


SHIFTING PARADIGMS IN COFFEE-BASED CULTIVATION: CULTURAL MANAGEMENT PRACTICES AND TECHNOLOGY UTILIZATION IN UPLAND, CAVITE, PHILIPPINES

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ARTICLE INFO	ABSTRACT
<p>Article history:</p> <p>Received 20 February 2023</p> <p>Accepted 22 May 2023</p>	<p>Purpose: The aim of this study is to analyze the changes in the cultural management practices and technology used in farming that have taken place with the coffee-based farming systems in an upland area in Cavite, Philippines from 2001-2020.</p>
<p>Keywords:</p> <p>Qualitative Research; Cultural Management Practices; Technology; Coffee-Based Cultivation; Coffee-Based Farming Systems; Triple Bottom Line; Rural Development; Community Development.</p>	<p>Theoretical framework: The Triple Bottom Line (TBL) paradigm is a sustainable development strategy considering social, environmental, and economic factors. Once agricultural systems are tested, TBL might help promote productive and sustainable farming practices that benefit producers, communities, and the environment. By adopting a complete sustainability strategy, the TBL framework may help develop socially, ecologically, and economically sustainable agricultural systems and contribute significantly to long-term adaptation and prosperity.</p>
	<p>Design/methodology/approach: The study is qualitative research design and used several data collection methods, including in-depth interviews, key informant interviews, focus group discussion, document analysis, field notes, and farm visits and observations.</p>
	<p>Findings: The results show that in farmers' different cultural management practices, significant changes have occurred in several methods over the past two decades. Regarding the application and use of new technologies, farmers applied newly introduced technologies by individuals and other institutions.</p>
	<p>Research, Practical & Social implications: The study sheds light on the current state of coffee-based cultivation and practices and make recommendations to further improve farmers' cultural management practices and sustain the local coffee-based farming system. In addition, access to new and relevant technology and knowledge on how to apply it to improve farming productivity among coffee-based farmers This study also provides valuable guidance for extension experts and workers, policymakers, coffee-based growers, and researchers who want to improve coffee-based farming systems' sustainability and economic viability at the same time empower farming communities.</p>
	<p>Originality/value: This study is a qualitative examination of how technology utilizations and cultural management practices interact with coffee-based agricultural systems in Upland Cavite, Philippines. This research provides much-needed in-depth knowledge of how traditional agricultural systems adjust to technology improvements during the global crisis since there have been few qualitative studies on this topic, particularly at such a trying time. It provides a localized perspective that acknowledges regional variations and the influences of geographical and socio-cultural nuances as it examines the socio-economic and cultural impacts of technology adoption in the specific sector of coffee-based farming, which is vital to the Philippine economy. Moreover, the study is noteworthy in providing a temporal component that describes how technology has changed practices through time. The findings of this research, which were obtained during an unprecedented period, should help</p>

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stakeholders create more effective and culturally-sensitive strategies for adopting technology and sustainability in coffee-based cultivation. Combining these distinctive elements highlights the research's significant uniqueness and worth.

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MUDANÇA DE PARADIGMAS NO CULTIVO DE CAFÉ: PRÁTICAS DE GESTÃO CULTURAL E UTILIZAÇÃO DE TECNOLOGIA EM TERRAS ALTAS, CAVITE, FILIPINAS

RESUMO

Objetivo: O objetivo deste estudo é analisar as mudanças nas práticas de gestão cultural e na tecnologia utilizada na agricultura que ocorreram nos sistemas de cultivo de café em uma área de terras altas em Cavite, Filipinas, de 2001 a 2020.

Estrutura teórica: O paradigma do Triple Bottom Line (TBL) é uma estratégia de desenvolvimento sustentável que considera fatores sociais, ambientais e econômicos. Quando os sistemas agrícolas são testados, o TBL pode ajudar a promover práticas agrícolas produtivas e sustentáveis que beneficiem os produtores, as comunidades e o meio ambiente. Ao adotar uma estratégia de sustentabilidade completa, a estrutura do TBL pode ajudar a desenvolver sistemas agrícolas social, ecológica e economicamente sustentáveis e contribuir significativamente para a adaptação e a prosperidade em longo prazo.

Projeto/metodologia/abordagem: O estudo é um projeto de pesquisa qualitativa e utilizou vários métodos de coleta de dados, incluindo entrevistas aprofundadas, entrevistas com informantes-chave, discussões em grupos de foco, análise de documentos, anotações de campo e visitas e observações de fazendas.

Conclusões: Os resultados mostram que, nas diferentes práticas de gestão cultural dos agricultores, ocorreram mudanças significativas em vários métodos nas últimas duas décadas. Com relação à aplicação e ao uso de novas tecnologias, os agricultores aplicaram tecnologias recém-introduzidas por indivíduos e outras instituições.

Implicações sociais, práticas e de pesquisa: O estudo lança luz sobre o estado atual do cultivo e das práticas baseadas no café e faz recomendações para melhorar ainda mais as práticas de manejo cultural dos agricultores e sustentar o sistema local de cultivo de café. Além disso, o acesso a tecnologias novas e relevantes e a conhecimentos sobre como aplicá-las para melhorar a produtividade agrícola entre os cafeicultores. Este estudo também oferece orientação valiosa para especialistas e trabalhadores de extensão, formuladores de políticas, cafeicultores e pesquisadores que queiram melhorar a sustentabilidade e a viabilidade econômica dos sistemas de cafeicultura e, ao mesmo tempo, capacitar as comunidades agrícolas.

Originalidade/valor: Este estudo é um exame qualitativo de como a utilização da tecnologia e as práticas de manejo cultural interagem com os sistemas agrícolas baseados no café em Upland Cavite, Filipinas. Esta pesquisa proporciona o tão necessário conhecimento aprofundado de como os sistemas agrícolas tradicionais se ajustam aos aperfeiçoamentos tecnológicos durante a crise global, uma vez que há poucos estudos qualitativos sobre esse tópico, sobretudo em um momento tão difícil. Ela oferece uma perspectiva localizada que reconhece as variações regionais e as influências das nuances geográficas e socioculturais ao examinar os impactos socioeconômicos e culturais da adoção de tecnologia no setor específico da agricultura baseada no café, que é vital para a economia das Filipinas. Além disso, o estudo é digno de nota por fornecer um componente temporal para a adoção da tecnologia.

Palavras-chave: Pesquisa Qualitativa, Práticas de Gestão Cultural, Tecnologia, Cultivo à Base de Café, Sistemas Agrícolas à Base de Café, Triple Bottom Line, Desenvolvimento Rural, Desenvolvimento Comunitário.

CAMBIO DE PARADIGMA EN EL CULTIVO DEL CAFÉ: PRÁCTICAS DE GESTIÓN CULTURAL Y UTILIZACIÓN DE TECNOLOGÍA EN TIERRAS ALTAS, CAVITE, FILIPINAS

RESUMEN

Objetivo: El objetivo de este estudio es analizar los cambios en las prácticas de gestión cultural y la tecnología utilizada en la agricultura que se han producido en los sistemas de cultivo de café en una zona de tierras altas en Cavite, Filipinas, desde 2001 hasta 2020.

Marco teórico: El paradigma de la triple cuenta de resultados (Triple Bottom Line, TBL) es una estrategia de desarrollo sostenible que tiene en cuenta factores sociales, medioambientales y económicos. Cuando se ponen a prueba los sistemas agrarios, el TBL puede ayudar a promover prácticas agrícolas productivas y sostenibles que beneficien a los productores, las comunidades y el medio ambiente. Al adoptar una estrategia integral de sostenibilidad, el marco del TBL puede ayudar a desarrollar sistemas agrícolas sostenibles desde el punto de vista social, ecológico y económico, y contribuir significativamente a la adaptación y la prosperidad a largo plazo.

Diseño/metodología/enfoque: El estudio es un diseño de investigación cualitativa y utilizó diversos métodos de recopilación de datos, como entrevistas en profundidad, entrevistas a informantes clave, debates en grupos focales, análisis de documentos, notas de campo y visitas y observaciones a explotaciones agrícolas.

Conclusiones: Los resultados muestran que en las prácticas de gestión cultural de los distintos agricultores se han producido cambios significativos en varios métodos a lo largo de las últimas décadas. En cuanto a la aplicación y el uso de nuevas tecnologías, los agricultores aplicaron tecnologías recién introducidas por particulares y otras instituciones.

Repercusiones sociales, prácticas y de investigación: El estudio arroja luz sobre el estado actual del cultivo del café y las prácticas basadas en el café y formula recomendaciones para seguir mejorando las prácticas de gestión cultural de los agricultores y sostener el sistema local de cultivo del café. También proporciona acceso a tecnologías nuevas y pertinentes y conocimientos sobre cómo aplicarlas para mejorar la productividad agrícola entre los caficultores. Este estudio también proporciona una valiosa orientación para expertos y trabajadores de extensión, responsables políticos, caficultores e investigadores que deseen mejorar la sostenibilidad y la viabilidad económica de los sistemas de cultivo de café y, al mismo tiempo, empoderar a las comunidades agrícolas.

Originalidad/valor: Este estudio es un examen cualitativo de cómo la utilización de la tecnología y las prácticas de gestión cultural interactúan con los sistemas de cultivo basados en el café en Upland Cavite, Filipinas. Esta investigación proporciona un conocimiento en profundidad muy necesario sobre cómo los sistemas agrícolas tradicionales se ajustan a las mejoras tecnológicas durante la crisis mundial, ya que hay pocos estudios cualitativos sobre este tema, especialmente en un momento tan difícil. Aporta una perspectiva localizada que reconoce las variaciones regionales y las influencias de los matices geográficos y socioculturales a la hora de examinar las repercusiones socioeconómicas y culturales de la adopción de tecnología en el sector específico de la agricultura basada en el café, vital para la economía filipina. Además, el estudio destaca por aportar un componente temporal a la adopción de tecnología.

Palabras clave: Investigación Cualitativa, Prácticas de Gestión Cultural, Tecnología, Cultivo del Café, Sistemas Agrícolas Basados en el Café, Triple Balance, Desarrollo Rural y Desarrollo Comunitario.

INTRODUCTION

Communities that depend on producing coffee-based crops have a rich cultural history ingrained in their customs, values, and ways of life. Farmers practicing coffee-based farming employ various cultural management techniques to preserve their cultural history and the quality of their coffee crops. Intercropping, shade-grown coffee growing, organic farming techniques, and other environmentally friendly agricultural approaches are frequently used in these operations. In order to increase the effectiveness and productivity of farming communities, new technologies have recently been implemented in communities that depend on coffee-based farming. These innovations involve good agricultural practices, including new practices and technologies, new equipment, and digital tools for tracking crop growth, soil health, weather conditions, etc. These innovations could aid growers in raising yields, lowering expenses, and enhancing the caliber of their farming activities, which could lead to agricultural and rural development (Malinao, 2022). The study of (Shariff et al., 2022) on long-term agricultural sustainability found a growing body of research on the characteristics that might persuade and encourage Asian farmers to incorporate modern agricultural practices into their farming activities. Such research results are crucial for the government and policymakers in adopting policies for sustainability (Ratnasari et al., 2023). According to the Farming Systems

and Soil Resources Institute FSSRI (1999), Filipino farmers have proven to be more willing to adopt technology when they realize that other farmers have successfully used it. There was also knowledge sharing on farming procedures among these farmers in Amadeo, Cavite, indicating that farmers are willing to learn new agricultural techniques and practices from their neighbors. Therefore, creating a sense of community can be created especially when increasing degrees of connection, and support, according to Dugas and Schweitzer (1997, as cited in Luna et al., 2023) to encourage these stakeholders like the farming communities. Technology is advancing in rural places such as the Philippines, where agriculture has traditionally been connected with human labor and archaic farming practices. The impression that farming is a low-paying occupation complicates the Department of Agriculture's (DA) aim to ensure food security and increase sector recruitment. However, the sector is currently experiencing slow but consistent development. In recent years, the public and commercial sectors have attempted to address self-sufficiency in crucial food staples through improved varieties, cutting-edge agricultural methods, and technologies in the agricultural industry. Since they were "planned in such a way that they would not only be able to respond to the requirements of the people in 6 years, but beyond ten years, 20 years, and even 50 years," the agency's core plans were made public by the Philippines DA the previous year. Several pieces of literature on the sustainability and success of farming systems have an emphasis on the inclusion of technology (FSSRI, 1999), (David et al., 2018), (Beaman et al., 2018), government extension support services, and farmer-driven extension (FSSRI, 1999), (Namvong and Baconguis, 2010), the Science and Technology Backyard (STB) Platform (Zhang et al., 2016), and the use of available information and communications technology (ICT) systems (Lindblom et al., 2016) as essential interventions and inclusion of agricultural development (Baconguis, 2008). This means that the fewer technologies and less good agricultural practices are applied, the lower production can be gained, which is also an indication that other countries are adhering and is evident in the experiences of several countries worldwide such as United States, China, Brazil, India, Canada, and other Asian Countries like Vietnam, Japan and among others. In their agricultural thrust, these prosperous countries are believed to have continually improved their agricultural programs up to the grassroots level and use sustainable frameworks. These frameworks are linked to agroecology and the Tripple Bottom Line. Agro ecology recognizes the value of farmers' knowledge and innovations and encourages local learning and innovation through stakeholder engagement and farmer-to-farmer transfer. It also seeks to create farming systems that are self-sustaining, effective, and inclusive while also promoting the well-being of farming

communities. The Triple Bottom Line (TBL) framework is a sustainable development approach considering social, environmental, and economic impacts. TBL could indeed contribute to promoting effective and sustainable farming methods that support farmers, communities, and the environment once tried farming systems. The TBL framework can help promote socially, environmentally, and economically sustainable farming systems and make a significant contribution to long-term adaptability and wealth by taking a comprehensive approach to sustainability. Most farmers in Amadeo, Cavite, Philippines, have been practicing coffee-based farming systems for decades. Their farming activities include different farming practices passed down by their ancestors and learning from observing and asking other co-farmers experiences about best farming practices. In upland Cavite, Philippines, limited research was also conducted investigating the changes in coffee-based farmers' cultural management practices and technology applications and practices through time. Thus, this study is imperative because it will not only add to the existing body of knowledge but will also serve as the foundation for the concerned agencies and organizations on how to improve further farmers' livelihood activities, particularly the incorporation of updated farming practices and technologies to empower farming communities further and improve their economic wellbeing. This qualitative research can also be used as basis to increase collaboration with other organizations and institutions and design extension programs that will use teamwork to promote evidence-based decision-making in rural communities.

Research Objectives

Generally, the study sought to examine the shifting paradigms that have taken place in the cultural management practices and application of technologies in the last two decades of coffee-based farmers in Upland, Cavite, Philippines. Specifically, it answered the following research questions:

1. What are coffee-based farming systems present in upland Cavite, Philippines?
2. What are the perceive changes in the cultural management practices among coffee-based farmers?
3. What are the perceive changes in applying technologies and practices among coffee-based farmers?
4. What are the causes and effects of these changes, and how did farmers adjust?
5. What recommendations can be given to improve and sustain the coffee-based cultivation in Upland, Cavite, Philippines?

MATERIALS AND METHODS

This study used a qualitative research method using multiple case studies based on Yin (2003) framework. The researcher used the resources provided in this study to examine phenomena in various settings and conduct in-depth analyses within and among contexts. The research was conducted in Amadeo, the top-producing coffee bean in the province of Cavite (Provincial Agricultural Profile) and known as the Coffee Capital of the Philippines. The said municipality has the largest coffee plantations in the province. More than 90% of the total land area of 4,790 hectares is devoted to agricultural activities.

Figure 1. Map showing the location of the study area



(Source: <https://sites.google.com/site/amadeocaviteph/location>)

Using semi-structured interviews, the researcher chose purposively the participants for the individual in-depth interviews for farmer participants, key informants and focus group discussion according to set criteria.

For the Coffee-based farmers: (a) he or she is personally attending to his or her farm in terms of management and actual field operations. (b) he or she has a minimum experience in coffee-based farming of at least 20 years. (c) he or she tills at least 0.5 hectare of coffee-based farmland either owned or tenanted. (d) he or she is known as having a successful track record of coffee farming. (e) he or she is willing to participate in the study. on industry, organization and institution partners: (a) key persons who are knowledgeable of the topic were interviewed; and (b) willingness of the key persons and members to join an in-depth interview within the given time period. The participants for the FGD were composed of farmers from the existing farming systems identified and farmer-members of a coffee-based association. The selection

criteria for the participants of the FGD were the following: (a) he or she is personally attending to his or her farm in terms of management and actual field operations. (b) he or she has a minimum experience in coffee farming of at least 20 years. (c) he or she tills at least 0.5 hectare of coffee-based farmland either owned or tenanted. (d) he or she is willing to participate in the study. Five to six participants in each identified type of farming system, and one to two informants from other institutions such as government agencies, state college or university and private institutions and six participants for FGD. The methods utilized in collecting data were in-depth interviews, key informant interviews, focus group discussion (FGD), document reviews, actual farm observations or visits, reconnaissance visits or transect walk and mapping. An informed consent form was secured from each participant, stressing that involvement is voluntary and that he or she has the right to withdraw at any moment. Participants were also told that confidentiality would be respected. During the data-gathering process, the researcher gave the participants follow-up questions based on the study objectives to clarify and validate the information gathered. Interviews were also recorded and transcribed.

The researcher adapted the framework by Lincoln & Guba. (1986) to ensure trustworthiness in qualitative research, which includes credibility, dependability, conformability, and transferability. The researcher's credibility was assured using proper data collection and key informant selection methodologies. In order to strengthen the legitimacy of the acquired data, the researcher validated the data collected with the participants for them to check its accuracy Creswell and Poth (2018). As the researcher performed a series of interviews, observations, and informal discussions, the data's dependability was assured, hence, iteration reinforced the correctness of the data acquired. Third, conformability was applied by including external researchers and experts in agriculture, rural sociology, extension education, and community development to check, critique, and give suggestions for the improvement of this research. Finally, the study's transferability is suggested because the researcher clarified components such as data gathering techniques, participants, and data analysis. As a result, it can assist other researchers in determining if the facts acquired, implications, recommendations given, framework and theory developed are transferable and their contribution to the body of existing knowledge (Creswell and Creswell 2017). In addition, the researcher adapted Braun and Clarke's (2013) six phases of the thematic analysis framework in the case study, such as familiarizing the data, coding, searching for themes, reviewing themes, defining and naming themes, and writing up. Moreover, the researcher utilized HyperResearch version 4.5.2 to organize, analyze, and interpret the qualitative data collected.

Participants of the Study

Table 1 presents the participants for this study. There are twenty-one (21) farmer participants from the various farming systems for the study. A focus group discussion was also held with six farmer members joining the discussion, and ten (10) selected key informants were also part of this study. The total composition of participants is thirty-seven.

Table 1. Participants of the Study

Participant	Number of Participants
Intercrop Farming System Farmers	5
Multi-Story Farming System Farmers	6
Integrated Farming System Farmers	5
Peri-Urban Farming System Farmers	5
Focus Group Discussion (1)	6
Key Informants (Groups, Organizations and other Institutions)	10
Total	37

Source: Prepared by the Author (2023)

RESULTS AND DISCUSSION

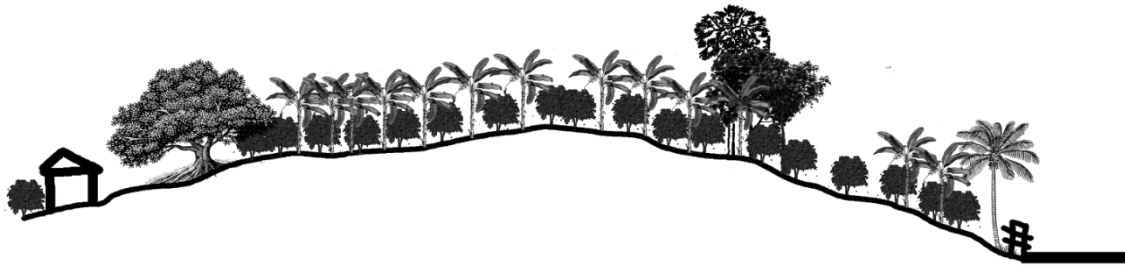
Classification of Coffee-Based Farming Systems in Upland, Amadeo, Cavite, Philippines

This study identified four farming systems based on coffee farming systems' dominating characteristics such as multi-story, intercropping, integrated, and peri-urban.

Intercropping Farming System

These are a dominant mixture of two major crops within a specific boundary and the most common species combinations are coffee and banana. It is claimed from the reconnaissance visits that, since coffee only bears fruit once a year, the upland farmers found ways to look for crops that could make up for the months with no income. Bananas are considered a crop that could fulfill their needs in months when coffee cannot provide for them financially. In one of the representative farms, aside from bananas and coffee, there are also trees like coconut, which serve as a boundary, guyabano, and mahogany. While there are some points where the topography is minorly customized, no significant differences except species composition are observed. Figure 2 is the product of transect mapping in one of the selected areas in Upland, Amadeo, Cavite, Philippines. Other intercrop farming systems also include an elevation that varies at some points. As in the previous example, coffee and banana are the dominant crops comprising the intercrop, there were other species, such as mango, antipolo, sintones (sinturis a citrus fruit), and pomelo. At the lowest point of the farm lies the village farm-to-market road.

Figure 2. Intercrop farm in Upland, Amadeo, Cavite, Philippines

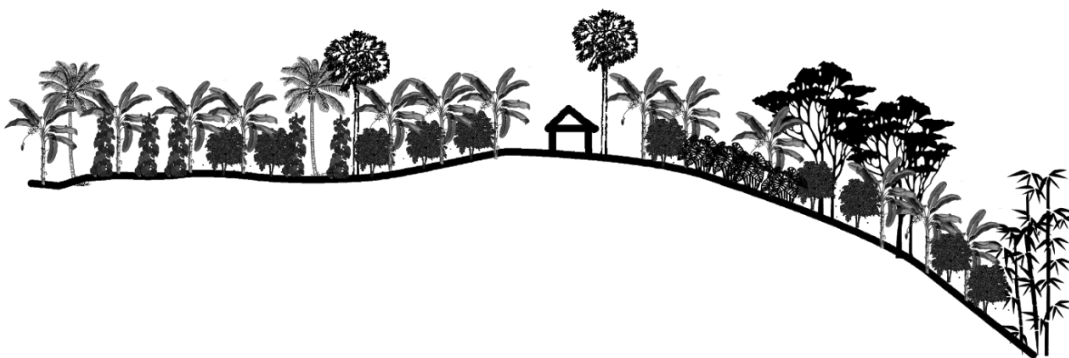


Source: Prepared by the Author (2023)

Multi-Storey

This multi-layered farming system was also observed in some farming systems in the municipality of Amadeo. One of the farms of this type is an upper-level vegetation composed of coconut, mahogany, antipolo fruit tree, banana, and bamboo (although this is also seen on the lower slope of the area). Coffee shrubs compose the mid-level vegetation, coupled with black pepper vines crawling through dead coffee trunks and other plausible clinging media. The bottom vegetation is composed of grasses and taro. On this representative farm, the species available comprise several crops such as coffee, coconut, banana, guava, cotton fruit or wild mangosteen, cassava, and taro. There are also units for papaya and pineapple. The multi-story farming system in Cavite is also combined with coconut and annual and perennial crops like papaya, pineapple, taro, banana, sweet potato, sayote, ginger, etc.

Figure 3. Multi-story Farm in Upland, Amadeo, Cavite, Philippines



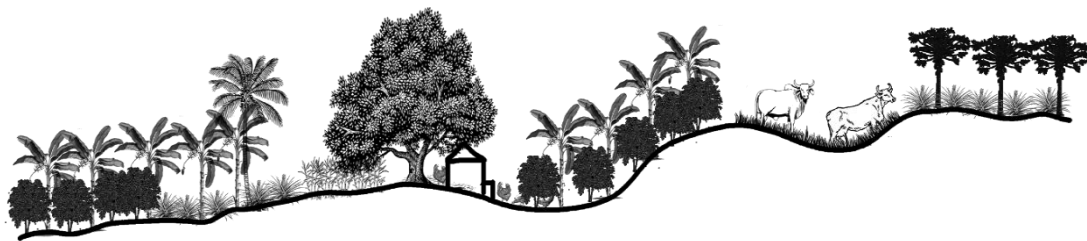
Source: Prepared by the Author (2023)

Integrated Farming System

The primary considerations for this farming system are the synergic presence of agronomic-horticultural and livestock components. The representative farm on integrated farming systems exhibits various agricultural system components. A coffee-based integrated

farm comprises intercropped mono-cropped and agro-pastoral zones. Aside from coffee, the farm has coconut and banana plantations, ginger patches, a designated area for corn production (used for native chicken feed and human consumption), a pineapple-banana intercrop, a papaya-pineapple intercrop, and a coffee-banana intercrop. On the side of livestock are heads of grazed cattle and free-range native chickens with respective areas for food and shelter. While coffee is an essential crop grown in this farming system, it is evident that the priorities of this specific farm do not rely solely on coffee.

Figure 4. Integrated Farm in Upland, Amadeo, Cavite, Philippines



Source: Prepared by the Author (2023)

Other integrated farming system in Upland, Amadeo, Cavite, Philippines, is also intercropped but integrated with units of native chicken, carabaos, goats and horses. This agricultural area is situated approximately 10 meters from Amadeo's national road. The crops available are also coconut, coffee, banana, cotton fruit or wild mangosteen, jack fruit, papaya, mango, and antipolo fruit tree (*artocarpus blancoi*). Some patches of red chili and taro are also cultivated around the farming area. The fecal matter produced by the horse and its other by-produced is shed and let out in the soil for soil health purposes, and the manure produced by the chickens is also expected to be integrated with the soil as a nutrient.

Peri-Urban Farming System

Five farms represent the peri-urban farming system in the municipality was visited. A farming area classified as "urban" lies at the periphery of the residential area, the town cemetery, and one of the town's installed cell sites. Small residential areas were established separately along the road after passing through the cemetery. Not so far away from the homes are poultry farms owned by those in the upland, Amadeo, Cavite. It is situated along the national highway and accessible to the general public, especially consumers and middle men. Generally, the projection of this specific peri-urban farm is flattened and planted with crops such as cacao, coconut, banana, durian, mahogany, mango, *madre de cacao* or "glabrous cassia, and *sintones*

(sinturis a citrus fruit), which make up most of the upper vegetation, and coffee in the middle portion, as it is regularly maintained by pruning further growth (offshoots) on the shrubs. Most of the ground vegetation is covered with various weeds and taro, which were initially unintendedly grown in the area.

On the other hand, other farm classified as per-urban is also near another cell site installed in the municipality. This relatively small peri-urban farm is alternatively aligned with dwarf and tall coconut tree varieties within its boundaries and enjoined by other fruit crops, namely: banana, jackfruit, *sintones* (sinturis a citrus fruit), pomelo, and rambutan. Coffee is also one of the farm's main crops. Trees in this part of the farm contribute to the canopy of the whole farming system, conditioning a relatively more relaxed (cooler) micro-environment for the farm. Topographically, the farm is flat.

Figure 5. Peri-Urban Farm in Upland, Amadeo, Cavite



Source: Prepared by the Author (2023)

Perceived Changes in the Cultural Management Practices in Upland Cavite, Philippines Across Coffee-Based Farming Systems

Changes in cultural management practices refer to the respondents' perceptions of changes in the various management practices of coffee-based farming over the past two decades. Farmers in the Upland Amadeo, Cavite, Philippines, have been practicing coffee-based farming systems for decades and their farming activities include various cultural farming practices passed down by their ancestors and learned from other neighboring farmers. According to FSSRI (1999), that Filipino farmers have proven that they are willing to adopt new practices and technologies when they realize that other farmers have successfully used it. There was also knowledge sharing on coffee-based farming procedures among these farmers in Amadeo, Cavite, indicating that they learned new agricultural methods from their neighboring farmers.

(That is what our father taught us when we were new to farming. I saw my grandfather's coffee-based farm, and it was good. My father told me that my ancestor was good at farming and taught me everything to me, especially the coffee-based farming practices he had been doing in farming.) (Folder 1; Farmer Participant).

(If I do not know or am unsure about something, I ask someone, especially about some best practices in cultivating coffee and other crops on my farm.) (Folder 1 Farmer Participant 1)

In terms of coffee-based farming systems, the researcher identified and themed the different cultural management practices through in-depth interviews. These identified CMPs have been applied and used by farmers for decades regardless of the type of farming system they have. It is noted that among these CMP, there were new changes, and others have had no recent changes at all for the past decades. These are: (a) land clearing and preparation; (b) seed preparation; (c) transplanting or spacing; (d) cropping patterns; (e) weeding; (f) fertilizer application; (g) pruning; (h) pest and disease management; (i) harvesting operations; (j) transportation; (k) post-harvest/drying/storage; and (l) marketing/selling of harvest. The specific definitions of these cultural practices are given below:

1. **Harvesting Operations:** Harvesting refers to the process of collecting mature fruits or crops from plants. It is important to harvest at the right time to ensure high quality. In coffee-based farming systems, harvesting is usually done manually by picking ripe coffee cherries and other crops such as bananas, corn, cacao, and coconut and other crops. For instance, the farmers practice harvesting red or ripe cherries only for coffee crops to ensure that quality beans are produced for the final coffee product.
2. **Transporting activities** in coffee-based farming systems relate to transferring agricultural goods or inputs, such as coffee cherries, fertilizers, or insecticides, from one area to another. These procedures are critical in ensuring that goods or inputs get to their destination in a timely and efficient way, which is critical for crop quality and the success of the farming endeavors. Transporting activities can be carried out using various techniques, including employing animals such as horses or mules to convey goods or inputs to and from the farm. Depending on the distance and topography involved, these are critical to the profitability of coffee-based agricultural operations.
3. **Seedlings Preparation:** Seedlings preparation involves the production of young coffee-based plants and other crops from seeds or vegetative materials such as cuttings. This is an essential aspect of coffee-based farming as it determines the quality and yield

of coffee production. As part of the Department of Agriculture programs, farmers in the upland Cavite Philippines were supported and provided crop seedlings in the past years.

4. **Pest and Disease Management:** Pest and disease management involves using various techniques to control pests and diseases that affect coffee-based production. These techniques may include chemical pesticides or biocontrol agents, crop rotation, and pruning.

5. **Fertilizer Application:** Fertilizer application involves using various fertilizers to improve soil fertility and increase crop yields. In coffee-based farming systems, fertilizers can be used to increase the nutrient content of the soil to support healthy coffee plant growth. In coffee-based farming in Amadeo, Cavite, Philippines, farmers practice digging fertilizer as new method to make crops more efficient and productive.

6. **Pruning** removes undesirable or dead branches from coffee and other plants to encourage healthy development and boost production which is a vital part of coffee-based system that necessitates expertise and understanding.

7. **Rejuvenation.** This is the process of rejuvenating aged coffee trees by pruning or other procedures. This is critical in coffee-based agricultural systems especially coffee trees to sustain high output and productivity.

8. **Land Clearing and Preparation:** Land clearing and preparation include clearing land for coffee-based production and planting soil. This is an important phase in coffee-based cultivation since it guarantees the best circumstances for coffee and other crops growth.

9. **Transplanting/Spacing:** The act of transporting young coffee and other crop seedlings from the nursery to the field to new areas is referred to as transplanting or spacing. Correct spacing practices is critical for maximum growth and production of coffee and other crops.

10. **Cropping patterns** are the arrangements of crops on a farm that maximize land utilization and yield. In coffee-based agriculture, crops may be intercropped with other crops to boost soil fertility and increase output and production.

11. **Weeding System:** Weeding systems remove undesired plants or weeds from a field. Weeding is necessary for coffee-based farming systems to avoid nutrient competition and to promote the maximum development and production of coffee and other plants.

12. Post-Harvest/Drying/Storage: These terms refer to the processing and storage of coffee beans following harvest. This is an essential part of coffee growing since it influences the quality and worth of the coffee beans.

13. Harvest Marketing/Selling: Finding purchasers for the coffee beans and negotiating a price is part of the harvest marketing and selling process. This is essential to coffee-based farmers since it influences the farmer's revenue and the farming enterprise's profitability. In the case of the farmers in Amadeo, Cavite, Philippines they use traditional practice such as contacting traders or buyers to do the harvesting operation of the crops and directly buy it from them.

Table 2. Perceived Changes in the Cultural Management Practices

Cultural Management Practices	No Change	2001-2005	2006-2010	2011-2015	2016-2020
Harvesting Operations		x	x	x	x
Transporting operations		x	x	x	x
Seedlings Preparation			x	x	x
Pest Disease Management			x	x	x
Fertilizer Application				x	x
Pruning				x	x
Rejuvenation				x	x
Land Clearing and Preparation	x				
Transplanting/Spacing	x				
Cropping Patterns	x				
Weeding System	x				
Post-Harvest/Drying/Storage	x				
Marketing/Selling of Harvest	x				

Source: Prepared by the Author (2023)

Looking at the table, we can observe that most CMPs saw modifications between 2001 and 2020. No changes were recorded in land clearance and preparation, transplanting/spacing, cropping patterns, weeding system, and post-harvest/drying/storage and marketing or selling of harvest. Harvesting operations and transporting operations saw alterations between 2001 and 2020. Changes in seedling preparation and pest disease control were observed between 2006 and 2020. Moreover, changes in fertilizer application, pruning, and rejuvenation was also observed between 2011 and 2020. *(In our experience, several practices had changes while other practices in farming have had no changes since we have been doing them even before, and we still find them effective in farming.) (Folder 1; Farmer Participant 1)*

According to the farmers, most of their seedlings, such as coffee, papaya, bananas, vegetables, and other crops that they integrate into their farms, are given for free through the local municipal, agricultural office under the program of the department of agriculture. Unlike before, they produce seedlings from their farms, buy them from the market, or get them to their

co-farmers. The said program of distributing free seedlings is one of the institution's projects to help our small farmers instead of buying from the market and sustaining their farming systems, which has been one of the current programs for the past ten years. Since this has happened in the past decade, this program has dramatically helped farmers access quality seeds from the department of agriculture through the local government unit's collaborative efforts. This has benefited farmers because it has made it easier for them to access seedling crops to be planted on their respective farms. In contrast, previously, it was an additional burden on their part to prepare, find, and purchase seed crops for their farms. Farmers mentioned that: *(They taught us this new method of cultivating coffee and other crops and gave us organic fertilizer, seedlings, and farming tools.) (Folder 1; Farmer Participant 2)*. In addition to these changes, a new way of applying fertilizer was also introduced to the farmers by the DA. Farmers were taught the proper fertilizer application to crops, especially coffee trees. *(The system for applying fertilizer has changed. Before, the method we used in applying fertilizer was different, but lately, we have been taught the new way of applying fertilizers to our coffee-based crops... it takes time to apply.) (Folder 1; Farmer Participant 2)*.

However, this adopted new changes in applying fertilizer has some effects on farmers: *(The method that we use, we noticed that our plants are improving. They flourished, like the digging we did in our coffee trees for fertilizer application. Seminars are a big help to us.) (Folder 1; Farmer Participant 12)*. Other adverse effects include the process being too laborious for them and the additional labor costs incurred as they hire additional people to complete the tasks. Some farmers could not apply the said new process or method because some were too old to apply it to their farm's coffee trees—hundreds or thousands of coffee trees. In addition, if they were to hire labor, it would be an additional input in their farming. *(Digging the fertilizers around the crops is too laborious and takes more time...)* (Folder 1; Farmer Participant 1).

Another noted change in the farming systems and practices of the farmers in Upland Amadeo, Cavite, was their practice of pruning. Regardless of the type of farming system, the department of agriculture introduced pruning through the local municipal agricultural office. The agricultural technicians of the locality have explained the importance of pruning their crops, especially coffee because this improved productivity of coffee crops. Farmers found this new practice introduced to them beneficial since they observed there are benefits not only to the coffee but also to other crops integrated into their farms, such as the distribution of sunlight and air. When it rains, it directly pours onto the crops like bananas and papayas planted alongside

coffee since these crops are not fully shaded anymore by the coffee leaves. *(We started using pruning, and it has been ten years when it was introduced to us.) (Folder 1; Farmer Participant 1)*

There have also been noted changes in farmers' practices in the last two decades, such as rejuvenation. They introduced a new practice of boosting coffee trees' productivity 5 and 10 years ago, like pruning. Instead of planting new coffee trees, rejuvenation was done by cutting the main branches of the coffee trees and waiting for 2-3 years for them to sprout, grow, and bear fruits. According to farmers, this is less time to wait since the usual waiting time for the coffee trees, from seedling to fruit-bearing, is five years or more. They introduced this practice to make the crops more productive, especially the coffee crops, since most of the coffee trees planted are already old, with an average age of 30. *(We were taught to rejuvenate coffee trees in the past 10 years and applied the new method. After a while, there are things that we need to put together...to the cut areas so that pests will not enter it.) (Folder 1; Farmer Participant 1)*

The participants also revealed changes in other farm practices for the past 20 years. These are harvesting operations, transporting operations, and pest and disease management on crops. Through time its application has changed, and some farmers learned these from attending programs crafted by the department of agriculture's local government unit. Farmers were also able to apply changes through learning and observing their co-farmers, which has benefited them. For instance, if harvesting operations were done traditionally, this time, coffee-based farmers are doing it properly when harvesting crops or producing on their farms. Farmers learned to pick only ripe red cherries for coffee and only harvest ready-ripe and matured crops to maintain and preserve the quality of beans and other harvested crops such as banana, coconut, pineapple, etc. As mentioned by the farmers:

(In the past 20 years, we also started doing some best practices in picking crops, and we consider picking only ripe or red cherries for coffee, even for other crops like bananas and other fruit crops). (Folder 1; Farmer Participant 21)

(In 2001 we started doing good practices in harvesting crops as we learned it from our neighbor farmers). (Folder 1; Farmer Participant 1)

(I remembered that in 2005, we practiced harvesting only the ripe and good crops readily and nearly for consumption because sometimes it will only destroy other crop harvests, and the quality is not good). (Folder 1; Farmer Participant 18)

(Yes, in the past years, it is good that we teach farmers to only harvest the ripe cherries for coffee and the ready-harvest crops. That is why it is essential to teach them the proper timing of planting rotations for cash crops so that the harvesting time is the same). (Folder 3; KII Participant 2)

(Previously we also practiced what we have learned from seminars and pieces of training, like the proper harvesting of crops in order to preserve their quality, especially for somewhat sensitive crops). (Folder 2; FGD Participants)

(Different from before, we made some changes these past decades on how we harvest our crops because sometimes it gets easily spoiled and will only be sold at a lesser price due to some damages and rejects). (Folder 1; Farmer Participant 15)

Another change that has occurred is in transporting operations among farmers. Instead of using the old style of transporting harvest, farmers are now using easy access and more conducive vehicles, such as renting vehicles for transporting easy transportation of crops to farmers' houses and the market. These changes have also had effects on farmers, such as it preserves the quality of the crops harvested and avoiding delays in bringing the harvest to farmers' houses, target buyers, and or markets. Farmers articulated that:

(During the last 20 years, we started using jeepneys and cars to transport our harvested crops, unlike before we used animals hired to help us carry harvested crops). (Folder 1; Farmer Participant 13)

(If I remember, in 2002, aside from hiring laborers, we used vehicles to transport our harvest from the farm to our house). (Folder 1; Farmer Participant 5)

(In 2001, we started using jeepneys to transport our harvest). (Folder 1; Farmer Participant 2)

Yes... these past years we have used other means of transportation in carrying our harvest, especially when drying the coffee beans (Folder 1; Farmer Participant 9)

If you observe that farmers are improving, especially in terms of transporting their harvest, they now use it to make it easier to bring their harvest to traders and buyers after harvesting. (Folder 2; FGD Participant)

These past decade farmers have hired vehicles to transport their farm produce (Folder 3; KII Participant)

Pest and diseases have also been damaging in the past decades, as noted by farmers, which they believe is inevitable. Since farmers do not want that these species will continually destroy their farmlands crop, they find other alternatives to lessen its adverse effects. Traditionally they only use pesticides or none, but by asking about other farmers' experiences and attending seminars and training conducted by the local government unit- the department of agriculture, they have learned some practical applications to solve some of the problems of the pest. They have found that continuous crop rotation, use of other biocontrol agents, constant cleaning, and maintenance of the farm are necessary factors to apply to manage the pest and diseases on coffee-based farms.

We learned to use more pesticides to control pests and diseases on the farm (Folder1; Farmer Participant 4)

In the past, sometimes, I used chemicals to lessen pests in my farmland. I also try to collect some and burn them. (Folder 1; Farmer Participant 11)

In the past decades, until now, we have practiced crop rotation so that pests will not stay so long. (Folder 2; FGD Participant)

I learned through training attended that good maintenance of the farm is also good practice to lessen pests and their adverse effects on our farm. (Folder 1; Farmer Participant 6)

These changes in harvesting operations, transporting operations, and pest and disease management on crops, of course, have good effects on coffee-based farmers. Aside from learning new things about farming operations, it has benefited their farm production. Through continuous application and maintenance as part of their coping strategies entails additional effort and cost, they believe embracing this new practice is beneficial for them.

As seen, the changes in the cultural management practices of the coffee-based farmers were part of the programs of the department of agriculture and other institutions. Such new changes in their practices were learned from the seminars and training initiated to improve their knowledge further and sustain their farming systems and livelihoods. The fact that these farmers are already old means they are still interested in participating in such programs conducted for them. The said programs also emerged from the different research-related activities conducted by institutions and individuals on the sustainability of farmers' farming systems, particularly in Amadeo, Cavite. People widely refer to this as a component of any state's agricultural research as any research endeavor designed to increase agricultural production performance and efficiency through genetic advancement, improved plant security, watering, storage facilities, agricultural mechanization, efficient commercialization, and improved resource governance Loebenstein & Thottappilly. (2007). In the expectation of significantly increasing agricultural production to satisfy the demands of expanding populations, agricultural research advancements have produced high rates of return through higher agricultural productivity in several countries. Moreover, in the past few years, there have been two significant concerns brought up about the comparative failure of research-extension services to increase crop production: Initially, the research problems being examined are typically not among the focus needs of agricultural producers and are, therefore of less significance in attempting to address the existing issues; furthermore, the relevant information acquired at the research facilities is not successfully transmitted towards the producers FAO (1997).

Knowledge systems (Roling & Engel, 1991) are made up of an expressed variety of actors, systems, and institutions that are anticipated to collaborate in order to assist the innovation process, propagation, handling, and control, in addition to enhancing the communications among understanding and the use of technology in a given realm of human activity. Based on the result of the study, the department of agriculture, together with other individuals and institutions that help farmers, should continue to operate from a knowledge systems perspective since research-driven technologies, partnerships, and innovative discoveries are the core knowledge products to serve the purpose of its target farmer stakeholders. To facilitate efficient knowledge processing, utilization of knowledge systems models such as the Agricultural Knowledge Information System (AKIS), Transfer of Technology (TOT), and Farming Systems Research Model (FSR) depends on the type of stakeholders they cater to, and the extension approaches used. Wageningen scholars operationalized the Agricultural Knowledge Management System (AKIS) and this concept provides "general systems thinking." It is a platform where researchers, farmers, educators, and extensionists work together for knowledge generation, dissemination, transformation, utilization, storage, and retrieval. This is related to the research's suggestion of Igberi et al. (2022) that further extension support and education access, among others, will help rural farmers.

Moreover, it serves as a method that connects individuals and organizations to encourage the exchange of knowledge and the generation, sharing, and utilization of agricultural innovations and relevant facts Gemechu (2013). Besides, this process allows farmers, agrarian teachers, experts, and extension workers to pool understanding and data from different channels to enhance agriculture and economic opportunities Mondal (2022). This can also be true among farmers if their collaborative efforts and programs for farmers' stakeholders are geared toward their implementation and continuously strengthened through the provisions of programs to sustain the farming systems of the coffee-based farmers in Amadeo, Cavite. This will make the farmers the center of development as each partner towards development does not view farmers as separate strata. The link between them is related to the model presented by David & Samuel (2014) regarding the iterative process of agriculture development.

The changes in cultural management practices over the past two decades have had both positive and negative implications for coffee-based farming systems. Improved seed varieties and propagation methods, integrated pest management practices, and more efficient fertilizer formulations and application methods have led to increased plant growth and yield, which has

benefited farmers. Better pruning and rejuvenation techniques and the use of shade trees have also improved growing conditions. However, the adoption of machine harvesting and other transportation facilities have potential risks such as lower-quality beans and decreased yields. Additionally, the use of pesticides to control diseases may have negative environmental implications. The changes in cultural management practices have also had financial implications for farmers, who must weigh the costs of adopting new practices against the potential benefits the need for proper training, continued research and development, and the adoption of sustainable and responsible farming practices. The implications of the absence of recognized improvements in cultural management techniques throughout coffee-based farming systems from 2001 to 2020 include stagnation in agricultural practices, negative environmental effect, and lower market competitiveness. These consequences underscore the need for cultural management methods to develop and improve, with an emphasis on sustainability, innovation, and market competitiveness

Farmers should adopt modern technologies and engage in research and development to improve their cultural management practices. They should carefully evaluate the costs and benefits of adopting new practices in their coffee-based farming systems. Proper training on the use of modern practices is crucial, and farmers should ensure sustainable and responsible use of fertilizers. Continued research and development of effective and sustainable pest and disease management strategies is imperative. Finally, the promotion of sustainable agriculture practices that promote soil health and biodiversity is also essential. By following these recommendations, coffee farmers can improve their yields and produce high-quality coffee while ensuring environmental sustainability.

Finally, as there were no new perceived changes in several cultural management techniques throughout coffee-based farming systems, implying stagnation in agricultural methods, negative environmental effect, and decreasing market competitiveness. Farmers may stimulate innovation and adaptability, implement sustainable agriculture methods, establish market links, and promote data gathering and analysis to address these consequences. By following these tips, coffee-based producers may remain up to speed on best practices, enhance production and profitability, and contribute to sustainable development. Overall, these strategies can assist coffee-based producers in remaining market competitive by establishing market links while decreasing their environmental effects and guaranteeing long-term viability.

Perceived Changes on the Application of Technologies and Practices in Upland Cavite, Philippines Across Coffee-Based Farming Systems

Technological change refers to variations in coffee farming technologies introduced and adopted, as well as indigenous or homegrown in the municipality of Amadeo, Cavite, Philippines. Under technological change, the farmers of the different coffee-based farming systems, recalled, observed, and experienced a change for the past two decades which is the change in the adoption and application of new technologies and practices.

Presented in Table 3, as perceived by these farmers through their experiences, and through in-depth interviews, key informant interviews and focus group discussion and through validation, researcher found out that that there are numerous applied technologies among coffee-based farmers that had taken place regardless of the farming systems they have.

(We have already applied multi-cropping since we started farming. We practice this by planting several crops besides bananas, coconut, and other cash crops). (Folder 1; Farmer Participant 13)

(Our farming system also involves cover crops where coffee and other plants have canopies so that crops are not directly under the heat of the sun, and the benefits are also good because it conserves water and preserves soil moisture, especially during summer). (Folder 2; FGD Participant)

(These past years, in 2014, we were invited and have learned it from farmer field school). (Folder 1; Farmer Participant 1)

(When I managed the farm again in 2013, I adapted to this new technology and practices given to us). (Folder 1; Farmer Participant 7)

(In the past, up to the present, our farmers also were taught how to do organic farming). (Folder 3; KII Participant)

(Representatives from the Department of Agriculture 2012 visited our farms for soil testing. They encouraged us to get samples of soil to be able to identify the condition of our farmlands). (Folder 1; Participant 10)

(In 2012, we were invited to seminars about pest management and vermicomposting. We also applied it on our farm until now, and it truly benefits us, especially with the technologies taught to us). (Folder 1; Participant 8)

(Part of what we have learned in our association for the past years is how we combat the effects of climate while farming. We are also optimistic about applying best practices like planting drought-resistant crops like bananas and other shrubs and crops helpful during summer). (Folder 2; FGD Participant)

(Since 2016, we have used social media as technology to sell and market our harvests. We have friends and relatives that can be easily contacted through this platform. My wife helps me do this). (Folder 1; Farmer Participant 6)

(Especially during the pandemic, we also learned to use other platforms by attending other activities online with the help of the department of agriculture

*of this municipality. This made us meet other people, and we still learn from it).
(Folder 1; Farmer Participant 3)*

Information about these new technologies and practices are given below:

1. Organic farming entails growing coffee and other crops utilizing natural remedies rather than chemically synthesized fertilizers and pesticides.
2. Farmer Field Schools provide growers with training and support on best coffee farming practices. Pest management, soil health, and climate-smart agriculture are topics they can cover. Farmer field schools can contribute to the long-term viability and profitability of coffee farming in the Philippines.
3. In-Field Soil Analysis uses handheld soil testing devices to evaluate soil health in real-time, allowing farmers to make informed choices about fertilization and other soil management techniques.
4. Agroforestry entails growing coffee plants alongside trees and other vegetation to improve soil health and biodiversity.
5. Shade-Grown Coffee - This is a type of agroforestry in which coffee plants are grown under a canopy of trees. This can aid in reducing soil erosion, increasing carbon sequestration, and providing wildlife habitat.
6. Cover crops. Non-coffee harvests planted between rows of coffee plants to improve soil health, prevent erosion, and provide shade for the coffee plants are known as cover crops.
7. Multi-cropping entails growing various crops alongside coffee plants to maximize land use and diversify income streams.
8. Integrated Pest Management (IPM) is a pest-control technique that employs various methods, including biological control, cultural practices, and pesticides, to manage pests in an environmentally friendly and sustainable manner.
9. Vermicomposting is the process of decomposing organic waste with worms to create a nutrient-rich fertilizer that can be used to improve soil health.
10. Regenerative agriculture entails crop rotation, composting, and reduced tillage to improve soil health.
11. Climate-Smart Agriculture entails employing procedures that can assist farmers in adapting to the effects of climate change, such as droughts, floods, and extreme temperatures. This can include soil conservation, water management, and drought-

resistant crops. Coffee-based farmers can better prepare for and mitigate the effects of climate change on their crops by implementing climate-smart agriculture practices.

12. Post-Harvest Processing entails using technology and best practices to improve the quality of coffee beans after they have been harvested. Wet processing, dry processing, and fermentation are examples of such methods.

13. Social media is an online community and network that allows users to create, share, and interact with content. Coffee-based farmers can utilize social media platforms to promote their harvests connect with customers, and share information regarding farming methods, among other things. For example, a coffee farmer may use social media to promote their harvests by posting photos of their farms and sharing stories about their farming practices if you're looking for a job well done. Coffee-based farmers can also use social media to reach a larger audience and create a community of followers around their products and farming techniques.

Table 3. Perceived Changes on the Application of Technologies and Practices

Technology and Practices	Before 2000	2001-2005	2006-2010	2011-2015	2016-2020
Shade Grown Coffee	x	x	x	x	x
Agroforestry	x	x	x	x	x
Multi-Cropping	x	x	x	x	x
Organic Farming		x	x	x	x
Cover Crops		x	x	x	x
Post-Harvest Processing			x	x	x
Farmer Field Schools				x	x
In Field Soil Analysis				x	x
Integrated Pest Management				x	x
Vermicomposting				x	x
Regenerative Agriculture				x	x
Climate Smart Agriculture				x	x
Social Media Use				x	x

Source: Prepared by the Author (2023)

The timeline shows that before 2000 to 2020, the data above depicts perceived changes in the application of new technologies and practices among coffee-based farmers. There was a significant rise in the use of various farming technologies and practices, with the majority occurring between 2001 and 2020.

Shade-grown coffee, agroforestry, multi-cropping, organic farming, and cover crops were among the practices used prior to 2000, and their use increased significantly between 2001 and 2020. These methods are regarded as environmentally acceptable and sustainable, allowing farmers to boost their productivity while preserving the environment. Post-harvest processing is a method used between 2006 and 2020 that includes the management of coffee cherries after

they have been harvested. Sorting, pulping, fermenting, and drying are all essential steps in assuring the quality of the coffee produced. Adopting this method is essential for ensuring that growers produce high-quality coffee beans harvest.

Other approaches implemented between 2011 and 2020 include farmer field schools, in-field soil analysis, integrated pest control, vermicomposting, regenerative agriculture, and climate-smart agriculture. These measures are essential to enhancing soil health, increasing crop yields, and lowering the use of pesticides and other hazardous chemicals in coffee-based farming. Coffee-based growers have also utilized social media, which has played an essential role in improving communication and selling their produced to a larger market. Farmers may use social media to exhibit their products, engage with customers, and gain feedback regarding their goods.

The reported research data has several implications for coffee-based farming. First, using environmentally friendly and sustainable technology and practices may improve productivity, lower expenses, and lower pricing for coffee-based goods. This is a good indicator for the future of coffee-based growing because it shows producers are trying to safeguard the life of their crops and the quality of the ecosystems on which they rely. Second, technology and processes can result in higher-quality coffee-based products with higher market pricing. Low adoption rates of some technology and techniques, such as in-field soil analysis and farmer field schools, may indicate a lack of access to these resources, limiting farmers' capacity to make educated decisions about their agricultural operations. Governments and organizations must work together to provide access to these resources so that farmers can make informed decisions and coffee-based growers apply best practices. Lastly, social media usage can improve the connection between growers and buyers, increasing sales and lowering coffee prices. Coffee-based growers' increased social media usage shows they are becoming more connected and knowledgeable of the newest growing methods and technology. This might result in the broader adoption of sustainable practices in the future. Farmers should be encouraged to use social media and other online platforms to remain connected and up to speed on the latest farming practices and technology.

With the facts supplied, coffee-based growing farmers should continue to embrace ecologically friendly and sustainable technology and methods. It is vital to promote and encourage the trend toward ecologically friendly agricultural methods through training and education campaigns and to provide financial incentives to farmers that embrace these practices. Organizations and governments should also work to make tools such as in-field soil analysis

and farmer field schools more widely available. Coffee-based growers should continue using social media to communicate better and sell their coffee products to a broader audience. Furthermore, the development of online forums, webinars, and other digital tools for farmers may assist in promoting sustainable practices and adopting new technologies. Coffee-based farmers can increase productivity, save money, and elevate the quality and price of their coffee and other products and harvests.

According to the report, farmers adopt new technologies and techniques for various reasons. One of these is a drop in coffee-based and other crops production in the region. According to farmers, coffee and other crops production has been steadily dropping for the past 20 years. They have begun exposing themselves to new knowledge, technology, and techniques to meet the need to enhance their coffee-based production by asking and observing other farmers and attending seminars hosted by their local government unit and other agencies. Farmers responded by being obedient and implementing what they learned from the teachings.

(It is probably because people here are always complaining about the decline of coffee and other crops. Lots of researchers are also coming here to inquire about what might be the possible problem with coffee.) (Folder 1; Farmer Participant 1).

(As for me, it is for the improvement of farming. It is for the increase in income and coffee yields. That is what I have in mind.) (Folder 1; Farmer Participant 1)

Applying new technologies and methods in farming is expected to help farmers make their tasks easier, improve farming production, and also help them market their produce. Furthermore, this is what farmers in Amadeo, Cavite, have experienced when they embrace new technologies and methods in farming. Participant 2 stated that as long as the procedure is followed and done correctly, one can expect sound effects. As mentioned,

(The same goes with organic. As long as you are doing right and following the procedure, you can see its good effect.) (Folder 1; Participant 2).

(When we used that synthetic, our produce grew larger. For example, in our corn, rice, banana, papaya, and other crops That was what we use: synthetic.) (Folder 1; Participant 11)

(Removing other branches will make your coffee grow more.) (Folder 1; Participant 8).

(It improved. Before, coffee trees were tall. However, because of what they taught us, coffee trees are lower. It is easy to pick coffee grains today.) (Folder 1; Participant 1)

However, these new technologies and methods have adversely affected some farmers' farming practices. For example, using herbicides makes weeding easier for farmers, but, as observed by them, it is harmful to their crops, such as bananas, vegetables, and other crops. Insecticides and fertilizers are also harmful when not correctly applied because they bring diseases to some farmers' crops. On the other hand, the rejuvenation of coffee trees that DA introduced also brought negative impressions. Farmers have mentioned that it takes a long time for the rejuvenated parts of trees to grow and yield fruit again. In addition, the new method of applying fertilizer adds input. It becomes more laborious and arduous on the part of aging farmers.

(There are lots of technologies nowadays. There are new methods that are being used. Back then, since we were using a traditional method of planting, not too many diseases were coming out. Lots of crop diseases are coming out now. That is because different fertilizers and insecticides are applied.) (Folder 1; Participant 11).

(The problem there is that the work has increased. Instead of just spreading the fertilizer, you need to hire labor to dig and put fertilizer in it.) (Folder 1; Participant 11)

Farmers' usual adjustments to embrace new practices and technologies were made. Although it was observed as effective and improved the coffee tree's growth and yield, applying a new fertilizer to many coffee trees seemed impossible, knowing that farmers were already old. Senior farmers have to involve other family members or hire laborers to do the work of farming, which adds to their farming costs. Some farmers adjust to using it immediately because they are adequately informed about the newly introduced methods and technologies since they want to improve their crop production. In contrast, others are hesitant and are still in the process of observing.

(It became difficult. You need to hire someone to dig. In addition, you have to pay for it. It became costly. However, it seems to have helped a lot. There is really a big improvement.) (Folder 1; Farmer Participant 12)

(It is better to try new things to increase our knowledge of planting. Because if we keep doing what we did before, we may harvest the same thing again and again. So we try new knowledge or methods for the improvement of life.) (Folder 1; Farmer Participant 1).

Farmers learned about these new technologies and methods in farming by attending seminars conducted by the Department of Agriculture (DA) and other private institutions like Nestle Philippines. This is related to the study of Beaman et al. (2018), which also implied that modernization is described by a complex contagion (rather than a simple contagion) learning

environment where most producers must gain knowledge from multiple sources before adopting new technology. They further argued that theory-based network targeting could surpass traditional approaches to extension.

In one of the questions raised to a key informant about how he adopts government and non-government programs, especially on new technologies, he said that he usually tried and followed those programs and mastered them to apply them well on his farm, especially in coffee. He also stressed during the interview that, as farmers, it is not advisable to depend entirely on the programs and technologies provided by these institutions. Instead, for the success of their farming system, each farmer must be able to discover new things (Folder 4; Field Notes; Page 10). Thus, continuous learning is essential and through learning new practices and technologies by reading valuable materials is crucial for a farmer who wants to improve and sustain his farmlands despite the effects of typhoons, climate change, pandemics, and the decreasing trend or yield of production like that of the farmer participant. (Field Notes, Page 33)

Farmers learned them by observing other farmers and imitating them. Sometimes, model farmers are called to attend seminars to learn about new technologies so that they will be the ones to inform or teach other farmers too. Some barangays assign officials responsible for disseminating new information about farming to the farmers in their areas. What is more, various government departments can also provide coffee-based farmers with advanced technologies, demand, public programs, and social infrastructures (Malinao, 2022), and since government policy is a factor that significantly affects the viability of agricultural communities.

CONCLUSION/IMPLICATIONS

Based on the findings of the study, the following conclusions/implications were drawn:

Except for seedling preparation, fertilizer application, trimming, and marketing, cultural management techniques have remained relatively stable, suggesting a sizable opportunity for additional technological interventions to boost productivity and sustainability in these fields. It also implies a possible barrier to adopting novel approaches in various economic, educational, or cultural fields. Future study goals could be to discover and remove these obstacles.

Cultural management practices and agricultural technologies in coffee-based farming encompass agricultural goods, services, and applications that improve various input-output processes. Access to new and relevant technology and knowledge of applying it are two of the most critical factors influencing farming success. The relevance of comprehensive extension services for farmers is emphasized by the crucial role that access to new technology and the

know-how to use it play. These findings imply that programs emphasizing technology dissemination and farmer education improve agricultural success. In order to guarantee the broad and efficient application of these agricultural technologies, cooperation between technology companies, governmental organizations, and local communities may be valuable.

Most farmers have adopted new technologies and farming techniques in the past two decades. This indicates that farmers are cooperative and willing to adopt new technologies offered to them. It is encouraging that farmers are receptive to innovation and change and are eager to accept new agricultural methods and technology. This might be used to promote and introduce technology developments, provided they are readily available, reasonably priced, and helpful. The adoption also suggests the possibility of mentorship and peer-to-peer learning among farmers.

It can be challenging to implement new technologies in coffee-based rural areas. Some farmers might not have the resources, such as finance, infrastructure, training, or access to infrastructure, to employ these technologies effectively. The difficulties that arise when deploying new technologies in rural areas, particularly those where coffee is the primary crop, underscore the need for a more comprehensive strategy in technology deployment. This can include providing financial aid, creating new infrastructure, running training programs, and facilitating easier resource access. The results indicate that a multi-stakeholder strategy incorporating local and federal government, NGOs, and companies dedicated to sustainable agriculture may be advantageous.

Since continuous development in agriculture is taking place nowadays, farmers need to attend programs and relevant training to cope and be knowledgeable with the changing practices and the use of new technologies in coffee-based farming. The continual changes in agriculture highlight the need for opportunities for farmers to get continued education and training. These findings imply the necessity for extensive, easily accessible, and locally relevant educational initiatives. Additionally, it emphasizes the possible use of digital technology for providing such training, particularly given the ongoing worldwide COVID-19 pandemic

RECOMMENDATIONS

The research findings prompted the following recommendations:

Farmers may continue to accept new practices and technologies offered to them to improve their coffee-based farming productivity further. Since it is believed that the adoption of new

practices and technologies continuously improves productivity. Program strategies that bring together agricultural educators, researchers, and extensionists with farmers to collect information and data from a variety of resources in order to improve farming methods and living conditions of the rural farmers are encouraged to help further the alleviation of the coffee-based industry in Upland Amadeo, Cavite, Philippines. Moreover, collaborative efforts and programs for farmers' stakeholders are geared toward its implementation and continuously strengthened through the provisions of programs to sustain the farming systems of the coffee-based farmers in Upland Amadeo, Cavite. Programs and interventions on how to improve farmers' practices, the use and adoption of new and relevant technologies are needed to sustain the coffee-based farming system in the locality, and knowledge on how to apply it are essential factors influencing the success and improvement farming productivity among farmers in Upland Amadeo, Cavite, Philippines.

The study offers insightful information but has drawbacks because of the pandemic setting, geographic emphasis, scope restriction to coffee-based farming, and qualitative methodology. Future research could benefit from a longitudinal design to track changes after the pandemic, comparative studies between regions or nations, an expansion of the focus to other agricultural sectors, a mixed-methods approach for a thorough understanding, and a focus on practices and efficient technology adoption strategies, taking into account the roles of different stakeholders.

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DATA AVAILABILITY

Data presented in this study will be available on a fair request to the corresponding author

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