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ARABICA COFFEE-BASED FARMING SYSTEM DEVELOPMENT AND UTILIZATION IN BANSALAN, DAVAO DEL SUR: DIFFUSION OF INNOVATIONS PERSPECTIVE

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DECLARATION

This is to certify that:

I. The special problem comprises only my original work towards the MRDM, except where indicated in the Preface

II. Due acknowledgment has been made in the text to all other materials used

III. The special problem is fewer than 25,000 words in length, exclusive of tables, maps, bibliographies, and appendices.

MILVA L. CARINAN
Name

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Abstract

This study examined the adoption and diffusion of the Arabica coffee-based farming system among members of the Gagpang Alegre Potato Small Farmers Association (GAPSFA) in Bansalan, Davao del Sur, using the Diffusion of Innovations (DOI) Theory (Rogers, 2003). A qualitative case study approach was applied, drawing on KIIs and FGDs with 12 farmer-adopters, interviews with the DA RFO XI research manager and personnel, and a document review, all of which were analyzed through pattern matching following Yin (2018).

Findings indicated that relative advantage and observability were the primary drivers of technology adoption, as reflected in increased income, visible farm improvements, and strong peer influence. Compatibility with local agroecological conditions and cultural practices further supported uptake, while perceived complexity of adopting the technology was abated through extension support. Trialability, particularly via demonstration farms, minimized uncertainty and encouraged participation. Adoption outcomes were shaped by adoption contextual factors as enabling conditions, including access to available financing, strong extension services, high market demand, and institutional trust. Interpersonal channels, especially farmer-to-farmer interactions and associations, emerged as the most effective diffusion pathway.

While adoption was sustained and widely diffused, financial and infrastructure constraints continued to limit full-scale implementation. The study concluded that effective agricultural technology diffusion depended on the alignment of innovation attributes, enabling adoption contexts, and appropriate diffusion mechanisms within a holistic, systems-based framework. It further highlighted the need to bridge the gap between research outputs and practical application through stronger knowledge-to-use systems and institutional support mechanisms. Accordingly, the study recommended strengthening access to financing, improving farm-to-market infrastructure, sustaining extension and technical support services, scaling demonstration-based learning platforms, leveraging farmer networks and associations, enhancing market systems and price transparency, integrating climate and risk management measures, adopting value chain-oriented promotion strategies, grounding adoption interventions in economic evidence and farmer learning, and reinforcing Research for Development (R4D) linkages—including institutionalized technology readiness evaluation—to ensure that innovations are validated and prepared for wider commercialization and scaling.

Keywords: Arabica coffee-based farming system; agricultural technology adoption; Diffusion of Innovations Theory; technology diffusion; Research for Development (R4D)

I. INTRODUCTION

A. BACKGROUND

Agriculture remains a vital sector in the Philippines, supporting livelihoods, food security, and regional economic growth, particularly among smallholder farmers and fisherfolk. In Region XI (Davao Region), favorable agro-climatic conditions enable the production of high-value crops for both domestic use and export. The region is a leading producer of commodities such as banana, pineapple, coconut, cacao, durian, and coffee, highlighting its significant contribution to national supply and export earnings (Department of Agriculture Regional Field Office [DA RFO] XI, 2025; Bureau of Customs [BOC], 2023).

Coffee, in particular, is both an economic and strategic commodity, especially in upland areas (Philippine Coffee Board, 2021). The Davao Region contributes 15.30% of national coffee output, ranking second in the country (DA RFO XI, 2025). In Davao del Sur, coffee is among the priority commodities, supporting over 2,200 farmers and covering approximately 1,200–1,500 hectares (Davao del Sur Provincial Commodity Investment Plan [PCIP], 2023). The province, particularly areas near Mt. Apo, is known for high-quality Arabica and Robusta varieties, with the municipality of Bansalan having the largest planted area of over 800 hectares and the highest expanded vulnerability and suitability analysis (e-VSA)[1] index of 0.721 (Davao del Sur PCIP, 2023). Despite its potential, coffee production faces persistent challenges,

[1] An expanded vulnerability and suitability analysis (e-VSA)) combines biophysical factors—such as climate and soil conditions—with socioeconomic data to determine the most suitable areas for specific commodities. It's a decision-support tool used by the Department of Agriculture-Philippine Rural Development Project (DA-PRDP) for identifying and prioritizing locations for agricultural infrastructure and enterprise development.

including declining productivity (Department of Agriculture – Bureau of Agricultural Research [DA-BAR] & DA RFO XI Project Terminal Report, 2023); limited adoption of Good Agricultural Practices (GAP) and inadequate access to training and extension services (Davao del Sur PCIP, 2023), as well as land and crop conversion, climate-related risks, and insufficient water resources (DA-Philippine Rural Development Project [PRDP], 2023)~~.~~

Research for Development (R4D) initiatives play a key role in improving agricultural productivity and competitiveness (Rivera & Alex, 2004; World Bank, 2006). However, their impact depends on the effective commercialization and adoption of technologies (Hall & Khan, 2003). Evidence shows that only 10–20% of government-funded R&D outputs reach commercialization (Buendia, 2025), indicating a gap between research and field application.

Given the continued difficulty in adopting improved technologies, understanding the factors influencing adoption, particularly for specific technologies and commodities, is essential to maximizing R4D investments and ensuring inclusive agricultural development.

B. RATIONALE

The DA RFO XI Research Division has implemented numerous R4D programs and projects (PAPs) targeting priority commodities, including coffee. Among these initiatives, the Arabica coffee-based farming system, integrating coffee with white potato and upland vegetables, is categorized under technology generation. The same PAP also stood as the biggest funded project at P8.6 million. Based on discussions with the RFO XI Research Division personnel, this PAP has emerged as a highly adopted technology among its target beneficiaries, the Gagpang Alegre Potato Small

Farmers Association (GAPSFA), in Barangay Alegre, Bansalan, Davao del Sur. This is reflected in the growth of farmer-member adopters from 65 to 180, and the expansion of cultivated areas from 67 to over 80 hectares over two years (GAPSFA KII & FGDs, 2026). This case provides a unique opportunity to examine the factors that facilitate the translation of research outputs into field-level adoption.

The Diffusion of Innovations (DOI) Theory (Rogers, 2003) emphasizes that the attributes/characteristics of an innovation, including relative advantage, compatibility, complexity, trialability, and observability, shape how potential adopters perceive and adopt new technologies. In addition, adoption outcomes are influenced by contextual factors (as enabling conditions) and diffusion mechanisms.

Applying the DOI theory to agricultural technologies developed by DA RFO XI will facilitate the analysis at the farmer level, where commercialization either ultimately succeeds or fails. Even within the same innovation system, technologies may experience divergent diffusion and utilization patterns depending on how potential adopters perceive the previously mentioned five attributes. Thus, while macro-level institutional factors shape availability and support mechanisms, DOI theory allows this study to examine micro-level adoption dynamics, that is, at the farmers and community level.

This study adopts a positive deviance approach by examining the successful case of Arabica coffee-based farming system technology diffusion. By analyzing how and why a particular technology achieved widespread adoption, the study seeks to identify diffusion factors that can inform the improved dissemination of future R&D outputs.

C. STATEMENT OF THE PROBLEM

This study will answer the main research question: “What factors explain the high diffusion and utilization of the Arabica coffee-based farming system technology developed by DA RFO XI in Bansalan, Davao del Sur?”

SPECIFIC RESEARCH QUESTIONS

1. How do adopters perceive the innovation attributes (relative advantage, compatibility, complexity, trialability, observability) of the Arabica coffee-based farming system?
2. How do adoption context factors (i.e., access to financing, extension services, infrastructure, market demand, and institutional trust) influence the farmers’/adopters' perception in general?
3. What diffusion mechanisms (i.e., farmer networks, demonstration farms, communication channels, partnerships) facilitated the spread of the technology?
4. What is the diffusion pattern (i.e., adoption intensity, continuity, and diffusion to others) among adopters?
5. What theory-informed and practical experience can be derived from this case study that can be used as sources of learning for other related or similar technology diffusion processes?

D. OBJECTIVES OF THE STUDY

General Objective

The general objective of this study is to analyze the factors that contributed to the successful utilization of the Arabica coffee-based farming system developed by DA RFO XI using DOI theory.

Specific Objectives

This study aims specifically to:

- Assess adopters' perceptions of the innovation attributes of the Arabica coffee-based farming system in terms of relative advantage, compatibility, complexity, trialability, and observability.
- Examine how adoption context factors (i.e., financing access, extension support, infrastructure, market conditions, and institutional trust) shape utilization outcomes.
- Identify the diffusion mechanisms (i.e., farmer networks, demonstration farms, communication channels, partnerships) that facilitated the spread of the technology among farmers in Bansalan, Davao del Sur.
- Assess the diffusion pattern (i.e., adoption intensity, continuity, and diffusion to others) among farmer adopters.
- Formulate evidence-based and theory-informed recommendations for improving the diffusion and adoption of a technology under similar scenarios or conditions.

E. SCOPE AND LIMITATIONS

Scope of the Study

This study geographically focuses on Bansalan, Davao del Sur, in the Davao Region, where the Arabica coffee-based farming system developed and implemented by DA RFO XI has been widely adopted.

At the institutional level, the study centers on agricultural technologies developed by the DA RFO XI Research Division, particularly those generated through its R4D PAPs.

At the sectoral level, the research is confined to the coffee subsector, specifically examining the Arabica coffee-based farming system that integrates coffee production with white potato and upland vegetable cultivation. The study adopts a case study approach, focusing on this single technology as a representative example of successful technology diffusion and utilization process.

The conceptual framework of the study is guided by the DOI Theory (Rogers, 2003), with emphasis on the following key dimensions:

- Perceived innovation attributes (i.e., relative advantage, compatibility, complexity, trialability, observability);
- Adoption context factors (i.e., access to financing, extension support, infrastructure, market conditions, institutional trust); and
- Diffusion mechanisms (i.e., farmer networks, demonstration activities, communication channels, partnerships).
- Adoption decision and diffusion pattern (i.e., adoption, non-adoption, adoption intensity, continuity, diffusion to others).

While the Rogers (2003) DOI theory likewise categorized adopters of an innovation into innovators, early adopters, late majority, laggards, and non-adopters, the classification of adopters is no longer covered in this study.

Similar technologies developed by other national government agencies (NGAs), state universities and colleges (SUCs), private firms, or international research institutions are not included in the analysis, unless they are directly involved in the diffusion process of the focal technology.

Limitations of the Study

First, the study focuses on a single agricultural technology, which limits the generalizability of its findings to other commodities, technologies, or places.

Second, the analysis concentrates on one geographic context (Bansalan, Davao del Sur) where the technology has been widely adopted. Adoption dynamics in other municipalities or regions may differ due to variations in socio-economic conditions, institutional support, and market environments.

Third, this study does not conduct a comprehensive institutional assessment of DA RFO XI's research management systems. Instead, the analysis focuses on how specific R&D outputs were diffused and are utilized by intended beneficiaries.

Fourth, the study primarily employs the DOI Theory as its conceptual framework. Other perspectives on innovation adoption —such as the broader innovation systems and institutional theory approaches—have not been adopted in the study.

Finally, the study relies partly on self-reported perceptions of adopters, extension workers, and institutional actors, which may introduce response bias.

However, triangulation through interviews and document review was used to enhance the validity of the findings.

F. DEFINITION OF TERMS

Diffusion of innovation - a process by which an innovation is communicated through certain channels over a period of time among the members of a social system (Rogers, 1987; 2003); the success of an innovation's diffusion is largely explained by five innovation characteristics or attributes – observability, relative advantage, compatibility, trialability, and complexity; diffusion of innovation adopters can be likewise classified into five – innovators, early adopters, early majority, late majority, and laggards (Rogers, 1987; 2003)

High value crops - crops other than traditional crops which include, but are not limited to: coffee and cacao, fruit crops, root crops, vegetable crops, legumes, pole sitao, spices and condiments, and cut flower and ornamental foliage plants (Republic Act No. 7900, 1995).

Innovation - transformation of an invention into a new product, process, or system (Reyes, 2003); an idea, practice, or object that is perceived to be new by an individual or other unit of adoption (Rogers, 1987; 2003).

Intellectual property (IP) - pertains to the creations of the intellect (Intellectual Property Office of the Philippines [IPOPHL], n.d.); mental creations, including inventions, literary and creative works, designs, and commercial symbols, names, and pictures (World Intellectual Property Organization [WIPO], 2020).

Intellectual property rights (IPR) - legal mechanisms (e.g., patents, utility models, industrial design, trademarks, copyright) designed to safeguard and ensure the exclusive rights of scientists, inventors, artists, and other talented individuals to their intellectual property and achievements (IPOPHL, n.d.).

Mature technologies - refer to technologies that are verified and tested, ready for adoption/commercialization, and are technically and financially viable; technologies that have already reached the upscaling stage (Department of Agriculture Memorandum Circular [DA MC] No. 28, 2023).

Research and development (R&D) – creative work undertaken on a systematic basis to increase the stock of knowledge, including knowledge of man, culture, and society, and to use this stock of knowledge to devise new applications (Republic Act No. 10055, 2010).

Research and development (R&D) management - the systematic coordination of scientific and creative activities to generate knowledge and ensure its effective translation, dissemination, and utilization into products, processes, and services that deliver socio-economic benefits (Philippine Statistics Authority [PSA], 2020; Department of Science and Technology [DOST], n.d.).

Research for development (R4D) – policy and governance approach that translates research outputs into tangible contributions to food security, sustainability, and rural development (DA–BAR, n.d.-a).

Technology - refers to any invention or innovation that is either tangible or intangible (Reyes, 2003); design, improvement, and construction of new types of products, equipment, and machinery (DA MC No. 28, 2023).

Technology commercialization - the utilization, adoption, and promotion/marketing of mature technologies that were generated/developed and tested/verified by R4D institutions (government or private) with the potential to generate income through sustainable enterprise development (DA MC No. 28, 2023).

Technology/Product development process - the introduction of a new or significantly improved good or service, driven by the need for better customer satisfaction and economic growth; involves a structured, often agile approach, encompassing idea generation, validation, and commercialization to address market demands and enhance functionality (Republic Act No. 11293, 2019).

Technology transfer - refers to the process by which one party systematically transfers to another party the knowledge for the manufacture of a product, the application of a process, or the rendering of a service, which may involve the transfer, assignment, or licensing of IPRs (Republic Act No. 10055, 2010).

Upland vegetables – in this case study, it refers to any of the following: white potato, carrot, bunching onion, cabbage, bell pepper, tomato, among others.

Value chain - encompasses the complete set of activities necessary to move a product or service from its initial conception through the various stages of production and processing, including physical transformation and the integration of supporting services, up to its delivery to end users and eventual disposal after use (Kaplinsky & Morris, 2001).

II. R&D MANAGEMENT FRAMING

A. SIGNIFICANCE OF THE STUDY IN THE WORKPLACE

This study is strategically significant to the DA RFO XI because it examined the diffusion perspective of R&D management, focusing on the "why" and "how" of the adoption process of a specific technology.

Guided by the DOI Theory (Rogers, 2003), the study shifts the evaluative focus from mere technology generation to utilization performance—examining why certain innovations achieve widespread adoption while others, despite comparable institutional support, do not. From an R&D management perspective, the study provides:

- Evidence-based analysis of perceived innovation attributes (relative advantage, compatibility, complexity, trialability, and observability) and their influence on adoption outcomes.
- Identification of contextual and diffusion-related bottlenecks, including access to financing, extension strategies, infrastructure, market linkages, and institutional trust, within technology transfer pathways.
- Insights into the role of extension systems, communication strategies, and partnership models in shaping utilization levels and the sustainability of adoption.

Rather than evaluating R&D solely through the number of technologies produced, the study reframes performance assessment toward technology diffusion and adoption, thereby strengthening results-based R&D management.

At a broader level, the study aligns with national and regional development frameworks, including Pagtanaw 2050, the Philippine Development Plan (PDP) 2023–2028, and the Davao Regional Development Research Agenda (DRDRA) 2023–2028, all of which emphasize innovation-driven, inclusive, and productivity-enhancing growth (National Economic and Development Authority [NEDA][2], 2023; DRDRA, 2023). By generating actionable insights into how mature technologies move from R&D outputs to sustained field adoption, the study contributes to strengthening the science, technology, and innovation (STI) ecosystem at the regional level.

Ultimately, this research will enable DA RFO XI to refine its R&D management approach, moving beyond technology generation toward strategically managing diffusion and impact, ensuring that innovations produce tangible benefits for farmers, communities, and the regional economy.

B. BENEFICIARIES OF THE STUDY

The primary beneficiaries of this study are the smallholder farmers, cooperatives, and agribusiness actors engaged in coffee production and other priority commodities in the Davao Region.

Secondary beneficiaries include:

- DA RFO XI researchers and extension personnel, who can refine technology design, demonstration strategies, and communication approaches based on adoption dynamics identified in the study.
- Local Government Units (LGUs), which may integrate findings into agricultural development programs, extension planning, and investment prioritization.

[2] Now the Department of Economy, Planning and Development (DEPDev)

At the national level, agencies such as DA, DA-BAR, Department of Science and Technology (DOST), Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development (PCAARRD), and DEPDev benefit from empirical evidence linking basic R&D management functions to diffusion performance, contributing to policy discussions on commercialization pathways, scaling mechanisms, and institutional coordination within the Philippine agricultural innovation system (AIS).

Academic institutions likewise benefit through an empirically grounded application of DOI Theory within a subnational agricultural R&D context, providing a model for integrating adoption theory into technology management studies.

C. CLIENT RELATIONSHIP

The client relationship in this study is anchored in DA RFO XI's dual role as both a producer and a steward of agricultural technologies for the Davao Region.

DA RFO XI provides: institutional context and operational data; access to mature technology information under analysis; and insights into internal R&D and extension processes.

In turn, the study delivers evidence-based and theory-informed recommendations for strengthening technology diffusion and adoption pathways and managerial insights into improving alignment among technology design, extension delivery, and farmer adoption behavior.

This partnership is mutually reinforcing. DA RFO XI gains evidence-based guidance to enhance its R&D management practices—particularly in improving technology transfer effectiveness and scaling performance. Simultaneously, the research contributes to the broader Philippine R&D and science and technology (S&T)

systems by demonstrating how adoption theory can inform results-oriented innovation governance.

By situating technology adoption and utilization within a structured diffusion framework, the study supports DA RFO XI's transition from output-focused R&D management toward impact-oriented innovation stewardship—ensuring that mature technologies generate tangible benefits for farmers, communities, and the regional economy.

III. CONTEXTUALIZATION OF THE R&D ORGANIZATION ENVIRONMENT

A. NATIONAL POLICIES ON TECHNOLOGY COMMERCIALIZATION IN THE DEPARTMENT OF AGRICULTURE

Technology commercialization in the Philippines is guided by a set of national policies that emphasize the role of STI in driving development (Table 3.1).

Table 3.1

Comparative Matrix of General STI Frameworks and Agriculture-Specific Frameworks

Dimension	General STI Frameworks (R.A. No. 10055, R.A. No. 11293, PDP)	Agriculture-Specific Frameworks (AFMA, DA–BAR, PRDP)
IP Ownership	Government-funded R&D IP managed by institutions via Intellectual Property Management Office (IPMOs); benefit-sharing with inventors (R.A. No. 10055)	Agricultural R&D outputs promoted and protected by DA–BAR; focus on farmer and agribusiness adoption
Funding Mechanisms	National Innovation Fund under RA 11293; STI programs under PDP	AFMA allocates modernization funds; Special projects (e.g., PRDP) provide grants and loans for rural enterprises
Commercialization Pathways	Licensing, spin-offs, public-private partnerships; the National Innovation Council (NIC) promotes innovation-driven entrepreneurship	Technology packaging, fairs, enterprise incubation, agribusiness support
Institutional Support	DOST, IPOPHL, NIC, NEDA	DA–BAR, DA RFOs, Special project (e.g., PRDP) implementing units
Development Focus	National productivity, competitiveness, and innovation ecosystems	Rural development, food security, farmer empowerment

National STI Frameworks

At the core of the Philippine STI ecosystem remains the Philippine Technology Transfer Act of 2009, which provides the legal foundation for the ownership, management, and commercialization of IP arising from government-funded R&D. The law institutionalizes mechanisms such as Intellectual Property Management Offices (IPMOs) in higher education institutions and research organizations, and promotes benefit-sharing, licensing, and spin-off creation (Republic Act No. 10055, 2010). Its implementing rules and regulations, through Joint DOST–IPO Administrative Order No. 02-2010, further operationalize these provisions by outlining procedures for IP valuation, protection, and commercialization pathways (DOST & IPO, 2010).

In recent years, implementation has been reinforced through programmatic and institutional innovations led by the DOST, particularly through the Technology Application and Promotion Institute (TAPI). As the lead agency for technology commercialization, DOST–TAPI has strengthened the national technology transfer framework through initiatives such as the Technology Transfer Day, which facilitates direct engagement between technology generators and adopters, and standardized processes for licensing agreements and commercialization (DOST-TAPI, n.d.-a). Complementary programs such as the Technology Innovation for Commercialization (TECHNiCOM) provide pre-commercialization funding and support to accelerate the market readiness of R&D outputs, aligning with national priorities under the Harmonized National R&D Agenda (DOST-TAPI, n.d.-b). These initiatives demonstrate a shift from policy formulation toward active market linkage, financing, and scaling support.

The Philippine Innovation Act (Republic Act No. 11293, 2019) further strengthens the ecosystem by institutionalizing the National Innovation Council (NIC) and promoting a whole-of-government approach to innovation governance. It emphasizes innovation-driven entrepreneurship, strengthens linkages among academia, industry, and government, and supports the commercialization of R&D outputs. This is reinforced by the PDP 2023–2028, which positions STI as a key driver of productivity and competitiveness, encouraging public-private partnerships and the scaling of innovation for inclusive growth (NEDA, 2023).

Taken together, these frameworks illustrate an evolving STI system in the Philippines—from a primarily regulatory and IP-focused approach toward a more integrated innovation ecosystem that actively supports technology transfer, financing, and market adoption.

Agriculture-Specific Frameworks

In the agriculture sector, STI and technology commercialization are embedded within broader rural development and modernization policies. The Agriculture and Fisheries Modernization Act (AFMA) (Republic Act No. 8435, 1997) promotes the adoption, dissemination, and commercialization of agricultural technologies as part of its strategy to enhance productivity and global competitiveness.

More recently, this policy direction is reinforced through the Climate-Resilient Agriculture and Fisheries through Transformative Research for Development (CRAFT R4D) Medium-Term Plan 2024–2028, which serves as a strategic framework for aligning research, innovation, and extension systems toward climate resilience and market-oriented development (DA-BAR, n.d.-b). The CRAFT R4D agenda emphasizes not only knowledge generation but also the translation, scaling, and utilization of technologies, ensuring that R&D investments lead to tangible outcomes for farmers and fishers.

Operationally, the DA–BAR plays a central role in bridging R&D and utilization. Its Technology Commercialization Program focuses on packaging, promoting, and protecting intellectual property derived from publicly funded agricultural research, ensuring that these technologies reach farmers, cooperatives, and agribusiness enterprises (DA-BAR, n.d.-c). These efforts align with national STI frameworks but are tailored to the specific needs of the agriculture sector, including extension, capacity-building, and location-specific adaptation.

In addition, flagship programs such as the DA-PRDP support the commercialization and scaling of agricultural technologies through investments in rural infrastructure, enterprise development, and value chain upgrading (DA, 2020). These interventions facilitate not only technology adoption but also the creation of viable agribusiness ecosystems that can sustain innovation uptake.

Overall, the Philippine policy landscape reflects a dual-track approach: national STI frameworks establish the enabling environment for intellectual property management and technology transfer, while agriculture-specific programs—now further strengthened by the CRAFT R4D agenda—operationalize these principles on the ground, ensuring that innovation contributes directly to rural development, food security, and inclusive growth.

B. THE DA AND DA-RFO XI

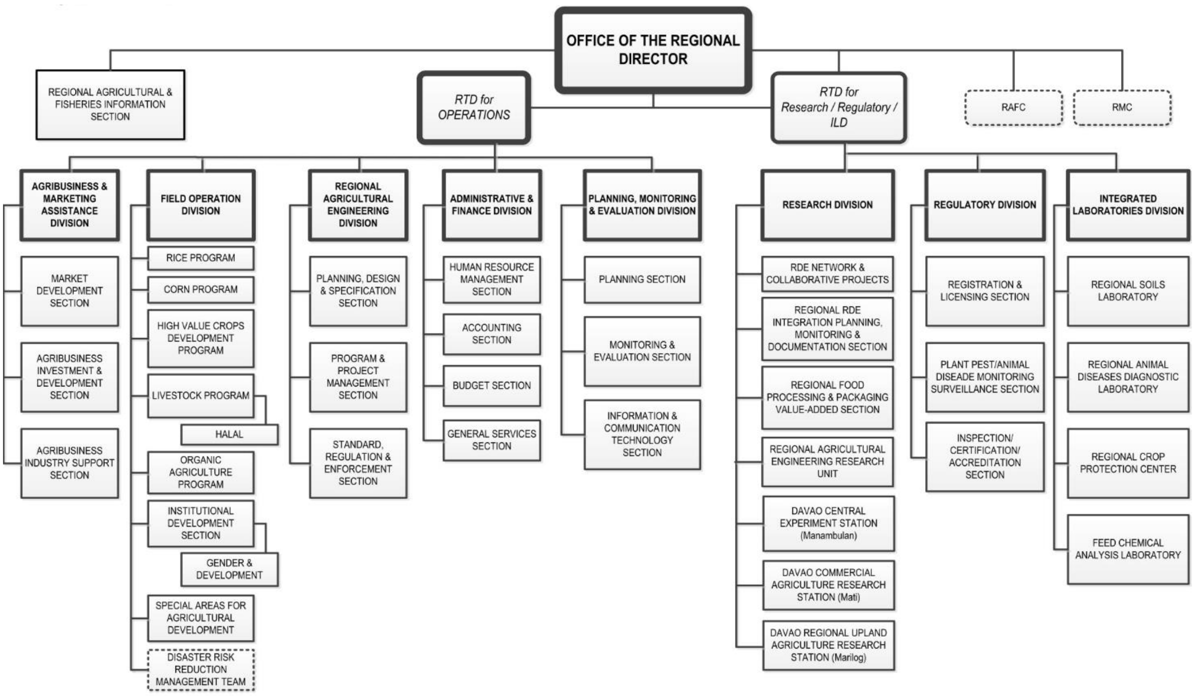
In the Philippines, the DA is the mandated government agency to promote agricultural development by providing the policy framework, public investments, and support services required for local and export-oriented economic businesses (DA, 2026). It envisions a diversified, dynamic, technologically sophisticated, and globally competitive rural economy through modernized agriculture and fisheries.

In terms of promoting agricultural innovations, the DA and its attached agencies play a central role. Programs funded and/or implemented by the BAR (DA, 2022; DA-BAR, n.d.-d) and RFOs aim to strengthen technology transfer through demonstration farms, farmer training programs, and partnerships with local government units.

At the regional level, the DA RFOs are mandated to operationalize national agricultural and fisheries policies, programs, and investments within their respective regions. All RFOs are responsible for translating national strategies into regionally responsive plans; providing technical, extension, and advisory support to farmers, fisherfolk, and agribusiness stakeholders; coordinating with local government units on devolved agricultural functions; monitoring and evaluating program performance; consolidating regional data for national planning; and supporting regulatory, disaster response, and climate-resilience initiatives as delegated by the DA Central Office, thereby ensuring coherence between national development objectives and local agricultural outcomes.

Organization-wise, the DA RFO XI is composed of eight Divisions and is headed by a Regional Executive Director and two Regional Technical Directors (Figure 3.1). The Research Division is mandated to ensure that all agricultural R4D initiatives are coordinated and undertaken for maximum utility to agriculture.

Figure 3.1. DA RFO XI organizational chart.



Source: DA-RFO XI, n.d.

In terms of its technology generation to commercialization and adoption process, the DA RFO XI follows the usual stages (Figure 3.2) as confirmed by its personnel. Nonetheless, depending on the nature of the technology, some PAPs require undergoing all stages, while others do not need IP protection.

Figure 3.2. Technology generation to the adoption process.

Source of information: DA RFO XI Research Division Resource Persons, 2026

The DA, including the DA-BAR, does not yet maintain its own independent technology readiness level (TRL) standards. Among the RFOs nationwide, only DA RFO II is known to have crafted its own TRL standards. Nonetheless, the DA works with DOST agencies, such as PCAARRD, to assess the readiness and commercialization potential of agricultural technologies. The DOST has formal TRL guidelines that it adapted from the National Aeronautics and Space Administration (NASA).

Over the past 15 years (2011–2016), the Research Division of DA RFO XI implemented 106 R4D PAPs (Table 3.2). Of these, 75 projects (71%) have been completed, 13 (12%) are ongoing, 13 (12%) have no available status data, and 5 (5%) have been terminated. In terms of classification, the majority of PAPs consist of applied research projects (65 or 61%), followed by extension and other related initiatives (21 or 20%). Additionally, 16 projects (15%) remain unclassified, while 4 projects (4%) focus on technology and information generation[3]. These R4D initiatives have been supported through both locally sourced and nationally allocated funding mechanisms.

Table 3.2

Summary of DA RFO XI R4D PAPs, 2011-2026

Status / Type of PAP	No. of R4D PAPs	Percent Share
By Status		
Completed	75	71%
On-going	13	12%
No data	5	5%
Total	106	12%
By Type		
Applied	63	59%

[3] The technology and information generation PAPs include: Outscaling of Arabica Coffee-Based Farming System in Brgy. Alegre, Bansalan, Davao del Sur; Commercialization of Apali Flour-Based Products in Region XI; Collection and Characterization of Philippine Native Corn Varieties in Region XI (CGUARD); and, Considering Farmers' Preferences in the Adaptation and Dissemination of White Corn as Staple Food in Region XI.

Status / Type of PAP	No. of R4D PAPs	Percent Share
Technology/Information Generation	4	4%
Applied/Participatory	2	2%
Extension	2	2%
Others	19	18%
No data	16	15%
Total	106	100%

Source of basic data: DA-RFO XI (2026)

C. REVIEW OF LITERATURE

Theoretical Foundations of Agricultural Technology Commercialization and Adoption

Agricultural technology commercialization and adoption can be understood through several theories and models.

Innovation systems theory

The innovation systems theory views innovation not as a linear pipeline but as the outcome of interactions among multiple actors embedded within institutional structures (Freeman, 1987; Lundvall, 1992; Hall et al., 2001). Rather than treating commercialization as a post-research activity, this perspective conceptualizes it as an ecosystem process involving research institutions, extension systems, private firms, financial actors, policymakers, and end-users.

The World Bank (2006) emphasizes that strengthening agricultural innovation requires moving beyond linear research-extension models toward integrated systems linking research, markets, and policy. Similarly, the Food and Agriculture Organization (FAO, 2019) discusses that innovation systems must be inclusive to ensure smallholder farmers benefit from commercialization pathways. The Asian and Pacific Centre for Transfer of Technology (APCTT, 2024) further highlights the role of crossborder networks and specialized linkages in accelerating the scaling of mature technologies.

From this perspective, commercialization gaps signal systemic coordination failures rather than purely technological shortcomings. In the Philippine context, Briones (2021) observes that although research and development institutions (RDIs) have generated mature technologies, weak R&D management and limited adoption mechanisms constrain impact. This suggests institutional and relational weaknesses within the AIS.

Linear and interactive models of innovation

The traditional R&D systems often follow a linear innovation model, progressing from research to development, extension, and finally adoption (Montes de Oca Munguia, Pannell, & Llewellyn, 2021; Röling, 1992). In the Philippines, agricultural R&D and extension have historically been organized around this linear model, with government agencies emphasizing sequential transfer from research to farmer adoption (Catibog, 2016; DA–BAR, 2017).

Contemporary innovation theory recognizes the iterative and interactive nature of technological development (Kline & Rosenberg, 1986). The Product Innovation Process (PIP) model of Gobeli and Brown (1993) outlines four stages—discovery, decision, development, and delivery—while acknowledging feedback loops across stages. Although structured, the model recognizes real-world innovation as non-linear and adaptive. Commercialization bottlenecks in agricultural R&D frequently occur between development and delivery, where market validation, financing, packaging, and institutional support become critical (Gutiérrez Cano et al., 2023; Organisation for Economic Co-operation and Development [OECD], 2019).

Thus, Philippine commercialization challenges may reflect weaknesses in feedback mechanisms and delivery systems rather than deficiencies in knowledge creation.

Institutional theory: the triple helix model of innovation

The Triple Helix Model of Innovation, developed by Henry Etzkowitz and Loet Leydesdorff in the 1990s, conceptualizes innovation as the outcome of collaborative relationships among universities (knowledge producers), industry (commercializers of technology), and government (policy and regulatory actors) (Etzkowitz & Leydesdorff, 1995; 2000). The model argues that the innovation process in a knowledge-based economy is driven by the interdependent and overlapping roles of these three institutional spheres, which collectively facilitate knowledge creation, technology transfer, and economic development.

Using the institutional theory, agricultural technology commercialization is embedded within governance systems, incentive structures, and policy coordination mechanisms (North, 1990; Scott, 2014). Fragmented mandates, weak industry-academe linkages, and limited entrepreneurial ecosystems increase transaction costs and reduce incentives for commercialization.

The NEDA (2023) emphasized integrated innovation ecosystems that move R&D outputs beyond knowledge creation toward measurable economic impact. Similarly, DOST initiatives seek to strengthen pre-commercialization support and measure outcomes in terms of jobs and productivity gains (DOST, cited in Ogerio, 2025). These reforms signal institutional recognition that commercialization is not automatic but requires coordinated governance and bridging institutions.

Diffusion of innovations (DOI) theory

As previously stated in Chapter I, the DOI Theory (Rogers, 2003) suggests that technology adoption depends on perceived relative advantage, compatibility with existing values, low complexity, trialability, and observability. Other than the innovation attributes, mediating factors such as adoption context and diffusion mechanisms likewise influence the adopters' decision. This is expounded further under the Theoretical Section of this paper.

Rogers (2003) further identifies adopter categories into innovators, early adopters, early majority, late majority, laggards, and non-adopters, emphasizing that diffusion is a socially embedded process influenced by communication channels, social norms, and institutional trust.

Applying to empirical findings in the Philippines, Briones et al. (2023) and Galang (2024) found that digital technologies are adopted when farmers perceive clear economic benefits and compatibility with existing practices. Conversely, complexity and limited trialability hinder uptake. The same theory also helps explain why some agricultural technologies (e.g., drought-resistant rice varieties, aquaculture innovations) are adopted quickly by innovators and early adopters but face resistance among smallholder farmers due to cost, training needs, or cultural factors (Mapiye, 2021). Moreover, Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA, 2019) and Briones et al. (2023) indicated that unequal information and communications technology (ICT) access and low digital literacy may exacerbate disparities if inclusive capacity-building is absent. Thus, digital commercialization must be embedded within broader extension and institutional support systems.

Agricultural Technology Commercialization in the Philippines

Institutional shifts toward market-oriented R4D

Within the DA, commercialization is increasingly embedded within R4D mandates. The DA-BAR demonstrates a strategic shift from research-output orientation toward market-driven innovation systems emphasizing enterprise development, scalability, and value chain integration.

Programs such as Sustainable Community-Based Action R4DE for Livelihood Enhancement, Upliftment and Prosperity (SCALE UP) and the Agri-Fisheries Technology Business Incubation (TBI) initiative aim to strengthen government–academe–industry collaboration, consistent with the Triple Helix model of innovation (Etzkowitz & Leydesdorff, 2000). Funding structures now incorporate packaging, adoption mechanisms, and market connectivity rather than focusing solely on technology generation.

The introduction of TechnoMerkado by DA RFO V (2024) represents a shift toward value chain integration, providing farmer-cooperators and research partners with market exposure for value-added products. This initiative signals institutional adaptation toward interactive innovation models.

The Philippine technology commercialization gap

Commercialization data at the national level demonstrate persistent performance gaps. Only an estimated 10–20% of government-funded R&D projects in the Philippines transition into marketable innovations (Buendia, 2025). Data from the DOST-TAPI show that in 2022, only 24 (~27%) out of 89 DOST-funded institutions successfully commercialized innovations (DOST, cited in Ogerio, 2025). Of 484 technologies developed that year, only 146 (~30%) were commercialized.

Studies examining the commercialization and utilization of agricultural technologies in the Philippines, however, remain limited. While the DA has implemented initiatives such as the National Technology Commercialization Program (NTCP), assessments of these initiatives have largely focused on program implementation rather than quantifying the overall commercialization rate of government-generated technologies. For example, a review conducted by SEARCA reported that at least 70 technologies had been commercialized under the NTCP as of 2010, covering commodities such as garlic, sweet sorghum, cassava biofuel, and pineapple (SEARCA, 2010). However, the study did not examine the proportion of technologies developed through the DA research system that eventually reached market adoption. Other studies, such as that of Romallosa et al. (2022), focused primarily on technical performance rather than commercialization outcomes or adoption levels.

Barriers to Commercialization

The literature consistently identifies institutional and adoption barriers to commercialization, underscoring that innovation failure is often systemic rather than technological in nature. These barriers collectively constrain the effective translation of research outputs into scalable, market-ready, and widely adopted innovations.

Institutional constraints

DA-BAR (2020) identifies fragmented mandates, insufficient R&D funding, and limited extension services as constraints. Catibog (2016) notes weak patenting and licensing capacity, limited commercialization infrastructure, and weak academic–industry linkages.

Comparative studies show that the Philippines lags behind its neighbors in R&D investment intensity (David & Inocencio, 2001). From an innovation systems perspective, these represent "missing institutions" necessary for scaling. Without venture capital, incubation, and bridging institutions, mature technologies remain within research centers.

Adoption constraints

Commercialization ultimately depends on sustained adoption. Studies in Davao Oriental (Sarita, 2025; Sarita & Inutan, 2025) reveal mismatches between innovation supply and farmer readiness, particularly in digital literacy and infrastructure.

Mechanization studies (Taldhay, 2024) identify high capital requirements, limited credit access, and insufficient technical support as constraints to scaling. Taer and Taer (2024) identify socio-cultural barriers such as farmer risk aversion and limited trust in institutions. According to Rogers (2003), such factors significantly influence diffusion rates.

Thus, commercialization must be assessed not merely by product launch but by long-term utilization within farming systems. It is contingent upon farmer capacity, extension effectiveness, and complementary services such as finance and maintenance.

Enablers and Comparative Innovation Ecosystems

Despite barriers, the literature identifies enabling conditions that strengthen commercialization outcomes. Strong cooperative models, market demand for high-value commodities, and institutional support programs enhance adoption (International Rice Research Institute [IRRI], 2024). Barroga et al. (2019) find that organizational readiness, financing access, and institutional backing significantly influence innovation uptake among micro, small, and medium enterprises (MSMEs) in Davao.

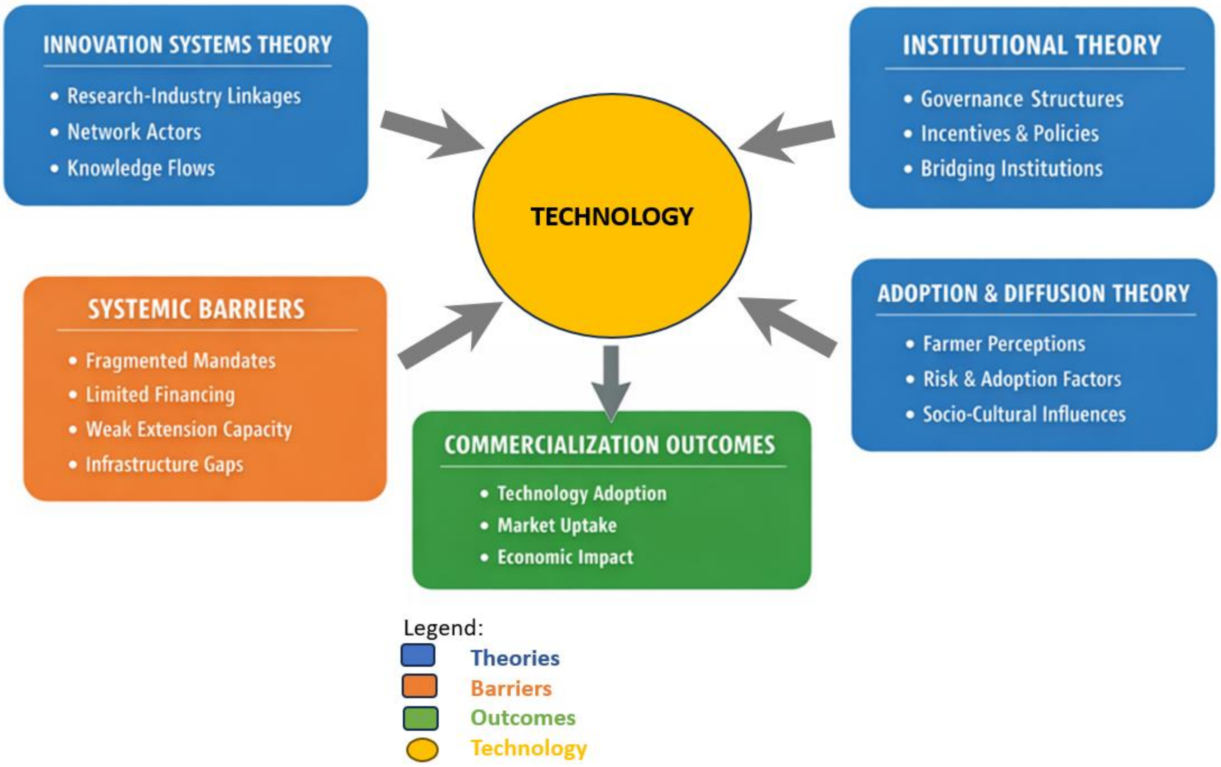
International experiences documented by the Australian Centre for International Agricultural Research (ACIAR, 2020) show that coordinated farmer cooperatives and public-private partnerships (PPPs) accelerate commercialization in Indonesia and Vietnam. Hall et al. (2001) argue that innovation systems thrive when institutional arrangements support knowledge flows and stakeholder collaboration.

These findings reinforce the view under the innovation system theory that commercialization is a collective, ecosystem-based process requiring coordinated governance, financing mechanisms, and strong network ties.

Synthesis and Research Gap

The preceding review demonstrates that systemic, institutional, and adoption-level factors shape the commercialization of agricultural technology in the Philippines (Figure 3.3). Innovation Systems Theory explains the importance of actor linkages and institutional coordination, while Institutional Theory highlights governance structures and incentive mechanisms that influence commercialization performance. However, while these macro-level perspectives clarify structural constraints, they do not sufficiently explain why certain technologies are widely utilized while others remain underutilized within the same institutional context. To address this analytical gap, this case study adopts DOI Theory (Rogers, 2003) as the primary theoretical lens.

Figure 3.3. Agricultural technology commercialization frameworks at a glance.



There are several studies that examined agricultural technology adoption using the DOI Theory. Much of the existing literature, however, primarily focuses on barriers to adoption, such as financial constraints, lack of technical knowledge, limited access to extension services, and socio-cultural resistance among farmers (Feder et al., 1985; Knowler & Bradshaw, 2007; Meijer et al., 2015). While these studies provide valuable insights into why technologies fail to diffuse, relatively fewer studies investigate cases where agricultural innovations are successfully adopted and sustained at scale, particularly within localized institutional contexts.

In the Philippine context, research on agricultural innovation has largely focused on national-level agricultural innovation systems and policy frameworks, particularly those implemented by the DA and its attached agencies (DA-BAR, 2020; Lantican, Sulaiman, & Hall, 2015). While these studies provide valuable insights into institutional arrangements and innovation policies, relatively few empirical studies examine how technologies developed by regional research institutions are disseminated and utilized within specific farming communities.

Furthermore, limited research integrates DOI Theory with an R&D management perspective to explain how innovation attributes, institutional support mechanisms, and local contextual factors interact to facilitate successful adoption. To address this gap, this study will examine the diffusion perspective of the adoption of the Arabica coffee-based farming system developed by DA-RFO XI and implemented in Bansalan, Davao del Sur. By analyzing this case through the lens of DOI Theory, the study aims to validate the diffusion of innovation factors that contributed to the successful utilization of the innovation.

Linking the Literature to the Present Study

The literature reviewed earlier identifies recurring barriers in Philippine agricultural commercialization, such as financing constraints, weak extension capacity, infrastructure gaps, institutional fragmentation, and limited farmer readiness and digital literacy. Under the DOI theory, these barriers may be analytically reframed as factors that influence the perceived attributes of technologies. For example, high capital requirements reduce perceived relative advantage; cultural resistance reduces compatibility; technical complexity increases perceived complexity; weak extension systems reduce trialability; and limited demonstration farms reduce observability.

Similarly, enabling factors such as strong cooperatives, PPPs, digital platforms, and institutional support mechanisms may enhance these perceived attributes and accelerate diffusion.

This reframing allows the case study to move from a descriptive listing of barriers to a structured, theory-guided explanation of why certain technologies become widely utilized.

D. THEORETICAL FRAMEWORK

Narrowing down to a single theory from those presented in Figure 3.3 in the preceding subsection, this study uses Rogers's (2003) diffusion of innovation theory to explain how a commercialized technology diffuses and is adopted, including its specific application in the agricultural sector.

Innovation Attributes

As indicated in the definition of terms, the diffusion of innovation refers to the process through which new ideas or technologies spread over time within a social system, communicated via specific channels (Rogers, 2003). Accordingly, adoption is influenced by five perceived attributes of an innovation: relative advantage, compatibility, complexity, trialability, and observability. These attributes account for 49%-87% of the adoption variation seen across all categories of adopters (Rogers, 2003).

1. Relative Advantage – refers to the degree to which an innovation is perceived as better than the practice it replaces; the perceived economic, productivity, or efficiency gains compared to existing practices.

2. Compatibility – refers to the degree to which an innovation aligns with the values, experiences, and needs of potential adopters; alignment with farmers' current production systems, cultural norms, and market structures.

3. Complexity – refers to the degree to which an innovation is perceived as difficult to understand or implement; the perceived level of difficulty in understanding and implementing agricultural technology.

4. Trialability – refers to the extent to which an innovation can be experimented with on a limited basis.

5. Observability – refers to the visibility of the results of an innovation; the visibility of tangible results within farmer networks.

Adoption Context

In addition to innovation attributes, adoption decisions are influenced by broader contextual factors. These include access to financing, infrastructure, market demand, and institutional trust.

These contextual factors do not directly determine adoption but shape perceptions of innovation attributes. For example, limited access to credit may reduce perceived relative advantage; weak technical services may increase perceived complexity; and poor infrastructure may reduce observability and trialability.

Thus, the adoption context functions as a mediating layer between institutional support structures and adopter-level decision-making.

Diffusion Mechanisms

According to the DOI theory (Rogers, 2003), diffusion is a social process. The strength and density of communication channels and networks influence how quickly and widely technologies spread. Even highly advantageous technologies may remain underutilized if diffusion mechanisms are weak or fragmented.

Rogers (2003) identified two primary communication channels: mass media and interpersonal interaction. Mass media channels are particularly effective in spreading awareness and building knowledge about an innovation. In contrast, interpersonal communication—direct exchanges between individuals—plays a crucial role in shaping attitudes toward innovation. These personal interactions strongly influence whether people ultimately adopt or reject the innovation, making peer evaluation a powerful determinant in the diffusion process.

Adoption Decision and Diffusion Pattern

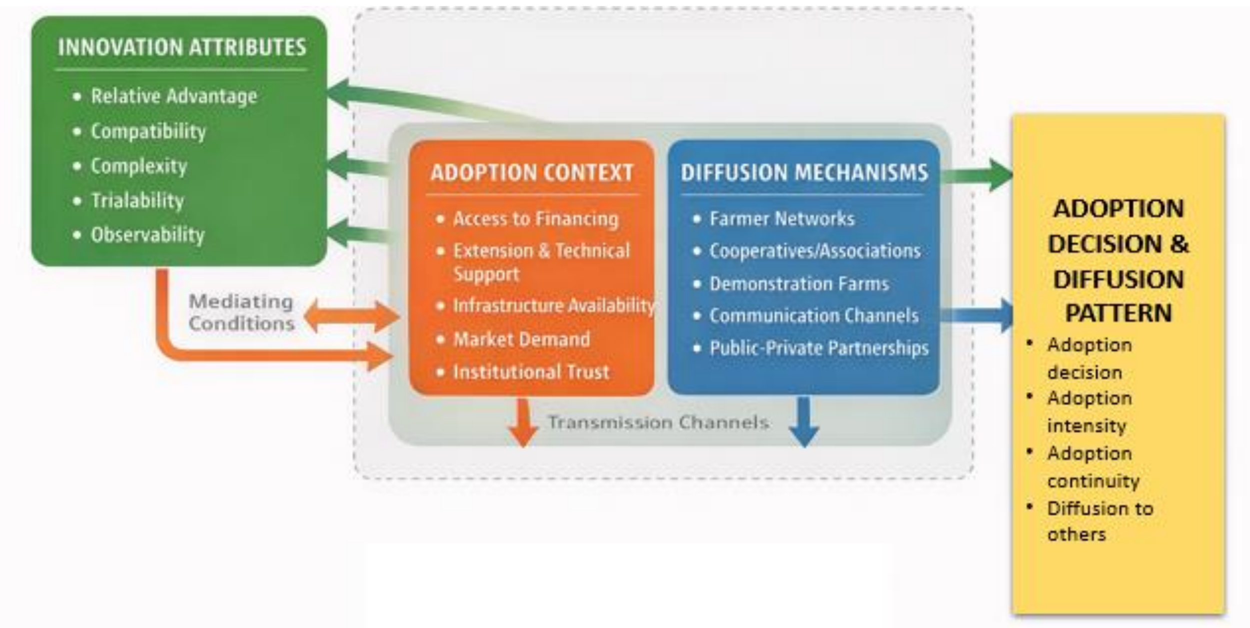
Among technology adopters, the diffusion pattern can be described by the following DOI adoption stages (Rogers, 2003): adoption decision; adoption intensity; adoption continuity (also known as confirmation); and diffusion to others. Farmer adopters move through the stages of innovation-decision and contribute to the spread of technology within their social system. As Rogers (2003) pointed out, adoption is not a one-time event but a process that includes decision, implementation, continuity, and eventual diffusion to others.

The adoption decision and adoption intensity reflect the level of commitment of adopters and their transition from knowledge acquisition to actual utilization of the innovation. The continuity stage captures the sustainability of adoption and post-adoption behavior. Diffusion to others reflects the role of adopters as change agents within their social system. Overall, this reflects farmer behavior within the broader innovation-decision process and highlights how individual adoption outcomes contribute to the wider diffusion of agricultural technologies.

E. CONCEPTUAL FRAMEWORK

Taking off from the general DOI theory and concepts in the previous Section, Figure 3.4 depicts the conceptual framework guiding this study as it is now applied to an agricultural technology. As shown, the adoption decision of a technology and diffusion pattern by a potential farmer adopter is primarily influenced by three major components: (1) innovation attributes, (2) adoption context, and (3) diffusion mechanisms.

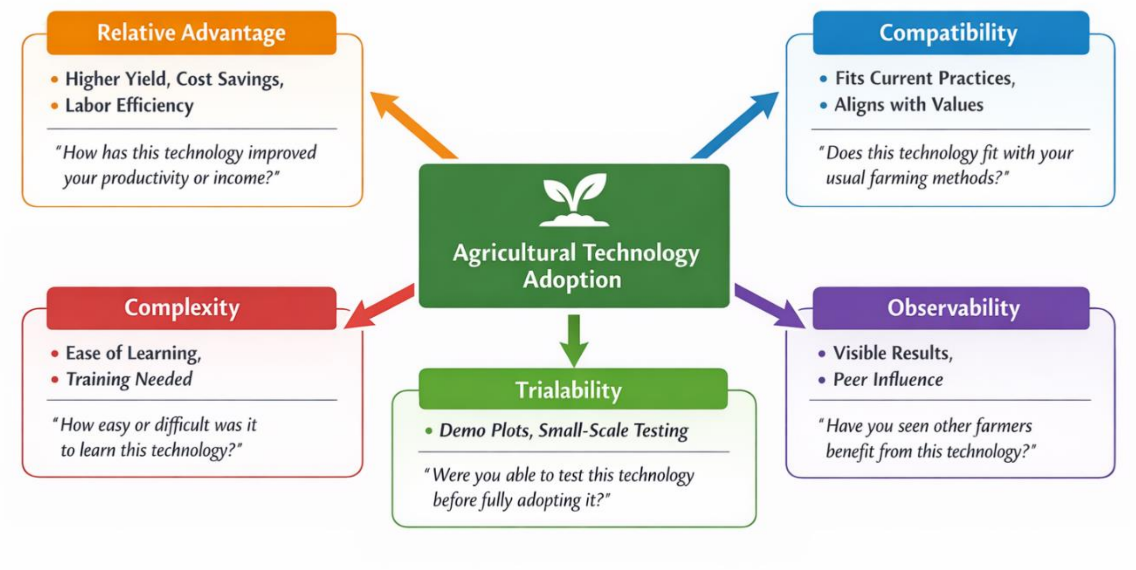
Figure 3.4. Conceptual framework.



Innovation Attributes

These attributes directly influence adoption decisions (Figure 3.5). Technologies perceived as advantageous, compatible, simple, testable, and visible are expected to demonstrate higher levels of utilization and adoption. Conversely, technologies perceived as costly, misaligned, complex, risky, or difficult to demonstrate are likely to experience limited uptake.

Figure 3.5. Innovation attributes in agricultural technology adoption.

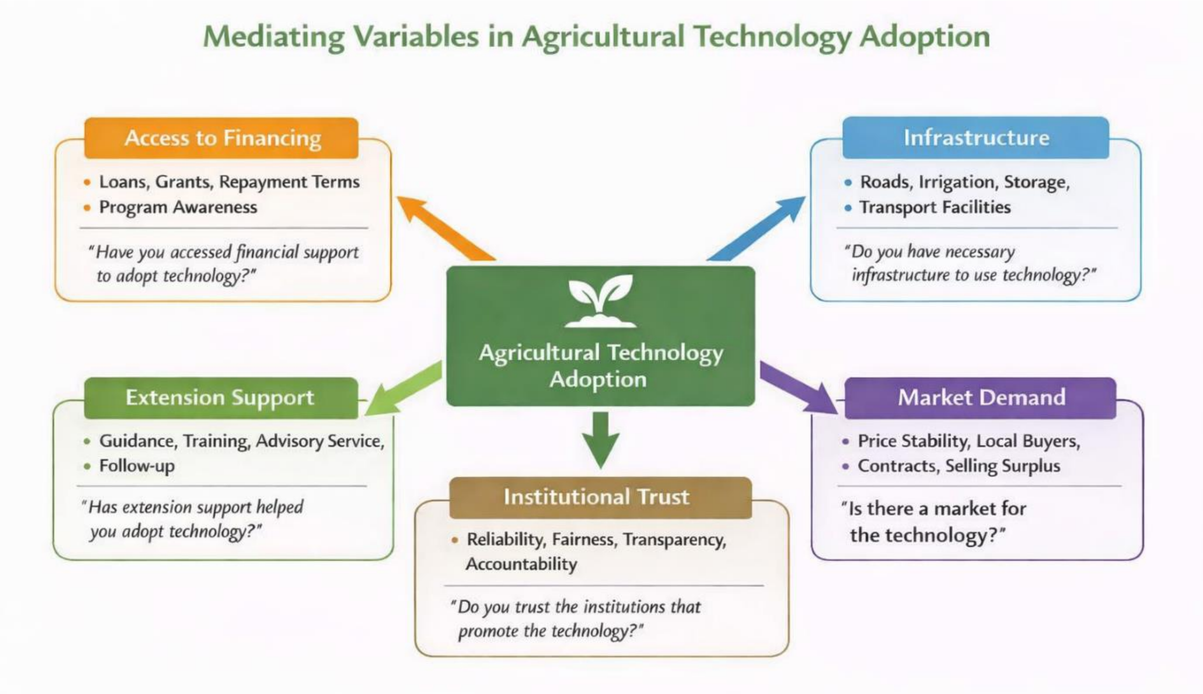


Agricultural technologies that improve productivity, income, or farm efficiency tend to exhibit higher relative advantage. Technologies that fit well with existing farming systems are more likely to be adopted. Technologies that are easier to use generally experience faster adoption. Opportunities to test technologies reduce uncertainty among potential adopters. Finally, when farmers can easily observe the benefits of a technology, adoption tends to increase.

Adoption Context

Mediating between the innovation attributes and the adoption decision is the Adoption Context, which conditions how the attributes are perceived and evaluated (Figure 3.6). This includes access to financing and credit; extension services and technical support; infrastructure availability (e.g., transport, irrigation, digital connectivity); market demand and price stability; and institutional trust in the DA and partner agencies.

Figure 3.6. Adoption context in agricultural technology uptake.

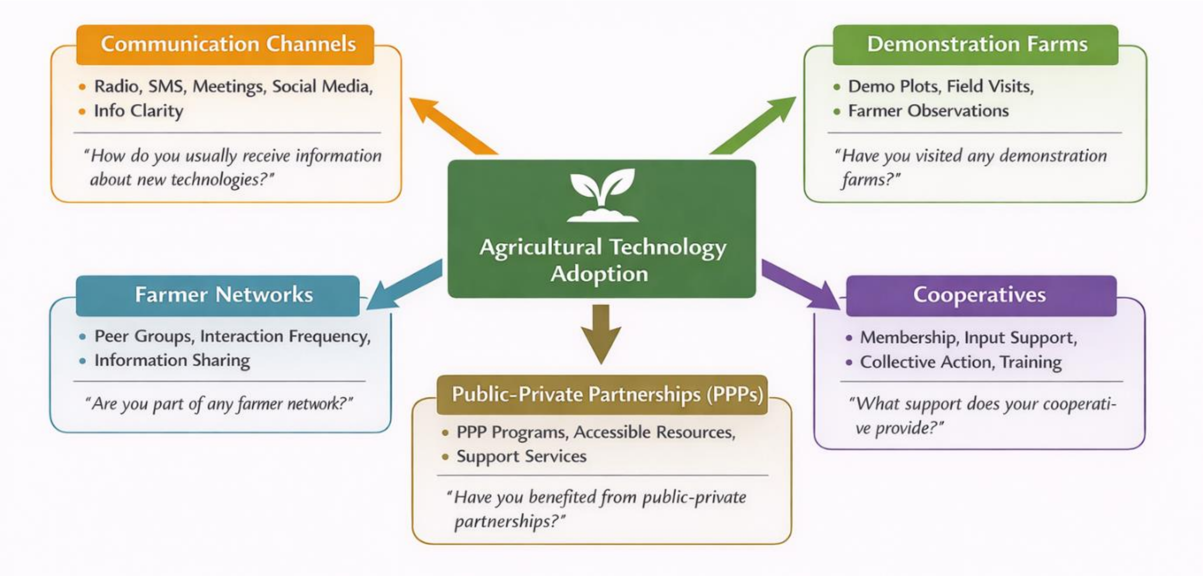


Access to credit and financial resources enables farmers to invest in new technologies, while infrastructure such as farm-to-market roads facilitates the transportation and marketing of agricultural products. Market demand also influences adoption decisions by providing incentives for farmers to adopt technologies that increase production or improve product quality. Institutional trust is another important factor in technology adoption. Farmers who have confidence in government agencies and extension programs are more likely to participate in technology promotion initiatives and adopt recommended practices.

Diffusion Mechanisms

The diffusion of agricultural technologies occurs through a variety of communication channels and institutional mechanisms (Figure 3.7).

Figure 3.7. Diffusion mechanism factors in agricultural technology adoption.



Extension workers, farmer field schools, demonstration farms, and farmer organizations serve as important platforms for disseminating knowledge about new farming practices.

Demonstration farms are particularly effective because they allow farmers to observe the performance of technologies under real farming conditions. Similarly, farmer networks facilitate peer-to-peer learning, enabling farmers to share experiences and knowledge about agricultural innovations.

Institutional partnerships among government agencies, local governments, farmer organizations, and research institutions also play a significant role in supporting technology diffusion. These collaborative arrangements can strengthen extension services and improve farmers' access to resources and technical assistance

In the context of DA RFO XI, diffusion mechanisms reflect the operational effectiveness of extension programs, partnership models, and demonstration strategies.

Adoption Decision and Diffusion Patterns

Among those who decided to adopt the focal agricultural technology in this study, the adoption intensity, the adoption continuity, and diffusion to others are the metrics that describe the pattern of diffusion.

The adoption intensity of the technology across the farm can be categorized into fully adopted, partially adopted, or modified. Adoption intensity can also be in terms of area, in percentage of the total area (measures the proportion of the farm area used to adopt the technology).

The adoption continuity describes how long the technology has been used, as this can indicate the sustainability of utilization on the ground. This can be characterized by whether the technology is consistently used over time, discontinued, or only tested. Factors influencing such decisions can also be identified and explored.

The diffusion to others can be explained by whether farmer adopters have shared or recommended the technology to others, and the channels through which such knowledge transfer occurs (e.g., farmer-to-farmer interactions, cooperative meetings, demonstration visits, and training activities.

IV. METHODOLOGY

A. RESEARCH DESIGN

This study employed a qualitative explanatory case study design to analyze the factors that contributed to the widespread adoption of the Arabica coffee-based farming system developed by DA RFO XI.

A case study approach is appropriate because the research seeks to examine a contemporary phenomenon within its real-life context, particularly the processes that influenced the diffusion and utilization of a specific agricultural technology (Yin, 2018).

Data were gathered through: key informant interviews (KIIs); focus group discussions (FGDs); and document analysis.

B. DATA SOURCES

The study employed multiple sources of evidence to enhance validity through triangulation, following Robert K. Yin (2018). These included KIIs and FGDs with DA RFO XI R&D management personnel, researchers, extension workers, and farmer-adopters of the Arabica coffee-based farming system, as well as a review of relevant DA RFO XI documents (e.g., terminal reports, adoption reports, extension records, and monitoring and evaluation reports). *See Appendix A.*

Interview guides were developed and translated into the local language, Bisaya, to ensure clarity and contextual relevance. These guides were semi-structured and explicitly aligned with the DOI constructs. To preserve the qualitative depth of the study and capture participants' lived experiences beyond predefined categories, each question included an open-ended option (e.g., "others, please specify and explain"), as applicable. This allowed respondents to articulate their own perspectives, ensuring that insights were not limited to the researcher's predetermined choices but instead reflected the real phenomena in their own words. *Please see Appendices B and C for the KII/FGD guide questionnaires for farmers and DA R4D personnel, respectively.*

C. SELECTION OF RESPONDENTS

Participants were purposively selected based on their relevance to: technology development; technology transfer and extension; and adoption and utilization.

Two main respondent groups were included:

1. Institutional actors who provided insights into R&D management practices, diffusion strategies, and institutional support mechanisms.
   - Division Chief and Project Leader of the DA RFO XI Research Division
   - Researcher/Project Staff of the focal technology
2. Technology users of the Arabica-based farming system among the GAPSFA members.
   - Farmers
   - Association leaders

The sampling strategy included purposive sampling for institutional actors and technology adopters. Snowball sampling was used to identify key technology adopters or opinion leaders. Recommendations from DA RFO XI and GAPSFA were also taken into consideration.

To reflect farmers' experiences while remaining manageable for in-depth analysis, a sample of 12 farmer members of GAPSFA was considered. This range balances the need for depth with practical field constraints, and aligns with established qualitative research practice showing that saturation of themes often occurs within the first dozen interviews (Guest, Bunce, & Johnson, 2006; Creswell, 2013; Aguboshim, 2021).

D. DATA ANALYSIS

The primary unit of analysis was the adoption of the Arabica coffee-based farming system developed by DA RFO XI among farmers in Bansalan, Davao del Sur.

Qualitative data collected from KIIs, FGDs, and documents were encoded and analyzed using thematic analysis. The analysis followed the pattern-matching logic recommended in case study research by Yin (2018), wherein empirically observed patterns from the interview data were systematically compared with theoretically predicted patterns derived from DOI Theory. This approach strengthens internal validity by assessing the degree of match between observed realities and established theoretical constructs, thereby enabling a more robust explanation of how and why the phenomenon occurs within the study context (Yin, 2018).

The analysis examined whether the adoption decision of the focal agricultural technology corresponds with expected patterns related to the utilization factors, namely: innovation attributes, adoption context, and diffusion mechanisms (Figure 3.4). These themes were examined collectively to explain the high adoption and utilization of the Arabica coffee-based farming system among coffee farmers in Bansalan, Davao del Sur. Beyond the initial decision to adopt, the analysis also examined the adoption intensity, its continuity over time, and diffusion to other farmer adopters.

Although the data collection process allowed for open-ended responses that could surface emergent themes, the analysis did not reveal other factors beyond those already covered by the DOI framework, indicating that the observed adoption patterns aligned closely with the study's guiding theoretical constructs and supporting the suitability of the framework as the primary analytical lens.

E. ETHICAL CONSIDERATIONS

Necessary permissions from the DA RFO XI and relevant agencies (i.e., Municipal Agricultural Office [MAO] of LGU Bansalan, GAPSFA) were secured before data collection began.

The study also adhered to the ethical standards of the UPOU, following the key principles:

1. Prior informed consent: Participants received an explanation of the study's purpose, procedures, risks, and benefits.
2. Voluntary participation: Participants were informed that they may withdraw at any time without penalty.
3. Confidentiality: Personally identifiable information was not disclosed. Codes or general descriptors were used to ensure anonymity.
4. Data security: Recorded interviews, transcripts, and documents were stored in password-protected digital folders.

V. FINDINGS

A. OVERVIEW OF THE ARABICA COFFEE-BASED FARMING SYSTEM

This sub-section is based on the project terminal report sourced from the DA RFO XI Research Division (DA-BAR & DA RFO XI, 2023), as well as KII and FGD with the focal technology Project Leader, support staff, and extension workers (DA RFO XI, 2026).

Problem/Opportunity that Motivated the Development of the Technology

The development of the Arabica coffee-based farming system was primarily driven by declining productivity and income among coffee farmers in Barangay Alegre, Bansalan, Davao del Sur. Coffee yields in the area had been decreasing due to senile trees, poor farm management practices, and limited adoption of appropriate technologies (DA-BAR & DA RFO XI, 2023). At the same time, farmers received low prices for their produce because of poor postharvest handling and limited knowledge of quality processing (DA RFO XI, 2026). As a result, many farmers abandoned or cut down their coffee trees and shifted to intensive vegetable monocropping, which provided short-term income but led to unsustainable farming practices and environmental degradation. The perennial coffee trees' root systems are more extensive and hold the soil better than the shallow-rooted short-lived monocrop vegetables.

At the same time, a clear opportunity existed in the growing domestic and global demand for high-quality Arabica coffee, particularly in the specialty market (DA-BAR & DA RFO XI, 2023). The area's favorable agro-climatic conditions made it suitable for both coffee and upland vegetables (e.g., white potato, bunching onion, carrot), presenting potential for integrated farming.

Thus, the development of the Arabica coffee-based farming system was driven by the need to address declining coffee production and environmental concerns while leveraging market opportunities through a more sustainable, diversified, and profitable farming system.

Technology Development and Validation Process

The technology was developed as an integrated farming system combining Arabica coffee with white potato and other upland vegetables, alongside improved agronomic and postharvest practices (DA RFO XI, 2026). It incorporated innovations such as intercropping, soil-based fertilization, pest and disease management, pruning and rejuvenation, and value addition through processing coffee cherries into green coffee beans (GCB). These components were designed to improve productivity, optimize land use, and enhance product quality.

It was introduced to GAPSFA in 2020-2023. Validation was carried out through on-farm implementation, supported by a 0.75-hectare technology model demonstration farm that demonstrated the full package of interventions (DA RFO XI, 2026). Baseline data were collected and compared with results from the improved system, including cost and return analyses of monocropping versus intercropping. The results showed that the integrated system generated higher income and lower production costs, thereby providing strong empirical evidence before scaling out the technology to more farmers' markets (DA-BAR & DA RFO XI, 2023).

Institutions / Stakeholders Involved in the R4D Process

The R4D process was implemented through a multi-stakeholder collaboration led by the DA-RFO XI through its Research Division, with funding support from the DA-BAR. Key government partners included the High Value Crops Development Program (HVCDP), also of DA XI, and the LGU of Bansalan through its MAO, which played crucial roles in farmer identification, coordination, and local implementation market (DA-BAR & DA RFO XI, 2023).

Other important stakeholders included the United States Department of Agriculture (USDA) - funded Agricultural Cooperative Development International and Volunteers in Overseas Cooperative Assistance (ACDI/VOCA)-PhilCAFE Project, which provided technical expertise and training, and the Davao del Sur State College (DSSC)[4], which contributed to knowledge support. Private sector actors, such as the Davao International Coffee Trading Corporation (DICTC), facilitated market linkage at the initial stage, while private sector input suppliers, technical experts, and extension workers from DA XI and LGU Bansalan supported production market (DA-BAR & DA RFO XI, 2023). At the community level, the GAPSFA served as the main beneficiary and implementing partner, highlighting the importance of organized farmer groups in the R4D process.

Intended Benefits of the Technology for Farmers

The Arabica coffee-based farming system was designed to improve farmers' economic conditions by increasing productivity, profitability, and income stability (DA-BAR & DA RFO XI, 2023). Intercropping coffee with high-value vegetables provided regular and diversified income streams, while processing coffee into green coffee

[4] Formerly known as the Southern Philippines Agribusiness and Marine and Aquatic School of Technology (SPAMAST) - Digos City Campus.

beans significantly increased earnings compared to selling fresh cherries (GAPSFA KII, 2026). Additionally, the system reduced production costs relative to intensive vegetable monocropping, making it more economically viable.

Beyond economic gains, the technology also aimed to promote environmental sustainability and climate resilience by improving farm management practices and reducing pressure on land resources. It aspired to enhance farmers' technical capacities through training in good agricultural practices, postharvest handling, and enterprise development. Furthermore, it is intended to strengthen farmer organizations and establish market linkages, enabling farmers to access better markets and participate more effectively in the coffee value chain (DA-BAR & DA RFO XI, 2023).

B. PROFILE OF FARMER ADOPTERS

The study involved 12 coffee farmers who are members of the GAPSFA in Bansalan, Davao del Sur. All respondents identified as farmers or producers, with a small number also serving as cooperative representatives, reflecting their active engagement in both production and organizational roles within the association. GAPSFA itself is a relatively established organization, having operated since 2019, and has grown from an initial 65 members to 198 members, 80% of whom are coffee farmers. At present, around 75% of its 80-hectare coverage (approximately 60 hectares) is already productive, indicating a steadily expanding and maturing coffee-based production system.

Respondents reported varied farming experience, ranging from 4 to 22 years in the coffee sector, with most having 5 to 10 years of experience. Their coffee farms are generally small-scale, ranging from 0.25 to 4 hectares, with an average farm size reflecting smallholder production systems typical in upland farming communities. In terms of livelihood, respondents rely on diverse agricultural combinations such as coffee farming, coffee–vegetable systems, and coffee–potato intercropping, highlighting the integrated nature of their farming practices.

Regarding the adoption of the Arabica coffee-based farming system promoted by DA RFO XI, most respondents reported 3 to 6 years of use, with a concentration at 6 years (6 respondents), followed by 3 to 5 years among others. This indicated that the majority of farmers are no longer in the initial adoption stage but have moved into sustained implementation of the system. Their continued use of improved practices—such as pruning, rejuvenation, and selective red cherry harvesting—further reflects system integration into routine farm management.

At the organizational level, GAPSFA played a critical role in value addition and collective marketing, currently producing an average of 200 kg of GCB, with a conversion ratio of approximately 6 kg of fresh berries to 1 kg of GCB. Once all coffee trees reach full productivity, the association is projected to significantly increase production, with estimates of up to 5,000 kg of fresh berries per hectare annually.

C. INNOVATION ATTRIBUTES

Shown in Table 5.1 are the frequencies of the five innovation attributes in accordance with the DOI theory (Rogers, 2003).

Table 5.1

Innovation Attributes Frequency

Indicator/Degree/Dimension	Frequency
Relative Advantage Indicators*	
Additional income from intercrops	11
Increased yield	8
Improved productivity	7
Reduced production risks	0

Indicator/Degree/Dimension	Frequency
Others	0
Complexity Degree and Key Challenges	
Very Easy	4
Slightly Easy	3
Difficult	5
*Key challenges**	
Needed training	12
Input requirement	6
Farm management skills	4
Technical knowledge	1
Others	0
Compatibility Dimensions*	
Upland suitability	12
Cultural acceptance	11
Align with the local climate, terrain, and farming conditions	11
Significantly changed from previous farming practices	10
Existing crops	8
Labor availability	7
Others	0
Trialability	
Tested the system before full adoption	11
Had access to demonstration farms	9
Observability and Key Visible Outcomes	
Observed results	12
Influenced by others	12
*Key visible outcomes**	
Increased yields	10
Income improvements	8
Healthy crops	7
Successful peers	7
Others	0

Source of raw data: GAPSFA (2026)

**Respondents were asked to answer as many indicators/challenges/dimensions as applicable; thus, frequency totals may exceed the total number of 12 respondents.*

Relative Advantage

Compared to the traditional coffee farming with no intercrops, farmers perceived the Arabica coffee-based farming system as economically beneficial, particularly in terms of increased income and improved productivity. The most frequently reported benefit was additional income from intercrops (Figure 5.1), such as white potato, bunching onion, carrot, bell pepper, tomatoes, and cabbage (11 respondents), followed by increased coffee yield (8 respondents) and improved overall productivity (7 respondents). These results indicate that income diversification through intercropping plays a central role in strengthening the system’s actual economic value.

These findings strongly support the DOI theory (Rogers, 2003), particularly the proposition that perceived relative advantage is a primary determinant of adoption. The integration of high-value intercrops enhances income diversification and strengthens the economic advantages of the system, thereby reinforcing adoption behavior.

The zero-reported perception of risk may reflect either strong satisfaction and positive bias resulting from successful implementation experiences or a potential underestimation of longer-term uncertainties, such as climate variability, price fluctuations, or production shocks. This suggests that while the system is currently viewed as highly advantageous, risk awareness may still require strengthening to ensure long-term sustainability and resilience.

Figure 5.1. Intercropping of Arabica coffee with upland vegetables.

Coffee with carrots

Coffee with white potatoes

Coffee with tomatoes Coffee with bell peppers

Coffee with bunching onions Newly plowed coffee farm ready for intercropping

Source of photos: DA-RFO XI (2026), GAPSFA (2026)

Complexity

Perceptions of complexity regarding the Arabica coffee-based farming system were mixed among respondents, reflecting both initial implementation challenges and the mitigating role of institutional support. When asked about ease of learning and implementation, 4 respondents described the system as very easy, 3 as slightly easy, while 5 considered it not easy or difficult, indicating that there can be a significant number of farmers still experiencing challenges during adoption.

The reported difficulties were primarily associated with input requirements (6 respondents), including the high cost and limited availability of fertilizers and medicines, followed by labor requirements (4 respondents) and farm management skills (4 respondents). Only one respondent specifically cited technical knowledge challenges, particularly in relation to the correct spacing of coffee trees following the correct farm layout of 2x5 meters of intercropping, suggesting that technical barriers were present but less dominant compared to resource and management constraints.

In relation to these challenges, all respondents confirmed that they required training or technical assistance to implement the system, underscoring the central role of extension support in facilitating adoption. This universal demand for training indicates that perceived complexity was significantly mitigated through institutional interventions, including capacity-building and technical guidance. As such, while the system was initially perceived as moderately to highly complex by many farmers, these difficulties were effectively reduced through sustained support mechanisms.

These findings align with the DOI theory (Rogers, 2003), which posits that perceived complexity negatively affects adoption but can be reduced through effective extension services, training, and observable benefits. In this case, extension support functioned as a key enabling mechanism that transformed a potentially complex innovation into a manageable and adoptable farming system.

Compatibility

The Arabica coffee-based farming system was generally perceived as highly compatible with local upland agroecological conditions and was also broadly accepted within the cultural context of farmers. All respondents confirmed that the system is suitable for upland conditions, while 11 respondents agreed that it aligns with local climate, terrain, and farming conditions in Bansalan. Cultural acceptance was likewise high, with 11 respondents reporting positive acceptance among farmers, indicating strong social and environmental fit.

However, compatibility was not absolute across all dimensions. While 8 respondents reported compatibility with existing crops and 7 confirmed alignments with labor availability, 10 respondents indicated that they needed to significantly modify their previous farming practices in order to adopt the system. This suggests that although the system fits well within the broader agroecological context, its implementation still requires adjustments in farm management practices, cropping arrangements, and labor allocation.

These findings indicate that compatibility is not a fixed condition but a dynamic process that may coexist with adaptation and behavioral change. Farmers were willing to make these adjustments because the perceived benefits of the system outweighed the required changes, suggesting that perceived relative advantage can compensate for partial compatibility constraints. In this case, strong perceived benefits and favorable environmental fit worked together to facilitate adoption despite the need for significant modifications in existing practices.

Trialability

The ability to test the Arabica coffee-based farming system on a small scale emerged as a critical factor influencing adoption, underscoring the importance of trialability in reducing uncertainty and building farmer confidence. Eleven respondents reported that they had the opportunity to experiment with the system before fully adopting it, and 9 respondents confirmed the availability of demonstration or pilot farms. Eleven respondents further emphasized that this opportunity to experiment was very important in their decision to adopt; the other one rated trialability as slightly important.

The demonstration farms, comprising 14 plots managed by GAPSFA, served as both training and experiential learning venues. These farms, covering around 0.75 hectares, were supported by multiple institutions, including DA RFO XI, ACDI/VOCA's PHILCAFE Project, and DSCC, highlighting strong multi-stakeholder collaboration in facilitating technology diffusion. The sites also functioned as learning hubs for farmers and partner organizations, including visits from other nearby farmer groups such as Balutakay Coffee Farmers Association (BACOFA) and Bagobo Tagabawa Farmers Association (BATAFAMA), further strengthening peer-to-peer knowledge exchange.

By allowing farmers to observe, practice, and gradually apply the farming system in a real-world setting, these demonstration farms reduced perceived risk and enabled incremental learning. This hands-on exposure strengthened farmers' confidence in the technology and confirmed that localized experimentation is essential in agricultural innovation adoption. These findings strongly support the DOI theory, particularly Rogers' (2003) proposition that trialability is a key determinant of adoption, as it allows potential adopters to test innovations before committing fully.

Observability

Observability emerged as one of the strongest drivers of adoption of the Arabica coffee-based farming system, strongly reinforcing its perceived benefits and reducing uncertainty among farmers. All respondents reported that they were able to observe the results of the technology from other farmers before adoption, and all likewise confirmed that demonstration farms and neighboring farms influenced their decision-making. This highlights the critical role of peer learning environments and model farms in shaping adoption behavior.

Farmers were particularly convinced by tangible and visible outcomes, including improved yields (10 respondents), increased income (8 respondents), healthy coffee plants (7 respondents), and the successful experiences of fellow farmers (7 respondents). These observable results provided concrete evidence of the system's effectiveness, making its advantages more credible and relatable within the local context. As emphasized during FGD, the phrase "to see is to believe" encapsulates this dynamic—visible success among fellow farmers fosters trust, reduces perceived risk, and strengthens motivation to adopt.

These findings strongly affirm the DOI theory (Rogers, 2003), particularly the role of observability as a critical determinant of adoption. When the benefits of an innovation are clearly visible and demonstrated within a community, they are more likely to be validated socially and adopted more widely.

D. ADOPTION CONTEXT

The adoption context played a significant mediating role in shaping farmers' perceptions of the innovation, not a direct determinant, consistent with the conceptual framework (Table 5.2).

Table 5.2

Adoption Context Frequency

Factor	Frequency
Accessed financing	3
Received extension support	11
Available infrastructure	10
Market demand and access	12
Institutional trust	11

Source of raw data: GAPSFA (2026)

Financing

Limited access to financing constrained the adoption intensity of the Arabica coffee-based farming system. Nine respondents reported that they had not accessed any form of financial support—such as loans, subsidies, or grants—to support adoption. Only a small number of respondents (3 respondents) were able to avail of financial assistance, primarily from DA RFO XI and MLGU/MAO, with minimal support also noted from the Department of Trade and Industry (DTI).

The limited reach of financial services restricted farmers' ability to invest in necessary inputs, expand production, and adopt recommended practices on a larger scale. As a result, while some farmers were able to initiate adoption using available resources and inputs provided, the absence of broader financial support mechanisms constrained the depth of adoption across the community.

Extension Support

Strong extension support reduced the perceived complexity of the Arabica coffee farming system, thereby enabling adoption despite its technical requirements. The majority of respondents confirmed that they received extension assistance, highlighting its critical role in facilitating understanding and implementation of the technology. Support was primarily provided by DA RFO XI (5 respondents), which offered technical know-how, and by MLGU/MAO (5 respondents), which delivered training and seedlings. Additional support from other institutions, such as DTI, further supplemented these efforts through the provision of coffee seedlings.

This combination of technical guidance, capacity-building activities, and input support helped farmers better understand key production and post-harvest processes, reducing uncertainty and the difficulty associated with adopting the system. As a result, even with the inherent complexities of coffee cultivation and processing, farmers were more confident and capable of adopting the technology.

Infrastructure

The presence of shared infrastructure (Figure 5.2) significantly enhanced efficiency and improved observability of the Arabica coffee farming system. In the area, key facilities and equipment provided by the DA RFO XI and DA-BAR —including hauling truck, storage house, coffee drying beds, dehuller, pulper, and water pipes — played a crucial role in supporting adoption. Notably, these resources were not distributed to individual farmers but were collectively managed through the GAPSFA, enabling members to access essential post-harvest facilities. This shared arrangement allowed farmers to better observe processing techniques, improve product quality, and gain confidence in the system, thereby encouraging wider adoption of the technology.

Figure 5.2. Shared infrastructure facilities.

Hauling truck

Storage house

Coffee dehuller

Coffee pulper

Water pipes for irrigation

Source of photos: DA-RFO XI (2026), GAPSFA (2026)

Market Demand and Access

High market demand for coffee served as a strong economic incentive for adoption by reinforcing its perceived relative advantage among farmers. Participants in the KIIs and FGDs consistently highlighted the strong and growing demand for coffee, which encouraged widespread participation in the Arabica coffee-based farming system. All respondents affirmed that they have access to markets for coffee and associated crops such as white potato and upland vegetables, indicating that market availability is not a major constraint to adoption.

For coffee specifically, multiple marketing channels are accessible to farmers. The majority identified GAPSFA as their primary market, one reported selling through a cooperative, others cited local buyers and traders for both coffee and vegetables, and even directly to coffee shops. Within GAPSFA, a structured value-adding system further strengthens market incentives: the association purchases fresh coffee berries from members at around Php 70/kg and processes these into GCB, which are sold at approximately Php 450/kg for unsorted beans and up to Php 600/kg for sorted Class A products[5]. This system makes the income potential of coffee production more visible and attainable, contributing to the decision of at least 80% of members to adopt coffee intercropped with highland vegetables.

However, despite accessible markets and strong demand, farmers expressed concerns about limited control over pricing. Many perceived themselves as price takers, dependent on buyers' classification ("*dili makabuot sa presyo sa merkado*"). Although buyers conveniently collect GCBs from GAPSFA, transportation costs are still deducted, slightly reducing farmers' net returns. Nevertheless, the combination of assured market access, diverse marketing channels, and strong demand continued to drive adoption by enhancing the overall economic attractiveness of the Arabica coffee farming system.

[5] Six kilograms of fresh berries make 1 kilogram of GCB.

Institutional Trust

Institutional trust further facilitated adoption by increasing farmers' confidence in and willingness to adopt the technology. Respondents emphasized that trust in government agencies and extension workers was very important because it helped ensure the success of their farming practices, enabled them to increase their income, and provided opportunities to gain knowledge and learn improved techniques. Farmers also perceived trusted institutions as credible sources of guidance that could enhance their skills and farm productivity ("*para makadugang sa kahibalo"; "para makakat-on*"). In addition, some noted that trusted institutions were more effective in influencing farmer decisions, highlighting the role of credibility and confidence in shaping adoption behavior.

E. DIFFUSION MECHANISMS

Interpersonal communication channels emerged as the most dominant and effective mechanism for the diffusion of the Arabica coffee-based farming system (Table 5.3). All respondents reported that they first learned about the technology through person-to-person communication, underscoring the central role of direct social interaction in awareness creation. These interpersonal channels included DA and MAO extension workers, training and workshop activities, farmer association (particularly GAPSFA), and farmer-to-farmer learning exchanges. In terms of perceived effectiveness, respondents also ranked person-to-person communication as the most effective diffusion channel (total score = 34), significantly higher than mass media (19) and social media (14), reinforcing its comparative influence on adoption behavior.

Table 5.3

Diffusion Mechanisms Frequency and Aggregate Score

Channel and Frequency	Aggregate Score*
Person-to-person • Fellow farmers (9) • Association officers (9) • DA & MAO extension workers (8)	34
Mass media • Radio (3) • Television (2) • Newspaper (0)	19
Social media • Facebook (4) • YouTube (2) • TikTok (0)	14

Source of raw data: GAPSFA (2026)

**Respondents were asked to rank each channel with 1 as the least effective and 3 as the most effective.*

While mass media (radio and television, reported by 5 respondents) and social media platforms such as Facebook and YouTube (reported by 6 respondents) contributed to initial awareness, they played a secondary role in actual decision-making. Adoption decisions were primarily shaped through trust-based interactions, peer validation, and experiential learning. This is further supported by the fact that fellow farmers (9 respondents), association officers (9 respondents), and LGU/MAO extension officers (8 respondents) were identified as the most influential actors in adoption decisions, alongside inputs from buyer companies (6 respondents) and development partners such as ACDI/VOCA (1 respondent).

Moreover, all respondents confirmed that their farmer networks, cooperatives, or associations played a key role in spreading the technology, highlighting the importance of organized social systems in diffusion. Demonstration farms and training programs further reinforced this process by providing experiential learning opportunities. Respondents emphasized that these platforms enhanced their knowledge, improved coffee farming practices, and allowed them to “see and believe” the effectiveness of the system through hands-on exposure.

These findings strongly indicate that diffusion is primarily driven by interpersonal trust, experiential learning, and social validation within farmer networks, rather than mass or social media channels alone. This pattern reinforces the importance of localized social systems and peer influence in shaping technology adoption behavior. Overall, the results strongly support the DOI theory (Rogers, 2003), particularly the proposition that interpersonal communication channels are more influential than mass media in the adoption decision process, and that social systems play a central role in accelerating diffusion.

F. ADOPTION DECISION AND DIFFUSION PATTERN

Adoption Intensity

Adoption of the Arabica coffee-based farming system among GAPSFA members was generally widespread but often partial, largely constrained by financial limitations (Table 5.4). While 5 respondents reported full adoption, the majority (7 respondents) indicated partial adoption, primarily due to insufficient capital, limited financial capacity, and the need to rely on available resources. In terms of land coverage, adoption intensity also reflected these constraints: 4 respondents applied the system to 26%–50% of their farms, 2 to 51%–75%, and 6 to 76%–100%, with higher coverage often motivated by perceived income gains and the desire to maximize land productivity through intercropping with carrots, potatoes, onion, cabbage, and bell pepper. This pattern indicates that while farmers recognize the benefits of the system, scaling remains financially constrained, resulting in selective or gradual implementation rather than uniform full-scale adoption.

Table 5.4

Adoption Decision and Diffusion Pattern Frequency

Indicator	Frequency
Adoption intensity	
Fully adopted	5
Partially adopted	7
Modified	0
Not adopted at all	0
Area application	
≤ 25%	0
26% - 50%	4
51% - 75%	2
76% - 100%	6
Continuity	
Continued use	12
Discontinued	0
Only tested	0
Diffusion to Others	
Shared with others during	11*
• farmer-to-farmer discussions	*8*
• association meetings	*6*
• training activities	*4*
• farm demonstration visits	*2*
Did not share with others	1

Source of raw data: GAPSFA (2026)

**Respondents were asked to answer as many as applicable; thus, totals may exceed the total number of 12 respondents.*

Continuity

Despite partial implementation among some farmers, sustained use of the system is very high. Eleven respondents reported continuous use since initial adoption, with durations ranging from 3 to 6 years, and no cases of discontinuation or one-time trial use. This indicates strong, sustained adoption of the technology within farming practices, reinforced by actual economic benefits such as improved income and better yields.

Diffusion to Others

In addition, knowledge diffusion beyond direct adopters is highly pronounced. Eleven respondents reported that they actively recommended or shared the Arabica coffee-based farming system with other farmers. Motivations for sharing were largely driven by perceived benefits and social responsibility, including observed income improvements *("nakita nako nga nindut ang income")*, awareness-building ("so he will know"), and a strong desire to assist others *("para makatabang sa ubang farmers").* Knowledge-sharing was facilitated through multiple channels, most notably farmer-to-farmer discussions (8 respondents) and association meetings (6 respondents), with additional dissemination through training activities (4 respondents) and demonstration farm visits (2 respondents). These structured and informal platforms highlight the important role of social networks and organized institutions in accelerating diffusion.

Overall, these findings show that adopters are not only end-users but also active change agents within the social system, reinforcing peer learning and community-based diffusion. The strong tendency toward continued use and active knowledge sharing further reflects the internalization of the technology and its perceived benefits, while partial adoption patterns underscore the continuing influence of financial constraints on scaling.

These results are consistent with the DOI theory, particularly the processes of implementation, confirmation, and diffusion through interpersonal channels, where adopters become key drivers of further adoption within their social system.

G. RESPONDENT'S PERCEPTION OF WHAT MADE THE FOCAL TECHNOLOGY SUCCESSFULLY ADOPTED

When asked what factors made the Arabica coffee-based farming system successful in their community, the respondents answered the following:

Economic Benefits and Productivity Gains

A major factor identified was improved income and productivity. Farmers consistently reported that the system generates higher income ("*dako nga income sa mag-uuma*") and better harvests ("*maayong abot/ani*"). The perception that coffee farming contributes to increased production and financial stability ("*makadugang ug* production," "*tungod sa maayong kita*") highlights its strong economic advantage. These benefits reinforce the attractiveness of the system as a viable livelihood strategy in upland farming communities.

Environmental Suitability and Sustainability

Another dominant theme was the system's positive environmental impact. Farmers noted that coffee farming helps prevent environmental degradation ("*para di madaut ang* environment") and contributes to environmental protection ("*nakatabang ug dakong kaayuhan sa environment ang pagtanum ug kape*"). Respondents also observed that the system is suitable for local ecological conditions, particularly altitude and temperature, which support coffee production. In addition, the farming system was perceived to be less damaging to land resources ("*dili dali madaut ang area*"), reinforcing its sustainability advantages.

Capacity Building and Knowledge Enhancement

Respondents also emphasized the importance of training and knowledge transfer in supporting successful adoption. The system was seen as a source of learning and skill development ("*makahatag sa among dugang nga kahibalo*," "training"), indicating that institutional support plays a key role in strengthening farmer capability and confidence. This suggests that beyond material benefits, the system also contributes to human capital development within the farming community.

Community-Level Benefits

At the broader social level, farmers perceived the system as beneficial to the community ("*nakatabang ug maayo sa komunidad," "makahatag ug kaayohan*"). This reflects a shared understanding that adoption extends beyond individual gain and contributes to collective welfare, including improved livelihoods and community development.

These results suggest that adoption is not solely motivated by profit, but also by environmental awareness and capacity-building opportunities. The integration of ecological sustainability and livelihood improvement strengthens the system's overall acceptability and long-term viability in the community context.

H. MAJOR CHALLENGES ENCOUNTERED BY RESPONDENTS

The challenges encountered by farmers in the adoption of the Arabica coffee-based farming system are primarily linked to infrastructure constraints, financial limitations, production inputs, labor demands, and environmental risks. These factors collectively affect farm productivity and the adoption intensity across farm areas.

Infrastructure and Access Constraints

A recurring challenge identified by respondents is poor farm-to-market road (FMR) access (Figure 5.3). Farmers described the roads as difficult ("*lisud ang dalan*"), particularly during rainy seasons when transportation becomes more challenging. Limited or poor access roads increase the difficulty of transporting inputs to farms and moving harvested products to market, thereby reducing efficiency and increasing production costs. This infrastructure constraint also discourages full utilization of farm areas for coffee production.

Figure 5.3. Poor state of the farm-to-market road.

Source of photos: DA-RFO XI (2026), GAPSFA (2026)

Financial Limitations and Constrained Expansion

Financial constraint emerged as one of the most critical barriers to adoption and scaling. Many respondents reported insufficient capital to fully maximize their farm areas for coffee planting. While farmers expressed willingness to expand production, the lack of financing limits their capacity to do so. Several also noted that production declines when there is inadequate financial support for proper farm management, indicating that capital is essential not only for expansion but also for sustaining productivity levels.

Input Costs and Farm Management Challenges

Rising costs of agricultural inputs, particularly fertilizers, were also highlighted as a significant concern *("pagtaas sa presyo sa abuno")*. Farmers emphasized that fertilizer availability and affordability strongly influence production outcomes, with some noting that adequate fertilizer application greatly improves yields.

In addition, respondents described the farming system as somewhat labor-intensive and demanding in terms of following proper farming practices *("kuti/laborious ang proseso")*, suggesting that adherence to recommended practices requires sustained effort and capacity.

Environmental and Production Risks

Farmers also identified environmental and climatic challenges, particularly calamities such as typhoons *("kalamidad sama sa bagyo")* and limited access to irrigation or water sources *("kakulang sa tubig/irrigation")* since not all farmers were reached by the water pipes provided by DA, given the distance of their farms. These environmental stressors directly affect coffee productivity and contribute to fluctuations in yield, further compounding the effects of financial and input constraints.

I. RESPONDENTS' RECOMMENDATIONS AND ADVICE

The respondents' recommendations for improving the adoption and diffusion of the Arabica coffee-based farming system consistently highlight the need for strengthened infrastructure, enhanced financial support, sustained capacity building, and continuous institutional assistance. These suggestions reflect the practical constraints experienced by farmers and their aspirations for a more enabling agricultural environment.

Infrastructure Development, Particularly Farm-to-Market Roads (FMR)

The most frequently emphasized recommendation is the improvement of road infrastructure. Farmers strongly called for the construction and upgrading of farm-to-market roads ("*ipaayo ang dalan," "mas maayo kun mapa-semento na among dalan*") to ease the transport of agricultural inputs and coffee products to market. Poor road conditions were repeatedly identified as a major bottleneck, and respondents believe that better roads would significantly reduce post-harvest difficulties, lower transportation costs, and improve market access. This underscores the central role of infrastructure in strengthening agricultural value chains and ensuring efficient product flow from farms to markets.

Financial Assistance and Input Support

Another key recommendation is the provision of financial assistance to farmers. Respondents highlighted the need for capital support to enable full adoption and expansion of coffee production. Financial assistance was also linked to the ability to purchase essential inputs such as fertilizers and farm implements ("*dugang nga suporta sa abuno ug mga gamit*"). This indicates that capital constraints remain a major barrier not only to scaling production but also to maintaining productivity and farm sustainability. Farmers expressed that consistent financial support would allow them to better manage their farms and maximize the benefits of the system.

Training and Continuous Capacity Building

Respondents also strongly emphasized the importance of continuous training and technical assistance. Many suggested "*dugang training*" and continuous training, support, and guidance reflecting a strong demand for ongoing capacity building rather than one-time interventions. Farmers also recommended that training should be complemented by closer monitoring and problem diagnosis ("*pagsusi sa mga mag-uuma kung unsa ang pinakaunang problema sa pag-atiman sa kape*"). This highlights the need for more responsive, adaptive extension services that address real-time field challenges and support continuous learning.

Strengthening Institutional Support and Innovation Diffusion

Beyond material and technical assistance, respondents called for sustained institutional support from DA RFO XI and other agencies. They emphasized the importance of continuous guidance ("*gabayan permi*"), consistent support ("*padayon nga suporta*"), and sustained engagement with farmers ("constant care"). Farmers also suggested promoting more processed coffee products and agricultural diversification to further enhance income opportunities and strengthen the coffee value chain. Additionally, they encouraged more experimentation and innovation to improve farming practices and productivity.

J. SYNTHESIS OF FINDINGS

Table 5.5 presents the Pattern-Matching Matrix (Yin, 2018), in which the DOI (Rogers, 2003) propositions are matched with the empirical findings from this study. This shows the full DOI pathway – attributes, context, diffusion mechanisms, and adoption decision and diffusion pattern.

Table 5.5

Pattern-Matching Matrix

DOI Proposition (Rogers, 2003)	Empirical Findings	Match
Innovation Attributes		
Relative advantage drives adoption	Strong income gains from intercrops, increased yields, and improved productivity made the system highly economically attractive; very low perceived risk further reinforced positive perception	Strong match
Compatibility enhances adoption	Highly compatible with upland conditions, terrain, climate, and cultural acceptance; however, required significant changes in farming practices and partial alignment with labor and existing crops	Strong match (with adaptive adjustments)

DOI Proposition (Rogers, 2003)	Empirical Findings	Match
Complexity reduces adoption	Moderately difficult; challenges related to inputs, labor, and management; complexity was mitigated through strong extension and training support	Partial match (mitigated by support systems)
Trialability reduces uncertainty	Majority tested the system before adoption; demonstration farms enabled hands-on learning and were considered “very important” in decision-making	Strong match
Observability accelerates adoption	All farmers observed results and were influenced by peers; visible outcomes included increased yields, income, and successful farmers, reinforcing “seeing is believing.”	Strong match
Adoption Context		
Adoption context influences perception of innovation (indirect role)	Adoption context (financing, extension, infrastructure, market, institutional trust) shaped perceptions but did not directly determine adoption decisions	Strong match
Access to resources (e.g., financing) facilitates adoption	Limited financing constrained scale and depth of adoption; majority lacked financial support	Strong match
Extension systems reduce complexity and enhance adoption	Strong extension support improved knowledge, reduced uncertainty, and enabled adoption despite technical complexity	Strong match
Infrastructure enhances observability and efficiency	Shared post-harvest facilities improved observability and processing efficiency; however, poor farm-to-market roads increased transport difficulty, costs, and limited the expansion of adoption	Partial match (enabling but constrained)
Market incentives drive adoption (relative advantage)	High market demand, multiple channels, and value-adding mechanisms increased perceived profitability	Strong match
Institutional trust enhances adoption decisions	High trust in DA and local institutions increased confidence, learning, and willingness to adopt	Strong match
Diffusion Mechanisms		
Interpersonal channels are most effective in the persuasion and decision stages	Person-to-person channels ranked highest; all respondents first learned through interpersonal communication	Strong match

DOI Proposition (Rogers, 2003)	Empirical Findings	Match
Opinion leaders and change agents influence adoption	Fellow farmers, association officers, and extension workers were most influential in shaping decisions	Strong match
Mass media is more effective for awareness than for decision-making	Mass media and social media contributed to awareness but had limited influence on adoption decisions	Strong match
Social systems facilitate the diffusion of innovations	GAPSFA played a key role in spreading the technology	Strong match
Experiential learning enhances diffusion	Demonstration farms and training activities enabled "learning by doing" and reinforced adoption through observation	Strong match
Adoption Decision and Diffusion Pattern		
Adoption occurs in stages (implementation → confirmation)	High level of continued use indicates a strong confirmation stage and sustained adoption	Strong match
Adoption may be partial due to constraints	Majority reported partial adoption due to financial limitations and resource constraints	Strong match
Intensity of adoption varies among adopters	Variation in land coverage (26%–100%) reflects differing levels of adoption intensity	Strong match
Continued use reflects perceived benefits	Sustained use driven by income gains and improved productivity	Strong match
Diffusion occurs through interpersonal networks	Widespread sharing via farmer-to-farmer discussions, meetings, trainings, and demonstration farm visits	Strong match
Adopters act as change agents within the social system	Majority actively promoted the technology, motivated by observed benefits and the desire to help others	Strong match

Source of raw data: GAPSFA (2026)

The findings demonstrated a strong overall alignment with the DOI theory (Rogers, 2003), with empirical evidence consistently supporting its core propositions across innovation attributes, adoption context, diffusion mechanisms, and adoption outcomes. The findings revealed that, despite the inclusion of open-ended response opportunities during data collection, no additional determinants emerged beyond those identified in the DOI framework, suggesting that the adoption patterns observed among participants were strongly aligned with the theory's established constructs and underscoring its explanatory relevance in this study.

Among the innovation attributes, relative advantage, compatibility, trialability, and observability exhibited strong matches, confirming their central role in shaping adoption behavior. The system's clear economic benefits—particularly income diversification through intercropping—emerged as the most decisive driver of adoption. Compatibility was likewise high, especially in terms of agroecological and cultural fit, although it required adaptive changes in farming practices, indicating that compatibility operates as a dynamic rather than static condition. Complexity showed a partial match, as initial technical and resource-related challenges were evident; however, these were effectively mitigated through strong extension support, training, and experiential learning mechanisms. This highlights the critical role of institutional interventions in transforming a potentially complex innovation into a manageable and adoptable system.

Similarly, the adoption context revealed a straightforward pattern: while factors such as extension support, market demand, and institutional trust strongly enabled adoption, constraints in financing and farm-to-market infrastructure limited the scale and intensity of adoption, reinforcing the study's conceptual framing that context acts as a mediating rather than deterministic factor.

The diffusion mechanisms further strongly validate the DOI theory (Rogers, 2003), particularly the primacy of interpersonal communication channels in influencing adoption decisions. Person-to-person interactions—through fellow farmers, association leaders, and extension workers—were not only the primary sources of information but also the most trusted and effective channels for persuasion and validation. In contrast, mass media and social media played secondary roles, mainly in awareness creation. The prominence of farmer associations such as GAPSFA, along with demonstration farms and training activities, underscored the importance of social systems, peer learning, and experiential knowledge in accelerating diffusion.

In terms of adoption decision and diffusion patterns, the findings reveal widespread but often partial adoption, largely constrained by financial limitations. Despite this, the very high level of continued use and the absence of discontinuance indicate strong confirmation and sustained adoption of the technology. Moreover, adopters actively functioned as change agents, facilitating knowledge sharing and reinforcing community-level diffusion through both formal and informal networks.

Taken together, these results suggest that successful adoption is not driven by the technological attributes alone but by a holistic, systems-based process in which innovation characteristics interact with enabling conditions, social structures, and institutional support. The findings highlight the importance of a value chain-oriented and multi-stakeholder approach—integrating production, postharvest infrastructure, market access, financing mechanisms, and extension services—to sustain and scale agricultural innovations. This integrated perspective not only strengthens the explanatory power of DOI theory in this context but also provides practical insights for designing more effective agricultural development interventions.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This study aims to (1) assess farmers' perceptions of the innovation attributes of the Arabica coffee-based farming system, (2) examine how adoption context factors shape utilization outcomes, (3) identify the diffusion mechanisms that facilitated its spread, (4) assess the resulting diffusion pattern among adopters, and (5) generate evidence-based, theory-informed recommendations for improving adoption in similar contexts.

The findings clearly show that these objectives were achieved and are strongly explained by the DOI Theory (Rogers, 2003). All five innovation attributes influenced adoption, with relative advantage and observability emerging as the most decisive factors. Farmers were primarily motivated by tangible economic benefits—especially income diversification through intercropping—and by visible results observed from peers and demonstration farms. Compatibility with local agroecological and cultural conditions further supported adoption, although it required adjustments in farming practices. While complexity posed initial challenges, these were effectively mitigated through strong extension support and training, highlighting the importance of institutional facilitation in the adoption process.

The study also confirms that the adoption context as an enabling condition plays a critical mediating role. Factors such as extension support, market demand, and institutional trust enhanced farmers' capacity and confidence to adopt the system. At the same time, limited access to financing and constraints in farm-to-market infrastructure restricted the scale and intensity of adoption, resulting in partial implementation among many farmers. This demonstrates that adoption is shaped not only by the perceived merits of the technology but also by the enabling or constraining conditions surrounding it.

In terms of diffusion, the findings strongly validate that interpersonal networks and social systems are central to the spread of innovations. Farmer-to-farmer interactions, associations such as GAPSFA, and extension workers were the most influential channels in both awareness creation and decision-making. Demonstration farms and training activities reinforced this process by enabling experiential learning and peer validation. The diffusion pattern further reveals widespread and sustained use, with most adopters continuing to apply and actively promote the system, indicating strong institutionalization and community-level diffusion.

Taken together, the study’s key message is that successful adoption and diffusion of agricultural technologies are not driven by technological attributes alone but by a holistic, systems-based process. The interaction of innovation characteristics, supportive institutions, functional markets, and strong social networks is essential to achieving sustained and scalable adoption outcomes. This underscores the need for integrated, value chain-oriented, and multi-stakeholder approaches in agricultural development.

The study’s findings should be interpreted within the context of its limitations, including its focus on a single technology and location, partial institutional coverage, reliance on a single theoretical lens, and the inherent constraints of self-reported data despite triangulation measures.

Despite these limitations, the study offered valuable empirical and practical insights into how agricultural innovations can be effectively diffused and sustained. It highlighted the importance of strengthening enabling conditions—particularly financing, infrastructure, and institutional support—while leveraging social networks and experiential learning to accelerate adoption.

B. RECOMMENDATIONS

To enhance the diffusion and adoption of similar agricultural technologies, several evidence-based and theory-informed recommendations were drawn out from this study. These recommendations were likewise aligned with DA programs and the value chain approach.

Strengthen Access to Financing (Aligned with DA Credit Programs)

Access to financing should be strengthened by expanding credit programs tailored to the needs of smallholder coffee farmers, providing targeted input subsidies—particularly for fertilizer—and introducing flexible financing schemes aligned with crop production cycles. These interventions would enable farmers to invest in required inputs and scale up adoption across larger portions of their farms, thereby addressing current limitations in adoption intensity and reducing input-related complexity.

The DA has existing credit windows such as the Agricultural Credit Policy Council (ACPC) programs (e.g., Production Loan Easy Access [PLEA]) and other concessional lending facilities. In addition, targeted input subsidies (e.g., fertilizer support under the HVCDP should be expanded. These interventions will enable farmers to invest across the value chain—from production inputs to post-harvest.

Improve Farm-to-Market Infrastructure (Value Chain Logistics)

Priority should be given to the construction and rehabilitation of FMRs to improve the physical connectivity of farming communities to markets. Improved infrastructure will reduce transportation costs, minimize post-harvest losses, and facilitate more efficient movement of goods. These improvements are expected to enhance the perceived relative advantage of the technology, strengthen market access, and increase the visibility of successful outcomes.

This can be done through DA and LGU convergence programs to improve logistics efficiency along the coffee value chain.

Sustain and Expand Extension Services (DA Extension System and ATI)

Extension services should be sustained and expanded through the DA extension system and the Agricultural Training Institute (ATI) by providing continuous hands-on training, field demonstrations, and strengthened farmer field schools. Within a Triple Helix model involving government, industry, and the academe, higher education institutions (HEIs) and SUCs should play a more active role in delivering science-based technical support, adaptive research, and extension innovations tailored to farmers' needs. The curriculum can cover mature technologies such as coffee GAP, integrated crop management, and post-harvest handling.

In particular, the academe can complement government extension efforts by offering site-specific technical coaching, facilitating participatory learning approaches, and translating research outputs into practical, farmer-friendly technologies. Strengthened collaboration among the DA, ATI, and academic institutions will ensure that farmers receive sustained, evidence-based guidance and access to updated knowledge. This integrated support system will help reduce the perceived complexity of the technology and enable farmers to better manage technical and operational challenges. Ultimately, these measures will enhance productivity and improve quality across the production segment of the coffee value chain.

Scale Up Demonstration Farms (Learning Hubs in the Value Chain)

Demonstration farms should be replicated and scaled up under the HVCDP and DA-LGU partnerships across additional barangays to serve as localized hubs for training, experimentation, and knowledge exchange. These sites can also integrate production, processing (e.g., depulping, drying), and quality grading to demonstrate full value chain functions. By providing farmers with opportunities to observe and test the technology under real conditions, these platforms will reinforce both trialability and observability, thereby accelerating adoption.

Leverage Farmer Networks and Associations (Cluster Development)

Farmer organizations such as GAPSFA should be further supported and strengthened through DA's clustering and consolidation approach, as central nodes for technology diffusion. Establishing structured farmer-to-farmer mentoring systems and facilitating regular knowledge-sharing activities can enhance interpersonal communication channels, which are critical for influencing adoption decisions. This approach also enhances the farmers' bargaining power and reduces transaction costs.

Enhance Market Systems and Price Transparency (Value Chain Upgrading)

Market systems should be improved by strengthening grading and pricing mechanisms and promoting transparency in transactions. DA programs should facilitate linkages with institutional buyers, specialty coffee markets, and MSMEs. In addition, support for value-adding activities such as processing and branding should be expanded to increase farmers' share of value. These measures increase farmers' share of value and reinforce perceived relative advantage.

Integrate Climate and Risk Management Support (Climate-Resilient Value Chains)

Climate and risk management support should be integrated into program interventions through the provision of irrigation facilities, promotion of climate-resilient farming practices, and introduction of crop insurance schemes (i.e., under the Philippine Crop Insurance Corporation [PCIC]). These strategies will help address long-term sustainability risks and improve the resilience of coffee farming systems.

Adopt a Systems-Based, Value-Chain Approach to Technology Promotion

A systems-based approach should be adopted by promoting integrated farming systems that combine coffee production with intercrops and value-adding processes. Interventions and support services should be delivered in a coordinated manner (DA, LGUs, DTI, and partners) to support integrated farming systems and enterprise development. This ensures holistic diffusion, sustained adoption, and competitiveness of the local coffee industry.

Ground Adoption Strategies on Economic Evidence and Farmer Learning

Economic evidence and visible benefits were important drivers of adoption. Farmers were motivated by observed income gains and productivity improvements. This reinforces the importance of presenting simple, clear cost-and-return analyses to farmers as part of extension work. Such evidence-based communication strengthens trust, reduces perceived risk, and enhances decision-making among potential adopters.

Strengthening R4D Linkages and Knowledge-to-Use Systems

Stronger institutional linkages among the DA, the academe, and RDIs should be established to reinforce the full pathway from knowledge generation to commercialization and farmer adoption. Anchored in the R4D approach and the Triple Helix model, SUCs should take a more active role in adaptive trials, technology validation, and co-creation with farmers to ensure that innovations are demand-driven, field-tested, and responsive to local conditions. At the same time, knowledge-to-use systems must be strengthened through improved feedback mechanisms, farmer-centered technology translation, and partnerships that support pilot enterprises and market integration.

A critical component of this process is the adoption of a more institutionalized TRL evaluation mechanism—potentially at the DA level—to systematically determine whether agricultural technologies are sufficiently mature for scaling and commercialization. Such a framework would provide clearer benchmarks for readiness, reduce premature deployment of underdeveloped innovations, and ensure that only validated, context-appropriate technologies proceed into extension and enterprise development pathways.

VII. PERSONAL LESSONS LEARNED (REFLECTIVE ESSAY)

My engagement with this case study has been both a professional and personal milestone. Although I am not currently affiliated with a formal RDI, my longstanding involvement with public RDOs has sustained my interest in the persistent challenges surrounding R&D management. In particular, I have been drawn to understanding the factors that hinder or facilitate technology commercialization, transfer, and sustainable adoption—an area that sits at the intersection of science, policy, and practice.

Over the years, my work in supporting the crafting and development of national and sub-national commodity roadmaps—including salt, milkfish, shrimp, seaweed, coconut, and coffee—has repeatedly exposed a common structural issue. Despite the substantial volume of R&D outputs generated by public institutions, their translation into tangible improvements in production, productivity, and profitability remains limited. The challenges of technology transfer and sustained adoption continue to surface as critical bottlenecks.

A striking example comes from value-adding initiatives supported by one public RDO. While many beneficiaries receive training in seafood processing and product development, only a few can sustain their enterprises in the long term. The competitive nature of the processed food market, combined with gaps in market access, business development support, and financing, often undermines these efforts. This suggests that capacity-building interventions, when implemented in isolation, are insufficient to ensure enterprise viability. Instead, they must be complemented by a broader ecosystem that supports market integration and competitiveness.

My experience with a public RDO-funded project on a porcine meat detection kit further deepened my understanding of these dynamics. In this case, I was involved in providing policy support for pre-commercialization efforts. However, it became evident that the product followed a “technology push” model, where innovation was driven primarily by scientific capability rather than market demand. The targeted private sector stakeholders expressed little interest in adopting the technology, citing the absence of regulatory requirements and the likelihood that additional costs would be passed on to consumers. In a price-sensitive market like the Philippines, where most consumers are not highly discriminating, such added costs can deter adoption. Although we identified a potential alternative user group, the experience underscored the need to revisit the product design and align it more closely with actual market needs.

These cumulative experiences shaped my motivation to undertake this case study. It provided me with the opportunity to systematically examine the factors influencing technology adoption, moving beyond anecdotal observations toward a more structured analysis. More importantly, it allowed me to validate and refine my understanding of the complex interplay between technological innovation and socio-economic realities.

One of the most significant insights I gained from this study is that scaling agricultural technologies requires far more than their technical introduction. Adoption is not a linear process driven solely by awareness or availability. Rather, it is deeply embedded within a system of interrelated factors, including access to finance, infrastructure, extension services, market linkages, farmer organizations, and climate resilience. These elements must work in concert within a value chain and systems-based framework to create an enabling environment for sustained adoption.

This realization marks a shift in perspective—from viewing technology as a standalone solution to recognizing it as one component of a broader development ecosystem. A holistic approach ensures not only initial uptake but also continued use, productivity gains, and inclusive rural development outcomes. It also highlights the importance of aligning R&D efforts with market realities, policy environments, and the lived experiences of end-users.

Ultimately, this case study reaffirmed my commitment to bridging the gap between R&D and practice. It strengthened my belief that meaningful innovation lies not only in generating new technologies but in ensuring that these technologies are relevant, accessible, and sustainable in real-world contexts. As I move forward, I carry with me a deeper appreciation of the need for integrated, demand-driven, and system-oriented approaches in advancing agricultural and fisheries development.

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APPENDICES

Appendix A

Discussions with Respondents

Discussions with DA RFO XI Research Division Team

Data gathering with GAPSFA coffee farmer members

Appendix B

KII/FGD Interview Guide for Farmers

Arabica Coffee Farming System Development and Utilization in Bansalan, Davao del Sur: Diffusion of Innovations Perspective

Purpose: This interview seeks to gather insights from coffee farmers regarding their perceptions and experiences with the Arabica Coffee-Based Farming System *(Kini nga interbyu nagtumong sa pagkuha og mga panan-aw ug kasinatian sa mga mag-uuma sa kape mahitungod sa ilang mga pagtan-aw ug kasinatian sa Arabica Coffee-Based Farming System)*.

DISCLAIMER AND CONFIDENTIALITY:

Please be informed that your participation is voluntary, and you may withdraw at any time without penalty. While the interview will be audio-recorded to ensure accuracy in transcription and analysis, rest assured that your response to the questions will be considered and handled with utmost confidentiality. Your personally identifiable information will not be disclosed, as codes or general descriptors will be used to ensure anonymity. Recorded interviews, transcripts, and documents will be stored in password-protected digital folders. *(Palihog mahibalo nga ang imong pag-apil boluntaryo lamang, ug mahimo ka nga mo-atras bisan unsang orasa nga walay silot. Bisan pa nga ang interbyu irekord pinaagi sa audio aron masiguro ang tukmang transkripsyon ug pagtuki, among panigurado nga ang imong mga tubag sa mga pangutana pagatagan ug labing taas nga lebel sa pagkakompidensiyal. Ang imong personal nga impormasyon nga makaila kanimo dili ipadayag, kay ang mga kodigo o kinatibuk-ang deskripsyon ang gamiton aron maseguro ang imong pagka-anonimo. Ang mga nairekord nga interbyu, transkripsyon, ug mga dokumento ibutang sa mga digital nga folder nga protektado sa password.)*

Section A. Respondent Profile/Background

1. Name, optional (*Pangalan*, *opsyonal*): ___________________________
2. Contact No. *(numero sa telepono):* ____________________________
3. Institution/Organization *(Organisasyon nga ikaw miyembro)*: ________________
4. Role in the agricultural sector (*Katungdanan sa sektor sa agrikultura*):
    - ☐ Farmer / Producer *(mag-uuma)*
    - ☐ Cooperative Representative (*representante sa kooperatiba*)
5. Primary agricultural livelihood *(Nagunang panginabuhian sa agrikultura)*: _____________________________
6. Years of experience in the coffee sector *(Pila katuig na imong kasinatian sa sektor sa kape)*: _______
7. Size of coffee farm, in ha (*Kadako sa imong uma sa kape*):_________
8. No. of years adopting the Arabica coffee-based farming system promoted by DA RFO XI *(Pila ka tuig ka na nga nigamit sa Arabica coffee-based farming system nga gipasiugda sa DA RFO XI)*: _____________

Section B. Innovation Attributes (Diffusion of Innovations)

1. Relative Advantage *(Relatibong Kaayohan)*

1.1 Compared with your previous farming practices, what benefits have you experienced from adopting the Arabica coffee-based farming system? Please check as many as applicable (*Kung itandi sa imong naunang mga pamaagi sa pag-uma, unsa nga mga benepisyo ang imong nasinati tungod sa pag-adopt sa Arabica coffee-based farming system? Palihog i-check ang tanan nga angay nimo).*

☐ increased coffee yield *(dugang nga ani sa kape)*

☐ additional income from intercrops (*dugang nga kita gikan sa mga intercropping nga tanom* - white potato, bunching onion, carrot)

☐ improved productivity (*milambo nga produktibidad)*

☐ reduced production risks *(naminusan nga risgo sa produksiyon)*

☐ Others, please specify and explain *(Uban pa, palihog isulat ug ipasabut)*

____

1.2 Are there risks or disadvantages associated with the Arabica coffee-based farming system *(Aduna bay mga risgo o mga kadaut nga may kalabotan sa teknolohiya)*?

☐ Yes *(Oo)*

☐ No (*wala)*

If yes, what are these risks/disadvantages (*Kung oo, unsa man kini nga mga risgo/kadaut*)?__________________________

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2. Compatibility *(Pagkahiangay/haom)*

2.1 Does the Arabica coffee-based farming system fit with your usual farming methods in terms of the following *(Uyon ba kini nga Arabica coffee-based farming system sa imong kasagarang pamaagi sa pag-uma sa mosunod nga mga aspeto)*:

2.1.1 Labor Availability *(Pagkaanaa sa Trabahante)*

☐ Yes *(oo)*

☐ No *(dili/wala)*

2.1.2 Compatibility with existing crops *(Pagkahaom sa mga kasamtangang pananom)*

☐ Yes *(oo)*

☐ No *(dili/wala)*

2.1.3 Suitability to upland conditions *(Pagkahaom/angay sa kahimtang sa kabungtoran)*

☐ Yes *(oo)*

☐ No *(dili/wala)*

2.1.4 Cultural acceptance among farmers *(Kultural nga pagdawat sa mga mag-uuma)*

☐ Yes *(oo)*
☐ No *(dili/wala)*

2.1.5 Others, please specify and explain *(Uban pa, palihog isulat ug ipasabut)*

2.2 Does the system align with the local climate, terrain, and farming conditions in Bansalan? *(Nahiangay ba ang sistema sa lokal nga klima, kahimtang sa yuta (terrain), ug mga kahimtang sa pagpanguma sa Bansalan?)*
☐ Yes *(oo)*
☐ No *(dili/wala)*

2.3 Did you need to significantly change your previous farming practices to adopt the system? *(Nagkinahanglan ba kamo og dagkong kausaban sa inyong kaniadto nga mga pamaagi sa pagpanguma aron ma-adopt ang sistema?)*
☐ Yes *(oo)*
☐ No *(dili/wala)*

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3. Complexity *(Kakomplikado)*
3.1 How easy or difficult was it to learn and implement the coffee-based farming system? *(Unsa ka sayon o lisod ang pagkat-on ug pagpatuman sa coffee-based farming system)*
☐ Very easy *(Sayon kaayo)*
☐ Slightly easy *(Medyo sayon)*
☐ Not easy/difficult *(Dili sayon/Lisod kaayo)*

3.2 Which components of the Arabica coffee-based farming system were most difficult to adopt *(Unsang mga bahin sa Arabica coffee-based farming system ang pinakalison nga i-adopt?)*?
☐ technical knowledge, please explain *(Teknikal nga kahibalo, palihog ipasabut)* ________________________________
☐ farm management skills, please explain *(Mga kahanas sa pagdumala sa uma, palihog ipasabut)*______________________________
☐ labor requirements, please explain *(Mga panginahanglanon sa labor, palihog ipasabut)*__________________________________
☐ input requirements, please explain *(Mga materyales nga gikinahanglan, palihog ipasabut)*__________________________________
☐ Others, please specify and explain *(Uban pa, palihog isulti ug ipasabut)*________________________________

3.3 Did you require training or technical assistance to implement the system? *(Nagkinahanglan ba kamo og pagbansay o teknikal nga tabang aron maipatuman ang Arabica coffee-based farming system?)*
☐ Yes *(oo)*
☐ No *(wala)*

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4. Trialability *(Ang posibilidad sa pagsulay)*
4.1 Did you have the opportunity to test the Arabica coffee-based farming system on a small scale before fully adopting it? *(Nakaangkon ba kamo og higayon sa*

pagsulay sa Arabica coffee-based farming system sa gamay nga sukod sa wala pa ninyo kini hingpit nga gi-adopt?)

☐ Yes (oo)

☐ No (wala)

4.2 Were demonstration farms, pilot farms, or field trials available? *(Aduna ba'y mga demonstration farm, pilot farm, o field trial nga magamit?)*

☐ Yes (oo)

☐ No (wala)

4.3 How important was the ability to experiment with the Arabica coffee-based farming system before full adoption? *(Unsa ka importante ang kahigayonan sa pag-eksperimento sa Arabica coffee-based farming system sa wala pa kini hingpit nga i-adopt?)*

☐ Very important *(Importante kaayo)*

☐ Slightly important *(Medyo Importante)*

☐ Not important *(Dili Importante)*

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5. Observability *(Ang pagkakita sa resulta)*

5.1 Were you able to observe the results of the Arabica coffee-based farming system from other farmers before adopting it? *(Nakakita ba kamo sa mga resulta sa Arabica coffee-based farming system gikan sa ubang mga mag-uuma sa wala pa ninyo kini gi-adopt?)*

☐ Yes (oo)

☐ No (wala)

5.2 Did demonstration farms or neighboring farms influence your decision? *(Nakaimpluwensya ba sa inyong desisyon ang mga demonstration farm o ang mga uma sa inyong kasilingan?)*

☐ Yes (oo)

☐ No (wala)

5.3 What visible results convinced you that the Arabica coffee-based farming system works? *(Unsang mga makita nga resulta ang nakakumbinsir kaninyo nga epektibo ang Arabica coffee-based farming system? Pilia ang mga saktong tubag, pwede daghan)*

☐ improved yields *(Dugang nga ani)*

☐ healthy coffee plants *(Himsog nga mga tanom nga kape)*

☐ income improvements *(Dugang ng akita/income)*

☐ successful farmer experiences *(Malampuson nga kasinatian sa uban nga mag-uuma nga nigamit sa Arabica coffee-based farming system)*

☐ Others, please specify and explain *(Uban pa, palihog isulti ug ipasabut)*

____

Section C. Adoption Context *(Konteksto sa pagdawat ug paggamit)*

1. Have you accessed financial support (loans, subsidies, grants) to adopt the technology? *(Nakakuha ba kamo og pinansyal nga suporta (loan, subsidiya, o grant) aron ma-gamait ang Arabica coffee-based farming system?)*

   ☐ Yes (oo)

   ☐ No (wala)

   If yes, from whom? *(Kung oo, gikan kang kinsa?)*

   ☐ DA RFO XI

   ☐ PLGU

   ☐ MLGU

   ☐ Others, please specify (*Uban pa, palihog isulti/isulat)*:

   ____

2. Did you receive extension support/technical assistance or training related to the technology? *(Nakadawat ba kamo og extension support, teknikal nga tabang, o pagbansay nga may kalabutan sa Arabica coffee-based farming system?)*

   ☐ Yes (oo)

   ☐ No (wala)

   If yes, from whom? *(Kung oo, gikan kang kinsa?)*

   ☐ DA RFO XI

   ☐ PLGU

   ☐ MLGU

   ☐ Others, please specify (*Uban pa, palihog isulti/isulat)*:

   ____

3. Is there available needed infrastructure related to this Arabica coffee farming system in your area that helped you adopt this technology? *(Aduna ba'y magamit nga mga kinahanglan nga imprastruktura nga may kalabotan sa Arabica coffee farming system sa inyong lugar nga nakatabang kaninyo sa pag-adopt sa teknolohiya?)*

   ☐ Yes (oo)

   ☐No (wala)

   If yes, please specify
   (Kung oo, palihog isulti/isulat): ____________________

4. Do you have markets and access to the market for coffee and associated crops such as white potato and upland vegetables? *(Aduna ba kamo'y merkado ug akses sa merkado para sa kape ug sa kaubang tanom sama sa patatas, sibuyas ug carrots)*

   ☐ Yes (oo)

   ☐ No (wala)

If yes, where is your market? *("Kung oo, asa ang inyong merkado?)*

____

If yes, how accessible is your market? *(Kung oo, unsa ka sayon maabot ang inyong merkado)*

☐ Very accessible *(Sayon kaayo maabot)*
☐ Slightly accessible *(Medyo sayon maabot)*
☐ Not accessible *(Dili sayon maabot)*

If difficult to access, why? *(Kung lisod maabot, nganong lisod?)* ___________

Can you describe the other current market demand conditions for coffee? *(Mahimo ba nimong ihulagway ang kasamtangang kahimtang sa panginahanglan sa merkado para sa kape?)* ____

5. Do you trust the government institutions or extension workers who introduced you to the technology? *(Nakasalig ba kamo sa mga ahensya sa gobyerno o mga extension worker nga nagpakilala sa teknolohiya kaninyo)*

☐ Yes (oo)
☐ No (wala)

If yes, how important is it to influence your decision to adopt the technology? *(Kung oo, unsa ka importante kini sa pag-impluwensya sa inyong desisyon sa pag-adopt sa teknolohiya)*

☐ Very important *(Importante kaayo)*
☐ Slightly important *(Medyo importante)*
☐ Not important *(Dili importante)*

Why important? *(nganong importante kini?)*______________________________

Section D. Diffusion Mechanisms *(Mga paagi sa pagkatap sa teknolohiya)*

1. Through what diffusion/communication channel did you first learn about the Arabica coffee-based farming system? Please check as many as applicable. *(Pinaagi sa unsang paagi sa pagkatap sa impormasyon/komunikasyon ninyo una nga nahibal-an ang Arabica coffee-based farming system? Palihog markahi ang tanan nga angay.)*

☐ mass media (e.g., tv, broadsheets, radio), please specify *(Mass media (pananglitan: TV, broadsheet nga mantalaan, radyo), palihog isulti ang detalye)*___________________________________
☐ social media (e.g., FB, tiktok, youtube), please specify *(Social media (pananglitan: Facebook, TikTok, YouTube), palihog isulti ang detalye)*_________________

☐ person-to-person (e.g., farmer-to-farmer learning, DA extension workers, LGU extension workers, training workshops, farmer associations/cooperatives, agricultural fairs or field days, company), please specify *(Personal nga tawo sa tawo (pananglitan: farmer-to-farmer nga pagkat-on, DA extension workers, LGU extension workers, training workshops, farmer associations/cooperatives, agricultural fairs o field days, kumpanya), palihog isulti ang detalye)*___________________

2. In terms of effectiveness in promoting the technology, rank the following with 1 as the least effective and 3 as the most effective? *(Sa aspeto sa kaepektibo sa pagpalambo sa teknolohiya, i-ranggo ang mosunod, diin 1 mao ang labing dili epektibo ug 3 mao ang labing epektibo)*

   _____mass media (e.g., tv, broadsheets, radio)

   _____social media (e.g., FB, tiktok, youtube)

   _____person-to-person (e.g., farmer-to-farmer learning, DA extension workers, LGU extension workers, training workshops, farmer associations/cooperatives, agricultural fairs or field days, company)

3. Who most influenced your decision to adopt the technology? Please check as many as applicable. *(Kinsa ang labing naka-impluwensya sa inyong desisyon sa pag-adopt sa Arabica coffee farming system? Palihug markahi ang tanan nga angay.)*

   ☐ Fellow farmer *(Kaubang mag-uuma)*

   ☐ Association/Cooperative officer *(Opisyal sa asosasyon/kooperatiba)*

   ☐ LGU extension officers *(Mga extension officer sa LGU)*

   ☐ Buyer company *(Kompanya nga mopalit)*

   ☐ Others, please specify *(Uban pa, palihog isulti/isulat)* :_____________________

4. Did your farmer networks, cooperatives, or associations help spread the technology? *(Nakatabang ba ang inyong mga network sa mag-uuma, kooperatiba, o asosasyon sa pagpakaylap sa teknolohiya)*

☐ Yes (oo)

☐ No (wala)

5. What role did demonstration farms, field schools, or training programs play in the diffusion of the technology? *(Unsay papel sa mga demonstration farm, field school, o training program sa pagkatap sa teknolohiya?)*____

Section E. Adoption Decision and Diffusion Pattern *(Desisyon sa Paggamit ug Pagpakaylap sa Uban)*

1. To what extent have you adopted the Arabica coffee-based farming system on your farm? *(Hangtud unsa nga lebel ang inyong pag-gamit sa Arabica coffee-based farming system sa inyong uma?)*

☐ Fully adopted *(Hingpit nga gigamit)*
☐ Partially adopted *(Gigamit gamay)*
☐ Modified *(Giusab)*
☐ Not adopted at all *(Wala gayod)*

For what reasons? *(Sa unsa nga rason?)*:________________________________

2. In terms of area, what portion of your farm have you applied the Arabica coffee-based farming system to? *(Sa aspeto sa kadako sa yuta, unsang bahin sa inyong uma ang inyong gipatumanan sa Arabica coffee-based farming system?)*

☐ $\leq$ 25%
☐ 25% - 50%
☐ 51% - 75%
☐ 76% - 100%

What factors influenced this decision? *(Unsa nga mga hinungdan ang naka-impluwensya niini nga desisyon?)*__________________________________

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3. After initially adopting the Arabica coffee-based farming system, have you continued using it over time? *(Human sa una nga pag-gamit sa Arabica coffee-based farming system, nagpadayon ba kamo sa paggamit niini hangtod karon?)*

☐ Consistently used over time, for how long? *(Kanunay nga gigamit sulod sa taas nga panahon, pila na ka tuig)* ____________
☐ Discontinued, after how long of use only *(Gihunong na ang paggamit, pila lang ka tuig gigamit?)*______________
☐ Only tested *(Gisuwayan lang ug wala na gayod gigamit pag usab)*

What factors influenced this decision? *(Unsa nga mga hinungdan ang naka-impluwensya niini nga desisyon?)*__________________________________

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4. Have you recommended or shared this Arabica coffee-based farming system with other farmers? *(Nakarekomenda o nakapaambit ka na ba sa Arabica coffee-based farming system ngadto sa ubang mga mag-uuma?)*

☐ Yes (oo)
☐ No (wala)

What made you decide so? *(Unsa ang naka-impluwensya kaninyo sa pagdesisyon nga buhaton kini)*____________________________________

If yes, how did you share the information? *(Kung oo, giunsa ninyo pagpaambit ang impormasyon, sa unsang mga okasyon? Palihug markahi ang mga imong nahimo na.)*

☐ farmer-to-farmer discussions *(Panag-estorya tali sa mga mag-uuma)*
☐ cooperative/association meetings *(Mga miting sa kooperatiba/asosasyon)*

☐ farm demonstration visits *(Pagbisita sa mga demonstration farm)*
☐ training activities *(Mga kalihokan sa pagbansay)*

If no, why? *(Kung wala pa nimo kini napa-ambit sa uban, ngano?)*_________________

Section F. Lessons and Recommendations

1. Based on your experience, what factors made the Arabica coffee-based farming system successful in your community? *(**Base sa inyong kasinatian, unsang mga hinungdan ang nakapahimo sa Arabica coffee-based farming system nga malampuson sa inyong komunidad?**)*

2. What improvements could be made to further support farmers adopting this system? *(Unsang mga kausaban o pagpaayo ang mahimong buhaton aron mas suportahan pa ang mga mag-uuma nga nag-adopt niini nga sistema?)*

3. What advice would you give to DA RFO XI to improve the diffusion of other agricultural technologies? *(Unsay inyong tambag sa DA RFO XI aron mapaayo pa ang pagpakaylap sa ubang mga teknolohiya sa pagpanguma?)*

Daghang salamat po!

Appendix C

KII/FGD Interview Guide for DA R4DE Manager, Researchers, and Extension Workers

Purpose: This interview complements the farmer interviews by capturing the institutional perspective on technology development, promotion, and diffusion.

DISCLAIMER AND CONFIDENTIALITY:

Please be informed that your participation is voluntary, and you may withdraw at any time without penalty. While the interview will be audio-recorded to ensure accuracy in transcription and analysis, rest assured that your response to the questions will be considered and handled with utmost confidentiality. Your personally identifiable information will not be disclosed, as codes or general descriptors will be used to ensure anonymity. Recorded interviews, transcripts, and documents will be stored in password-protected digital folders.

Section A. Respondent Profile/Background

1. Name (optional): ___________________ Contact No.______________
2. Institution / Organization: __________________
3. Role in the DA RFO XI R4DE Program:
    - ☐ Technology Developer
    - ☐ Extension Worker
    - ☐ R4DE Manager
    - ☐ Others: ____________________________
4. No. of years involved in coffee-related R&D or extension initiatives: ________
5. Role in the development or promotion of the Arabica coffee-based farming system:
    - ☐ Technology Developer
    - ☐ Extension Worker
    - ☐ R4DE Manager
    - ☐ Others: ____________________________

Section B. Technology Development (R&D Perspective)

1. What problem or opportunity motivated the development of the Arabica coffee-based farming system?
2. How was the technology developed and validated before being promoted to farmers?
3. What institutions or stakeholders were involved in the R&D process?
4. What were the intended benefits of the technology for farmers?

Probe:

- productivity improvement
- climate resilience
- diversification of farm income

Section C. Innovation Attributes (DOI)

Relative Advantage

1. In your view, what advantages does this technology offer compared to traditional coffee farming practices?
2. How does the system improve farmer productivity, income, or sustainability?

Compatibility

1. How well does the technology fit with existing farming practices in Bansalan?
2. Were there any cultural or farming practice adjustments required?

Complexity

1. What challenges did farmers face in understanding or implementing the technology?
2. What support mechanisms were provided to reduce complexity?

Trialability

1. Were farmers able to test the technology before full adoption?
2. What role did demonstration farms or pilot projects play?

Observability

1. How visible were the benefits of the technology within the community?
2. Did demonstration sites influence adoption among neighboring farmers?

Section D. Adoption Context

1. What contextual factors facilitated the adoption of the technology?
2. How important were extension services in the adoption process?
3. Did farmers have access to financing or input support?
4. What role did local government units or cooperatives play?

Section E. Diffusion Mechanisms

1. What strategies did DA RFO XI use to promote the technology?
2. How important were demonstration farms in spreading the technology?
3. Did farmer networks contribute to the diffusion process?
4. What communication channels were most effective?

Probe:

- training programs
- farmer field schools
- farmer-to-farmer learning

Section F. Lessons for R&D Management

1. Why do you think this technology achieved relatively high adoption compared with other technologies?

2. What lessons can DA RFO XI learn from this case for future technology dissemination?

3. What improvements can be made in the research-to-extension-to-adoption pathway?

Appendix D

DECLARATION OF RESPONSIBLE USE OF ARTIFICIAL INTELLIGENCE (AI)

As a student of the University of the Philippines Open University (UPOU), I hold myself to a high standard of integrity, and by signing/accepting this declaration below I reaffirm my pledge to act ethically by honoring the UP Principles for Responsible and Trustworthy Artificial Intelligence, and UPOU Guidelines on the Use of AI in Teaching and Learning.

I hereby declare that I used AI **only** for the following purpose/s (please check all that apply):

- finding information about the activity, assignment, and report
- writing a draft outline
- checking grammar and syntax
- generating ideas for titles of research papers, etc.
- checking codes
- generating voice/text-to-speech
- others: ________________
- I did not use any AI in any of my course requirements.

I acknowledge that the work I submit is largely the result of my own intellectual effort.

I am fully accountable for any breach of the UP Principles for Responsible and Trustworthy Artificial Intelligence, and UPOU Guidelines on the Use of AI in Teaching and Learning.

In accordance with the rules and regulations of the University of the Philippines on student conduct and discipline, I certify that all my answers here are my own work, and that I have cited all references that were used in this assignment:*

MILVA LUNOD-CARINAN

* As approved by the BOR at its 876th meeting on September 2, 1976 and as amended at the 923rd BOR meeting on January 31, 1980 and 1017th BOR meeting on March 8, 1988 and further amended at the 1041st BOR meeting on July 4, 1991 and 1051st BOR meeting on June 25, 1992