Chesbrough and Bogers, 2014), as summarized in Table 6.

Innovation among agro-SMEs remains predominantly reactive, driven mainly by customer

requests and market feedback. While this limits proactive or strategic innovation, it also reflects agility, a recognized competitive strength in SMEs (Lichtenthaler, 2011). Consistent with Bican and Brem (2020), the findings suggest that in resource-constrained contexts, open innovation often emerges through the creative use of simple digital tools and strong social capital rather than through sophisticated technological systems. Strengthening digital open innovation therefore requires interventions that enhance knowledge circulation and collaborative learning, alongside gradual improvements in digital capability.

### Community-Embedded Collaboration

Field observations reveal that collaboration among Depok-based agro-SMEs is fundamentally community-embedded, arising informally through trust-based interactions rather than formal agreements. SME owners routinely exchange practical tips on packaging, pricing, and booth arrangements during training and bazaars, illustrating how social capital shapes knowledge flows and collective problem-solving (Putnam, 2000). Innovation similarly emerges from these social encounters: new product variants and packaging adjustments often originate in peer discussions or reseller groups, functioning as informal incubators of inbound open innovation (Chesbrough and Bogers, 2014).

Community networks enable SMEs to absorb external ideas aligned with their capabilities and market needs, supporting co-creation despite the absence of formal R&D or knowledge management systems. Through routine interactions, SMEs develop basic dynamic capabilities—sensing opportunities, seizing them through small-scale experimentation, and incrementally reconfiguring resources—that help sustain competitiveness under resource constraints (Teece, 2007), as summarized in Table 7.

Table 6. Barriers and opportunities observed

Theme	Barriers (Field Evidence)	Opportunities (Field Evidence)
Digital Tools	Use limited to WhatsApp/Instagram for communication; no systematic use for stock or R&D	Familiarity with commonly used digital platforms (e.g., WhatsApp Business, Shopee, and GoFood) facilitates broader digital adoption
Knowledge Sharing	Innovation not documented; ideas often lost after events.	Peer-to-peer learning in bazaars and training provides rapid, practical knowledge transfer
Resources	Financial limits to adopt advanced systems; reliance on family labor.	Free/low-cost platforms reduce entry barriers and are already widely utilized
Ecosystem Linkages	Minimal collaboration with universities or research centers	P4S functions as a connector, providing regular workshops and mentoring.
Innovation Behavior	Reactive – responding only when customers request changes.	Direct customer feedback accelerates adaptation of products and packaging

Table 7. Community-embedded collaboration among agro-SMEs

Observed Practice	Illustrative Example	Innovation Outcome
Informal peer learning	Sharing packaging tips during training sessions	Improved packaging design and product presentation
Trust-based collaboration	Exchanges of ideas with known peers in community groups	Stronger willingness to adopt peer-inspired innovation
Socially triggered innovation	Idea of starfruit jam emerged during community gathering	New product variants aligned with local resources.
Bazaar-based knowledge exchange	Sellers visiting peers’ booths to discuss layout and customer interaction strategies	Enhanced booth design and improved customer engagement
Reseller-driven product adjustment	Tofu producers adding spicy variants after reseller discussions	Market-responsive product diversification
Community as micro-incubator of ideas	Knowledge flows embedded in neighborhood or association meetings	Faster adaptation and diffusion of practical know-how

The Depok case highlights a distinctive pattern of open innovation in developing economies, in which community trust and social capital function as practical substitutes for structured partnerships and institutionalized knowledge systems (Spithoven *et al.*, 2013). Therefore, strengthening SME competitiveness requires not only expanding access to digital and formal innovation mechanisms but also reinforcing community-based practices that underpin everyday innovation.

### Linking Open Innovation to SME Capabilities and Competitiveness

Field evidence indicates that open innovation—though modest and largely informal—contributes meaningfully to the capability development and competitiveness of agro-SMEs in Depok. Inbound knowledge flows from community exchanges, training, and digital platforms help build the core dynamic capability dimensions of sensing, seizing, and reconfiguring (Teece, 2007). Digital tools, such as WhatsApp Business and Instagram, initially used for

basic promotion, have gradually become channels for real-time feedback and small-scale experimentation, creating iterative learning loops that enhance SMEs’ ability to sense and respond to market changes. Peer learning during bazaars and government programs similarly expands SMEs’ “open search breadth” (Laursen and Salter, 2006) by exposing them to diverse ideas for product and packaging refinement.

Although still emerging, AI-based training has introduced accessible tools for content creation and design, reflecting the democratization of open innovation (West and Bogers, 2017). Together, these practices strengthen differentiation, visibility, and relational capital, enabling SMEs to adapt and compete more effectively. Consistent with Teece (2014), the Depok case demonstrates that competitiveness in dynamic environments relies not on static resources but on the continual integration and reconfiguration of knowledge, supported by community trust as a social foundation and digital engagement as an expanding pathway for innovation.

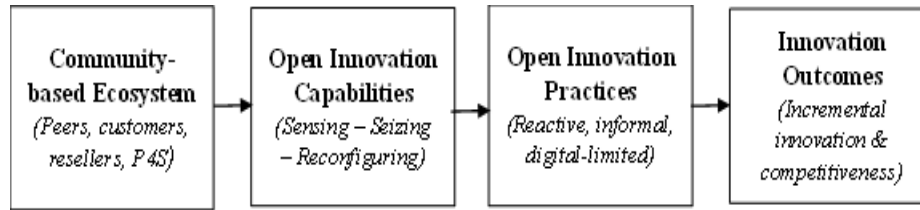


Figure 1. Community-based open innovation framework for agro-SMEs

### Synthesis of Open Innovation Practices, Capabilities, and Competitiveness among Agro-SMEs in Depok

This subsection presents a visual framework that synthesizes the qualitative findings and illustrates how community-based ecosystems shape open innovation capabilities, practices, and innovation outcomes among agro-SMEs in Depok. Figure 1 summarizes the empirical relationships identified in this study. Community-based ecosystems, comprising peer networks, customers, resellers, and P4S as a local intermediary, provide key knowledge inputs that shape SMEs' open innovation capabilities (sensing, seizing, and reconfiguring). These capabilities are enacted through predominantly reactive, informal, and digitally limited open innovation practices, resulting mainly in incremental innovation outcomes and enhanced competitiveness.

### CONCLUSIONS AND RECOMMENDATIONS

#### Conclusions

Implications for capabilities and competitiveness. The findings indicate that open innovation remains largely informal and reactive, driven by input from customer, peer, and supplier input, providing flexibility but limiting absorptive capacity due to weak knowledge management. Digital tools primarily support communication and sales, whereas early exposure to generative AI reflects experimental openness rather than systematic adoption, highlighting the need to strengthen digital literacy and embed collaborative routines. Theoretically, this study contributes by showing that open innovation in agro-SMEs is community-driven and digitally mediated rather than based on formal R&D collaboration, with AI-based training functioning as a learning-oriented mechanism for capability development through experimentation. However, the study is limited by its single-case and short-term focus; future research should adopt longitudinal or comparative designs to assess the sustainability of digital open innovation practices.

#### Recommendations

Agro-SMEs should enhance digital knowledge integration and develop more structured collaborations with external actors to support open innovation. Future research should employ larger samples and longitudinal designs, while examining digital maturity and institutional support as key moderating factors.

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