Improving Communication and Coordination through an Information and Communication Technology (ICT) Application within Avocado Cooperatives in Meru County, Kenya

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IMPROVING COMMUNICATION AND COORDINATION THROUGH AN INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) APPLICATION WITHIN AVOCADO COOPERATIVES IN MERU COUNTY, KENYA

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A RESEARCH THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE

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MASTER OF AGRICULTURAL PRODUCTION CHAIN MANAGEMENT: HORTICULTURAL CHAIN

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DEDICATION

To my family,

I AM, only because of you.

Thank you for your love and support.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYMS	MEANINGS
ASOK	Avocado Society of Kenya
€	Euros
EU	European Union
FAO	Food and Agricultural Organisation
FGD	Focus Group Discussion
FORQLAB	Food Waste Reduction and Food Quality Living Lab
FPEAK	Fresh Producers Exports Association of Kenya
GAP	Global Agricultural Practices
GDP	Gross Domestic Product
HCD	Horticultural Crop Directorate
ICT	Information and Communication Technology
KALRO	Kenya Agricultural and Livestock Research Organisation
KSh	Kenyan Shillings
KEPHIS	Kenya Plant Health Inspectorate Service
MUST	Meru University of Science and Technology
P.E.S.T.E.C.	Political, Economic, Social, Technological, Environmental, Cultural
PICTD	Participatory Information and Communication Technology Development
S.W.O.T.	Strengths, Weaknesses, Opportunities, Threats
ToC	Theory of Change
USAID	United States Agency for International Development
WCDI	Wageningen Center for Development

ABSTRACT

The agri-food sector accounts for 34% of Kenya's national GDP and 65% of all export-related earnings, including avocado exports. Since 2017, Kenya has been Africa's largest exporter and currently is the fifth global producer of avocadoes.

Coordination and communication are functions of each other and critical for a well-functioning value chain. However, poor communication and inefficiency are causes of food loss in the avocado value chain of Meru County, Kenya. Fragmented communication, information asymmetry, and lack of transparency have disrupted the sustainability of the value chain, leaving farmers vulnerable to exploitation. It called for a collaborative solution to improve communication and coordination within the chain.

This study aims to improve communication and coordination among avocado farmer cooperatives in Meru County, Kenya, using ICT. It is part of the Food Waste Reduction and Food Quality Living Lab (FORQLAB) project to contribute to the structural reduction of post-harvest losses and food quality improvement in the avocado value chain using technological solutions. Specifically, the research focused on assessing the specific needs of the farmer cooperatives in terms of functionalities, determining the key steps and timeframe required for development, highlighting the resources for development, and developing an action plan that will facilitate the implementation of the application.

The research employed qualitative tools using desk research, focus-group discussions with the Mt. Kenya Avocado Growers' Cooperative, Abothuguchi Avocado Growers' Cooperative and semi-structured interviews with the ICT experts (KALRO, eProd Solutions, Pharox Intelligence, and the functional application developer) to understand underlying challenges, gain insights into existing applications, identify the possibilities for the farmer cooperatives based on the assessed needs.

The result showed that the proposed application includes features that provide real-time market information, chat capability for seamless communication, financial services for mobile payment, and agricultural best practices tailored towards avocado farming in Meru County. Developing an application requires a deep understanding of the value chain and gathering accurate data to inform the system design, cost efficiency, funding options, and pricing models. The developmental steps of the application require a structured approach: identification of ideas for the app, meeting of the developer with the client, development, testing of prototypes, deployment, and maintenance. According to the experts, developing an application requires time (it takes two to six months), technical resources, financial resources, human resources, infrastructure, and market.

In conclusion, the action plan for developing and implementing an application that improves communication within the farmer cooperative involves:

(a) background research and problem identification, (b) needs assessment, (c) choosing developing organisation and securing funding, (d) prioritizing functionalities, (e) recruitment of personnel, (f) acquisition of infrastructure), (g) designing and developing the application, (h) training, (i) deployment and implementation, and (j) monitoring and evaluation.

While there are opportunities for improved communication and efficiency, challenges related to digital literacy, infrastructure, and trust must be addressed to ensure the successful integration of the application within the cooperatives. In light of this, this study proposes key strategic recommendations such as enhancing technical capacity and digital literacy of the users and building strategic partnerships with stakeholders.

CHAPTER ONE: INTRODUCTION

The agri-food sector accounts for 34% of Kenya's national GDP and 65% of all export-related earnings, including avocado exports (Snel et al., 2021). Avocados are a major horticultural crop in the country, contributing significantly to the income of farmers and the national economy. Over 80% of the Kenyan population is directly dependent on agriculture as a source of living (Snel et al., 2021; Ireri et al., 2021). As the production and consumption of avocados continue to increase significantly in recent years and there is a consistent expansion into diverse markets, there is a necessity for effective distribution and coordination within the chain (Kourgialas, 2021).

Coordination and communication are functions of each other and critical for a well-functioning value chain. Poor communication has been identified as a major reason for food loss in the avocado value chain of Meru County, Kenya (Bouma, 2024). Research shows that an estimated 35% of avocadoes are lost before they reach the market or consumers because of inefficiencies in supply chains (Snel et al., 2021). The losses occur because of fragmented communication and limited information flow amongst the stakeholders within the value chain, resulting in interlinked problems. This lack of transparency creates information asymmetry, where one party has a significant advantage due to better knowledge. This asymmetry fuels uncoordinated or even detrimental decision-making. Furthermore, inefficient information disrupts planning, logistics, and market access, and the farmers lacking market information become vulnerable to exploitation.

In Meru County, the three farmers' cooperatives working towards bridging the communication gaps in the chain are Mt. Kenya Avocado Growers' Cooperative, Mt. Kenya Abogeta East Avocado Growers' Cooperative, Abothuguchi Avocado Growers' Cooperative (NFP Connects, 2022). These cooperatives were established because farmers required better pay and organized marketing structures for their produce (Murithi, 2024). The roles of the cooperatives include supporting farmers through resource sharing, market access, and collective bargaining. The cooperatives provide extension and agronomic services to the farmers; and organize trainings, marketing strategies and linkages to exporters.

The avocado sector in Meru County, Kenya, has grown significantly recently. However, effective communication and coordination within the farmers' cooperative remain key challenges (Verschuur and Bouma, 2024). To address these challenges, this research proposal aims to assess the specific needs of the farmer cooperative in terms of functionalities for an Information and Communication Technology solution and to develop an action plan that will facilitate improved communication and coordination within the avocado cooperatives in Meru County in coming years.

This research is commissioned by the SIA project "Food Waste Reduction and Food Quality Living Lab (FORQLAB)" representative Peter Bouma. However, this problem mainly affects the farmers' cooperatives.

1.1 Food Waste Reduction and Food Quality Living Lab (FORQLAB)

The Food Waste Reduction and Food Quality Living Lab (FORQLAB) is a research consortium established to address the challenge of food waste in Kenya's agricultural sector. The project focuses on two commodities avocados and dairy products (Verschuur and Bouma, 2024). To address these challenges, FORQLAB seeks to:

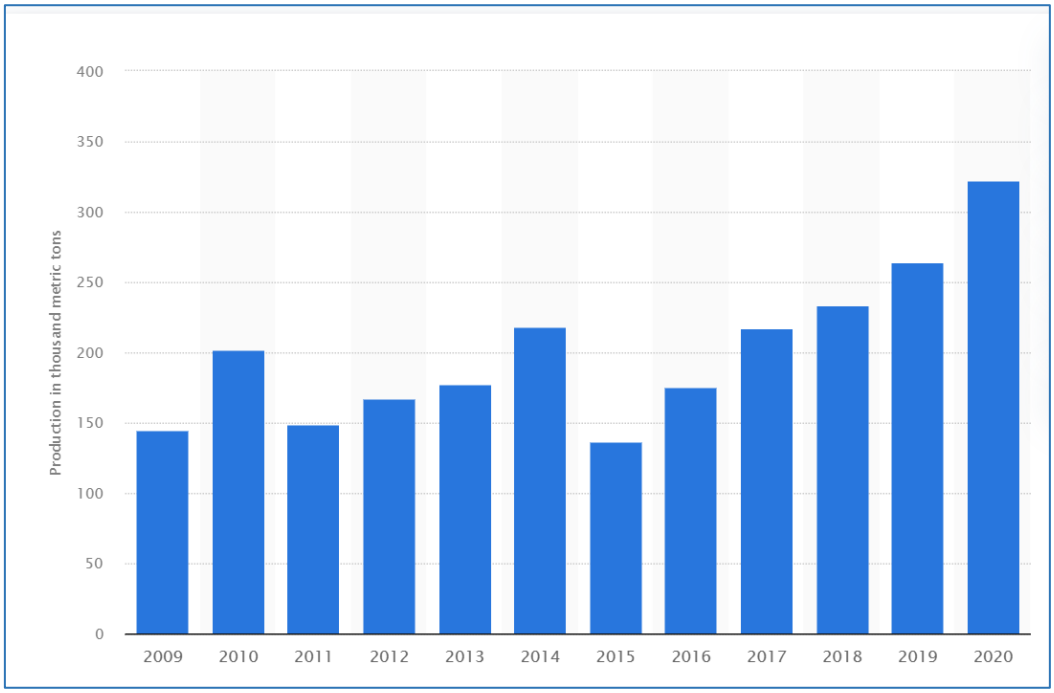
- Reduce food losses in the avocado and dairy value chains.
- Enhance food quality and safety.
- Improve efficiency and sustainability within the food system.
- Empower farmers through knowledge sharing, improved practices, and cooperative actions.

FORQLAB is a collaborative effort led by four Dutch universities, Van Hall Larenstein University, HAS Green Academy, Inholland University, and Aeres University of Applied Sciences in partnership with two Kenyan universities: Egerton University and Meru University of Science and Technology. It also involves cooperatives, companies, business support organizations, and knowledge partners from the dairy and avocado sectors (NFP Connects, 2022). It employs a living lab approach that involves conducting applied research alongside industry partners, co-creating and testing solutions in real-world settings, and focusing on practical implementation and scalability (NFP Connects, 2022).

1.2 Avocado Sector in Kenya

The avocado (Persea americana) is a well-known fruit and a highly lucrative commercial crop for the Kenyan domestic market and the international market (Mokria et al., 2022). Small-scale producers, spread across central highlands, south of the Rift Valley and western Kenya (Murithi, 2024) majorly do avocado cultivation. As one of the leading producing regions in Kenya, the avocado value chain in Meru County, Kenya, has witnessed significant growth in recent years.

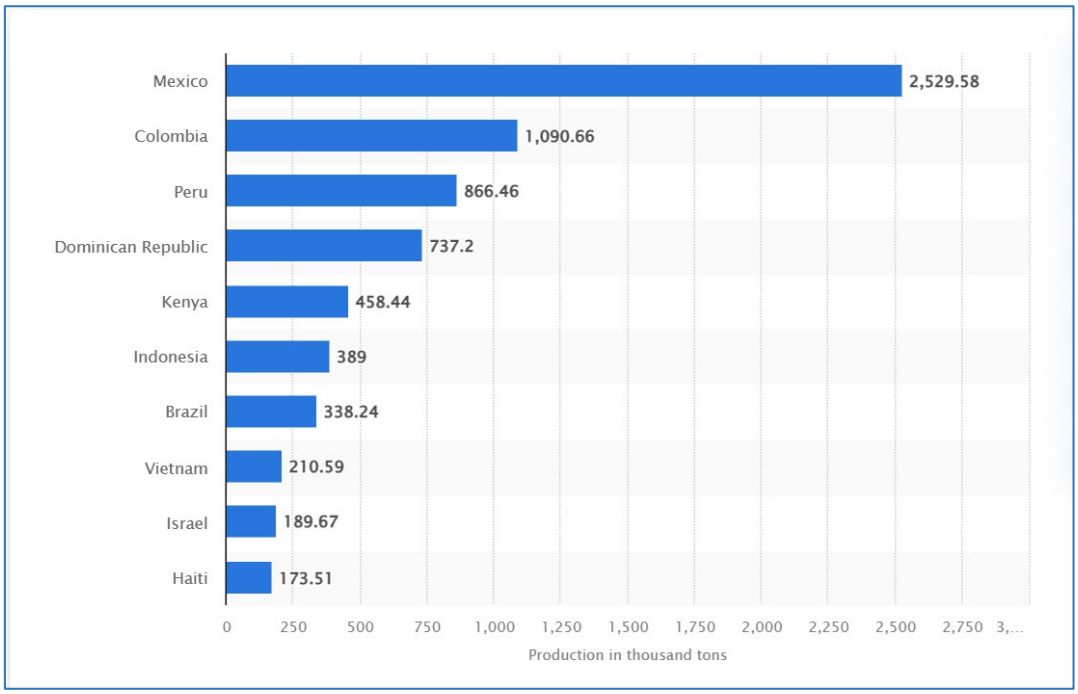
Figure 1: Production Volume of Avocados in Kenya from 2009 to 2020 (in 1,000 metric tons)



Source: Statista, 2021.

In 2020, Kenya produced around 322,600 metric tons of avocados (Statista, 2021)—*See Figure 1*, which showed an increase of 22.2% from 2015 to 2020. About 70 per cent of this production is by small-scale farmers, of which 60% is for export purposes to Europe—the Netherlands, France, and Spain—and prospective growing markets in the Middle East, China, and India (World Bank, 2019). Since 2017, Kenya has been Africa's leading avocado exporter (Avocado Society of Kenya, 2020), and the current report ranks her as the fifth largest producer globally with a volume of 458,440 metric tonnes (Statista, 2024)—*See Figure 2*.

Figure 2: Global Avocado Production in 2022 by Country (in 1,000 tons)



Source: Statista, 2024.

The avocado sector in Kenya is projected to grow by around 1,500 hectares annually, according to a report from Rabobank (2020). The report recommended chain-upgrading strategies to improve product quality and logistics for the international market. This development calls for increased collaborative efforts by the stakeholders across all levels to communicate effectively and transparently share knowledge to retain excellent produce quality and maintain the status as a leading exporter of avocado into Europe.

1.3 Problem Context

Information and Communication Technologies in agriculture have become more common in Africa. Some initiatives and research have been carried out to improve the countrywide ICT system by promoting ICTs to enhance information-sharing efficiency within the agricultural value chains. The growth of ICT in recent times has led to significant progress in agriculture as the conventional communication channels of farm/home visits and meetings in villages and town halls for dissemination of information are counterproductive, causing slowness in decision-making processes (Churi et al., 2012).

Studies have shown that the avocado sector is dominated by 70% of smallholder farmers (Amare et al., 2019). According to Karing'u et al. (2020), limited funding and support to small-scale farmers hinder their participation and weaken relationships with other stakeholders, thus limiting the development of a sustainable chain. Other studies reported that the general absence of market information, information asymmetry, and lack of transparency in the avocado market is evident in the small number of avocado farmers formally organised into producer organisations, and having contractual arrangements with marketing agents and buyers (Imani, 2019; Amare et al., 2019; Rampa & Dekeyser, 2020). Among other challenges, limited and distorted market information, weak farmer organisations, and limited access to technical knowledge underscore the communication obstacles that impede efficiency and development in the chain. (Mwambi et al., 2016).

In addition to this communication challenge are governance issues. Unclear or inconsistent regulations regarding avocado production, quality standards, and market structures (such as price determination) have left farmers confused and vulnerable (Mati et al., 2022). Weak farmer cooperatives disadvantage farmers, as an inadequate representation of their interests weakens their negotiating position within the value chain.

Literature reported that all these challenges have arisen from limited technology adoption, a fragmented value chain, and weaknesses in governance (Isaboke and Ndirangu, 2022). According to Waweru (2023), the limited adoption of ICT among smallholder avocado farmers is attributed to low digital literacy levels to use these platforms effectively. Currently, in Meru County, there is limited use of digital tools for communication and coordination within farmer cooperatives. Consequently, this results in communication breakdowns, delays in information-sharing and suboptimal decision-making.

The FORQLAB commissioner anticipates that deploying an ICT application designed to meet the unique requirements of Meru County's farmer cooperatives will improve real-time information flow, aid in decision-making, lower transaction costs, increase market access, and ultimately guarantee the sustainability of the avocado value chain.

A junior researcher of one of the FORQLAB partners has laid the groundwork with functional ideas for the ICT application.

1.4 Research Problem

The importance of effective communication and governance in an agri-food value chain cannot be overstated. Enhancing collaboration and communication between the farmer cooperatives in Meru County is necessary to reduce avocado loss and wastage. The underlying problem lies with cooperatives' inability to effectively articulate the needs of their members nor translate them into actionable plans. Cooperatives lack a clear picture of the specific communication and data management functionalities that best address farmers' challenges and provide support. This inefficiency is due to a lack of transparency in information sharing, information asymmetry, mismatch of demand and supply, inadequate data management, and lack of a proper structure with a clear strategic vision for financial and operational management. This knowledge gap impedes the capacity to provide farmers with efficient support and to maximise the avocado value chain. Further complicating the issue is the absence of a defined roadmap for implementing an Information and Communication Technology (ICT) application.

The academic project partner of FORQLAB has sketched a functional design with basic ideas. However, additional information is required to prioritise urgent functionalities, determine the time scope, and address other relevant issues.

In light of this, this thesis research assessed the needs of the farmer cooperatives in terms of functionalities for an Information and Communication Technology application, develop an action plan that will facilitate improved communication and coordination within the cooperatives in Meru County in coming years, and propose a feasible recommendation for the board of cooperatives for further research.

1.5 Research Objectives

The objective of this research is to develop an action plan for implementing an ICT application to improve communication and coordination within the farmer cooperatives in Meru County.

1.6 Research Questions

The main research question is: What action plan can be developed to implement an ICT application that improves communication and coordination within the farmer cooperatives in Meru County?

Sub-Research Questions:

1. What are the communication and coordination needs of the farmer cooperatives in Meru County solvable with an ICT application?
2. What are the necessary functionalities of the ICT application that will address the needs of the farmer cooperatives?
3. What are the key steps and timeframe for developing the application?
4. What resources are needed in developing the application and implementing the action plan?

1.7 Thesis Structure

This thesis has six chapters. This first chapter describes the background and research, defines the problem, and states the research questions and objectives. In Chapter Two, the ideas of communication, governance, and information communication technology are studied and used to inform the research's conceptual framework, which serves as the study's theoretical framework. Chapter Three contains a detailed description of the research methodology and methodologies. Chapters Four and Five present the research findings. The sixth chapter answers the research questions and makes recommendations consistent with the study's objectives.

CHAPTER TWO: LITERATURE REVIEW

This chapter will review the literature on concepts relating to the research topic and questions. The main ideas for this study are ICT, value chain communication, and governance. The literature review will also be the basis for the conceptual framework for this study.

2.1 Defining Concepts

2.1.1 Value Chain

A value chain is a series of activities required to convey any product from conception through different phases, until delivery to the final consumers and disposal after use (Kaplinsky, 2000).

2.1.2 Communication

Communication refers to an exchange of information between individuals, parties, or the broader community. In agriculture, parties that rely on effective communication are typically stakeholders, suppliers, institutions, government agencies, or companies that convey information between themselves and consumers. As a result, effective communication is essential for a successful agribusiness (Ducker, 2023). Information flow can be of two types: Vertical and Horizontal.

- **Vertical Communication** refers to the exchange of information between people at different levels in an organisational structure—in this case, the value chain. It can be in two forms: top-down or bottom-up (Simonsson, 2022).
- **Horizontal Communication** refers to the exchange of information between people at the same level in an organisational structure—in this case, the value chain (Simonsson, 2022).

2.1.3 Value Chain Governance

Governance is the relationships among the stakeholders—buyers, sellers, service providers, and regulatory institutions— who operate within different activities needed to bring a product or service from inception to its end use (Market Links, 2022). It is the distribution of power and information amongst stakeholders in the chain.

3R Frameworks of Governance

The challenges the horticultural sector in Kenya faces have influenced the chain sustainability, institutional governance, and innovation support systems. As communication is a function of these elements, there is a need to examine the 3R framework (robustness of the chain, resilience of the innovation support systems and reliability of institutional governance) to ensure understanding points for intervention (Matui et al., 2016b).

a. Robustness of the Chain

Robustness refers to the efficient and trustworthy interactions among the stakeholders in the chain (Matui et al., 2016b). It entails productivity, flow, and product quality. A robust chain includes efficient transactions, shared costs, diversification, traceability, sustainability, and financial inclusion.

b. Resilience of the Innovation Support Systems

It describes the ability of the system to adapt to changing circumstances and support continuous improvement (Matui et al., 2016b). A resilient system can foster new technologies, practices, and business models to improve efficiency and sustainability.

The resilience of innovation support systems is the ability to address challenges and capitalize on growing opportunities and is dependent on stakeholders' constantly exchanging and applying knowledge, mobilizing resources, and coordinating co-innovation networks (Bebe et al., 2015). It considers research and development, knowledge sharing, and capacity building.

c. Reliability of Institutional Governance

It refers to a policy framework encouraging investment and collaboration to improve trade opportunities (Matui et al., 2016a). It involves public-private cooperation, co-innovation, and a public economic policy framework that supports private investment and enhances opportunities for international trade.

It emphasizes the importance of a stable and transparent governance environment. It ensures fair play, transparency, and accountability for all stakeholders involved. It includes regulations and enforcement, collaboration, market access, and dispute resolutions.

2.1.3.1 Governance Structure of the Avocado Value Chain in Kenya

Pieces of literature have given diverse perspectives on the governance structure in the avocado value chain in Kenya. Dengerink and Rijn (2018) thought that the avocado value chain in Kenya characterized by the weak institutional capacity of small-scale producers and uncoordinated export. It is because of the limited capacity of farmer groups and small-scale producers to improve the accountability and quality of avocados in the value chain. Snel et al. (2021) reported that the lack of market information and transparency in the avocado market contributes to the weak governance structure.

Despite these challenges, Rampa & Dekeyser (2020) acknowledge that a few avocado farmers are organized formally into producer organizations. These organizations have contractual arrangements with marketing agents and buyers, offering some access to the market. However, it is important to note the limitations within farmer cooperatives. Kessler et al. (2020) mentioned that farmers' cooperatives are still vulnerable due to limited entrepreneurial and internal governance capabilities, and insufficient compelling value propositions for their members.

As an intervention point, Matui et al. (2016a) discuss the rise of the private sector. Although the private sectors are not well developed in Kenya because the economy is often informal, commercial sectors such as avocados have witnessed and benefited from the rise of the private sector.

2.2 Information and Communication Technology

Information Communication Technology (ICT) is defined as "the skills around computing and communications devices, software that operates them, applications that run on them, and systems that are built with them" (Mid-Pacific ICT Centre, 2014). Communication connects farmers, stakeholders, and other industry professionals, providing access to critical information such as weather patterns, market prices, and new technologies to help the chain actors make informed decisions. ICTs are technologies that facilitate communication and enable the processing and transmission of information electronically. ICTs include contemporary social networking, reading and writing interfaces on the web, file sharing online, and policies and laws governing the transfer of media and devices (Yakubu et al., 2013a). It is an avenue for bridging communication gaps among stakeholders in the value chain through a network called the "Research-Extension-Farmer-Inputs-Linkage System (REFILS)" (Yakubu et al., 2013b). ICT has been useful for farmers exchanging information (such as market prices, disease outbreaks, and produce distribution), collaborative learning, and connecting with distributors. For other stakeholders in the chain, it has been helpful for brainstorming, exploration of alternative technologies, facilitation of credit and market access, training and demonstrations, knowledge sharing, etc. ICT proposes the benefits of improved information sharing, increased transparency, and better coordination within the value chain.

Barakabitze, Fue, and Sanga (2017) reported from Deloitte's 2012 research on the process of e-transforming the agricultural sector in Africa through a participatory approach at certain stages of the ICT-farming cycle—Pre-cultivation, cultivation, harvesting, and post-harvest. It concluded that the ultimate result of the use of ICT in the value chain is when disseminated through a participatory approach. A participatory approach involves using tools, methods, and techniques that not only facilitate information generation but also ensure the understanding of the needs of the stakeholders in the value chain—knowing what is required (Barakabitze, Fue, and Sanga, 2017).

2.2.1 ICT Infrastructure

ICT infrastructure is the foundation of all modern organizations. It comprises the interconnected network of hardware, software, networking devices, and services that enable an organization to function efficiently (Čolaković and Hadžialić, 2018). The key components of ICT infrastructure are:

- **Hardware:** This includes all the physical devices or tangible components that make up the IT system, such as servers, computers, laptops, tablets, smartphones, printers, scanners, etc. (Afriyie, 2012; Gupta et al., 2021). Servers are the workhorses of the network, storing data, running applications, and managing user access.
- **Software:** The collection of programs and applications that run on the hardware (Afriyie, 2012). It includes the operating system (OS) that manages the computer's resources and productivity applications like word processing, spreadsheets, and email (Gupta et al. 2021). It also includes specialized software for accounting, customer relationship management (CRM), and enterprise resource planning (ERP) (Pan, Ren, and Fang, 2008; Afriyie, 2012).
- **Networks:** A network is a system that allows computers and other devices to communicate with each other. It includes devices such as routers, switches, and firewalls (Afriyie, 2012). Routers direct traffic between different networks, while switches connect devices within a network. Firewalls protect the network from unauthorized access.
- **Data Storage:** Data storage is the physical location where data are stored. It includes hard disk drives (HDDs), solid-state drives (SSDs), and tape drives (Schulz, 2016). Currently, cloud storage is utilized to store data off-site (Pawar, Patil, and Chaudhari (2014); Ristov, Mrvica, and Miskovic, 2014).
- **Security:** Security is essential for protecting the ICT infrastructure from unauthorized access, data breaches, and other threats (Coulibaly, 2020). Security measures include firewalls, intrusion detection and prevention systems (IDS/IPS), and data encryption (Borky,et al., 2019).
- **Services:** These are essential for keeping ICT infrastructure running smoothly. These services include IT support, network management, and security services (Afriyie, 2012).

2.2.2 ICT Functionalities

ICT has the power to change cooperative societies (Patel, 2019). It helps transform cooperatives by strengthening existing networks, broadening potential network, improving management practices and records keeping, among other things, which boosts efficiency (Patel, 2019). According to Kumar (2012), the implementation of ICT applications in cooperatives management is crucial to enable participation in the global market, and globally, cooperatives have facilitated development of farmer systems linking farmers to farmers and farmers to government for sector growth. The management of cooperatives can obtain up-to-date information, minimise job duplication, dependability of human information storage, and accomplish a variety of tasks that are necessary for the cooperatives by implementing ICT (Ngongo, 2019).

The 2018 policy brief report from Feed the Future in collaboration with the United States Agency for International Development (USAID) and Climate Focus reported that Information and Communication Technology (ICT) solutions are increasingly beinsg applied to agricultural value chains. The brief identified five key services provided by ICT-for-agriculture solutions:

a. **Information Sharing** allows communication and receipt of information and knowledge between two or more actors within the agricultural value chain. It can be done electronically or through face-to-face communication. Information sharing includes communicating via mobile applications or online forums for enquiries and feedbacks (Mapiye et al., 2023); and knowledge sharing on sustainable agricultural practices, financial management, and extension services for farmers (Tiwari, 2022; Samadder and Rao, 2023). An example of an information-sharing platform is iShamba, which farmers subscribe to receive tailored information on

market prices, weather, and agronomic advice based on their location and crop type (Agritools, 2016).

b. **Access to Markets** includes digital marketplaces for the buying or selling of various inputs, goods and or services; enhanced internal systems for supply chain or aggregator management; and strengthened external market linkages (FAO, 2013). It allows real-time data on market information (demands, price trends, consumer preference, high demand periods etc.) (Anandaraja et al., 2009; Samadder and Rao, 2023).
c. **Information Analytics** involves data analysis and management on production, yields, inventory management, sales data etc. (Yang et al., 2018) and communicates results to either external customers/partners or for internal reporting and efficiency. It can be paired with a sharing component but cannot be directly done vice-versa (Feed the Future Policy Brief, 2018).
d. **Access to Finance** facilitates payments, provides credit, or manages collateral; can also provide financial data to third parties that will then offer these or other financial services to farmers (Zook et al., 2013).
e. **Tracking and Traceability (T&T)** uniquely identify products as they travel through a supply chain (tracking) or for downstream actors to pinpoint origination (traceability) (Feed the Future Policy Brief, 2018).

These functions accomplished with ICT are called ICT Functionalities. ICT Functionalities refers to the specific features and capabilities of an ICT solution designed to address communication and coordination needs within an organisation. Aldea et al. (2012) highlighted the functionalities to be included in a communication application as audio, video streaming, instant messaging, whiteboard facilities, and sharing functionalities.

Murakami et al. (2007) and Sørensen et al. (2011) reported these aspects important for the development of an information system including:

1. Understanding of the specific needs of the farmer cooperative.
2. Design of a simple user-interface that allows scalability in the long run.
3. An application that allows the integration of expert knowledge and user preferences.
4. Training and capacity building of farmers with necessary digital skills to effectively use ICT.
5. A user-friendly and affordable application with specific technical capabilities.
6. Increasing access to consistent and affordable internet connectivity.
7. The provision of continual technical support, guidance, and modifications for the users.
8. The provision of standardized data storage and security system.

Samadder and Rao (2023) also highlighted some of these— as above— in their research.

2.2.3 Existing ICT Solutions

The agricultural industry is experiencing a transformation driven by increased adoption of technology on different frontiers. Through the digitisation of agriculture, farmers enjoy superior seed quality, have access to markets, can accurately predict the weather, and monitor product distribution.

Kenya is a forerunner within Africa in the use of information and communication technologies (ICTs) and has more digital-for-agriculture (D4Ag) enterprises and users than any other country in Sub-Saharan Africa, with over 100 solutions on the market (Meza, Hansen, and Osgood, 2008; Bolwig et al., 2021). These existing solutions include:

1. The mobile money platform (M-PESA and Kilimo) is widely used for financial transactions within the country. It facilitates easier payments between farmers and other stakeholders in the chain—*see Annex II*—

2. Kenya Agricultural & Livestock Research Organisation (KALRO) offers several resources and mobile applications focused on various agricultural topics including apps on banana, garlic, cassava, maize, and avocado to help farmers make informed choices. KALRO's mission is to digitise the agricultural value chain (KALRO, 2021a). The information includes:

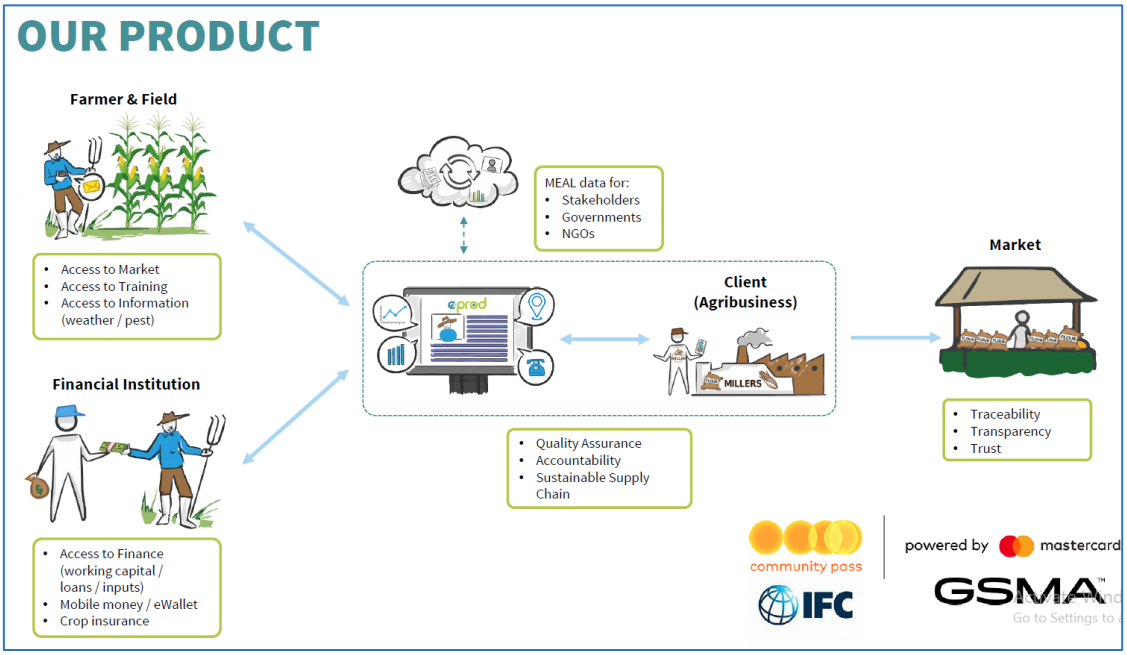
- Land preparation and planting techniques.
- Irrigation and pollination methods.
- Intercropping strategies to maximize land use.
- Fertilization, mulching, and weeding practices.
- Pest and disease management.
- Harvesting, post-harvest storage, and marketing information (KALRO, 2021a).

KALRO offers two mobile applications specifically designed to assist avocado farmers.

- KALRO Avocado Seedling App provides users with information on avocado varieties suitable in Kenya, alongside guidance on seedling multiplication (KALRO, 2021b).
- KALRO Avocado Varieties provides users with information on the 40 varieties. Out of the 40 varieties of Avocado, Hass is the main export variety and Fuerte is preferred for processing. Other commercial varieties are Keitt, Reed, Booth 8, Simmonds, Pinkerton, Nabal, Puebla, Tonnage, Ettinger, Hayes, G6 and G7. Varieties used as rootstocks include Puebla, Fuerte, Duke, G6, and G7 (KALRO, 2021b).

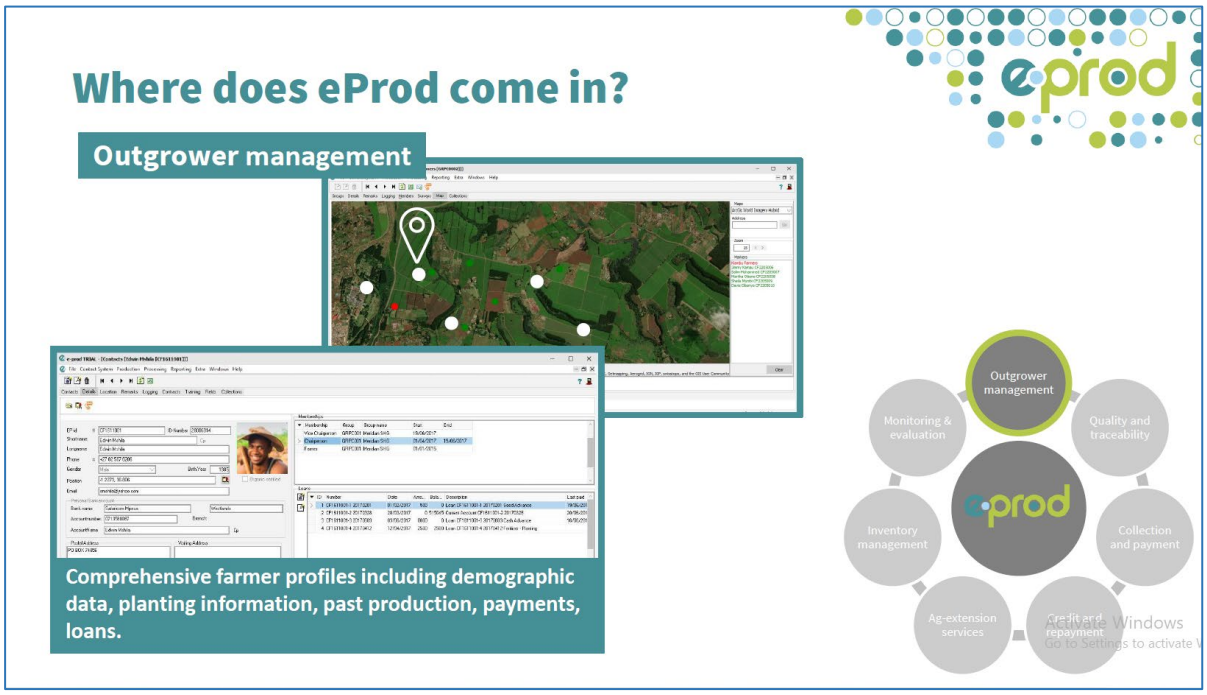
3. eProd Solutions cater to larger agribusinesses using Enterprise Resource Planning (ERP) Systems to manage inventory, track orders, and improve overall supply chain efficiency—*See Figure 3 and 4*—. Their solution comprises tools that streamline processes, ensuring seamless collaboration with thousands of suppliers from procurement to distribution and managing farmer networks, from registration to field monitoring to payment processing. It manages input distribution, loans to farmers and their repayments, monitors and evaluates the performance of farmers, providing feedback and incentives to improve their productivity and produce quality. It has an inbuilt end-to-end traceability and mapping tools (GPS, Polygons) that allow geotagging to verify the location and origin of your products while enhancing transparency and traceability (eProd Solutions, 2024).

Figure 3: eProd Solutions Services



Source: eProd Solutions, 2024.

Figure 4: eProd Membership Comprehensive Database Prototype



Source: eProd Solutions, 2024.

4. Pharox Logistics Intelligence is centered on a seamless logistics chain and processes that are achievable with technology (Pharox Logistics Intelligence, 2024). They have several solution options:
    a) **U-POD**: A mobile app solution that digitizes the value chain in real-time for effectiveness and efficiency. It shares logistics information and automatically alerts all trip deviations.
    b) **SMART MOVE**: It provides visibility and integrity of shipment/assets. It has features such as seamless condition monitoring before, during, and after trips, workflow automation, and auto-billing (Pharox Logistics Intelligence, 2024).

2.3 Avocado Value Chain Stakeholders in Meru County

2.3.1 Chain Actors

- **Input Suppliers**

Certified input suppliers and purchase centres reported from previous studies are Meru University of Science and Technology, and Kaguru Institute (Habineza, 2022). Although many other outlets offer certified seedlings, some unreliable sellers distribute uncertified seedlings to farmers.

- **Farmers**

Smallholder farmers, typically managing 3 to 40 trees, primarily produce avocados in Meru County (Masinde, 2022). Medium-scale farmers manage 40 to 100 trees, while large-scale farmers have over 100. Smallholder farmers sell their produce to brokers who aggregate, grade, and export, the remaining produce are sent to the domestic market. The large-scale farmers also supply avocados to the intermediaries (Onyango, 2022).

- **Brokers/Middlemen**

These intermediaries—often uncertified—play a role in avocado trading. While some are government-certified, others falsely claim to work for exporters to negotiate lower prices with farmers. They collect both ripe and unripe fruits from farmers, resulting in losses.

- **Farmers' Cooperatives**

There are three cooperatives: Mt. Kenya, Abothuguchi, and Mt. Kenya East. Mt. Kenya cooperative is in its early stages and lacks a formal structure. While Abothuguchi and Mt. Kenya East cooperatives share the same goals, there is a need for collaboration and unity to ensure consistency and stability among farmers towards their respective cooperatives.

- **Processors**

Research reports that three industrial-scale avocado processors have been established in Kenya. The lower grades and rejects are used in processing avocado oil, which is exported abroad for refined processing (Snel et al., 2021). Limbua Group is one of these processing companies in Kenya.

- **Domestic Market**

The Kenyan domestic market consumes more than two-thirds of all the avocados produced (Snel et al., 2021). Rejected avocados and non-export varieties go to the local market. Consumers prefer local varieties because they are larger than the Hass and Fuerte varieties.

- **Exporters**

The export market is formal and structured with stringent quality and phytosanitary requirements and export regulations (Amare *et al.*, 2019; World Bank, 2020). As such, a limited number of large-scale export companies dominate the avocado export market, including Vegpro Kenya, Sunripe, Keitt Exporters Ltd., Kakuzi PLC, Olivado Kenya, East African Growers, Kenya Horticultural Exporters, Mutanda, Ideal, etc. (Amare *et al.*, 2019).

These exporting companies have long-standing relationships and formal contracts with small-scale avocado producers or producer organisations. Some companies support the farmer groups with training, advisory services, certification and other requirements to access the export market (Imani, 2019).

These exporters obtain avocados in three ways: by placing orders with brokers who supply avocados to their warehouses, by organising transports to pick up the produce directly from farmers' groups in major growing areas, or by obtaining them from contract farmers who deliver their avocados directly to them.

2.3.2 Chain Supporters

- **Kenya Plant Health Inspectorate Service (KEPHIS)**

KEPHIS is a government regulatory agency tasked with ensuring the quality of agricultural inputs and produce to prevent adverse impacts on the economy, the environment, and human health (KEPHIS, 2024). They execute training on sustainable avocado practices, issue phytosanitary certificates and plant import permits, and conduct facility inspections (KEPHIS, 2024).

- **Horticultural Crops Directorate (HCD)**

The HCD is a regulatory body that performs four broad functions: market research and development, regulations and compliance, technical and advisory services, and corporate services (Horticultural Crops Directorate, 2024).

- **Kenya Agricultural and Livestock Research Organization (KALRO)**

KALRO works with the Kenyan Government in research and coordination of the agri-food sector, knowledge sharing and transfer to stakeholders in the agri-food sector, capacity building and training programmes, and the promotion of improved technologies and practices. The mission of KALRO is to digitise the agricultural value chain (Kenya Agricultural and Livestock Research Organisation, 2018).

- **Food Waste Reduction and Food Quality Living Lab (FORQLAB)**

FORQLAB is a consortium led by four Dutch universities (Van Hall Larenstein, HAS, InHolland, and Aeres) alongside two Kenyan universities (Egerton University and Meru University). The objective is to reduce food waste in Kenyan avocado and dairy supply chains by working together, innovating, and enacting policy reforms while improving food quality using a living lab approach (NFP Connects, 2022).

- **Avocado Society of Kenya (ASOK)**

ASOK is the principal association for Kenyan avocado producers, exporters, and other stakeholders. The society promotes partnerships among stakeholders to provide innovative services that influence the transformation of agriculture and promote marketing towards the long-term profitability of the avocado business (Avocado Society of Kenya, 2024).

- **Meru County Government**

The County Government provides extension services to farmers, partners with the farming community to cultivate quality seedlings, provides subsidies, and sometimes links farmers to the market (Meru County Government, 2024).

- **Pharox Logistics Intelligence and eProd Solutions**

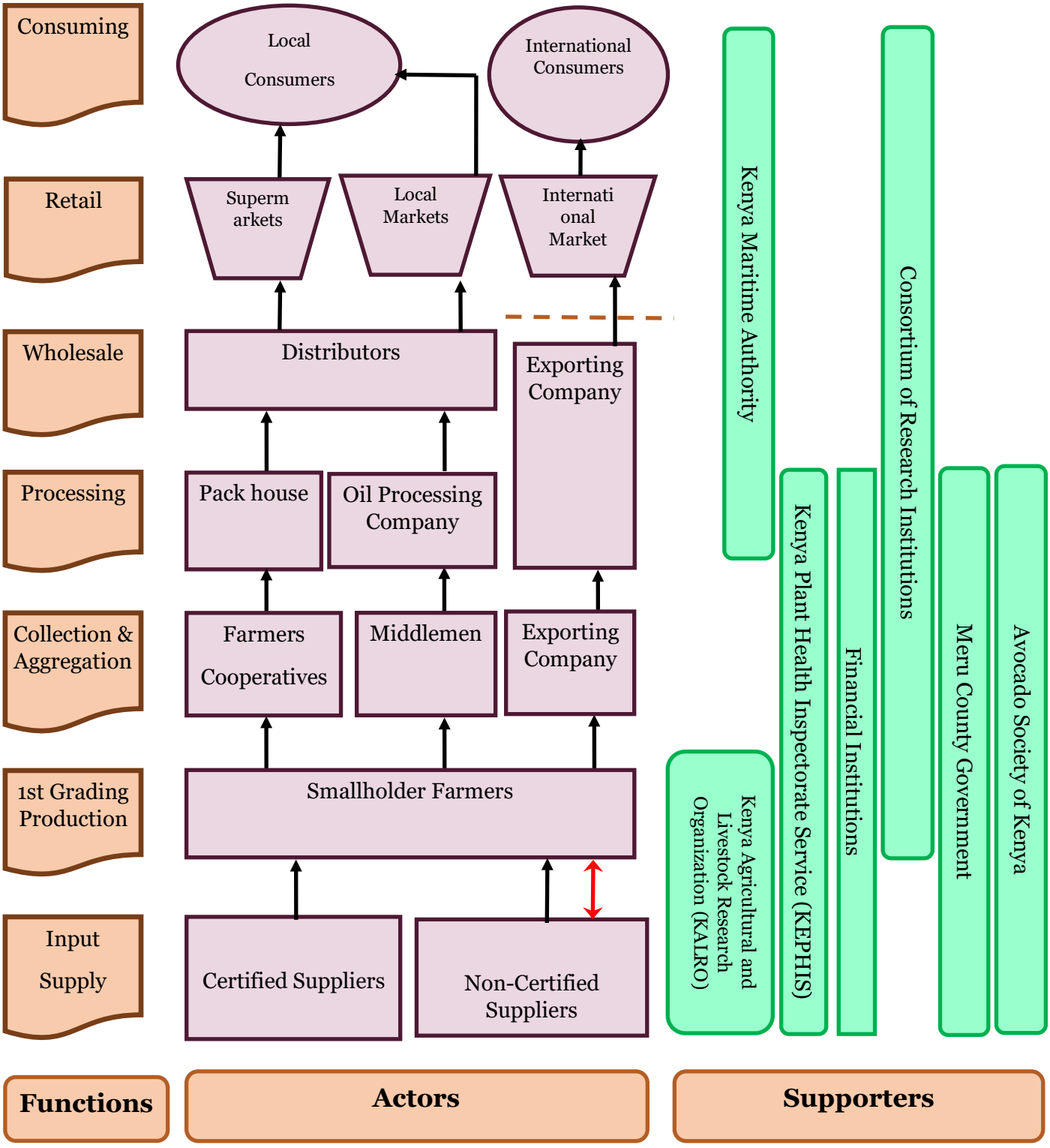
Currently, these two organisations do not have a role in the existing avocado value chain. However, it has been realized that to achieve the objective of this research, we need some necessary information from them. Therefore, this research investigated their future role in the ICT development of the avocado value chain in Meru County.

- **Application Developer**

Jesper Giesbers, a junior researcher with one of the research institutions (HAS Green Academy) has worked on a basic application with predetermined functionalities.

2.3.2 Avocado Value Chain Map in Meru County

Figure 5: Avocado Value Chain Map of Meru County

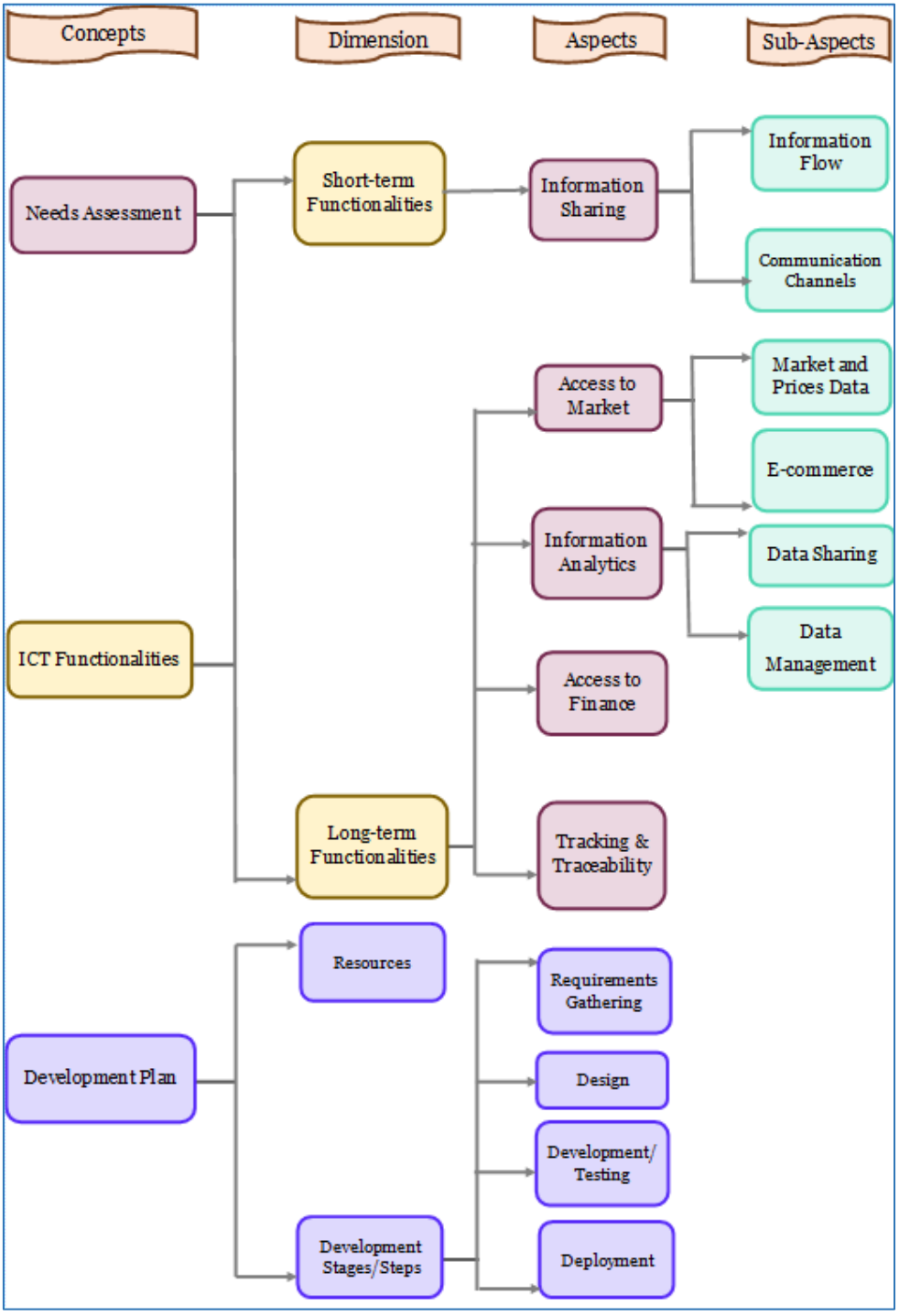


Source: Author's Compilation, 2024 (Adapted from Literature Review).

2.4 Conceptual Framework

Jabareen (2009) defined *conceptual framework* as a network of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena. The concepts that constitute a conceptual framework support one another, articulate their respective phenomena, and establish a framework-specific philosophy. This research's conceptual framework—*See Figure 6*—presents an overview of the interlinkage of the key concept and elements used in the course of the research.

Figure 6: Conceptual Framework



Source: Author, 2024.

CHAPTER THREE: RESEARCH METHODOLOGY

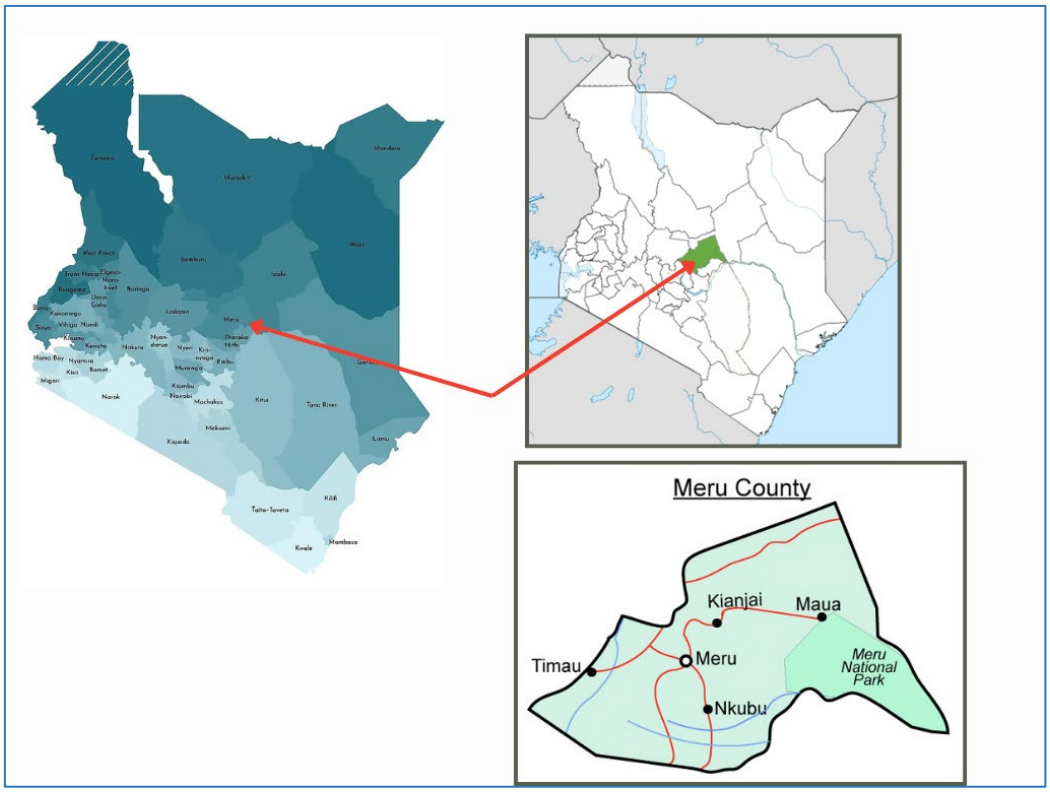
3.1 Study Area

Meru County—*See Figure 7*—is located in east-central Kenya and is one of the 47 counties in the country. It borders Isiolo County to the north, Tharaka-Nithi County to the south, Nyeri County to the southwest, and Laikipia County to the west. Meru County was created from the Eastern Province when Kenya replaced its provinces with counties.

The county covers an area of 7,006 km^2, of which 972.3 km^2 is declared forest (The Council of Governors, 2018). The county experiences variations in climate based on altitude. It has a biannual rainfall pattern with precipitation between 853 and 1500 mm and a temperature range of 12.9–25°C (Muthee et al., 2015). The highlands are cool and wet, with an average temperature range of 10–20 °C and reliable rainfall. The lowlands are hot and dry, with average temperatures exceeding 25°C and more rainfall that is erratic. It also has varied ecological zones, including upper and lower highlands and upper and lower midlands, which greatly influence major economic activities. A distinct feature of the county is Mount Kenya, which has an altitude of 5,300 feet (1,600 metres) above sea level, which is favourable for avocado production (The Editors of Encyclopaedia, 2024). The lower eastern plain is semi-arid, with savanna grasslands and woodlands. The Central Highlands have rolling hills and fertile valleys.

Many ethnic groups with distinct languages and cultural customs call Meru County home. The dominant group is the Meru people, known for their agricultural practices, social structures, and rich cultural heritage. The county has an estimated population of 1,545,714, wherein 70% are small-scale subsistence farmers (Muthee et al., 2015; Munene, 2019).

Figure 7: Map of Kenya Highlighting Meru County



Source: World Atlas, 2024.

3.2 Research Approach

For this research, a social constructivist approach was selected. Laws et al. (2013) stated that a social constructionist is interested in obtaining broad information and asking open questions, thereby identifying issues with an approach, which makes assumptions about the needs of the respondents.

The social constructivism enables investigation of the contributing factors to the cooperatives' communication needs, recognising common and divergent viewpoints when introducing an ICT application, detecting potential biases and constraints, and determining the stages for developing an implementation strategy. As a feature of qualitative research, a greater understanding will be attained by continually analysing the problem as a researcher and with participants (Aspers and Corte, 2021). Interviews and focus group discussions were utilized in this research—*See Table 1*.
This approach is ideal for this research because it provides a nuanced understanding of communication dynamics within the cooperatives and paves the way for guiding steps of an ICT application tailored to their specific needs. This research was conducted in six weeks—*see Annex III.*

3.3 Data Collection

This survey was conducted in Meru County, Kenya. Two data types collected for this research:

- **Secondary Data**: A desk study was conducted to gather secondary information on the background information on avocado, communication and governance structure in the county, understanding of ICT functionalities and components, existing ICT solutions in the county, key steps and timeframe for developing the application and potential ICT application using Google Scholar, ScienceDirect, and previous thesis on Greeni.
- **Primary Data:** This research utilized qualitative tools including semi-structured interviews and focus group discussions with the farmer cooperative, app developer, KALRO, Pharox and eProd Solutions to gain insight into the existing functionalities, shared experiences, identification of the specific needs, and the possibilities for the farmer cooperatives

Table 1: Summary of Research Approach

RESEARCH QUESTIONS	RESPONDENTS	METHOD
What are the communication and coordination needs of the farmer cooperatives in Meru County solvable with an ICT application?	• Farmer Cooperatives	Focus Group Discussion
What are necessary functionalities of the ICT application that will address the needs of farmer cooperatives?	• Farmer Cooperatives • eProd Solutions • App Developer • KALRO	Focus Group Discussion with cooperatives Interviews with eProd, developer, and KALRO
What are key steps and timeframe are for developing the application?	• App Developer • eProd Solutions • KALRO • Pharox	Interviews Desk Research
What are the needed resources in developing the application and implementing the action plan?	• App Developer • eProd Solutions • KALRO • Pharox	Interviews

Source: Author, 2024.

Sampling Strategy

The sampling—*see Table 2*—gives an overview of the stakeholders involved in the research, the size of the interviewees, the research tool employed, and the chosen sampling method.

This research selected six stakeholders for interviewing:

a. Two farmers' cooperatives—Mount Kenya Cooperative and Abothuguchi Cooperative—using the Focus Group Discussion. Each focus group discussion consisted of a sample size of six members. The cooperatives were chosen on purpose because they are FORQLAB Project partners and stakeholders.

b. Three individual Stakeholders: eProd Solutions, represented by its founder and CEO, was included through purposive sampling. The director of Pharox Logistics, an ICT Officer from the Kenyan Agricultural and Livestock Research Institute (KALRO), and a functional application developer from the academic partner of the FORQLAB project.

Table 2: Sampling Overview

STAKEHOLDERS	RESPONDENT	SIZE	TOOL	SAMPLING METHOD
Farmers' Cooperative	Mt. Kenya Cooperative	6 cooperative members	FGD	Purposive Sampling of Cooperatives Random Sampling of Participants
	Abothuguchi Cooperative	6 cooperative members		
eProd Solutions	Founder/CEO of eProd Solutions	1	Interviews	Purposive Sampling
App Developer	Junior Researcher with FORQLAB Project	1		
KALRO	ICT Officer	1		
Pharox Logistics	Director of Pharox	1		

Source: Author, 2024.

Sampling Justification
The sampling method was structured with these perspectives in mind**.**

Focus Group Discussions with Farmers' Cooperatives

- **Efficiency:** Choosing FGD is an efficient way to obtain in-depth information from these groups because it brings together a variety of perspectives from individual farmers, allowing for a broad range of data in a single session rather than with individual interviews.
- **Comprehensiveness:** FGD not only allows for the individual perspectives of farmers but also explores group dynamics and shared experiences within the cooperative. It allows the researcher to gain a more comprehensive understanding of the research objectives.

Selection of Two Farmer Cooperatives
Choosing Mt. Kenya Avocado Growers Cooperative Society and Abothuguchi Avocado Growers Cooperative out of the three cooperatives because:

- The forward thinking of the president of the Mt. Kenya cooperative and the large membership size of the Abothuguchi cooperative.
- The anticipated differences in needs and priorities of the two cooperatives.
- Triangulation of information.

By incorporating perspectives from each cooperative, this research got a more balanced view of the situation. *See Annex I for the interview checklist.*

Pharox Logistics Intelligence, eProd Solutions and KALRO
These organisations are potential supporters of the existing avocado value chain in Meru County. Their selection is due to their existing applications and solutions for other export crops regarding data

management, information sharing, and seamless logistics operations (tracking and traceability). This research obtained vital information and assessed the possibility of developing a specific application for the farmer cooperatives. *See Annex I for the interview checklist.*

3.4 Data Analysis

For this research, the findings from the qualitative analysis—interviews and focus group discussion—were analysed using Thematic Analysis, presented in a Microsoft Excel Sheet.
Steps of Analysing:

1. Transcription: Interviews and focus group discussions were transcribed verbatim to create a written record of the data.
2. Coding: Each transcript was coded line-by-line or passage-by-passage to identify key concepts and ideas.
3. Developing Themes: Based on recurring patterns, codes are grouped into broader themes.
4. Data Presentation of Thematic Analysis in Excel Sheet.

Thematic analysis is a flexible and efficient method for identifying, analysing, and reporting patterns (themes) within qualitative data. It is particularly well suited for this research because it allows insight into a broad range of experiences and perspectives related to the study.

Excel provided an organized way to present the coded data and thematic relationships. It allows for visual representation where applicable.

Further analysis was conducted using:

- P.E.S.T.E.C Analysis to consider the factors that are conducive to strengthening the implementation of the ICT application.
- S.W.O.T. Matrix assesses the current ICT infrastructure of the cooperatives, identifies areas for improvement, and explores opportunities for new solutions.

3.5 Research Ethics

In research, ethics is defined as the moral principle(s) and values that guide researchers in conducting their research and a code of practice that protects the people being researched from unethical processes (Orb, Eisenhauer, and Wynaden, 2001; O'Leary, 2021).
For this research, the ethical considerations put in place included:

a. Requesting consent from the respondents before taking audio recording and photographs.
b. Reiterating the purpose of this study and the importance of respondents' participation is to the research.
c. Obtaining consent to use names and affiliated organisation names during the report.
d. Respected the choice of the third cooperative (Mount Kenya East Cooperative's) unresponsiveness in participating in this research while trying to include more respondents on the field.
e. Awareness of individual biases as a researcher and thereby choose to quote respondents verbatim in my discussion chapter.

3.6 Expected Outcomes

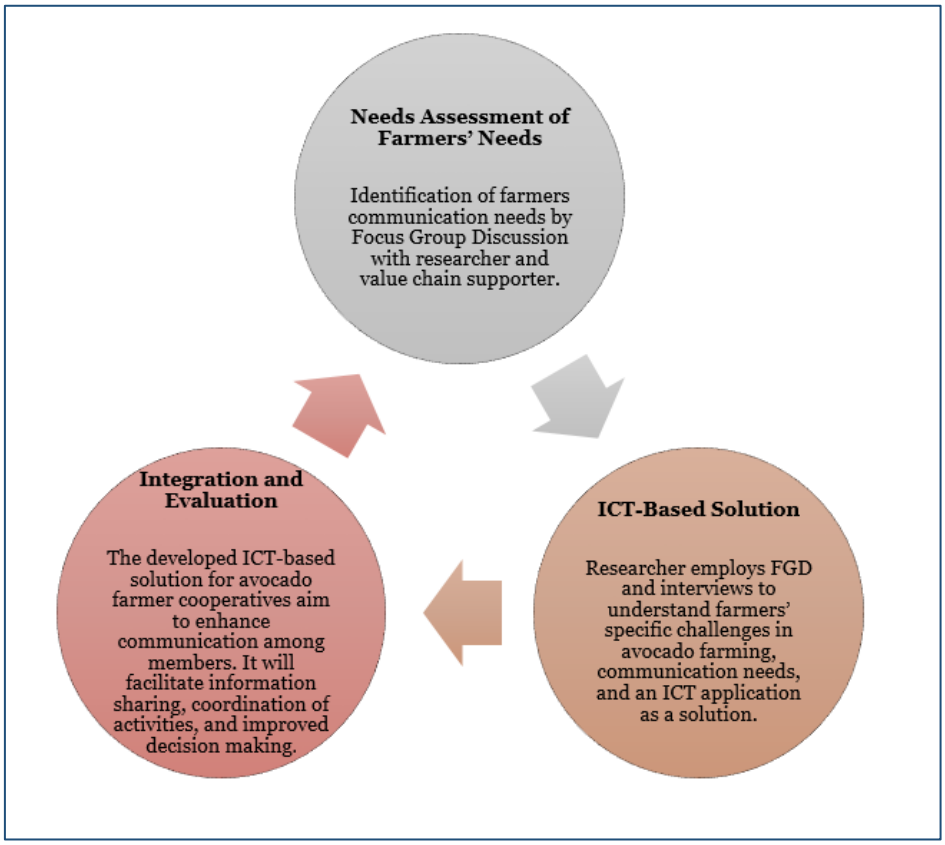
1. Advise the cooperative board of executives on the functionalities of an ICT application for communication and coordination in the short-term and the long-term.

2. Developing an action plan for strengthening communication and coordination using an ICT application.

3.7 Research Framework

The research framework in *Figure 23* outlines the research objective, the process, and the proposed solution.

Figure 8: Participatory Information and Communication Technology Development (PICTD) Approach between Farmer Cooperatives and Researcher



Source: Author's Adaptation from the PICTD Approach of Barakabitze, Fue, and Sanga (2017).

CHAPTER FOUR: FINDINGS

4.1 Communication and Coordination Needs of the Farmer Cooperatives in Meru County

What are the communication and coordination needs of the farmer cooperatives in Meru County solvable with an ICT application?

This research investigated the needs of the farmer cooperatives in Meru County. However, in understanding their needs, there is a need to understand the underlying challenges the farmers are facing, which requires the necessity of this research. Findings showed that cooperatives are experiencing intertwined challenges, with communication emerging as a critical bottleneck. Inefficient information dissemination and reliance on traditional methods of communication are central contributors to this issue.

From the focus group discussions with Mount Kenya and Abothuguchi farmer cooperatives, the study revealed that the challenges of the farmer cooperatives are inclusive but not limited to the following—*see Figure 9*:

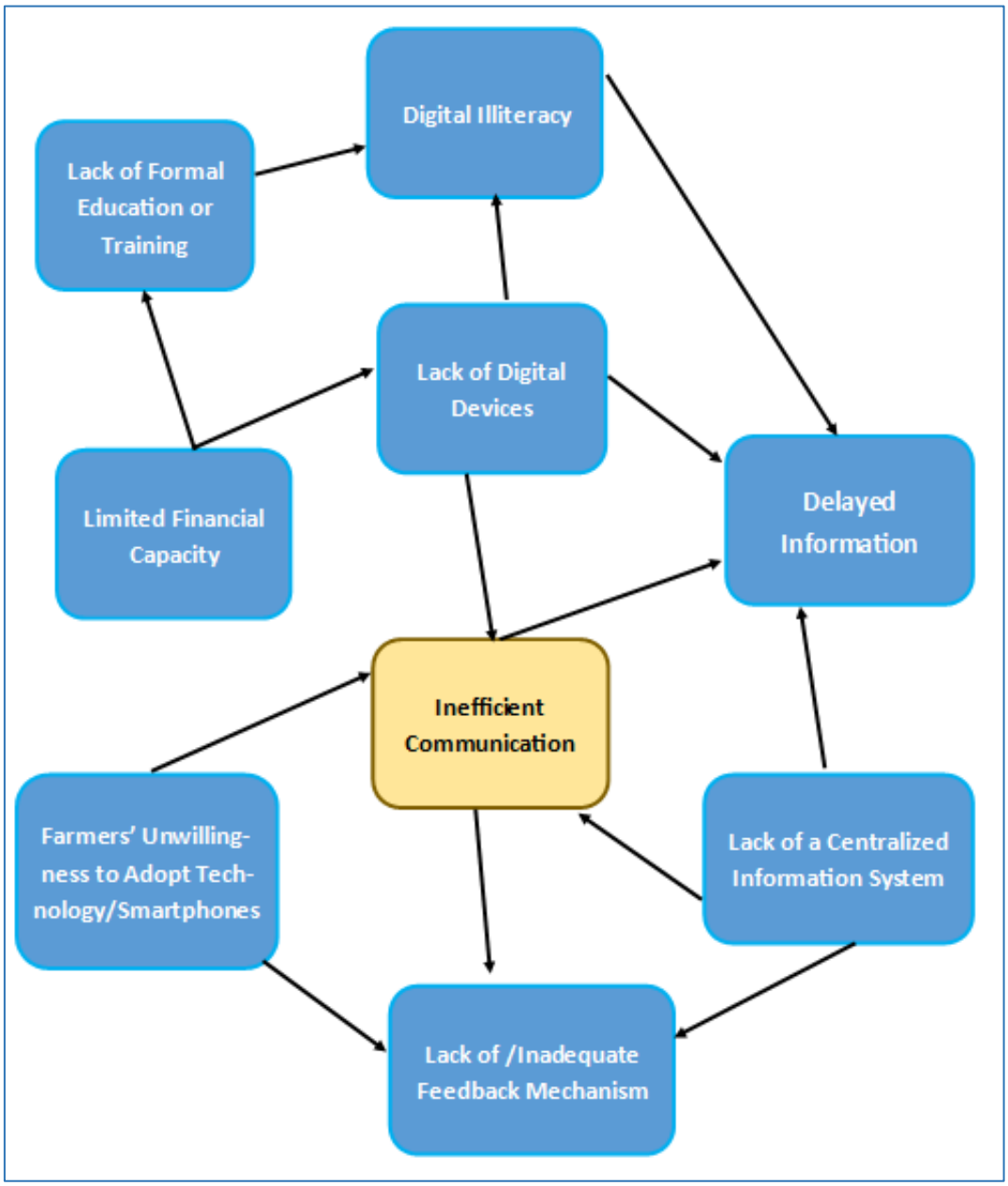
- Limited reach: Some of the farmers do not have smartphones, which limits their access to information and resources.
- Delayed Information: (Break in communication) Untimely transmission of urgent information from extension officers to cooperative executives and from the cooperatives to farmers.
- Lack of a centralised system for communicating and educating
- Lack of a feedback mechanism.
- Farmers are not always readily available for new information and implementation. It takes time to adopt new initiatives.
- Current communication methods are slow, expensive, and unreliable.
- Digital literacy: Farmers need training to utilise digital devices effectively.
- Need for Real-Time Communication: A system for instant messaging to all members is essential.

The cooperative members attributed the digital divide—the absence of smartphones—amongst some farmers as a primary obstacle to timely communication, particularly from cooperative executives to farmer members. Because of this disparity, urgent updates on best agricultural practices, pests and disease control, market trends, and prices are often delayed or undelivered altogether. Consequently, this has been disadvantageous to avocado farmers, hindering their ability to optimise yields and get the best prices for their produce.

Compounding the aforementioned primary obstacle is the lack of a centralised communication system for the cooperative, particularly the Abothuguchi cooperative. The absence of a unified platform for receiving information and education has left farmers reliant on physical gatherings, which are often slow, expensive, and unreliable, leading to delays, and inaccurate and fragmented information, thereby limiting farmers' ability to make informed decisions. The time lag in information transmission has resulted in severe consequences, as farmers have missed crucial windows for applying agrochemicals, identifying diseases and pest attacks, and even harvesting.

To bridge the communication gap, there is an urgent need for a real-time communication system that can reach all farmers, and an inclusive communication strategy must be adopted. This is not limited to ensuring a user-friendly and accessible system, digital literacy training programmes to equip farmers to utilise the application effectively.

Figure 9: Causal Diagram of the Communication Challenges of Meru County Avocado Farmers



Source: Author's Compilation, 2024.

From the findings, farmers need information on the opening and closing of Markets, production practices, market prices, weather forecasts, agricultural support, farmers' training, buyers/clients, quality standards, and financial services. Upon analysing the challenges the farmer cooperatives are facing, the needs assessment from the focus group discussions with the farmer cooperatives revealed that these needs are grouped into functionalities under the following themes:

a. Comprehensive member database on all members, allowing room for updates and easy report generation. Including personal data, number of trees owned, land size and location, etc.
b. Production Database: Including production history with a tracking system, cumulative sales, inventory, and financial status. Record sheets that allow cumulative data on avocados harvested, quantity sold, and quantity left, etc.

c. Market information: Real-time market data accessibility. Including market prices, buyer information, payment details, etc.
d. Service tracking feature: Providing a concise record of agronomic services provided to farmers, including support, observations, recommendations, etc.
e. Financial statement.
f. Forecasting feature: Data on fruit trees and production prediction.
g. Farmer feedback platform.
h. E-commerce platform: Online marketplace for buying and selling avocados.
i. Traceability: Ability to track avocados from our farms to the destination market, ensuring precise product origin and quality.

4.2 Key Functionalities to Address the Needs of the Farmer Cooperatives

What are necessary functionalities of the ICT application that will address the needs of farmer cooperatives?

This study gathered from the focus group discussions with Mount Kenya and Abothuguchi farmer cooperatives the important features farmers would like to see in the proposed application. The functionalities are as follows:

1. **Data Management Functionality:** A website for the cooperative with members' login profiles that allows for a comprehensive member database including biodata, number of trees owned, land size and location, production history of individual farmers, sales, and inventory management. It also should have a feature for predicting or forecasting yields for future harvests.

   "For me, one important feature I would want is a database. We should have a database of all our members and their details, and it should be able to update. For example, if we want to know the production of which member every year, we should have that history in that application. It should also be able to generate reports (Karichu, 2024)".

   "I would think that as a cooperative, we would need a website. On this website, we can have a member portal as you would have a staff portal. You can log into the system with your membership number and a password (Mbogori, 2024)".

2. **Market Data Functionality:** This provides farmers with real-time market data on market opening/closing periods, available markets, and price trends, allowing room for generating market data reports seamlessly.

   "We should be able to, at a glance, see where the markets are. We should have a feature like Excel to have cumulative figures on the amounts sold, fruits available, that kind of data (Mwarani, 2024)".

3. **Support or Educational Service Functionality:** This allows adequate record keeping of support services to individual farmers on sustainable agricultural practices and provides a training feature for knowledge sharing. It should include a comprehensive production/husbandry information section on avocado management practices.

   "Another important feature I feel would be good to have in that system is where we see the services provided to a farmer, be it agronomy or support, if the agronomist visited the farm. They probably need to put down a report on observations and recommendations viewed from the system. That way, it can be verified that it happened. If farm inputs are given to the farmers, be it on credit or free of charge, we also need to be able to see that. (Murithi, 2024)".

4. **Financials Functionality:** Allows record keeping on sales prices, profits, market prices, and loans/credit obtained specifically on each farmer's dashboard.

5. **Traceability Functionality:** Allows detailed tracking of avocadoes from a specific origin to the destination market.

   "The features which are very important for us is one. How do we assess to know where our fruit will be going? To the customer? If we know where the customer is and how much he is paying for it. What it costs him to buy our fruit. Then we know the quality he needs. He should say from this particular place. It should be traced back to its source (Kirera, 2024)".

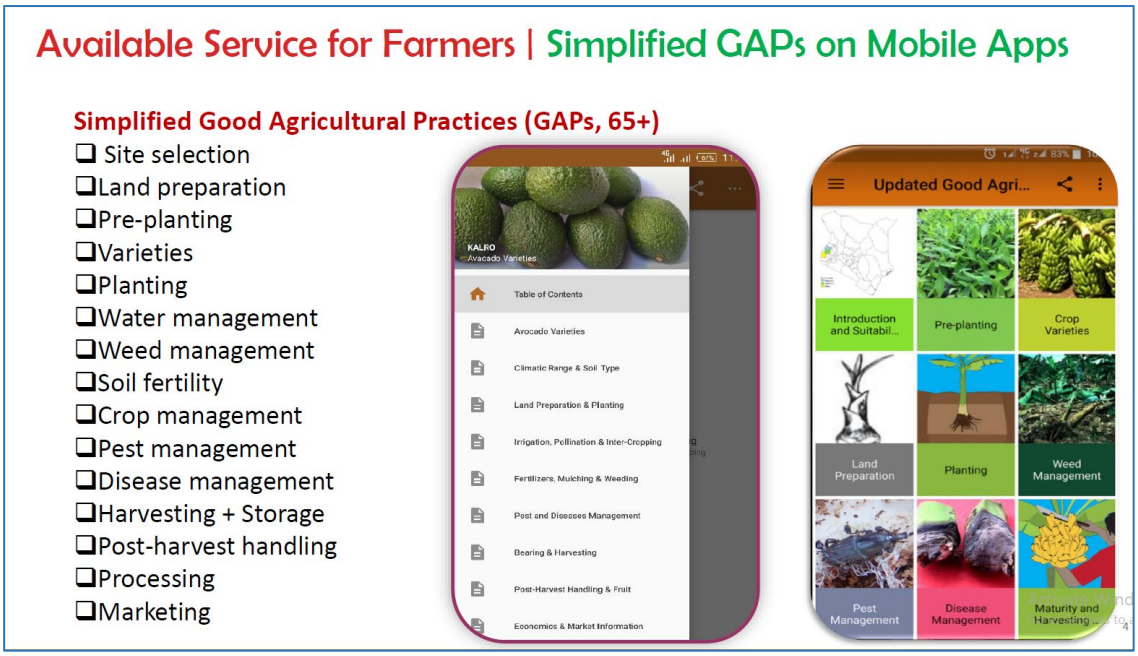
   "To emphasize that source, that traceability. Avocado comes from Kenya. Which part of Kenya? Meru. Where in Meru? Exactly, that is important. (Kimathi, 2024)".

6. **E-commerce Feature:** An online marketplace for selling and buying avocadoes for the best prices. It allows transparency and prevents farmers from being exploited by brokers.

Following interviews with the functional design developer and ICT experts from KALRO, Pharox, and eProd solutions highlighted some salient features as vital functionalities to be included in the application. It is inclusive and not limited to the following:

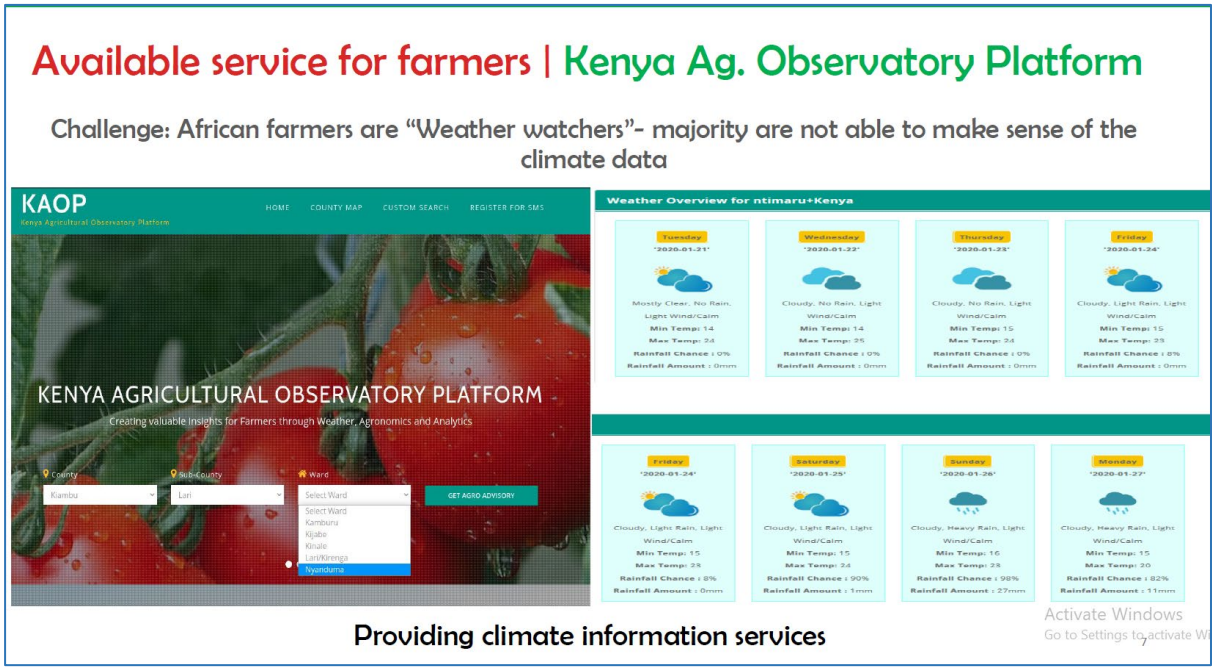
- Chat capability feature that allows real-time communication on urgent matters and knowledge sharing.
- Financials features for savings and credit, market prices and trends.
- Data management features for gathering, analyzing, recording, and storing communication data to identify trends and enhance processes.
- Support/educational features for production, weather information, and training information—*see Figures 10 and 11.*
- Centralized dashboard: Provides an overview of membership profile and farm details, facilitating communication, reporting, and two-way feedback —*see Figures 12 and 13*.

Figure 10: KALRO Application Available Services for Farmers



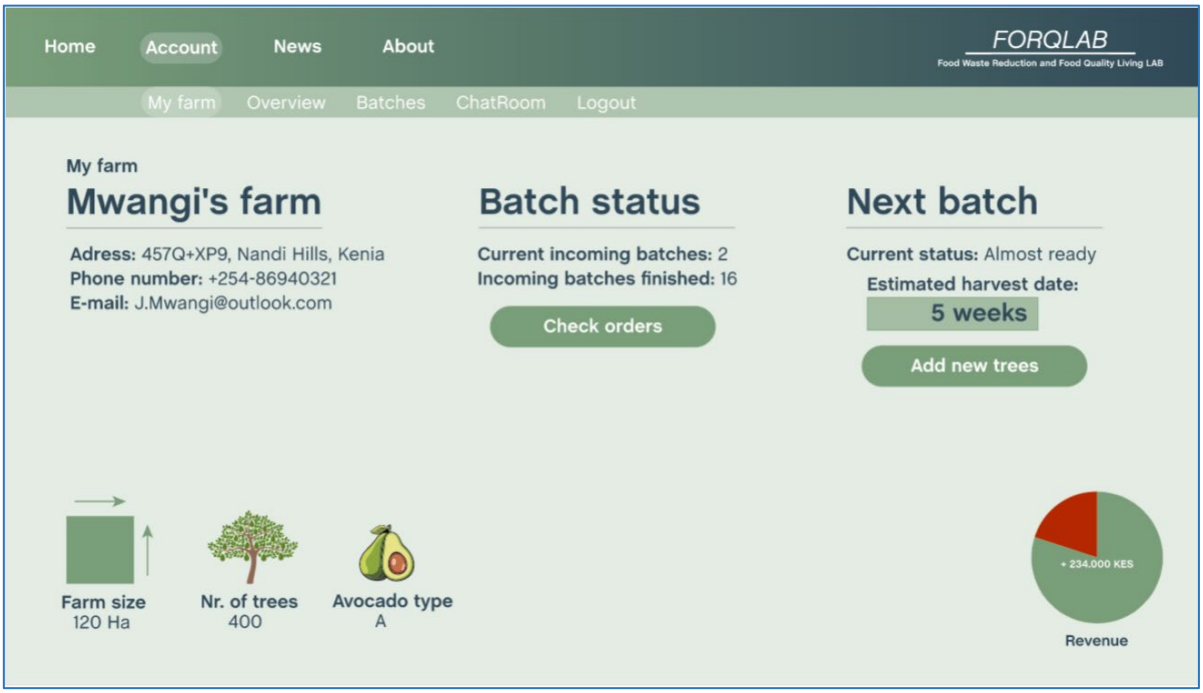
Source: Kimani, 2024.

Figure 11: Kenya Agricultural Observatory Platform (KAOP)



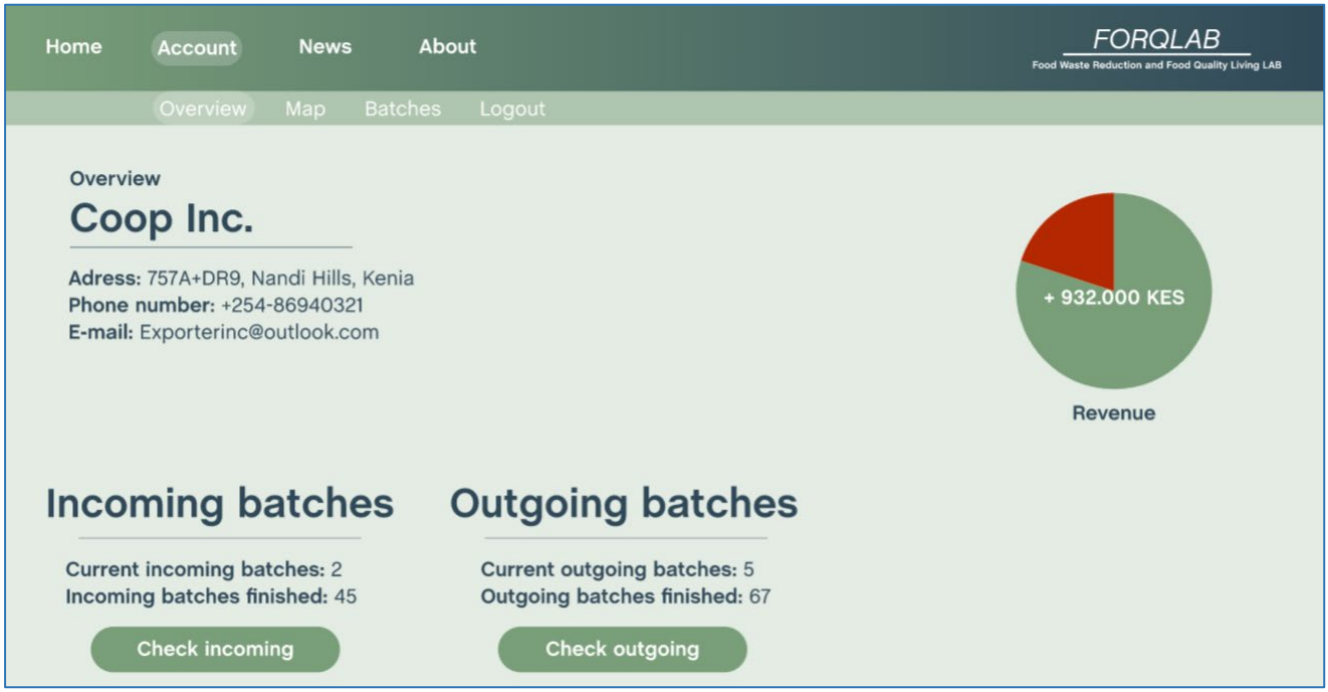
Source: Kimani, 2024.

Figure 12: Functional Design - Farmer's Portal Overview



Source: Giesbers, 2024.

Figure 13: Functional Design - Cooperation / Importer's Portal Overview



Source: Giesbers, 2024.

According to the interviews with ICT experts, when adapting long-term functionalities, it is important to:

- Prioritise Features: Outline the system's key and desired features.
- Future-Proof Design: Plan for future needs and design the system to meet them, avoiding costly redesigns.
- Scalability: Create a system that can expand and adapt to changing needs.
- Maintain an open dialogue about prospective features and priorities throughout the development process.

4.3 Key Steps and Timeframe for Developing an Application

What are the key steps and timeframe for developing the application?
Following the interview with ICT experts from KALRO, Pharox, and eProd Solutions, the following aspects make an application user-friendly:

- A user interface designed from customer experience with simplicity and easy accessibility. It should be designed with visual elements such as colours and icons that appeal to users.
- It must include only necessary elements (for instance, data entry, chat function, separate pages per participant, data view etc.).
- Availability of application on single and multi-app platforms/operating systems i.e. Android and iOS.
- Compatibility of the application with mobile and web platforms with seamless user experience, based on user preference.
- It must be designed with simple language. In the instance of the KALRO application, English and Kiswahili are base languages and then translated to other dialect languages e.g. Kikuyu, Luo, and Luhya etc.).

- Process Alignment and Optimization: The IT system should support existing processes rather than dictating them and its goal is to enhance users' operations.

Kimani from KALRO highlighted that the development of an application follows an Agile Development Process. This process involves an iterative method of development that is dynamic and allows for continual user feedback.

> *"So we take all the groundwork information and put it together in a framework. A communication team or a content team does this. We use an agile development process. What do I mean by an agile development process? We sit down with the developers. They develop wireframes. Once the wireframes are developed using the specialized tools, we can see how this application would look, and once we have agreed, all teams agree. They code the application. In addition, once they have done that, we go down to testing, and the application before we roll it out. Of course, there is the back and forth. Once we are assured that the application is okay, we deploy. We test it once again with the end users—that is the farmers. That stage, we call it validation, and once validated and both sides are satisfied; now we launch the application (Kimani, 2024).*

Tenhagen of Pharox also corroborated the developmental steps as follows:

> "*Firstly, it's important to have maybe one or two needs assessment meetings right with the clients to collect background information on the supply chain (mapping), then the first design draft. After, we can make a plan, and a cost indication and we can map that plan then with the client we decide whether to go ahead with it based on that, after which it is developed and a small-scale pilot with the first versions is conducted to obtain feedbacks from different stakeholders and get an additional layer of information. If all required requirements are inclusive, a second rollout should be conducted to additional stakeholders after which full deployment is done (Tenhagen, 2024)*".

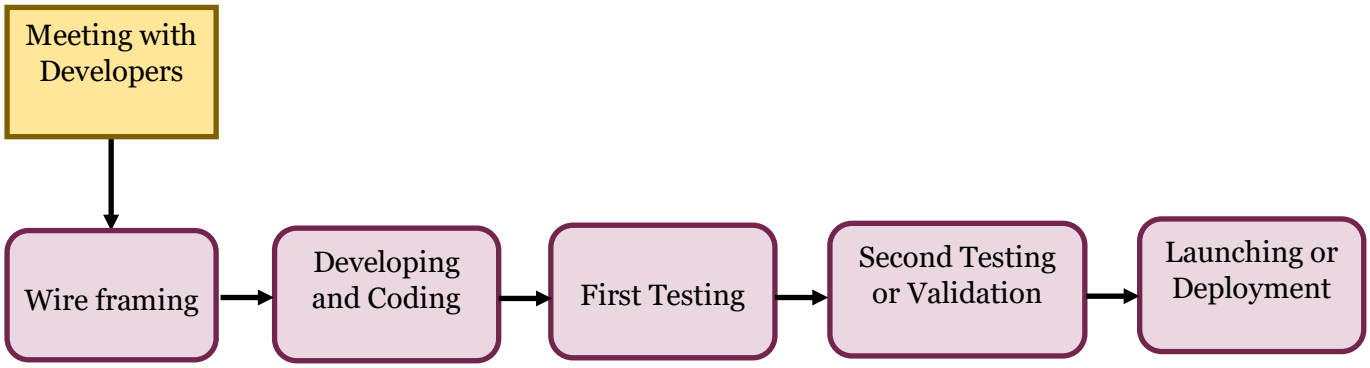
Based on the information gathered from the ICT experts, the key steps for developing the application are as follows:

1. **Project Initiation and Requirements Analysis:** This involves detailed research on the value chain, prioritizing the list of desired information, and an in-depth assessment of users' needs.
2. **Initial Meetings:** Conduct one or two meetings with the client to gather detailed information about the supply chain process. Also, a meeting with the developer(s) to relay the requirements and agree on a design.
3. **Value (Supply) Chain Mapping:** A visual representation of the avocado value/supply chain is illustrated identifying key steps and potential areas for improvement.
4. **Solution Design:** Based on the mapping, the design of a potential solution that addresses the client's needs and is cost-effective.
5. **Cost and Time Estimation:** Preparing a cost estimate for the proposed solution.
6. **Wireframing:** This is the preliminary stage of design creating representations of the user interface. Essentially, it is the blueprint of the application and is often sketched with simple tools focusing on the layout, structure, and app functionality without going into the visual design elements. It can take two weeks.
7. **Coding (Developing):** This involves the programming stage. It can take two weeks or more.
8. **First (Pilot) Testing:** A small-scale testing is conducted internally with the value chain expert and the developer.
9. **Second Testing (Validation):** The value chain experts, the KALRO content team, the agricultural officers, selected farmers, agro-dealers, or agri-tech carry this out.

10. **Iterative Improvement:** Gathering feedback from the pilot and validation, refining the solution, and expanding its implementation.
11. **Full-Scale Deployment (Launch):** Once the solution proves effective, it is rolled out to all relevant stakeholders.

The flow chart in *Figure 14* below illustrates the key steps in developing an application, according to Kimani (2024) and Tenhagen (2024).

Figure 14: Developmental Steps of an Application

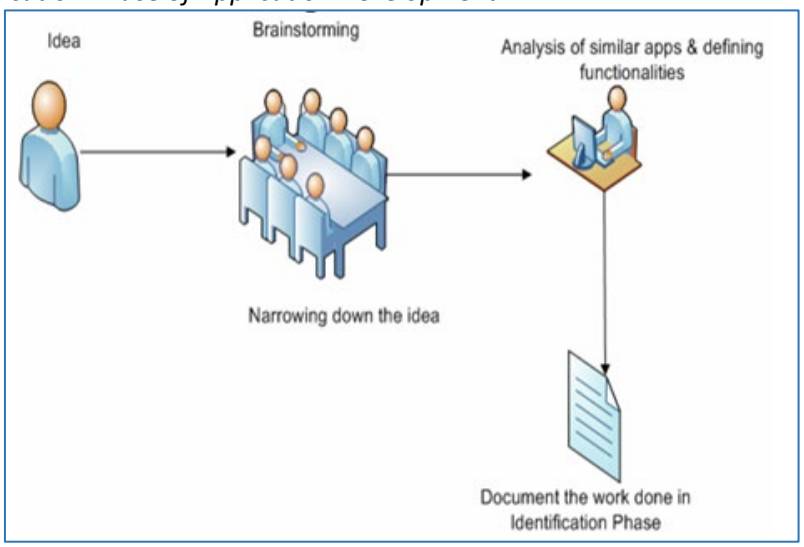


Source: Author's Compilation from Interview with KALRO ICT Expert (Kimani, 2024).

Building from desk research, the developmental steps of an application are based on a framework designed in 2013 called the **Mobile Application Development Lifecycle (MADLC)**—*see Figures 15 to 21.*

a. **Identification Phase:** Ideas are collected and categorized. The ideas can come from the users or the developers. These ideas are built upon and analysed. The feasibility of the design, the existence of similar applications in the market, and the differences of such applications are studied and compared. During this phase, the time required to develop the application is defined and the initial requirements gathering is completed. Overall, the work done by the "idea team" is documented and forwarded to the "design team" (Vithani and Kumar, 2014).

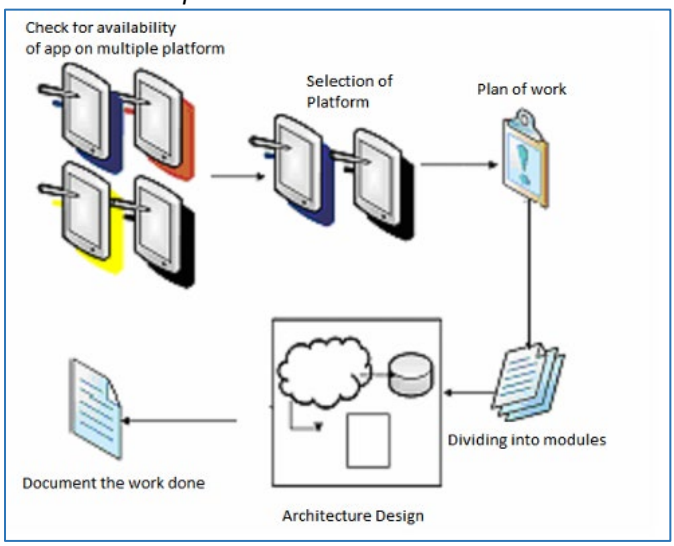
Figure 15: Identification Phase of Application Development



Source: (Vithani and Kumar, 2014).

b. **Design Phase:** Ideas are compiled, the feasibility of developing is determined, and a specific mobile platform is identified. In this phase, the decision on the subscription/pricing model is stated and the application functionality is categorized into modules and prototypes. A software design has been created, along with a storyboard for the user interface. The work done by the "design team" is forwarded to the "developmental/coding team" (Vithani and Kumar, 2014).

Figure 16: Design Phase of Application Development



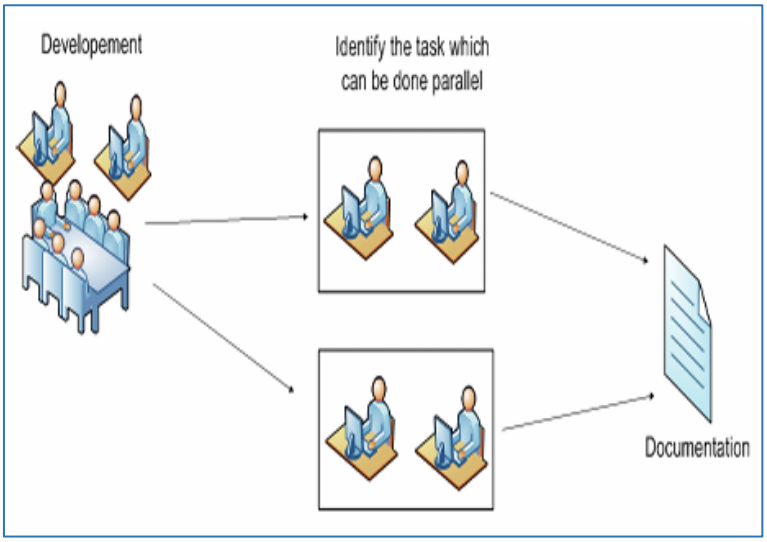
Source: (Vithani and Kumar, 2014).

c. **Development Phase:** Here, the application is coded. The coding can be in two forms:

- Coding for Functional Requirements
- Coding for UI Requirements.

Coding could be done in parallel and integrated later. The work done by the "developmental/coding team" is forwarded to the "prototyping team" (Vithani and Kumar, 2014).

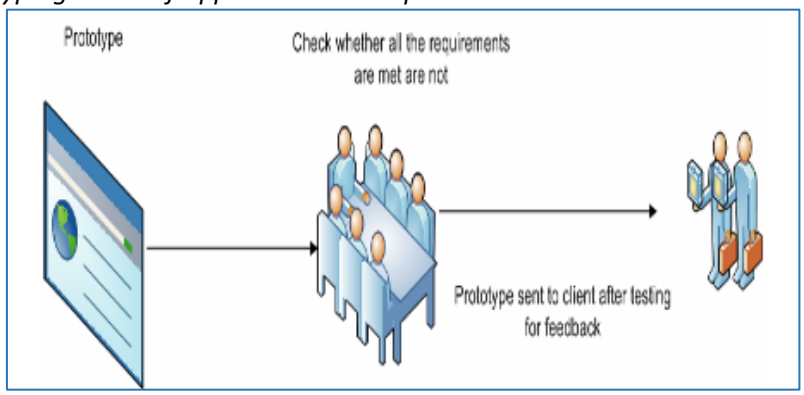
Figure 17: Development Phase of Application Development



Source: (Vithani and Kumar, 2014).

d. **Prototyping Phase:** Here, the functional requirements of the prototype are analysed, tested and sent to the client for feedback. Feedback changes are, merged with a second prototype for additional feedback. The prototyping, development, and testing phases are iterative stages of app development. The final prototype is sent for final feedback. The work done by the "prototyping team" is forwarded to the "testing team" (Vithani and Kumar, 2014).

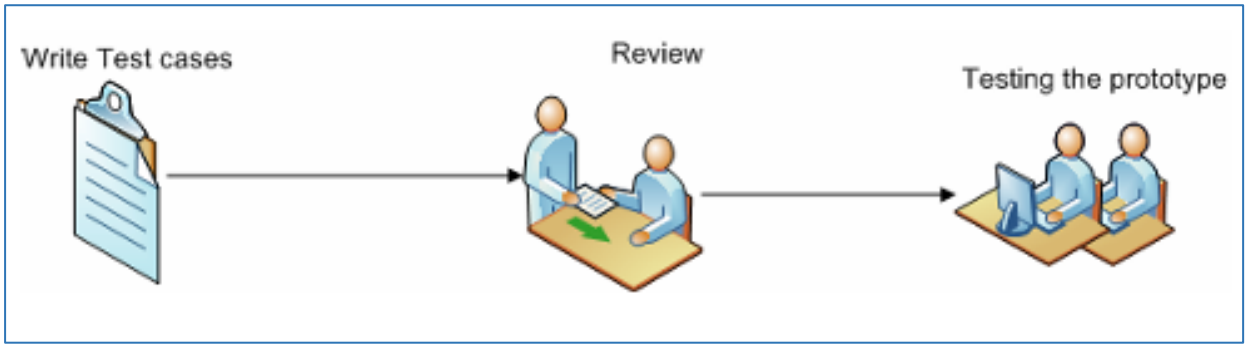
Figure 18: Prototyping Phase of Application Development



Source: (Vithani and Kumar, 2014).

e. **Testing Phase:** Testing is a crucial and iterative phase performed on a simulator followed by a mobile device on multiple operating systems platforms. This is to ensure its functionality across various users. The work done by the "testing team" forwarded to the client for feedback (Vithani and Kumar, 2014).

Figure 19: Testing Phase of an Application Development



Source: (Vithani and Kumar, 2014).

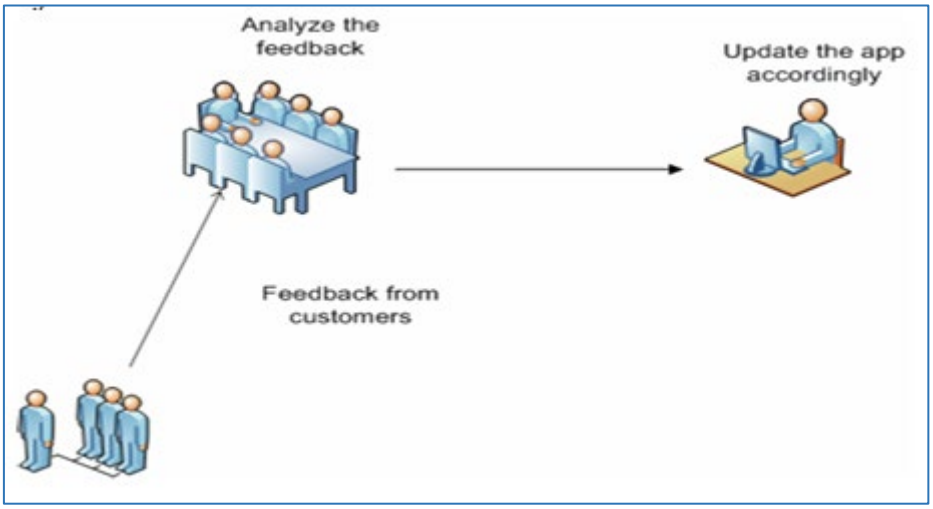
f. **Deployment Phase/Launch:** Final phase of the MADLC. After the final testing and feedback, the application is launched into appropriate application stores for usability.

Figure 20: Development Phase of an Application

Source: (Vithani and Kumar, 2014).

Maintenance is a continuous process for an application. Feedback is collected from users regularly to make updates to the app. Security updates, additional functionality, and updated user interfaces are included over time.

Figure 21: Maintenance of an Application



Source: (Vithani and Kumar, 2014).

Following the information gathered from the ICT experts, the timeframe for developing the application varies from two to six months.

- Giesbers, the functional design developer estimated 2-3 months for full implementation and continued back-office support.
- KALRO's ICT expert, Kimani estimated 3 months without breaks from wire framing until launch, but it is based previous research ahead of development.
- Pharox's, Tenhagen and eProd solutions, van Casteren estimated 6 months maximum dependent on available information, databases, appearance etc.

4.4 Resources for Developing an Application and Implementing an Action Plan

What are the resources needed in developing the application and implementing the action plan?

For the development of an application:

- Leveraging expertise: Collaboration of the development team's technical knowledge with the cooperatives' in-depth understanding of the supply chain and other key stakeholders will ensure the efficiency and accurate production of the users' requirements.
- A multidisciplinary team is essential, including tech experts, communication specialists, value chain experts, visual designers, scientists, and marketers.
- Hardware: This is inclusive of laptops, and mobile devices, optional items include Bluetooth, printers, internet & SMS registration and credit (van Casteren, 2024).
- Third-party applications like Agro cares soil testing kit and license (van Casteren, 2024).
- Market research of the end users: It is important to capture the key features required.

Tenhagen of Pharox however also highlighted the following crucial points for the cost analysis for app development.

- Understanding the Supply Chain: A comprehensive understanding of the cooperative's supply chain is crucial for designing an effective solution. This includes mapping out all stages from the grower to the final market.
- Identifying Key Processes: Determining specific processes within the supply chain, such as collection, quality checks, and transportation, is essential for targeted solution development.
- Data Collection and Analysis: Gathering data on various aspects of the supply chain, including quality checks and shipment volumes, will inform system design and optimization.
- Cost Efficiency: The primary goal is to develop an effective and cost-efficient solution, thereby reducing operational expenses.
- Iterative Design: The solution designed flexibly, allowing for adjustments based on feedback and evolving needs.

Upon analysis of the requirements, a time and cost estimate for the development of the application. For research question 3, development could take between two to six months. On costs estimation, Jan Willem van Casteren, founder and CEO of eProd Solution estimated based on previous discussions with the cooperatives 367,252 Kenyan Shillings *(€2568)*for Mount Kenya Avocado Cooperative and 562,685 Kenyan Shillings for Nandi Cooperatives *(€3934)—See Figure 22 and 23*.

Figure 22: eProd Budget for cooperative with shared training (Mt Kenya cooperative) excl. VAT, inclusive of SMS/ ID Cards/ Airtime/ shared dashboard.

eProd Basic	
Max users (farmers)	1,000
Number of computers configured in a network (desktop or laptop)	1
Mobile app users (max)	10

License and Set-up Fees	**KES**
Data preparation and set-up fee	31,460
eProd Basic	157,300
Mobile app user fee (max 10 mobile apps)	31,460
SMS set up and startup credit (5,000 KES)	20,000
Farmer ID Cards	14,300
Dashboard	39,325
Sub total	**293,845**
Training of your team	
First training session (Basic Training)	41,947
Follow up training (Advance Training)	31,460
Travel, DSA and accommodation costs	TBC
Remote back-office support (e.g. Teams) (2 hour per month)	-
Sub total	**73,407**
Total (excl. VAT)	**367,252**

Source: van Casteren, 2024.

Figure 23: eProd Budget for cooperative with individualized training (Nandi cooperative) excl. VAT, inclusive of SMS/ ID Cards/ Airtime/ shared dashboard

eProd Basic	
Max users (farmers)	1,000
Number of computers configured in a network (desktop or laptop)	1
Mobile app users (max)	10

License and Set-up Fees	**KES**
Data preparation and set-up fee	31,460
eProd Basic	157,300
Mobile app user fee (max 10 mobile apps)	31,460
SMS set up and startup credit (5,000 KES)	20,000
Farmer ID Cards	62,920
Dashboard	39,325
Sub total	**342,465**
Training of your team	
First training session (Basic Training)	125,840
Follow up training (Advance Training)	94,380
Travel, DSA and accommodation costs	TBC
Remote back-office support (e.g. Teams) (2 hour per month)	-
Sub total	**220,220**
Total (excl. VAT)	**562,685**

Source: van Casteren, 2024.

KALRO and Pharox mentioned that the development of an application is dependent on various things while KALRO estimated 600,000 Kenyan Shillings *(€4195)* for development, they also indicated they do not develop a single application within the organisation, i.e. this estimate might be applicable for more than one application development.

Collecting information on cost estimates also begs the question of who funds the application. In the interview with Pharox and eProd solutions, clients/cooperatives pay the organisation to develop the application. KALRO indicated that as a research organisation, the applications are free for the farmers. In light of this, the funding comes from developmental bodies and private organisations based on their interests: the Government of Kenya, the FAO, the World Bank, GIZ, the Bill and Melinda Gates Foundation, The European Union, and Kenya County Government.

Developing an application, however, requires users to pay a yearly subscription for access. eProd Solutions estimated a subscription fee of 1,100 Euros/farmer/year, while KALRO stated that the app is free. Tenhagen of Pharox indicated that there is flexibility in various pricing options that can accommodate different customer preferences. It includes one-time payments, fixed monthly fees, and transaction-based pricing.

4.5 Factors that Influence the Implementation of an ICT application

As part of this research, some factors influence the implementation of ICT within the avocado cooperatives—*see Table 3*. These factors are categorised based on their influences on the uptake of an ICT application among the Meru County avocado farmers. Understanding these, stakeholders within the chain can ascertain effective strategies to promote ICT application and strengthen the efficiency of the chain with it.

Table 3: P.E.S.T.E.C. Analysis of Influencing Factors for Strengthening ICT Implementation

FACTORS	RESULTING IMPACT
Political	▪ Encouraging governmental support and investment towards ICT implementation such as the KALRO apps for diverse value chains. ▪ Stable political environment in Kenya for developmental organizations to invest and for the successful adoption of ICT. ▪ Supportive regulations regarding data privacy and cybersecurity.
Economic	▪ Struggling financial capacity of the farmers to afford the associated costs of the application. ▪ Growing economy of the country. ▪ The presence of reliable and quality internet connectivity and electric supply, albeit unaffordable for some low-income class. ▪ Increased international demand for Kenyan avocadoes determine the need for a transparent application.
Social	▪ Some farmers are resistant towards change and technology (Mugambi, 2024). ▪ Digital illiteracy especially with old-time farmers. ▪ Minimally strong social networks of farmers on knowledge sharing and technical support on their farms.
Technological	▪ The availability, although limited affordability of mobile devices and software. ▪ High subscription costs/pricing model of such an application. ▪ Digital illiteracy.
Environmental	▪ Varying climatic changes in counties and resultant effects of the pests such as False Codling Moth (FCM) especially in the warmer counties (Kiera, 2024). ▪ An application centered on promoting sustainable practices already existing like the KALRO apps.
Cultural	▪ The priority of a cultural appropriate app by the developers. For instance, the KALRO apps are designed in major languages of English and Swahili, and also transited into other county languages of Kenya for easy user accessibility. ▪ Conflicting beliefs and values of the avocado farmers.

Source: Author's Field Compilation, 2024.

4.6 S.W.O.T. Analysis of the ICT Infrastructure and its Impact on the Avocado Value Chain

This S.W.O.T. analysis—*see Table 4*—provides an overview of the current ICT infrastructure and its impact on the Meru County avocado farmer cooperatives. It highlights the strengths, weaknesses, opportunities, and threats of using an ICT application. The key findings showed that while there are opportunities for improved communication, efficiency, and traceability, challenges relating to digital literacy, infrastructure, and trust must be addressed to ensure the successful integration of the application within the cooperatives.

Table 4: S.W.O.T. Matrix of the Farmer Cooperatives ICT Infrastructure

STRENGTHS	WEAKNESSES
▪ Existing ICT Infrastructure: KALRO avocado app, mobile devices, internet connectivity. ▪ High cooperative power within the farmer cooperatives. ▪ Successful ICT initiatives such as MPESA, eProd ERP app, and Pharox's U-Pod.	▪ Low level of digital literacy/lack of technical skills in accessing applications amidst old farmers. ▪ Infrastructural gaps: Limited power supply in remote areas, high cost of internet bundles, lack of smartphones. ▪ Financial constraints by farmers for the application. ▪ Lack of trust amongst farmers.
OPPORTUNITIES	**THREAT**
▪ Better communication and transparency amongst the avocado value chain stakeholders. ▪ Efficiency in operations and reduced costs of operations. ▪ Traceability and tracking of produce in real-time. ▪ Market accessibility and price transparency. ▪ Knowledge sharing and capacity building.	▪ Disruptions or failures in application resulting from infrastructural challenges such as internet connectivity or electric supply in remote areas. ▪ Redundancy of the app usage by users due to digital illiteracy or unwillingness to adopt. ▪ Cybersecurity risk.

Source: Author's Field Compilation, 2024.

CHAPTER FIVE: DISCUSSION

This chapter presents and discusses the findings while backing them up with relevant literature. It is in the sequence of the research questions and the findings.

This study researched the role of an ICT application in strengthening communication within the avocado farmer cooperatives in Meru County, Kenya. The study has shed light on the communication challenges of the cooperatives: limited access to information, delays in information dissemination, and ineffective coordination among members. In the same vein, an assessment of the solution of an ICT application revealed that cooperatives require a centralised data management system that facilitates real-time communication. This application should have functionalities including a comprehensive membership database, chat capability, production database, market information, service tracking, financial services, feedback options, traceability, and e-commerce features.

Bhat et al., (2024) also states the availability of a centralised system via this ICT application promises improved real-time communication and information sharing, increased productivity, improved decision-making, enhanced market access, transparent transactions and fair prices, and better farmer satisfaction. On the value and impact of ICTs within the value chain, the pros and cons of ICT were highlighted with emphasis on the advantages of usage being improved performance and profitability of the value chain, accessibility to information and crucial services, and risk mitigation (Warwimbo, 2017).

An ICT application has the power to transform the avocado cooperative societies into a similar cooperative system as the Mount Kenya Milk cooperative by expanding their scope of potential networks and strengthening existing networks, enhancing management practices and records, increasing efficiency, and reducing operating costs. Adopting and implementing such an application will make the avocado value chain more competitive and sustainable.

5.1 Communication and Coordination Needs of the Farmer Cooperatives in Meru County

This study found similarities in the needs assessment of the farmer cooperatives in Meru County. Both cooperatives emphasised the lack of access to digital devices for all members and the absence of a communication application, which hinders real-time and urgent information sharing. It all boils down to the lack of a centralised data management system.

Amongst the highlighted points was the need to communicate better on the opening and closing of the market seasons, production practices, the quality management of the harvested avocado fruits, uniform and timely alerts on pests and disease management, and obtaining fair trade prices for their harvest. Furthermore, the cooperatives reported scenarios where ineffective communication within the cooperative has led to missed fruit pickups on some farms during harvest, unclear ownerships of picked produce upon arrival at pack houses, and losses due to pest infestation. The Abothuguchi farmer cooperative members highlighted the need for a comprehensive member database similar to a tertiary institution's academic portal that grants access to the members, allowing timely information sharing with alerts and the foresight for data/report generation and harvest forecasting.

Meera, Jhamtani, and Rao (2004) in their study reported the information needs of farmers include: marketing information, weather forecasting, question-and-answer service, access to land records/online registration, information about rural development programmes and subsidies, general agriculture news, best agricultural practices, input prices and availability, pests and diseases management, soil testing and sampling etc. This is supported by the December 2021 Temarin Issue Brief by Bolwig et al. (2021) which states, "digitalisation enables the provision of services to value chain stakeholders" and categorised into:

a. Farm Advisory and Information Services: Weather forecasts, agronomic services, storage, and agricultural data (Bolwig et al. (2021).
b. Market Information and Linkages Services: Inclusive of price information and access to traders and markets (Bolwig et al. (2021).
c. Supply Chain Management Services include product traceability and quality assurance, enterprise resource planning (ERP), contract farming operations, etc. (Bolwig et al. (2021).
d. Financial management services include mobile payments, savings, credit, e-commerce, and crowdfunding (Bolwig et al., 2021).

These services referred collectively as "agriculture ICT services" include critical activities such as data management, customisation, and maintenance.

By bridging the digital divide among the farmers and improving communication channels, the avocado cooperatives in Meru County can facilitate seamless knowledge sharing, improve farming practices, and ultimately get better prices for their produce. Ultimately, efficient communication is the cornerstone of agricultural progress. In addition, by overcoming existing obstacles, the Meru County avocado sector can harness the potential of an ICT application to empower its members and drive sustainable growth.

5.2 Key Functionalities to Address the Needs of the Farmer Cooperatives

Literature report features of a communication application to include audio and video streaming, instant messaging, whiteboard facilities, and sharing capabilities (Aldea et al., 2012). It is evident from the findings that an application designed for cooperatives should address the various aspects of the value chain operations, from production to market. A key theme from the discussions was the importance of a comprehensive database system to store and manage information about members, their production records, market trends, and financial transactions. Such a database would enable cooperatives to make informed decisions, track the performance of individual members, and generate reports on various aspects of their operations.

In addition, the ICT experts highlighted the need for communication tools, such as messaging platforms and chat functions, to facilitate effective communication amongst the cooperative members and with other stakeholders. These tools would enable rapid information sharing, coordination of activities, and dissemination of updates. The matter of traceability was a major point of focus during the discussions. The cooperatives and experts stressed the importance of having a traceability system, as it would improve product credibility, boost consumer confidence, and potentially result in fair trade prices.

While the interviews provided valuable insight into the needs of the farmer cooperatives, it is crucial to note that implementations of such solutions may face challenges (resistance from old farmers, literacy issue, lack of use upon launch, financial constraint etc.) and thereby preventive measures must be prepared.

5.3 Key Steps and Timeframe for Developing an Application

In understanding the steps and time it takes to develop an application, it is pertinent to understand what makes an application user-friendly, particularly in ascertaining its continuous use after development. This critical input needs consideration before development. From the findings, user-friendliness in an application is defined by its simplicity, the presence of a user interface, the inclusion

of only necessary aspects (data entry, chat function, unique portals), the availability of multiple software, appealing visuals, and simple language.

According to the interviewed experts, development of an application will take a minimum of two months and a maximum of six months. In line with the findings from Kimani (2024) and Tenhagen (2024) and desk research showed the developmental steps of an ICT application require a structured approach that begins with field research of the value chain as a whole, filtering and sorting the information to go into the application.

Sommerville (2011) recognised the software development lifecycle as a critical milestone in application development. With the rise of mobile applications, Intel IT, an American technology organisation, created a framework lifecycle in 2013 called Mobile Application Development Lifecycle (MADLC), which defines specific activities, tools, and resources to support mobile application development (Doolittle et al., 2012). MADLC handles specific requirements, such as lifespan, functionality, memory capacity and utilisation, cross-platform development, and maintenance (Vithani and Kumar 2014).

The mobile application development lifecycle (MADLC) involves stages such as:

- Identification: Gathering and analysing ideas for the app. Including feasibility studies, market research, and initial requirements gathering.
- Design of the user interface, functionality, and platform selection.
- Development/Coding.
- Functional prototypes designed for testing and feedback.
- Rigorous testing on simulators and devices to ensure quality and functionality.
- Deployment on app stores.
- Maintenance: Ongoing updates, bug fixes, and improvements to maintain the app's performance and relevance.

5.4 Resources for Developing an Application and Implementing an Action Plan

Developing an application requires a deep understanding of the value chain and gathering accurate data to inform the system design, cost efficiency, funding options, and pricing models. The interviewed experts indicated that the resources for developing an application include:

a. Idea and Planning: Involving concept (a clear idea of what the application will do and its users), market research (understanding the target audience and competitors), and requirements (detailed specifications of features and functionalities).
b. Technical Resources: The choice of programming language depends on the developer’s platform. In addition, it includes development and testing tools.
c. Financial Resources: This includes the budget (for development, testing, marketing, and maintenance) and funding. The budget varies based on project complexity and scope. The funding options include self-funding, government agencies, developmental bodies, investors, and crowdfunding. The cost estimates for developing an application range from KSh 367,252.00 (eProd) to KSh 600,000.00 (KALRO) (€2568 to €4195).
d. Human Resources includes project managers, developers, value chain experts, communication professionals, visual designers, scientists, marketers, etc.
e. Infrastructure: This includes hardware and software.
f. Marketing, Launch, and Maintenance: This allows the promotion of the application and its accessibility by the target audience.

5.5 Action Plan for the Implementation of the Application

The research proposes an action plan for developing and implementing an ICT application tailored to the specific needs of the farmer cooperatives. Based on information from the research, the action plan include:

PHASE ONE: PROBLEM IDENTIFICATION AND NEEDS ASSESSMENT

a. ACTIVITIES:

- Background research on the value chain,
- Initial meeting with farmer cooperatives, needs assessment.
- Identification and prioritization of the functionalities to be included in the application to address these needs.

b. **WHO**: Student Researchers, Farmer cooperatives, FORQLAB Academic Partners, and developing organisations.

c. **WHEN:** In the beginning. Timeline of six weeks.

PHASE TWO: FUNDING AND PARTNERSHIPS

a. ACTIVITIES:

- Identification of potential partners, assessment, and selection.
- Preparation of grant proposals.
- Evaluation of proposals.
- Application for subsidies or cooperative funds.
- Securing funding through agricultural grants and cooperative funds.

b. **WHO:** Student Researchers, FORQLAB Academic partners, and development partners.

c. **WHEN:** Commences during needs assessment. It is a continuous process.

PHASE THREE: RESOURCES ACQUISITION

a. ACTIVITIES:

- Recruiting human resources: Developers, visual designers, project managers, value chain experts. Communication specialist and technical support staff.
- Acquisition of technical Resources: Development and testing tools, ICT infrastructures, servers, internet connectivity etc.

b. **WHO:** Framer cooperatives, FORQLAB Academic partners, and development partners.

c. **WHEN:** Commences once funding is secured. It is a continuous process.

PHASE FOUR: APPLICATION DEVELOPMENT

a. ACTIVITIES:

- Prioritization of functionalities.
- Identification of the appropriate design based on available resources and infrastructure.
- The development of the application.

b. **WHO:** Application Developer, developmental funders, project manager, value chain experts, communication specialist, Technical Support Staff, FORQLAB consortium.

c. **WHEN**: Within six months of the needs assessment phase.

PHASE FIVE: TRAINING AND CAPACITY BUILDING

a. **ACTIVITIES:**

- Curriculum development tailored to age, education, and digital literacy levels.
- Awareness training: Educating the avocado farmers about the benefits of digital devices and efficiency of running their operations.
- Application Training: These involves training modules that will cover the use of the new mobile application, basic ICT skills, best practices in digital communication, and data security. The modules will also include use of ICT for marketing, inventory management, and mobile financial services. The training program will be designed to be an ongoing program, with refresher courses and updates provided bi-annually. Similarly, the approach of the mobile payment platform in Kenya, MPESA can be adopted.
- In addition, the cooperatives executives should organize quarterly knowledge sharing events using field days demonstration on sustainable avocado production practices for the cooperative members as a whole, this should be made a mandatory requirement to be a cooperative member. These events hosting must be rotated amongst the cooperatives in Meru County for balance and in-depth understanding given that there are variances in soil and climate type of the county.

b. **WHO:** Farmer cooperatives, extension officers, FORQLAB academic partners, Meru County Government.

c. **WHEN:** Commence three months before application deployment. It should run monthly per cooperative with quarterly rotations continually for one year.

PHASE SIX: IMPLEMENTATION, DEPLOYMENT, AND MONITORING

a. **ACTIVITIES:**

- Implementation and deployment of the application for utilisation within the cooperatives.
- Monitoring and evaluation.
- Maintenance of the application.

b. **WHO**: Application developer, extension officers, FORQLAB academic partners, and the Government of Kenya.

c. **WHEN:** Immediately upon launch and quarterly.

This action plan requires a collaborative effort from the following stakeholders:

1. Student Researchers: Conduct the needs assessment, identify, and prioritization of functionalities.
2. Farmer Cooperatives: Primary users of the application. They are responsible for providing input on their needs and participating in training.
3. ICT Developing organization and application developer: They are responsible for developing, implementing and maintaining the application.
4. Supporters (Meru County Government, KALRO, eProd Solutions, Funders/developmental organisation): Provide support, infrastructure, and resources to facilitate the development and implementation of the application.
5. Agricultural Extension Officers: Provide technical assistance and training to farmers on using the application and best agricultural practices.

5.6 Reflections on Research

5.6.1 Reflection on Research Methodology

In terms of methodology, a purely qualitative approach ensured in-depth information obtained from the interviewees to crosscheck information from the focal point—the farmer cooperatives. This research on introducing an application tailored towards farmers' cooperatives in Kenya is a novel idea. As a result, more research into user perspectives is necessary, as the farmers' needs cannot be met at once. This study addressed the current demands, but future research should focus on long-term functionality.

Regarding the research process, during the proposal defence, the assessor picked on the non-feasibility of the delivery of the magnitude of the research topic within the given timeframe, and there was a cut-down of the research scope. The research objectives and questions have been changed to reflect the revised research scope. The narrowing of the research scope narrowed the number of interviewees.

The approach of having a focus group discussion with the farmer cooperatives increased the chance of not losing information to translation, ensured adequate information, and gave room for probing with the farmers. Adopting a systematic approach for the interviewing facilitated a comprehensive understanding of the focal areas and identified additional questions for the next interviewees. Data collection proved relatively straightforward, but the subsequent analysis and interpretation presented a significant challenge. Finally, the iterative review of data and report writing allowed meaningful deductions from the raw data.

5.6.2 Reflection on Quality of Data Collected

Reflecting on the validity and reliability of this research, choosing a similar checklist for the cooperatives and a similar checklist with minor modifications for the ICT interviewees and triangulating their responses with similarities and differences ensured obtaining data relevant to this research and drawing meaningful conclusions.

For the methodology, the choice of a constructivist approach allowed prioritisation of the respondent's needs. Despite the unfamiliarity of the research scope, this approach facilitated a deep understanding of the users' perspective.

5.6.3 Limitations of the Research

The primary challenge encountered during this research was getting the focus group of the farmer cooperatives. There was a lot of cancellation and rescheduling to get the focus group discussion carried out. In addition, the third farmer cooperative members were unreceptive to getting interviewed, expressing a greater interest in financial incentives, which was not included in the research budget.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This study aimed to improve communication and coordination within the avocado cooperatives using an ICT application in Meru County. This chapter presents the answer to the research questions.

From the findings, it is clear that developing an application is crucial to enhance communication and coordination within the avocado farmer cooperatives in Meru County. The research highlighted the significant contribution of the avocado sector to Kenya's economy, the challenges the cooperatives face, and the potential of ICT to address these challenges.

From the findings, the communication and coordination needs of the cooperatives include the opening and closing of markets, sustainable production practices, market prices, weather forecast updates, extension services, and training information. The findings reported an ICT application that includes messaging and feedback, data management, market data, support/educational services, financials, and traceability features. The research provided an overview of the existing applications and highlighted the following considerations while developing an application:

- Understanding the specific needs of the farmer cooperatives.
- Designing a simple and user-friendly interface.
- Integrating expert knowledge and user preferences.
- Training and capacity building for farmers in digital skills.
- Affordability and accessibility of the solution.

The interviewed expert stated developing an application with such features takes two to six months after conducting background research on the value chain. The developmental steps begin with the identification of ideas or needs, the initial meeting of developers with clients, wireframing (blueprint of the application), developing and coding, pilot testing, second testing or validation, and deployment. Finally, the development of an application requires resources such as financial resources, human resources, technical resources, and infrastructure. Findings indicated funding ranging from KSh367,252.00 to KSh600,000.00 (€2568 to €4195), from cooperatives, government agencies, private investors, or developmental organisations.

From the findings, the ICT application could help address these communication and coordination challenges by:

- Facilitating efficient data generation and retrieval.
- Improving system performance through data-driven decision-making,
- Ensuring accurate data collection and analysis.
- Supporting forecasting for system improvement.
- Documenting and storing the education days.
- Centralising operations and reducing information transmission time.

In conclusion, the action plan for developing and implementing an application that improves communication within the farmer cooperative involves:

(a) background research and problem identification, (b) needs assessment, (c) choosing developing organisation and securing funding, (d) prioritizing functionalities, (e) recruitment of personnel, (f) acquisition of infrastructure), (g) designing and developing the application, (h) training, (i) deployment and implementation, and (j) monitoring and evaluation.

6.2 Recommendations

The study has assessed the needs of the farmer cooperatives and highlighted the benefits of better information flow, knowledge sharing, improved market access, and more efficient operations for the avocado cooperatives of Meru County. However, to leverage the potential of this application, these recommendations are put forward to the FORQLAB Project and the Meru County Avocado Cooperatives as intervention points for improved communication.

Recommendation 1: Enhancing Technical Capacities and Digital Literacy
Implementing an application within the cooperatives presents the medium to enhance communication and collaboration. However, successful adoption and utilisation depend on the users' technical capabilities and digital literacy.

It is important to raise awareness and improve the skills of farmers so that they can understand how to use the application effectively. It involves considering their education and digital literacy levels when designing training programmes and incorporating user information into the application. To increase farmer participation, the first step is to raise awareness among young and middle-aged farmers about available services. It is advisable to introduce older farmers to ICT networks at a later stage. Additionally, developing digital literacy skills helps farmers recognise potential risks and safeguard their privacy online.

Investing in the training programmes empowers and fosters a culture of continuous learning within the cooperatives. Developing the technical capacities and digital literacy of the farmers is critical for fully leveraging the sustainability of the application.

Recommendation 2: Building Strategic Partnerships
The development of an application requires significant resources. Building strategic partnerships with various stakeholders can provide the funding and resources to support. Partnerships with:

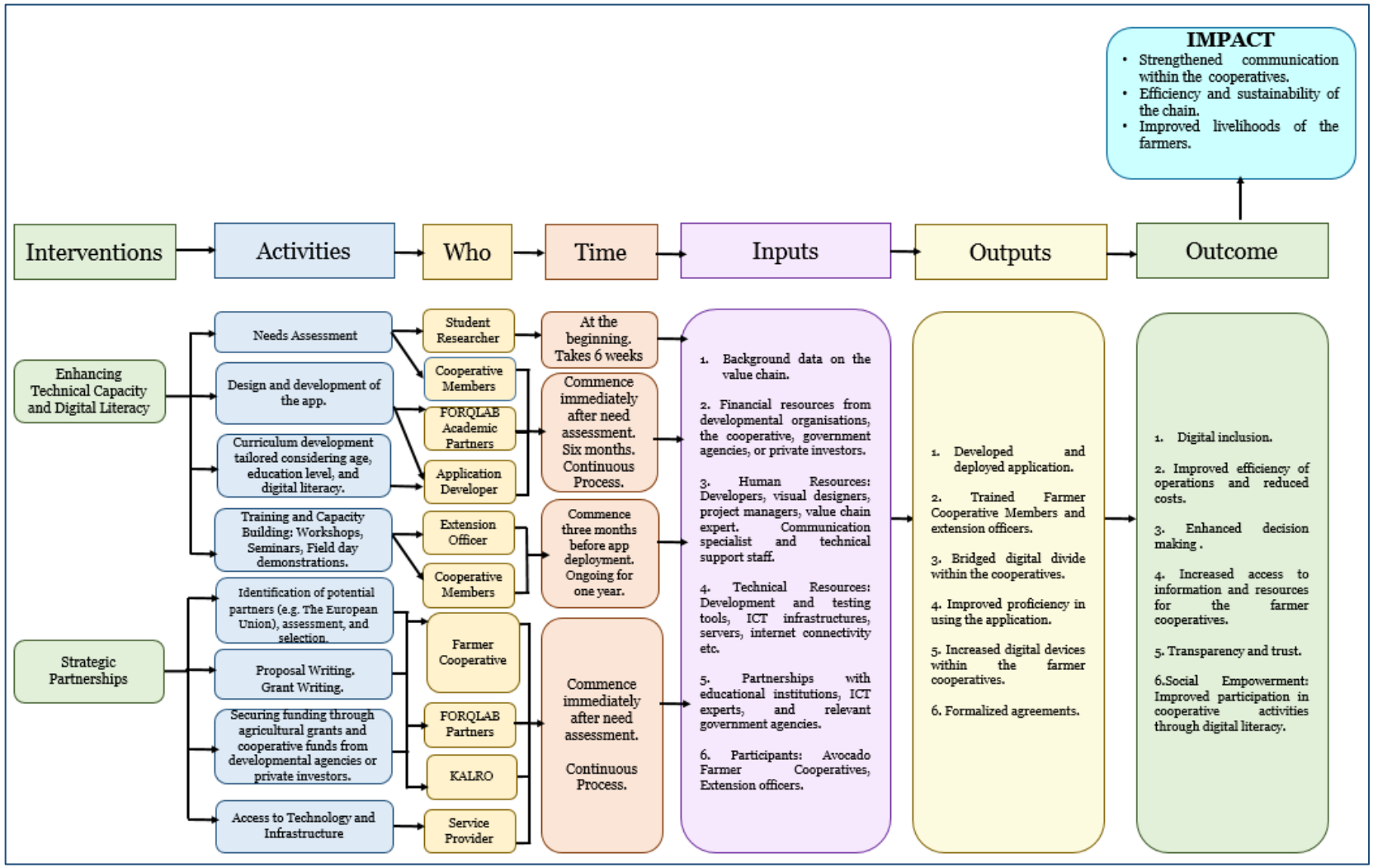
1. Government Agencies: For example, KALRO's connections/access to the developmental organisations that support agricultural development initiatives. Also, engagement with the local county and the national government provides access to subsidies, grants and technical assistance, particularly for a high-export crop like avocado.
2. Private Sector Investment: Partnerships with technology companies such as eProd Solution, Pharox, Digifarm, venture capital firms, and Safaricom can provide access to financial resources, technical expertise or market access.
3. Donor Organisations: Identifying donors with a focus on agricultural development and sustainability such as from foundations or non-governmental organisations can increase chances of securing financial assistance through grant or proposal writing.
4. Cooperative Partnerships: Joint pooling of resources and expertise amongst the avocado cooperatives in the country.
5. Research Institutions: Collaborating with private research institutes/universities can provide access to human resources and infrastructure for development.

6.3 Theory of Change

Mayne (2017) explained the theory of change (ToC) in her study as an explicit theory of “how” and “why” a social policy or program activity leads to outcomes and impacts. It is a systematic framework for explaining how a program’s activities/intervention will lead to desired outcomes or developmental change (impact).

The theory of change for the recommendations in shown in *Figure 24.*

Figure 24: Theory of Change



Source: Author's Compilation, 2024

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ANNEX I: INTERVIEW QUESTIONS

Farmers Cooperatives

- Can you describe the current challenges you face in communication within your farmer cooperative?
- Does your cooperative currently have access to digital devices?
- What information needs to be shared better?
- How do you share information on updates about market prices, crop yields, and best practices with other cooperative members? Are there any difficulties with this approach?
- Are there any existing applications or tools you currently use that address some of these needs? If so, what functionalities do you find helpful or lacking?
- Have you encountered any situations where better communication or coordination could have improved your cooperative's success? Can you elaborate?
- How do you think an ICT application could help address these communication and coordination challenges?
- What are your biggest concerns about using a new ICT application?
- In your opinion, what functionalities would be most helpful in an ICT application to address these communication and coordination needs within the cooperative? Is there anything else you would like to see included in an ICT application designed for farmer cooperatives?
- What information would be most helpful for you to have readily available through an ICT application?
- What specific tasks or activities within the cooperative would benefit most from an ICT application?
- Are there any technical skills or resources readily available within the cooperative that could be utilized for developing the application?
- What kind of training or support would be most helpful for cooperative members for effective utilization of the ICT application?
- How would you like to be involved in the development process of the application?

eProd Solutions

- In your opinion, what features would be most beneficial for communication within the cooperative?
- What specific tasks or activities within the cooperative would benefit most from an ICT application?
- Do you envision any features in an ICT application that would facilitate communication and collaboration within the cooperative both short and long term?
- In your experience, what makes an application user friendly or accessible?
- From your perspective, what is a realistic timeframe for developing and implementing an ICT application for the cooperative?
- Apart from a financial standpoint, what other resources are needed for the development of an application?
- How do the developers communicate with farmers and cooperatives?
- What is the estimated budget for the development of the application?
- Where does the funding usually come from?
- Are there any licensing fees?
- Is the app subscription fee affordable for the cooperative?
- What monitoring tools will be used to track the application’s performance?
- Are there specific protocols or measures to protect against data breaches or unauthorized access? Confidentiality?

App Developer

- In your opinion, what specific tasks or activities within the cooperative would benefit most from an ICT application?
- Can you envision any features in an ICT application that would facilitate communication and collaboration between members?
- What in your experience makes an application user friendly or accessible? What is needed?
- From your perspective, what is a realistic timeframe for developing and implementing an ICT application for the cooperative?
- Apart from financials, what are other resources needed for an application development?
- What was the thought of the cooperatives about your presentation on the functional ideas?

KALRO

- What in your experience makes an application user friendly or accessible?
- From your perspective, what is a realistic timeframe for developing and implementing an ICT application for the cooperative?
- Apart from financials, what are other resources needed for an application development?
- How do your developers communicate with farmers and cooperatives?
- What is the estimated budget for the development of the application?
- Where does the funding usually come from?
- Are there any licensing fees?
- Is the app subscription fee affordable for the cooperative?
- What monitoring tools are to track application performance?
- Are there specific protocols or measures to protect against data breaches or unauthorized access? Confidentiality?

Pharox Logistics Intelligence

- What in your experience makes an application user friendly or accessible?
- From your perspective, what is a realistic timeframe for developing and implementing an ICT application for the cooperative?
- Apart from financials, what are other resources needed for an application development?
- How do the developers operate with farmers and cooperatives?
- What is the estimated budget for the development of the application?
- Where does the funding usually come from?
- Are there any licensing fees?
- Is the app subscription fee affordable for the cooperative?
- Are there specific protocols or measures to protect against data breaches or unauthorized access? Confidentiality?

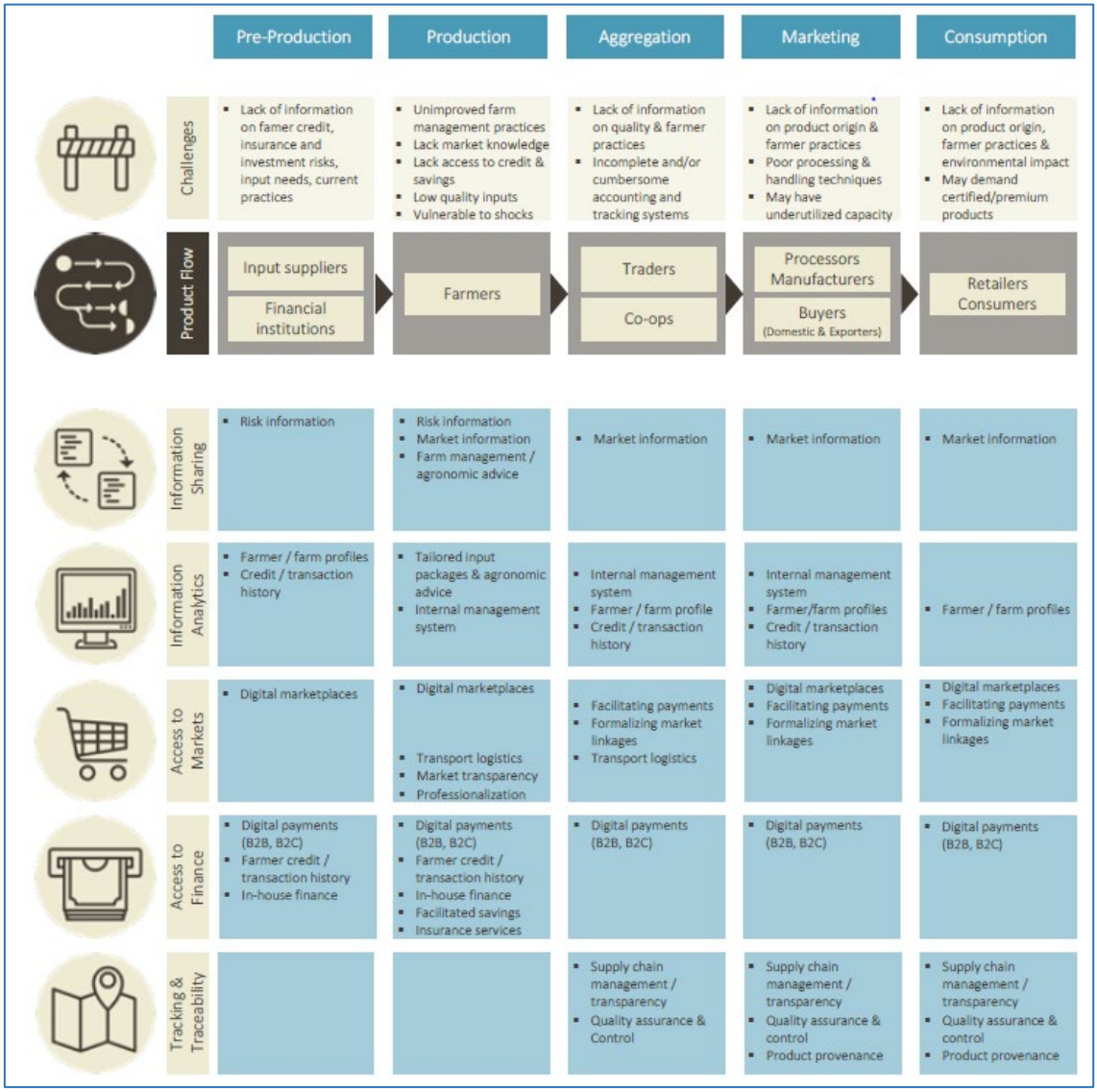
ANNEX II: LITERATURE REVIEW ATTACHMENTS

SUCCESSFUL ICT SERVICES IN THE AFRICAN AGRICULTURAL SECTOR

Applications`	Description
M-Farm	Owned by M-farm Ltd a software solution and Agribusiness Company which provides up-to-date market prices to farmers and links them to buyers through their marketplace and current agro-trends (Macharia, 2013). This mobile application gives the farmers the opportunity to sell their yields collectively and also to buy farm inputs by use of mobile phones or their website. The software also provides market prices to the farmers
iCow	This is an agricultural web platform that provides important information to livestock farmers on their products through mobile phones. It helps the small scale dairy farmers to manage their dairy cows inorder to have greater profits
KUZA Doctor	It's a mobile based application that help farmers receive critical information on how to increase their production and their incomes through their "KUZA DoctorsSM" a mobile based SMS tool.
Kilimo Salama	Its run by Syngenta and it offers farmers crop insurance against extensive rains or drought. Helps to collect significant information about serious weather changes that may reduce yields and it sends the reports through SMs to the farmers.
M-kilimo	This is a mobile based service that build a virtual information system that link all stakeholders in the agricultural sector and connects them to significant agricultural information and also empowers them on good agricultural practices
M-pesa	It is a mobile phone money transfer system that helps farmers make and receive payments for the farm inputs and their crops from their customers also linking farmers to other financial institutions therefore making it easier for farmers to get access to loans
Fishward.com	A free tool for fish farming that helps the farmers to monitor their fish production and profitability. This tool guides fish farmers through the whole production cycle from stocking the ponds, feeding, grow-out, harvesting, post-harvesting and marketing
iprocure	An application that provides virtue warehouse services to agro input. It provides farmers with procurement and distribution services, thus helps them to improve their supply chain services.

Source: Warwimbo, 2017.

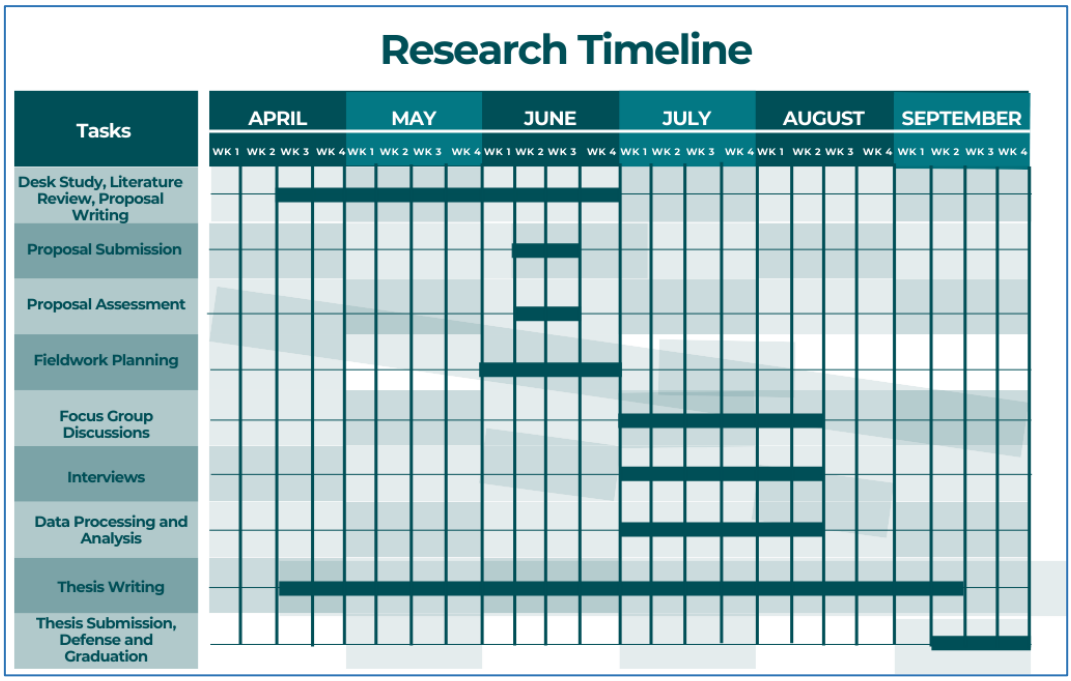
Stage	Action points	Champion countries
Pre-cultivation stage	Leverage GIS, Remote Sensing (RS) and satellite imagery technologies to enhance land tenure security for farmers (land registration, crop inventories)	Cameroon, Egypt, Ethiopia Mozambique
	Use mobile phone as a payment tool for crop insurance and credit in the agriculture sector	Kenya (Kilimo Salama, using M-PESA)
	Build a virtual common information system platform (through mobile phone) linking all stakeholders in the agriculture sector, comprising a database containing farmers' information	Kenya (M-Kilimo)
	Provide information through mobile phones on crop cultivation, best agriculture management practices and market prices to enhance agriculture production and productivity in a sustainable way and increase farmers' income	Kenya (Agri VAS), Mali (Agri VAS) Tanzania (Agri VAS), Ghana (Agri VAS) Côte d'Ivoire (Agri VAS)
Post-harvest stage	Use mobile phones in commodity exchange to disseminate information on market prices and knowledge data on products as well as facilitate coordination and contract enforcement between buyers and sellers	Ghana (E-Soko) Ethiopia (Ethiopia Commodity Exchange)
	Provide quality and traceability information on products through mobile phones to improve integration into global agriculture value chains	Kenya (iCow, Syngenta)



Source: Feed the Future, USAID Policy Brief (2018).

ANNEX III: METHODOLOGY ATTACHMENTS

Research Timeline



Research Budget

Budget Items	Number of Items	Cost per Item or Diem (€)	Total Cash Cost (€)
I. Pre-departure Costs			
Roundtrip Airfare Cost	1	AMS - NOB Emirates (Economy)	1,554.95 €
Visa and Permits	1	34.95 US Dollars	32.51 €
NACOSTI Permit	1	2000 KES	16.00 €
Medical Insurance	40 days		50.00 €
II. In-country Costs			
Accommodation	53 Nights	Studio at Makutano, Meru	600.00 €
Living Expense	53 days	10 Euros	530.00 €
Travel Expense from Nairobi to Meru Town to Accommodation			30.00 €
Local Transportation (Within Meru)	53 days	Covered on ground	
Incentives to Farmers			150.00 €
Fieldwork Supplies		Covered on ground	
Miscellaneous (10% total cost)			296.35 €
Total			3,259.81 €

ANNEX IV: INTERVIEW TRANSCRIPT - eProd Solutions

Date of Interview: 29th of June 2024

Researchers introduced themselves and the purpose of the study and reiterated the information will be used solely for the purpose of the study. They requested consent for recording information provided.

The interviewee is Jan Willem van Casteren, Chief Executive Officer of eProd Solutions. HomePage - eProd Solutions (eprod-solutions.com)

Interviewers are Kareeemat Opeyemi Fakorede (K.) and Mercy Moraa (M.).

INTERVIEWEE (J.W.): Explained the operations of their organisation in depth with a presentation.

INTERVIEWER (K. and M.): In your opinion, what features are most beneficial for communication within the cooperative?

INTERVIEWEE (J.W.): SMS, as many farmers are using feature phones. Also, Two-Way SMS can be a useful tool

INTERVIEWER (K. and M.): What specific tasks or activities within the cooperative would benefit most from an ICT application?

INTERVIEWEE (J.W.): ICT will play a role in all processes across the cooperative; see below.
Group, farmer, and field registration and polygon mapping, field inspections, collections, contracts, payment (mobile, bank), payment based on quality, certification, reporting, SMS communication (one-way and two-way), soil sampling, loan cycle management (with and without banks), digital ID/biometrics, etc.

INTERVIEWER (K. and M.): Do you envision any features in an ICT application that would facilitate communication and collaboration within the cooperative, both in the short and long term?

INTERVIEWEE (J.W.): One-way and two-way SMS, possibly USSD.

INTERVIEWER (K. and M.): In your experience, what makes an application user-friendly or accessible? What is needed?

INTERVIEWEE (J.W.): User interface designed from customer experience, offering a real solution to the users.

INTERVIEWER (K. and M.): From your perspective, what is a realistic timeframe for developing and implementing an ICT application for the cooperative?

INTERVIEWEE (J. W.): 2-3 months for full implementation and continued back-office support

INTERVIEWER (K. and M.): Apart from a financial standpoint, what other resources are needed for the application development?

INTERVIEWEE (J.W.): Hardware (laptops, mobile devices), optional: Bluetooth scales, printers. Internet & SMS registration and credit. In addition, third-party applications like Agro-Care soil testing kits and licences.

INTERVIEWER (K. and M.): How do the developers operate with farmers and cooperatives?

INTERVIEWEE (J.W.): Developers would communicate with cooperative leaders, if at all. It would be more appropriate for the senior management of the cooperative to communicate with the salesperson of the IT Company. This person would then translate the requirements in detail to the developers.

INTERVIEWER (K. and M.): What is the estimated budget for the application development?

INTERVIEWEE (J.W.): Attached in Findings

INTERVIEWER (K. and M.): Where does the funding usually come from?

INTERVIEWEE (J.W.): Client/ Cooperative

INTERVIEWER (K. and M.): Are there any licensing fees?

INTERVIEWEE (J.W.): Yes

INTERVIEWER (K. and M.): Is the app subscription fee affordable for the cooperative?

INTERVIEWEE (J.W.): The subscription is about 1,100 Euro/ farmer/year. Depending on the value chain, turnover of the cooperative, and the number of farmers, this is something they can afford.

INTERVIEWER (K. and M.): How will the budget be allocated across the different phases of the project?

INTERVIEWEE (J.W.): I don't know how long each phase is.

INTERVIEWER (K. and M.): What monitoring tools will be used to track the application's performance?

INTERVIEWEE (J.W.): We have quarterly Data Health Checks with the cooperatives to assess their current performance and advice on improvements.

INTERVIEWER (K. and M.): Are there specific protocols or measures to protect against data breaches or unauthorised access? Confidentiality?

INTERVIEWEE (J.W.): We sign an end-user license agreement and a service level agreement with the clients that also address issues on data ownership etc. This is though signed with the cooperative.

ANNEX IV: INTERVIEW TRANSCRIPT – Mount Kenya Farmers' Cooperative

Date of Interview: 13th of July 2024

Researcher introduced herself and the purpose of the study and reiterated the information will be used solely for the purpose of the study. She requested consent for recording information provided and taking photographs.

***The interviewees are Mt Kenya Farmers' Cooperative Executives: Chairman Kelvin Murithi (K.), Vice Chairman* Peter Kirimi (P.), Secretary Nkatha Karichu (N.), Treasurer Florence Mwarani (F.), Rachel Riungu (R.), and Mutuma Muriuki (M.).**

Interviewer is Kareemat Opeyemi Fakorede (K.)

INTERVIEWEE (K.M.): Introduces the researcher. Kareemat is a student at Van Hall Larenstein University in the Netherlands. And she's in the country to conduct a master's study. She will tell us in which discipline it is. But she requested that she meet the officials of the Mount Kenya Avocado Cooperative. This is for a needs assessment interview. For an ICT and communication system. And all of us needed to participate in this interview. So, you're most welcome Miss Kareemat. And feel free to interact with us. At least you've met two of us you've not met our secretary she's called she's going to introduce herself and our treasurer Florence is also going to introduce herself, so Kareemat you may take over and tell us what you want to do and then for those you have not met they'll have a chance to say hi.

INTERVIEWER (K.): Good morning, everybody. I am Kareemat, I am from Nigeria, but I'm studying for my master's in agricultural production chain management in the Netherlands at the moment. So for my master's thesis, I'm working on how to improve communication within the avocado value chain with the focus of an ICT application. So this is like the chairman has said, this is a need assessment to understand what you as a farmer and as a cooperative, need from this application that will save you both in the short term and the long term. It's a pleasure to meet the people I have met. Thank you very much for taking the time to do this. And I'll be as short as possible to get this done. So thank you.

INTERVIEWER (K.): So I would start. I would like to let you know that I'm recording the meeting because I need the transcription to be included in my document at the end of it. And this isn't a physical meeting. I would have taken a picture as well to attach. So we would go to the question. We have had the study to understand what exactly is going on with the avocado value chain in Kenya. And we have had past students work on this with the FORQLAB project. But from your perspective, and in particular, to Mount Kenya Cooperative, what are the current challenges that you are facing in communication within the executive chain and also with your farmers? What are your current challenges?

INTERVIEWEE (F.): Yeah. The biggest challenge we have with communication is that, especially among our farmers, most of them don't have smartphones so they cannot access WhatsApp. They have the other type of phone. And that now means that they cannot easily access information. Yeah.

INTERVIEWER (K.): As you said, it is not everybody has a digital device, but in your opinion, which other information do you need? Do you think you need to, needs to be shared better apart from the production information, which other information should be shared better within the farmer cooperative?

INTERVIEWEE (F.): The most important information is on marketing. Yeah, that is the one which really touches on our farmers and it impacts even on production. Yeah. Okay.

INTERVIEWEE (K.M): Maybe to add on to that as well, there is other information that currently we have not been able to share effectively with our farmers because we lack a centralized education system. So we have to send an SMS to one or two people in the communication. One of the most important information is about the opening and closing of the markets. Farmers need to be aware of those periods and should be communicated well. OK. The other thing is we need to send alerts, especially on disease and when to apply certain farm inputs for uniformity. Yeah. Okay.

INTERVIEWEE (M.): The challenge is that farmers are not always readily available for new information and implementation. The current channels are calls and WhatsApp which are not always quick and direct.

INTERVIEWER (K.): So the information that you do share currently, how do you share information? How do you share these updates? About the opening and closing of the market, the prices, how do you currently share information?

INTERVIEWEE (K.): Currently, we have a WhatsApp group, but not all of our members are in the group because as the treasurer mentioned, some lack smart devices. So we communicate on WhatsApp, which is one. And then as much as possible, try to share the same information on SMS. Okay. Yeah. But looking into the future, we would love to probably have an application, maybe of our own or one that can be generically used to keep updating and sharing more information on such an application. And maybe to cater to those who don't have digital devices, frequent SMSs to keep them updated.

INTERVIEWEE (M.): Within the cooperative, the current channels are calls and WhatsApp which are not always quick and direct. Outside the cooperative, currently, it is based on calling buyers and farmers who need the service. The challenge is the speed at which the agreement between buyers and farmers takes place. They are usually very slow and if the price is not agreeable the produce is not picked.

INTERVIEWER (K.): Are there any existing applications or tools you currently use that address some of these needs? If so, what functionalities do you find helpful or lacking?

INTERVIEWEE (M.): For farmer data, info on their farms, quantity and pickup dates for the produce. The functionality is in data management which needs a third party.

INTERVIEWER (K.): So since you have established the Mount Kenya Cooperative, has there been any situation where you felt that better communication or coordination would have improved the cooperative success? Have you had such an instance?

INTERVIEWEE (M.): Yes. During picking, there is a need for improved communication between a genuine buyer and the farmers so that it does not take long for farmers to have their fruits picked and farmers will not go to middlemen who buy at a throwaway price. Time is usually lost on the side of the supplier reducing the price the farmer would have sold it for.

INTERVIEWEE (R.): Our cooperative does not have an operations office, and so our farmers do not have a central place for easy consultations. If an operations office is established, communication amongst the members as a cooperative unit will significantly improve.

INTERVIEWEE (K.): Oh, definitely many, many instances because sometimes. For example, this year we successfully arranged for the picking of fruits, however, due to the communication breakdown. Some farms were left behind. They never got picked. And later when the exporter was picking another area, a few farmers came up with complaints that they were never reached. That is one. We also lack

a feedback mechanism. For example, if you are a farmer and fruits have been picked from your hand, you rely on the exporter to communicate that information or the farmer. And if the two do not communicate that information, then we do not know whose produce was picked and whose produce was left behind.

INTERVIEWER (K.): Feedback mechanism. Okay. So in that sense, not only for, I will slash that question. Now, how do you think an application will help you overcome these challenges with communication and coordination in the chain? How do you think it will help? Apart from sending information in real-time, how else can you think of it helping?

INTERVIEWEE (K.M.): The ICT application will help us generate data and information when needed very easily. I feel it to be a more accurate approach because once every data is collected, it's easier to develop whatever information from that data. At the moment, we have to do everything manually. We feel these impact on our decision as well. So if we were to have an ICT application, we wouldn't be able to predict what we need to do to improve our systems.

INTERVIEWER (K.): To generate data for more accurate reports and then forecasting. Yeah.

INTERVIEWEE (K.): OK.

INTERVIEWEE (M.): Also, the simple and implementable design of the application will ensure the communication issues are addressed and also help the cooperative build future realistic projections

INTERVIEWER (K.): But then, if we are looking at the positive side of this application, we also have to look at the setback. What are your biggest concerns if this application is made ready? What are your biggest concerns about using it? Not only for yourself but for your farmers. What are your biggest concerns?

INTERVIEWEE (K.M.): Let me speak from the point of eProd because you had an opportunity to interact with the system. Firstly, I think the costs would be a setback. We feel that the cost of implementing the system is a bit high. Two, we would love maybe to have, instead of a subscription, to have a one-time off payment, if that's possible, and a maintenance contract. To come with it and then number three in the case of eProd I felt there needs to be the farmer needs to interact with the system, probably not even input anything, but at least be able to see what is happening about his transactions with the cooperative. And if that's possible, then we can use the same channel to send alerts and other quick information that the farmer might need.

INTERVIEWER (K.): I'm still going to come back to eProd, but I thought we already have background information about what they have in store for you guys, but I would still come back to that. Okay. But then the application that is being proposed, what features do you require in it? What features do you want to see in it? In the short term, in the long term, what do you think are most important to be helpful to your cooperatives?

INTERVIEWEE (M.): The speed and uptake of the application by farmers. The latency of the application.

INTERVIEWEE (R.): Limitations of a central place for information storage, man power to handle info, many farmers not well exposed.

INTERVIEWER (K.): So in an application, you want to use an application for a reason. What are the features that you want to see in it? What do you require in it? This is the question about the needs assessment. In the short term, what do you want to use the app for? And in the long term, what are the features you want to see in it? That's my question.

INTERVIEWEE (N.): For me, one important feature I would want is. How do you put it? Like the database, it should be able to, we should have a database of all our members and their details, and it should be able to update. For example, if we want to know the production of which member every year, we should have that history in that application. It should also be able to generate reports very easily.

INTERVIEWEE (R.): Features such as discussion forums, meetings and workshops.

INTERVIEWER (K.): Okay. Other members, what features would you like to see in it?

INTERVIEWEE (F.): We should be able to, at a glance, see where the markets are. Yeah, so we should have that feature. Just like the secretary said, I think we should have a feature like Excel, something so that we can have cumulative figures on the amounts that have been sold, fruits available, and you know, that kind of figures, that kind of data. Okay.

INTERVIEWEE (P.): ...And also the number of fruit trees to predict next season's harvest.

INTERVIEWEE (M.): Message alerts, training highlights, location of farms, quality, quantity of harvest and harvest times.

INTERVIEWEE (K.): Probably we should be able to maybe another important feature I feel would be good to have in that system is where we see the services that were provided to the farmer be it agronomy support. If the agronomist visited the farm, they probably need to put down a report on observations, recommendations that can be viewed from the system. That way we can verify that it happened. In addition, farm input! If farm inputs have been given to the farmers, be it on credit or free of charge, we also need to be able to see that. Yeah, and probably the status, that is, what the farmer is owed by the cooperative or what the farmer owes the cooperative, for instance, an income statement.

INTERVIEWER (K.): So you would still like financials, maybe in the long run? Yes.

INTERVIEWEE (F.): Yeah, we should also have something on challenges. Farmers should be able to give us the challenges they're experiencing, whether in production or marketing. Okay.

INTERVIEWER (K.): What information would be most helpful for you to have readily available through an ICT application?

INTERVIEWEE (M.): Farmers training info, market price, buyer of produce, and financial services.

INTERVIEWEE (R.): Agricultural advice and market prices.

INTERVIEWER (K.): Are there other features you want to see included in the application?

INTERVIEWEE (M.): Financial service, weather, soil nutrients, and USSD service.

INTERVIEWER (K.): Hmm. Okay. But, um, you have mentioned that some of your farmers do not have access to smartphones. Do you think that, um, there is, uh, a specific skill that would be necessary for them to be able to use this app effectively? You are not using the phone. Is it because they are not digitally literate, do they require training? Do they need anything else to be able to use the app? Because the essence of the app is for them to be able to do all of these things that you have highlighted. So what do you think is necessary to get them to use the app effectively?

INTERVIEWEE (P.): One thing, they should all have smartphones. OK. Second, I think they need training. Those who are not able to use the app can be trained so that they can be able to use it. OK.

INTERVIEWER (K.): Any other skill that you can think of?

INTERVIEWEE (K.M.): I think the issue is once the farmers see the need, you see they're doing the avocado as a business. And there is a need for them to be able to interact with what you're doing. So I believe once they see the need, they can have access to smartphones. Based on that need probably for now a few things might put them putting them off but I believe it's not difficult to get so like my colleague I said training would be important once they acquire these devices because our smartphones are quite cheap now Is this something that you see them adopting?

INTERVIEWER (K.): And not just like having it, but not using it?

INTERVIEWEE (K.M): I think I see a feature where they want to adapt it. Because if we look at the interactions on social media, on WhatsApp we have, about 100 farmers are there already. And ... I see it as an effective communication tool, for us. So, I believe they will adapt it.

INTERVIEWER (K.): Okay. Mr Kirimi wanted to say something as well.

INTERVIEWEE (P.): About the adapting? Yes. I think they, they, they can adapt, because ... Even these gadgets we are using, we were trained on how to use, you train yourself and you are trained, some of us are trained by others how to use them. So they can also be trained and they will be able to use them. And they will adapt, they will adapt it. For me, not a big problem.
Also, I think having USSD knowledge makes it easier to adapt the application.

INTERVIEWER (K.): What specific tasks or activities within the cooperative would benefit most from an ICT application?

INTERVIEWEE (M.): Financial projections and quantity of harvest.

INTERVIEWER (K.): But as a cooperative, do you have any resources readily available to support the development of this hub?

INTERVIEWEE (K.M.): At the moment, no, we are not generating enough income to develop such. However, if there happens to be one, I believe if put at affordable prices, then we are in a position to subscribe. To such a service, because that would allow us to pay minimal fees and the full benefits. Okay.

INTERVIEWER (K.): You have mentioned, Mr. Murithi that instead of a subscription you would propose a one-time payment and maintenance cost. Looking back at the offer that he brought us for you, is this something that you highlighted with them? Because I think it's like a subscription cost. And what was their opinion about that?

INTERVIEWEE (K.M.): We alerted that during the meeting we had with them and they said for small cooperatives, they do have packages where they can scale down the price. But based on the information they sent us, the initial cost was a bit high. I can't exactly remember the figures. But I believe working with them, we can reach at an agreeable subscription fee.

INTERVIEWER (K.): Is it possible, because you have mentioned and I have seen the figures as well, and like I said, it's a bit high, especially since the cooperative is not generating resources. But is it possible to propose to eProd what you need as a cooperative in the short term if it can be developed for you? Then maybe it might be at a lesser price. Is that an alternative?

INTERVIEWEE (K.M.): I think that is an alternative.

INTERVIEWER (K.): Okay, I think I've... Some of my questions have been answered with some of your replies, but is there any other thing that you would want us to know about this? Is there any recommendation you would require the developer to keep in mind when developing this application?
INTERVIEWEE (K.M.): Maybe I may have said this, but let me repeat it. It would be good to have this as a purely management system, but also provide a small window for the farmer to interact with the information that is relevant to them. Okay.

INTERVIEWEE (F.): I agree with what Mr. Murithi said. Farmers and executives should be able to access that application and be of use to all of them and as we said earlier, it is important to sensitize our farmers on the use of this application, because it's the only way they will access the services they need.

INTERVIEWER (K.): I think for now, these are the questions that I have. However, I have not had a conversation with the other stakeholders as I want to; I suppose if I speak with them, I might have more questions for the cooperative regarding this. So is it possible for me to have another meeting if I do have extra questions for you, to call on you?

INTERVIEWEE (K.M.): No problem. I think we will be open to such a meeting.

INTERVIEWEE (K.M.): Thank you so much for taking your time. Also, let me thank my members for being available for this. Sorry about yesterday. It was such a hectic day for me and the Nandi team. We successfully prepared a consignment to one of the prospective markets and I believe in less than 24 we can have the first shipment out to Europe.

INTERVIEWER (K.): It is all right. I understand.

ANNEX V: INTERVIEW TRANSCRIPT – Abothuguchi Farmers' Cooperative

Date of Interview: 11th of July 2024

Researcher introduced herself and the purpose of the study and reiterated the information will be used solely for the purpose of the study. She requested consent for recording information provided and taking photographs.

***The interviewees are Abothuguchi Farmers' Cooperative Executives: Chairman Joseph Nteere Njau (J.), Vice Chairman* Erastus Tuerandu Kimathi (E.), Secretary Gerrisnon Kirera (G.), Samuel Mbogori (S.), and Stanley Mutai Mugambi (M.).**

Interviewer is Kareemat Opeyemi Fakorede (K.)

INTERVIEWER (K.): So, we have had, like I said, past students that have discussed the challenges that avocado farmers face in the course of practicing. But I would like to know from your perspective, what are your current challenges at the moment that you face with communication within yourself, but also within other farmers cooperatives? What are the challenges that you face in communication?

INTERVIEWEE (G.): First, we have a problem because, one, we don't have a system where we can pass in messages straight away. It becomes very expensive because if I've got to tell all of them, I've got to call each and every one of them, especially if some of them don't have water for that sort of thing. So expenses go, and the time it takes for that information to get there. Instead of being on time, that time takes too long. And it should have been immediately. You have something to do or want to do. Like when you're doing marketing, you get a new change of things or dates of harvesting and those things. You need to have strictly this time that you know. It's difficult to get all the members to know at the same time. Some of them cannot get them on the telephone. Literally, there's a problem with the sort of telephones we have. The expense is also there. So the information delays. And the moment the communication is not right, then everything goes. I mean, it doesn't go smoothly the way it's supposed to be.

INTERVIEWEE (E.): In other words, communication is not in real time. There is a time deletion between the communicator and the recipients. I think that is a very big challenge. I'm not trying to emphasize what I said earlier. Because if it was in real time, everybody would get information uniformly. It's like addressing a meeting when you've got an audience. That is what you don't have. And there's something that we would wish that it could be enhanced and improved.

INTERVIEWEE (S.): Just maybe to add on that. You realize most of our farmers, quite a big proportion, don't use smartphones. That makes sharing of information quite difficult. In fact, a big hindrance. For example, if we want to share information with the farmers. Like the other day, I had pictures of different types of avocado. Some showing the types of diseases. A very clear picture. Almost ten of them. But now, you can only share those pictures with those with smartphones. I think training also. Farmers need a bit of training. Especially on how to use the smartphone. I don't know how that can be done. Training most of our members to understand the importance of smartphones. And how it can make sharing of information very easy. I think that was one thing that we are considering. In terms of farmers that are not digitally literate to use this. How do we make that happen?

INTERVIEWER (K.): But in your perspective, you said you wanted to share information on pictures of different types of avocado. Other than that, what information do you think needs to be shared better within the cooperative? What other information do you think you need to share better?

INTERVIEWEE (E.): When the season sets, the marketing season sets. We normally get information from the government authority officer. In fact, the one he (the chairman) was just talking to. The department known as HCD. HCD is Horticultural Crop Directorate. This is a government agency.

INTERVIEWER (K.): Yes, I've read about it. Okay, that's the one.

INTERVIEWEE (J.): And I've been talking to the person in charge in this area.

INTERVIEWEE (E.): So, when it is time for the market, as much as they release it on the internet, how many farmers will access the internet? You see? And if they have got an equipment to do that, how many are literate enough? Just like my colleague said, a computer literate has got IT knowledge to access those applications. To be able to read. To get proper information. Exactly. That is what we want.

INTERVIEWEE (J.): When it comes to even calling a meeting, we face challenges. In fact, we use the analog method of writing on our paper, taken to the church, and then it is read in the church. It is read. Poster. And even sticking them on the road, where there is a tree.

INTERVIEWER (K.): That's stressful.

INTERVIEWEE (E.): It is very stressful. You are right. It is very stressful.

INTERVIEWEE (S.): Still further, us as committees, there is a lot we already know about avocado farming by virtue of our offices. I have watched YouTube, quite a number of, I think three or four videos of a farmer talking like now him. I have listened to one Ugandan, another two Kenyans, and they give complete process. How they started, like he (the chairman) did in 2021, up to maybe where he has reached four years on. How to dig the hole, how to prepare the hole for planting the tree, how to take care of the tree, how to manage diseases. But now, how do we share that with our members? The medium of sharing information is very poor.

INTERVIEWEE (M.): Correct. Yes. Also, there is something which is very difficult. Our farmers have got a lot of ignorance. Some are illiterate. They don't know. And even if they are told, they take time to get the concept of who is Harina. Instead of Harina reading, they themselves, they read themselves. And they get lost. That is where we come to either the starting of this project. If you don't interact, like now how we have interacted here. Now we have known my brother's Shamba, the value and the weight of his product. We have known the other one. And that will make us understand and know why. Why is his heavier than mine? So, when we interact with the society and the environment where you are measuring these cooperatives, you will be able to understand and give information to those who don't have. The one I am giving, they have got a lot of ignorance. Because our society is not advanced. There are a lot of deficiencies of so many aspects of communication, of planning. So, those are the people who are forefront. Leaders who can be able to lead others together in the right direction

INTERVIEWEE (E.): Actually, before you record about ignorance, I would say it is adaptation. Because if somebody is able to use even a small telephone, it shows that there is an element of literacy there. IT literacy. Are we together?

INTERVIEWER (K.): Yes.

INTERVIEWEE (E.): But then it is adaptation. To accept that equipment, that this one is a tool. A very important tool. You have been here for now almost two weeks?

INTERVIEWER (K.): Almost two weeks.

INTERVIEWEE (E.): Yes, let's call it two weeks. Two weeks yesterday. You can do more than two weeks. You recall that Gen Z, they were demonstrating in this country. One leader said that... Actually, he is a university professor. He said this. He said that the biggest tool that Gen Z have are three things. Mobile phone, water to be able to manage the tear gas. The tear gas, yes. To handle, not to manage. To handle the tear gas.

INTERVIEWER (K.): The water.

INTERVIEWEE (E.): Yes. In addition, toothpaste.

INTERVIEWER (K.): Toothpaste?

INTERVIEWEE (E.): Yes. They apply toothpaste around the eyes. So nothing gets... Therefore, when that smoke comes, the toothpaste absorbs it. That is a good thing. You see. They are winning the war. They are able to adapt. Then, they are not transferring... Unfortunately, they are not transferring that information or that knowledge into... What?

INTERVIEWER (K.): The older generation?

INTERVIEWEE (E.): Into actual profitable practice like in farming.

INTERVIEWEE (E.): I would not say the Gen Z are not practicing agriculture. However, there is this debate about agriculture not being enticing in Africa. In the Netherlands, you see people saying, I am a third generation, a fourth generation. Their father transferred agriculture to them. Therefore, I think it is something that needs to be embraced here in Africa. To know that agriculture is a real way. However, our government is not making it as enticing as it should be for the Gen Z. I have met people that say, oh, just give me a land; I will go to the rural area and practice agriculture. They want to do it, but maybe the economy is not as favourable for them as it should be.

INTERVIEWEE (E.): No.

INTERVIEWEE (S.): I will support that reasoning. You see, the Gen Z are looking at the farmers who have done the farming for years. Including their brothers and their parents, and they have not transformed themselves economically. They have not, surely. So, it is not motivating. Yes, it is not. If I have looked at my parents who do farming, they have not grown rich. I have looked at my older brothers and sisters who do farming they have not become rich. Why? What makes me think I will become rich when I do farming? So there is that. The government needs to make agriculture well-paying.

INTERVIEWEE (E.): True. By giving incentives. Yes, exactly. And some of the incentives. For example, the agro-inputs, agricultural inputs. We are talking of fertilizers. We are talking of workshops and seminars. We are talking of...

INTERVIEWEE (G.): Marketing is very, very, very important. Right? And this is why the FORQLAB project came up. Because avocados were found to have been going into wastage in the supermarkets while we were in the Netherlands. Yes. And other parts of Europe would buy from us. Why? It is because there is a delay between harvesting like we have done today and the delivery there. Even harvesting.

INTERVIEWEE (E.): You see, we were involved in this. In fact, one, two, three. All of us here. All of us. We were involved in the program. And those are some of the issues which came up. Wastage. Handling is part of it. Delay in picking. Ready for transportation. And of course, generally the husbandry of the fruit. Yes. Yes. Yes. So you see, when we talk about information, look at it this way. Our chairman here was talking to HCD senior agricultural officer. He gave us very important information. But for him, he has not been bothering to give us that information. Now he is giving us information which has cost us a lot of waste.

INTERVIEWEE (G.): See? There is a break in communication. Either from the government to us. And between us, the little we know to our farmers. Because our farmers, then we have a problem. They don't use this *(indicates the phone*). Not that they don't know. There are even some who have it. But they don't even open up anything else.

INTERVIEWEE (S.): Expense also comes in. Because you would say, okay, to buy a bundle, a minimum, you buy 20 shillings. One hour. Then what is he going to do? It is not enticing to go through it. It is costly. Even for us. To get some information, he is telling you to get more information. He has to have internet. Get it?

INTERVIEWEE (G.): Look at this scenario. Which we have just witnessed. He has talked to an individual. A very senior government officer. The information has come to him. Had he not put his phone on speaker, we would not have picked. Now, how many people have picked that information? And it is very vital. We have now understood about the metamorphosis of FCM. That way the stuff (*the whitish residue on the avocado in the farm*) you saw there. We have now understood. We have picked the information from him. By the way, it is only that he has used our mother tongue to explain. The white tissue you see is waste. From that insect which is already inside the avocado. That is damaging the fruit. It enters the avocado at a very young age. When the fruit is small and young. The egg has gone in there. It has become puberous. It is eating the fruits now. That is its waste. Actually, we see for our society. The best way to pass information. Say for example, for the fruit or this tree, the husbandry. The best way actually is to have a field day. Where farmers come to a farm. And then they are taught everything concerning the husbandry. Education day. With a tight program. Maybe a day or two. With the activities. So that farmers ask any question. On the ground.

Because actually the information we have to share with the farmers. Starts all the way from planting to selling. At all levels. There is information to share. But there is another thing you should understand. If we earn something which could be storing that information in our system. And you get the information. Then disseminate it is very easy. Even if somebody doesn't come there. Those who cannot have that. So get the information. It's so important that we have something. Teleconferencing. Distance and open learning. Where lectures are recorded. Then members can access it. Yes. Like one would go into YouTube and watch a farmer. Educating people. Or giving a talk.

INTERVIEWER (K.): So from this conversation. I would presume that you don't have any support that you are currently using. You don't have any existing platform that you are using for communication?

INTERVIEWEE (G.): In our cooperative? Yes. We don't have. We only use our own telephones.

INTERVIEWER (K.): So if an ICT application is being proposed to help you communicate and coordinate better. What are the things that you want to be included in this application? What do you want in it? Because this is a needs assessment. To know what you want to be included in the application. So what would you like in it? If you can think of it.

INTERVIEWEE (E.): We want to share production information. About how to plant.

INTERVIEWER (K.): But other than that. What else do you think is useful for the cooperative?

INTERVIEWEE (E.): Let's start from planting. We need production. From production. Then you come now to harvesting and marketing. All those go together. Because it is a continuous process. We are planting. As we harvest we are still planting more. And there are farmers who are coming in new who need all that knowledge. From planting. Selecting the seedlings and all those things. And then planting it. Looking after it until we start harvesting. And from harvesting to marketing. Which means now. You can keep them. Or you take care of all that. Before it is taken. There is a lot in every stage. Planting stage there is a lot of information. Managing the crop. There is a lot of information. Like that.

INTERVIEWER (K.): When we were doing desk study. We found out that. We would want something that is like. Like an e-commerce. I don't know if you know about that. There is a buying and selling. You want to sell to an exporter. But you want to be able to see that. This is how many kilograms I am selling. And at what prices. But this is something that you want at the moment. But maybe for a long term. For the cooperative. Something like that. Something to show the market prices. How you are being paid. What you are being paid. You don't have to go to. I don't know how you do the payment system. But with a button, you can just like be paid. So are these other things. What are the other features? That you can think of. Should be included in this hub. That is what I would like to know.

INTERVIEWEE (G.): The features that are very important for us is one. How do we assess to know? Where our fruit will be going. The customer. If we know where the customer is and how much he is paying for it. What it costs him to buy our fruit. Then we know the quality he needs. Whoever is exporting? Even if we have to export ourselves. We know already. We are taking our fruit to so and so. And he is paying us so much. So we are aware to plan. We can plan for our own money. Because we know at least. If I produce one ton. This is what I will get. And from the expenses I have done. This is how the farmer gets. That is why I was talking about. Marketing in general. But it is specific. That we know exactly. The source. Of the person who is eating the fruit. And that person is the consumer. And then that person should know us. That is the producer. So it is not. There is nobody else who will use our name. To sell to him. And tell him it came from. From Kenya he does not know the answer. He should say from this particular place. It should be traced back. To where it came from. And we can trace our food. To where it came from. So if I may get you. Right.

INTERVIEWEE (S.): That question on IT. Because that question to me. Sounds like it is. Going into IT. A bit. Because if I am getting you right. You are asking. What are some of the features that the software would include? Or maybe it is a website. Or it is a software. Or an app. What details would that include? Is that what you are asking? Yes. Because that now means. As users. Of a system.
I would think. That maybe as a cooperative. We would need. First of all a website. Isn't it? We would need a website. And in this website. A member. We can have. A member portal. Like you would have a staff portal. You can log in. Into the system. As a member with a number. Where you use your credentials. To log into the system. Maybe your membership number. Which is confidential. And a password. You log into the system. Then that website has. A lot of information. From. Who are the. Buyers of avocado in the world. And where they found. What prices are there? So I think. That is one step.

INTERVIEWER (K.): Thank you. I noted that down. I have that down. It is another thing. That we can always think about. You are talking about the source. Yes. Even the details.

INTERVIEWEE (E.): About that source. That traceability. Avocado comes from Kenya. Which part of Kenya? Meru. Where in Meru? Exactly. That is very important. And that part of Meru. Where you get avocado. How is it managed? Is it by a company? When we were coming. Was it today? Or the other

day? I showed you. The milk plant. She told us. In the Netherlands. They have something like that. And it is for cooperative. So something like that. It is something like that. Modelled on. Say that line. Right? And. So that it is possible. Somebody.

INTERVIEWEE (S.): So in your university, when you are there. And you log in. To this. To Avocado in Kenya. You go down. Find out where the source is. Find that it is in Meru. In Abothuguchi. Now. When you key in Abothuguchi. Right? It comes there and then you find. Even their management. Who is it? He takes care of this. Who manages this? That kind of information. I wish. Using that system. A farmer can log into the system. Inform the rest of the world. That your Avocado is ready. Exactly. Precisely. Yes. A farmer should be able to tell. The outside world. That my Avocado is ready. And I quote by price. Yes. Either a farmer or a society. Because now we are in the same zone. We can say our society. In our society. Avocados are ready. And we tell them what expectation we want. We think we have got. Cartons or whatever kilos or tons. So that somebody knows already. I go there. I want one ton. Or twenty. Because that is from a company.

INTERVIEWEE (G.): Quality. That is very important. Identity. Exactly. Because what we are working on is. We want specifically on quality. That is what we want to sell. Because farmers are very limited. And the quality is different. We don't want just to sell Avocado. No. We want to sell quality Avocado. Quality Avocado. And that is what we want. We want our name there. As a quality producer of this. As a brand. Exactly. As a cooperative. We want to associate ourselves. With the best quality. And we want to pursue that. As a goal. And that is what we need. In our system. So that somebody can. You question our quality. I think you see it. Yes. In terms of quality. I have seen that. Although you do judge it by the highs.

INTERVIEWER (K.): But back in the Netherlands. We saw that there is this. This portable machine. They use in testing quality. And then the exporters as well use it to check it. Is it something that you have?

INTERVIEWEE (G.): Unfortunately we don't have. At the moment we don't have. But we need. Yes. We judge by our highs. We need it. We need it. We know the need. But the financial capability is yet to come to us.

INTERVIEWER (K.): So you have mentioned that. Your need. To train the farmers on how to use. That training them on how to use a smartphone. Is important. But also what other things do you think are necessary for your members to use this application effectively? What other skills can you think of apart from training and the field day that you have mentioned? It could be part of it, but what other things do you think is necessary?

INTERVIEWEE (S.): Basically. Computer literacy. Exactly. Just only training. Yes. Some of us did not go to any school. To train on the computer. But the moment you start using it. It's challenging. But it takes a bit of time. With a good app. You don't need a lot of complications. You know if you can get. In effect this is everything.

Like I tell my students in class, tell whoever is responsible for financing your education that a good phone is not a luxury to a university student. It is a learning tool, like a laptop. Because we are communicating with our students using the phone. I share the course outline, course content using the phone. If I want to share notes with the students, we use the phone. Yeah. So, phone is very useful. So the moment our farmers know how to use a phone effectively which translates to basically computer literacy, actually. If they know the importance, they cannot fail to learn.

INTERVIEWEE (G.): Exactly. If they know the importance of it, definitely they must learn how to do it, how to use it. Let me give you an example. At the moment, even those ones who have got a small phone. When the fruits are starting to be sold, they don't stop calling you every day.

INTERVIEWER (K.): Now, if this application is there to use, other than the farmers not knowing how to use it, what other challenge do you think can be there from using it that can prevent you from using it? What other concerns? Yes, what can prevent you from using it if it is not available yet? Assuming now the farmers are completely free. Yes. What other issues?
Yes.

INTERVIEWEE (S.): What other challenges can stop the members from using that app? Finances. Finances. Yeah, because they cannot afford the bundles. Yes, airtime. Airtime is an issue. Affording Wi-Fi and airtime, that is a big challenge. Because for someone to stay online for say 30 minutes to watch a trading video, you require a lot of bundles. Yeah. Sometimes I buy bundles for advertising and they don't stay for long. They don't stay for long.

INTERVIEWEE (G.): Yes. Also, we have put some pockets where there is no electric power. But one could say, what about solar energy? Yes, solar energy could be accessible, right? Although the solar energy could be just not cheap, not many have installed the solar, much as it is an alternative to electricity. Okay, not many farmers have got, quite a number of farmers don't have electricity in their homes. So, that also is a challenge when it comes to using internet because you have to go very far to charge your phone or to charge your laptop to be able to use it.

INTERVIEWER (K.): But now, you said finance is a major issue. But we all know that the people developing the application are spending money to develop it, and so they expect a return on the application. How do you think, as a cooperative, there is bound to be a subscription cost for this application? Then, if you say finance is a problem, but you need this application, how can you as a cooperative come together to pay the subscription cost for this because of the people making the application?

INTERVIEWEE (G.): We come together to subsidize. To make a subscription, to pay the subscription cost maybe monthly or annually. Like we subscribe to have Wi-Fi. Yes. Like you pay something monthly when you are connected with Wi-Fi. Yes. I think that's okay as long as the cost is minimal.

INTERVIEWER (K.): So, is this something that you are willing, as a cooperative, to join, share and make happen?

INTERVIEWEE (S.): Yes. Our clients, they deal with the farmer one-on-one. Although we have been thinking and getting involved so much that we wish the payments to be channelled through a society. A society must run. For example, look at today. All the work we have been doing today. 70% of the costs have been covered by us, individuals. Yes. You get that? Yes. I fuel my car, he fuels his. We sacrifice our time. We do what we have done. Purely, I do not ask any money from anybody. Yes, and we are doing that because this is the behaviour with the members. At least to get a bearing somewhere. If somebody cannot sacrifice and do this or that, then there will be no society. It will be a community service, community movement.

INTERVIEWER (K.): When you say channel the money through the society, what do you mean by that? The cooperative?

INTERVIEWEE (G.): No. Yes. Look at this. If we can sell our product as a cooperative. Right? I believe you know how a cooperative works. Yes. As a cooperative. Then the client should be in a position to

pay via the society's account. Do you have one? We have, but it is not very strong. We are still building it now. Yes. We are actually building it up. It is there. But the product that you have brought today, you have brought it as a cooperative now. Yes.

INTERVIEWER (K.): How are they paying you? When I say we are not getting paid, these are samples.

INTERVIEWEE (G.): For this? We are taking them out so that they see what we have. It is a sacrifice. Sacrifice. For us as the leaders. We are marketing ourselves. So we have to sacrifice for them to see our product. I get it. You get it? Yes, I get it.

INTERVIEWER (K.): But then, like you said, that later, if you are selling your product as a cooperative, then they have to pay as a unit. And then you guys decide this is the amount that goes to each person.

INTERVIEWEE (G.): But I don't know whether you observed how our avocadoes was handled when we were emptying. Did you see a clock, a pen and a writing pad recording the weight?

INTERVIEWER (K.): Yes, I did.

INTERVIEWEE (G.): That is not actually what should have happened. This cooperative here is more honest than ourselves because it started that way. So to make something like that, when we sell, now suppose you are the person in Europe who is buying a product from us. We send the consignment. Money in that consignment is yours. Yes. Right? So at the reception point here now, every delivery is recorded, should be recorded. So, the client, when the produce is delivered to the client, should record every delivery with us. From the farmers who have delivered that. When the payment is done, then we shall know that we deliver a certain kilograms, then we pay you again the same amount. And if there are dues that you owe to the cooperative, say you collected the fertilizers from us, you collected the other agro-foods, you had an agronomist's services, and those ones will be recovered. That is the kind of assistance that would actually, we would like it to be, or wish it to be developed.

INTERVIEWER (K.): But, to my understanding, it's that you have outsourced this pack house. But are there like a middleman between you and the client at this moment? Or you have a direct contact with the client?

INTERVIEWEE (E.): You see, when we bring our product to sell, we have to pay for the other needs. And then from there... But they are not collecting payment on your behalf when it comes to that stage? No, we pay them from our own... Either we have our own site... But the client pays directly to you? The client pays directly to the cooperative, not to them.

INTERVIEWER (K.): Ah, okay. For now, this is all I have, the questions that I have. But, like I said, can I still come back?

INTERVIEWEE (G.): You are welcome, anytime. Even if we are not together, I think we can take our numbers. You can ask individually, you can take our contacts.

INTERVIEWER (K.): Yes, I will. Also, you can email the cooperative with us. Alright, alright. Yes, thank you.

ANNEX VII: INTERVIEW TRANSCRIPT – Pharox Intelligence Agency

Date of Interview: 18th of July 2024

Researchers introduced themselves and the purpose of the study and reiterated the information will be used solely for the purpose of the study. They requested consent for recording information provided.

The interviewee is Joris Tenhagen (J.), Director/Founder of Pharox

The interviewers are Kareemat Opeyemi Fakorede (K.) and Mercy Moraa (M.)

INTERVIEWER (K.): OK. We'll keep it as short as possible, but I would I would explain what we are doing at the moment. So this is a needs assessment to understand how communication can be improved within the farmer cooperative and the farmers in the avocado value chain in Kenya. So I'm working in Meru County and Mercy is working in Nandi. So but we want to understand where Pharox can come in.

In our research, we are focusing on ICT application to improve the communication and coordination within the avocado value chain.

INTERVIEWEE (J.): OK. Good. Yeah, I thought. Maybe briefly, what we do in Pharox. We are active in digitization of the supply chain. And supply chain there that comes along with a lot of steps. Of course. It starts with the farmers and then goes to the next step and to the next step and to the next step and to the next step. So as a typical supply chain from growing until it reaches the end customer and to all the transport and quality control that it can, it can be between two parties communication but can also be to third parties in communication. To get to have a full picture of inside of the supply chain. And that means that you have to do a lot of communication on all these handovers and handover all documents, but also to hand over for course of the of the of the goods of the. In this case avocados. Yeah. Then that's. So that's very important to. Yeah. To have systems in place where you can communicate very easily from all the different stakeholders or to all the different levels. Right.

INTERVIEWER (K.): Yes

INTERVIEWEE (J.): Yeah. And how is, how is that currently? I mean if you would look to the supply chain when it starts with the half thing, how does the current stage for instance with a farmer and within the cooperative, how is that part of the communication done? Do you have, did you did you already analyse that or?

INTERVIEWER (K.): We already we spoke to the farmers, but majorly they're still using the old method of face to face almost especially.

INTERVIEWER (M.): Yeah.

INTERVIEWER (K.): Calling. Not. And there are some farmers that don't have the smartphone, so he's still like the old way of calling and texting. And in churches they have to use a placard to like, send their message across. So, there is no like, oh, there's no central system for sharing information in real time. So it's in a little bit later for some people and causes a lot of issues.

INTERVIEWER (M.): Yeah. In addition to that in Nandi. It's also the same, but of late they're starting to use AM Tech which is a product app, but like that's actually have the database for all the farmers. And to know like this one has applied this amount of quantity. So with time I feel like they want to start the process now in Nandi County.

INTERVIEWEE (J.): And so did the question from basically from your research is to uh, to have a look how. This whole communication within the supply chain can be more centralised or can be not centralised, but in any easier way or what is what is? What is the goal?

INTERVIEWER (K.): Our goal is to understand how communication can be improved with an ICT application with the centralised system amongst the cooperatives, so that is our goal to understand from the farmer's perspective, what would they need in this application, both in the short term and in the long term. At least in the cooperative for the moment. So yes, that is our goal.

INTERVIEWEE (J.): Yeah. OK. What could be in terms of there, of course are a lot of technologies that can be can be used. But to make it simple I think. What is important is where farmers can come into place, but that you have like you have from the growing that you know OK which plants are in which areas and which area which yield and so on.

Basically, start with identifying. In this case the avocados and the avocado trees on which they belongs, to which farmer and from there. What is the status before they pluck it and they offered it and then it goes to the next stage? It most likely can be a quality check and those things have to be are the first types that has to be locked in a way, and that can be like, of course, with traditional systems and paperwork. But yeah, that's difficult to share in real time. So would be would be logic more is to use like a mobile app with workflows.

INTERVIEWEE (J.): Where you can log in and register this part of your supply chain and for the whole supply chain of this part. In this case the harvesting. Then it might be that there are on behalf of the corporation there might be.

And a system for certifying the farmers right on their quality or what, how they produce and how they use certain material just and now for to maintain the quality or fertilisers or whatever and that should be is one part that should be locked in a way that so and then you go to the next stage and the next stage what I see and what can be the most valuable and the most simple way.

That you all do that as much as possible with digitised workflows in mobile apps. Because if you sit together with each other and design, what needs to be handed over from the workflow one in activity one in the beginning of the search and then goes to the activity 2 and the beginning of the chain and so on to do all the activities behind each other. That when certain activities are finished then it goes to a next, often the next day stakeholder.

And so if you lock with your mobile app and your workflows, you lock different information points in your process in your activity A or a one or two for instance. And then you hand it over to the next takeover that you'll be able to easily. Select those relevant information of these activities and then you hand it over together with the product to the next stakeholder. So what you then have, and if you then. And take into account that, OK, this takeover can get this information out from me, my system, but some information they don't get out of my system because they're not allowed to. Then it it's easier that you can always reduce this information to the next stage to the next stage, to the next stage. Yeah. And I think that's that. That would make it very easy.

So that basically would mean that you have, you have to design a system where different stakeholders can add information and extract information from depending on their role and depending on the activities in the whole chain. And if you have that in place then and you have the rules in place, who can see what and when, or who can add information or can't add information to it, then you can reuse a bit of all the information throughout all supply chain. Can you follow me?

INTERVIEWER (K.): Yes.

INTERVIEWER (M.): Yeah. OK for me, I have a question. So for me, I was thinking cause we have like the eProd people who like will set up the app. We're still thinking also talking with other developers. So would it be possible like because I know you have U-pod, that your company and eProd. So is there

a way that it can be integrated into the app that you want so that it can help with the logistics and the trafficking very life, the real time trafficking of the produce and all that.

INTERVIEWEE (J.): Mm hmm mm hmm I have a slide. What if I maybe can show you briefly what's in our app because we have also have other apps. Yeah, OK. So what I mean is like here you have in this case a potato value chain. This whole process you have you have basically you have, you can see it as an event and then you have an extra edge and a next stage and a next stage. Usually you can all have all these events and we can lock that in our software in, in our app.

And so that would be maybe of interest for the avocado growers to integrate this system into their complete supply chain because this is fully based on with a different workflows in the mobile app and based on this you can add all this information to it and then in the end you get something like this.

INTERVIEWER (M.): In developing these apps, which resources why you did you need to develop these apps?

INTERVIEWEE (J.): Hmm. Well, we have to discuss with the corporation and with the stakeholders. How can we integrate it into something like this into your process and that we can make it applicable and available for all the growers and all the corporation and the next stakeholders. Because are we now in your case, are we just focusing on this part, like the growers and then the collection part and maybe doing something with the Afrikaans and then in transportation like would directly to the end customers. In Kenya? Or is it like it doesn't need to go to the retail or do you include that as well. I don't know what's the scope of your case?

What would be the need for you and for the corporation and the growers? What if what part of the solution, would they would they be of interest in? Is it from the growing prospect from really from the grower part to start till what point?

INTERVIEWER (K.): A farmer cooperatives? Yes, from growing till the harvesting stage.

Those that I've spoken to are like the two major points where they have major issues how to plant it right, how to address the disease that affects them in some of the areas. Then also which market to sell to and at favourable prices. So I think they need solution from the production up to the marketing level.

INTERVIEWEE (J.): Okay. And if you lock that, and if you do quality checks from the, for instance, what you mentioned in terms of how they grow it and if they need a certain things to improve that you could lock as well with it and within the workflows in a mobile app, that's saying something about the quality or the quality checks and make correlations between quality checks and the exact quality or feedback from.

The next stage, for instance, because you do your own quality check and if you send sell it to the next stage, they have their quality check and then you can do map these quality cheques and say something about how it's accepted for market A versus market B.

INTERVIEWER (K.): OK.

INTERVIEWER (M.): On these quality checks, if this check reaches up to the market or to the maybe the retailer, and if it reaches to the end user, is it like a different cost? Like if we choose to the end user will the cost be higher than if it reaches up to the retailer point?

INTERVIEWEE (J.): No. Well, if the data thing about this approach is that you make. And if you do the right quality checks upfront and log it in a digital way is easier for you to share it to the next day or so. For instance, the, the, the, the part in between you and the retailer or to the retailer. And that means that gives the retailer and good insight on the quality that they can expect. And then they don't have to do that many quality checks and it's safe basically cost for the retailer,

right. And it gives them a better idea on having a good constant quality of their inbound. So they know how they can sell this to their end customers. So and yes, you could even go one step further that you can say you digitised it that step. For instance, to lock that in the packaging. And the end user can use theirs with a smartphone. They'll scan for instance. A code on the packaging and they have to pull trail back on the quality and so that that's a nice service for a certain type of market that would be interested in it.

But I think the most important one is between a grower and the retailer. And if it directly passes the retailer and goes directly to the customer of course then and then customers is interesting, but if like the volume goes like I expect I'd like a 95 or 90% off for the volume goes from the retailer to the end customer. Then of course, the important thing is that you have this information in place till the retailer, and in terms of cost, it doesn't matter to that much.

INTERVIEWER (K.): OK. I think I missed the response to Moraa's question about the resources that are needed in the development of an application like this that you have, but I think I missed the answer, but what's what is a realistic time frame for you in the development of your application that you have done? What is the time frame that you suppose that can be used to develop it and to implement it for the cooperatives?

INTERVIEWEE (J.): Yeah. And so that's the central, basically the central organisation. And there are how many cooperatives in this case?

INTERVIEWER (M.): Well. 4.

INTERVIEWER (K.): I have 3 cooperative in my study area, and Mercy has 1 in hers.

INTERVIEWEE (J.): And each cooperative has like on an average how many farmers under the umbrella of the cooperative?

INTERVIEWER (M.): Like mine is like 1000 from us.

INTERVIEWEE (J.): Mm hmm mm hmm. And then what would the next question would be? Do the members of the cooperatives, do they have to comply with the cooperative agreement and cooperative rules and quality? The systems that is in place?

INTERVIEWER (M.): I think it's in place cause it like where I was. They actually like trained on the GLOBALGAP standards, so they know like the rights requirements to, like, grow the avocados and all that.

INTERVIEWEE (J.): OK. Yeah. According to it, regarding to the GLOBALGAP, yeah, OK. OK. And like, do you have an idea on the use of mobile phones and the percentage or the coverage of mobile use and underneath these thousand members is it like 90% or is it like 30%? How?

INTERVIEWER (M.): Like 70% cause even though some are old, their children are still there and they like help them with their applications. So majority of them are going, yeah.

INTERVIEWEE (J.): Yeah. Because then I think we can make it and we can make a cost and time estimate. But if we standardise that and it doesn't need to take that long. I mean, we're talking about a couple of months, half a year maximum.

INTERVIEWER (K.): Half a year and then you said costs, what will be like your estimated budget for it then?

INTERVIEWEE (J.): Yeah. Well, I think for me it would be good to understand the whole business case, right? So because then we can we what we do all with these kind with such case is that we design basically make every design session, OK, how does the supply chain look like? So for you from your growers as a cooperative and then do the next stage, how many stages are then afterwards?

And how does the supply chain look like under the umbrella of the cooperative? Is that always the same? I mean, it will be not 100% always exactly the same, but roughly. It goes from the grower responsibility to the quality check.

Then who's doing the transport? Is that done by the grower itself or under the responsibility of the grower before it goes to the next stage? Or is it always going centralised to the cooperative and like a warehouse of the cooperative for the next stage? How does that go? Because based on this information, yeah, they're going to collection here, right? How they how it's collected. And there there's most likely will at the collection point they will be done quality checks.

INTERVIEWER (M.): After they collect data.

INTERVIEWEE (J.): Maybe not on every shipment, but on batch level or on volume level or weekly level? Because that's for us a little bit important to understand how you can make such a system really. Digital in a smart way with at an efficient way and efficient means lower cost, right? So you can develop it and deploy it at a lower cost.

INTERVIEWER (M.): Yeah.

INTERVIEWER (K.): Yeah. OK. No, I have two questions from the question from your response.

INTERVIEWER (M.): OK, good.

INTERVIEWER (K.): You said first that you have to understand this business case in particular the other applications that you have that you have, are they specialised to one value chain or they can be used across various value chain?

INTERVIEWEE (J.): Mm hmm. Yes, it can be used across various supply chains, correct.

INTERVIEWER (K.): Is it applicable to the avocado value chain that we are looking at? The current system that you have in place?

INTERVIEWEE (J.): Yeah, I think so. I think so. Based on what I have known from the earlier research I think it is applicable and usable and scalable for the avocado value chain.

INTERVIEWER (K.): OK. But also if it is applicable, but it is also possible to create something entirely new specifically for the farmer groups of the cooperative.

INTERVIEWEE (J.): Yeah, we can, we can customise, we can customise. Yeah, we can customise, yeah.

INTERVIEWER (K.): That's ensures communication. OK. Then also you said design is a very integral part of the development of an application. What other stages are involved in the developmental process?

INTERVIEWEE (J.): It's important to have maybe one or two meetings right with the clients. To collect background information on the supply chain and that you say from the as a cooperative to say we are looking for such a solution and I would like to have this topic included like so like for instance so where to start?

Which process steps are should be included and at what part of the supply chain it stops?

Or maybe it stops really in the end, but that's better for you to decide and say OK, if you can map that basically and can be one A1 pager, right? It doesn't have to be that that difficult but say OK, we have these four or five steps in our supply chain from the cooperative to the market and I want to have a better service to that specific market and that can be maybe there you can divert to say OK for this market we maybe need some additional steps and for this type of market, maybe less steps that can be possible, but if you can describe certain a 1 pager that would help us a lot at say OK oh then we need next step would be do we have we can map based on that quickly and outline of how the total system should work on an efficient way in a low cost possible way and then in that meeting we can

dive into. OK. Oh here in this part of the supply chain, we need to discuss with maybe one of your farmers one of two of your farmers, how they really would like to have it maybe in the next stage after in the collection of the people in the operation. How do we need that part because then you narrow down your wishes and we had a good dose of you on OK we have to do. But how can you customise it in an efficient way? That would be, that's all the wishes from different stakeholders within or different pharmacy, different stakeholders within your corporation are included in a one-size-fits-all.

INTERVIEWER (K.): Okay. So firstly, an assessment of the need of the people, then after it's the design. Then after design, what comes next after the design?

INTERVIEWEE (J.): Yeah, after the design then we have next step because after they will be. If we did this high level design we can make a plan, a cost indication and we can map that plan and then you can decide, OK, we want to go ahead with it based on that.

INTERVIEWER (K.): OK.

INTERVIEWEE (J.): So that and that's the investment up front. What we have to what you have to make what we have to make that we say OK we spend time in it up front to do this mapping and to for the design and then you can say OK based on this we see that's a good business case and then what happens then if you say yes I tick the box we're going to do it together right.

INTERVIEWER (K.): OK.

INTERVIEWEE (J.): It's very short. But if you say OK along this then this feels good for both of us. Then we can say OK how can we approach it and you we can we make the planning and we make test plan. And we always start small, because by making it small and also developing small, then you have a quicker way and you can start working with it and you can get feedbacks of your members very quick to maybe and do if you do that like on the cooperative level in two or three.

You do a small scale pilot with the first versions you get feedback and you get two or three feedbacks from different stakeholders or different views. You can we can you get as a layer of information on top of each other and say okay these are the generic topics where if we can optimise it serves all the wishes of all the people at the same time.

Better to have such intermediate meetings. And because then you can develop and deploy it very efficiently. And so that means you have a faster time to market with the whole set up and you have less question marks or oh, this is not working well or I meant something else. And then you have to do the rework and that's not efficient.

INTERVIEWER (K.): OK. OK. Thank you for that.

INTERVIEWEE (J.): And then if so that kind of approach and then afterwards you say, OK, now the minimum wanted requirements are in the system, it works on small scale then you could say let's do a second round of roll out to some additional farmers. For two months, and then you can say now it works completely and then you go live.

INTERVIEWER (K.): But now in our research context that we want to make a communication application, what do you think is the most important feature that such an application should have for the farmers, like in the short term, what is most important for them? Yes.

INTERVIEWEE (J.): And mm hmm. I think. I imagine that an application should have a kind of a chat function that you can chat on certain topics, label these topics because it's easier than to automate these. The next actions on these topics and that you can add information in the chat like pictures or comments or whatever or documents. I think that would be a wise thing to add. And then you have for instance within the cooperatives because you can communicate. Within this case you can

communicate with thousand members, have an overview, a dashboard, and a centralised system for reporting purposes, but also to give feedback directly that you can manage these communications and that those will be specifically or most likely be focused on the exceptions, right? I mean, if you together have within your corporation you have a procedure how to operate, how to produce everything and the quality and everything is according to the global cap, then you only have to most likely communicate with each other. That's really nice, because then you can also, for instance, put some part in the communication on sharing information and experiences that could be part of communication, and the rest is on daily operations. But if you have daily operations really good organised, then you have happy flow.

And you only have to focus on the exceptions. What doesn't go well and there you have to make maybe one, two or three possible options in the communication. What steps will be taken if events X, Y or Z happens? In a standardised way, because then you'll know. You could use communication to create standard operating procedures and it helps you to standardise and get quality right to kind of communication faster and to automate certain things with the communication and the quality stamps due to the fact that you categorised these events and maybe label them afterwards.

After the next step in the events and then you can use that for feedback for the next summer/next year/the next half. The options to give direct feedback to the cooperative/users. You could use it for instance for monitoring also to the end customer and the retailer. If you then use their feedback and you share it directly and merge that with specific comments of a farmer. Then you have facilitated basically the communication in the whole chain.

INTERVIEWER (K.): OK.

INTERVIEWER (M.): OK. Other farmers, maybe you know, not all of them have access to the smartphones, so the ones who have the small phones, and can that information be translated into a USSD code or what?

INTERVIEWEE (J.): What? What information can be translated to?

INTERVIEWER (M.): Like maybe the farmer wants to know about the weather information from the app. Is there a way it can be translated into USSD info for the other farmers who can't access with the smartphone?

INTERVIEWEE (J.): Yeah, that's possible.

INTERVIEWER (M.): OK. And also I feel what I've gotten is that you are able like to customise an app for the cooperatives. What if in another instance are you like able to work with another company, maybe collaborate because you know Pharox is so good at the logistics part, are you able like to work with them? Are you fine with that? If that is possible.

INTERVIEWEE (J.): If possible to cooperate with others that are active in logistics, yes.

INTERVIEWER (M.): No. OK, no, they are. The other company has already like done apps with farmers. So maybe in this specifically one for avocado, we will need your professionalism on the logistics part for it to be to help them with that. Are you open to that?

INTERVIEWEE (J.): Mm hmm. Yeah. One. Yeah. Yeah, we're open today.

INTERVIEWER (M.): OK.

INTERVIEWEE (J.): Yeah.

INTERVIEWER (K.): A question for me, what's in your experience so far makes an application user friendly or accessible, especially for farmers that are not as tech savvy as the younger generation. What makes it user friendly for them?

INTERVIEWEE (J.): Yeah, I think it's very important that there's always with the designing is that you have to go to the gamba, which means going to the floor to the floor. Go to the field and to the operation. And that's why this designing of this process is so important, because then you can know where application can really help in the operation, because they operate the communication and in IT systems like this and also with this this slide what I showed you is it's only IT tool basically that should support how the current processes are working and it can help optimising the current processes, but it first has to be on the same ground as how the current process works. With that you could say, OK, this in terms of making fair user friendly, it should be with colour coding icons and make it very simple with as less steps as possible.

INTERVIEWER (K.): Oh, OK then where does the funding to build this application? Where does it come from?

INTERVIEWEE (J.): Yeah?

INTERVIEWER (K.): Who funds it?

INTERVIEWEE (J.): That's what we sometimes what we have to discuss with each other. I don't know how DAO within FORQLAB shows yes or no. I don't know that. What can be done from the cooperative or from the government side, I don't know.

INTERVIEWER (K.): But in your own organisation, generally who funds the applications that you have out today.

INTERVIEWEE (J.): OK. That's our clients, our clients funded, yeah, yeah.

INTERVIEWER (K.): And are there licencing fees, subscription cost?

INTERVIEWEE (J.): Yeah, yeah, that depends a little bit on what information goes through the whole system? And so if again if you have these design map design in place then we know that the real cost basically of all the data goes through and it's better to have a good design, because then we know really exact the cost instead of guessing, because if we have to guess then the price will be higher of course, right. It is logical to understand what payment plan is possible because it can be easier to have like 1 fee per month per cooperative and not specifically for every farmer. But for instance it facilitates that 1000 farmers can log in from the cooperative of Mercy.

Based on that, we look at when is it for you a good and solid business case? And because of that should that's part of the beginning of such a journey that you have an idea on that on how does the what should the system do then we know how what the costs are. And with that you can say OK this is a feasible business case for us. And because we don't have we, we and you both, we don't have anything about saying, OK, this would be nice and we build it not on an efficient way. So the costs are too high and then you then you cannot use it right.

INTERVIEWEE (J.): Now, it's because it is event based, so you can do it in in multiple ways. You could say it's, it's a fixed price per month or insert per corporation. Or it can be a transactional based throughout the supply chain, based on all the events and then that one is very clean and when you don't use it, you don't have any cost basically. But that takes a lot of cheques and balances in the system and that makes it often then more expensive, so I guess.

But that's what we have to do, discuss with each other after we have some shared like this one pager and then we can discuss better. OK, how many stakeholders or how many farmers will be using it? How many people will be using the mobile app? Which functions? Who will be in the control of the central dashboard? And in your case, it will be most likely be 3 different cooperatives and in my case, one and this can be maybe two people or five people or one person within the corporation. So that's something that says something about the total number of users. And based on that, we can say, OK, this is the best model. Like a fixed price per month or a transactional based price.

INTERVIEWER (K.): On this pricing, so something came up with one of my cooperative and he was like, oh, because our cooperative is still struggling and. Is it possible for a one-time payment for the whole cooperative? Is that an option you have talked about on monthly basis?

INTERVIEWEE (J.): Yeah, that's also possible

INTERVIEWER (K.): In a one-time payment? OK.

INTERVIEWER (M.): But would it not be so expensive. A one-time payment? Because if you're saying monthly payments, that is still feasible.

INTERVIEWEE (J.): That that. Yeah, that, that that is of course possible but and the disadvantage of. One time asking you have you have one time payment for the development? That's always the case, but then you have like the usage on monthly level or per year. That is, depending on how it's used.

INTERVIEWER (K.): OK. You have spoken about the fact that funding majorly comes from your clients? For in the case of the farmer cooperatives, that's they are struggling and they can't come up with the funding because I know it takes a lot to build these applications. Then what can be a source of what can they do in that process? Who can finance it for them?

INTERVIEWEE (J.): I would. That's a good idea. Maybe what we could do is also discuss it, because I know other stakeholders were involved with it in the FORQLAB project. So there's multiple stakeholders in which we could discuss with and like we have a specific meeting on that.

INTERVIEWER (K.): Yes.

INTERVIEWEE (J.): Like after we did an upfront meeting with the stakeholders in the FORQLAB project in terms of how because there are not only us benefiting from the system, but also almost have benefit of the system. To digitise her solution and then you can say, OK, who can benefit from it and then talk to with each other about the cost.

INTERVIEWER (K.): OK. Thank you.

INTERVIEWER (M.): Yeah, it's not so. After you created the app and they buy the training. I know the company's based in Netherlands, so how would you be able to train the cooperatives?

INTERVIEWEE (J.): Yeah. What we normally do is that we make like it's important that you make the system as simple as possible and then also to get mentions. So user friendly as possible. Then we will always make videos of the tools and how to use it. We can do training so we can do remote training. Maybe this will part be part of the deployment will be at the site phases to discuss it with the all the users or with a group of users. And from there you could have an approach could be that you have like one of your front runners, basically, or a couple of front runners within the cooperative that are using it and they are with the hand of support of from us and with guidelines and videos that they can do local training. That could be a good setup which you also can include for when you for instance when you do start with a small scale pilot, you can. I think it would be wise to include that part of training into the pilot, because then you will again get feedbacks.

There are smarter shortcuts and add-ons for application or for training because that makes it gives upfront before you do the full roll out and you get more feedback how you can do the roll out very smartly and efficiently with a good, stable, stable planning, robust planning. So I was thinking that these guys would be wise always start small. Use this small scale pilot to get feedback and it would be an idea of how we have the training also included. And it's better to do it in small pieces in this way and then then work from start and then we'll work for half year. Then we're going to deliver and then? While you miss so many opportunities for feedback. That there's then a big chance that you build

something really big and then you have to do some re-work. So I would advise also that part of the training be included in as a pillar in the pilot.

INTERVIEWER (M.): OK, I had some issues with my Internet, but I just want to clarify some clarification. When you said about the training course, maybe you have someone from Pharox within Kenya?

INTERVIEWEE (J.): No, not yet. But it can be a partner that is already working with you and where we can work with.

INTERVIEWER (M.): OK, because also know like some of the costs for them like the daily allowance and all that will add up to the cost of the app and all that.

INTERVIEWEE (J.): Yeah. Mm hmm mm hmm and it will be more on the part of the roll out. Yeah. Correct. That's one time. Uh cost. Yeah.

INTERVIEWER (M.): Nope.

INTERVIEWEE (J.): OK. OK. OK. And again, if you make it smart, if you make it smart with it, you should add with. If we have multiple meetings up front right, we would like these kind of meetings with after the one page here we can say OK this this is would be a way of doing the training more on a smart and efficient way.

INTERVIEWER (M.): OK. You have come better at these discussions upfront and then again develop for instance the training and then oh, are confronted with, oh, if we had that information earlier, then we did not went in this direction, we would have chosen the other direction more efficient direction.

INTERVIEWER (M.): Yeah.

INTERVIEWEE (J.): It's always how we'd in our approach of developing and rolling out make it more. Two step front, one step back, two step front, one step back if needed, one step back and then and you can take so many input for multiple purposes you take away you for the next step and then you keep it very efficient and then you can manage your expectations in both ways. Very efficient.

INTERVIEWER (M.): OK, OK. Something else I learned from a cooperative. I know the app before the cooperatives, but it should be in a way that the people from Nandi can have their information alone for them not like the other cooperatives also can see their work they want like that privacy still for them and all that.

INTERVIEWEE (J.): Mm hmm. Yeah, I understand that. But all our system work in a way that you define who can see what and to what extent.

INTERVIEWER (M.): OK. That others would not have access to their data.

INTERVIEWER (K.): you earlier mentioned that every application should start small. So we are looking at the short term features. What is most important for them to have now in the application but also in the long run they would need some things to be added in place? So is the application can it be designed in a way that it allows for accommodation of new features in the future?

INTERVIEWEE (J.): Hmm, that's good. That's always possible. But it's good that you that you say. OK, for instance, come back to the one patient you said. These are the processes. These are the wishes or it can be too patient. But it doesn't matter. And that and you say, OK, these are these are the priorities also for our features but we also think about new feature these are features on top of our mind for a later stage. It's better to pronounce it or to write it down, because then we can with design thinking we can already think about. OK. If you design something here, but in the future this is important or might be important, even if it's not well not taking place. If the even if the customization or additional feature will not come to that in that point. That by putting it on the table and discussing it up front

then it's easier already in the design. As you design the whole system, you take it into account and that you make it scalable for the future already for this possible future instead of making something really tight and adding something in the future and then you have to do a redesign of the of the first part.

INTERVIEWER (K.): OK. Thank you. That that's the last question for me.

INTERVIEWER (M.): Oh, on the resources for the development of an application. I don't think you told us the resources that are required in developing an app.

INTERVIEWER (K.): What other resources? She's asking because I didn't get it as well. Apart from the capital, the funding, what other resources are needed to for the developer to develop an application? Yes.

INTERVIEWEE (J.): Yeah, it's important to have these kind of meetings with each other and like with what do you do your end users. So in this case it would be important that you have maybe one or two meetings. Or that you have their feedback. And there are other roles, maybe within your cooperative, looking to your and you know your supply chain way better than we know your supply chain. I have an idea on. I mean we're in logistics and also in food logistics in the bar. So we know it a little bit, but amongst others from amongst others from Mexico where avocado but it's you know you're sure you're surprising a way better so. Within your cooperative, you have maybe people that also will feed the system or needs to extract information out of the system. Those people, one or two of all the one or two of these people, at least one of each should be able to communicate with the system. That should be. That should be in part and should be part of the team and maybe not all the time, but at least you have to be able to have.

INTERVIEWER (M.): OK.

INTERVIEWEE (J.): Be in direct contact with them to ask them or to get them on board temporary during a meeting. Because it makes it more efficient. And yeah, you build up also a team together, right in that way. And our experience is if you build, it's a build up a team with some of these experiences within your team on your side and we from our side then you have. The most efficient project. And the most efficient development.

INTERVIEWER (K.): OK, I think that's it for me.

INTERVIEWEE (J.): Yeah.

INTERVIEWER (K.): I don't have any. I don't have any other question. Mara, do you have any other question?

INTERVIEWER (M.): No, I'm OK. Maybe. But with ten, maybe might get more questions. So hopefully we can still send you an e-mail and you'll be able like to reach to us. We will gladly appreciate that.

INTERVIEWEE (J.): Yeah, we can do that. We can do that. No problem. That would be good. That would be a good next step.

And the other topic about the like funding and if you if you please also think about what you think, what all the stakeholders should be involved.

ANNEX VIII: INTERVIEW TRANSCRIPT – Kenya Agricultural and Livestock Research Organization (KALRO)

Date of Interview: 24th of July 2024

Researchers introduced themselves and the purpose of the study and reiterated the information will be used solely for the purpose of the study. They requested consent for recording information provided.

The interviewee is Irene Kimani (I.), Communication and ICT Expert at KALRO

The interviewers are Kareemat Opeyemi Fakorede (K.) and Mercy Moraa (M.)

INTERVIEWER (K.): Okay. The first question is, we would like to understand, I would like to understand that, is there a particular application for the avocados value chain, precisely? Because we have been checking, but we see that it's mostly for general value chain that you have. So is there a specific hub for the avocado value chain? Thank you.

INTERVIEWEE (I.): My name is Irene Wambui Kimani. I'm an ICT specialist. I work at KALRO Headquarters and also one of the lead innovators in the ICT team at KALRO.

Okay. So, your first question was, if there is an application for avocado value chain? Yes. The answer is, yes. There is an application for avocado value chain. KALRO has developed over 65 value chain applications. So, on Play Store, we have over 65 value chain that are on various or different value chains, avocado being one of them. And there is for Android applications.

INTERVIEWER (K.): Because we were unable to access this specific one for the avocado, we've been looking for it. What exactly is entailed in the application? Let me put it that way. What does it do? What is it meant for?

INTERVIEWEE (I.): The avocado value chain or the avocado application is developed to guide farmers on how to... The first thing is how to prepare the land, where to get the varieties. Then the next thing they learn is the type of varieties and what are their purposes and where they can best grow. So then we have how to plant. So how do they plant these avocados? Then they have... The next thing is how to do weed management, fertilization, watering, up to maturity. So then there's something about the diseases that affect avocado and how they should manage the diseases, how to identify and manage the diseases. Then they have another... They have also marketing. Once they are directed how to harvest and how to post harvest handling and marketing and also other utilization, even at cottage industry. So that is what is on the avocado value chain application.

INTERVIEWER (K.): Ms Irene, does the application has a specific feature, like a platform that facilitates communication between the farmers and also with other stakeholders in the chain? Do you have a feature for it specifically?

INTERVIEWEE (I.): KALRO uses many channels to communicate to farmers. I had also prepared for you a list which I can share after this meeting on how many farmers we have registered as avocado farmers. So as a country, we conducted a national registration of farmers and we registered the farmers who are practicing of the avocado value chain and how many we have in each county and whether they are male or female. I'll share with you that data so that you can see also the male farmers.

But coming back to how we communicate to farmers, one, we have a call centre. At the call centre, it's a toll free number. So when we communicate to these farmers on avocado information through SMS, we run a service. Then they are able to get back to us at the call centre. Our call centre is 24 hours.

Then we also have other channels like SMS, as I have told you, or the list of farmers that are given the avocado value chain. They receive SMSs during the growing season. So our growing seasons are two. So we have the short rains and the long rains. Now we are starting the short rains, which start in October. But the long rains start in March. So farmers during that time, they are given, they are sent messages on the value chain that they are growing. Which information are they given? They are given the same information I told you, site selection, types of avocado, and types of diseases to look for. We are running various models. So we are able to advise them on which diseases to look for at which particular time and how to manage them.

We are also running marketing models, so, we are able to advise them on various market prices at different markets in the country. So that is the SMS service. I have already talked about the call center. So we reach our farmers through the SMS service again. Our platform farmers can call us back. Apart from call us back, it's for free to them. They can also SMS us back and we answer them back. We have trained specialists who address their questions. And if they cannot be able to address, they forward the question or the call to an expert. We are connected to all our KALRO experts. At the SMS platform, they can also receive weather advisories. They also get, so we call them agro-weather advisories, so they can know what weather they will expect in their region.

I hope I was not too fast?

INTERVIEWER (K.): No, not too fast. Thank you. That was detailed. But still, I want to ask, the avocado application that you have, is there like a function that allows farmers to share information amidst themselves on that application, like a messaging platform within the application? Other than you sharing information to them, is there something like that in the application that you have? On this, the particular one for avocado?

INTERVIEWEE (I.): Yes. I really wish we had a physical meeting because this, our application for avocado, as I have told you, we have many channels of dissemination. So like the application for avocado has the information I have told you. But this particular application, it is still on another platform that we call KEEP. Kenya e-extension platform (KEEP). And when you go there, you find now all the 65 applications. Now it is not an individual application.

So when it is not an individual application, so there you can send as many questions as you want. You can communicate back either through WhatsApp, SMS or call toll free number. So our applications stand alone and they also stand as within others. I don't know whether I'm able to, you're able to see the scenario?

INTERVIEWER (K.): I understand that. Yes. Yeah.

INTERVIEWEE (I.): And since the avocado value chain has specific farmers who are growing, growing it and we know them and we know where they are because we have registered them in our database. We are able also to reach them with various messages and they are able to reach us back through the same channels, SMS, call centre, email or WhatsApp. Hmm.

INTERVIEWER (K.): Okay. Okay. Thank you.

INTERVIEWER (M.): Yeah. On the avocado apps, we had that when I was in Meru, in Nandi, my extension is, uses the KALRO avocado variety app. So I was trying to check online if it's there, but it's not online. So I was wondering why it was like removed.

INTERVIEWEE (I.): I am actually trying to multitask to see, to, to look at my applications and I'm able to find all my applications. Our applications are even downloaded even in other countries. Like the apps that stand alone, you find that the avocado app is really downloaded in DRC Congo. We think because their weather and our weather are almost the same.

INTERVIEWER (K.): Maybe we should just move on because of time. Ms Irene, what in your experience makes an application user-friendly or accessible to its users? What is needed for an application to be user-friendly?

INTERVIEWEE (I.): Yes. There are many, there are many things that we are rating. One of them is language. Okay. The other one, before we get to language, because they're already, that is you have already gotten into the application.

One, I have said we have allowed, you can get our application on a platform that has more applications than just one, but you can also get them as single application. That is very important because sometimes the farmers or the users only want one application. Others want, if it's an extension officer, they need all the applications in one platform. But if it's an individual farmer, they probably want only one application. There are other, there are other ways that we have made our application user-friendly. We started with the Android phones and now we moving to iPhones. So we're getting a license for the app store. That will, that one will be a great improvement because we realize many people are using iPhones, especially the youth. They prefer to use the, the iPhones. Now that's moving from the gadgets. I am trying to, to, to talk very fast because of time.

The next thing after moving from the gadgets is our technology. We are moving our technology to friendlier technology as we develop. What do I mean? We are developing our technologies in a way that our application is both available on web and mobile. And the same thing that you see on web is the same thing you see on mobile. And when it goes back on mobile, we design it in such a way that it's able to wrap itself very nicely on the mobile. If you move to tablet, the view is just seamless. You just make it as easy as possible between various devices.

Moving from the devices, I want to go to the language. Our applications are very simple to use. We sit with our researchers or our value chain experts, and we try to remove all the jargon that might hinder the users from using the application. So we make it as simple as possible. And we also test that using various tools that are developed. So we ensure that our application is 90% simple language user friendly.

Then the other thing we also do, our country has 42 languages. So we try to translate our applications to the major languages. Sometimes which are the major communities are Kikuyu, Luwo, Luya, the ones who have the bigger numbers, while we are also still trying to move to the smaller numbers. Our applications are in Kiswahili, they're in English, they're in Maasai etc. and this is seamless. The users just change the language based on the language that they want.

I don't know whether we have, I don't want to say that I have achieved 100% user friendliness. Maybe now you can also ask me based on a category, then I can be able to answer. Because now I have only answered in terms of the gadgets, in terms of the language, in terms of the visuals.

Our visuals are very, very appealing. And now you can ask me in terms of user friendliness in other categories that I could have not addressed. I welcome questions.

INTERVIEWER (K.): Oh, no, no, I don't have. Mora, do you have?

INTERVIEWER (M.): Yeah, no, not on that. I don't have on that.

INTERVIEWER (K.): Okay. My other question is, when developing such avocado applications, what resources do you usually need?

INTERVIEWEE (I.): We need a lot of resources. Because for one, for us, we are tech and for me, I'm a communication and an ICT expert. So one of the things that we need is to bring our team together. Our avocado value chain expert, you need to bring in the communication experts. You need to bring the tech guys, the tech team. You also need to bring, you might not have all the pictures or the

diagrams. So you need also visual experts. So really is a team. The application is not developed by one person, it is developed by a team.

INTERVIEWER (K.): Okay. So to add to Mora's question, apart from team, apart from finances, what also is necessary in developing an application? Apart from these two that we have highlighted, what else do you think is needed?

INTERVIEWEE (I.): Oh, I highlighted the finances, the technical personnel. The technical, you need really experts. Our team is made of programmers. Our team is made of scientists. KALRO has over 600 scientists. Our team is made of communication experts. You would need a good team. One that is the most important and they must be conversant in all areas. Because you start from, you need breeders, marketers, post-harvest team. You need weather experts. So it is a rich team.

Once you have sorted your team, you also need finances. Because sometimes this work is done to put the teams together. You might be spending some money or resources to put them in the same place. You realize that if you have already visited KALRO, the secretariat sits in one place; the breeders sit in one place. The people who do post-harvesting handling. Therefore, you probably need resources to bring them together.

Of course, you need the resources to be able to pay for the licenses. We pay this license to put our applications on Play store. We pay for it. We also pay for SMSs. We are not the ones who own the SafariCom, the Airtel—the Telecoms. Therefore, we actually pay to the Telecoms. We only develop the application, but pushing to the farmer who pay the Telecoms to pass our messages.

INTERVIEWER (K.): Now we have talked about the user-friendliness and the resources needed. But from your perspective, what is the time frame needed in developing an application? How long does it take? Then what are the key steps after bringing the team together? You are doing design. What other steps are necessary in the development of an application?

INTERVIEWEE (I.): What is very necessary as you are asking is remember KALRO is a research organization, so it's not like we are developing the contents. Already, KALRO has researched on the varieties, best practices, the diseases and their management. So really, most of the groundwork has already been done in the formal set up for research.

So all we are doing is taking this information and putting it together in a framework. The framework that I just read to you, site selection, planting, post-harvest, taking those bits of information and putting them together. So you really need now also a good communication team or a content team in our office. We call them a content team who can be able to piece this information from different places and put it up together in that framework that we have agreed that these mobile applications, will are going to be looking like this. So we get that team that puts now that content together. You even need editors who now edit to ensure that the content you have put up is user friendly or it communicates.

So the advantage KALRO has is that it already has a good background or a good backbone since it's a research organization. So the only layer they were missing is the delivery of the information to the end users. Have I come clear?

INTERVIEWER (K.): You have, but I would still like you to like, now, from my understanding, if you want to develop an application you said it, you've had this groundwork, and you have all this information together. But in the course of putting this information into the platform, you have to have an idea of how much of this information you will put in there. But what are the other key steps that we do not know about yet before it eventually gets to the end user? I would like to know those intermediate steps during the development.

INTERVIEWEE (I.): Oh, during the development?

INTERVIEWER (K.): Yes.

INTERVIEWEE (I.): Then now I'll go to the ICT part. I'll become more ICT than in content. What we do, we normally use an agile development process. What do I mean by an agile development process? We sit down with the developers. They develop wireframes. Once they develop the wireframes of using the specialized tools, so we almost can see how this application would look, and once we have agreed, all teams are in agreement. They now sit down and develop that by doing the actual coding. They actually code this application. And once they have done that, we go down to testing. And the application before we roll it out. Of course, there is the back and forth. Once we have, we are assured that it is okay, we deploy the application. We test it once again with the end users—that is the farmers. That stage, we call it validation. And once they have validated and we are satisfied, now we launch the application.

INTERVIEWER (K.): Okay, yes, that's what I really needed. Thank you. But during the testing phase, who does the testing? Do you have a selected number of farmers that you have to do it? Or is it the developers that try to test it and then make necessary adjustments?

INTERVIEWEE (I.): Okay, we have two testing, because once we do the wireframes, we do developing and coding. We do testing. The value chain experts and the developers do the first testing. Or rather the team that is at KALRO headquarter or KALRO in general, because they must not all be from headquarter. So that's the team that does it, it is almost an internal affair.

INTERVIEWER (K.): And then the second one?

INTERVIEWEE (I.): Then after the second one, then once we make it, we'll make it public, but on our IP, not so public. This time, it will not probably be available on Google Play Store, but it will be available for us on our own platforms. Second time now, we'll go out there now to the farmers. Now again, we will test with them. So we again take the same team, the value chain experts, the content team, so it will be probably a team of about four different experts. Including the agricultural officers at the lowest level. So we do test together now, the world agricultural officer, the farmer, and the other experts at the county. Maybe even probably invite an agro dealer or an agri-tech at the county. And so that testing is done by various stakeholders at world level. Then that testing, we also call it validation.

INTERVIEWER (K.): Okay. The other part of that question that I've asked is, what is then the timeframe to develop an application? After having all these things, how long does it take to develop one application?

INTERVIEWEE (I.): Apart from when we started, we, the first time when we started, we started with three applications. Yes. Then the second phase, we did 17. Then the second phase, we did all the others together. So nowadays, as an organization, we don't develop just one application.

So what we do, we identify the value chains that we want to develop. Because counties, even if we are working across counties, different counties, prior to the different counties, we identify the value chains and we'll get to that. So the first part where you're referring to the requirements gathering can take two weeks, very fast. And remember, they might not follow because there's availability of the, of the experts. So another two weeks to probably do the wireframe, another two weeks to do the, the, the coding, another two weeks to do the internal testing, coding, developing and coding, another two weeks to do the deployment, another two. So you can find an application. Once we embark on a particular set of application, we end up giving it the minimum up to market level. Now, without taking breaks for three months

INTERVIEWER (K.): Three months without break? From design to launch?

INTERVIEWEE (I.): Yeah. Because once we embark on a particular application, but kindly remember, we don't do, we no longer do one application. We probably do a set of applications, unless our very advanced portals like crop selector, the weather app, Kenya agricultural observatory platform, mostly

we'll be doing more value chains than one. So we could give it a time frame of about three months. Three months. Yeah. From scratch to deployment, to launch.

INTERVIEWER (K.): Okay. Moraa?

INTERVIEWER (M.): Yeah. So where do you get the funding for developing the apps?

INTERVIEWEE (I.): As an organization, the first thing is that the organization is a government organization. So GOK or the government of Kenya is the first input. Then we have, we have various development partners.

One of them FAO, i.e. the farmer registration. Farmer registration was the national farmer registration was sponsored by FAO. Then we have our SMS platform, Kenya agricultural observatory platform and advanced platforms like crops sponsored by World Bank. Then we have smaller applications like Avocado Cafe. Now you find we have different, different development partners based on their interest. For example, right now we have GIZ. GIZ is sponsoring applications in Western Kenya that support food, food systems. So we are actually in that particular project. Then we have a county specific, like we have the Laikipia GAPS. The Laikipia GAPS is county specific. It is specific to Laikipia and Laikipia sponsored the development. And because they also wanted it translated in languages that were specific to Laikipia and value chains that rest Laikipia County. And I forgot to mention one of our other development partners, Bill and Melinda Gates. They sponsor our weather application. That is because we are able to access quality data. So we can be able to put, to disseminate what specific advice is on weather. Okay. We also have the EU. Many, many people sponsored different applications based on their need. Many donors. We also have the EU.

INTERVIEWER (K.): Okay. Then what is an estimated, although you have mentioned that you do not develop one app, but what is an estimated budget for the development of one application in this case? I know you, you might have an estimation for three, but roughly what might be it for one application? How much is it?

INTERVIEWEE (I.): As I said, we don't develop one app and this is actually on based on the scope of the particular application. Some of our applications are quite advanced. So it's not like we develop one application anymore. We develop several of them. And even if we're developing an app, there are different functionalities for each application. So based on users that, or the audience you want to take the application to.

INTERVIEWER (K.): But can you give, uh, in the case of our own research, can you give an estimation of how much it might be to develop an app that facilitates communication, but also includes all of this, a little bit of everything that you have mentioned with the KALRO app. What would it cost?

INTERVIEWEE (I.): That one has caught me off guard, but I can, I can, I could probably put it at about 600. Yeah.

INTERVIEWER (K.): 600,000 Kenya shillings?

INTERVIEWEE (I.): Yeah. Okay. Although it has caught me off guard. But remember, I have said our dissemination channel is not one. We use application. We use call centre. We use SMS. We use website. And we also use face to face. Okay. Yeah.

INTERVIEWER (K.): Okay. You mentioned, um, licensing fees that you pay, um, Google play store to put the application there to pay telecommunication. What other licenses are there on your parts to this, um, other partners, but also in the path of the, um, users of the application, do they pay licensing fees to KALRO to use it?

INTERVIEWEE (I.): The last question come again.

INTERVIEWER (K.): Um, you have mentioned that as an organization, KALRO pays licensing fee to Google play store and then to telecommunication to facilitate your work. Also on the path of these users, the farmers that are using the application are they paying licensing fee to KALRO itself to use the applications?

INTERVIEWEE (I.): No, I said the farmers do not pay, uh, the farmers do not pay. Therefore, it is free to the farmers. Even the use of the application.

INTERVIEWER (K.): No, no subscription costs.

INTERVIEWEE (I.): No subscription costs. It is all free to the farmers. Even the messages we send to them. It is free on their site. We have already incurred the payment cost, now our services are free.

INTERVIEWER (M.): Okay. So when coming up with these apps, you have told us how like they have information like husbandry, market, diseases. So after some time, do you usually add other features into these apps or you don't add any new features onto them?

INTERVIEWEE (I.): Um, yes, we continue adding features to these applications, um, depending on the purpose and the target. We have applications like crop selector. Uh, we have applications like, uh, Kenya agricultural observatory platform. Uh, we have applications like the marketing information system where data is being added every day. The crop selector is in real time. So the data is dynamic. It is changing every, every day. Things that might not change every day, like good agricultural practices are those ones we will update as soon as the scientists have new information on the good agricultural practices.

INTERVIEWER (M.): Okay. And while developing these apps are some features, are they like easy to put in the short term and some do like take more time to put them inside the app or?

INTERVIEWEE (I.): Yes, some features are easy to develop. And there are some which are a bit harder to develop. Like for example, we have some applications that actually the advisories automated. So those particular features that are harder to implement or, or take longer to implement compared to where the key is a general advisory. I am going to say we have a service where, where farmers receives specific, uh, information based on their location. So that one is a bit harder to implement compared to a feature where you are just giving a general information because this one is reading from very many databases.

INTERVIEWER (K.): Okay. So, a question for that question. You have mentioned that, um, some of these features are difficult to, to put into it, maybe in the course of development. But do you, do you make rooms for accommodation that, Oh, in the long time, we would like to include this, but we cannot include it at the moment?

Is there room to include new features into the application to just add on to it?

INTERVIEWEE (I.): Uh, thank you. Yes, that is what we do. When we discuss our requirements for a particular application, we know they are short term, those that that would be achieved first. And we know they are also long term, those that will be achieved in the long run. Once the application probably is even in the field. Okay.

INTERVIEWER (K.): What are the monitoring tools that you have in place as an organization to track the performance of these apps that you have to see that they are really meeting the right people that you want them to meet? What are the monitoring tools that you have in place?

INTERVIEWEE (I.): We have put in place some with this Google analytics. We have various features where we are able to track where the applications are being used, how long, uh, and by whom and where they've been downloaded. Uh, so we get that data and we are, we are able to make informed decision using the data that we are receiving from these, the analytics from the analytics team.

INTERVIEWER (K.): Okay. So according to you, from your perspective, if we were to create an ICT application for communication within the cooperatives, which features would you recommend for us? For communication within the cooperatives.

INTERVIEWEE (I.): One of the things that makes people go to cooperatives is savings and credits. So definitely it has to have a, a savings and credit feature. Uh, the other is the other feature is, uh, which value chains is this cooperative dealing with? So probably, you can have information on that particular value chain that is the cooperative is dealing with.

Another reason why, um, people are in the cooperative is to get market information about the value chain that they are working with. So I think the, the prices or the market information is very, very important. Uh, another thing is that our country is still, uh, doing many refined practices. So the farmers need to, or the, the, the users need to know about the weather.

INTERVIEWER (K.): Okay. Do you have, um, specific protocols or measure to protect against data breaches or unauthorized access within the hub itself? Is it included?

INTERVIEWEE (I.): Okay. One, there are very many rules that are guiding us. One is the data protection law which does not allow us to share, uh, personal data on the applications. Therefore, when you go to our application, you will find that we are not sharing personal data. Uh, the, the, the data that we share is actually public good already. It was in the public, but probably not organized in the, in the, the form that we have organized it.

INTERVIEWER (K.): Okay. Okay. Yeah. That's, that is it for me more. Yeah. I have also, I'm so grateful.

INTERVIEWER (M.): Yeah. You are really given us more information and thank you for that. Yes, a lot.

INTERVIEWEE (I.): You are very, very welcome. Thank you. Thank you for your time, Ma.

INTERVIEWER (K.): We appreciate it. However, before you said you would send us a list or something, you said you send us a list in the beginning of the interview. I will share it on the wall. Also, can we like have like a, um, a blueprint of the hub so that then we can understand the features that are in it although you have mentioned it to us, is that possible? No problem. Okay. Therefore, we would not like to keep you. Thank you so much for your time. We really appreciate it.

INTERVIEWER (M.): We really appreciate it.

INTERVIEWEE (I.): You are welcome.

Total Number of farmers Receiving Avocado Advisories by County and Gender **(Source: KALRO)**

County	Female	Male	Total
Baringo	63	58	121
Bomet	120	169	289
Bungoma	63	61	124
Busia	53	57	110
Elgeyo/Marakwet	219	281	500
Embu	273	524	797
Garissa	0	1	1
Homabay	87	92	179
Isiolo	3	1	4
Kajiado	210	264	474
Kakamega	40	53	93
Kericho	26	45	71
Kiambu	2211	2889	5100
Kilifi	5	4	9
Kirinyaga	257	630	887
Kisii	1097	916	2013
Kisumu	32	45	77
Kitui	78	76	154
Kwale	4	1	5
Laikipia	264	266	530
Lamu	0	2	2
Machakos	3919	3556	7475
Makueni	487	629	1116
Mandera	15	9	24
Marsabit	2	3	5
Meru	598	902	1500
Migori	15	23	38
Muranga	5014	5546	10560
Nakuru	405	556	961
Nandi	74	111	185
Narok	15	29	44
Nyamira	75	98	173
Nyandarua	32	38	70
Nyeri	1126	1702	2828
Samburu	3	0	3
Siaya	70	90	160
Taita Taveta	55	61	116
Tharaka-Nithi	245	441	686
Transzoia	60	79	139
Uasin Gishu	36	105	141
Vihiga	524	406	930
Wajir	3	0	3
West Pokot	146	125	271
Grand Total	**18024**	**20944**	**38968**

ANNEX IX: INTERVIEW TRANSCRIPT – Functional Design Developer

Date of Interview: 15th of July 2024

Researcher introduced herself and the purpose of the study and reiterated the information will be used solely for the purpose of the study.

The interviewees is Jesper Giesbers (J.), a junior researcher at Hans Green Academy and the functional design developer.

INTERVIEWER (K.): What specific tasks or activities within the cooperative would benefit most from an ICT application?

INTERVIEWEE (J.): I think mainly the efficiency between the farmers and the exporter is increased when an ICT application is deployed. Think about picking up the acvocados at the right time. In addition, better communication can ensure that farmers' knowledge is increased, which also increases the quality and quantity of avocados.

INTERVIEWER (K.): Do you envision any features in an ICT application that would facilitate communication and collaboration between members?

INTERVIEWEE (J.): Most importantly, that there is a chat capability in the application. In addition, it is important that the data being recorded is always entered and maintained correctly. If the data (entered by farmers, for example) is not correct, collaboration will not improve much.

INTERVIEWER (K.): In your experience, what makes an application user-friendly or accessible? What is needed?

INTERVIEWEE (J.): To make an app user-friendly, it should not be overly complicated. Make sure that only the necessary elements are present (data entry, chat function, separate pages per participant, being able to view data). By keeping all elements simple and implementing only the most important you ensure that the app cannot be misinterpreted.

INTERVIEWER (K.): From your perspective, what is a realistic timeframe for developing and implementing an ICT application for the cooperative?

INTERVIEWEE (J.): This remains difficult to estimate, which also depends on the knowledge available. Thought must be given to the databases, the appearance of the app and the user-friendliness. But if I have to make a guess, this should be possible within six months.

INTERVIEWER (K.): Apart from financials, what other resources are needed to develop an application?

INTERVIEWEE (J.): The most important thing is to have the knowledge required when developing such an app. In addition, it is important to take another look at the market that will use the app. What features are most important for them to include in a first version?

INTERVIEWER (K.): What did the cooperatives think about your presentation on the functional ideas?

INTERVIEWEE (J.): I did not give the presentation myself, my colleague Peter Bouma did. However, I got back that they were very enthusiastic and want to see how this idea can be developed further. So they were very positive and saw potential in it.