EXAMINING KNOWLEDGE SHARING DYNAMICS AMONG MANGO FARMERS FOR ECONOMIC SUSTAINABILITY IN MAKUENI COUNTY, KENYA.

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT FOR THE AWARD OF THE DEGREE OF PHILOSOPHY IN INFORMATION SCIENCE IN THE SCHOOL OF PURE AND APPLIED SCIENCE, KIRINYAGA UNIVERSITY

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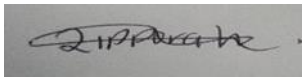

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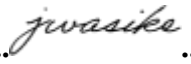
Signature .....  **..... Date.....13/07/2026.....**

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DEDICATION

I dedicate this work to my parents Mr. and Mrs. Benjamin Kimote Nzou, my children Emmanuel, Evelyn, and Isaac.

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Primarily, I would like to express my deepest gratitude to God Almighty for granting me the strength, health, and perseverance to complete this research just to say thank you God, you carried me through.

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God's blessings be upon your life.

ABSTRACT

Knowledge primarily lives in individuals' minds, and while it is sometimes documented, much of it becomes untraceable once its creator is unavailable. Consequently, knowledge sharing is essential for safeguarding organizational wisdom, promoting continuous improvement, and ensuring long-term success. This study examines the dynamics of knowledge sharing among mango farmers in Makueni County, Kenya, as a mediating pathway toward enhancing food security and fostering economically sustainable development. The main purpose of the study was to analyze how knowledge-sharing practices contribute to economic sustainability in Makueni County. Specifically, the study sought to: (i) examine how knowledge-sharing network structures promote information exchange and market access; (ii) establish the applicability of existing ICT technologies in facilitating knowledge sharing; (iii) assess the influence of existing institutions on value addition in mango production; and (iv) develop a model for effective knowledge sharing within the county. The study was grounded in three theoretical frameworks: the Social Exchange Theory (SET), Social Capital Theory (SCT), and Organizational Knowledge Creation Theory (OKCT). A survey research design was adopted for this study, targeting a population of 12,622 registered mango farmers and 11 agricultural officers in Makueni County. The sample size formed 292 participants, determined through multi-criteria sampling, and calculated using Andrew Fisher's formula (2023). Data were collected using a combination of interviews, questionnaires, document reviews, and observations. To ensure validity and reliability, the research instruments were piloted and later reviewed by a panel of experts. Data analysis employed a thematic narrative approach and descriptive techniques. The study findings revealed that mango farming serves as a major source of income for local farmers. While social networks have been adopted to ease collaboration and knowledge exchange, their implementation faces several challenges. Farmers showed a degree of ICT literacy; however, they reported limited financial support and minimal access to training opportunities. The study proposes several strategies to enhance knowledge-sharing practices, including the implementation of digital literacy training programs, infrastructure development, content localization, and financial aid for device acquisition. Additionally, the initiatives to implement the proposed knowledge sharing model which addressed the factors promoting equitable participation in the digital agricultural ecosystem, enabling smallholder farmers to access online markets, receive real-time information, and make informed decisions. The study recommends localizing organizational systems for knowledge management and resource mobilization. The interconnection fostered through these networks is expected to significantly enhance the economic resilience, adaptability, and long-term sustainability of mango-farming communities in Makueni County. The research highly recommends further research on how open science and community science integration can promote both scientific and indigenous knowledge sharing in agriculture for economic empowerment and sustainability, how knowledge professionals can help bridge the gap of information to promote knowledge sharing.

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ABBREVIATIONS / ACRONYMS

AFJARE	African Journal of Agricultural and Resource Economics
AGORA:	Access to Global Online Research in Agriculture
AGRA:	Alliance for Green Revolution in Africa
AGRIS:	International System for Agricultural Science and Technology
AI:	Artificial intelligence
AIMS:	Agricultural Information Management Standards Portal
AKIS:	Agricultural Knowledge and Information Systems
ASAL:	Arid and Semi-Arid lands
AST:	Adaptive Structural Theory
CABI:	Centre for Agriculture and Bioscience International
CGIAR:	Consultative Group on International Agricultural Research
COP:	Communities of Practice
FAO:	Food and Agriculture Organizations
GSMA:	Global System for Mobile Communications Association
ICTs:	Information Communication Technology
IRISAT:	International Crops Research Institute for the Semi-Arid Tropics
IFAD:	International Fund for Agricultural Development
ITOCA:	Information Training & Outreach Centre for Africa
ITU:	International Telecommunication Union
JKUAT:	Jomo Kenyatta University of Agriculture and Technology
KADP:	Kenya Agricultural Data Sharing Platform
KALRO:	Kenya Agricultural Livestock Research Organization
KEFRI:	Kenya Forestry Research Institute

KEPHIS: Kenya Plant Health Inspectorate Services

KIPPRA: Kenya Institute for Public Policy Research and Analysis

LMS: Learning management system

MCFDMA: Makueni County Fruit Development and Marketing Authority

MFPP: Makueni Fruit Processing Plant

NACOSTI: National Commission for Science, Technology & Innovation

IRB: Institutional Review Board

NAVCDA: National Agricultural Value Chain Development Project

NGO: Non-Governmental Organization

NOP: Network of Practice

OKCT: Organizational Knowledge Creation Theory

PPPs: Public-Private Partnerships

RD: Rural Development

SACCO: Savings and Credit Cooperative

SDG: Sustainable Development Goals

SEI: Stockholm Environmental Institute

SCT: Social Capital Theory

SECI: Socialization, Externalization, Combination, Internalization

SET: Social Exchange Theory

SPSS: Statistical Package for Social Sciences

UN: United Nation

USAID United States Agency for International Development

CHAPTER ONE

INTRODUCTION AND BACKGROUND FOR THE STUDY

1.1 Introduction

This chapter outlines broader issues investigated regarding the implications of knowledge sharing in the agricultural sector, highlighting the background and outline of the research problem, statement of the problem, research objectives, the research questions, the justification of the research, the scope of the study, the limitations, and the delimitation of the study.

Background to Study

Knowledge management is not a single discipline but an amalgam of several pursuits and academic specialties. Yeboah (2023) states that there are two knowledge management track activities from a meta-level perspective. Information management is covered in the first, and people management is covered in the second. This study focused on managing both people and information, where people will disseminate the required information to the information seekers. Consequently, the definition that follows is used in the research: The definition of knowledge management given by Alavi and Leidner 2001 cited by Kassem et al. (2021), is a systematic and organization-specific process for acquiring, organizing, and communicating both tacit and explicit knowledge so that people may utilize it to be more effective and productive in their work." p.107. Since information can be shared, it may spread across the whole business, making it a crucial component of knowledge management.

Kassem et al. (2021) define knowledge management as the exchange of essential information between knowers and knowees, including facts, viewpoints, and concepts that have been acquired by research, observation, or firsthand experience. One of the main purposes of my knowledge management program is to facilitate information exchange among departments or organizations.

Yeboah (2023), the exchange of knowledge dates to 15000 BC, when drawings were used to convey information graphically. These archaic pictures showed hunting, farming, and other vital information meant to be shared with information seekers. As time went on, documentation advanced and changed from pictures to letters and from walls to scrolls. Scholars and monks took up the task of organizing encyclopedias, transcribing books, and keeping knowledge hidden in private libraries. According to the pioneer of printing, Moran 1973, the printing press's creation in 1440 marked the beginning of the easy distribution of knowledge through print media. The public did not have access to libraries until more than four hundred years later.

Knowledge exchange had a significant revolution in the 20th century. According to Syed et al (2018), the changes peaked in the 1980s with the creation of the internet, but they started at the beginning of the century with real-time radio transmission. It became more difficult to envision living without the technology that allowed for this new degree of connectedness as knowledge became more widely available. It was soon apparent that some way of controlling this surplus of, albeit immensely helpful, data was needed. Consultants were among the first experts to investigate and discuss the best practices for knowledge dissemination.

Knowledge sharing in agriculture is essential for sustainable development and improving food security, according to FAO (2022), some international organizations that took the initiative of promoting knowledge-sharing in agricultural practices include FAO (Food and Agriculture Organization),the Agricultural Information Management Standards Portal (AIMs), AGORA (Access to Global Online Research in Agriculture), and AGRIS (the International System for Agricultural Science and Technology). Through its various knowledge programs, FAO helps to

increase the accessibility and visibility of research products related to food and agriculture by making the information available, accessible, and usable globally. FAO is crucial in promoting the exchange of scientific research and technical knowledge related to food and agriculture. Furthermore, Knowledge Lab supports initiatives aimed at building the capabilities of the communities of practice, such as the Agricultural Information Management Standards Portal (AIMS). They provide specialized online training activities to current stakeholders who utilize and contribute to the knowledge platforms. AGRIS provides free access to structured bibliographic records on food and agricultural literature in over ninety languages, while AGORA focuses on subscription-based journals to advance higher education and inform public policy decisions.

Another initiative for agricultural knowledge-sharing practice is AgExchange. This is a platform that eases knowledge-sharing among agricultural practitioners. The AgExchange covers current practices, challenges, tools, and approaches related to agriculture which revolve around knowledge capture, sharing, and application. The themes for AgExchange include developing dynamic and demand-driven knowledge-sharing activities, where Practitioners should consider what information to share, with whom, and how to reach the targeted audience effectively. Another theme of the AgExchange is maximizing human connections and networks which entails building strong networks to enhance knowledge sharing and achieving Sustainability through knowledge application aimed at not just collecting information but about applying knowledge effectively, empowering organizations and People to actively take part and collaborate leading to food security and sustainable development. The forum had an initiative aimed at bridging the knowledge divide and strengthening interactions among professionals with diverse cultural backgrounds and affiliations toward solving food security issues, FAO, 2022.

According to World Bank (2020) institutions like the World Bank collaborate on Agricultural Knowledge and Information Systems for Rural Development (AKIS/RD), had an initiative that aimed to integrate agricultural education, research, and extension, ensuring that rural people are active partners rather than mere recipients by having the right information through knowledge sharing with a goal to poverty reduction, improved livelihoods, and enhanced food security.

Tumwebaze et.al. (2022). The intertwined history of agriculture and knowledge sharing has shaped our understanding of farming practices, food security, and poverty alleviation. From cave drawings to modern agricultural knowledge information systems (AKIS), the quest for knowledge continues to drive progress in agriculture. According to Wang and Wang (2021), sharing information has a favorable effect on both innovation and business performance. Explicit knowledge sharing increases the pace and financial performance of innovation, while tacit knowledge sharing enhances the quality and operational performance of innovation. Again, knowledge sharing promotes engagement and dissemination of information.

International, regional, and national organizations collaborate to scale up the dissemination of information. This engagement ensures that valuable insights reach the right stakeholders at the appropriate time. Through knowledge sharing, the quality and effectiveness of research and education are enhanced, this is reached through disseminating best practices, lessons learned, and innovative approaches, for empowering practitioners to make informed decisions. Through information access and dissemination, communities get empowered leading to sustainable development.

According to FAO (2022), Knowledge sharing plays a pivotal role in shaping the landscape of agriculture. Some of the roles include the accessibility of information, engagement, and dissemination, Quality and effectiveness of research and education. Access facilitates the sharing of scientific and technical information on food and agriculture. Making information accessible and

visible contributes to sustainable transformations in global food systems. Access is promoted using networks of practices (NOP), the role of NOP is the integration of dispersed Knowledge. (Oostervink et al., 2016) indicated that social network practices facilitate free access to vital knowledge without boundary spanners, enabling the integration of knowledge from diverse sources.

The World Bank offers governments and other stakeholders some suggestions on strategies and intervention designs for the eradication of hunger and poverty. The World Bank, (2022), stated some of the reasons for stubborn poverty levels include lack of knowledge sharing and reliance on natural income rather than agriculture and rural development projects. The Food and Agriculture Organization of the United Nations (FAO,2022) provided instructions on planting orchards through the Ministry of Agriculture to diversify food production and align it with the achievement of the first Sustainable Development Goal.

FAO (2022) states that sharing agricultural knowledge is essential to Africa's progress and sustainable development. The International System for Agricultural Science and Technology (AGRIS), which is housed under the Food and Agriculture Institution (FAO) and is attempting to increase its presence in Africa, is one example of an institution that promotes agricultural information exchange throughout the continent. AGRIS is a worldwide network of data providers who voluntarily contribute information (metadata) on food and agricultural science publications. These suppliers include publishers, governmental agencies, and research groups. The data are available in several languages and usually have full-text links that allow users to access international scientific publications. AGRIS collaborates with the Information Training & Outreach Centre for Africa (ITOCA) to address challenges and build an active community of data providers in key African nations. Target countries include Botswana, Egypt, Ethiopia, Ghana,

Kenya, Morocco, Uganda, Senegal, South Africa, and Tunisia. ITOCA is a Sub-Saharan African organization that builds the ability of African librarians, information experts, scientists, researchers, and students in the field of information and communication technology (ICT). It accomplishes this by making recent technologies more accessible and providing instruction on how to utilize and manage electronic resources and information tools.

ITOCA also prioritizes giving the academic and research community access to current, reasonably priced, published scientific literature and data. The initiative focuses on strategic engagement, effective communication, and capacity building to improve the visibility and accessibility of technical and scientific agricultural information on the continent.

Another initiative in African regions is the use of ICTs for Agricultural Knowledge Sharing; some experts believe that knowledge sharing via Information and Communication Technologies (ICTs) will drive agricultural growth and transformation in African countries. Wiggers 2013 states that "it is no surprise that ICTs are becoming increasingly important for rural development in developing countries. Other experts argue that knowledge sharing via ICTs will be one of African countries' most powerful drivers of agricultural growth and transformation." But according to new research from the African Development Bank (2022), Africa still has a long way to go before developing a knowledge economy that can compete on a global scale. According to the International Telecommunication Union (ITU), by 2024 only about 38% of Africa's population was using the internet This may be attributed to two things: the first is the accessibility and affordability of programs such as AGRIS; the second is the importance of ICTs in promoting an interconnected agricultural knowledge base in Africa and bringing about constructive changes in international agricultural practices.

In Kenya, some recommended efforts are put in place to promote agricultural knowledge sharing, for example, a study conducted by researchers at the Kenya Agricultural & Livestock Research Organization (KALRO, 2022) explored knowledge-sharing practices among crop researchers, the study investigated how researchers within KALRO share agricultural knowledge, tools, and methodologies. Another initiative in Kenya is the availability of the Kenya Agricultural Data Sharing Platform (KADP, 2024), the Farm Stack's Kenya Agricultural Data Sharing Platform serves as a hub for sharing, discovering, and leveraging agricultural insights and knowledge, by joining KADP, stakeholders in Kenyan agriculture collaborate, access data, and drive growth and sustainability.

According to the Agriculture and Food Security (2022), one of Kenya's key national initiatives is Vision 2030 for Agriculture, which positions the agricultural sector as a central economic driver required to achieve a 10 percent average annual growth rate, a 25 percent reduction in poverty, and a 30 percent increase in food security by the year 2030. Although approximately 20 percent of Kenya's land is suitable for farming, maximum yield potential has not yet been realized, signifying considerable opportunity for productivity gains. Many farmers continue to operate without access to modern agricultural technologies, quality input, and adequate agricultural extension services, which limit their ability to adopt improved practices and enhance output.

Moreover, recurrent crises, particularly droughts in the arid and semi-arid lands (ASALs), have continued to undermine farmers' livelihoods and overall agricultural productivity. Nevertheless, realizing the agricultural potential of these ASAL regions could transform rural communities, generate long-term wealth, and significantly enhance the living standards of millions of Kenyans (Agriculture and Food Security, 2022). Through collaborative knowledge sharing among key agricultural stakeholders, horticultural farming has increasingly been adopted in the

ASALs. This subsector is now recognized as one of the fastest-growing components of Kenya's export economy, recording an average annual growth rate of over 7 percent (Agriculture and Food Security, 2022). Among the horticultural enterprises embraced in these regions, mango farming has emerged as a particularly promising and profitable venture, contributing to both household income generation and national export earnings.

The mango fruit originated in the Indo-Burma region specifically northeastern India, Myanmar, and Bangladesh where it has been cultivated for over 4,000 to 6,000 years (Fruit-Crops.2023). Archaeobotanical evidence suggests that early civilizations in India domesticated the mango both for its fruit and as a sacred tree symbolizing prosperity. According to Britannica (2024), the mango was introduced from India to Southeast Asia and Malaysia long before recorded history, becoming deeply integrated into local diets and cultures.

Traders and colonial explorers facilitated the global spread of mango. During the 16th century, Portuguese traders introduced the fruit from India to East and West Africa, as well as to Brazil and the Caribbean (ITFNet, 2016). By the 18th century, mango trees were well established in the Americas, where they adapted successfully to tropical climates (Britannica, 2024). Throughout the 19th and 20th centuries, commercial mango cultivation expanded with the development of improved varieties, grafting techniques, and organized orchard systems (Fruit-Crops., 2023). Today, mangoes are one of the most widely cultivated tropical fruits Worldwide. In 2022, global production exceeded 59 million metric tons, with Asia accounting for approximately 77 percent and Africa for about 10 percent according to the African Journal of Agricultural and Resource Economics (AFJARE), 2025). Major producing countries include India, China, Thailand, Indonesia, and Mexico. The global mango industry now encompasses fresh-fruit trade, processing for juice and puree, and a growing international market emphasizing quality and export standards.

Mango cultivation in Africa dates to the early 16th century when Portuguese traders

introduced it from India via maritime routes along the East and West African coasts (ITFNet, 2016). The fruit adapted remarkably well to the continent's diverse tropical and semi-arid conditions. Early cultivation spread from coastal settlements inland, supported by missionaries and colonial agricultural programs that promoted exotic fruit crops.

Africa contributes eight million metric tons of mangoes annually, accounting for a significant share of global production (Maingi et al., 2024; FAOSTAT, 2022). Countries such as Egypt, Sudan, Nigeria, Kenya, Mali, and Côte d'Ivoire are among the leading producers on the continent. Mango farming in most African countries is dominated by smallholder farmers, who account for a large proportion of production and typically rely on traditional practices and local varieties (Onyango The fruit is largely consumed fresh in domestic markets, although a relatively small proportion is processed into juice, dried fruit, and other value-added products due to limited processing capacity and infrastructure (Maingi et al., 2024)

Despite its potential, African mango farming faces several challenges. Pests such as fruit flies (Bactrocera dorsalis), diseases like anthracnose, poor post-harvest handling, and inadequate storage facilities cause significant losses (World Agroforestry Centre, 2022). However, growing regional and international demand has prompted new investments in pest management, processing infrastructure, and export certification schemes. These developments signify a gradual shift from subsistence-based production to a more commercialized, value-chain-oriented sector.

Kenya has emerged as one of Africa's leading mango producers. The mango was introduced into East Africa around the 10th century by Persian traders along the Indian Ocean coast (Onyango et al, 2023). Initially cultivated in coastal regions such as Kilifi and Kwale, the crop later spread inland to the Eastern, Central, and Rift Valleyregions through colonial horticultural

programs and local adoption.

By the late 20th century, mango had become a key fruit crop in Kenya. According to RSIS International (2022), the area under mango cultivation expanded from about five hundred hectares in 1970 to over 30,000 hectares by 2008. Production increased from approximately 254,000 tons in 2005 to 448,000 tons in 2008, reaching around 650,000 tons by 2023.The Lower Eastern region comprising Makueni, Kitui, and Machakos counties, accounts for more than half of Kenya's total production (Frontiers in Sustainable Food Systems, 2023).

1.1.1 Makueni County

The study examines knowledge-sharing dynamics among mango farmers as a mediating pathway to enhancing food security and fostering sustainable economic development in Makueni County, Kenya. Kenya's Makueni County was formerly part of the Eastern Province. Wote is the county's capital, the county is in the southeast and borders Taita Taveta to the south, Machakos to the north, Kitui to the east, and Kajiado to the west. Makueni, which spans 8,008.7 km2, is located between latitudes 1° 35´ and 3° 00´ South and longitudes 37º10´ and 38º 30´ East. Most of the county is semi-arid or desert, and it frequently experiences droughts. Rainfall in the upper parts ranges from 800 mm to 900 mm, while that in the lower regions is between 250 and 400 mm. (Envitech, 2020).

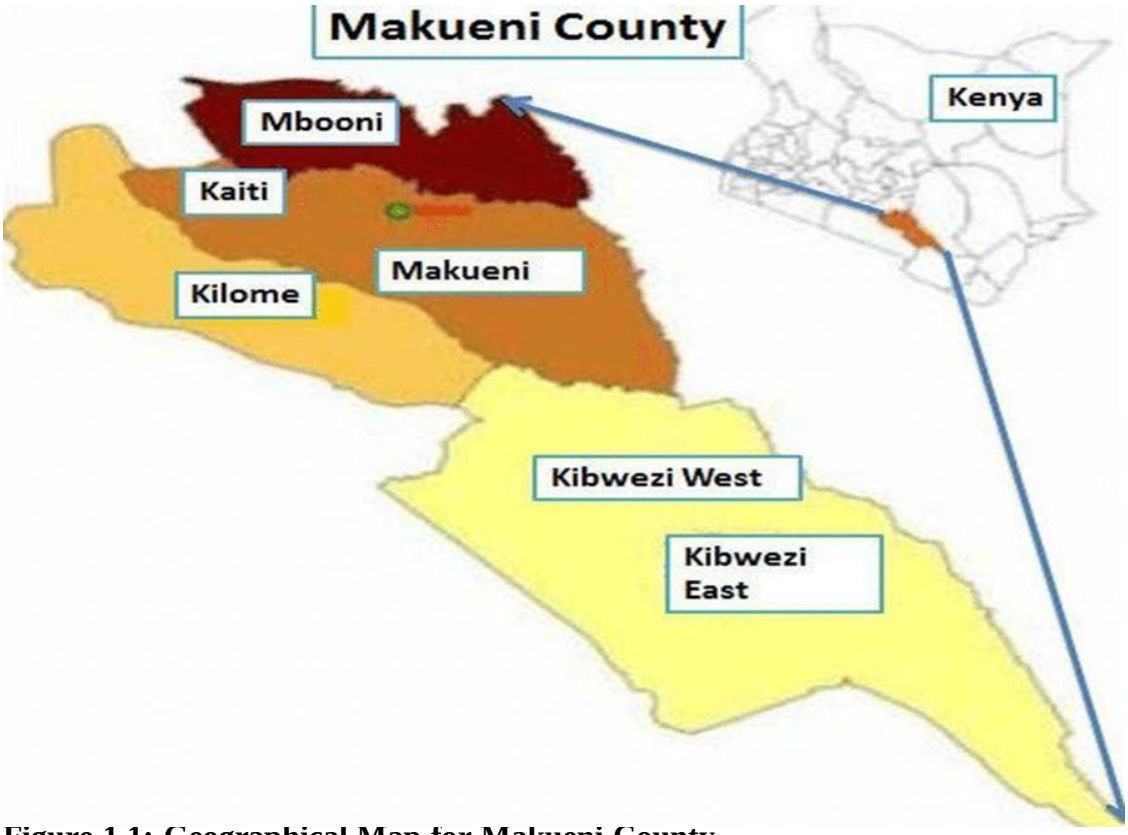


Figure 1.1: Geographical Map for Makueni County
Source: Makueni County Government Website,2024

According to the Maarifa Center (2023), Makueni County practices horticultural farming, which is commercial and substance use. Among the horticultural farming practices in Kenya, the county leads in Mango farming. Different varieties of mangoes are planted which include Apple, Ngowe, Haden, Kent, Sabire, Tommy, Atkins, Van dyke, and zill. All the varieties depend on the climatic conditions of the area.

Kenya News (2024) shows that despite the high production of the product, the farmers incur losses after commercializing the product, and others decay due to their short life span. Several studies have been done about mango farming in the county, including an evaluation of the marketing channels selected by mango growers in Makueni, Kenya by Vamba (et al 2023), which.

revealed the need for more studies on the challenges and possibilities farmers encounter to develop inclusive policies and/or practices.

The results of a study on the effects of devolution of agriculture on small-scale farmers' marketing of mangoes in Makueni County, Kenya (2023) suggest that the county government and other stakeholders fund extension services and research initiatives that assist farmers in identifying and managing pests and diseases efficiently and sustainably. In Makueni County, Kenya (2021), another research on the Participatory Project Planning and Performance of Mango Farming Projects by Kasumbi et al (2022) was also carried out, and the results suggested that planning for practice, policy creation, and its implementation, strong planning procedures will improve the mango fruit.

A study on Participatory Project Monitoring and Evaluation and Performance of Mango Farming Projects in Makueni County, Kenya (2022) was also done. The study recommended that mango farmers should invest more in monitoring and evaluation to avoid mango losses associated with pre-harvest and post-harvest problems. Another study on Knowledge management in the agriculture sector: A Systematic Literature Review (2022) concluded that there is a lack of research that considers knowledge management interactions among multiple heterogeneous stakeholder groups. Thorn et al (2020) in their research found a gap in that farmers' knowledge receives no attention and remains unexplored beyond farmers. Assefa et al 2011 cited by Iman et al (2021) reinforced power differentials in the Agricultural sector and how such factors affect knowledge transfer. Tumwebaze et al., (2022) in systematic literature review research, recommended that there is a lack of research that considers KM interactions among multiple heterogeneous stakeholder groups.

While research from non-KM studies identified the importance of farmers and farming communities and informal knowledge-related activities, this was absent from KM journals.

Although knowledge heterogeneity is valuable, the extant KM literature did not conceptualize or legitimize farmers' indigenous knowledge or consider its effects on KM processes. Based on what the existing researches included, several gaps have been identified like Measuring outcomes explicitly which includes, how knowledge sharing in its different forms leads to improvements in food security (availability, access, utilization, stability), not just adoption of practices or yield increases but linking knowledge flows to economic indicators (income, poverty reduction) has not be researched hence the need of the study.

1.2 Statement of the Problem

Mango farming in Makueni County has been widely recognized as a critical driver of economic growth, food security, and sustainable livelihoods. The county is Kenya's leading mango-producing region, generating approximately 38,000 metric tons annually and outperforming other counties in production (Market Systems Symposium, 2023). Despite this substantial output, the full economic potential of mango farming remains largely unrealized. Farmers continue to face persistent challenges, including high post-harvest losses, inefficient procurement systems, limited technical expertise, and constrained access to both local and export markets (Market Links, 2021). As a result, it is estimated that over 40% of mango produce is lost annually, significantly undermining farmers' incomes and the overall value chain (Maarifa Centre, 2022).

In response to these challenges, various knowledge-sharing initiatives have been introduced to enhance productivity, improve value addition, and strengthen market linkages. These initiatives include the formation of farmer groups and cooperative societies, which facilitate collective learning, resource mobilization, and coordinated market participation. Additionally, the integration of information and communication technologies (ICTs) such as mobile phones and social media platforms has expanded access to real-time information on market prices, weather patterns, and agronomic practices, thereby

improving decision-making and coordination among value chain actors. At the policy level, efforts to commercialize agriculture in Makueni County have emphasized knowledge dissemination, farmer organization, and improved market access as key enablers of value addition (Kenya News Agency, 2025).

However, despite these interventions, the effectiveness of knowledge-sharing systems remains constrained by several structural, technological, and institutional challenges. Limited access to timely, relevant, and actionable information persists, particularly among smallholder farmers in remote areas where extension services are inadequate and overstretched (Kimote et al., 2025). Furthermore, the digital divide characterized by insufficient ICT infrastructure, prohibitive costs of internet services, and low levels of digital literacy continue to impede the effective utilization of digital knowledge platforms (Ayim et al., 2020).

Institutional weaknesses, including fragmented stakeholder coordination, insufficient funding for extension services, and limited policy support for integrated knowledge management systems, further constrain knowledge dissemination. In addition, social barriers such as exclusion of smallholder farmers, low levels of trust, and weak governance structures within farmer organizations limit effective participation in knowledge-sharing networks (Kimote et al., 2025). Market-related challenges, including reliance on intermediaries and limited access to formal markets, further inhibit farmers' ability to translate acquired knowledge into tangible economic gains. High post-harvest losses `estimated at 40–45%—also reflect gaps in knowledge related to post-harvest handling and access to appropriate processing technologies (UN Women, 2018).

While existing studies have examined agricultural productivity, ICT adoption, and value chain development, there remains a limited understanding of how knowledge-sharing dynamics specifically influence economic sustainability within the mango value chain in Makueni County. There is a lack of empirically grounded models that integrate social networks, ICTs, and institutional frameworks in

promoting effective knowledge exchange. Therefore, this study seeks to address this gap by investigating the role of knowledge-sharing practices in enhancing economic sustainability among mango farmers in Makueni County. The study aims to develop a context-specific knowledge-sharing model that can inform policy, strengthen value chain integration, and support sustainable agricultural development.

1.3 Purpose of the Study

The purpose of the study is to examine knowledge-sharing dynamics among mango farmers as a mediating pathway to enhancing food security and fostering economically sustainable development in Makueni County in Kenya.

1.4 Objectives of the Study

1. To investigate the role of social network structures among mango farmers in Makueni county in enhancing knowledge sharing and facilitating access to local and regional markets.
2. Investigate the influence of Existing Agricultural Institutions (Government and NGO) on knowledge-sharing among mango farmers in Makueni County to improve quality of yield.
3. Establish the applicability of existing ICT technologies in facilitating knowledge sharing among mango farmers.
4. Assess the knowledge-sharing resources for Financial Support initiatives available to mango farmers towards promoting value addition.
5. Develop an Integrated Model for assessing knowledge-sharing dynamics among mango farmers to enhance food security and economic empowerment in Makueni County.

1.5 Research Questions

1. How do social network structures affect access to the mango market?
2. How do existing agricultural institutions (government and non-governmental organizations) influence

knowledge-sharing practices among mango farmers in Makueni County to improve the quality of yield?

3. How often are ICT applications embraced towards knowledge sharing among the farmers?
4. What knowledge-sharing resources and financial support initiatives are available to mango farmers in Makueni County, and how do they influence knowledge exchange and agricultural productivity?
5. Does Makueni county have an operational model for assessing knowledge sharing practices among mango farmers?

1.6 Assumptions of the Study

Makueni has a semi-arid climate with moderate temperatures (24°C to 32°C) and seasonal rainfall favorable for mango cultivation. The soil conditions is well-drained, sandy-loam soil with a neutral to slightly acidic pH (5.5–7.5), suitable for mango trees, assuming the production will always be high.

Improved varieties of mango (e.g., Apple, Kent, Tommy Atkins, Ngowe) are planted due to higher yield and market preference; it is assumed that the variety will lead to diversified market access. The market will always be available if the production is of high quality, and different buyers will always avail themselves, hence no need for centralized marketing. Another assumption is that government policies will be supportive when applied. Specifically, it is assumed that these policies will help in the registration of mango farmers, thereby enabling the formation of a mango farmers' cooperative society within the county.

This study assumes that effective knowledge-sharing mechanisms among mango farmers significantly enhance the availability, accessibility, and use of scientific and agricultural information. It is further presumed that strengthened interaction and collaboration between farmers and key stakeholders including governmental and non-governmental institutions, ease the efficient dissemination and uptake of best practices in mango production.

1.7 Justification of the Study

Studies conducted in Makueni County by different agencies and researchers like KARLO (2025) concluded that most mango farmers have basic traditional knowledge of mango farming and limited access to modern agronomic practices like pest management, post- harvest handling techniques, finding access to market and technology adoption.

The county government of Makueni is exploring ways of enhancing the economic value of the product by enhancing innovation and adding value to cushion farmers from incurring more losses. It is through knowledge sharing that the county government will support its initiative to save the situation. Knowledge sharing entails issuing the acquired and required information to the seekers; by sharing farming experiences, farmers can find better solutions to the problems they have encountered. Knowledge sharing allows the exchange of successful techniques that are inherently place-based, which contribute to sustainable practices.

FAO (Food and Agriculture Organization) promotes knowledge sharing/exchange related to food and agriculture. Through programs like AGRIS (International System for Agricultural Science and Technology), FAO increases accessibility to research products worldwide. AGRIS provides a multilingual database supporting the fight against hunger. Knowledge sharing empowers farmers, sustains livelihoods, and contributes to achieving global goals like the Sustainable Development Goals (SDGs).

There is a need to enhance social networks in agriculture. There is a strong need for farmer training programs, especially on pest management and value addition, better extension service delivery, awareness, and subsidies for appropriate technologies and strengthened farmer cooperatives to improve knowledge sharing and market access.

1.7 Significance of Study

Knowledge sharing constitutes a critical mechanism for enhancing the productivity, profitability, and sustainability of mango farming in Makueni County. Effective knowledge exchange helps the dissemination and adoption of best agronomic practices, thereby enabling farmers to improve yield, enhance product quality, and minimize post-harvest losses. Structured knowledge transfer platforms such as farmers' field schools, agricultural extension services, and organized farmer groups play a pivotal role in promoting the uptake of improved mango varieties and innovative farming techniques. Consequently, these interventions contribute to increased household incomes through improved market access, better pricing, and the adoption of off-season production strategies, including irrigation.

Knowledge sharing strengthens social capital by fostering cooperation, trust, and collective action among farmers. Through collaborative networks and cooperatives, farmers are better positioned to engage in bulk marketing, access financial services, obtain inputs collectively, and enhance their bargaining power in competitive markets. These networks also facilitate access to critical market intelligence, including price trends, consumer preferences, and compliance requirements for export markets. As a result, farmers are empowered to make informed decisions regarding optimal harvesting periods, grading standards, and value addition practices.

In addition, knowledge sharing serves as a vital bridge between research and practice by linking farmers with research institutions, non-governmental organizations, and government extension systems. This interaction ensures that scientific knowledge and technological innovations are translated into context-specific, practical applications that are accessible and relevant to farmers. Ultimately, such integration enhances the effectiveness of agricultural research and supports evidence-based farming practices, contributing to the overall development and resilience of the mango value chain.

1.8 Scope and Limitations of the Study

1.8.1 Scope of the Study

Mango farming in Makueni County plays a vital role in the county's economy, food security, and rural livelihoods.it is one of the main horticultural activities in the Makueni county, with over twenty thousand farmers who do either large-scale or small-scale farming for economic sustainability. It is a seasonal income generation product depending on the climatic conditions of the country. Common mango varieties cultivated include Apple mango (most preferred for local and export markets), Ngowe, Kent, Tommy Atkins, Keitt, Peach, Zebra, and Kienyeji, among many.

This study was geographically confined to Makueni County, a region characterized by significant mango production, with an estimated annual output exceeding 50,000 metric tons and substantial revenue generation from both domestic and export markets. Within this context, the study focuses on selected mango producing areas in the county including Kiteta, Kako, Ukia, Ilima,Tulima,Kisau, and Kilima sub counties where different mango varieties are cultivated, exhibiting variations in yield, shelf life, marketability, and pest resistance. The research specifically targets mango farmers involved in production and marketing, as well as selected stakeholders engaged in value addition activities such as juice processing, dried mango production, and pulp extraction, given their role in supporting agro-processing enterprises.

In terms of market scope, the study considers mango value chains operating within local markets, urban centers, and regional markets, with limited attention to export markets, particularly where farmers meet certification requirements such as Global Good Agricultural Practice (GPA) and organic standards. However, the study does not extend to a comprehensive analysis of international market dynamics or global trade policies affecting mango exports.

The boundaries of the study include smallholder and medium-scale mango farmers, relevant agricultural extension officers, and selected representatives from agro-processing enterprises within the study area. It excludes large-scale commercial exporters operating outside Makueni County, international buyers, and policymakers at the national or global level. Additionally, while acknowledging the diversity of mango varieties and their characteristics, the study does not undertake a detailed agronomic or biological analysis of these varieties, but rather focuses on their implications for knowledge sharing, production practices, and market access among farmers.

1.8.2 Limitations of the Study

This study is limited to selected mango farmers in Makueni County and does not include other mango-producing counties like Embu, Machakos, and Kitui despite similar mango-producing ecological conditions. The research focuses exclusively on mango farming, excluding analysis of other fruits like oranges, avocados, paw paws, and pixies, which are also cultivated in the county, and most of the farmers practice mixed horticultural farming.

The research focuses on assessing knowledge sharing dynamics with interest on how social networks influence knowledge sharing, impact of ICT in knowledge sharing, the role of financial institutions in promoting knowledge sharing, but doesn't go into details about legal analysis governing knowledge sharing, for example to what extend can knowledge be shared, intellectual property law government right to hold and reproduce information, data protection policies and other legal policies protecting production and sharing of the knowledge.

1.8.3 Definition of Operational Terms

Community of Practice (CoP)

This is a collection of individuals who, by constant interaction, increase their knowledge and ability in a certain field and share a concern, a set of issues, or a love for it.

Explicit Knowledge

Any knowledge that can be recorded, saved, and distributed to others is also referred to as expressive knowledge. This information is easily communicated to an organization's clientele. Usually, people may use this kind of information as a resource. This information may be preserved in various media, including books, movies, manuals, and databases.

Knowledge Management

A discipline that encourages the development, acquisition, arrangement, accessibility, and utilization of an organization's information assets in an integrated manner. These resources include organized databases and written materials like policy and procedure manuals.

Knowledge-Creating Organization

An organization with the ability to codify and transform implicit information into explicit knowledge appropriate for a new setting. To bring about these changes, managers and employees must constantly reflect on their own, as well as on the levels of their teams and organizations.

Knowledge Hub

An organization or network committed to gathering, disseminating, and trading development experiences with partners both domestically and internationally to hasten development.

Knowledge Management

A field that encourages identification, capture, assessment, retrieval, and sharing of all the information assets inside an organization.

Knowledge Repository

A networked data storage system that can include several different technologies. Knowledge assets can be added, maintained, updated, recycled, and disposed of more easily thanks to resource management. Additionally, it enables access to and centralized management of knowledge assets. Platforms for knowledge management or knowledge resources are other names for repositories.

Learning Management System (LMS)

An electronic learning program or course administration, tracking, reporting, documentation, and delivery software application**.**

Learning Organization

An entity that possesses the ability to generate, obtain, and disseminate information as well as adapt behavior considering fresh understandings and discoveries.

Organizational Behavior

The study of how people behave both individually and as a team inside an organization, as well as how people interact with the company itself.

Organizational Culture

Employee behavior is shaped by a set of shared beliefs and values. Its origins are frequently discovered in the founder's personality, administrative style, and principles.

Organizational Memory

Mutual readings of the historical narratives of an organization among its constituents. "Semantic" or "episodic" memories can exist in an organization. While the latter is independent of such experiences, for instance through stories told by someone who was not present during an encounter, the former depicts the recollections of a person who had the experiences that are contained in the memories.

Sustainable Development Goals

The UN adopted these initiatives, often known as the "Global Goals," in 2015 as part of a worldwide call to end poverty, protect the environment, and ensure that everyone lives in peace and prosperity by the year 2030.

Tacit Knowledge

is information obtained from personal experience. This information is particular to each person and situation, informal, and tailored. Informing people of implicit information might be challenging at times. It is conceivable that there is too much information to adequately explain, depict, communicate, or describe in writing.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter provides a literature review of past studies on how knowledge sharing has been used as a pathway to enhance food security toward sustainable economic development, The objectives of the research will be discussed which include how social network structures affect the dynamics of knowledge sharing, the effectiveness of information communication technologies in knowledge sharing amongst the community of COP, the influence of the relevant institution in knowledge sharing and financial initiatives in place to support knowledge sharing and an integrated model will be developed as a tool to enhance knowledge sharing if adapted. Theoretical and conceptual frameworks for knowledge sharing are discussed. This will provide an in-depth understanding of the themes of the research. The literature is reviewed from scholarly articles, Scopus, Science Direct, and repositories from organizations.

2.1.1 Impact of Social Network Structures on Knowledge-Sharing Dynamics

Social networks function as interactive digital spaces that facilitate online communication (Mamgain et al., 2020). They support dialogue, large-scale information exchange, advertising, and knowledge dissemination (Paudel & Baral, 2018). These platforms consist of websites and applications that users engage with to create, share, and interact with digital content. In the agricultural sector, farmers increasingly incorporate social networks into their activities, using them to exchange information, seek expert advice, and build collaborative relationships with fellow farmers (Cinelli et al., 2021). Social media has also strengthened communication between farmers and their clients and enhanced farmers' online visibility. Beyond simply accessing

information or networking with other information seekers, farmers use these platforms as avenues for knowledge exchange. Such knowledge sharing plays a critical role in broadening access to useful insights and maximizing their benefits. Connecting individuals through social networks has proven to be an effective means of promoting and supporting the sharing of knowledge (Mehmood et al., 2022; Saeed et al., 2022).

Ray (2024, as cited in Encyclopedia Britannica, 2024) describes a social network as an online community where individuals interact by exchanging messages, sharing information, and at times working together on shared activities. Although closely related, the concepts of social media and social networking differ: social media primarily focuses on using digital platforms to build and engage an audience, while social networking emphasizes forming and sustaining online communities. According to Chinda and Okpor (2023), social networks enable the flow of information, ideas, and resources, allowing users to remain connected and collaborate across various subjects.

(i) Social Media as a Tool for Knowledge Sharing

The advent of social networks has significantly transformed interpersonal communication, information dissemination, and collaborative practices (Ahmed, 2023). These platforms are considered essential tools for knowledge sharing because they bring together large numbers of users who can readily exchange insights and articulate ideas, experiences, and perspectives. Organizations can also leverage social media to create and distribute content, thereby tapping into the collective knowledge and expertise of employees and customers (Trawnih, 2021).

Social media has driven innovation and efficiency across multiple fields, including healthcare (Zeng et al., 2023; Ouyang et al., 2023) and education (Liu et al., 2022; Salim et al., 2022). Its influence extends to other sectors as well, such as tourism (Okazaki et al., 2017) and business.

(Chin et al., 2022; Mohammed et al., 2023). The widespread use of social media enhances the speed of knowledge dissemination, diversifies channels for accessing information, and fosters global knowledge exchange and innovation. Despite its potential, individuals are often reluctant to share knowledge on social media. Consequently, examining the factors that influence users' intentions to engage in knowledge sharing on these platforms is both necessary and timely.

In their widely cited work, Kaplan and Haenlein 2010 define social media as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content" (Maryville University, 2020). According to Aichner et al. (2020), the term exchange has increasingly been replaced by the term share. They argue that exchange implies an expectation of receiving something in return, whereas share reflects a willingness to provide something to others without anticipating reciprocity—an interpretation that aligns more closely with the concept of knowledge sharing adopted in this study. Notably, semantic technologies in the emerging Web 3.0 offer enhanced capabilities for both individuals and machines to connect, share, and utilize knowledge in innovative ways (Atzori et al., 2020), creating a more dynamic and conducive environment for knowledge sharing. Furthermore, social media platforms leveraging emerging technologies such as artificial intelligence (AI), data science, and blockchain demonstrate substantial potential to enhance knowledge-sharing practices. AI improves the efficiency and accuracy of knowledge acquisition through personalized recommendations, automated content generation, and intelligent search systems (Castaneda and Cuellar, 2020). Data science uses big data analytics and user behavior analysis to optimize content distribution strategies and ensure the credibility of shared knowledge via sentiment analysis (Saura, 2021). Meanwhile, blockchain provides a decentralized and secure

approach to storing and sharing knowledge, protecting intellectual property, and verifying the authenticity of information (Chai et al., 2020). Collectively, the integration of these technologies enhances the effectiveness of knowledge sharing on social media platforms, promoting global dissemination, and fostering innovation.

(ii) Challenges of Knowledge Sharing in Social Networks

Following Shayne (2021), this study considers a broad range of social networks, including social media platforms (e.g., Facebook and Twitter), messaging applications (e.g., WhatsApp and WeChat), photo and media-sharing platforms (e.g., Instagram and YouTube), blogging and publishing networks (e.g., Weibo and HubSpot), interactive and short-video apps (e.g., Snapchat and TikTok), online discussion forums (e.g., Quora and Reddit), bookmarking and content-curation sites (e.g., Pinterest and Flipboard), review networks (e.g., Yelp and TripAdvisor), social shopping platforms (e.g., Etsy and Faveable), interest-based communities (e.g., Goodreads and Houzz), sharing-economy platforms (e.g., Uber and Airbnb), audio-only applications (e.g., Clubhouse and Spotify), and anonymous social networks (e.g., Whisper and 4chan). According to Statista data, the number of global social media users reached 4.95 billion in 2023 (Petrosyan, 2024).

In 2022, the average daily social media usage worldwide was 151 min daily (Dixon 2023). Furthermore, social media users are expected to increase to almost six billion in 2027 (Dixon 2023). Social media attracts users mainly because people use it to stay connected with friends and family, to fill their free time, to read news stories, to share their knowledge, or to discuss their opinions with others (Meltwater, 2023).

Social media has transformed the ways individuals communicate, share content, interact, and collaborate, making it a vital source of knowledge across multiple fields. According to

Meltwater (2023), approximately 30.3% of adults use social media to seek relevant information. For instance, students rely on social media to access professional knowledge (Gamlath & Wilson, 2023), patients turn to these platforms for health-related advice (Yan et al., 2019), tourists use social media to plan travel routes and understand cultural heritage experiences (Ramírez-Gutiérrez, 2018), and consumers consult social media for product-related information (Nguyen, 2021). Thus, social media has become an indispensable platform for knowledge sharing at both individual and organizational levels (Nguyen, 2021). Consequently, encouraging greater participation in knowledge-sharing activities on social media is increasingly important (Khan et al., 2019).

Nevertheless, sharing knowledge on social media is still challenging for some people (Li, et al 2019) found three obstacles to knowledge sharing: (1) not knowing that the knowledge they have is valuable to others, (2) not having the motivation to share it, and (3) not having a suitable medium through which to share that knowledge. Consequently, studies have been undertaken to understand knowledge-sharing intentions on social media. (Ahmed, 2023; Cai., 2022; Jia, 2023). assume that intentions are a prerequisite for action. The Theory of Planned Behavior (TPB) posits that the influence of attitudes, subjective norms, and behavioral control on these intentions supports the association between intention and action. Therefore, it is vital to understand the factors that increase the intention to share knowledge via social media.

Despite the increasing use of social media for knowledge-seeking and sharing, there is a significant gap in our understanding of the factors that influence knowledge-sharing intentions on these platforms. Earlier research has primarily focused on individual behaviors, and few have considered other influences, such as social, technological, and environmental contexts. Identifying all the contributing factors is critical to consolidating existing knowledge and guiding future

research. This systematic review aims to fill this gap by synthesizing extant literature and providing a clear direction for enhancing knowledge-sharing practices on social media.

(iii) Psychology of Knowledge Sharing Using Social Networks

The psychology of knowledge sharing examines the motivations and cognitive processes that influence how and why individuals share knowledge within organizations and other social contexts. Several studies have identified a range of psychological factors that affect knowledge-sharing behavior on social media (Jia, 2022; Yen, 2022; Kaur, 2023; Liu, 2023). Existing literature also emphasizes that leadership plays a crucial role in promoting knowledge-sharing behavior (KSB) (Khalil et al., 2021). Research has highlighted both negative (e.g., abusive, and exploitative) and positive (e.g., paternalistic, and entrepreneurial) forms of leadership as influential in shaping KSB (Chaudhary et al., 2021; Goswami and Agrawal, 2022; Guo et al., 2021; Islam et al., 2021a, 2021b; Islam & Asad, 2021; Offergelt and Venz, 2022). However, the role of empowering leadership in fostering employees' KSB has received limited scholarly attention. (Bhatti et al., 2021; Joo et al., 2022) argue that empowering leaders or supervisors can significantly encourage employees to engage in knowledge sharing. When leaders empower their staff, they not only share their own knowledge but also create an environment where employees feel confident, valued, and motivated to reciprocate through knowledge sharing. Psychological empowerment, in this regard, is understood as a process that enhances employees' perceptions of self-efficacy, thereby motivating them to express their ideas and share knowledge with others.

Spreitzer (2024) defines psychological "empowerment as an intrinsic form of motivation grounded in four cognitions: meaning, competence, self-determination, and impact" (p. 2). She further explains that learning goal orientation (LGO) is "a stable dispositional trait that

describes the extent to which individuals strive to understand something new or increase their level of competence in each activity. In line with this, Islam et al. (2021b) state that LGO reflects an individual's motivation to develop work-related competencies and get new skills.

Accordingly, individuals who are motivated to enhance their competence are more inclined to engage in knowledge sharing. Conversely, members who are focused on protecting their position or status may withhold knowledge, exaggerate their own ability, or undervalue the knowledge of others to gain personal advantage. Thus, LGO plays a crucial role in determining which organizational members actively share knowledge transparently rather than hiding or manipulating it.

Despite numerous studies on knowledge management behavior, a research gap remains about the factors that can address the knowledge-sharing dilemma. This study seeks to investigate and resolve this dilemma from two psychological perspectives. First, it posits that higher levels of psychological well-being ease overcoming barriers to knowledge sharing. Second, it suggests that stronger quality in leader–member exchange (LMX) relationships encourage employees to take part more actively in knowledge exchange, thereby mitigating the dilemma. In other words, this study aims to demonstrate that employees with high psychological well-being and strong LMX are more likely to engage in knowledge sharing, achieving higher effectiveness and performance in knowledge management.

Attributes of Social Networks

(i) Connectivity

Social networks give people a way to interact with each other and create a virtuous community through their web of contacts. Communities' knowledge sharing has been acknowledged as an organization's main resource according to Chinda and Okpor (2023). Qualities of units and qualities

of interactions between units are the two main categories into which the theoretical explanations of knowledge practices may be divided (Chinda and Okpor,2023). Extensive investigations have been conducted to examine the impact of unit attributes on knowledge practices. Nonetheless, studies on how interactions between units affect knowledge transmission are still in their infancy (Chinda and Okpor, 2023). Earlier research by (Scheuer et al., 2021; Hébert-Dufresne et al., 2022; Yeboah, 2023) said connection between knowledge practices and underlying social dynamics. When knowledge is concentrated in the center, in a centralized system, it displays an unequal distribution. Furthermore, a centralized organization is primarily dependent on a single leader, who might not always be able to offer the other group members enough assistance. Additionally, it would take a lot of time for a single center to maintain contact with several people and exchange information, and the inflated cost might hinder the efficacy and efficiency of knowledge transmission. As a result, the study postulates that knowledge sharing in teams is adversely correlated with the centralization level.

(ii) **Information sharing**: Social networks enhance the sharing of distinct types of content, including text, images, and videos, through their network connections.

(iii) **Communication**: Social networks provide communication tools, like messaging, commenting, and liking, to facilitate interaction and engagement among users.

(iv) **Community formation**: Social networks help in the formation of communities or groups depending on shared interests, goals, or affiliations.

(v) **Virality and influence**: Information shared within social networks spreads fast and influences the opinions and behaviors of network members.

a) Aspects of Social Networks

Enhanced Knowledge Sharing: Lei and Zeng (2020) enhanced knowledge sharing leads to a greater exchange of ideas, perspectives, and best practices, enabling organizations to tap into a diverse range of knowledge resources, which helps in facilitating knowledge sharing among individuals and teams. Users can actively contribute and share their expertise, experiences, and insights with a broader network, accelerate Knowledge Creation and Innovation to foster creativity by providing a platform for collaboration and idea sharing, and individuals can co-create new knowledge and generate solutions.

The collective intelligence and diverse viewpoints available in social networks enable organizations to address complex issues and seize opportunities more effectively (Wang et al., 2022). Another aspect of social networks is to improve collaboration and teamwork. This is attained by providing channels for real-time communication, file sharing, and collaborative document editing. This enables geographically dispersed teams to work together seamlessly, share information, and collectively contribute to projects, leading to improved productivity and outcomes (Pacheco 2022).Facilitated Expertise Location and Identification Social networks within KMS facilitate the location and identification of expertise is another aspect of social networks, attained through leveraging connections and network relationships, were individuals can quickly identify subject matter experts within the organization. This promotes effective knowledge exchange, mentoring, and problem-solving, as individuals can directly reach out to the right experts for guidance, advice, or collaboration (Wang et al., 2022).

b) Dissents of Social Networks in Knowledge Sharing

Information Overload: One of the challenges of social networks in knowledge sharing is the potential for information overload. With the vast amount of information being shared and

disseminated through social networks, individuals may find it difficult to filter and process the relevant knowledge. This leads to decreased efficiency in knowledge retrieval and decision-making, requiring effective information management strategies to mitigate this challenge (Chinda and Okpor 2023). Trust and Privacy are other concerns that pose a challenge in the context of social networks in KMS. Users may be hesitant to share sensitive or proprietary knowledge due to concerns about data security, privacy breaches, or intellectual property issues. Building trust within the social network and implementing robust privacy measures are essential to address these challenges and encourage active knowledge sharing (Zhang et al., 2022).

Quality Control and Reliability: Maintaining quality control by ensuring the reliability of knowledge shared through social networks can be challenging. Since social networks allow for user-generated content, there is a risk of inaccurate or misleading information being disseminated. Establishing mechanisms for content verification, moderation, and peer validation can help mitigate this challenge and ensure the reliability and accuracy of shared knowledge (Q. Liu et al., 2018).

According to Mthunzi (2024), Cultural and organizational barriers can hinder the effective integration of social networks into KS. Different organizational cultures, attitudes, and norms toward knowledge sharing and collaboration may impede the adoption and utilization of social networks. To overcome resistance to change, promote a knowledge-sharing culture, and align social network usage with organizational goals is essential to address these barriers and maximize the benefits of social networks in KS. Addressing these challenges requires a proactive approach that is designing effective information filtering mechanisms, implementing robust security and privacy measures, establishing quality control processes, and fostering a supportive organizational culture that embraces knowledge sharing and collaboration.

c) Integrating Social Networks into Knowledge Sharing

1. Some of the ways of integrating social networks into knowledge sharing include designing Social KMS Interfaces this involves designing user-friendly and intuitive interfaces that incorporate social features. This includes incorporating familiar social media elements, such as news feeds, liking, commenting, and sharing, into the KMS interface. By designing social KMS interfaces, organizations can encourage active participation, engagement, and knowledge-sharing among users (Cho et al. 2020).

2. Social Network Analysis for Knowledge Mapping: Social network analysis techniques can be applied to map the knowledge flows and relationships within the organization, this can be achieved through interactions and connections among individuals in the social network, by identifying key influencers, knowledge brokers, and communities of practice (Francis 2024). This knowledge mapping facilitates effective expertise location, knowledge transfer, and collaboration within the organization.

3. Communities of Practice and Social Learning: Integrating communities of practice (CoPs) within social networks in KMS foster social learning and knowledge sharing. CoPs bring together individuals with shared interests or expertise, facilitating the exchange of knowledge, experiences, and best practices. This is achieved through promoting collaboration and participation in CoPs through social networks, and creation of vibrant communities that enhance learning, problem-solving, and innovation (Cho et al. 2020).

4. Gamification and Incentives for Knowledge Sharing: Integrating gamification elements and incentives into social networks within KS motivates and reward knowledge-sharing behaviors. Gamification techniques, such as points, badges, leaderboards, and challenges, can encourage active participation and contribution. Additionally, providing incentives, such as recognition,

rewards, or career advancement opportunities, can further promote knowledge-sharing and collaboration among employees and foster a sense of achievement and motivate members in the organizational network to contribute high-quality knowledge within the workplace (Oliveira and Kang, 2021); this may cause the users to excessively prioritize growth speed while overlooking the quality of the shared knowledge in public platforms in which users are not familiar with each other (Petter et al., 2020). integrating social networks is achieved by social interfaces, utilizing social network analysis, fostering communities of practice, and incorporating gamification and incentives.

d) Managerial Implications

(i) Developing Social Network Policies and Guidelines: Developing social network policies and guidelines is crucial for managers to ensure responsible and effective use of social networks in the organization. By establishing clear policies, managers can define acceptable behavior, data privacy guidelines, and intellectual property protection measures. Guidelines help employees understand their roles and responsibilities when using social networks, mitigating potential risks, and fostering a safe and secure environment for knowledge sharing (Dyikuk and Chinda, 2017).

(ii) Nurturing a Knowledge-Sharing Culture: Developing a culture of information sharing inside the company is a major responsibility of managers. Managers may motivate staff members to actively engage in knowledge management projects by fostering a culture that values cooperation, open communication, and information sharing. This is accomplished by promoting cross-departmental knowledge-sharing possibilities, offering forums for idea exchange, and acknowledging and rewarding knowledge-sharing initiatives (Ahmed et al., 2019).

(iii) Investing in Training and Development: Training and development programs enhances knowledge management skills. Training educates employees on effective knowledge-sharing

practices, the use of social networks in KS, and the benefits of collaborative learning (CFE 2023), by equipping employees with the necessary knowledge and skills, managers can foster a more knowledgeable workforce capable of using social networks and KMS for improved performance and innovation.

(iv) Fostering Cross-Functional Collaboration: Managers should actively promote cross-functional collaboration to enhance knowledge sharing and collaboration across different departments and teams. By breaking down silos and encouraging interdepartmental communication and collaboration, managers enable diverse perspectives and expertise to come together (Kane, 2017). This fosters the exchange of knowledge, accelerates problem-solving, and stimulates innovation within the organization. These managerial implications emphasize the importance of developing social network policies, nurturing a knowledge-sharing culture, investing in training and development, and fostering cross-functional collaboration (Cho et al. 2020). By implementing these strategies, managers can effectively harness the power of social networks and knowledge management systems, leading to improved organizational performance, innovation, and competitive advantage.

2.1.2 Information Communication Technology in Knowledge Sharing

According to the Kenya National Farmers Federation (KENAFF) (2022), the agricultural industry has experienced a significant digital shift during the past ten years. The way farmers raise crops and how customers purchase them is changing due to new digital technologies. The use of information and communication technology (ICT) is improving farming practices. With the proliferation of mobile phones and other digital devices, it is now feasible to remotely monitor anything from weather patterns to soil conditions, potential marketplaces, and the current pricing

of commodities in other markets. This has made it simpler for farmers to keep an eye on their crops, react fast to dangers like disease or pests, raise yields while consuming fewer resources, and reach markets.

Execution of ICT in Promoting Knowledge Sharing

The phrase "information and communication technology" (ICT) is used to refer to a broad range of devices and services, including computers, mobile phones, radios, televisions, newspapers, the internet, and digital libraries. Rapid technological advancement and digitalization are transforming many industries, including agriculture. Agriculture is transforming due to the need to boost agricultural productivity and save expenses in the face of rising consumer demand, unstable supply, and fluctuating prices (Zamari and Esmaeli 2024).

(i) Agronomical and market information

The difficulty of farmers getting market and agronomic information remains one of the biggest challenges, according to Atom (2022). ICT solutions may make sure that more farmers obtain knowledge on agricultural techniques, which will improve their abilities and adoption rates and lessen information asymmetry and eliminate intermediaries. Additionally, they can provide them with access to up-to-date market data. Applications for knowledge and information transfer that are most common include weather, pest, and risk-management information; market demand and price information; and best practices to boost agricultural output and meet quality and certification criteria.

(ii) Farm management and planning

Resti et al (2024) states that lack of sharing agricultural operations records and not having access to diagnostic tools that help farmers understand how their decisions may affect income and/or productivity, many farmers are unable to make well-informed judgments about farm management.

On the other hand, inadequate record-keeping and a dearth of reliable farm-level data are frequently associated with limited access to financial services. Utilizing agronomical, agricultural, and soil data, digital solutions may help farmers plan and manage their operations, which will open more financing options.

(iii) Mobile payments and other financial services

Xelius (2025) Mobile financial services to rural regions, digital technologies offer several ways to give farmers access to financial services. Loan and insurance payments are made easier with the use of digital finance solutions. By processing advances and payments efficiently and transparently, digital payments made through mobile money platforms, for example, not only improve company and farmer safety but also allow farmers to establish financial histories through the data they collect that is needed to apply for loans or insurance. Farmers may use their electronic wallet to pay for other services and industries, such as mobile banking, power, health care, and others, after a strong network of cash-in/cash-out agents and merchants have been established.

ICT Innovation

The above-mentioned roles of ICT cannot be attained without producing innovative ways to boost the outcome. KENAFF (2022). Some of the trends that are of significant use for sharing agricultural knowledge in information searches include:

(i) Integration of Artificial Intelligence (AI)

One of the sectors where artificial intelligence (AI) has recently produced ground-breaking innovations is agriculture. AI has proved to be a powerful tool in agriculture, revolutionizing traditional farming practices and providing innovative solutions to the world's food crises. According to Javaid et al. (2022) and Sharma et al. (2022). To study the developments in

artificial intelligence (AI) in agriculture, this research examines and contrasts the varied agricultural landscapes of Africa with the USA. The use of innovative technology, such as automation, data analytics, and machine learning, to improve many facets of agricultural operations is known as artificial intelligence in agriculture. (Misra et al., 2020; Smith, 2018). This includes a broad range of uses, including crop monitoring and precision farming.

Artificial Intelligence (AI) in agriculture leverages computer power and data-driven insights to solve complex issues, increase production, and make well-informed decisions. Artificial intelligence (AI) is important to agriculture because it has the potential to drastically change traditional farming methods. In 2018: Bannerjee et al. Artificial Intelligence (AI) enables accurate and effective resource management by integrating state-of-the-art technology. This maximizes agricultural yields, minimizes environmental impact, and increases overall production. AI provides farmers with tools to mitigate risks, make educated decisions, and support resilient and sustainable agricultural practices. These technologies range from autonomous machinery and smart sensors to sophisticated analytics.

Globally, the use of AI in agriculture is changing conventional agricultural methods and promoting sustainability and higher production (Lakshmi and Corbett, 2020). Strong infrastructure and broad access to technology facilitate the use of AI in agriculture in the United States (Khan et al., 2021; Lezoche et al., 2020; Abrahams et al., 2023). According to Tang et al. (2021), the agriculture industry in the United States is distinguished by sophisticated equipment, established communication systems, and high-speed internet availability. These elements foster an atmosphere that is favorable to the implementation of AI technology, allowing farmers to easily take advantage of data-intensive applications, autonomous equipment, and precision agriculture. Infrastructure and technology accessibility gaps in Africa influence the widespread use of AI in agriculture.

Many places struggle to get modern agricultural machinery and have unreliable internet access. The implementation of AI-driven technologies is hindered by inadequate infrastructure, particularly in isolated and rural regions where a substantial proportion of farming operations takes place (Ly, 2021; Ozor, et al., 2023). The USA has the benefits of a well-established agricultural research and development environment and an abundance of resources. The integration of artificial intelligence (AI) technology in agriculture is facilitated by the presence of research institutes, trained people, and financial resources. These factors encourage innovation. Large-scale farms in the United States are frequently financially able to invest in state-of-the-art technologies, which has aided in the quick adoption of AI-driven solutions. On the other hand, the widespread application of AI in agriculture is hampered by resource limitations in many African countries.

AI development and implementation are hampered by a lack of finance, trained labor, and research infrastructure. Smallholder farmers, who make up a substantial portion of Africa's agricultural sector, might not have the funds to purchase pricey AI-driven equipment and tools (Amankwah- Amoah and Lu,2022; Gikunda,2024).

Collaboration is essential to closing the gap between developed and developing regions, given the differences in AI adoption (Aderibigbe et al., 2023; Adaga et al., 2024). Efforts centered around technology dissemination, skill building, and knowledge transfer are essential to guarantee that everyone can profit from artificial intelligence in agriculture.

International cooperation is necessary to build sustainable AI solutions due to the global character of agricultural concerns (Tzacho et al., 2022; Abrahams et al., 2024). Collaborations among nations, academic institutions, and commercial companies enable the sharing of concepts, innovations, and best practices.

(ii) Internet of Things (IoT)

Morchid at el, (2024) suggested that in an era where digital transformation is reshaping industries, agriculture is not left out. The integration of the IoT in this age-old sector is a remarkable example of how technology can revolutionize traditional practices. The Internet of Things in agriculture represents a significant leap toward smarter, more efficient, and reliable farming methods. Many agricultural sectors have shifted to IoT engineering for smart farming to boost performance, production, and the worldwide market in addition to other aspects like reduced human intervention, time, and expense. Technology development guarantees that sensors will continue to get smaller, more contemporary, and more reasonably priced. The most effective and vital approach for creating problem-solving designs is the Internet of Things. IoT develops from several building parts, including sensors, apps, network components, and other electronic devices (Loganathan, 2021). The Internet of Things (IoT) facilitates data sharing across a network without the need for human intervention and increases the effectiveness of knowledge.

IoT technology makes it easier to access the internet from any laptop with the least amount of physical effort. It also facilitates time management, which improves communication.

Haseeb et al. (2020) states that innovative ideas and Internet of Things techniques are required to boost farming production and lower barriers. By focusing on the agriculture industry, the Internet of Things (IoT) is helping farmers overcome the enormous challenges they encounter. Farmers may get access to a multitude of information on emerging trends and innovations using IoT. Miles at the El (2020) Rural intercolumniation may be both a major barrier to agricultural reform and advancement and a key factor in supporting steady and sustainable economic growth in terms of agricultural improvement.

Uses of IoT in Agriculture

(i) Smart Agriculture

The phrase "smart agriculture" describes methods used in agriculture and food production that use big data, IoT, and sophisticated analytics. The incorporation of analytics, automation, and sensing technologies into current agricultural operations is known as the Internet of Things. The following are some uses in smart agriculture according to Miles at el (2020)

a) Sensor-based systems keep an eye on fields, crops, livestock, storage facilities, and everything else that affects output.

b) Intelligent agricultural vehicles, such as drones, autonomous robots, and actuators.

Smart greenhouses and hydroponic systems are examples of connected agricultural environments.

c) Data analytics, visualization, and management systems.

The Internet of Things in agriculture enables data-driven operations, automation, resources and expense savings, and hitherto unachievable efficiency. However, these benefits are not innovations in agriculture; rather, they are fixes for a sector beset by a number of serious problems.

(ii) Leverage of using IoT in Agriculture

Extremely efficient: Agriculture now functions as a sport. Despite these difficulties, the deteriorating soil, limited acreage, and increasingly unpredictable weather—farmers are expected to increase production to meet demand. Thanks to IoT-enabled agriculture, farmers can check the conditions and products they cultivate in real time. They have fast eyes, the ability to predict issues before they arise, and the knowledge to make well-thought-out decisions on how to avoid them. IoT applications for agriculture include automated components like robotic harvesting, demand-based fertilizing, and watering. (Miles at el 2020)

Expansion: when the world's population reaches nine billion, 70% of people will dwell in cities, predict Miles et al. (2020). Shortened food supply chains are also made possible by IoT-based greenhouses and hydroponic systems, which should produce fresh fruits and vegetables for human consumption. Thanks to modern closed-cycle agricultural technology, food can now be produced in supermarkets, on building walls and on top of roofs, in shipping containers, and, of course, in people's comfortable homes.

Resources are in short supply: IoT solutions for agriculture aim to use land, electricity, and water resources as effectively as possible. Precision farming enables farmers to precisely apply the right amount of nutrients to a single plant by using data gathered from a range of sensors in the field.

Hygienic Procedure: One tried-and-true way to cut back on pesticide and fertilizer use is through smart farming using IoT. Precision farming significantly reduces the need for pesticides and fertilizers while also saving energy and water and making farming more environmentally friendly. When using this technology instead of typical farming practices, the final product is more organic and leaner. (Priya and Sudha, 2021)

Agility: Using IoT in agriculture has several advantages, one of which is increased operational flexibility. Farmers can respond swiftly to any notable changes in the weather, humidity, air quality, crop condition, and soil in the field thanks to real-time monitoring and forecasting systems. Professionals in agriculture may now safeguard crops in case of extreme weather changes if they alter this new talent. (Priya and Sudha, 2021)

(iii) Improved quality of production

According to Priya and Sudha (2021), data-driven agriculture helps produce commodities of a higher caliber. Farm mapping, aerial drone monitoring, and crops and soil sensors aid farmers in understanding the complex relationships between crop quality and the environment. Using

connected systems, they can imitate ideal conditions and boost the nutritional value of the commodities.

2.1.3 Role of Institutions in Facilitating Knowledge Sharing

Knowledge is the key and a crucial part needed for an organization to survive, according to Islam et al., (2021), and Alfred et al. (2022). Since knowledge is the foundation for generating economic value and competitive advantage, it has been a crucial organizational resource (Nickerson and Zenger, 2022). Knowledge management has therefore always existed and is crucial to the functioning of every company. Businesses concentrate on the value of their ability and make it distinctive to set their products apart from their rivals (Rafique et al., 2018). The quantity and quality of information at an organization's disposal influences its efficacy and success by fostering collective intelligence, avoiding redundant efforts, enhancing decision- making, promoting continuous learning, driving Innovation, reducing knowledge silos, improving employee engagement and satisfaction lastly staying competitive in the market.

Knowledge Sharing Organizations

World Bank (2020) states that knowledge-sharing organizations grow on their accomplishments and methodically learn from their errors. The World Bank views knowledge as a valuable resource and views its operating experiences as opportunities for staff members and outside partners to learn. Thus, companies that share information can enhance the quality of services provided by both their own and other peer organizations, both domestically and internationally. Nevertheless, groups that share information are created, not born. They must decide to get over the innate obstacles to information exchange. An organization to become knowledge-sharing should practice the habit of knowledge capture, learning, and sharing, involving leadership that supports necessary cultural changes, offers finance, supports governance

structures, and external collaborations. All of these are necessary for a business to become a knowledge-sharing institution.

a) Fundamentals of knowledge sharing in organizations

Linking knowledge to action: Yeboah (2023) notes, "Knowledge today must prove itself in action." Knowledge gains the same value as productivity or goods and becomes an asset for any firm. Businesses that execute with operations as normal but do not engage in constant introspection, learning, course correction, iteration, and application of solution approaches will lag those who use knowledge to change their service delivery. It is through knowledge sharing that knowledge is linked to action through.

(i) The ideal organization

World Bank report of (2020). Describes an ideal organization as an intricate network of individuals working toward a common goal, while using procedures and systems to increase productivity. By dissecting each section of that description, we can better understand why information sharing is necessary. Ideal organization ensures that information is transferred to all levels of the employees to ensure that they perform their task effectively. Businesses need to remember that their most valuable resource is their workforce, and the effectiveness of the company will be mostly figured out by how its employees interact, collaborate to solve issues, and how enthusiastic they are about their work, and how they handle hardship. For workers to be well- versed in their colleagues' ability, information sharing is necessary.

(ii) The people work together toward a shared goal.

Coordination and collaboration are not compromised by the formation of silos in successful companies. However, they bring the many components of the company together and harmonize them, efficiently exchanging operational information across organizational groupings constantly.

Activities with little to no return on investment will be avoided, while successful organizational techniques will be copied by others.

(iii) Processes and systems ease work.

To enable transactions between individuals, organizations need processes, and they create systems to support these activities. Prosperous establishments will not only be concerned with protocols but also with how to carry them out optimally, which needs information exchange. They create procedures and methods that are shared, avoid situations and behaviors that might have unfavorable effects and capitalize on their achievements. Organizations engage with other local or foreign partners and constituents that have valuable information to impart or receive, according to a World Bank report of 2020. Effective companies adopt focused strategies suitable for every level of internal, local, and international organizations and consider carefully how information might flow between them and their external stakeholders.

(b) Practices that Encourage an Internal Knowledge-Sharing Culture

According to Taylor (2024), companies may efficiently transfer information by recruiting intelligent individuals and easing communication between them. Regretfully, it is more difficult to implement the second piece of advice." There are three stages of learning in an organization: individually, through teams of employees, and institutionally, at the organizational level, encompassing the levels of the person, the group, the team, and the organization. Every level makes sure that the organization is learning-infused.

iv) Knowledge Sharing Dilemmas

Organizations face challenges with knowledge-sharing, according to the World Bank (2020); to meet these challenges, they should use the following strategies:

• Accessing vital information where and when needed will help organizations become more productive. Information access speeds up operating procedures and reduces errors.

• Preserve a high standard of institutional repository even if important personnel leave the company.

• Address operational issues by iteratively assessing and scaling up what has been added and what is still lacking.

Common Dilemmas

Some of the conundrums illustrated by Halisha (2021) and include Lack of Trust: Individuals in a team who do not trust each other may be reluctant to offer their thoughts for fear of misappropriation or incorrect credit. Fear of Losing Power: Workers may be reluctant to impart information out of concern that it would make them less valuable or important to the company. Incentives Misalignment: Organizational incentives do not always line up with the dissemination of information. For instance, workers may hoard information to stand out if performance reviews are figured out on individual accomplishments rather than team contributions. Cultural Barriers: Knowledge sharing may be discouraged by a corporate culture that is competitive or isolated. Conversely, it can be fostered by a collaborative culture.

To solve these problems, a welcoming atmosphere where exchanging information is valued and encouraged must be proved. Restructuring incentives, building trust, and encouraging a collaborative culture are a few examples of how to overcome knowledge-sharing dilemmas.

Table 1.1: Summary of Characteristics and Indicators of Knowledge-sharing Organizations and Traditional Organizations

characteristic	Traditional Organization	Knowledge-sharing organization
Leadership Behavior	In many organizations, senior management tends to perceive knowledge sharing as primarily the responsibility of the communication and IT departments. Decisions are often communicated to staff without adequate explanation, and employees are rarely provided with opportunities to contribute through sharing their own experiences or insights.	Senior management can model effective knowledge sharing by engaging in open communication, organizing participatory meetings, and sharing relevant experiences and insights with staff.
Recognition	The organization perceives knowledge sharing as distinct from its core operational activities.	The organization recognizes knowledge sharing as a critical behavior that enhances performance and supports the achievement of core business objectives.
Systems And Process	Organization provides only limited means for knowledge sharing to happen.	Systems, platforms, and processes that ease systematic knowledge sharing

		are actively used by members of the organization.
Collaborations	Collaboration among individuals and teams is not actively encouraged or supported.	Teams are rewarded for collaboration that leads to faster or better results.
Governance	Roles and responsibilities for knowledge sharing have not been clearly defined, and knowledge-sharing activities are often perceived as the responsibility of only a few individuals in the IT or learning departments.	Clear roles and responsibilities have been proved across the organization for critical tasks related to knowledge capture, storage, and sharing, fostering a culture in which knowledge sharing is recognized as everyone's responsibility.
Skills	The organization has no time to show, capture, store and share operationally relevant experiences and lessons learned.	The organization has the necessary technical skills to support essential knowledge-sharing functions. Tools for finding, capturing, storing, and issuing knowledge are widely used across all levels of the organization.

Financing	The organization has not developed a dedicated budget for knowledge sharing	The organization budget for knowledge sharing.
Networks and Partnership	The organization does not see partners and networks as a valuable source of knowledge to improve its operations.	The organization uses knowledge sharing networks and partnerships to improve its operations.
Systematic Capturing	The members of the organization do not systematically document experiences and lessons learned.	Members of the organization actively contribute to the knowledge repository by regularly sharing their experiences and lessons learned.
Accessibility	Knowledge and how to give guidance is difficult to find in the organization.	Knowledge needed by members of the organization is made easily and readily available in a just-in-time, just-when-needed and just -where needed manner.
Learning	Predominantly lecture based training is the primary format for learning offering in the organization. The content of learning offerings is generic, not customized.	Participatory offerings engage the learners through a variety of action-oriented activities. The content is customized to the specific needs of the learners.

Opportunities	The organization has not developed formal spaces for knowledge sharing and relies on informal knowledge sharing to happen when and where needed.	The organization provides time and dedicated physical or virtual spaces for engaging in knowledge sharing, such as through organized events. Informal knowledge sharing is also encouraged, eased by open office layouts, collaborative architecture, and extracurricular activities.
Measuring Results	The organization does not check or evaluate its knowledge sharing.	.Knowledge capture and sharing activities are continuously checked and evaluated to enhance the quality of outcomes and ensure their operational relevance.

Source: World Bank (2020)

2.1.4 Financial Support Initiatives

Adegbite at el (2020) states that an organization's commitment to knowledge sharing may be decided by looking at its budget for knowledge and learning. It shows that senior management is prepared to make investments in its employees and the company's overall knowledge and learning capacities. Staff members may conclude that knowledge sharing is not worth the effort if funding for knowledge and learning is not distributed. Without foundational support, creative concepts and methods might easily fade into obscurity. A knowledge-sharing organization should always include some internal money for the program, but it can also supplement its budget with outside funding sources. Some of the financial support initiatives for knowledge sharing include:

(a) Developing a Budget

Although knowledge exchange is a low-cost activity, planning and execution nevertheless come at a substantial expense. When launching a knowledge-sharing program, a company must provide cash for technology, content creation, event facilitation, travel, communications, and training, as well as reallocate staff time or recruit added employees to oversee it. "Managers must make organizational learning an activity of central, strategic importance in the organization's agenda as one way of achieving institute organizational learning mechanisms and appropriating the necessary resources for their proper operation," as Lipshitz, Friedman, and Popper (2022) put it. This is necessary for organizational learning to take hold.

The ability to utilize resources efficiently and sustainably is a crucial part. By incorporating the wise use of technology into essential activities, knowledge-sharing expenses may be reduced. The most expensive part will always be labor. As with staff training or information technology, knowledge management and sharing are recognized by successful firms as typical components of central overhead investments.

Fundamental factors that cause costs for knowledge sharing to vary significantly are the organization's size and goals, the number and location of staff members involved, the staff capacities required, the infrastructure that needs to be developed, the choice of instruments and modalities for sharing knowledge, and the length and frequency of the activities. The amount of funds needed for efficient knowledge exchange must be figured out by weighing trade-offs. For instance, in-person communication is usually the best kind of cooperation, but small businesses may not be able to afford it.

(b) Sources of Financing

(i) Central Budget

Paramati et al. (2018) often, the central budget serves as the first source of funding for essential knowledge-sharing expenses. The yearly central budgeting procedure should incorporate the projected expenses for the infrastructure and operations of technical knowledge management each year. An organization's central budget usually provides more help when it launches its knowledge-sharing initiative. One benefit of central financing and coordination is that it lessens the possibility of fragmented investments, which may happen when several departments use money that were originally intended for different goals to undertake separate knowledge- sharing programs. Uncoordinated expenditures in databases, webpages, and other IT systems are particularly inefficient. Nonetheless, increased support is shown when department heads incorporate a provision for knowledge exchange as part of their share of the central budget. “To encourage knowledge sharing, the companies distribute funds as follows.

•The online platform is sponsored by the IT department, whilst the HR budget supports the agency's core knowledge-management support personnel. The funding for the theme network community managers and associated events, such as the exchange.

•While various departments seek project funding and construct separate websites to fulfill their demands for cooperation, a centrally funded intranet is set up.

•Technology platforms are primarily funded by a central knowledge-sharing unit, which also gives limited seed financing to start themed communities of practice. The proper department bears the cost of staff participation, including webinars and travel expenses.

Centralized planning and control will be necessary to prevent unnecessary duplication that may result from random attempts to issue information across the business, even while departmental money can be distributed differently. Numerous groups are experimenting with various funding sources, such as multiyear initiatives, donor monies, and grants from the government (Pan et al., 2021). A lot of institutions also give attention to non-traditional PPPs, co-financing plans, membership fees, and knowledge-sharing programs that generate revenue. If organizations want to ensure that finance reaches the required scale and quality, they need to have strong capabilities for financial programming, execution, and accountability. **(ii)External cooperation funds and grants**

A company may often increase its investment in IT infrastructure and knowledge exchange by securing financing from both domestic and foreign sources. Through the development of new capacity in staff members' specialized skills and technological infrastructure, the organization will be able to support future increases in knowledge exchange at a cheaper cost. For instance, a one-time payment from a private foundation may cover the cost of a multi-year online platform for cooperation.

(c) Partnerships for Financing

Through networks, institutions such as universities, private sector businesses, and peer groups often collaborate on knowledge-sharing projects. An organization may access an increasing

number of cooperation possibilities by packaging and sharing its knowledge. In contrast to direct funding, partnerships are more likely to provide matching finances, manpower, infrastructure, or content to a joint effort. Corporate partners can offer technology, technical services, or housing; universities can offer meeting spaces, help with research, or support with content packaging. These contributions raise the amount of money available for other employees and activities by lowering the demands on the internal budget.

(d) Cost recovery

Matthew et al. (2019) an appealing strategy to raise more money for a knowledge-sharing program might be service agreements or sponsorships from outside organizations looking for knowledge-sharing goods and services. While most public sector organizations might not be able to implement this finance model, those whose legal structure allows it may find that a cost-recovery or fee-for-service strategy aligns with the institution's goals.

2.1.5 Integrated Model for Assessing Knowledge-Sharing Dynamics

According to Sawan and Hikman (2021), knowledge sharing does not happen in a vacuum, but organizational, technological, and human factors influence it. The study poses an empirically addressed issue of how social networks, information communication technology, existing institutions, and financial support initiatives influence knowledge sharing in the communities of practice. The researchers developed an integrated model for assessing knowledge-sharing dynamics in organizations and communities of practice to ensure information flows from institutions to seekers or searchers. For knowledge sharing to be enabled, the following should be key: Leadership and culture, systems and Governance structures, Budget and Financing, preserving knowledge, Partnerships, and Validation.

(i) **Leadership and Culture**

Almulhim, (2024) Leadership and culture are the most influential factors used in shaping effective knowledge sharing. They figure out not only whether knowledge is shared but also how and why individuals are motivated to share what they know. Leaders should encourage cooperation on information-sharing throughout the business to foster a strong culture of knowledge-sharing, this is because knowledge sharing is a fundamental process through which organizations use their intellectual capital to enhance innovation, performance, and learning.

Leadership and Knowledge Sharing

According to Aboramadan and Karatepe, (2021) Leadership plays a key role in setting up conditions that encourage knowledge exchange. Leadership styles like Transformational, ethical, and digital leadership styles are known styles for fostering effective knowledge sharing environment. Aboramadan and Karatepe, (2021) said that leaders should be ethical in there operations, where ethics includes virtues like acting with integrity, fairness, and concern for their followers. This boosts knowledge sharing significantly through embracing knowledge-sharing behaviors by building trust and identification within teams. Similarly, transformational leaders inspire employees to go beyond self-interest, creating a sense of shared purpose that motivates knowledge exchange (Pham et al., 2023).

Recent research by Aslam et al. (2025) highlights the importance of leadership in the modern workplace. The research emphasized the effectiveness of digital leadership, which integrates technological skills with strategic vision, leading to digital readiness and open communication, and also enabling knowledge sharing across physical and virtual spaces. Another research by Kim and Lee (2025) concluded that transactional leadership is based on reward and punishment, shown to have indirect effects on knowledge sharing, through its

influence on human capital development. Hence, leadership that combines ethical behavior, vision, and empowerment appears most effective in cultivating a knowledge-sharing culture.

Organizational Culture and Knowledge Sharing

While leadership sets the tone, culture provides the context within which knowledge sharing occurs. Muneer et al., (2024) states that a supportive culture is one characterized by trust, openness, collaboration, and learning orientation. This culture encourages employees to exchange both explicit and tacit knowledge without fear of exploitation or criticism. Conversely, rigid, hierarchical, or blame-oriented cultures create barriers that inhibit communication and knowledge flow (Mutisya and Njenga, 2024).

Banda and Singh, (2024) in their research found that organizational culture affects knowledge retention, Study in public sector organizations showed that a positive culture promotes not only knowledge sharing but also knowledge retention and transfer among employees.

Moreover, in knowledge intensive industries, culture mediates the relationship between leadership and knowledge performance outcomes, highlighting its significant role in sustaining long-term knowledge management (Almulhim, 2024).

The Interaction Between Leadership and Culture

Leadership and culture are interdependent. Leaders dictate culture through their behavior, communication, and decision-making. When leaders prove transparency, recognize contributions, and reward sharing behaviors, they help embed a culture of collaboration (Atlassian, 2024). Over time, this culture reinforces itself, creating an environment were knowledge flows freely across teams and departments. In contrast, if leaders hoard information or discourage open dialogue, they can inadvertently reinforce cultures of secrecy and competition (Muneer et al., 2024). affecting flow of knowledge sharing.

Implications for Organizations

Kim and Lee, (2025) To promote effective knowledge sharing, organizations must develop both leadership capabilities and cultural enablers. Leaders should prove openness, model sharing behaviors, and align incentives with collaborative goals. Organizations should also invest in platforms and processes that make sharing easy and safe. Establishing psychological safety where employees feel secure to share ideas and mistakes is especially vital for tacit knowledge exchange. When right leadership and culture are in place, knowledge sharing becomes not a forced activity but a natural part of how work done.

Leadership and culture are mutually reinforcing pillars of effective knowledge sharing. Leadership sets the direction and example, while culture sustains the behaviors and values that make knowledge exchange possible. Organizations that cultivate ethical, transformational, and digital leadership within a culture of trust and collaboration are more equipped to use collective intelligence for innovation and long-term success.

(ii) Governance Structures and System

Al Qassim and Ahmad (2023). Effective knowledge sharing is not only a product of leadership and culture but of the governance structures and systems that enable, check, and sustain knowledge flows within an organization. Governance in this context refers to the frameworks, rules, roles, and technological systems that guide how information and knowledge are created, shared, and used. These structures and systems ensure that knowledge management aligns with organizational strategy, accountability, and performance aims.

Governance Structures and Knowledge Sharing

Governance structures figure out the decision makers, responsibilities distribution, and the mechanisms in place to support collaboration and transparency. A well-designed governance framework promotes openness, accountability, and coordination across units all essential for effective knowledge sharing (Razmerita et al., 2024).For instance, organizations that establish knowledge governance committees or communities of practice create formal pathways for employees to exchange insights, solve problems collaboratively, and ensure that critical knowledge is captured systematically (Ali et al., 2022). These structures clarify roles in knowledge ownership and prevent duplication or loss of valuable knowledge.

Centralized governance ensures consistency in knowledge policies, while decentralized or hybrid structures promote flexibility and responsiveness. Decentralized systems allow local units to share domain-specific knowledge while adhering to overarching standards set by the central governance body (Al Qassim and Ahmad, 2023). The balance between standardization and autonomy is critical: too much control stifles innovation, while too little results in fragmentation and information silos.

Moreover, governance frameworks that embed transparency and accountability enhance trust, which is a prerequisite for knowledge sharing (Nguyen et al., 2024). In contrast, poorly defined governance structures can create ambiguity and power imbalances that discourage employees from contributing knowledge.

Systems Supporting Knowledge Sharing

Alongside governance structures, information systems and technologies play an instrumental role in easing knowledge exchange. Knowledge management systems (KMS), intranets, collaboration platforms, and enterprise social networks provide the infrastructure that

supports documentation, retrieval, and dissemination of organizational knowledge (Al-Kurdi et al., 2024). For example, cloud-based platforms such as Microsoft Teams, Slack, or Confluence enable synchronous and asynchronous communication, reducing geographical and functional barriers (Atlassian, 2024). When the systems are integrated into governance processes through clear policies on data quality, access rights, and privacy, they create a secure yet open environment for sharing.

Ali et al. (2022) add that governance ensures that all the governance systems are effectively used for example, Policies governing data classification, version control, and access management keep the integrity and reliability of shared knowledge. Research by Nguyen et al. (2024 shows that governance systems with defined standards, metrics, and audits for knowledge management enhance organizational learning and performance. Some systems, like technological governance including digital ethics, cybersecurity, and compliance, reinforce trust in the systems used for sharing knowledge. Employees are more likely to engage in knowledge sharing when they trust that the system protects their intellectual contributions (Nguyen et al., 2024).

Integrating Governance, Systems, and Culture

Governance structures and systems must run in harmony with leadership and culture to fully support knowledge sharing. Governance offers formal control mechanisms, while culture and leadership supply the informal enabling factors, such as trust, motivation, and openness. An integrative governance model, one that combines policy with participative decision-making, encourages both compliance and voluntary sharing (Al-Kurdi et al., 2024).

Razmerita et al. (2024) support that governance and structures integrated by leadership and cultures enhance knowledge sharing by concluding organizations that implement knowledge.

governance frameworks aligned with their strategic goals see higher levels of knowledge reuse and innovation These frameworks define not only who owns knowledge but also how it should be shared, stored, and rewarded.

Governance structures and systems are vital enablers of knowledge sharing. Clear governance defines accountability, roles, and policies, while robust systems provide the technological infrastructure to capture and distribute knowledge. Together, they ensure that knowledge sharing is not left to chance but is incorporated in the organization's formal architecture. When integrated with supportive leadership and culture, effective governance transforms knowledge sharing from an ad hoc activity into a sustained organizational capability.

(iii) Budget and Financing

Knowledge sharing is essential for organizational learning, innovation, and long-term competitiveness. However, the effectiveness of knowledge sharing does not depend only on leadership, culture, and governance and structures but also relies on the availability of financial resources and budgetary support. Budget and financing mechanisms decide whether organizations can invest in the tools, training, incentives, and systems that make knowledge sharing possible and sustainable (Nugroho et al., 2023). Without adequate funding, even the best- designed knowledge management strategies stay theoretical. Ashikuzzaman (2024) states that an organization's commitment to knowledge sharing may be decided by its budget for knowledge and learning. It shows that senior management is prepared to make investments in its employees and the company's overall knowledge and learning capacities.

Financial Investment as an Enabler of Knowledge Sharing

Budget allocations directly affect an organization's ability to implement knowledge management infrastructure. Financial resources are needed for acquiring and maintaining

knowledge-sharing systems such as intranets, knowledge repositories, databases, and collaboration platforms (Al-Kurdi et al., 2024). These technologies facilitate the collection, storage, and dissemination of both explicit and tacit knowledge. For instance, investing in digital platforms like SharePoint or Confluence can enhance communication and knowledge flow across departments, reducing duplication of effort (Atlassian, 2024).

Beyond technology, financial support is needed to fund training and capacity building initiatives. Employees require the skills to use digital tools effectively and to understand the value of knowledge sharing in their roles (Nugroho et al., 2023). Training budgets enable workshops, mentoring programs, and communities of practice, all of which strengthen an organization's knowledge-sharing culture.

Incentives and Reward Systems

Budgeting also allows organizations to design incentive mechanisms that encourage knowledge sharing behaviors. Employees are more likely to share expertise when they perceive that such behavior is recognized and rewarded (Kaba and Rama, 2022). Financial incentives such as bonuses, awards, or performance-linked pay can be tied to measurable knowledge-sharing activities, like contributions to knowledge databases or institutional repositories and mentoring junior staff.

Research by (Cheng and Wu, 2023) shows that non-financial rewards, supported by adequate budget allocations (e.g., career advancement, recognition programs), can be equally effective in sustaining long-term motivation Therefore, organizations should allocate budget not only for direct monetary rewards but also for designing holistic recognition systems that reinforce collaboration and trust.

Budgeting for Knowledge Governance and Evaluation

A well-structured knowledge management budget should also include provisions for monitoring, evaluation, and continuous improvement. Funding supports the measurement of knowledge-sharing performance through surveys, analytics, and audits. According to Al Qassim and Ahmad (2023), organizations that regularly evaluate their knowledge-sharing initiatives using structured performance indicators achieve better knowledge retention and innovation outcomes. Budgeting also supports governance mechanisms, ensuring compliance, data integrity, and accountability in knowledge-sharing systems. Allocating funds for data protection, cybersecurity, and system maintenance builds employee trust in the reliability and safety of shared information (Nguyen et al., 2024).

Strategic Financing for Sustainability

Knowledge sharing is not a one-time project but a continuous strategic process. Sustainable financing ensures that knowledge management systems evolve with organizational needs and technological advancements. Flexible budgets allow organizations to upgrade systems, integrate artificial intelligence tools, and respond to emerging opportunities in digital collaboration (Razmerita et al., 2024).

Furthermore, cross-departmental funding can promote collaborative projects where different units co-invest in shared knowledge platforms, reducing duplication and increasing efficiency. This financial alignment reinforces a collective approach to learning and innovation.

(iv) Partnership

Any business operating in an increasingly complex environment must form partnerships to remain competitive and innovative. Some firms choose to focus on global alliances, leveraging

international relationships to gain exposure to industry best practices and access to modern technologies (Uzoka et al., 2024). Others prioritize domestic collaborations, often with educational institutions or research organizations, to scale proven solutions locally (Okonofua et al., 2025). A third collaboration strategy emphasizes securing funding, where public–private partnerships or R&D consortia provide financial resources for innovation and development. Such partnerships support knowledge acquisition, peer review, and joint research and development, thereby accelerating learning and innovation (Widjaya, 2024; Tech4Biz, 2024; Frontiers, 2022).

Benefits of partnership

Widjaya, (2024) Expanded skills base- through partnerships, companies may have access to a wider range and deeper level of knowledge than they could create themselves. Partnerships allow the organization to increase its force since they give such access on a regular and systematic basis. Capacity development- Partnerships improve the organization's technical proficiency and performance. Through staff learning and increased capability to provide high-quality services on a larger scale, collaboration builds capacity both at the individual and organizational levels.

Innovation- Through partnerships, people are exposed to fresh perspectives, which may lead to creative solutions. Deep down, partnerships provide the openness and trust that are the best conditions for finding and modifying novel methods, strategies, and approaches.

Adaptation- Organizations may respond quickly to changing situations when they have partnerships. Complicated problems, like those brought on by climate change, cannot be handled on alone; rather, one must work with others' skills to collaborate, learn, and adapt.

Financing - Certain collaborations are established to boost funding. Most partnerships in developing nations are created by national organizations and foreign donors. State money may be available for domestic collaborations, which can improve information exchange.

(v) Preserving knowledge.

Mthunzi (2024). This is the process of building knowledge resources, or repositories. It is important to examine the advantages that come to businesses when they gather and store operational information. Knowledge should be kept in a way that makes it easily available and retrievable, and knowledge transfer should occur directly between the knowledge provider and the knowledge seeker. ScienceDirect knowledge transmission enables more in-depth conversations and investigation of topics that would not have been part of a paper; it is often more successful than indirect information transfer. On the other hand, the supplier and the seeker may not be acquainted with or may not be available simultaneously.

Babagana, and Kemboi, (2024) Knowledge that has been documented is always accessible, even when specialists are not present, and it has several advantages which consist of keeping important staff workers' experience information from evaporating, accelerating and improving decision-making, particularly by preventing mistakes from being made again, creating distinctive materials for employee training initiatives, creating exclusive materials for external information exchange. Knowledge sharing consists of key steps which include Identifying, capturing, validating, formatting, and translating for learning, which should all be built as part of the organizational management culture.

Nyathi, et al. (2023) Capturing is obtaining information at the appropriate moment, and location is known as knowledge capture, it is crucial for getting past obstacles and making better decisions. Because there is probably a lot of knowledge maintained within business, it is of immense importance to know the proper knowledge for the right usage. Since explicit knowledge is already available in books, reports, case studies, and articles, it is not the focus of information capture.

Organizations ought to focus instead on documenting the experiences of those who are involved with the organization. To put it another way, to record implicit or experienced knowledge.

Organizations must carefully consider their options due to limited resources. It is unrealistic to use an encyclopedic approach, in part because trying to distill lessons from everything that has been done would significantly diminish productivity. Selectivity is essential because, in most cases, each knowledge asset that is collected needs to be maintained and updated, and even then, its lifespan is frequently short. However, how we can choose the essential knowledge is still a mystery. Practitioners can decide whether to record a specific lesson learnt from an encounter or incident by using a clear set of criteria. The American Productivity and Quality Center (APQC 2023) states that the most often utilized criteria are the prospective knowledge asset's alignment with organizational strategy and the difficulty of replacing lost knowledge.

The potential knowledge resource should be relevant, focused, shareable, easy to capture or document, easy to validate, and not at risk of being lost. Evaluating the State of Knowledge in an Organization Systematically Organizations need to devise strategies for methodically recognizing new and existing knowledge, even with these requirements in mind. Peer-assisted learning, social network analysis, knowledge audits, white pages, and knowledge gaps are among the requirements.

Validating knowledge assets may be done in several ways, such as through group examination, real-world testing, comparison with validation criteria, and confirmation with the original authors or experts. The validation structures can use one or more of these techniques. Assessing the knowledge asset in practice. In summary, if all these steps of knowledge preservation is put in place, knowledge will be easily available for application and for posterity reasons.

2.2 Theoretical Frameworks

The theoretical framework serves as a study's basis and main source of support. It is the investigation's blueprint. It offers the structure necessary to understand an investigator's thorough investigation of a subject from the perspectives of analysis, technique, philosophy, and epistemology. The purpose of a theoretical framework, according to Adom et al. (2016), is to ensure generalizability and that research findings are appropriate and related to the theoretical concepts in the field of study. A theoretical framework may have ideas and definitions from the theory that are pertinent to the research issue, together with one or more theories that support the researcher's thinking on the topic of study (Osanloo and Grant, 2019).

Several theories and models, such as Bourdieu's Social Capital Theory (SCT) and George Hormans' Social Exchange Theory (SET), both developed in 1986, provide support for knowledge-sharing studies. The knowledge-sharing model was developed by Cheng, Ho, and Lau in the year 2009, the Organizational Knowledge Creation Theory (OKCT) was developed by Nonaka and Takeuchi, and the Adaptive Structural Theory (AST) was produced by Harborer 2011 Miscott Poole.

2.2.1 Social Exchange Theory

George Homans, a sociologist, first proposed the SET in 1958. It was then expanded upon by Blau and Emerson (1976), who built it into a theory. SET uses the core ideas of contemporary economics as a basis for studying how relationships and human behavior affect the complexity of social structures. Human behavior analysis was the purpose behind the development of SET (Homans, 1958, as stated by Davlembayeva and Alamanos, 2023. Later, Blau used the idea to comprehend organizational behavior. One popular framework for examining a person's knowledge-sharing behavior is the application of SET.

Individuals engage in social interactions based on a self-interest appraisal of the advantages and disadvantages of those interactions, according to SET (Thibaut & Kelley, 2017). Within the context of organizations, SET highlights the importance of formal inter-organizational interchange behavior and norms, particularly those related to social institutions. According to SET, people and organizations work together to maximize benefits and reduce expenses. Furthermore, people establish social connections to share resources and services with others and to optimize advantages (Wang and Liu, 2019) One of the most important theories for comprehending workplace behavior is social exchange theory (SET). Behavior is commonplace and affects every element of our daily lives. Exchanges occur in social contexts as well as in corporations.

Three components comprise the SET, as stated by Cropanzano et al. (2017): (i) the actor approaches the target, (ii) the target reacts with a similar demeanor or action, and (iii) the connection that develops. In today's business, both environment and relationships are becoming more complex (Chernyak-Hai and Rabenu, 2018). Therefore, because of the growing complexity of human behavior and business activities, it is essential to recondition SET (Cooper and Morrison, 2019). SET emphasizes the significance of norms within the context of an organization, especially those seen in formal inter-organizational trading conduct and social institutions. Following SET, individuals and groups collaborate to optimize gains and minimize costs. Additionally, people form social bonds with others to fully share resources and services and profit from them possible. (Cropanzano at el 2017).

Two ideas that are fundamental to the SET are marginal utility and indifference curves, Blau (2017). Marginal utility is the profit or loss resulting from changing how much an item or service is used. The interactions between two people in an extrinsic trade are described by the idea of "indifference curves" (supply and demand). Blau distinguishes between three distinct kinds of

expectations regarding indifference curves: comparative, special, and general. The roles that people play are linked to the prevailing expectations.

In contrast, Comparative expectations are related with rewards received from a particular person, while comparative expectations are the rewards of a relationship minus the benefits of maintaining the relationship (Blau, 2017). Additionally, trust, commitment, and social interactions are of immense value for the social exchange process as indicated by Blau. In connection with the assumptions of social exchange theory in the present study, the theory suggests that individuals engage in exchanges with the expectation of reciprocity. In the context of knowledge sharing, this means people are more likely to share information when they anticipate receiving something in return. For instance, farmers within a community might exchange expertise, advice, or insights with the expectation that their contributions will be reciprocated, leading to a mutually beneficial relationship.

In connection with the study, SET also implies the cost and benefits of Sharing Knowledge. The benefits include Social Capital, reciprocity, and learning and growth where Sharing knowledge strengthens relationships and builds trust, having the expectation that the community will reciprocate; by sharing knowledge, individuals learn from others and expand their understanding. Social capital to the networks, relationships, and trust that is in existence within a community, organization, or group of individuals.

Social capital helps the communities through enhancing access to resources thus individuals with strong social capital can tap into a wider range of resources like information, opportunities, and financial support. Social capital also enables collective action; this is achieved when people trust each other and work together, leading to achieving common goals like development, and sustainable practices. Social capital also in the SET theory says reduced transaction costs enabled through trust and

shared norms leading to smoother collaboration and less friction when seeking or providing information.

Davlembayeva et al (2020) social exchange theory advocates trust and commitment in the organization. Trust is a crucial factor in knowledge sharing. When individuals trust that their contributions will not be misused or undervalued, they are more likely to share Commitment to the collective goals of a group or organization. Strong commitment fosters a culture of collaboration. According to theory, the impacts of commitment to knowledge sharing include motivation where committed individuals actively take part in knowledge sharing because they feel invested in the collective success.

a) Strength and application of the SET Theory

The theory's strength is its empirical support, which is generated from various knowledge-sharing studies. Social interaction and trust are drawn from the social exchange theory to promote individual knowledge sharing. Social exchange theory is a comprehensive framework, fitting many micro and macro-sociological theories. The generic conceptualization of relations within communities enables the theory to explain almost any reasonable finding about the pattern of behavior (Cropanzano et al., 2017).

Organizational commitment, trust, and commitment foster individual knowledge sharing and the intention to share knowledge. (Cropanzano et al., 2017) indicated that dedication, mutual communication, and trust within SET are crucial components of knowledge-sharing. Davlembayeva, at el, 2022). assessed the reciprocity norm as a belief in fair exchange. A great deal of empirical evidence has provided support for the principle of the theory that the expectation of reciprocity drives individuals' engagement in relations.

Gaps in the SET Theory

The theory lacks accuracy and consistency in terminology. Blau's original works in 2017 referred to social and economic exchanges as transactions and not relationships, like mainstream literature. Despite attempts to clarify the difference between relationship and exchange, there is still a need to define whether an exchange is a type of relationship, a transaction that leads to a relationship, or vice versa (Cropanzano and Mitchell, 2017). For instance, a prior relationship between parties can affect the exchange, and the exchange can contribute to the development of continued relationships. This debate has not been resolved to date, as scholars use the terms (transaction, and relations) interchangeably (Mora Cortez and Johnston, 2020; Davlembayeva, Papagiannidis and Alamanos, 2020; Davlembayeva, Papagiannidis and Alamanos, 2021).

The fourth limitation concerns the operationalization and the taxonomy of concepts. Although a vast number of empirical studies have measured the underpinnings and the outcomes of interpersonal relations (Davlembayeva, at el 2020), the literature still stands for behavior or social actors in too simplistic a way. Specifically, researchers differentiated the concept of positive and negative actions without a critical understanding of how the valence of action is defined (Cropanzano et al., 2017). As a result, the need to use broad standards for evaluating the deviance of behavior that can be useful in finding out the value of social exchange constructs was questioned. Another issue is the simplicity of presenting the structure of reciprocity. Reciprocity constructs fall into opposite categories – negative and positive. The logic behind this categorization is that the absence of a positive event (e.g., supportive behavior) equates to a negative event (e.g., abusive behavior). However, this representation is unidimensional. It does not consider the activity dimension, which can be used to differentiate actively showed positive/negative behavior from.

2.2.2 Social Capital Theory

Kehinde, et al (2021) and Rivera et al. (2020) every kind of group, from clubs to communities to every other type in between, has social capital. The critical significance that several experts have revealed plays in integrated rural development initiatives. Religion and social capital can be built to address the difficulties faced by rural economies to improve their livelihoods and prosperity, according to research by Junaidi and Lefebvre et al. (2022) and Rivera et al. (2019). Relationships between people who have certain things in common are facilitated by social capital, which makes it easier for society to function in three areas: relational, cognitive, and structural.

Structural Social Capital

Ganguly et al (2019) Structural social capital is a dimension of social capital that describes the network of relationships between people or units. It is a theoretical approach that explains how individuals, groups, and organizations access knowledge resources and manage relationships. In the context of knowledge sharing, structural social capital can be important because it provides access to people and resources that are needed to share knowledge.

Structural Social capital refers to communication and social engagement, which builds up the need to access resources through social interaction ties. Ganguly et al (2019) Social interaction serves as a conduit of knowledge sharing in the structure-function. Language sharing and vision sharing are two dimensions of cognitive and social capital, including values, attitudes, beliefs, and perceptions of support. The structure of links and social interactions among the network's actors is referred to as the structural dimension. Social interaction linkages are a conduit through which information and resources move. The contacts are characterized by duration, proximity, and reciprocal services. According to this study, social interaction between farmers and agricultural extension agents is essential for fostering information exchange.

Relational Dimension

According to Paul 2007 and cited by Claridge (2018) the personal relationships that individuals have cultivated over time because of their contact reciprocating with one another make up the relational dimension of social capital theory. Moreover, the relational dimension encompasses assets that are created and can be beneficial through trust, the norm of reciprocity, and identification. According to the relational dimension, friendship, reciprocity, and respect allow participants to influence one another's conduct. According to Claridge (2018), the relationship also characterizes the level of trust that results from social engagement, reciprocity, and identification. As a result, the relational dimension views identification, reciprocity, and trust as crucial components of the exchange of social capital between people. People form connections with one another to socialize and take advantage of social possibilities. They favor other social resources, including knowledge sharing on social media, since they trust one another.

(i) Trust

Trust is a collection of values that are mostly concerned with being truthful, kind, and letting partners interact socially. Additionally, it limits the social complexity associated with the other party's potential future actions. According to Andersson and Liljenberg (2020) to social capital theory, trust is a vital part of capital transactions. Individuals' trust in an institution is regarded as an exchange of intellectual capital. Trust is also seen as a way of creating organizational value; it plays a significant role in information exchange in online environments. Trust plays a crucial role in sharing information within virtual communities, achieved through encouraging individual sharing. In a similar vein, (Grootenboer 2018), the role of trust is motivating, facilitating, and sustaining development.

Interpersonal trust fosters a culture of information sharing among communities and organizations. Relationship exchange is facilitated by trust, and relationship exchange promotes the

interchange of high-quality knowledge. Norms and trust are significant sources of social capital in addition to the network of contacts. Consequently, trust is associated with positive quality and quantity of knowledge sharing in the communities.

(i) Reciprocity

Kumar at el (2020) describes the norm of reciprocity as a knowledge exchange that is mutual and perceived by the actors as fair. reciprocity as positive feedback, subject to rewarding reactions from others and that ends when these expected reactions are not cooperative. Reciprocity motivates knowledge sharing among actors.

(ii) Identification

People identify themselves as related to a person or a group through the identification process, as noted by Tsounis et al., (2023). Identification is a resource that influences how beneficial knowledge sharing is perceived. Identification emphasizes the willingness to continue participating actively in the network and encompasses a sense of belonging and favorable feelings toward a social network. People typically wait to impart knowledge until they are accepted as fellow members of the group. Therefore, identifying communities of practice is crucial to encouraging a mindset of information sharing.

People in a community with a social network would effectively exchange their ability. Identification and information sharing were found to be positively correlated in the study. Tomlinson and Anderson's (2021) identification in social capital theory supports people in keeping their promise to exchange resources. claim that identification is a resource that influences people's motivation to pool and share knowledge among themselves and with management.

Cognitive Dimension

Weiler et al (2024) cognition is related to the tools, including shared language and vision, which enable the creation of common interpretations and meanings within a network.

(i) Shared Language

People's ability to obtain knowledge is aided by shared language. However, Lőrincz at el (2019) contends that because language codes differ, people are kept apart and are unable to understand one another. Lesser and Storck add that common language is more than just words; it also includes abbreviations and underlying presumptions that are commonplace in day-to-day encounters.

Shared language affects the conditions for the combination and exchange of intellectual capital in several ways, including making it easier for partners to obtain knowledge, Additionally, it offers a standard conceptual framework for assessing the potential advantages of combination and exchange. People can pool their social exchange knowledge and share it with others when they speak the same language. In this way shared language helps communication which leads to understanding shared ideas.

Language sharing is therefore crucial to easing knowledge sharing amongst people, particularly in settings where languages are spoken. People form relationships, spend time in social contact, and uphold social ties with others through the common language of cognitive and social capital, according to research by Lőrincz et al (2019) To improve their capacity to obtain precise, sufficient, reliable, and timely information, they share knowledge and ask questions in a common language.

(ii) Shared Vision

Shared vision comes when social network members have similar aims and aspirations. Weiler et al (2024) foster shared knowledge of interaction styles and improve chances for resource sharing without misunderstandings. A shared vision symbolizes the aspirations and aims of the community.

Therefore, in the context of this study, shared vision is viewed as a unifying factor that aids in the assimilation of knowledge by farmers and agricultural organizations. Farmers and agricultural authorities with similar visions are thought to be more willing to collaborate on information exchange. Communities of practice are united by common values and objectives because these enable them to collaborate, which promotes sustainable economic growth. A shared vision is essential to this study since it is anticipated to raise awareness of the importance of knowledge sharing for improved agricultural performance in Kenya, and in this case, the county of Makueni.

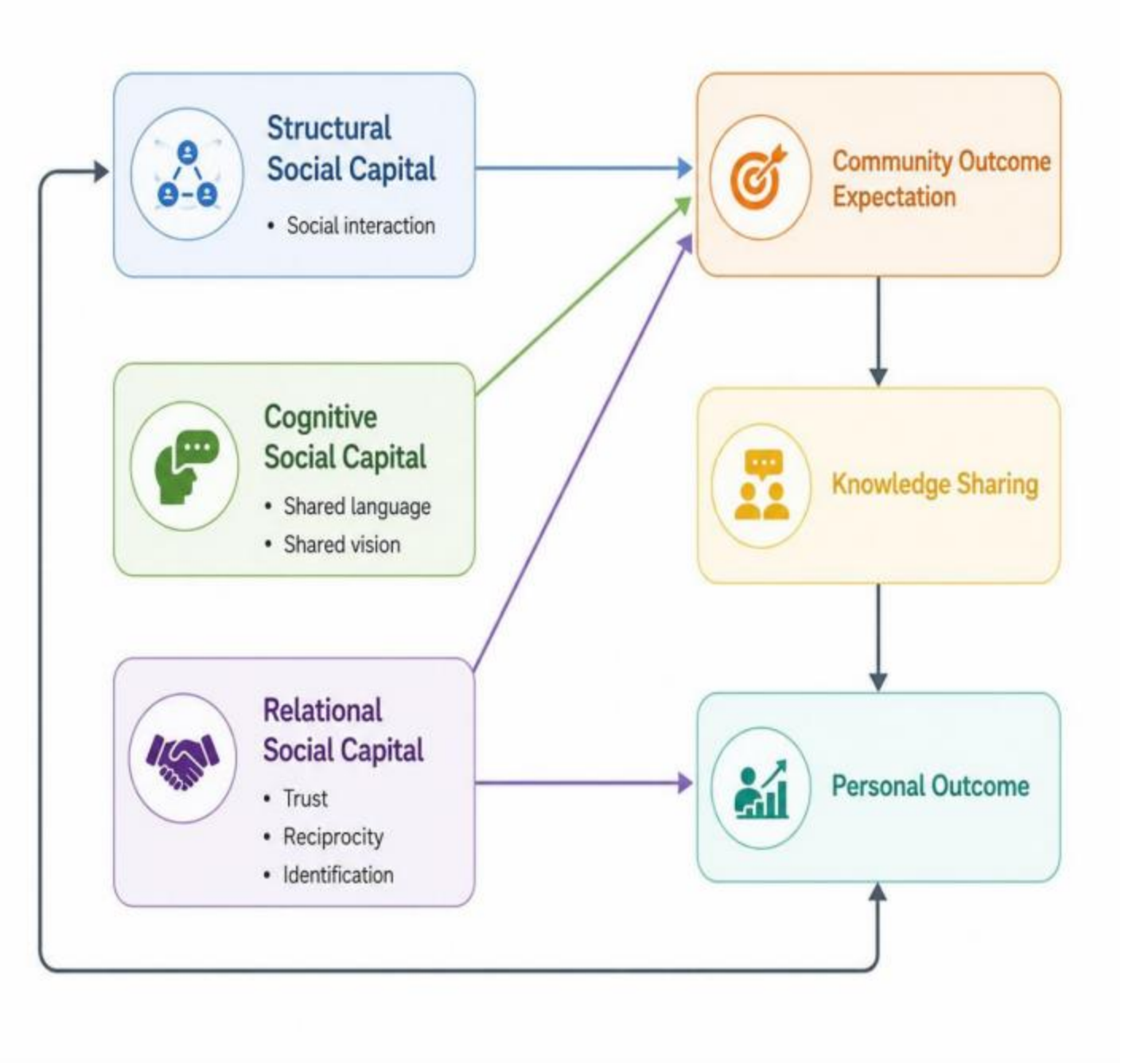


Figure 2.1: Social Capital Theory Framework
Source: Claridge, (2020)

Strength and Application of Social Capital Theory

The Social capital theory considers social interaction ties as channels for information and resource flows. The SCT has three components: social structure, cognitive, and relational. To share knowledge, social structures are needed to set up social interactions, trust, reciprocity, and shared language for effective sharing of knowledge. Therefore, trust, normal reciprocity and shared language are important components in knowledge sharing. Related studies on knowledge sharing have used SCT. Claridge, (2020) used SCT to study the relationship between individuals, groups, and organizations in knowledge sharing, Weiler et al (2024) found that social interactions had a considerable influence on knowledge sharing and that trust played a significant role in increasing the quality of knowledge shared. Leitão et al (2023) outlined the strengths of SCT in social ties (structural dimension), social trust (relational dimension), and shared goals (cognitive dimension) which influence knowledge sharing among individuals. Lin, Feutherman, and Sarker (2023) found that SCT provides a good prediction of social media users' information-sharing practices.

Social Capital Theory Gaps

Social Capital Theory lacks the technological part that is necessary for knowledge exchange in businesses. Technology utilization is essential to the current study. part that acts as a channel for the communities' access to and distribution of information. ICT is vital for sharing, organizing, storing, and making knowledge easily accessible. Moreover, the SCT does not consider individual or organizational cultures when analyzing the effects on knowledge sharing. Research on information sharing needs to consider the major influence that culture has on knowledge sharing. Consequently, the study has no relation to social capital theory.

2.2.3 Organizational Knowledge Creation Theory (OKCT)

Early in the 1990s, Nonaka and other coauthors developed a dynamic model to show OKC in a series of publications that were published. A knowledge-creation paradigm called Socialization, Externalization, Combination, and Internalization (SECI) was introduced in 1991. It underwent more development to become the OKC hypothesis. It was first given a theoretical term in 1994 Similarly; businesses and management specialists have been focusing more on OKC. Numerous fields have used the OKC theory to explain events: human resource management and leadership, organizational performance management, innovation and technology management theory of organization, and strategic management.

Organizational knowledge production theory has experienced a rise in attention from managers in institutions; thus, the theory is now a crucial component of management practices across a range of institutions (Nonaka, et al 2020) this approach holds that information is produced by individuals, shared by them, and ultimately transformed into organizational knowledge. The information that is produced can be disseminated by a variety of methods, including print media, electronic media, in-person meetings, imitation, and observation.

The OKC theory clarifies this process, which is concerned with showing conditions necessary for knowledge creation to improve innovation and learning in organizations. In other words, what organizational members learn in the workplace helps the organization and their coworkers. According to (Nonaka et al, 2018), the theory uses the four OKCT modes—Socialization, Externalization, Internalization, and Combination to explain organizational creativity, change, and innovation. Nonaka, at el (2018) Unleashing the Knowledge Potential of the Community for Co-creation of Values in Society. In highlighting the dynamic processes of organizational knowledge production, the theory of organizational knowledge production seeks to supplement the knowledge-based perspective of the company and the theory of dynamic

capacities. It also seeks to clarify the characteristics of knowledge assets and management techniques. Ichijo 2007 cited Dolco (2024) highlights that the degree of information generated and issued inside an organization is the primary factor influencing its performance. Three revolutions, or streams, have transformed the theory: the first, second, and third generations of OCKT theories.

To enhance the theory, certain other fundamentals were introduced in each of these streams/revolutions. These added elements assured the theory's viability while advancing its development.

I. First-Generation OKC Theory

Although the SECI concept was first introduced in 1991, it was expanded for wider applicability in "The Knowledge-Creating Company" according to Nonaka and Takeuchi 1995 cited Schlamp, et al (2020).The intuitive comprehension and precise portrayal of the conversion of tacit information into explicit knowledge and vice versa made the SECI model popular, especially among professionals in social science and management. This model illustrates how knowledge evolves through interactions between individuals, communities, and organizations using the dynamic, spiral interplay between two types of information: implicit and explicit.

Nonaka and colleagues have tried to demonstrate that knowledge-generating or knowledge-based organizations continuously encourage the exchange of information between individuals and groups inside the organization to produce both types of knowledge internally. The SECI model's basic concept is that information is created and enhanced as it moves across different organizational levels and between individuals and groups. This version of the concept addresse knowledge assets, the process of converting knowledge, knowledge epistemology, and OKC enablers.

Epistemology

According to Nonaka and other authors in 2006 and cited by Seirafi, (2020), "Epistemology is the study of the theories of knowledge and ways of knowing, particularly in the context of the limits or validity of knowledge". Up until the end of the 1990s, most theories, according to Nonaka, maintained that knowledge and information were interchangeable. In OKC theory, however, knowledge is first viewed as a legitimate belief that is justified. It indicates that individuals use their observations of the outside world to verify the correctness of the monitoring they are doing. Second, knowledge is the ability to assess a situation and decide on the best course of action. Thirdly, knowledge may be classified into two categories: explicit and tacit. The idea of knowledge prompted additional assessment of knowledge conversion, which is the next essential component. The OKC theory raised various concerns regarding the relationships between implicit and explicit knowledge (Seirafi, 2020).

Ontology

The ontological dimension of knowledge creation extends from the person to the group, team, and organization, and includes layers of knowledge-creating entities such as individuals, groups, organizations, inter-organizational systems, and technology. According to this theory, information originates within the individual and then spreads via social interactions with other people, groups, and the entire company. Consequently, the organization identifies information, shares it, finds specific difficulties, and generates new knowledge to solve the issues (Nonaka et al., 2020). It is possible to exchange implicit and explicit information and eventually use it to develop new knowledge.

Nonaka and Takeuchi 1995 also cited Nonaka et al (2020) introduced a four-stage spiral model to explain how current information is created in organizations and how tacit and explicit knowledge differ from one another. The stages include Internalization, Combination, Externalization, and Socialization. The relationship between implicit and explicit knowledge might exist outside of the ontological levels of a person, group, organization, or inter-organizational entity. The company makes use of the implicit information that everyone generates and accumulates.

The four knowledge conversion processes of socialization, externalization, combination, and internalization (SECI) then enhance tacit knowledge. It then crystallizes at a higher ontological level and is exchanged to generate new knowledge (Nonaka, at el, 2020).

Organizational knowledge production theory started to take shape when epistemology, ontology, and knowledge conversion were combined according to Nonaka et al., 2006 cited by Seirafi, (2023). In an organization, creating knowledge is the process of becoming from being developed or becoming through the previously said four modes of the knowledge conversion process (SECI). The foundation of organizational knowledge production theory is the SECI model. Because of its four knowledge conversion modes, which transform implicit information into explicit knowledge and vice versa, SECI is sometimes referred to as the engine of knowledge production. The SECI model is displayed beneath.

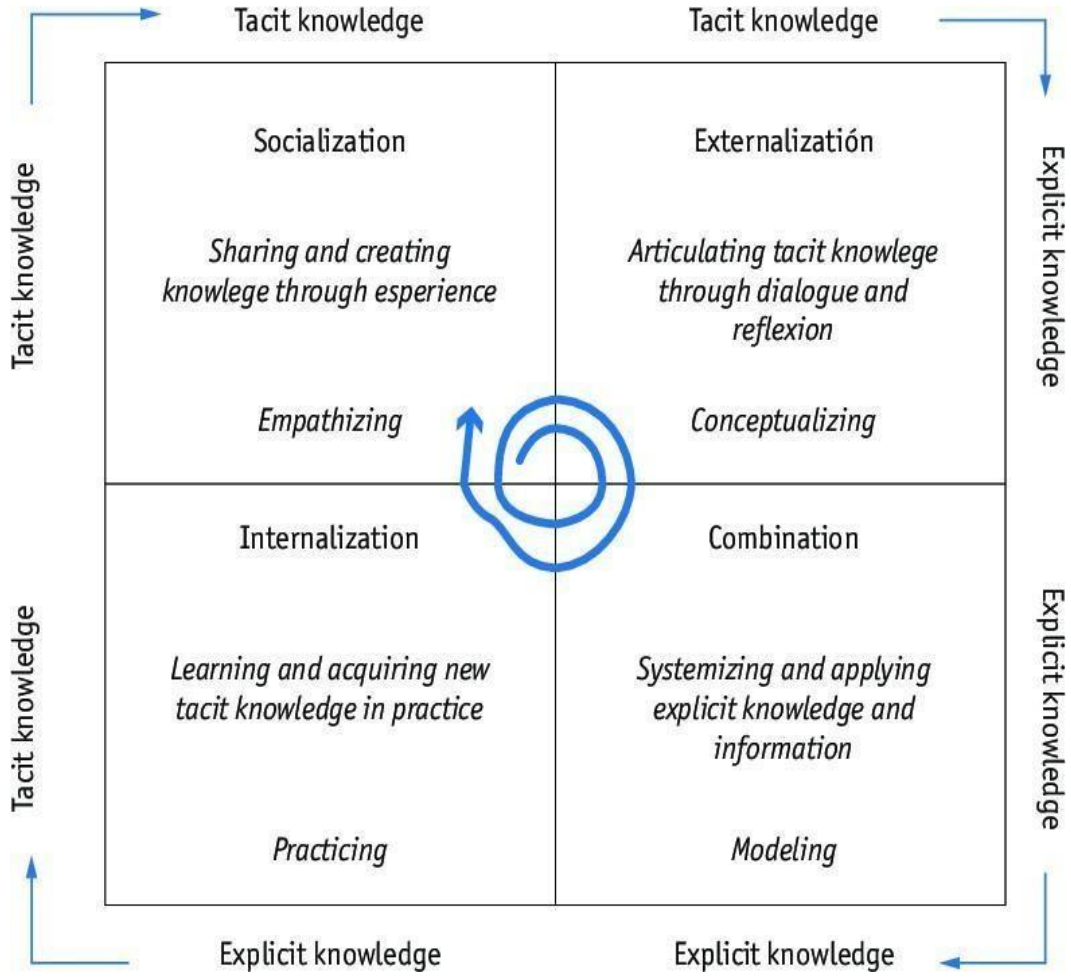


Figure 2.2: Knowledge Conversion (SECI) process)
Source: (Nonaka, at el, 2020).

Knowledge is continuously added to during the SECI process as each person's knowledge is integrated with that of others and given a common justification. The following are the key components of the SECI model: Socialization is the transfer of tacit knowledge between people. The process of transforming implicit information into explicit concepts is known as Externalization. Combining several explicit knowledge items is referred to as a Combination, and Internalization describes how explicit knowledge is embodied into tacit knowledge.

This cycle involves verifying, connecting, and integrating one's own knowledge with that of others (Nonaka, et al 2020).

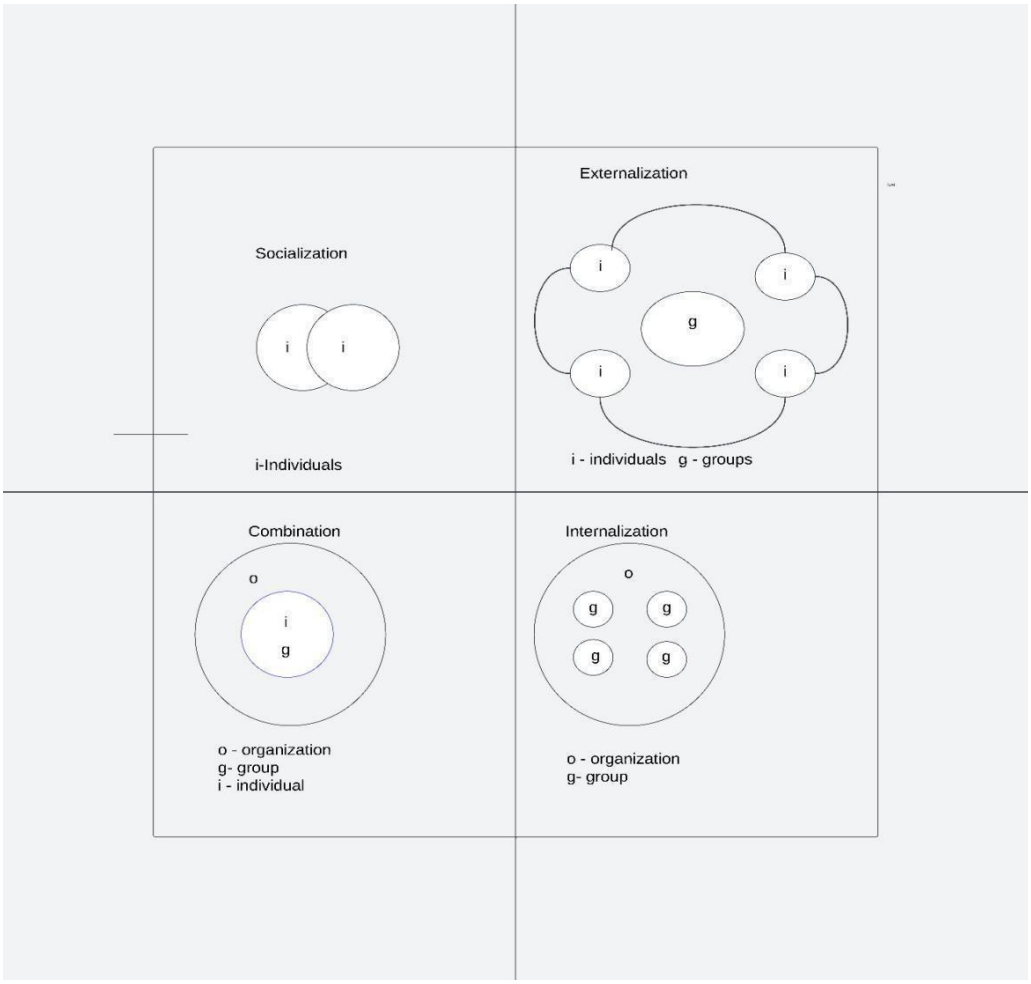


Figure 2.3: Socialization, Externalization, Combination, Internalization Process
Source: Nonaka, et al (2020)

Socialization: Socialization transfers and converts implicit information into new implicit knowledge, which includes shared mental models and task-related technical skills. Socialization is attained through observation, experience, and imitation, and people learn implicit expertise from one another. For example, employees undergoing on-the-job training learn implicit knowledge via experience, innovative dialogue, and the growth of mutual trust (Nonaka 2020). People must be willing to share knowledge inside and outside organizations.

Externalization: This is the second phase in Nonaka's approach, describing how implicit information becomes explicit knowledge. The primary method of conceptualizing someone's tacit knowledge is through language expression. Moreover, one of the most important stages in creating a new thought is creating a language that can communicate innovative ideas and generate added information that is shared. It has been shown by Nonaka, Toyama, and Konno 2000 that verbalizing tacit knowledge crystallizes it, making it available to others and acting as the basis for new knowledge. Seirafi (2023) showed that concepts and propositions should be expressed in systematic language and coherent logic because people's perceptions are the same.

Combination: In the model of Nonaka et al., the third phase is the combination and systematization of explicit knowledge (implicit to explicit). Now that the model's earlier mode has clarified the tacit knowledge, it may be sorted, combined, and categorized. Then, explicit information may be transformed into more intricate and organized explicit knowledge sets, and partners can be formed to efficiently exchange new knowledge (Nonaka et al., 2020).

Acquiring, integrating, analyzing, and communicating current internal and external information are other essential combination techniques. The combination may be made easier by contemporary technology through networking, which stores organizational data in databases to make knowledge.

exchange easier. Organizations are supposed to communicate clear information, like in the case of the current study.

Internalization: internalization aims to reconvert explicit information into tacit knowledge. (Nonaka et al., 2020). Which is a fundamental component of the idea that people learn by doing. An individual becomes a tremendous asset at the organizational level when experiences gained via socialization, externalization, and combination are integrated into one's tacit knowledge bases in the form of shared mentor models (Seirafi,2023). Furthermore, to improve people's tacit knowledge verbalized and diagrammed information must be kept in written materials, manuals, or oral histories. When partners communicate tacit information through socialization, externalization, combination, and internalization, a new cycle of knowledge generation may begin, according to SECI.

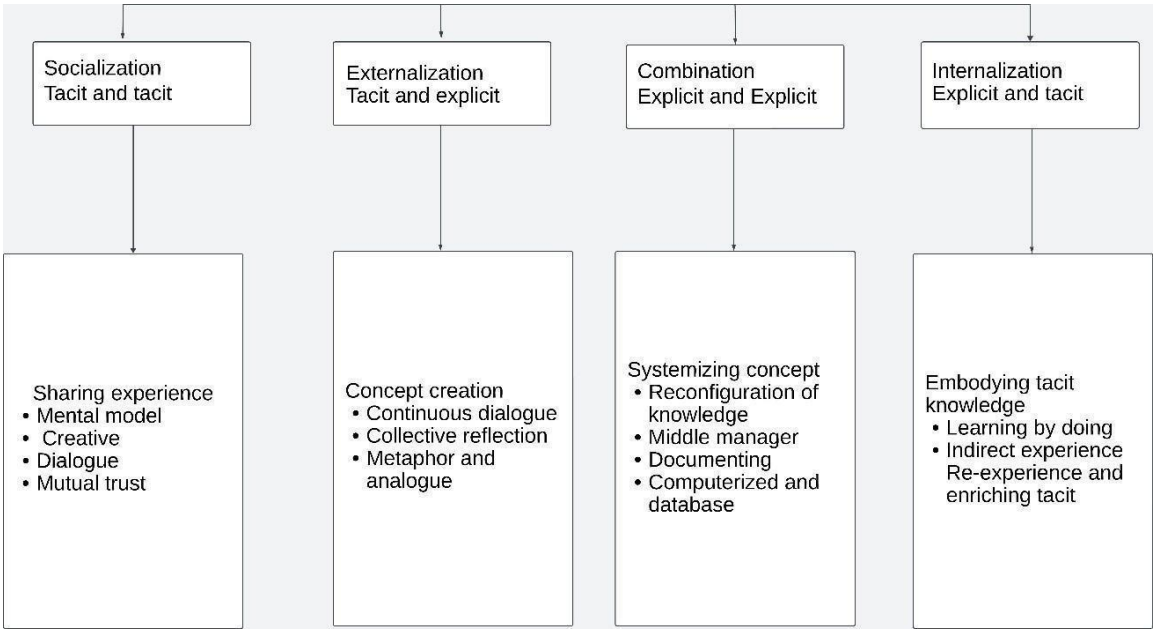


Figure 2.4: Organizational Knowledge Creation Theory (OKCT)
Source: Nonaka et al., 2020

(ii) Second-Generation OKC Theory

In 1998, the OKC hypothesis was supplemented with a second cultural premise. The Japanese concept of Ba was first established by Nonaka et al. in 1998; Ba refers to the material, social, and religious aspects of a location, or, more generally, the "context". Knowledge assets, Ba, and SECI are the three primary components of OKC in this instance. According to McElroy (2020), "An organization uses the SECI process in Ba to produce new knowledge using its current knowledge assets. The information generated is incorporated into the organization's knowledge assets, which serve as the foundation for an ongoing cycle of knowledge development." Managing the information stream alone is not a typical way to steer such a knowledge-creating process. Therefore, in addition to leading the effort to work on all three OKC process components, top and intermediate directors attempt to investigate the circumstances. The knowledge vision is prepared by leaders, who also create and reinforce Ba, expand and promote information exchange, and enable and advance the never-ending cycle of knowledge generation (Nonaka et al., 2020).

Ba

The foundation of OKC operations is Ba. "It is the point where dialectical dialogues and practices take place to implement the vision and driving objectives of the firm," Virkkunen (2020). Ba can show up in a variety of settings, including private conversations, email groups, project teams, working groups, individuals, and informal circles. It can also appear in short-term gatherings. Regarding each of the four quarters of the SECI model, which collectively make up the knowledge spiral, there are four distinct sorts of Ba. The Originating Ba provides a setting for people to exchange perceptual models, experiences, feelings, and sensations. The Dialoguing Ba is where implicit knowledge is converted to explicit form and recorded. Metaphors and dialogues are two crucial communication techniques in this context. In the virtual environment known as

Systematizing Ba, information technology, facilitates the simple integration of existing explicit knowledge to create new explicit knowledge. Explicit information is converted into tacit knowledge in the Exercising Ba (Seirafi,2023).

(iii) Third Generation OKC Theory

Nonaka and associates began attempting to clarify the idea of the corporation to view it as a knowledge-creating unit in the early 2000s, as cited by Jafari and Rezaeenour, J. (2023). According to their perspective, a corporation may be seen as a knowledge-generating entity, a collection of knowledge assets, and a dialectic organism that uses its vision, Ba, creative processes, incentive structures, and dispersed leadership to reconcile many paradoxes. Their opinions caused them to disagree with the knowledge-based theory of the company, a contemporary approach to understanding the organization. This approach predates two main ideas: an elementary human perspective and the OKC process.

According to knowledge-based conceptions of the company, people are not interchangeable parts of an organization; rather, they are unique creatures that transcend themselves to pursue new objectives because they are dissatisfied with the situation and are not like each other. (Nonaka and Toyama, 2020). The knowledge, vision, and driving objectives, which guide and energize the SECI process, the knowledge assets, which are the inputs and outputs of the SECI process, Ba, an existential space for the SECI process, the environment as a multilayered bionetwork of knowledge, and the SECI process itself are the seven fundamental components of this model (Seirafi, 2023).

In summary, Organizational Knowledge Creation theory, which incorporates knowledge assets, the SECI process, and epistemology as its three primary pillars, was made possible by the three revolutions. We looked at and discussed the novel components of the theory, including Ba,

knowledge vision, driving objectives, knowledge leadership, and ecosystem of knowledge. Next, the opinions of Nonaka and colleagues on the organization's theory were discussed. Understanding the theory might help later in creating conceptual models that show advancements and applications for the OKC process in real-world scenarios. Moreover, the perspectives put forward in this essay may aid knowledge-creating or knowledge-based businesses in their endeavors to improve their OKC protocols.

Gaps in Organization Knowledge Creation Theory

However, because the OKCT is founded on ideas that are deeply ingrained in Japanese work practices and society, it is questioned for its implicit universalistic presumptions. It is constrained by the fact that OKCT is ingrained in Japanese industrial culture and is its values. According to Nonaka at el (2020), each one of the four SECI modes in Japanese culture has a strong cultural basis. The SECI paradigm could only be understood as a culturally biased metaphor that had no relevance to reality outside of Japan.

The conclusions of Macca, (2024) study on the contextualization of Nonaka's theory of knowledge in China, it was incredibly challenging to reproduce the SECI model in China due to the complex cultural linkages between China and Japan. Molina González Cruz Garcí Lirios (2024) state that the OKCT is not a universal model, hence it does not apply to the current investigation. Consequently, Macca (2024) noted that while examining knowledge management models created in a single nation, in this example the SECI model, it is critical to avoid blindness and give close attention to pertinent embedded contextual components.

2.3 Conceptual Framework

2.3.1 Knowledge Sharing Model

One of the most crucial components of the knowledge management process is information sharing. Nguyen (2020) posits that knowledge sharing is an essential technique in knowledge management (KM) that involves exchanging information, experience, and expertise. According to (Clercq & Pereira, 2020), this entails exchanging advice, ideas, opinions, and information.

The act of transferring knowledge from one employee to another is known as knowledge-sharing behavior (Javaid and Abdullah, 2020). Knowledge sharing can also be described as an employee's behavior that makes it easy to share information with others. Knowledge-sharing behavior is a type of group behavior where participants exchange information, skills, and expertise between departments and corporations (Rohman et al., 2020). Knowledge sharing is a process that enables information held by individuals and groups to be elevated to the organizational level and utilized in the development of new products, services, and processes. Furthermore, sharing information entails both acquiring and imparting knowledge.

Knowledge is increased via sharing, not by hoarding. People have typically passed on their learned knowledge and commercial acumen to the next generations via stories about their ideas, work, and experiences (Luhombo, and Muluka,2024). Organizations are struggling to survive in the modern knowledge-intensive economy, and one high-performance strategy that has helped them is knowledge sharing (Zou 2024). Information exchange inside an organization and with other companies operating in the same environment is essential for effective organizational performance (Abzari et al., 2016). Workers in a firm need to talk to one another and share experiences to generate new knowledge. Thus, the endeavor benefits the business, particularly in the form of a competitive edge (Lee, 2017).

Knowledge hoarding decreases knowledge sharing. This is enabled through stories about their ideas, labor, and experiences, which people have traditionally passed on to subsequent generations through their acquired knowledge and business savvy (Luhombo and Muluka,2024). In the current knowledge-intensive economy, organizations are fighting for survival, and knowledge sharing is one high-performance technique that has helped them do so (Zou 2024). Effective organizational performance depends on information sharing inside an organization and with other organizations in the same setting (Abzari et al., 2016). To create new knowledge, employees in a company must communicate with one another and exchange experiences. As such, the company gains from this effort, especially in the form of a competitive advantage (Lee, 2017). Though knowledge-sharing techniques are often discussed, little is known about how knowledge-sharing differs within industries, both conceptually and experimentally. Industry features like industry type may regulate the link between processes and knowledge-sharing facilitators. Compared to manufacturing, service organizations are more knowledge-intensive because they develop innovative methods for knowledge creation and dissemination. Organizations must learn how to enable and promote both explicit and tacit knowledge, which may put them at a competitive disadvantage if improperly handled. As a result, the goal of this work is to create a conceptual model of information sharing that leads from food security to economic sustainability.

2.3.2 Knowledge sharing: Conceptual framework for the study

Zou (2024) established the knowledge-sharing paradigm that serves as the foundation for this investigation. Three components form the basis of this model: technological, individual, and organizational aspects that impact knowledge-sharing activities.

(i) Organizational Factor

Noor at el (2023). The management's assistance in fostering an environment that eases knowledge exchange inside the firm and provides sufficient resources is one of the organizational elements. Effective knowledge sharing is a result of an organization's good attitude toward sharing information. According to Connelly and Kelloway's 2003 research, people's normative opinions of information sharing are significantly influenced by their views of management support for knowledge management and sharing activities. In the information-sharing paradigm, management support plays a crucial role in balancing organizational and individual cultures, structures, reward structures, and knowledge management and sharing rules. Noor and Salim (2023) provided evidence to support the claim that managerial support aided in the creation of policies, organizational culture, and innovation inside a company.

The common values, beliefs, and presumptions that govern an organization's behavior are known as its organizational culture (Santhose and Noble, 2023). Adapting to an organizational culture involves being aware of common values, customs, and viewpoints toward the exchange of knowledge. It also covers behaviors that specify how one should feel, think, and behave in an organizational context. Al-Alawi defines organizational culture as the common values, presumptions, and beliefs that spur organizational learning in the face of environmental issues and problem-solving strategies. Organizational culture is defined by Molina González 2024 as the fundamental principles, ethical standards, and social mores that control how people act and behave

within a company. It is the culmination of common beliefs, presumptions, standards, expectations, attitudes, and conventions.

According to Noor at el (2024), knowledge sharing will succeed if there is a support system in place that loosens the limits on information flow across divisions. The well-thought-out and adaptable organizational structures promote cross-border cooperation and knowledge exchange. According to Santhose and Noble, formal organizational structures inside firms may foster contact among employees , which improves effective information exchange .Organizational incentives and rewards encourage and affect the exchange of information across enterprises. Incentives, whether monetaryor non-monetary, can serve as rewards for staff members and encourage them to impart their ability to others. Molina González (2024) Rewards and information sharing were found to be positively correlated discovered that financial incentives had a direct impact on the willingness to share information.

(ii) Individual Factors

Sharing knowledge is a process that depends on each person's experiences, attitudes, goals, and beliefs (Chedid et al, 2022). It is well-acknowledged by academics like Bock and Kim (2001; Bock et al., 2005; Cabrera et al., 2006; Howell and Annansingh, 2013 that keeping information rather than sharing it is a natural tendency. For several reasons, people often hoard knowledge. One needs a compelling personal motive to support knowledge sharing to change this behavior (Memon et al., 2024). In Budiyono et al (2024), "orientation of motivation concerns the underlying attitudes and goals that give rise to action." The definition of motivation is "being activated or energized toward an end." Two factors influence an individual's attitude toward engaging in knowledge-sharing activities, according to research: intrinsic motivation (knowledge self-efficacy

and delight in assisting others) and extrinsic motivation (anticipated organizational incentives and reciprocal benefits).

a) Intrinsic motivation

Behavior driven by intrinsic motivation stems from a person's demand for competence and independence. Only activities that pique an individual's intrinsic interest will result in intrinsic motivation; these are pursuits that fulfill the demands of autonomy (self-determination) and competence (self-efficacy) in people (Deci et al., 2017). Research has indicated that intrinsic motivational variables play a crucial role in explaining human behavior across several domains (Deci and Ryan, 2017) influenced by their satisfaction with helping others.

b) Extrinsic motivation

In contrast to internal drive, extrinsic motivation's primary objective is to obtain incentives from the organization or reciprocal advantages (Obermayer and Toth, 2019). Extrinsic motivation is defined as "behavior where the reason for doing it is something other than an interest in the activity itself," as Deci and Ryan (2017) indicated. Many extrinsically driven attitudes and behaviors are significant in the social environment, even though extrinsic motivation is thought of as a poor and weak kind of motivation (Ryan and Deci, 2017). Systems of incentives known as organizational rewards have the power to encourage people to share their expertise as cited by Nonaka et al, Yang and Chen; and Obermayer and Toth (2019). But other incentives besides money may be used to extrinsically motivate a person's conduct.

(iii) Networking Factor

Mahami-Oskouei (2024) concludes that formal and informal connections and interactions are viewed as vital for knowledge sharing and points out that networking is a critical individual component that could affect knowledge sharing in communities. People do not work, learn, or

transmit knowledge in isolation, Pham Thi (2022) asserts networking is a circle in which individuals interact and connect in a variety of contexts, creating relationships and sharing information consequently. The goal of networking, according to Fauzi (2019), is to encourage and boost information exchange. Additionally, it is expected to affect the extent of information sharing (Pham Thi 2022) and establish the essential framework for successful and effective knowledge sharing. Knowledge sharing requires networks and a willingness to participate in the process. Individuals' and institutions' interests influence how a network functions. Individuals with a tendency to network are more eager to exchange ideas and information (Fauzi et al., 2019; Ishrat and Rahman, 2020). According to Riege (2020), one of the obstacles to information exchange is a lack of networking.

(iv) Technological Factors

Davidavičienė et al (2020) Knowledge is the awareness and understanding of a set of information and ways it can be made useful to support a specific task to reach a decision". Knowledge involves the link made between people, information, and its potential applications. Information and Communication Technologies (ICTs) cover an enormous diversity of heterogeneous technologies that facilitate organizations in sharing knowledge and information. Information Technology strengthens the self-efficacy of employees and makes effective use of organizational resources.

Technology eases and encourages knowledge sharing (Zhang et al, 2024). Besides, information technology (IT) is an important intervention in knowledge sharing as it is used to connect partners and ease interaction and access to data that supports their daily activities. Technology plays a key role in knowledge management systems. When a company uses contemporary technology, information sharing is easy, and people may engage both inside and

outside the business. Zamiri, (2024) emphasized the role that IT plays in making it possible to gather, store, index, and link data and digital objects to assist management choices. Well-established Information technology infrastructure facilitates knowledge-sharing practices by linking information communication structures such as data processing, storage, and communications systems.

Zhang et al (2024) advocated that technology enables academics to create linkages to external resources which make it possible to share knowledge hastily and globally with a large number of people. The use of Information technology facilitates information search, access, and retrieval Zamiri, (2024) argued that improving knowledge sharing in a meaningful way requires a delicate marriage of technology with a keen sense of cultural or behavioral awareness. Consequently, since technology makes communication and information sharing easier, it is impossible to separate knowledge sharing from its usage.

Additionally, technology may provide immediate access to vast volumes of information and expertise, allowing for long-distance cooperation that promotes teamwork inside and across company divisions (Zamiri, 2024) This model's strength lies in its integration of interpersonal, organizational, and technological elements that impact information sharing. Interactions and trust, culture, communications, ICT, and social networks that encourage and support knowledge exchange are some of these elements.

Technology eases, encourages, and supports knowledge sharing. Zhang et al 2024 reveals that technology supports, influences, and increases the ability to share knowledge. Jones (2017) organizational hierarchy, individual trust, and knowledge-sharing technological systems have direct relationships with knowledge-sharing. Noor and Salim (2022) point out that an organization is a social entity where knowledge-sharing takes place; it enables knowledge to be created,

captured, organized, and shared among individuals who are the key actors in implementing knowledge-sharing practices. As a result, the three elements mentioned above are crucial to information exchange inside a company. Three main variables—organizational, individual, and technological—are shown in the model. Numerous similar research has confirmed the significance of these parameters in information exchange. Knowledge-sharing is most affected by people and technological elements, such as IT systems.

Additionally, social networks, managerial support, and organizational culture all have an advantageous effect on knowledge-sharing. According to Farooq (2018), knowledge sharing is a people process, people's involvement in information sharing is crucial for knowledge generation, people are unwilling to share knowledge inside the company, and knowledge management efforts would be unsuccessful.

Consequently, an organization deals with policy formulation, structure, culture, reward system, work process, and management support that enables the organization to maximize knowledge-sharing practices. Individual attitudes, trust, personality, motivation, pleasure of sharing, and willingness to share knowledge are essential in knowledge sharing. Technological factors such as IT Infrastructure and applications enhance knowledge sharing and lower communication barriers between participants (Farooq 2018)

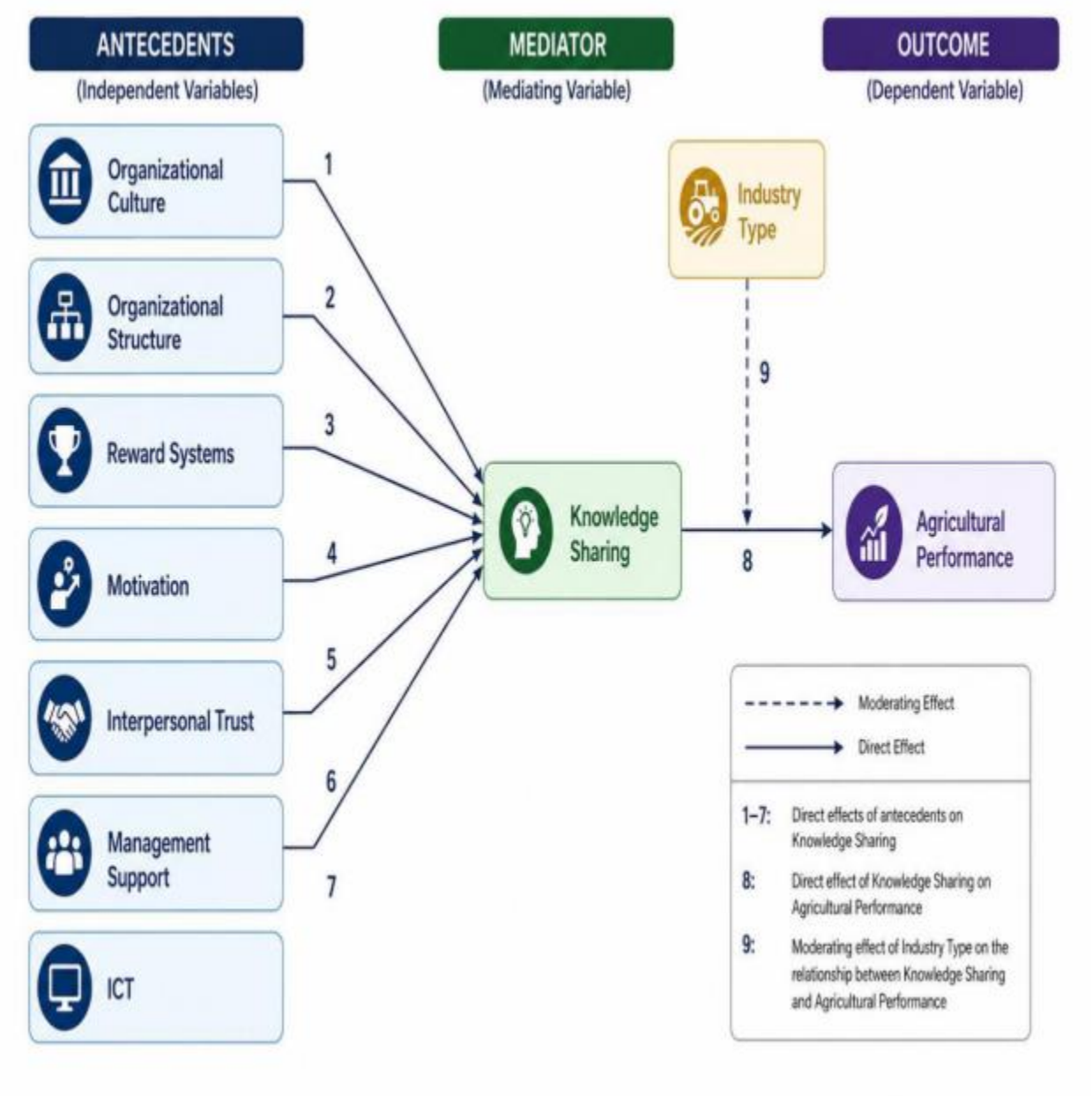


Figure 2.5: Knowledge Sharing Conceptual Framework for the Study
Source: Researcher, (2025)

2.3.3 Application and Strength of the Model

Farooq (2018) found that technological, institutional, and individual factors are the driving forces in knowledge sharing. Individual factors included awareness, trust, personality, motivation, the pleasure of sharing, self-efficacy, willingness to share, and job satisfaction. Technological factors include information technology application, infrastructure, and use, and finally, organizational factors include organizational policy, structure, culture, management support, reward system, leadership work process, and office layout to enhance knowledge sharing according to the model.

Researchers have also used the same model to study the influence of individual, organizational, and technological factors on knowledge sharing. The results showed that individual and organizational factors significantly influenced knowledge-sharing processes. In their study, Ismailand Yusof 2008 investigated how personal, managerial, and technology aspects were used to leverage the knowledge of their staff and noted that the organization needs to understand the factors that make their staff share knowledge. They premised their study on the fact that if academicians did not share their knowledge, then the benefits of knowledge sharing would not be actualized in the universities.

The strength of this model is that it contains essential elements needed in knowledge sharing, such as organizational culture, structure, leadership, management support, and commitment reward Systems. Individual attitudes, personal expectations, and IT applications help knowledge sharing (Sawsan and Lyn, 2022).

Table 2.1: Identified Relevant Research on Application of Knowledge Sharing

S NO.	RESEARCH TITLE INCLUDE THE AUTHORS	SCOPE	FINDINGS
1.	Knowledge management in the agriculture sector:a systematic literature review (2023)	Systematic literature review	Systematic literature review This SLR found that while KM-related aspects of agriculture were examined, such research is sparse in KM journals, mostly published in non-KM journals.
2.	An Empirical Study to Investigate the Impact of Factors Influencing Knowledge Sharing in Virtual Teams (2023)	Due to limited research on knowledge sharing in a virtual team, it is difficult for software organizations to improve virtual team performance. The results of this study cannot be generalized because the survey was conducted in Pakistan's SMEs.	Due to limited research on knowledge sharing in a virtual team, it is difficult for software organizations to improve virtual team performance.

3.	Exploring Knowledge Sharing Practices among Paddy Farmers towards Building a Foundation for Knowledge Creation (2015)	A study was carried out in a major rice-producing area, the central region of the Peninsula.	Farmers' knowledge and experiences on climate change, local farmer innovations, natural resources management, and indigenous knowledge could be captured to document best practices in agricultural. activities.
4.	Strengthening the flow among Agricultural Stakeholders (2018)	This study was conducted in the Morogoro region of Tanzania	To improve the flow of agricultural knowledge, the involvement of different stakeholders is inevitable. Each agricultural stakeholder should be involved in conducting relevant agricultural knowledge-related roles to enhance the accessibility, sharing, exchange, dissemination, and usage of agricultural knowledge. This study was conducted in Morogoro region of Tanzania
5.	Knowledge Sharing Strategies between Coffee Farmers and Coffee Research Institute (2021)	The study was undertaken at the CRI and Gitwe Farmers' Cooperative	Coffee farming requires specialized knowledge. The success of the venture in terms of quantity and quality of yields depends on the availability and access of relevant knowledge.

		Society in Kiambu County, Kenya.	The extant literature on sustainable economic development has a significant gap and hence there is an urgent need for specific research that fills that gap
6.	The Role of Agricultural Financing And Development on Sustainability: Evidence from ASEAN Countries (2021)	This research Investigates the Impact of agricultural finance, Agricultural and Rural development on the Sustainable Development of ASEAN countries	The extant literature on sustainable economic development has a significant gap, and hence there is an urgent need for specific research that fills that gap

2.4 Conclusion of Literature Review

The literature reviewed was carefully selected and informed by the research objectives and relevant variables from the theoretical model that underpinned the study. The literature identified three main factors that facilitate knowledge-sharing practices include organizational factors like organizational culture, organizational structure, organizational communication, management support, strategic planning, and

reward systems. Knowledge management and sharing policy is required to enhance knowledge-sharing activities in organizations.

Technology is an enabler of knowledge sharing, playing the role of mediating between the organization and the information seekers/searchers. Organizational structures also play a key role in ensuring knowledge-sharing strategies and policies are in place that include creating awareness and motivating employees to create, use, and share knowledge where needed to ensure effective and efficient sharing practices The literature further revealed factors that constrained knowledge production and sharing.

Most literature on knowledge sharing was found to be concentrated in the business sectors, and limited research exists in agricultural environments. Besides, most extant literature is found in developed countries. In Africa, and specifically Kenya, little research has been undertaken on knowledge sharing among farmers, especially in the mango farming community, hence the need for the research to act as a reference tool in support of Mango farmers on how knowledge sharing can be of importance towards commercializing the product.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter is organized thematically as follows: research paradigms, research design, target population, sampling method, research methods, data collection procedures, data analysis strategies, validity and reliability of data collection instruments, ethical considerations, and summary.

3.1 Research Paradigms

The primary goal of any research is to expand the body of knowledge by addressing societal problems, enhancing the knowledge base, and providing practical solutions. This process is often shaped by the researcher's paradigm. A research paradigm is a set of shared beliefs and assumptions among experts within a discipline about how problems should be understood and investigated. In essence, a research paradigm represents a worldview that guides researchers in perceiving and analyzing issues. This worldview influences their understanding of truth, knowledge, and reality, shaping their thinking, beliefs, and assumptions about the world and society.

According to Ulz (2023), a research paradigm is a worldview or philosophical framework that guides the research process, encompassing the researcher's ideas, beliefs, and biases. The paradigm in which a study is situated shapes how the research is conceptualized and conducted. Each paradigm is characterized by its ontology (the nature of reality), epistemology (the nature of knowledge and how it can be acquired), and methodology (the approach used to investigate the phenomenon).

Omodan (2024) explains that ontology, a branch of philosophy, concerns the nature of reality and prompts researchers to inquire into the kind of reality that exists. Epistemology, in contrast, focuses on the origin, nature, and limits of human knowledge, addressing the relationship between the researcher and the phenomenon under investigation (Pretorius, 2023). Methodology refers to the approach used to understand reality, including how the researcher seeks knowledge and the specific methods employed. Pretorius (2023) argues that methodology is a practical branch of philosophy concerned with the systems, methods, and rules guiding the conduct of inquiry. In essence, methodology encompasses the processes through which a researcher investigates phenomena. The choice of methodology is influenced by the three major paradigms commonly employed in social science research: positivism, interpretivism, and post-positivism. Researchers select a paradigm based on the nature of the study and the type of knowledge they aim to generate.

3.1.1 Post-Positivist Paradigm

This research adapted the post-positivist paradigm. McGlinchey (2022) argues that a researcher's ideas and identity inevitably influence their observations and can shape the conclusions drawn. Post-positivism seeks objective answers while acknowledging and addressing these biases, relying on theories and knowledge developed by previous scholars. This paradigm has emerged from the recognition that reality can never be fully known and that attempts at measurement are inherently constrained by human understanding. Consequently, methodological pluralism using both qualitative and quantitative approaches is widely accepted in post-positivist research**.**

Post-positivist paradigm is considered critical realism, where reality is viewed as complex and needs to be investigated by multiple measures, as none of the methods is best.

Pervin and Mokhtar (2022) comment that the realization that neither of the paradigms can best explain reality to perfection has given rise to a new thinking that has labeled the post-positivism paradigm.

The post-positivist paradigm is positioned between the positivist and interpretive approaches, this enabled the researchers to employ both perspectives within a single study (Pretorius, 2024). The study adopted a post-positivist paradigm to capture multiple participants' meanings and attitudes, measure variables, and generalize findings. This approach was particularly suitable for investigating the true state of knowledge sharing within organizations. Similar applications of the post-positivist paradigm can be found in studies by Wiewiora (2013), Turyasingura (2011), Van Vuuren (2011), Fullwood (2014), and Pretorius (2024). The research paradigm does not only fulfill a methodological requirement but also clarifies the researcher's philosophical stance, guiding principles, and the rationale behind methodological choices, thereby enhancing the clarity, integrity, and overall impact of the research.

3.2 Research Design

The research design is the overall strategy used to integrate the various components of a study in a coherent and logical manner, ensuring that the research problem is effectively addressed. It serves as a blueprint for the collection, measurement, and analysis of data. According to Sacred Heart University Library (2024), the primary function of a research design is to ensure that the evidence obtained enables the researcher to address the research problem as clearly and unambiguously as possible. In social science research, obtaining relevant evidence involves specifying the type of data required to test a theory, evaluate a program, or accurately describe a phenomenon. However, researchers often begin investigations prematurely, before critically considering what information is needed to answer their research questions. Neglecting

these design considerations can result in weak or unconvincing conclusions that fail to adequately address the overall research problem.

In line with the post-positivist paradigm adopted for this study, the research design was carefully developed to balance both qualitative and quantitative approaches. Tashakkori et al (2025) this design enables the systematic collection of measurable data while also capturing participants' subjective meanings and perspectives. By integrating multiple methods, the study ensures that evidence is robust, comprehensive, and capable of addressing the research problem regarding knowledge-sharing behaviors within organizations. The design also provides a clear framework for data collection, analysis, and interpretation, enhancing the reliability, validity, and overall rigor of the study's findings.

According to Poth (2025), Mulili et al (2025) Ayiro (2024) indicated that a good research design clearly identify the research problem and justify its selection, review previously published literature related to the problem area, clearly and explicitly specify hypotheses (research questions) central to the problem selected, effectively describe the data that will be necessary for an adequate test of the hypotheses and explain how such data will be obtained, describing the analysis applied to determine whether or not the hypotheses are true or false. However, research designs can vary greatly depending on the length of the study.

This study applied a survey design. This design will be used as a tool by researchers to gain a greater understanding of individuals' and groups' perspectives relative to the topic of interest. The mixed research method will be used as the method of collecting data (qualitative and quantitative research). Quantitative surveys are numerical and are usually analyzed using statistics. Quantitative designs allow researchers to obtain a general snapshot of trends in the

population of interest. Mixed methods help us understand, not just whether an intervention works, but how, why, and for whom.

3.2.1 Qualitative

Qualitative research entails open-ended survey questions that allow for the collection of detailed responses, offering depth and context to explore the reasons behind certain behaviors or opinions. Tomaszewski (2020) stated that qualitative research is the methodology researchers use to gain a deep contextual understanding of users via non-numerical means and direct observations. Researchers focus on smaller user samples to reveal data such as user attitudes, behaviors, and hidden factors: insights that guide better designs. Qualitative research is a subset of user experience, which is research and user research doing qualitative research, the researcher aims to gain narrowly focused but rich information about why users feel and think the way they do. It can also examine organizational functioning, relationships between individuals and groups, and social environments.

Khadim (2023) points out that qualitative approaches establish the perceptions and experiences of organizations towards the sharing of knowledge among themselves and provide a deeper understanding of the respondents' interactions. He also states that in qualitative study, knowledge is not “out there but constructed through communication and interaction within the perceptions and interpretations of people. Vanderstoep and Johnston (2009) cited by Ayiro 2024 pointed out that a qualitative perspective assumes that a researcher cannot analyze and understand an entity by analysis of its parts; rather, a researcher can examine the larger context in which people and knowledge function.

In this approach, the researchers try to understand participants’ experiences with the central phenomenon in a natural setting, using research approaches such as surveys or case

studies. The researchers collect words and images about the phenomenon of the study. Without predetermined hypotheses or ideas, the researchers analyze the data for common themes to allow multiple interpretations of participants' individual experiences.

This view of knowledge with a qualitative approach is like an interpretative paradigm. Even though the qualitative method targets areas of concern, and concentrates on specific segments to collect valuable information which takes less time and requires fewer resources, it is more versatile, the researcher can adjust questions and adapt to circumstances that can change or changing the environment has some limitation like sample sizes were a big enough group of participants is required to ensure results are accurate, if the sample size is not large enough data collection may be insufficient. Issues of bias can arise where workers can give a popular answer other than their true opinion. This can negatively influence the outcome of the study. Qualitative approaches can be artificial, thus affecting the findings as it is outside the norm of regular behaviors and interactions. Due to the limitations, the design cannot be used alone in the study, hence calling for some support from other designs.

3.2.2 Quantitative Research Design

These surveys included structured questions with predetermined responses, such as multiple-choice or rating scales, aimed at gathering measurable data. They are excellent for assessing trends, frequencies, or patterns within large populations.

Jian (2023) states that Quantitative research design is a research method used in various disciplines, including social sciences, psychology, economics, and market research. It aims to collect and analyze numerical data to answer research questions and test hypotheses.

Quantitative research design offers several advantages, including the ability to generalize findings to larger populations, Quantitative research is verifiable and can be used to

duplicate results. Quantitative research is faster than other methods. Quantitative research can be done anonymously, with the potential for statistical analysis and hypothesis testing, and the capacity to uncover patterns and relationships among variables. However, it also has limitations according to (Adam, 2023), such as being limited to numbers and figures, tests can be intentionally manipulative, results being open to subjective interpretation, the potential for oversimplification of complex phenomena, questions, adapting to circumstance, and the reliance on predetermined categories and measurements. Some of the advantages of using quantitative design are that it can be tested, provide straightforward analysis, and prestige.

The approach alone is unsuitable for this study; the mentioned limitation can directly affect the study's outcome, hence calling for mixed research methods.

3.2.3 Mixed Research Methods

According to Ayiro (2024), he stated that back in the 1970s and 1980s, qualitative and quantitative research were seen as two opposing paradigms, each with their supporters, most of whom would have denied the possibility of mixing them. This period is referred to as "the paradigm wars". During the last two decades, however, researchers in both camps have begun to see the importance of each other's data. According to George (2023), mixed research methods help to gain a more complete picture than a standalone quantitative or qualitative study; they integrate the benefits of both methods.

The benefits of mixed research design over one research design include generalizability. Qualitative research usually has a smaller sample size and thus is not generalizable. In mixed methods research, this comparative weakness is mitigated by the comparative strength of a large number of externally valid quantitative research.

Contextualization: Mixing methods allows the researcher to put findings in context and add richer detail to the conclusions. Using qualitative data to illustrate quantitative findings helped in adding content for analysis and finality mixed methods have been proven to be credible; the qualitative and quantitative data converge, strengthens the validity of the conclusions, and this process is called triangulation.

This study employed a mixed research method. The reasons for using mixed methods in this study included the fact that provided more comprehensive evidence for studying a research problem than either quantitative or qualitative research alone could achieve. Moreover, the mixed method is useful as the weaknesses that could be encountered by using one method in the study were offset by the other. Ayiro (2024), recognizes and supports the use of the two methods to study one phenomenon. He asserted that bringing together both quantitative and qualitative research benefits from the strengths of both approaches, leading to a better understanding of research problems than either approach alone. The mixed research method addressed all the objectives of the research; again, mixed research methods helped the researcher to overlap the advantages of quantitative and qualitative methods while mitigating their weakness and supplying a better understanding of the research problem.

3.3 Study Population

There are three kinds of populations in a study, as cited by Asiamah et al. 2017 he identified these populations as general, target, and accessible populations. The general population is the entire group about which some information is required to be ascertained. The target population is the group of people or participants with specific attributes of interest that are of relevance to a study. The accessible population is the population in research to which the researcher applied their conclusions. This population is a subset of the target population and is

also known as the study population. It is from the accessible population that researchers draw their samples. The target population was 28,696, registered mango farmers, Ministry of Agriculture, Makueni County, 2024, Agricultural Extension officers representing the eight sub-counties where mango farming is actively practiced.

3.4 Sampling Method

Turners (2020) stated that sampling is the selection of a subset of the population of interest in a research study. In most research endeavors, the participation of an entire population of interest is not possible, so a smaller group is relied upon for data collection. Sampling from the population is often more practical and allows data to be collected faster and at a lower cost than attempting to reach every member of the population. The sample was used to make inferences about the population. Understanding how the data arrived in the database was an important aspect of analyzing and drawing conclusions from that data.

The probability Sampling method was employed for this research. The researcher stratified the population of farmers depending on the type of mango planted, and then randomly sample within each stratum. This way, a proportional number of participants on the stratification characteristic was represented in the final sample chosen for data collection using a simple random sampling technique.

Ayiro (2024) reveals that simple random sampling eliminates bias, and the sampling error can be estimated. Through simple random sampling, all mango farmers have an equal chance of being selected as participants in the study. Purposive sampling was used to sample the Agricultural institutions and the sub-county Extension officers. This non-probability sampling technique was preferred because it has the characteristics the researcher needs for the sample like the organizations are all agricultural; all the interviews had customary practice.

Purposive sampling is common in qualitative research and mixed methods research. It helped the researcher make the most out of limited resources.

3.4.1 Sample Size

The sample size references the total number of respondents that was included in the study, and the number was often broken down into sub-groups. In this research, the sample size of mango farmers was grouped according to the type of mango planted. These include Apple, Kent, Nogwe, Tommy, Van Dyke, Sensation, Boribo, Batawi, Saber Kienyenji, and Peach Kienyeji. The sampling was anchored on Andrew Fisher's formula (2023) which is $n=Z2\cdot P\cdot(1-P)\ d2$

Where:

n = Sample size

Z = Z-value (e.g., 1.96 for a 95% confidence level)

P = Estimated proportion of the population

d = Margin of error (d=0.05)

Andrew Fisher's formula (2023) is a well-known sample size calculation formula that is computed by determining the population size, specifying the confidence interval and level, determining the standard deviation, and lastly, converting the confidence level into a Z-Score (Knapp, 2018).Thus, for a population of 28,696, the sample size was 279 farmers,4 Directors of Institutions, the Chief Executive officer in the county, and 8 extension officers representing wards.

3.5 Data Collection Instruments

Given the nature of the study, and in conformity with the qualitative and quantitative methods applied, data was be collected using interviews, questionnaires, and document review. These three methods complement each other. Data triangulation allowed the researcher to collect a variety and rich data about the phenomena, enriching the findings for building standards.

Interviews

Primary data collection was done using semi-structured interviews with Extension officers representing the Ministry of Agriculture, A semi-structured interview schedule was used to ensure that the same basic lines of inquiry are pursued with each person who were interviewed. A list of questions to be covered was derived from the research questions.

The questions were structured thematically to sufficiently provide insight into the themes of the study and provided an opportunity for thematic analysis during the discussion of findings. The interview questions were designed in a way that allowed the researcher to build a conversation within a particular area guided by the objectives of the research. Data was collected by notes-taking. Each interview took an average of 30 to 45 minutes. Verification of the answers conducted through recorded phone communication and email.

Observation

Direct observation was used for this research to complement the interview method. The type of observation was nonparticipant, where the researcher conducted the observations from ‘outside’ and took notes. In qualitative research, this method was ideal. This is because the direct observer endeavors to be as modest as possible to avoid bias in the observations

employed, to observe the participants in sequences and procedures, and to see the physical aspects requiring study, such as the mango plant detail.

Document Review

Document review is a methodical procedure for analyzing documents both printed and electronic material. Like other analytical methods in qualitative research, document review requires that data be examined and interpreted to elicit meaning, gain understanding, and develop empirical knowledge (Ayiro, 2024). Document reviews were conducted for the Agricultural Institution under the Ministry of Agriculture.

Questionnaires

The researcher used Questionnaires as a method for gathering quantifiable information on communities rapidly and systematically. Like interviews, questionnaires were used for collecting declarative data from the community of mango farmers; Questionnaires were combined with other methods like observation and interviews that guided processes. The questionnaire was bilingual to harvest all relevant information from the interview, being a rural setting, this was not inevitable.

3.6 Piloting of Instruments

Prior to the main data collection, the research instruments underwent a piloting process to evaluate their suitability, clarity, and effectiveness. The pilot study involved selecting a representative subset of the target population to test both the qualitative and quantitative tools. As part of this process, a consultative meeting was held with representatives from the Ministry of Agriculture to review and pilot the qualitative interview guide. This engagement helped assess the appropriateness, sequencing, and comprehensiveness of the qualitative questions.

For the quantitative instrument, a sample of 50 (fifty) mango farmers was identified and

issued with the draft questionnaire. The researcher then gathered feedback on key elements such as clarity of questions, adequacy of response options, logical flow, length of the tool, and the ease with which farmers could understand and respond to items. The pilot also offered an opportunity to detect potential ambiguities, leading questions, or culturally inappropriate terms that could compromise reliability or introduce bias.

Analysis of the pilot data enabled the researcher to evaluate the internal consistency, reliability, and content validity of the instruments. Based on this feedback, the research tools were refined to improve clarity, remove redundancies, align questions with study objectives, and enhance overall usability. The revised instruments were therefore better suited to collect accurate, comprehensive, and contextually relevant data during the main study.

3.7 Data Collection Procedures

The procedure for data collection began after approval from the University to proceed with data collection. Data collection for the study was among mango farmers in Makueni County and in the ministry of Agriculture. A mixed-methods approach that combines both quantitative and qualitative techniques to capture comprehensive and context-rich information was used, observation and document review were also used as tools for data collection. The process was conducted in several carefully coordinated stages to ensure rigor, accuracy, and representation of farmers across the region. Quantitative Data Collection Procedure.

The quantitative phase began with the identification of mango-growing sub-counties and wards within Makueni, after which the researcher obtained permission from the ministry of Agriculture and other licensing bodies. Once approval was granted, the researcher engaged the agricultural extension officers who helped in identifying clusters of active mango farmers. From these clusters, a simple random sampling procedure was used to select individual farmers to ensure broad coverage and reduce sampling bias.

Before fieldwork began, the researcher developed a structured questionnaire that held closed-ended items focusing on farm characteristics, production practices, access to extension services, market participation, income levels, and adoption of agricultural technologies. The questionnaire was reviewed by experts before released for data collection. During the data collection exercise, the researcher visited selected homesteads and orchards accompanied by assistant familiar with the local language (Kikamba). After introducing the purpose of the study and obtaining informed consent, the structured questionnaire was administered face-to-face to each farmer. This approach accommodated farmers who had limited literacy levels and provided an opportunity to clarify any questions in real time. Responses were recorded directly onto printed questionnaires or tablets, depending on accessibility. Each session took roughly 30–40 minutes. The completed forms were checked daily to ensure accuracy, completeness, and clarity before being securely stored for data entry and analysis.

Qualitative Data Collection Procedure

The qualitative phase was conducted after initial quantitative data had been reviewed, allowing the researcher to identify emerging patterns that needed deeper exploration. This phase aimed at capturing the farmers lived experiences, perceptions, and contextual realities surrounding mango production and marketing in Makueni.

Purposive sampling was used to select participants who represented the ministry of Agriculture and different segments of the mango-farming community, including smallholders,

commercial-oriented farmers, women farmers, youth farmers, and farmers from remote areas prone to post-harvest challenges. This ensured diversity in insights and rich contextual depth. Key agricultural officers, and lead farmers were also identified as key informants Data was collected using semi-structured interviews, and field observations. The researcher designed interview guides with open-ended questions that encouraged the extension officers to open on experiences using their own words. Topics included knowledge sharing and networking and challenges were discussed on mango production processes and marketing like experiences with brokers, related risks, and perceptions of government and NGO support programs.

Additionally, the researcher conducted systematic field observations in selected mango orchards. These observations helped document actual farming practices, how networks are distributed in different sections and observed how lead farmers share information after conferences and workshop training. These observational notes provided valuable context that complemented both quantitative and interview data.

Again, document review was also undertaken by the four agricultural institutions in Makueni county on issues about their role in knowledge sharing. The researchers interacted with their websites and reviewed their objectives, their mission, vision and goals and their role in promoting sharing to community.

Interviews were conducted at locations chosen by the participants by organized meetings in various offices and often, at farmer group meeting points, or in their orchards to ensure comfort and openness. Conversations were audio-recorded with consent and accompanied by detailed field notes capturing non-verbal cues, environmental cues, and reflective observations. The researcher and the assistants facilitated in Kikamba with translation where necessary.

3.8 Data Analysis

In this study, data were analyzed sequentially, where qualitative and quantitative data were analyzed individually and then combined in the presentation and discussion of findings. The collected data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 29 of 2024. For the analysis to be effective, the researcher collected data and ensured it was in a format compatible with SPSS (Excel). Revise sentences to make it clearer. Then, the data was imported into the selected file. After importing, data cleaning took place to ensure no missing values or outliers were present, and these were addressed appropriately. Following data cleaning, a statistical test was chosen. In this research, the T-test was chosen because it works with Different Sample Sizes, does not require a perfectly normal distribution, is Easy to calculate, and it is a versatile application. The analysis of the data commenced from descriptive to inferential statistics, and lastly, the findings were interpreted into a conclusion. The results were presented clearly and concisely, with tables and graphs that were appropriate to visualize the data.

3.9 Reliability and Validity

Reliability and validity are two criteria used to judge the quality of all standardized quantitative measures. To ensure reliability pilot study was conducted to measure the range of opinions and ideas people have in the study to test the instruments, ensuring that the data collected is consistent, accurate, and trustworthy helped confirm that a tool or method yields the same results under consistent conditions, reducing errors and increasing confidence in the findings.

Reliable data supports valid conclusions, allows for repeatability of the study, and strengthens decision-making based on the results.

Validity on the other hand is the accuracy and degree of precision demonstrated by a researcher from all the data in the study (Karnia, 2024), the credibility of people's interpretation (Silverman, 2013). Lodico, Spaulding, and Voegtle (2010:93) pointed out that validity focuses

on ensuring that what the instrument claims to measure is truly what it is measuring, thus showing the instrument's accuracy. Brayman (Estremera, 2024) articulates that validity is the issue of whether an indicator that is planned to test a concept measure that concept. The goal of measurement validity is to ensure that instruments, such as questionnaires, consistently and reliably measure something (Aithal and Aithal, P. S. (2020) Karnia, (2024) demonstrate the importance of conducting a pilot study was to establish whether the sampling frame and technique are effective and whether resources needed for the study such as people and funding are available. Validity in mixed research methods involves using strategies that address potential issues in data collection, data analysis, and the interpretations that might compromise the integration of the quantitative and qualitative methods of the studyand the conclusion drawn from the mixture. Ayiro (2024) pointed out that to have value, the instrument must have sound reliability and validity. Therefore, the researcher conducted a pilot study to ensure validity and tested the tools to ensure reliability and measurement of the study.

3.10 Ethical Considerations

Considerations of ethical issues in research were integral throughout the research process to avoid collisions between the researcher and participants. In conducting this research, the following ethical principles were strictly observed to protect the rights, dignity, and welfare of all participants in Makueni County:

The study, informed consent was obtained from all participants prior to data collection. The researcher fully explained the nature, purpose, and potential benefits of the research to each participant in clear and understandable language. Participants were assured that their involvement was entirely voluntary and that they had the right to decline or withdraw at any point without any negative consequences. No form of coercion, inducement, or undue influence was used to encourage participation.

To further uphold ethical standards, participants were informed of the types of information that would be collected, including farm characteristics and personal data where relevant. It was emphasized that their privacy would be always protected. Personal identifiers such as names, phone contacts, and GPS coordinates of farms were kept strictly confidential and were not disclosed to any third parties without explicit permission from the participants. Every effort was made to anonymize the data, and unique codes rather than actual names were used during data entry and analysis.

The researcher committed to safeguarding all information provided, ensuring that it was stored securely and used solely for academic purposes. By providing verbal or written consent, participants acknowledged their understanding of the study and agreed to participate willingly and without coercion. The study adhered to the highest standards of ethical research, particularly in respect to confidentiality, privacy, and voluntary participation.

Avoidance of Harm was also considered: which included avoidance of sensitive or invasive questions in the interview. Cultural sensitivity was also factored in the research, where the researcher respected the cultural norms and local authority structures of Makueni County. Transparency and Integrity of the findings were reported truthfully: without exaggeration or distortion, and any possible conflicts of interest were declared. Research assistants were trained in ethical data collection and respectful communication. The county government was consulted before the researcher started field work. Time spent with each participant was kept reasonable to avoid interfering with their daily activities. The use of Data was only used for the purposes stated in the consent process. It was stored securely, deleted or archived responsibly after the study is complete. Ethical Clearance was approved by NACOSTI before fieldwork began.

3.11 Conclusion

This chapter has outlined the methodological framework that guided the study, demonstrating how the research was systematically structured to address the research problem on knowledge sharing among mango farmers in Makueni County. Grounded in the post-positivist paradigm, the study embraced methodological pluralism, enabling the integration of both qualitative and quantitative approaches to capture the complexity of the phenomenon under investigation.

A mixed-methods survey design was adopted to ensure a comprehensive understanding of knowledge-sharing practices by combining the strengths of both qualitative and quantitative research. The chapter detailed the target population, sampling procedures, and determination of sample size, ensuring representativeness and rigor in the selection of respondents. Data collection methods including questionnaires, interviews, observation, and document review were carefully chosen to allow for triangulation and the generation of rich, reliable, and valid data.

The piloting of research instruments enhanced their clarity, reliability, and validity, while structured data collection procedures ensured consistency and accuracy in the field. Data analysis was conducted using both descriptive statistics, supported by qualitative thematic analysis, thereby enabling robust interpretation of findings. Furthermore, issues of reliability and validity were rigorously addressed to strengthen the credibility and dependability of the study.

Ethical considerations were upheld throughout the research process, including informed consent, confidentiality, voluntary participation, and adherence to institutional and national research guidelines. Overall, the methodological approach adopted in this study provides a solid foundation for generating credible, reliable, and contextually relevant findings that inform the subsequent chapters of the research.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This chapter presents in detail the findings, interpretation and discussion of the data generated from the interviews, questionnaires, observations, and documentary reviews to examine knowledge-sharing dynamics among mango farmers for economic sustainability in Makueni County. Babajide (2022) describes the purpose of interpretation, findings, and discussion of research as to summarize the information collected to formulate an answer to the research questions, with the main aim of discovering useful information, conclusions, and supporting empirical decision-making.

Data Analysis Procedures

The analysis of data in this study followed a systematic mixed-methods approach that involved interviews, questionnaires, observation, and document review data. Each type of data was analyzed using procedures appropriate to its nature, while ensuring that the findings were eventually integrated to provide a comprehensive understanding of the research problem.

The analysis of quantitative data began with careful cleaning and preparation of responses collected from questionnaires. Once the completed survey forms were sorted, the researcher checked them for completeness, internal consistency, and accuracy. Any missing values or ambiguous responses were reviewed and handled appropriately to ensure the dataset remained reliable. After cleaning, the responses were coded into numerical form and entered statistical software (SPSS). Before conducting major analyses, the dataset was screened to confirm that key statistical assumptions such as normality, linearity, and homoscedasticity were satisfied. Descriptive statistics were then generated to summarize the main characteristics of the

farmers, including measures such as frequencies, percentages, means, and standard deviations. To address the research questions, inferential statistics such as correlation, regression, and other appropriate tests were performed. These techniques helped reveal relationships between variables and allowed the researcher to draw meaningful conclusions from the numerical patterns that emerged.

Qualitative data analysis proceeded concurrently but followed a different process focused on identifying meaning rather than numerical trends. All interviews which were open-ended responses were transcribed verbatim. The researcher first read the transcripts several times to become familiar with the content and to gain an overall understanding of the participants' experiences and perspectives. Initial coding was then undertaken, where significant statements, phrases, or ideas were marked and labeled. These codes were gradually grouped together into broader categories that represented recurring concepts. From these categories, themes were developed to capture the deeper patterns and issues raised across the participants' narratives. Throughout this process, the researcher constantly compared emerging themes with the raw data to ensure they accurately reflected participants' voices. Interpretation of the qualitative findings involved linking the themes to the study objectives and explaining what they revealed about the lived experiences of knowledge sharing among the mango farmers.

Observation data were analyzed in a manner like qualitative data, although with greater emphasis on the physical issues. The researcher began by organizing and typing up field notes taken during farm visits and community interactions. These notes included both descriptive accounts of what was observed and reflective remarks about the significance of those observations. The data was then coded to identify recurring patterns. These patterns were compared with what farmers reported in interviews, enabling the researcher to confirm the

accuracy of self-reported data and uncover aspects that might not have been mentioned explicitly. The interpretation of observation data contributed a practical, real-world dimension to the overall findings.

Document review data were analyzed through content analysis. Relevant documents such as their mandate, training manuals, and policy documents were examined carefully to extract information related to the study. Key statements, figures, and policy positions were identified and coded based on their relevance to the research objectives. These coded excerpts were then organized into categories to highlight significant issues such as market policies, extension programs, and value chain regulations. By comparing document evidence with interview and questionnaire data, the researcher was able to identify consistencies, contradictions, and gaps across sources. After each type of data was analyzed independently, the final stage involved integrating the findings as required in mixed-methods research.

Quantitative patterns were compared with qualitative themes to identify areas where the two datasets converged or diverged. Qualitative insights helped explain why certain statistical trends appeared, while quantitative results provided measurable evidence to support or challenge narrative accounts. Observational and documentary data further strengthened this integration by offering context and verification. Through this comprehensive approach, the study produced well-rounded conclusions that reflected both numerical trends and lived experiences, thereby providing a deeper and more holistic understanding of mango farming in the study area.

The study was conducted in the wards that dominate mango farming, according to a report obtained from the Ministry of Agriculture, Makueni County 2024, the sizes of the land in hectares occupied by mango trees and the number of mango farmers demonstrated in the table below:

Table 4.1: Mango Farming Distribution in Makueni County

Ward	Hectares	No of Farmers
Emali/Mulala	978	1,862
Ilima	428	4,372
Ivingoni/Nzambani	129	947
Kako/Waia	1,073	3,906
Kalawa	707	2,007
Kasieku	340	2,867
Kathonzweni	551	1,797
Kee	163	2,528
Kiima Kiu/Kalanzoni	188	1,197
Kikumbulyu North	108	366
Kikumbulyu South	249	843
Kilungu	20	1,216
Kisau/Kiteta	1,593	6,231
Kithungo/Kitundu	182	1,985
Kitise/Kithuki	293	732
Masongaleni	822	726
Mavindini	733	1,791
Mbitini	112	3,031
Mbooni	222	1,524

Mtito Andei	125	401
Mukaa	86	1,630
Maua/Kikumini	1,338	3,720
Nguu/Masumba	314	1,692
Nguumo	308	748
Nzaui/Kilili/Kalamba	4,038	6,500
Thange	140	1,226
Tulimani	744	5,224
Ukia	2,124	5,634
Wote/Nziu	1,720	4,049

Source: Ministry of Agriculture

Makueni County 2024

The statistics show that Makueni County has invested in agribusiness for mango fruit.

A total of 19,828 hectares of Makueni County land occupied by mango farming, with 29314 farmers distributed in different wards of the county. This is clear that mango farming is one of farming practices in the county. Maarifa Centre (2022) supports the finding by noting that mango farming is a major economic activity in Makueni County, contributing to the livelihood of many households; however, uneven distribution of the product is clear. Some wards have numerous farmers, while other areas were found to be scanty. For example, Nzaui, Kilili, and Kalimba wards have several thousand farmers, unlike Mukaa, Kilungu, and Makindu wards, which have fewer than a hundred farmers practicing mango Agribusiness.

The findings in Table 3 agree with Kefri (2022) that some of the factors affecting the distribution of mango farming includes different climatic conditions and soil types. Some

Makueni County have climatic conditions favorable for mango production, and others are unfavorable, hence the difference in mango distribution in the region. Muthini (2011), also cited by Maarifa Center 2022 indicates that the proximity to the infrastructures and processing facilities has also led to the different distribution of the plant. Statistics established that areas near the Makueni fruit processing plant (MFPP) have many mango farmers, unlike the wards that are far from the processing plant.

The wards with high mango production were sampled for the study, according to Maarifa Center 2022 and supported by reports from the Ministry of Agriculture in Makueni County. The selected wards included Ukia, Kisau, Kako, Kilima, Ilima, Tulima, and Kiteta. The selected samples represent the quantitative method.

Table 4.2: Participants in Quantitative Data Representation

Ward	**Target Population**	**Respondents**	**% of the Response**
Ukia	60	50	83%
Kisau	40	35	86%
Kako	40	36	87%
Kilima	40	35	80%
Ilima	50	44	88%
lima	40	34	85%
Kiteta	50	46	92%
Total population	320	255	87%

Source: Field Data,2025

The researcher, through the ward Agricultural Extension Officers, identified the lead farmers in each ward. The lead farmers guided the researcher to the mango farmers. who were classified depending on the type of mango tree they cultivated. The respondents had an average of 79% of the total population sampled.

The sampled wards were dominant in mango production and were categorized depending on the type of mango cultivars. Samuel (2023) states that mango farming depends on climate and soil conditions, among other factors.

Qualitative data presentation

The interviews were conducted with the Ministry of Agricultural officers from the selected subcounty. The interviewees included subcounty Extension Officers, chief Executive officer and the CS Agriculture in Makueni county. The knowledge-sharing model adopted by this researcher underpinned the study, which applied the postpositivist paradigm with quantitative and qualitative approaches.

Table 4.3: The Participants in Qualitative Data Representation

Target population	Sample size	Response Percentage %
Agricultural Extension officers	N=8	100%
Agricultural Institutions	N=4	100%

Source: Researcher, 2025

The participants in qualitative methods had 100% representation, face to face interview was conducted between the researcher and the county Executive Officer representing the CS Agriculture, discussion was conducted amongst the Extension officers, Agricultural Directors representing the Agricultural departments and the researcher, telephone call also were used especially for clarification of some issues which seemed opaque or ambiguous to the researcher and also booking of appointments. To comply with the privacy of the participants, the researcher concealed their identities by using symbols that were used in the presentation and analyzing the data.

The knowledge-sharing model underpinned the study. The post-positivist paradigm was applied with quantitative and qualitative approaches. The same approaches were used in a similar study on knowledge-sharing strategies between Coffee Farmers and the Coffee Research Institute: A Case Study of Gitwe Farmers' Co-Operative Society (2021).

Survey questionnaires were administered to 320 farmers, of which 255 were completed. and returned, yielding a response rate of 79%. Interviews were administered to 8 (100%) Agricultural Extension officers were targeted. Furthermore, 3 (75%) Directors were interviewed out of four respondents who were targeted. The study attracted a high response rate of 79% to 92.3% from all categories of respondents. The high response rate was ascribed to follow-ups with the respondents to make sure they completed and returned the questionnaires. and were available for interviews.

Survey lab (2025) states that the acceptable response rate should be at least 60% of the sampled population. They further point out that response rates can be ranked: 60-69%, acceptable; 70-85%, incredibly good; and 85% and above, excellent. According to Sataloff and Vontela (2021),

a response rate exceeding 60% is sufficient for adequately representing the target population and supports the validity of conclusions and recommendations based on the collected data.

Survey Lab (2025) points out that low response rates do not lend themselves to any advanced statistical analysis and should be avoided. Therefore, the response rate in the current study was exceptionally good. The overall response rates for all respondents were (N=292); farmers 255 (79%), extension officers 8 (100%), and Directors 3(75%).

Conclusively, the response rate was high, meaning the findings generally lead to reliable data quality, generalization, and minimization of bias in the findings; hence the complete rate of the response is highly dependable.

4.1 Demographic Characteristics of the Study Population

The study sample included 255 respondents engaged in mango farming, exhibiting diversity across gender, age, and educational attainment, distributed in the different wards of the county.

4.1.1 Gender Composition

The gender distribution indicates a predominance of male respondents, who constituted approximately 64.5% (n = 181) of the sample size, whereas females represented 35.1% (n = 98). This gender imbalance reflects prevailing trends in agricultural participation within the region, where males often dominate farming activities.

Demographic Characteristics of the Study Population

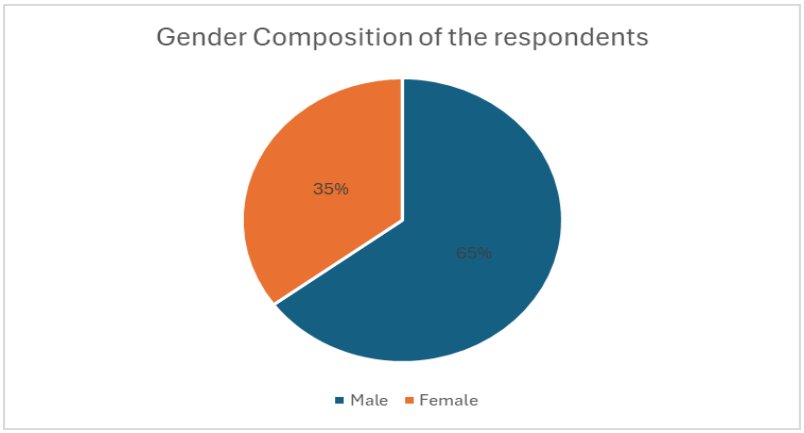
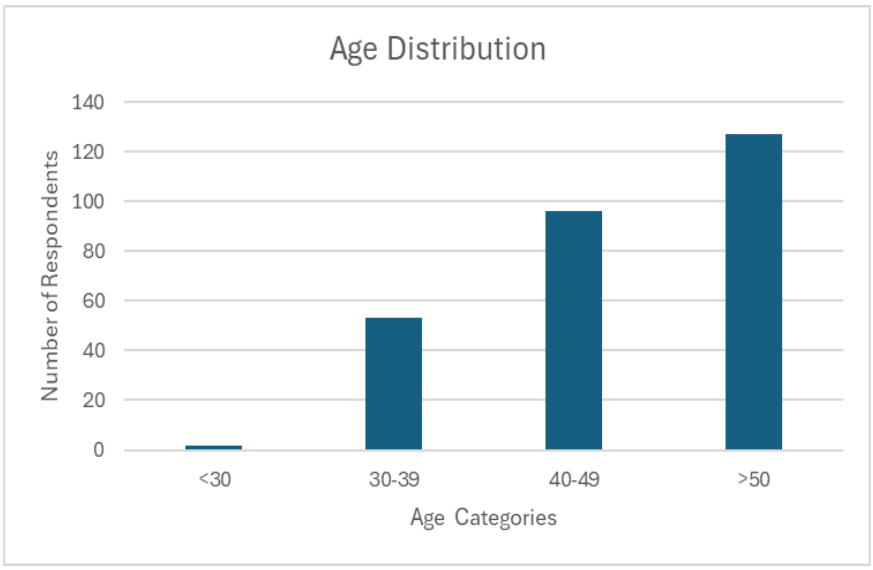


Figure 4.1: Gender Composition of the Respondents
Source: Field Data,2025

4.1.2 Age Distribution

The age profile of respondents reveals concentration in the middle-aged and older adult cohorts. Specifically, individuals aged above 50 years formed the largest subgroup, accounting for 45.5% (n = 127) of participants. Those aged between 40 and 49 years comprised 34.4% (n = 96), while the 30 to 39 years age group represented 19.0% (n = 53). Notably, respondents younger than 30 years were minimally represented, with only 2 individuals (<1%) in this category. This age structure suggests that mango farming is primarily undertaken by experienced adults, with limited youth involvement. The Age Distribution was illustrated in the graph.



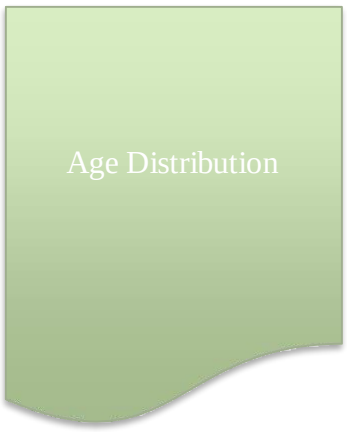


Figure 4.2: The Age Distribution
Source: Field Data,2025

4.1.3 Educational Attainment

The educational background of respondents was varied, with a substantial proportion possessing post-secondary qualifications. The largest educational category was college or university graduates, constituting 31.9% (n = 89) of the sample. Vocational education holders accounted for 25.5% (n = 71), and those with secondary education comprised 24.0% (n = 67). Advanced degrees were held by a smaller segment, with master's degree holders representing 12.2% (n = 34) and doctoral degree holders 1.1% (n = 3). A minority, 5.4% (n = 15), had not completed primary education. This distribution indicates a relatively educated farming population, which may influence the adoption of innovative agricultural practices and technologies.

Table 4.4: Educational Attainment

Education Level	Frequency	Percent (%)
Not finished primary	15	5.4
Secondary	67	24
Vocational	71	25.5
College/University	89	31.9
Masters	34	12.2
PhD	3	1.1

Source: Field Data, 2025

4.1.4 Ward Distribution

The respondents were evenly distributed across the seven wards surveyed, indicating a representative geographic coverage of the mango farming communities. The largest group of respondents came from Kiteta ward (16.9%), followed closely by Ukia (16.1%) and Ilima (16.1%) wards. Other wards such as Kako (13.3%), Kisau (12.9%), Kilima (12.5%), and Tulima (12.2%) also contributed substantial proportions of the sample. This balanced distribution suggests that the findings reflect diverse local contexts within the study area.

Table 4.5: Ward Distribution of the Respondents

Ward	Number of respondents	%
Kiteta	47	16.9%
Ukia	45	16.1%
Ilima	45	16.1%
Kako	37	13.3%
Kisau	36	12.9%
Kilima	35	12.5%
Tulima	34	12.2%

Source: Field Data, 2025

4.1.5 Farming Experience

The respondents' farming experience varied, with a majority demonstrating considerable tenure in mango cultivation. Approximately 44.4% of farmers reported having more than 10 years of experience, while 44.1% had between 6 and 10 years of experience. A smaller proportion, 11.5%, had relatively limited experience of 1 to 5 years. This distribution indicates that the sample predominantly consists of experienced farmers, which may influence their knowledge, practices, and openness to innovation.

Farming Experience in Years

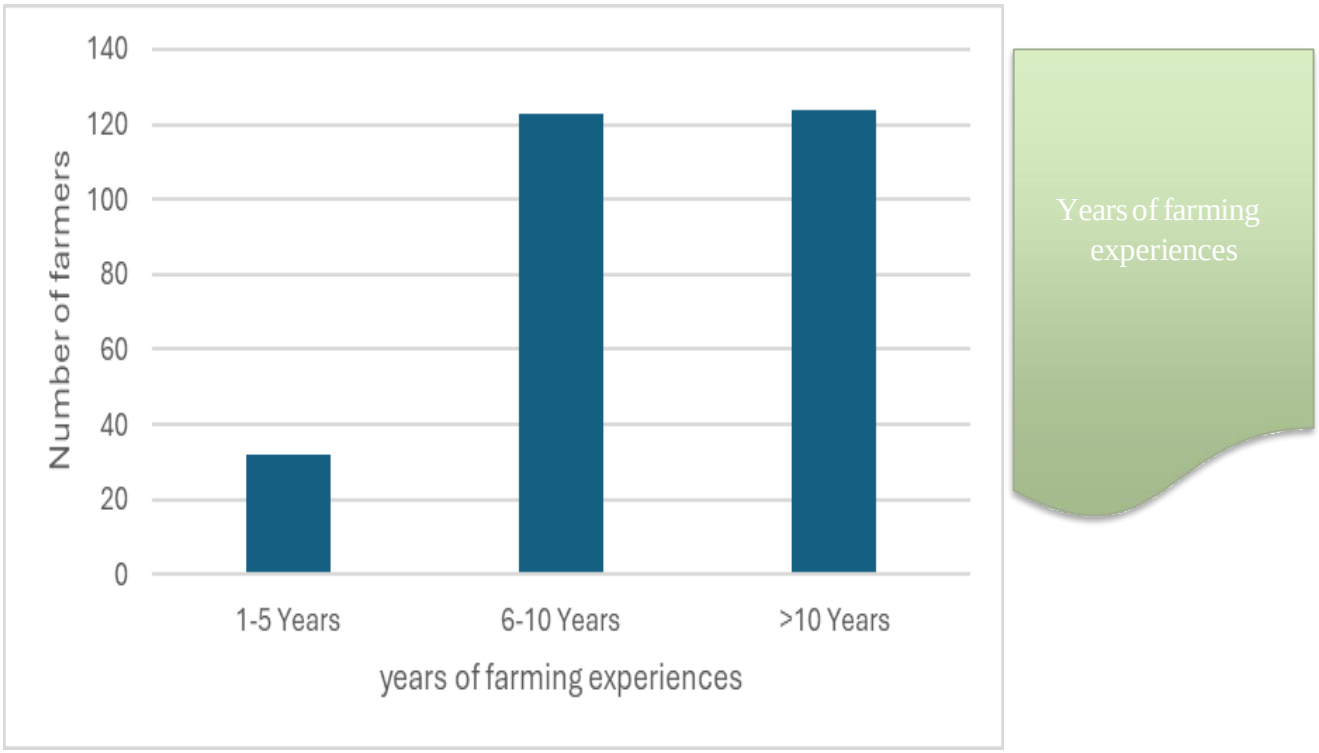
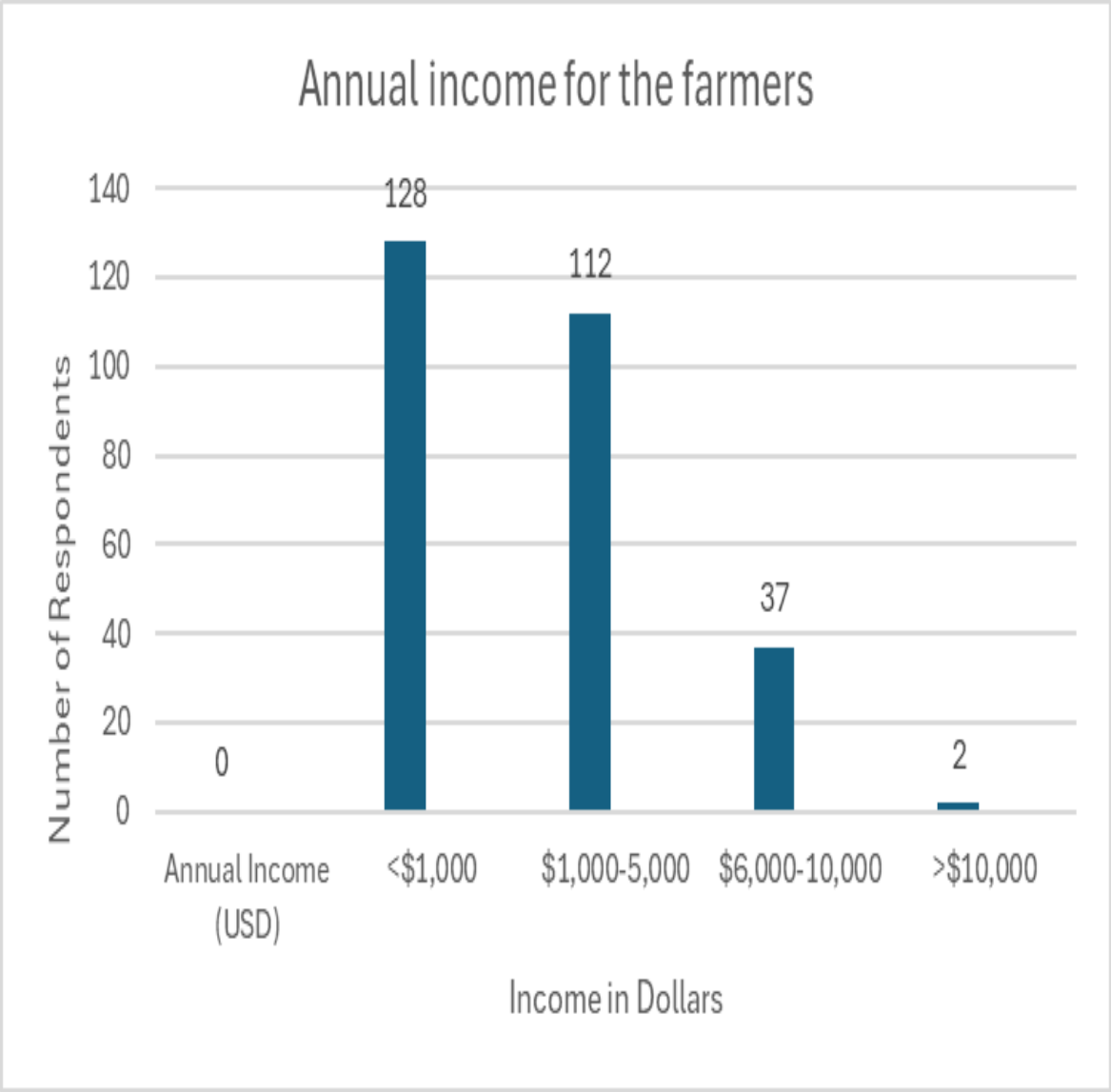


Figure 4.3: Farming Experience in Years
Source: Field Data,2025

4.1.6 Annual Income

Annual income from mango farming showed a broad range, with nearly half of the respondents (45.9%) earning less than $1,000 annually. A substantial portion, 40.1%, reported income between $1,000 and $5,000, while 13.3% earned income between $6,000 and $10,000. Only an exceedingly small fraction (0.7%) reported income exceeding $10,000. These findings highlight that most mango farmers operate at a modest income level, which may affect their capacity to invest in inputs, technology, and market activities.

The annual income for farmers was presented in the chart below.



4.1.7 Acres Used for Mango Cultivation

Landholding sizes varied considerably among the respondents. Nearly half (47.5%) of the farmers cultivated between 1 and 5 acres, while 32.4% managed farms of 6 to 10 acres. Smaller farms of less than one acre were rare (1.8%), and 18.4% of respondents reported using more than ten acres for mango production. This variation in farm size reflects a mix of smallholder and medium-scale farming operations within the community.

Table 4.6: Acres Used for Mango Cultivation

Acres Used	No. of respondents	%
<1 acre	5	1.8%
1-5 acres	132	47.5%
6-10 acres	90	32.4%
>10 acres	51	18.4%

Source: Field Data,2025

The study, therefore, concludes that male farmers dominate in mango farming in the region, reflecting gender imbalance in mango farming within the region. Young respondents (youth) are not undertaking mango farming, unlike farmers who are more than 50 years old. A big percentage of farmers are literate, with a small percentage of illiterate farmers. The income rate of the farmers ranges between1000-5000per annual. Most of the farmers are small- scale farmers, but are distributed in the county, making mango farming a major agricultural practice in the county.

4.2. Effects of Social Network Structures on Mango Market Access

The study sought to establish the effects of social network structures on accessing mango markets in Makueni County Different type of social networks for knowledge sharing were explored, frequency of use, type of information shared, the impact of the shared information, specific knowledge or techniques learned through social networks that have been applied, the challenges faced when using social networks and how the challenges have been mitigated was part of the question posed to the interviewers. The findings were analyzed as follows.

4.2.1. Different Social Networks used by the Farmers.

The results indicated (past tense) that the most used communication channel among respondents is social media and messaging, reported by 66.3% (n = 169) of the sample. Agricultural Platforms are the second most prevalent, utilized by 20.8% (n = 53) of respondents. Radio is also notable, with 9.8% (n = 25) indicating it as their primary network. Other channels- including Farmer Networks, Direct Communication, Print Media, and Workshops/Seminars- are each used by less than 1% of respondents. Only 1.2% (n = 3) reported they did not use any network at all. The data findings indicated that several networks are in place, including both traditional and digital networks.

An interview with MCO 1 enquired about the social networks used by the ministry to reach the farmers. The finding was that the Ministry uses different networks to share knowledge with the farmers. The most preferred network was using the lead farmers to disseminate information to farmers through barazas, posters, and occasionally through radio announcements and social

media, which was contrary to the farmers' findings, which indicated their most preferent network is social media and short messaging media.

The researcher observed that most farmers were digitally literate with smartphones with applications for social networking and with cameras for photo taking in case of an identified anomality like unknown pest attacks.

Ottawa (2020) agreed with the findings that social media and messaging platforms enable farmers to access market information and buyers in real time. For example, WhatsApp/Telegram groups and Facebook pages serve as informal marketplaces or "extensions" where farmers broadcast available produce and buyers make offers.

Table 4.7: Social Networks used for Knowledge-Sharing

Social Network used	Frequency	Percent
Social media & Messaging	169	66.27%
Agricultural Platforms	53	20.78%
Radio	25	9.80%
Do not use	3	1.18%
Farmer Networks	2	0.78%
Direct Communication	1	0.39%
Print Media	1	0.39%
Workshops/Seminars	1	0.39%
Total	255	100.00%



Source: Field Data,2025

The findings from the farmers were supported by other researchers who stated that the international community has made great strides towards providing the necessary support to grow the developing world's agricultural sector. However, many farmers continue to lack the necessary information and support networks to avoid crop and animal loss, find markets, or adapt to the effects of climate change. Attempts have been made by some NGOs to design technological services to fill this gap, but they have fallen short due to a top-down structure and inability to provide the means for a community of farmers to communicate and share information on a participatory and horizontal basis. When faced with a gap in their needs, the developing world is extremely adept at using its available resources in search of a solution. As a result, farmers throughout sub-Saharan Africa, and particularly in Kenya, have turned to social media Ottawa, (2020) World Bank Publication (April 2019), WhatsApp's growing presence in the developing world has led to a grassroots movement of messaging groups designed to serve relevant needs for the world's poor. Farmers lacking adequate information and seeking to join a community of practice have created WhatsApp groups that are specific to agricultural livelihoods.

Another Research by Boateng et al (2022) also supported the finding and stated that "We create WhatsApp groups into which we put our trainees, and we encourage them to use these WhatsApp groups as a marketplace…" Currently, we have several WhatsApp groups for the various training sessions that are formed after training for people in crop farming, livestock farming, agricultural technology, and agribusiness." Josephine, Hapa Space Community Manager. Digital social media and messaging platforms enable farmers to access market information and buyers in real time. For example, WhatsApp/Telegram groups and Facebook pages serve as informal marketplaces where farmers broadcast available produce and buyers make offers by linking scattered growers and traders.

These networks improve price discovery, where farmers learn current prices and negotiate better deals, linking the sellers to the buyers directly. They also support collective actions, for example, farmers' WhatsApp collectives have coordinated supply strategies to influence the prices from different buyers. Importantly, social media tools allow rapid information dissemination. In effect, digital networks overlay physical farming with a communication layer that can bypass middlemen and speed up transactions.

The findings are also supported by a study done by FAO (2024). Use of social media in Latin America is also growing. Studies by FAO and others note that smallholders in Latin America and the Caribbean increasingly rely on Facebook, WhatsApp, and YouTube to share farm information. For example, coffee and cacao farmer co-ops in Central America run WhatsApp groups to coordinate farm tours and share market prices. In Mexico and Brazil, agroecology networks use Facebook pages to distribute short videos on organic pest control and soil conservation. While rigorous impact studies are fewer in Latin America, development reports emphasize that digital platforms have democratized access to agronomic knowledge across the region.

The findings highlight a strong reliance on digital and social media platforms for information dissemination, with traditional media like radio still serving a significant minority, while other forms of communication play a minimal role in this context. The findings suggest that more farmers prefer digital networks to traditional networks.

4.2.2 Frequency of Use

The survey on the frequency farmers use social networks was also of interest to the researcher, the results indicate that most respondents use social networks frequently to share agricultural knowledge. Over half (54.18%) reported using these platforms daily, and an additional 38.18% use them weekly. A smaller portion of respondents (6.55%) share knowledge monthly, while only 1.09% indicated that they have never used social networks for this purpose. This suggests that social networks are an integral part of regular knowledge exchange in the agricultural community.

Respondent MCO 1 response on how often the ministry shares information with the farmers stated that it is all on a need basis, depending on current developments in place. Research done for cocoa in Ghana 2024 on social media got findings that social networks is a notable change in improving agricultural extension delivery,31.86 % of farmers spend thirty minutes to one hour daily browsing social media for agricultural information, which supports the findings on the frequency of social network use in Makueni County. In Indian horticulture, active social media facilitates daily advice, while formal visits are rare; this supports the findings from Makueni County mango farmers on the daily use of social networks. Mango growers in Asia or Africa are often served by mixed methods: some use social media on a need basis, while others only meet agents at seasonal training (typically once or twice a year), which supports respondent MCO 1.

Frequency of Social Network Use

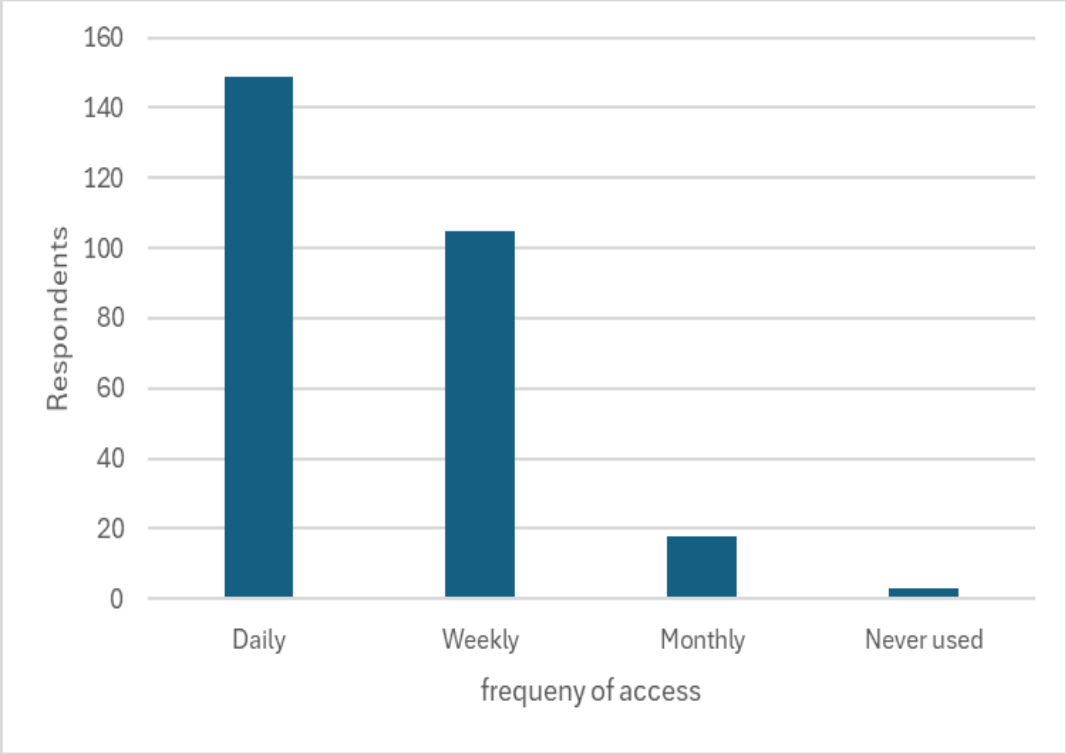


Figure 4.5: Frequency of Social Network Use
Source: Field Data,2025

These findings highlight the prominent level of engagement with social networks for agricultural knowledge-sharing, with daily and weekly use being the norm for most participants. These platforms are becoming primary sources of agricultural knowledge, market trends, pest/disease alerts, and access to buyers. In a 2021 study conducted in Kenya by CTA and Dalberg, over 80% of digitally connected farmers reported using social networks daily or weekly to receive or share farming information, which supports the findings from the research. Digital divide suggests that the frequency of social network use is strongly correlated with age, education.

level, mobile literacy, and network infrastructure. An increase in usage may also be spiked depending on season, for example, harvesting seasons and flowering seasons, where communication on pesticides is highly needed.

The study concludes that the frequency of using social networks is often indicative of real-time sharing of information, depending on the seasons, especially the flowering season, to ensure the recommended pesticides and harvesting season due to market networks.

4.2.3 Types of Agricultural Information Shared on Social Networks

The study sought to understand the type of information shared on the social network. The study revealed that different Information is shared on social networks. The respondents reported on a wide range of topics. The most shared information related to Crop & Farm Management, which accounts for nearly 31% of all responses. This is followed by Market Links & Value Chains (15.3%) and General Innovations (9.4%). Other notable categories include Innovations & Digital Technologies (7.1%), Community Engagement & Extension (5.9%), and Irrigation & Water Management, Language & Localization, and Variety & Seed Selection (4.7%). A small proportion of respondents (1.96%) indicated they share no agricultural information.

The data reflects a strong emphasis on practical farming practices and market access, with growing interest in digital innovations and community engagement. Less frequently shared topics include post-harvest handling, pest and disease management, climate and environment, and youth inclusion.

According to respondent MCO1, *building strong outreach systems and making sure they're decentralized and inclusive is one of the main types of information shared by the Ministry of Agriculture, which is mainly shared through radio announcements, posters, WhatsApp, Facebook, and community barazas.*

Respondents MCO2 and MCO3, and MCO4 in the interview stated *that social networks are highly used to leverage farmers at both the local and county level, promoting collaborations and farmer-to-farmer or peer-to-peer knowledge sharing.*

The study concludes that most farmers shared information includes best crop management practices, which include soil testing, an appropriate type of mango tree, irrigation, climate change, adopting modern technologies, and accessing markets, shared more among the farmers.

Table 4.8: Types of Agricultural Information Shared on Social Media

Type of Information Shared	**Frequency**	**Percent**
Crop & Farm Management	79	30.98%
Market Links & Value Chains	39	15.29%
General Innovations	24	9.41%
Innovations & Digital Technologies	18	7.06%
Community Engagement &Extension	15	5.88%
Irrigation & Water Management	12	4.71%
Language & Localization	12	4.71%
Variety & Seed Selection	12	4.71%
Interactive Approaches	10	3.92%
Open-source Data Sharing	7	2.75%

Agri-Financing & Credit	6	2.35%
None users	5	1.96%
Pest & Disease Management	5	1.57%
Post-Harvest Handling	7	1.57%
Climate & Environment	3	1.18%
Total	**255**	**. 100%**

Source: Field Data,2025

Research by Eduafo et al (2024) Cocoa farmers on the level of awareness of agricultural information on social media, found that the farmers regard social media platforms as potential sources of agricultural information. The respondents use social media to access agricultural information and implement farming practices, and farmers use social media information to improve crop yield and pest management. This supports the findings (cite the report) from Makueni County mango farmers who are using social networks to access information on distinct aspects, as indicated in the table above. Crop management entails soil testing, Pest control, plant management, and flowering until fruit ripening.

The International Fund for Agricultural Development (IFAD,2020) also supported the finding, indicating that social media and digital solutions are especially helpful in knowledge sharing. Many IFAD-supported programs, for instance, have created WhatsApp groups with lead farmers, allowing them to identify issues as they occur and develop innovative solutions. Farmers, markets, and suppliers also use online platforms and apps such as geo-mapping tools to build connections. In Cambodia, the IFAD-assisted ASPIRE project plans to use geo-mapping to locate and trace beneficiaries. Similarly, communities of practice have played a crucial role in allowing stakeholders to share problems, knowledge, and best practices across

countries and projects, enabling quick learning and the potential scale-up of solutions.

The study therefore noted that most shared information includes best crop management practices, which include soil testing, the appropriate type of mango tree, irrigation, climate change, adopting innovative technologies, and accessing markets, are among the most shared information by the farmers.

4.2.4 Social Networks and Access to Agricultural Knowledge

When asked how using social networks had improved their access to agricultural knowledge, respondents provided a broad spectrum of answers, which have been grouped into meaningful categories. The most often cited improvement was Information Sharing & Communication, being 14.5% of all responses. This highlights the significant role that social networks play in facilitating the exchange of knowledge, ideas, and best practices among farmers and agricultural stakeholders.

Other notable areas of improvement included Water & Irrigation Management (11.0%), reflecting the importance of efficient water use and irrigation techniques in modern agriculture. Both Market Access & Trends and Technology & Innovation were each cited in 10.2% of responses, indicating that social networks are valuable tools for being informed about market opportunities and technological advancements.

Production & Yield Improvement was mentioned in 9.4% of the responses, while Training, Knowledge & Extension activities made up 8.2%. These findings suggest that social networks.are also used to increase productivity and build farmers' capacity through education and extension services.

A significant share of respondents (7.8%) provided responses that were categorized as Other/Unspecified/Blank, indicating either that their answers did not fit neatly into the

predefined categories or were left blank. Other less frequently cited but critical areas include Post-Harvest & Value Addition (6.7%), Cooperatives & Collective Action (5.5%), Climate Resilience & Adaptation (5.1%), Pest & Disease Management (4.7%), Financial Support & Institutions (4.3%), and Quality & Seed Selection (2.4%).

Overall, these results demonstrate that social networks have become a vital resource for accessing a wide range of agricultural knowledge, from technical best practices to market information and collaborative opportunities.

A respondent stated that:

Our market is volatile in terms of pricing and cannot be predicted. The group has enabled me to talk to other farmers and know approximately how much a product will cost in the market. In the past, we needed to go to brokers, but now we can rely on each

Table 4.9: Improvements in Access to Agricultural Knowledge via Social Networks

Different Improvements	Frequency	Percent
Information Sharing & Communication	37	14.51%
Water & Irrigation Management	28	10.98%
Market Access & Trends	26	10.20%
Technology & Innovation	26	10.20%
Production & Yield Improvement	24	9.41%
Training, Knowledge & Extension	21	8.24%
Other/Unspecified/Blank	20	7.84%
Post-Harvest & Value Addition	17	6.67%
Cooperatives & Collective Action	14	5.49%
Climate Resilience & Adaptation	13	5.10%
Pest & Disease Management	12	4.71%
Financial Support & Institutions	11	4.31%
Quality & Seed Selection	6	2.35%
Total	255	100%

Source: Field Data,2025

Findings on improvements brought about by social networks in farming were discussed. Farmers indicated that knowledge sharing and communication have improved. Farmers get information almost immediately if connectivity is stable. Innovations and technology applications were also improved. This finding was also supported by different researchers who

agreed with the findings that social networks have improved knowledge sharing and effectiveness in communication.

Sadono and Unggara (2024) a study by the Asian Development Bank revealed that Indonesian rice farmers utilizing social networks increased knowledge about productivity, enhancing products, including organic fertilizers and pesticides. Notably, farmers who engaged with social media for over a year showed direct improvements in farm productivity.

Kanu (2024), rice farmers indicated that social media platforms, particularly Facebook and WhatsApp, significantly improved access to timely agricultural information. This facilitated peer-to-peer learning, reduced reliance on traditional extension services, and enhanced decision-making processes.

Almasi et al (2023) a study conducted in 2022 examined how small-scale chicken farmers in Arusha City, Tanzania, used social media to access market information, the finding was WhatsApp emerged as the most frequently used platform for accessing market information. Factors that improved profits to the farmers influencing this usage included perceived usefulness, ease of use, and smartphone ownership.

Koech, (2025) In Kericho, Kenya, young farmers are leveraging social media to revolutionize sustainable agriculture. For instance, Silas Kipruto utilizes WhatsApp and TikTok to educate peers on organic farming techniques, leading to increased visibility and business growth. These findings support Makueni County mango farmers, who stated that through social networks, improvement has been achieved in different areas.

The research concludes that social networks have revolutionized access to agricultural knowledge, making it faster, broader, and more collaborative. When integrated with formal

agricultural support systems, they can significantly enhance productivity, sustainability, and resilience in farming communities.

4.2.5 Specific Knowledge Learned Through Social Networks

A question to provide examples of specific knowledge or techniques learned through social networks that they have applied, the respondents indicated that the most frequently cited improvements related to Market Access & Trends, which accounted for 23.5% of all responses. This highlights the importance of social networks in helping farmers access new markets, understand market demands, and promote their products.

The next most common category was Post-Harvest Handling & Value Addition, mentioned in 17.7% of responses, reflecting the value of social networks in teaching techniques for preserving and adding value to agricultural products. Irrigation & Water Management was cited in 16.5% of responses, indicating that social networks are a key source of information on efficient water use and irrigation practices.

Production & Yield Improvement was reported in 12.9% of responses, followed by Pest & Disease Management at 9%. These findings show that social networks also play a significant role in sharing knowledge on increasing yields and managing pests and diseases. Other notable categories include Innovations & New Techniques (5.1%), Crop Management Practices (4.3%), Knowledge Sharing & Extension (2.8%), and Soil & Nutrient Management (1. 6%). Finally, Other responses-those that did not fit neatly into the predefined categories or were unclear-made up 6.7% of the total. These may include miscellaneous or unspecified examples, further illustrating the diversity of knowledge shared through social networks in agriculture.

Table 4.10: Knowledge Learned Via Social Networks

Types of social Networks	**Frequency**	**Percent**
Market Access & Trends	60	23.53%
Post-Harvest Handling &Value Addition	45	17.65%
Irrigation & Water Management	42	16.47%
Production & Yield Improvement	33	12.94%
Pest & Disease Management	23	9.02%
Other	17	6.67%
Innovations & New Techniques	13	5.10%
Crop Management Practices	11	4.31%
Knowledge Sharing & Extension	7	2.75%
Soil & Nutrient Management	4	1.57%
Total	255	100%

Source: Field Data, 2025

The findings on specific techniques learned by farmers demonstrated that through social networks, new and innovative techniques have been acquired from dissimilar sources of information, including farmer-to-farmer, peer-to-peer, and from experts. This finding was supported by other research on distinct types of techniques acquired through social networks. Mercy Corps (2021) supported the finding that during the January 2020 locust outbreak, smallholder farmers used a WhatsApp number (Media's iShamba service) to send photos of

locusts for expert verification and advice. This enabled real-time mapping of locust sightings and early warning for management measures, helping authorities target control efforts.

Fertilizer application advice, which helps farmers with crop management, is delivered via WhatsApp (AI chatbot) in Kenya. Farmers in Kericho and Machakos counties used an AI-powered "Virtual Agronomist" on WhatsApp to get tailored fertilizer recommendations for their coffee. One reported case saw a coffee yield jump from 2.3 to 7.3 tons per hectare after following the chatbot's advice, illustrating a large productivity gain from WhatsApp-based recommendation.

Jomantas et al (2021) supported the finding, "On their initiative plant doctors began to use chat groups to communicate on a wide range of topics, sharing observations on pest incidence, seeking advice on treating less-common plant pests, discussing logistics, and also socializing with colleagues." These online spaces "became nationwide peer-to-peer support groups of geographically dispersed plant doctors, with additional input provided by national experts in plant protection and research." stated that post-harvest storage technique using hermetic bags learned via YouTube video campaigns in Ghana, Kenya, and Nigeria demonstrates how farmers are getting new techniques for post-harvest storage of their products. A USAID-supported project produced short animations (in local languages) showing how to store beans in sealed containers to prevent losses. This was shared through the social network that served a large population. This huge viewership indicates wide exposure of smallholders to the improved storage method, implying potential adoption to reduce post-harvest spoilage, which has strongly supported the findings of how social networks are helping farmers on innovative technologies in farming.

The findings imply that social networks offer dynamic, context-specific, and timely agricultural knowledge that is often more accessible and practical than traditional sources. They

enable continuous learning, improve decision-making, and foster innovation among smallholders and commercial farmers alike.

4.2.6 Challenges Experienced Using Social Networks for Knowledge Sharing

The study sought to understand the challenges farmers experience when using social networks to access the market. The results revealed the main challenges farmers faced when using social networks for knowledge sharing. Misinformation and fake information are the most reported issues (32.94%), followed by information overload (21.96%). Connectivity issues (14.90%) and market access and buyer-related challenges (10.98%) are also significant barriers. Technical or operational issues (6.67%), product quality and shelf-life concerns (5.49%), monetization or commercialization of information (3.14%), water scarcity (1.57%), and other unspecified challenges (2.35%) are less frequently mentioned.

Table 4.11: Challenges Faced when Using Social Networks for Knowledge Sharing

Challenges Faced	Frequency	Percent (%)
Misinformation/Fake Info	84	32.94
Information Overload	56	21.96
Connectivity Issues	38	14.9
Market Access & Buyers	28	10.98
Technical/Operational Issues	17	6.67
Product Quality/Shelf Life	14	5.49
Monetization/Commercialization	8	3.14
Other	6	2.35
Water Scarcity	4	1.57
Total	255	100

Source: Field Data,2025

Chowdhury et al. (2023) supported the finding that Misinformation and trust issues as one of the main challenges experienced by farmers. They further indicated that social media could spread rumors; in farmer groups, a single complaint (e.g., about a bad seed lot or low auction price) can influence others' expectations, sometimes unfairly. A Kenyan study by (Caribou Digital, Kilimo Source, & Habitus Insight, 2022, p. 36). reported some cases of "mob psychology," which happens when one member's negative story causes others to avoid buying from the same source. Farmers often receive conflicting advice on social media, sometimes from unverified sources. This leads to skepticism and reluctance to adopt new techniques shared online. This has also been supported by CGIAR (2023). Plant Village Nuru, an AI-powered app

developed by Penn State and FAO, enables farmers in Nigeria and Kenya to diagnose pests and disease accurately via smartphone photos. The system connects trained extension agents to validate advice, creating trust and reducing misinformation.

Connectivity issues were also mentioned as a major challenge affecting farmers in using social networks. The World Bank (2021) supported the finding that many rural areas lack stable mobile or broadband connections. Even where access exists, mobile data remains too expensive for frequent use of apps like YouTube or WhatsApp. Without infrastructure and affordable internet, digital agriculture cannot scale. The oldest farmers are especially disadvantaged, for instance, the researchers observed a skills gap among agripreneurs using social media, and that fewer women-owned farms were leveraging these digital tools.

Information overload is one of the main challenges experienced by farmers in social networks. A 2021 study by Chiumbu and Mutsvairo in Information Development found that Zimbabwean farmers on social media were overwhelmed by constant streams of advice, which often led to inaction due to confusion or skepticism.

Too much information affects decision-making, especially from unverified sources, which can lower farmers' ability to make timely and informed decisions. This overload reduces trust in extension systems or leads to reliance on peer opinions over expert advice. In support of the finding, an evaluation by Digital Green (2022) in Kenya showed that farmers receiving fewer, curated messages from extension agents were more likely to adopt recommended practices than those active in unmoderated peer-led WhatsApp groups.

The study concludes that, while social networks have transformed knowledge sharing in agriculture, these challenges highlight the need for digital training programs, reliable content moderation, and Partnerships between governments, NGOs, and tech platforms to make social media a more effective and inclusive tool for agricultural development.

4.2.7. Overcoming Challenges of Social Networks for Knowledge Sharing

The study sought to understand the mechanisms put in place to counter the challenges mentioned by the respondents. The findings indicate that most respondents rely heavily on Consultation & Expert Advice to overcome challenges, with over 80% (80.78%) reporting this as their primary strategy. This underscores the importance of professional guidance, agricultural officers' support, and access to expert knowledge in helping individuals navigate difficulties effectively. It suggests that formal advice and consultation remain the cornerstone of problem-solving in this context.

Following this, Information Comparison emerges as the second most common approach, utilized by 11.37% of respondents. This strategy involves actively comparing dissimilar sources of information, reflecting a critical and discerning attitude towards knowledge acquisition. It highlights that many participants seek to validate information before applying it, which is essential for informed decision-making.

Other strategies, such as Farmer Interaction and Use of Websites & Wifi, account for 2.35% of responses. These methods emphasize the role of peer support and digital tools in complementing expert advice. The relatively low percentages may indicate limited access to technology or underutilization of peer networks compared to consultation with experts.

Finally, Water & Irrigation strategies are the least reported (0.78%), indicating that only a small fraction of respondents specifically address challenges through resource management techniques. The Other category, encompassing miscellaneous or less frequent strategies, accounts for 2.35% of responses and is placed last to maintain clarity in the presentation of primary approaches.in the discussions, the respondents agreed the need of more

information literacy training to the farmers and other stakeholders which will help them in filtering information from experts and from any other authority.

Respondents MCO 5, 6, 7, 8 were in consensus that the challenges are visible, and collaboration is required. MCO 7 stated that social networks move the focus from individual actors to groups of people who interact. Overall, the data reveals a clear preference for expert consultation, supplemented by information validation and community or technological support, illustrating a multi-faceted approach to overcoming challenges.

Strategies for Overcoming Challenges

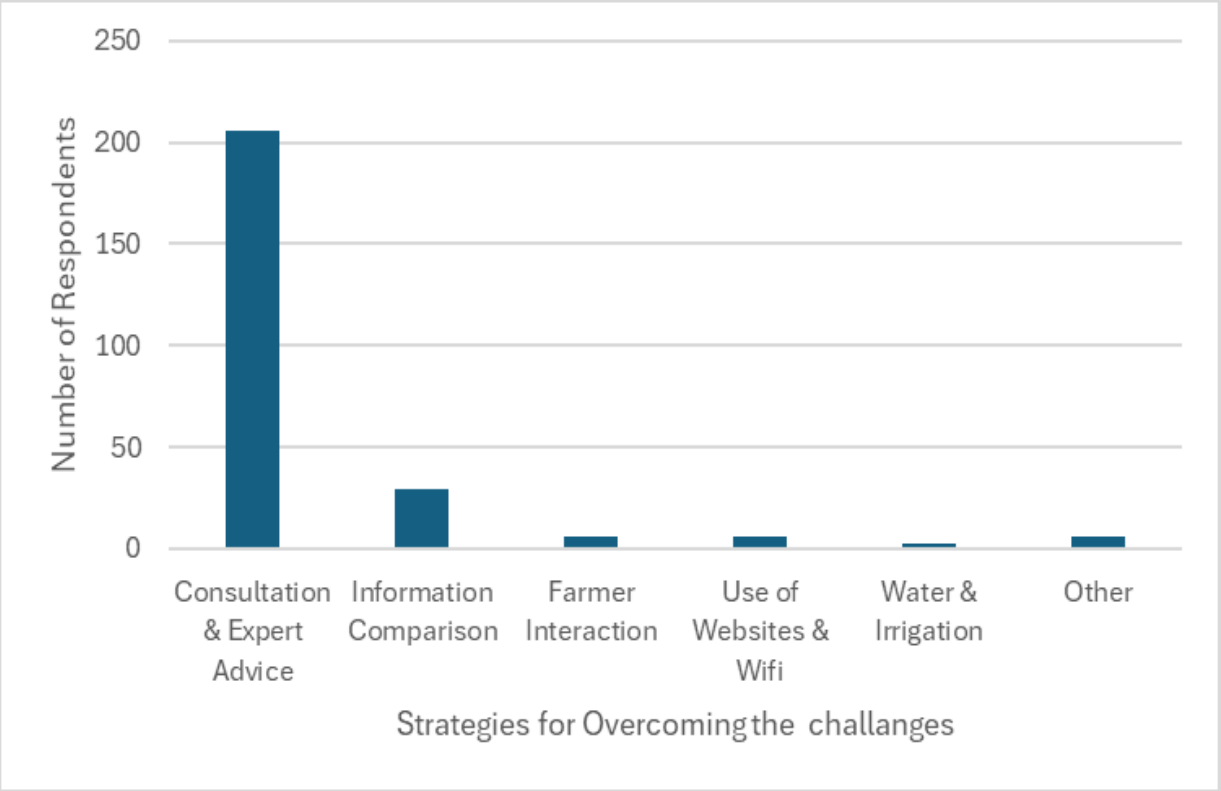


Figure 4.6: Strategies for Overcoming Challenges
Source: Field Data, 2025

Social networks have emerged as important platforms for knowledge exchange within organizations and communities. However, despite their potential, several challenges hinder

their effectiveness. These challenges can be tackled through strategic interventions, cultural shifts, and technological improvements**.**

FAO (2022) supported the strategies applied by farmers in India, using digital advisory services like AgriBot and WhatsApp groups run by agricultural universities, significantly reducing the spread of misinformation by involving certified agronomists (experts). Experts and agricultural extension officers act as fact-checkers, correcting inaccurate posts and providing evidence-based information that helps the farmers verify information.

Tambo et al (2019) in their study in Uganda found that WhatsApp consultations with local extension officers improved farmers' ability to manage Fall Armyworm outbreaks. Experts use data and experience to offer context-specific recommendations tailored to a farmer's region, crop, and challenges.

The World Bank (2021) highlighted that in Ethiopia, engagement of public extension officers in Telegram groups led to higher adoption of drought-resilient practices. Having experts or recognized agricultural officers actively engage in social network groups builds confidence in the shared advice. Experts serve as trusted voices, reducing reliance on hearsay.

In Kenya, as reported by the International Fund for Agricultural Development (IFAD 2023), digital literacy programs paired expert trainers with farmers, significantly improving the way farmers filtered and shared information on WhatsApp, promoting a culture of digital literacy and responsible information sharing.

Another Strategy to overcome the challenges of social networking, according to the respondents, was information comparison. This entailed cross-verifying information from multiple sources before application. This strategy was supported by several researchers (CGIAR, 2023) Social networks allow farmers to interact with peers in different geographic

zones by comparing how the same problem is addressed in different regions, adjusting the techniques applied to different conditions, learning from success and failures, and understanding the context of varying advice. The exchange of regional experiences among farmers on social media supports context-based validation of agricultural advice (CGIAR, 2023).

World Bank (2021) supported the findings that farmers who compare information across sources are more likely to make better-informed and context-specific decisions. This is attained by regularly comparing information sources, leading to independent decision-making, reducing reliance on unreliable influences, and gaining confidence in distinguishing between true and false content.

Websites and peer-to-peer (P2P) support systems are proving to be valuable tools that help farmers overcome the challenges of using social networks for knowledge sharing. These two tools complement each other by providing accurate information and real-life experience, thereby building resilience, and promoting informed agricultural practices.FAO,2022 supports the finding that access to online agricultural resources improves the quality of decision-making for farmers and reduces reliance on rumors spread via social media. Some reliable agricultural Websites include: FAO e-Agriculture, Plant Village, Kenya Agricultural and Livestock Research Organization (KALRO), CABI Plantwide Knowledge Bank, among others. Websites and peer-to-peer support are essential tools that help farmers to validate the information they receive on social networks and help in gaining insights from real experiences, leading to confidence in decision-making. When used together, they form a robust agricultural knowledge system that blends science and experience, improving productivity and resilience in rural communities.

Overcoming the challenges in social media-based knowledge sharing requires inclusive, localized, and participatory strategies that are guided by experts and integrating technology, education, human-centered design, and social networks can become more effective platforms for agricultural development, innovation, and empowerment.

4.2.8 Improvement for a better Agricultural Social Network

The data highlighted the principal areas where improvements are suggested for the use of social networks in knowledge sharing. Training & Capacity Building was the most recommended improvement (28.63%), followed by Information Verification & Trust (20.00%). Access to Innovations &Networks (13.33%), Partnerships & Collaboration (12.94%), Feedback & Community Engagement and Localized & Relevant Content (both 5.88%), Market & Buyer Connectivity (5.10%), Other (4.31%), and Offline & Technical Support (3.92%) are also identified as critical areas for improvement.

Improvement of a Better Agricultural Social Network

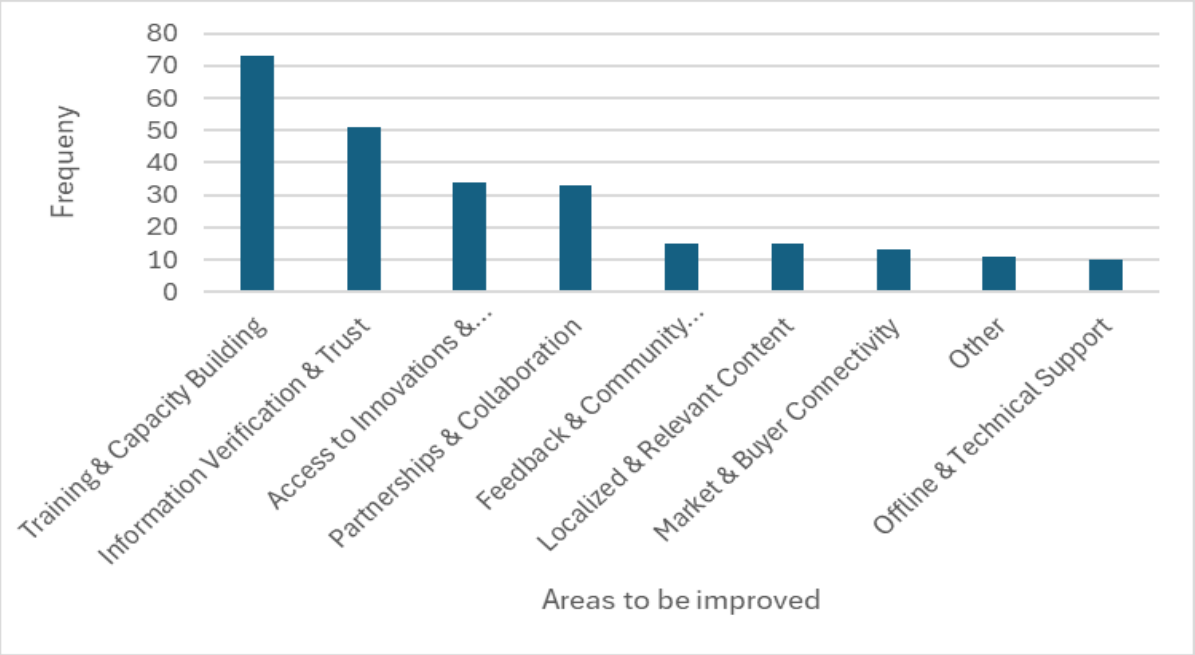


Figure 4.7: Improvement of a better Agricultural Social Network
Source: Field Data,2025

As demonstrated in the diagram above, training and capacity building took the greatest percentage of areas that need to be improved, followed by verification of information and trust in the information shared. FAO (2022) supports the findings by highlighting community-based training sessions as essential to improving farmers' capacity to use digital tools effectively. This can be attained by highlighting community-based training sessions as essential to improving farmers' capacity to use digital tools effectively. This can be enabled through Enhancing Digital Literacy Training Programs, which provide digital training tailored to farmers, significantly boosting adoption. For instance, Farmer LINE in Ghana and Digital Green in India offer smartphone and digital literacy training to smallholders through local extension agents.

Through training and capacity building, communication channels are strengthened by providing programs that equip farmers with digital literacy skills, enabling them to use social media and online platforms to connect with peers, experts, and markets.

Allen (2024) agreed with the finding in his research that training and capacity building are areas that need to be improved stated that training facilitates knowledge exchange, sharing experiences, and learning from each other, hence building trust within the agricultural communities. Training and capacity building encourage cooperative development, achieved by having programs that often emphasize the benefits of farmer cooperatives, helping individuals form groups that enhance collective bargaining power and resource sharing.

Training helps in the integration of modern technologies, training programs introduce farmers to smart farming technologies, which help in improving their ability to engage with digital marketplaces and agricultural innovation networks. According to Allen (2024) the core of the transformation in rural agriculture is the drive towards innovation and sustainability. Training programs are not just about imparting knowledge; they are also about inspiring farmers to think creatively and adopt innovative practices that can lead to more sustainable and productive farming systems.

Kenya Institute for Public Policy Research and Analysis (KIPPRA, 2024) concurred with the finding that most smallholder farmers lack the digital literacy skills required to safely use digital tools and platforms. Limited technical proficiency and limited knowledge may result in less use of smartphones compared to simpler feature phones. The complexity of some apps, such as a complicated registration process that requires an email address (Ulima app), discourages farmers from using them, which lowers uptake and usage rates. In addition,

Smallholder farmers are deemed to have a low level of education and are more likely to be digitally illiterate.

KIPPRA (2024). Information verification and trust were areas that needed improvement. Improving information verification and trust is crucial for promoting knowledge sharing and enhancing market access for farmers, Izuchukwu (2023) stated that promoting and strengthening digital platforms, encouraging peer-to-peer networks, leveraging ICT solutions, enhancing transparency in market transactions, and providing expert-led training by agricultural extension services and consultation help farmers distinguish sources from unreliable ones and authentic Sources.

Access to Innovations & Networks infrastructures was also indicated as an area that needed to be improved, KIPPRA (2024). Inconsistent and unreliable power supply in most rural areas limits the efficient use of digital technologies as it hinders farmers' engagement with online markets, real-time information, and data collection, and the operation of digital tools and equipment. Reliable electricity in remote farming communities is pivotal for unlocking the full potential of technology, enabling smallholders to access markets, make informed decisions, and participate effectively in the agricultural produce market, ultimately fostering economic growth and sustainability in rural Kenya.

While social networks have already begun transforming how agricultural knowledge is shared, their full potential can only be realized by making them more accessible, credible, and purpose- driven, which can be achieved through information literacy training. Improvements in content quality, usability, trust, and integration with formal systems will ensure that social media becomes a powerful tool for agricultural and sustainable development.

4.3 The Role of ICT in Knowledge Sharing among Farmers

In this section, the researcher wanted to establish if farmers have adopted the use of Information and communication technology (ICT) in their farming practices. The survey results indicate a remarkably high adoption of Information and Communication Technology (ICT) among respondents in their farming practices. Specifically, 96.05% (243 out of 253) of participants reported having experience using ICT in their agricultural activities. This suggests that most farmers in the sample are integrating digital tools, platforms, or technologies into their farming operations, reflecting a strong trend towards modernization and digital engagement in agriculture.

Conversely, only 3.95% (10 respondents) indicated that they do not have experience with ICT in their farming practices. This minority highlights a small segment of the population that may face barriers to ICT adoption, such as lack of access, skills, or resources. These findings demonstrate that ICT usage is widespread among the surveyed farmers, positioning digital solutions as a vital component of contemporary agricultural practice in the study area.

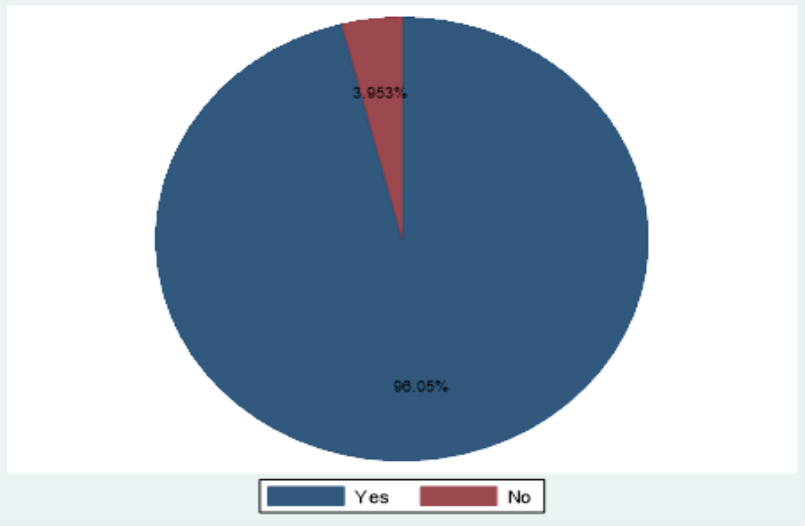


Figure 4.8: Experience of Using ICT in Farming Practices
Source: Field Data,2025

The figure illustrates that most of the farmers are digitally literate and a smaller group of farmers are illiterate**.** There is need to bridge the gap on digital literacy among the farmers to ensure all the farmers benefit equally in knowledge, accessing and sharing.

4.3.1 ICT Tools Used to Access Information by the Farmers.

The researcher wanted to establish the types of tools used to access information for those who indicated they are compliant. The data on ICT types used among respondents shows a clear dominance of digital device usage. An overwhelming majority of 98.42% (249 out of 253) reported using Digital Devices, which include smartphones and computers. This highlights the widespread adoption of modern digital technologies within the surveyed population. Only an exceedingly small fraction of respondents indicated no use of ICT, with 1.19% (3 respondents) reporting None, meaning they do not use any ICT tools. Additionally, a negligible proportion, 0.40% (1 respondent), reported relying on Traditional Media such as community meetings

(chief barazas) rather than digital technologies. These results demonstrate that digital devices are the primary means through which respondents access ICT services, underscoring their importance for communication, information, and agricultural or financial activities.

Table 4.12: Types of ICT Tools Used to Access Agricultural Information

ICT Type Group	Frequency	Percent (%)
Digital Devices	249	98.42
None/Do not used	3	1.19
Traditional Media	1	0.4
Total	253	100

Source: Field data, 2025

4.3.2 How Often Do you Use ICT tools to Access Agricultural Information

The data reveals that most respondents use ICT tools frequently to access agricultural information. Specifically, 51.78% of participants reported using ICT tools daily, indicating an elevated level of regular engagement with digital resources for farming-related knowledge. This suggests that over half of the farmers rely on ICT as an integral part of their daily agricultural decision-making process.

An additional 37.15% of respondents use ICT tools weekly, reflecting consistent but less frequent interaction with digital platforms. Together, these two groups account for nearly 89% of the sample, demonstrating that ICT usage is a routine activity for most farmers.

The remaining 11.07% reported using ICT tools occasionally, indicating occasional or sporadic access to agricultural information through digital means. This smaller segment may face barriers such as limited access, lack of familiarity, or intermittent connectivity. These findings highlight the widespread and frequent use of ICT tools among farmers for accessing

agricultural information, underscoring the importance of digital technologies in contemporary agricultural practices. A study by Ahmadi et al (2025) Unpacking the impacts of digitalization of knowledge transfer in agri-food sector, through sociotechnical systems theory: a systematic literature review, supported the finding by revealing the importance of the interaction subsystem as the interface through which technical and social aspects co-evolve. Knowledge management, e-governance, and connecting farmers directly to advisors and scientists increase productivity and other socioeconomic spillovers, such as reducing poverty, establishing inclusive policies, and promoting sustainable agricultural practices.

Table 4.13: Frequency of ICT use to Access Agricultural Information

Frequency	**Frequency (n)**	**Percent (%)**
Daily	131	51.78
Weekly	94	37.15
Occasionally	28	11.07
Total	253	100

Source: Field data,2025

4.3.4 Challenges Experienced in Integrating ICT and Farming

The study identified several key challenges faced by farmers in integrating Information and Communication Technology (ICT) into their agricultural practices. The most prominent challenge, reported by over half of the respondents (53.33%), relates to connectivity and infrastructure. This includes issues such as poor internet access, inadequate technological infrastructure, and unreliable power supply, which significantly hinder effective use of ICT tools in farming. Cost and affordability emerged as the next major barrier, with 10.20% of

respondents highlighting the high expenses associated with acquiring and maintaining ICT devices and services. Closely related are challenges concerning technical support and the availability of suitable devices, reported by 9.80% of participants. These challenges reflect the need for accessible technical assistance and appropriate technology tailored to farmers' needs. Training and skills deficits were also notable, accounting for 7.06% of the challenges.

Many farmers lack adequate training programs and digital literacy, limiting their ability to effectively utilize ICT solutions. Concerns about data privacy and the relevance of information constituted 5.10% of the reported challenges, indicating apprehensions about security and the quality of digital content. Resistance to adopting recent technologies and slow uptake were reported by 3.53% of respondents, underscoring behavioral and cultural barriers to ICT integration. Lastly, a diverse range of other challenges, comprising 10.98% of responses, captured unique or less common issues that did not fit neatly into the main categories.

Overall, these findings highlight that improving connectivity infrastructure, reducing costs, enhancing technical support, and providing targeted training are critical to overcoming barriers and promoting effective ICT adoption in agriculture.

Table 4.14: Challenges Experienced in Integrating ICT and Farming

Challenge Group	Frequency	Percent (%)
Connectivity & Infrastructure	136	53.33
Cost & Affordability	26	10.2
Technical Support & Devices	25	9.8
Training & Skills	18	7.06
Data Privacy & Information	13	5.1
Adoption & Resistance	9	3.53
Other	28	10.98
Total	255	100

Source: Field Data,2025

Recent research by FAO 2022 confirms that smallholder farmers face multiple barriers when adopting information and communication technologies in agriculture. Analyses highlight a broad digital divide: for example, FAO/ITU (2022) stress the need to strengthen rural connectivity to connect the unconnected in sub-Saharan Africa. The reports on data.unchr.org support the findings from the research which mentioned connectivity and infrastructures as the major challenges experienced by the farmers and are also supported by interviews from the County Government respondents.

A study by Gizachew (2024) found that even when farmers have devices, many live in areas with poor network or power. A recent review in sub-Saharan Africa found that insufficient network coverage, unreliable electricity supply, and poor internet connectivity are familiar challenges in rural areas. In practice, this means farmers cannot consistently access real-time weather forecasts, market prices, or online extension content. For example, Ethiopian farmers

and officials explicitly cited a lack of internet access in remote districts as a top barrier to using digital services.

Development agencies including International Fund for Agricultural Development (IFAD) World Bank, and Ungana-Afrika also echo the findings of FAO/ITU, which call for massive investments in rural telecoms to close the digital gaps in connectivity and infrastructure.

Some of the identified gaps include Coverage gaps, many villages have no or spotty 3G/4G signals. Farmers report that even when mobile networks are available, the network is often slow and unstable. Power shortages, unreliable electricity mean phones and routers go dead. Solar panels and community chargers are often suggested stopgaps.

Agency finding: A FAO/ITU survey of 47 African countries explicitly highlights the need to strengthen digital infrastructure for universal connectivity in rural areas. Cost & Affordability is cited as common barrier to ICT adoption among farmers, including the excessive cost of devices, digital services, and internet/data plans. These costs limit both access to and sustained use of agricultural technologies, especially among smallholder farmers in low-income regions.

A 2022 report by the Alliance for a Green Revolution in Africa (AGRA) supported the finding by reporting that rural farmers limited their use of agricultural apps (e.g., Digi Farm and iCow) due to unaffordable data charges. Many reported that they could only afford to top up data once or twice a month, limiting their access to real-time information like weather alerts or market prices.

Advanced technologies remain out of reach for many small businesses. Smallholders reported that pay-per-use models were still too costly without government subsidies. Affordability remains a structural barrier to digital agriculture. Farmers interviewed in recent studies overwhelmingly stated that if digital tools were cheaper or paid off financially, they would use them more often. The challenge is not just access, but sustained use. Addressing

this requires coordinated efforts from governments, NGOs, and private companies to subsidize costs, build cost-effective models, and provide financial support tailored to farmers' realities. The findings imply that, while ICT has enormous potential to modernize agriculture and improve livelihoods, its integration faces multi-dimensional challenges, which include technical, social, economic, and institutional. To overcome these, it is essential to invest in rural infrastructure, provide farmer-centered training and support, and develop inclusive, affordable, and localized digital solutions.

4.3.5 Platforms for Agricultural Knowledge Sharing

The analysis of ICT platforms used by respondents to access agricultural information reveals a clear preference for Agricultural Platforms and Apps, which constitute most responses at nearly 62%. This category includes a variety of digital tools such as farm management software, soil health monitoring apps, and precision farming technologies, highlighting the vital role of specialized agricultural applications in supporting farmers' information needs.
Following this, Farmers Markets platforms account for approximately 11% of the responses. These platforms facilitate direct connections between farmers and buyers, playing a vital role in market access and trade. E-Extension and E-commerce platforms represent 8.63% of the responses, indicating the importance of digital extension services and online marketplaces in disseminating agricultural knowledge and enabling transactions.

Other notable categories include social media and Communication platforms (3.92%), such as WhatsApp and Facebook, which serve as informal but effective channels for information sharing and community engagement. Websites and Internet platforms account for 3.14%,

reflecting on the use of online resources and agricultural websites. Lastly, Specific Platforms, including named services like Agri Webb and Digi Farm, make up 2.75% of the responses. Finally, the other category, comprising 8.63% of responses, encompasses diverse or less common platforms that do not fit neatly into the main categories, indicating a variety of additional tools and technologies utilized by farmers. Gwelo (2025) supported the findings on his research on Social Media Apps and the Democratization of Agricultural Knowledge, he stated that policymakers, agricultural support agencies, and digital platform designers must recognize and actively support the evolving role of social media in agricultural knowledge systems. This means moving beyond conventional approaches that prioritize top-down extension models and instead fostering environments where peer-to-peer knowledge exchange is legitimized, supported, and integrated into formal agricultural strategies.

Table 4.15: ICT Platforms used to Access Agricultural Information

ICT Platform Group	Frequency	Percent (%)
Agricultural Platforms & Apps	158	61.96
Farmers Markets	28	10.98
E-Extension & E-commerce	22	8.63
Social media & Communication	10	3.92
Websites & Internet	8	3.14
Specific Platforms	7	2.75
Other	22	8.63
Total	255	100

Source: Field data,2025

The study findings point to the fact that diversity of platforms from social media and apps to field schools and radio ensure that agricultural knowledge can be shared across different regions, literacy levels, and technology access points. A combination of these platforms, when localized and inclusive, can greatly enhance the resilience, productivity, and profitability of farming communities.

4.3.6 Use of ICT Tools to Improve Farming Practices

The results show that the most reported improvement from using ICT in farming is better access to information and support for decision-making, mentioned by 28.24% of respondents. Many farmers highlighted that ICT helps them obtain timely and relevant information, which improves their ability to make informed choices. Following closely, 25.49% of respondents said ICT has contributed to increased productivity and better crop management. This includes improvements in monitoring crops, managing diseases, and adopting effective farming practices. About 14.12% of farmers reported that ICT has helped them connect directly with buyers and improve their market access, which supports better sales and income. Other improvements include better access to financial products and increased profitability (5.88%), the adoption of innovative technologies (4.71%), enhanced collaboration and networking with other farmers (3.14%), and improved access to weather and environmental information (2.75%). Lastly, 15.69% of respondents mentioned various other improvements that did not fit into the categories above, reflecting a range of additional benefits experienced using ICT.

Table 4.16: Improvements Experienced by Use of ICT in Farming

Improvements Experienced by Use of ICT	Frequency	Percent (%)
Information & Decision Support	72	28.24
Productivity & Crop Management	65	25.49
Market Access & Direct Sales	36	14.12
Financial Access & Profitability	15	5.88
Innovation & Technology	12	4.71
Collaboration & Networking	8	3.14
Weather & Environmental Info	7	2.75
Other	40	15.69
Total	255	100

Source: Field Data,2025

The adoption of Information and Communication Technology (ICT) tools has brought substantial transformation to farming practices globally. The findings reveal that ICT tools help farmers improve productivity, decision-making, market access, climate resilience, and climate resilience, finance access, and collaboration. The findings were supported by different researchers.

CTA and Dalberg (2023). The integration of ICT (Information and Communication Technology) into agriculture has notably strengthened information dissemination and decision support systems, particularly for smallholder farmers. This transformation empowers farmers with timely, accurate, and actionable insights, leading to better planning, increased productivity, and climate resilience. The findings emphasize that ICT plays a vital role in narrowing

the information gap and enabling smarter farming decisions. ICRISAT (2023) ICT-powered decision support systems in agriculture offering data-driven recommendations based on issues like soil health, weather patterns, market demand, and historical crop performance. These tools reduce guesswork and help farmers allocate resources more efficiently.

In conclusion, ICT tools are transforming agriculture into a more efficient, profitable, and sustainable sector, enabling better planning, timely interventions, and improved market access. These technologies empower farmers to make informed decisions, improve yields, and adapt to climate challenges. However, scaling their impact requires investment in digital literacy, infrastructure, and inclusive access.

4.3.7 Specific Information Acquired Through ICT

Data revealed that nearly half of the respondents (46.27%) applied knowledge related to Crop and Pest Management. This category includes techniques such as pest and disease control, soil health analysis, fertilization, and seed propagation, highlighting the critical role of ICT in improving crop health and productivity.

The second most shared area of application is Decision Making and Information, reported by 16.86% of respondents. Farmers in this group benefit from improved decision-making, access to real-time weather information, expert advice, and risk management strategies facilitated by ICT.

Farming Techniques and Productivity improvements were mentioned by 11.76% of respondents. This includes sustainable farming practices, post-harvest handling, and modern farming methods learned through ICT platforms. Both Collaboration and Extension and Market Access and Pricing were reported by 3.92% of respondents each. These categories reflect the

use of ICT for accessing extension services, peer learning, and improving market participation and pricing knowledge.

Water and irrigation-related knowledge and techniques were applied by 6.67% of respondents, indicating the role of ICT in supporting efficient water management and irrigation practices. Finally, the other category accounts for 10.59% of responses. This group includes diverse or less frequent examples that did not fit into the main categories, suggesting some unique or individual uses of ICT in farming. The results demonstrate that ICT has a broad impact on various aspects of farming, with a strong emphasis on crop management and decision support.

Table 4.17: Examples of Information Acquired Through ICT

Information Learnt through ICT	Frequency	Percent (%)
Crop and Pest Management	118	46.27
Decision Making & Information	43	16.86
Farming Techniques & Productivity	30	11.76
Water and Irrigation	17	6.67
Collaboration & Extension	10	3.92
Market Access & Pricing	10	3.92
Other	27	10.59
Total	255	100

Source: Field Data,2025

Information and Communication Technology (ICT) in agriculture has become instrumental in knowledge transfer, helping farmers learn and adopt modern and different farming techniques. ICT tools such as mobile apps, digital videos, SMS platforms, and e-learning portals have bridged the knowledge gap, especially for smallholder farmers. The findings indicate that ICT is not just a source of information but also a practical learning platform for acquiring new agricultural techniques.

New knowledge aquired by farmers by applying ICT in farming, according to the findings, entails different farming techniques. Other researchers agreed with the finding that through learning application of ICT in agriculture, differences in farming have been noted. For example, ICRISAT (2023) supported the finding that Farmers are learning how to implement precision agriculture methods through ICT platforms, including data-based fertilization, irrigation scheduling, and pest control. In India, farmers using the Kheti-Badi app have learned to use drip irrigation systems and GPS-based field mapping. This knowledge has led to better water and nutrient use efficiency.

Digital Green (2023) ICT tools support the dissemination of climate-smart and environmentally friendly farming methods such as crop rotation, cover cropping, and organic composting. Digital Green, a platform that shares community-produced agricultural training videos, has enabled Ethiopian and Indian farmers to adopt organic pest control techniques and improved composting methods. This technique has been adapted in Makueni County, minimizing the use of chemicals in the prevention and management of pest control.

GSMA Agri Tech (2023) ICT platforms are increasingly offering training on processing techniques, branding, and marketing of agricultural products, allowing farmers to move up the value chain. In Nigeria, the Farm rowdy platform includes tutorials on producing tomato paste, packaging honey, and producing organic fertilizer for sale, helping farmers turn raw produce

into commercial goods.

The findings indicate that ICT is a vital tool for agricultural learning and capacity building. Cite a study with comparable results to strengthen the point… Farmers are not just accessing generic advice but are actively learning new techniques from precision farming to post-harvest handling, through user-friendly and scalable digital platforms. These technologies help bridge the gap left by insufficient agricultural extension services, especially in remote areas. However, to realize the full potential of ICT in agricultural learning, challenges such as digital literacy, affordability, and infrastructure must be addressed.

Concisely, ICT tools provide farmers with critical, timely, and specific information that enhances every aspect of farming from crop planning to marketing. This knowledge empowers farmers to become more productive, resilient, and profitable.

4.3.8 Challenges Faced in Using ICT Knowledge-Sharing Tools

The analysis of challenges faced by respondents in using ICT knowledge-sharing tools reveals several key barriers. The most frequently reported challenge is Connectivity Issues, cited by 20.39% of respondents. This includes problems such as unreliable internet connections, poor network coverage, and unstable networks, which significantly hinder effective ICT use.

Closely following are Cost and Affordability challenges, accounting for 19.22% of responses. Excessive costs of devices, services, and connectivity remain major obstacles for many users.

Training and Digital Literacy challenges are also prominent, reported by 18.04% of respondents. This reflects difficulties related to lack of training programs, limited digital skills, and low digital literacy, which affect users' ability to effectively utilize ICT tools.

Infrastructure Challenges, such as inadequate infrastructure and unreliable electricity, were mentioned by 12.94% of respondents, highlighting the foundational barriers to ICT adoption in

many areas. Technical Support and Access issues, including limited technical assistance and lack of access to appropriate technology, account for 7.45% of the challenges. Content and Language Barriers were reported by 6.27% of respondents, indicating that a lack of relevant content and language support limits ICT effectiveness. Resistance and Adoption challenges, including reluctance to adopt modern technologies, were cited by 5.10% of respondents. Data Privacy and Security concerns make up 3.53% of responses, reflecting data misuse and privacy concerns. Finally, the other category, comprising 7.06% of responses, includes diverse or less familiar challenges that do not fit neatly into the main categories. The findings highlight the multifaceted nature of barriers to ICT use, with connectivity, cost, training, and infrastructure being the most significant challenges to address.

Table 4.18: Challenges Faced in Using ICT Knowledge-Sharing Tools

Challenge Group	Frequency	Percent (%)
Connectivity Issues	52	20.39
Cost & Affordability	49	19.22
Training & Digital Literacy	46	18.04
Infrastructure Challenges	33	12.94
Technical Support & Access	19	7.45
Content & Language Barriers	16	6.27
Resistance & Adoption	13	5.1
Data Privacy & Security	9	3.53
Other	18	7.06
Total	255	100

Source: Field Data, 2025

This study explored the challenges farmers face when using ICT-based knowledge-sharing tools for agricultural purposes. The findings of this research are consistent with previous studies and shed light on several critical issues affecting the effective adoption and use of ICT tools in the agricultural sector. Firstly, the study found that poor internet infrastructure and network coverage in Makueni county emerged as a key challenge. Participants reported difficulty accessing timely information due to unstable or non-existent mobile networks. This is supported by the findings of KIPPRA (2024), which observed that inadequate Internet penetration in rural areas hinders farmers from receiving real-time market information, thus affecting their ability to make informed decisions, leading to potential losses and inefficiency in the agricultural produce market. As of 2023, Internet penetration in Kenya was 32.7 per cent, with 17.86 million users and 63.94 million active cellular mobile connections. Despite major investments to improve rural connectivity by installing Internet/WIFI in rural markets, Internet access remains prohibitively expensive for a sizable portion of the population. In addition, many rural areas have not profited from Kenya's high-capacity bandwidth, owing to market inequities and limitations in last-mile connectivity, which is costly and necessitates basic facilities such as electricity and roads, which are frequently underdeveloped.

Inconsistent and unreliable power supply in most rural areas limits the efficient use of digital technologies as it hinders farmers' engagement with online markets, real-time information. Policy emphasis on enhancing power infrastructure and implementing sustainable energy solutions is paramount. Reliable electricity in remote farming communities is pivotal for unlocking the full potential of technology, enabling smallholders to access markets, make informed decisions, and participate effectively in the agricultural produce market, ultimately fostering economic growth and sustainability in rural Kenya.

Limited affordability and access to smartphones and computers hinders rural farmers from utilizing digital tools. The choice to use a digital agricultural platform depends on the farmers' ability to access and use the existing technologies. Farmers facing financial constraints may lack the necessary tools to engage in digital agriculture, creating a digital divide that exacerbates information asymmetry, limiting farmers' ability to access online markets and make informed decisions. Policy makers must prioritize initiatives that promote affordable devices and digital literacy, bridging the technological gap. Addressing this issue is vital for ensuring equitable participation in the digital agricultural ecosystem, enabling smallholders to access online markets, receive real-time information, and make informed decisions in the agricultural produce market, thus contributing to their economic empowerment and overall development. Most smallholder farmers lack the digital literacy skills required to effectively use digital tools and platforms. Limited technical proficiency and limited knowledge may result in less use of smartphones compared to simpler feature phones.

A gap in communication between users' involvement in app development and app developers limits the usage of these apps. The bulk of mobile applications fail to recognize that farmers require direct market links in addition to price information. They are unable to capitalize on these opportunities despite having price information. Twiga Foods, for instance, depicts a working collaborative model as it has a complete value chain relationship that connects farmers to consumers. Other apps come with subscription fees, which farmers may not be able to afford. Developers need to consider and understand the social and economic context in which the apps will be utilized to make them relevant and user-friendly.

These findings underscore the need for targeted interventions to address the identified challenges. Strategies may include digital literacy training programs, infrastructure

development, content localization, financial support for device acquisition, and initiatives to build trust in digital platforms. Addressing these issues is vital for ensuring equitable participation in the digital agricultural ecosystem, enabling smallholders to access online markets, receive real-time information, and make informed decisions, thereby contributing to their economic empowerment and overall development.

The research concludes that ICT tools hold great promise for transforming agricultural knowledge sharing, but systemic and practical challenges remain to improve adoption, and impact infrastructure must be improved, tools must be localized and affordable, farmers must be empowered through training, trust-building, and inclusive design.

4.3.9 Additional ICT Tools for Agriculture

The analysis of the features of ICT tools used by respondents reveals that the majority, 62.35%, reported using Alerts and interactive voice features. This indicates that timely notifications, updates, and advisory services are the most valued and commonly utilized ICT functionalities among the users, likely to help farmers stay informed about important agricultural events, market conditions, or weather changes. A substantial portion, 31.37%, falls under the offline able app, another sizeable group suggests that nearly one-third of the participants may not be actively using or aware of specific ICT features, or possibly do not have access to such functionalities. Other categories were reported much less frequently. Quality & Standards features, which include tools for tracking produce quality and improving farming standards, were mentioned by 1.96% of respondents. Similarly, Content & Educational Tools and Market Access & Prices each accounted for 1.57% of responses, reflecting a smaller but meaningful use of ICT for learning and market-related purposes.

Finally, Financial Services, such as microloans or mobile banking features, were the least reported, at 1.18%, indicating limited use or access to financial ICT services among the respondents. These results highlight that while alerts and advisory services dominate ICT usage, there is a massive portion of users who either do not engage with specific features or lack access, and other functionalities like quality control, education, market access, and financial services are less commonly utilized.

Table 4.19: ICT Features Used by Respondents

ICT Feature Group	Frequency	Percent (%)
Alerts and interactive voice response	159	62.35
Offline-enabled app	80	31.37
Quality & Standards	5	1.96
Content & Educational Tools	4	1.57
Market Access & Prices	4	1.57
Financial Services	3	1.18

Source: Field Data,2025

As digital agriculture continues to gain prominence, it is increasingly clear that the current design and implementation of ICT tools must evolve to meet the needs of smallholder farmers, particularly in low- and middle-income countries. While existing platforms provide access to information on weather, market prices, and best practices, several notable features and support systems remain underdeveloped or absent.

One of the most pressing needs is the inclusion of voice-based interfaces in local languages. An outsize proportion of rural farmers require tools like interactive voice response (IVR) systems or AI chatbots that communicate in local dialects (e.g., Swahili, Kikuyu, Yoruba) would enhance accessibility. A study by Adesina et al. (2023) emphasizes the effectiveness of voice services in improving farmers' engagement with agricultural content, particularly among illiterate and elderly users. Another critical feature is offline functionality. Poor internet infrastructure in rural regions severely limits access to real-time agricultural information. ICT tools should be capable of storing data locally and updating only when connectivity is available. According to Nduati et al. (2024), offline-enabled mobile apps to have shown improved adoption rates among farmers in remote parts of East Africa, where mobile signal coverage is inconsistent.

Furthermore, there is a growing demand for AI-powered personalized advisory systems. Farmers need guidance that is specific to their location, crop variety, and soil type. Tools integrated with artificial intelligence and geographic data can provide tailored recommendations for pest control, irrigation, and planting schedules. A pilot project in Uganda by the FAO (2023) demonstrated that farmers using AI-enhanced apps achieved significantly higher yields than those relying on generic advisory content.

Real-time market intelligence is another feature that farmers value highly. ICT tools should offer up-to-date information on market prices, demand forecasts, and buyer locations. When such data is accessible, farmers can make more informed decisions about what crops to grow, where to sell, and when to harvest, improving profitability and reducing post-harvest losses.

In addition to these technological features, visual and multimedia content can be an effective means of communicating complex farming techniques. Short video tutorials and pictorial guides are more engaging and easier to understand than text-based instructions,

particularly for semi-literate users. Mobile money integration also holds transformative potential. Seamless integration with platforms like M-Pesa allows farmers to pay for inputs, receive loan disbursements, and sell produce digitally. This not only enhances convenience but also promotes financial inclusion.

Finally, to sustain user engagement and ensure long-term adoption, ICT tools must include user training, onboarding support, and access to technical assistance. Farmers often require step-by-step guidance when adopting recent technologies. Government agencies, NGOs, and private developers must invest in training programs and community-based digital ambassadors to fill this gap (KIPPRA, 2023).

The study findings, therefore, imply that respondents leverage a variety of ICT features based on their device ownership, literacy level, internet access, and specific agricultural needs. Simpler tools like voice calls and SMS dominate in low-resource settings, while apps and social media gain popularity among digitally literate users.

4.4 Mango Farmers on Financial Support Institutions

The study sought to understand what types of financial services farmers accessed Eighty one point one eight percent (81.18%) of respondents (207) reported using some form of loans. This category includes bank loans, microfinance loans, microcredit, and other lending services. The high uptake suggests that access to credit is a major financial need and is widely utilized, possibly for agricultural investment, business expansion, or personal needs.

Eighteen percent of respondents (48) reported using savings services, such as savings accounts or informal savings mechanisms. While this is a significant minority, it is much less common

than loan usage, indicating that saving may be less accessible, less prioritized, or less promoted among this population.

In the interview, MCOs 2, 3, 4, and 5 agreed that the ministry is bringing together all the farmers to form cooperatives, which can enhance access to financial aid. MCO 3 stated Respondent 1: Forming cooperatives is an effortless way to help our famer unit to access financial aid.

Another responded added: we have some farmers who have benefited from financial aid from the county, though not familiar.

Respondent 3: Access to financial aid is limited to individuals.

Respondent 2: The financial support for farmers comes from the national government through subsidies like fertilizers and non-government institutions that provide collaborative efforts for projects like pest control.

Respondent 4. Despite the challenge of data protection and lack of trust, forming cooperatives is key to enhancing financial aid to farmers.

Respondent 5. Lead farmers should be in front-line training on the importance of group formation stands despite the resistance from farmers.

The response from the interview was in support of the finding from the farmers who indicated they mostly access secured loans using collateral, and also on an individual basis, the respondents also supported the finding that the finance support provided by the county government is quite minimal if it is available.

Table 4.20: Types of Financial Services Used

Financial Service	Frequency	Percent (%)
Loans	207	81.18
Savings	48	18.82
Total	255	100

Source: Field Data,2025

Access to financial support remains a critical factor in enhancing the productivity and profitability of mango farmers and the effectiveness of agricultural institutions. In many developing economies, including Kenya, smallholder mango farmers face persistent challenges in accessing affordable credit, agricultural insurance, subsidies, and investment capital. This impedes their ability to adopt improved technologies, access quality inputs, and expand into value-added production.

According to Githumbia, et al. (2024). Assessment of factors influencing adoption of postharvest loss reduction practices along the mango value chain in Embu, Machakos, and Nairobi counties, Kenya., most mango farmers in Machakos and Makueni counties struggle to meet collateral requirements, which prevents them from securing loans from commercial banks. In support of the findings, the financial institutions and development partners have developed tailored financial products for fruit farmers. For example, the Agricultural Finance Corporation (AFC) in Kenya has introduced low-interest agricultural loans targeting horticulture farmers, including mango producers. However, uptake remains low due to limited awareness and bureaucratic loan processing procedures (KIPPRA, 2023). Government Subsidies and Grant Programs; Government-led financial support initiatives,

such as input subsidies and grant programs, can significantly boost mango farming.

The Kenyan Ministry of Agriculture has occasionally offered fertilizer and seed subsidies under the National Agricultural Value Chain Development Project (NAVCDP), with mango value chains being among the priority crops. However, delivery inefficiencies and poor targeting mechanisms have limited the impact on smallholder mango farmers (FAO, 2024).

Also, Public-Private Partnerships (PPPs) lead to collaborations between government, financial institutions, and agribusinesses, appearing as a viable model for supporting mango value chains. Supporting the findings can ease access to finance, market linkages, and capacity building. For instance, the Kenya Markets Trust has partnered with mango processors and farmer cooperatives to provide embedded finance and contract farming arrangements, ensuring both input supply. The study concludes that Mango farmers use a mix of formal and informal financial services depending on their size, location, and market orientation. Expanding access to affordable credit, mobile banking, and insurance can significantly boost mango production, reduce post-harvest losses, and support sustainable livelihoods.

4.4.1 Ease of Access to Financial Services

The findings reveal that most respondents face significant challenges in accessing financial services. Nearly four out of five participants (79.92%) reported that it is "Not Easy" to access such services, showing widespread barriers and difficulties in the process. Additionally, 10.24% of respondents described access as requiring "A lot of sacrifices," highlighting not only practical obstacles but also the personal and financial burdens involved. A further 9.84% specifically cited "Collateral Issues" as a major impediment, suggesting that the requirement for collateral is a notable barrier for a segment of the population. Overall, these results underscore that access to financial services is still a significant challenge for most respondents, with only a small minority able to obtain services without major difficulty

or sacrifice. This points to a need for more accessible, affordable, and less burdensome financial products tailored to the needs of the community.

Table 4.21: Ease of Access to Financial Services

Access Group	Frequency	Percent (%)
Not Easy	203	79.92
A lot of sacrifice	26	10.24
Collateral Issues	25	9.84
Total	254	100

Source: Field Data, 2025

Despite advancements in financial inclusion and digital technology, many farmers, especially smallholders, still face significant barriers when trying to access financial services such as loans, insurance, savings, and payments. These challenges limit their ability to invest in inputs, adopt modern practices, and cope with risks such as climate change or price volatility that could hinder an increase in productivity and resilience.

GSMA AgriTech (2023) supported the finding, most smallholder farmers do not have registered land titles or fixed assets to serve as collateral. Additionally, many operate outside the formal financial sector, lacking documented income or credit histories, becoming very tough to access financial assistance. In Kenya, despite increased mobile loan services like M-Shwari, many mango farmers in Makueni County are still ineligible for larger loans due to a lack of documented earnings or land registration.

FAO & World Bank (2023) also supported the findings that prohibitive cost and rigid loan terms

remain a great Challenge to farmers. The organization stated that Loans provided to farmers often have high interest rates, short repayment schedules, and hidden fees that are misaligned with agricultural seasons. World Bank (2022) Climate and market-related lending risk also a main challenge affecting access to financial assistance, the organization added that banks are hesitant to lend to farmers due to unpredictable weather patterns, price fluctuations, and pest outbreaks that affect repayment ability.

FAO (2023) Limited and inflexible financial products is another challenge that affects easy access to financial support. Many financial institutions offer one-size-fits-all products that do not align with the unique needs of different crop cycles or local conditions. Mango farmers in Burkina Faso struggle to find loan products that support long-term orchard investment, as most loans are geared toward short-term annual crops.

The findings underscore the fact that while finance is transforming rural economies, significant structural and operational barriers continue to hinder farmers' full participation in financial systems. Addressing these challenges will require coordinated efforts involving governments, financial institutions, agri-tech innovators, and farmer cooperatives. Policies promoting land registration, financial literacy, gender inclusion, and rural digital infrastructure will be key to unlocking the full potential of financial access for all farmers.

4.4.2 Participation in Training Programs Organized by Financial Institutions

Most respondents, 84.71% (216), reported that they have not participated in any such training programs. This indicates that most individuals in the surveyed group have had little to no formal educational engagement facilitated by financial institutions. This lack of participation suggests limited outreach or accessibility of these training opportunities to the broader population. Conversely, only 15.29% (39) of respondents indicated that they have participated in training programs organized by financial institutions. This small minority represents those

who have received some form of financial education or training, which could enhance their knowledge, skills, and confidence in managing financial products and services. Overall, these findings highlight a substantial gap in financial education outreach. The limited participation in training programs may contribute to lower financial literacy and awareness, potentially impacting respondents' ability to effectively access and utilize financial services.

Table 4.22: Participation in Financial Institution Training Programs

Response	Frequency	Percent (%)
No	216	84.71
Yes	39	15.29
Total	255	100

Source: Field Data, 2025

Finding indicates that most of the respondents do not participate in training called by the financial institution, a gap in information dissemination and awareness is noted. Section needs at least a citation or to be complete.

4.4.3 Training Sessions to Improve Financial Practices

A vast majority of respondents-84.46% (212 out of 251)-indicated "None," meaning they either did not participate in any training sessions or did not find them useful for improving

farming practices. This suggests that most individuals have not benefited from such programs, either due to lack of participation or perceived lack of relevance or impact. Among those who did participate, 11.95% (30 respondents) described the training as "Helpful. This group found value in the sessions, indicating that, for a small segment of the population, these programs contributed positively to their farming practices. A smaller portion, 3.59% (9 respondents), reported that the training was "Not Very Helpful." This indicates that even among participants, some felt the sessions did not significantly enhance their farming knowledge or skills. These findings highlight a substantial gap in either the reach or the effectiveness of training programs organized by financial institutions. While a minority found them beneficial, the overwhelming majority did not engage with or benefit from these opportunities, pointing to the need for more accessible, relevant, and impactful training initiatives.

Document review of reports in the Ministry of Agriculture demonstrates the commitment of the agricultural officer in capacity building to the farmers. According to Makueni County's Agriculture Annual Report (2023), over 5,000 farmers benefited from capacity-building workshops and field demonstrations between 2022 and 2023, training sessions on mango farmers on modern agronomic practices, pest and disease management, post-harvest handling, and value addition. This report contradicts the findings from the farmers, where 84.42% responded they have not been trained or have not got the usefulness of the training, which represents a substantial number of respondents, while 11.95% indicated the training was extremely useful.

Table 4.23: Usefulness of Financial Institution Training Sessions

Usefulness	Frequency	Percent (%)
None	212	84.46
Helpful	30	11.95
Not Very Helpful	9	3.59
Total	251	100

Source: Field Data,2025

The findings indicate that financial training sessions delivered through workshops, mobile platforms, farmer field schools, or extension services play a vital role in enhancing farmers' financial literacy, decision-making, and access to financial services. These sessions not only empower farmers to make informed financial choices but also increase their trust in formal financial institutions and improve their creditworthiness.

Training sessions have proven to be highly valuable in enhancing the financial practices of mango farmers, particularly in regions where access to financial literacy and agribusiness skills is limited. These training programs delivered by government agencies, NGOs, and agribusiness partners have significantly contributed to better financial decision-making, record-keeping, budgeting, and investment planning among mango producers.

According to Mercy Corps (2023) Training sessions have significantly improved farmers' understanding of core financial concepts such as budgeting, saving, loan management, and cost-benefit analysis of farm investments. In Kenya, mango farmers who participated in the AgriFin Accelerate Program by Mercy Corps reported improved cash flow planning and savings behavior. They began tracking input costs and aligning their expenditures with crop cycles.

A study by Karanja et al. (2023) found that farmers who received structured financial training under the USAID-KAVES mango value chain program were 60% more likely to track income and expenses compared to untrained counterparts. Enhanced Financial Literacy training equips farmers with the knowledge to understand core financial concepts such as budgeting, saving, credit management, and cost-benefit analysis. With such skills, mango farmers are better positioned to plan for input purchases, manage debt, and evaluate the profitability of their farming activities.

The research findings imply that training sessions by financial institutions play a transformational role in rural agricultural economies. The training empowers farmers to make informed financial decisions, which enables the farmers to increase the uptake and success of agricultural loans and support sustainable farming practices through better resource management.

4.4.4 Impact of Accessing Financial Services on Farming Practices

The research enquired about how accessing financial services has affected farming practices. The responses in the mango farmer forum (Baraza) data were collected using interviews and group focus discussions.

Responses were as follows; I have managed to increase investment in Quality Inputs. Another respondent stated that access to financial services has led to the adoption of modern technologies like drip irrigation.

Another Respondent stated that access to financial services has Improved Cash Flow and Business Planning. Also, Finance has allowed me to join marketing cooperatives and producer groups, which pool resources to access larger markets, meet quality standards, and secure better prices. One farmer who was a female stated that access to inclusive financial products,

like group savings and lending schemes, has empowered women and youth to participate more actively in mango farming.

A respondent in the forum representing farmers stated access to finances led to improved yields, with farmers reporting an average yield increase of 25–35%, however, collateral requirement is a big hindrance.

Another respondent, who is a lead farmer, stated that access to finance has led to management in value, and additional training is required to help farmers venture into the right business.

MCO 1 added to the discussion that it will be through the creation of a cooperative Sacco, which will enhance benefits from financial institutions with low interest rates.

These findings from the forum indicated that despite these benefits, challenges such as limited financial literacy, high loan interest rates, and collateral requirements still hinder many mango farmers from fully utilizing financial services. There is also a need for tailored loan products with flexible repayment tied to harvest cycles, and stronger linkages between financial institutions and farmers' cooperatives.

Access to financial services has played a crucial role in modernizing mango farming. It has enabled farmers to improve productivity, manage risks, invest in technology, and integrate into profitable value chains. For continued impact, efforts should focus on financial education, digitized service delivery, and inclusive finance models that address the needs of rural smallholders.

The findings of this study reveal that access to financial services significantly influences farming practices, productivity, and the overall economic well-being of farmers. Among mango farmers surveyed in Makueni County and similar regions, financial services such as credit, insurance, mobile banking, and savings facilities have improved input access, risk management,

business planning, and market participation.

The study found that respondents who accessed financial services were able to invest in high-quality inputs such as certified mango seedlings, fertilizers, and irrigation systems. These investments led to improved yields, with farmers reporting an average yield increase of 25–35% compared to those without financial access. This finding aligns with Karanja et al. (2023), who reported that credit access among horticultural farmers in Eastern Kenya correlated positively with increased farm output and income.

The research also found that farmers who accessed loans or participated in savings groups were likely to engage in value addition, such as drying mangoes or processing juice. Moreover, membership in cooperatives is often a prerequisite for group-based lending or input subsidies, enabling farmers to access larger, more lucrative markets. This supports findings by Kenya Markets Trust (2022), which emphasized that access to financial services improved farmers' ability to meet market standards and aggregate produce for sale.

It can therefore be concluded that accessing financial services empowers farmers to farm more efficiently, profitably, and sustainably. It enhances productivity, reduces risks, and supports long-term growth of agricultural enterprises.

4.4.5 Innovations Adopted due to Financial Support

The interviews with respondent MCO 4: indicated that in Makueni County, Kenya, mango farming is a major agricultural activity and has seen several improvements and innovations enabled by financial support from development partners, NGOs, government programs, and private initiatives.

Respondents 2 and 3 agreed that through financial Support from organizations like USAID through Feed the Future Program and the International Centre of Insect Physiology and Ecology (ICIPE) lead to Improvement/Innovation through introduction of affordable fruit

fly traps and biopesticides to control mango pests, training farmers in Integrated Pest Management (IPM) techniques, and establishment of demonstration plots.

Respondents 1; Introduction of Grafting and Certified Seedlings sponsored by World Bank through the National Agricultural and Rural Inclusive Growth Project (NARIGP) and County Government of Makueni lead to Improvement/Innovation, farmers trained and supplied with grafted mango seedlings (varieties like Apple, Ngowe, and Kent) and support youth groups and nurseries to propagate quality planting materials.

Respondent MCO 1: Support for Mango Value Addition and Processing an innovation through the European Union and DANIDA, led to the establishment of the Makueni Mango Processing Plant in Kalamba, and provided training on making juice, jam, and dried mango slices to reduce glutes during harvest season.

Respondent MCO 1: Digital Market Linkages and Mobile Advisory financial support from Techno Serve, SNV Netherlands Development Organization, and Safaricom Foundation provided.

Improvement/Innovation on Mobile platforms like Digi Farm and M-Farm supported mango farmers with market price updates, weather information, and mobile-based extension services. Respondent MCO 1: Access to Mango Packhouses and Cold Storage facilities financially supported by the European Union (EU) through Kenya Crops and Dairy Market Systems (KCDMS) and the Government of Kenya (Ministry of Agriculture) lead to Improvement/Innovation which lead to the Construction and equipping of packhouses and cold storage units in areas like Kalamba and Kitise and Aggregation centers which allow farmers to sort, grade, and preserve mangoes before transportation.

In Makueni County, financial support has been instrumental in transforming mango farming from a subsistence activity to a more commercial and sustainable enterprise. Innovations enabled by such support have helped improve yields, reduce losses, boost incomes, and open new market opportunities for farmers.

The findings could therefore mean financial support through loans, grants, subsidies, or cooperative savings will enable mango farmers to innovate across the value chain, from production to marketing. These innovations can lead to an increase in productivity, reduce harvesting losses, enhance incomes, and open new market opportunities.

4.4.6 Challenges Faced in Accessing Financial Services for Agricultural Purposes

Interviews on the challenges experienced by farmers were held. According to the lead farmers who were representing the farmers in the different wards of Makueni County, the farmers experienced different challenges. Limited access to credit was noted to be a major challenge, expressed as a common challenge to most farmers; collateral remains a thorn to the farmers. Unpredictable production income was mentioned as another challenge affecting the financing of farmers. Policy and regulatory barriers were another challenge; high interest rates also affected agricultural loans, often with high interest rates, making them less affordable for small-scale farmers and perceived as considerable risk by financial institutions, affecting farmers' access to finances.

Coa et al (2025) based on this finding, there are policy implications that the county government should focus on supporting financial inclusion in improving farmers' anti-risk capacity. For example, in terms of agricultural socialization services and the purchase of

agricultural products, the corresponding services should be provided with convenience and preferential policies in terms of use. Appropriately relaxing land transfer-related policies to promote the expansion of the scale of agricultural land management and ownership. It is necessary to continuously improve the development of local infrastructure and improve the digital ability of farmers, to promote the inclusive role of digital financial inclusion in the development of agricultural anti-risk capacity. On the other hand, there is a need to promote the flow of financial resources to the surrounding economically less developed areas and leverage the diffusion effects of digital financial inclusion.

Addressing these challenges requires a multi-faceted approach, including policy reforms, financial product innovation, rural infrastructure development, digital literacy training, and targeted support for women and youth. Enhancing collaboration between financial institutions, government agencies, and agricultural stakeholders is crucial to improving access to financial services for smallholder farmers.

Addressing the above challenges, Policy interventions are needed to guide the farmers (e.g., loan guarantees, interest subsidies), Financial literacy programs, mobile and group-based innovations, and tailored financial products that align with the realities of agriculture need to be enhanced.

4.5 Model for Assessing Knowledge Sharing in Agriculture

The study being inclined to social sciences, the researcher adopted the following procedures in developing the model for the study.

4.5.1 Development of the Model

1. In this study, the problem was well defined, and the researcher understood the knowledge sharing dynamics were. Preliminary visits to the field were made, and there were stakeholders' engagements.
2. Reviewing existing literature was done, where gaps identified were to be filled by the proposed model.
3. Key actors were identified, and these included mango farmers and officials from the Ministry of Agriculture in Makueni County. The essence was to understand the dynamics of knowledge sharing among mango farmers for economic sustainability in the county.
4. Quantitative and Qualitative data collection methods were administered. Quantitative data were collected through administering questionnaires to the farmers to map and examine knowledge sharing dynamics, A Qualitative method used interviews, and the researcher also did observation and document review while collecting the data to examine knowledge sharing dynamics among mango farmers for economic development in the county.
5. The study organized the findings into key components of the model based on the item with a lot of "weight" or influence.

Following the procedures the Researcher developed a model taking into consideration various components in terms of inputs, process, outputs, and a flowchart was used for presentation. The developed model was an integrated knowledge sharing model for agricultural sustainability,

conceptualized as a systems-based framework grounded in the post-positivist paradigm. The model adopts an input -process–output–outcome–feedback structure, reflecting the dynamic and interactive nature of knowledge sharing within agricultural systems. It combines principles from knowledge management, agricultural innovation systems, and socio-technical systems theory to provide a comprehensive understanding of how knowledge flows among stakeholders. The model is contextualized to mango farming in Makueni County and integrates both formal knowledge systems, such as research institutions and extension services, and informal systems, including indigenous knowledge, all supported by enabling infrastructures like ICT tools and financial organizations.

The development of the model followed a rigorous, multi-stage methodological process. Initially, an extensive review of literature and policy documents provided the theoretical and conceptual foundation. Key sources included agricultural knowledge-sharing theories and policy frameworks such as the Makueni County Government agricultural policies, the Makueni County Fruit Development and Marketing Authority (MCFDMA) Act (2017), the Export Supply Hub (ESH) Initiative, and other agricultural support programs in Kenya. This stage enabled the identification of critical constructions, including knowledge sources, enabling infrastructures, and knowledge-sharing processes.

Subsequently, empirical data were collected using a mixed-methods approach involving surveys, interviews, observations, and document review. Quantitative data from mango farmers provided measurable insights into knowledge access and utilization patterns, while qualitative data from extension officers and institutional stakeholders offered deeper understanding of experiences, challenges, and institutional roles in knowledge sharing. The integration of these data sources through triangulation allowed the researcher to identify key variables and relationships, which

informed the structuring of the model into inputs, processes, outputs, outcomes, and feedback mechanisms. The draft model was then refined to ensure alignment with empirical findings and policy frameworks, as well as logical coherence and practical applicability.

Model testing was conducted through both quantitative and qualitative approaches to assess its internal consistency and empirical support. Quantitatively, data were analyzed using the Statistical Package for the Social Sciences (SPSS) Version 29. Descriptive statistics, including were applied to examine relationships between variables such as access to knowledge sources, use of extension services, and adoption of improved farming practices. The results demonstrated consistent patterns indicating that improved access to knowledge and institutional support significantly influences farmers' adoption of best practices and overall productivity. Qualitatively, thematic analysis of interview data provided further validation of the model by confirming the relevance of knowledge creation, dissemination, and networking processes. Respondents consistently emphasized the importance of extension services, farmer networks, and ICT platforms, thereby supporting the structural components of the model.

4.5.2 Validation of Model

The validation of the model was undertaken using a multi-method approach to ensure its credibility, relevance, and applicability. Content validation was achieved by aligning the model components with existing literature and policy frameworks, ensuring that the model accurately reflects real-world agricultural knowledge systems. Expert validation was conducted through consultations with agricultural officers, institutional representatives, and stakeholders during the piloting phase, where the structure, relevance, and applicability of the model were critically reviewed. Additionally, respondent validation, also known as member checking, was employed to confirm that the findings and interpretations accurately represented the experiences and perspectives of the participants.

Further validation was achieved through triangulation, where data collected from multiple source surveys, interviews, observations, and document reviews were compared to ensure consistency and convergence of findings. Evidence of validation is proved through the successful piloting of research instruments, where feedback from both farmers and Ministry of Agriculture representatives led to refinement of the tools and confirmation of the model assumptions. The consistency of findings across different data sources further strengthened the validity of the model, while its alignment with county-level agricultural policies confirmed its practical and institutional relevance.

The validation process involved multiple stakeholders, including mango farmers, agricultural extension officers, Ministry of Agriculture officials, and representatives from agricultural institutions. This inclusive approach ensured that the model captured both grassroots experiences and institutional perspectives. Various tools were used in the validation process, including SPSS for statistical analysis, interview guides for expert feedback, structured questionnaires for empirical validation, observation checklists for verifying field practices, and document review frameworks for assessing policy alignment.

4.5.3 Proposed Model

After validating and testing the draft model, the researcher developed the model in line with the findings from the respondents and reviewed existing mango farming policy information sources, like Makueni County Government Website, farming in Kenya consultancy, Kilimo Kwanza, , Agricultural Training and Support, - Makueni County Fruit Development and Marketing Authority (MCFDMA) Act, 2017 and Export Supply Hub (ESH) Initiative, which has specific policies on farming in Makueni county.

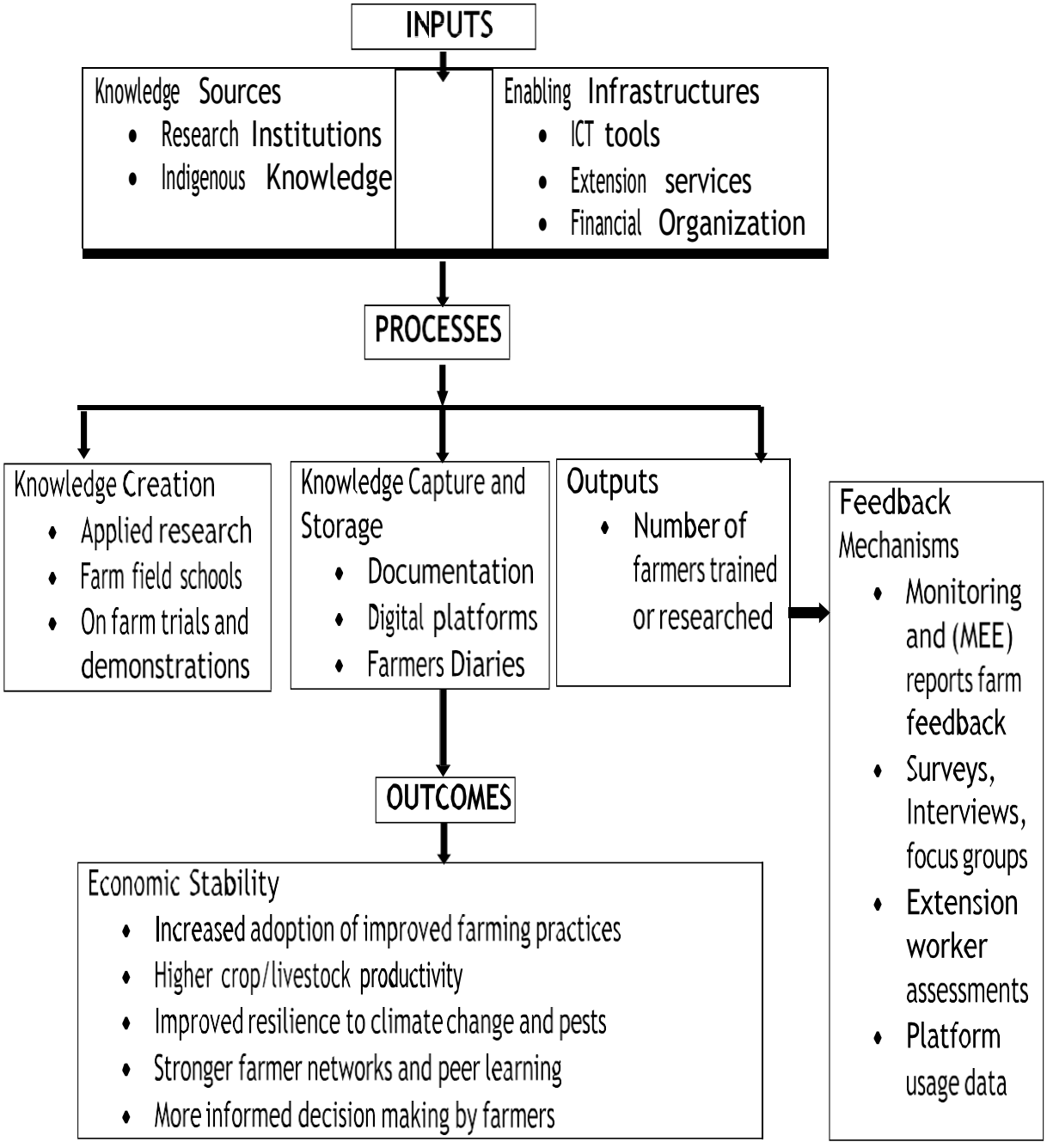


Figure 4.9: Model for Accessing Knowledge Sharing in Agriculture
Source: Researcher, 2025

The model is a knowledge-sharing model for assessing dynamics in which knowledge can be shared to help build economic sustainability for farmers. The model implements a systematic method toward knowledge sharing institutionalization, simultaneously maintaining knowledge sharing alongside agricultural sustainability for economic development. The model uses documentation systems to compile knowledge sharing and implements social networking as a tool that boosts knowledge sharing and promotes economic sustainability for farmers.

The model consists of the following components.

1. The inputs consist of the various sources of information, including research institutions and indigenous knowledge working together with enabling infrastructures, ICT tools, extension services, financial organizations, and the farmers are the infrastructures leading to knowledge sharing. This input helps in building capacity to farmers through training of the farmers and knowledge product dissemination, leading to deployment of extension officers and engaging digital platform users.

2. The process of developing a knowledge sharing model includes knowledge creation, knowledge capturing, and storage, where the result is the output is trained and knowledgeable farmers. Knowledge is created through applied research from different researchers and research institutes or organizations, from farmers' field schools and on-farm demonstrations, which should be done by experts in specific areas, coordinated by the knowledge officers. Knowledge capturing and storage include the formation of documentation centers, the creation of digital platforms, and farmers' diaries, which house different information. When the processes are followed, the output will be knowledge sharing, and farmers become more knowledgeable and informed about the best agricultural practices.

3. Outcome: After the processes are in place, increased adoption of improved farming practices will be expected, leading to higher crop productivity and improved resilience to climate change, and tests with stronger farming networks and peer learning with more informed decision making by the farmers, hence economic sustainability will be achieved.

4. Feedback mechanisms: Monitoring and evaluation will be required to measure progress and report. This can be attained through farmers' feedback (survey, interview,), extension workers' assessment Platform usage data should be a continuous process. By adopting this model, the Ministry of Agriculture, together with other stakeholders, will attain sustainable economic development for the farmers and Makueni County at large.

In conclusion, the model was developed through a systematic and iterative process that integrated theoretical insights, empirical evidence, and policy considerations. Its testing and validation were strengthened using mixed methods, triangulation, and stakeholder engagement, ensuring both methodological rigor and practical relevance. As a result, the model is robust, contextually grounded, and well-suited to guide knowledge-sharing practices and promote economic sustainability among mango farmers in Makueni County.

4.6. Summary of the Chapter

This chapter presents and discusses the research findings that emerged from the data analysis process. The researcher analyzed quantitative data using the Statistical Package for Social Sciences (SPSS), Version 27, which enabled the computation of descriptive statistics and the generation of graphical representations. In contrast, qualitative data obtained through interviews, observations, and document reviews was analyzed thematically, allowing for the identification of recurring patterns and meanings.

The study findings are presented using multiple formats, including bar graphs, pie charts, tables, and detailed narrative discussions to enhance clarity and interpretability. Each major finding is supported by existing scholarly literature, highlighting congruence between the study results and the perspectives of established researchers. This alignment with prior studies strengthens the credibility, validity, and authority of the research outcomes which was supported by the proposed model.

CHAPTER FIVE:

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary, conclusion and recommendations of the study based on the interpretation given to findings discussed in chapter four. The purpose of the study is to examine knowledge-sharing dynamics among mango farmers as a mediating pathway to enhancing food security and fostering economically sustainable development in Makueni County in Kenya.

Effective sharing of knowledge plays a pivotal role in ensuring economic sustainability for agricultural practices. This is attained through applications of multiple formal and informal networks of information dissemination. The channels include farmer-to-farmer networks, which include informal discussions at markets, farmer groups, or during social gatherings. Peer-to-peer learning has been critical in spreading practical knowledge on pest control, pruning, and organic treatments. Agricultural Extension Services is another network applied by Government extension officers and NGO field agents that provide technical guidance, showcasing the best practices through demonstration plots and field schools. Digital Platforms and Mobile Apps, including Platforms like iCow, Arifu, and DigiFarm, have been adopted by tech-savvy farmers, which offer real-time agronomic advice, weather updates, and market information via SMS or smartphone applications. Farmer Cooperatives and Producer Organizations act as hubs for bulk training, input access, and market linkage. NGOs and Development Agencies Organizations such as SNV, GIZ, and USAID, have supported knowledge dissemination on mango value chain upgrading, including pest management (fruit fly control), post-harvest handling, and export

readiness. This chapter synthesizes the key findings of the research to propose actionable recommendations and future directions.

5.2 Summary of the Chapters

Chapter one of this study sets the stage for the research by presenting the background, rationale, and context. It introduces the statement of the problem, explaining why the study is important and outlines the purpose of the study research and providing the objectives of the study, guiding questions for the research, assumption of the study, significance of the study and the scope and limitation of the study.

Chapter two discussed literature review which consists of empirical literature, theories adapted for the study and lastly conceptual framework.

Chapter three of the study consists of research paradigms adopted for the study, research design, study population, sampling methods, piloting of the research instruments, data collection procedures, data analysis, reliability and validity and final ethical considerations for the research.

Chapter four represented the data finding, analysis, and presentation for the researcher, which was presented graphically and descriptively.

5.3 Summary of the Findings

5.3.1. Social Network Structures on Mango Market Access

The findings of the effects of social network structures on mango market access revealed that strong social networks improve Market linkages, thus farmers embedded in dense social networks (e.g., cooperatives, village groups, farmer associations) have better access to market information, such as prices, buyers, and quality requirements.

Digital tools are weakly integrated into social networks, while many mango farmers own mobile phones, few social groups systematically use digital platforms; they rely on WhatsApp and Facebook, while others use farmer-to-farmer or peer-to-peer networks to organize sales or share price information. The potential of tech to amplify market access via networks is still underutilized.

Trusted peers share insights on how to negotiate with brokers or meet export standards. Information asymmetry limits fair access was noted; not all farmers benefit equally from market knowledge shared in networks. Some groups hoard information or limit participation, creating exclusion effects, especially for women, youth, and newcomers.

Central farmers gain preferential market access, and farmers who are central in the network (information leaders or aggregators) are more likely to access premium buyers, often becoming lead suppliers. Peripheral farmers rely on these central figures but may have less bargaining power.

Strong ties help access Distant or high-value markets. Farmers with strong ties (e.g., connections to buyers, NGOs, or urban traders) often access new or high-value markets (e.g., export markets or processors), even if contact is infrequent. These ties function as "bridges" beyond local and traditional marketing channels.

5.3.2 Role of ICT in Knowledge Sharing for Farmers

The findings from the research indicated that ICT significantly enhances timely access to agricultural information. Mobile phones, SMS platforms, and agricultural apps help farmers access real-time information on: Weather forecasts, Market prices, Pest and disease alerts, and best agronomic practices. This leads to quicker decision-making and improved farm planning. Mobile-based platforms are widely used and effective. Services such as SMS-based training

modules, access to extension advice, input prices, and nearby agro-dealer locations are popularly shared amongst farmers. In areas with poor extension coverage, these tools bridge the gap and reduce information asymmetry.

ICT Improves Farmer-to-Farmer Knowledge Sharing, or peer-to-peer knowledge sharing. Platforms like WhatsApp, Facebook groups, and community radio forums enable farmers to share success stories, discuss problems, including crop diseases and pest control, and recommend solutions depending on experience or after seeking expert opinions. These tools promote horizontal knowledge transfer and strengthen peer learning.

Digital tools enhance inclusivity but also risk exclusion and wider coverage, younger, literate, and male farmers are more likely to use ICT tools effectively than women, elderly, and low- literacy farmers often face barriers such as Lack of digital skills, limited phone ownership, language barriers (English or Kiswahili instead of local languages).

Integration of ICT with traditional media increases reach and solves the challenge of language were radios broadcast in vernacular language, cutting across all listeners.

Combining ICT tools with radio, community meetings, and farmer field schools increases message penetration. For example, radio programs followed by SMS quizzes or feedback reinforce learning.

5.3.3 Mango Farmers on Financial Support Initiatives

Many mango farmers struggle with limited access to credit due to high interest rates, lack of collateral, and weak financial literacy. Strengthening farmer business groups and improving

financial education are key strategies to overcome these barriers. Joining or forming farmer groups or cooperatives is strongly encouraged. This is because being part of a cooperative increases bargaining power, access to group loans, training, and bulk purchasing of inputs, leading to access to financial support.

Farmers need to be sensitized about joining training, workshops, seminars on how to benefit from financial institutions and how to keep proper records, which aid in accessing financial support.

Access to formal Credit stays exceptionally low. Mango farmers rely on informal sources such as savings groups (chamas), SACCOs, or relatives for capital, this is because formal financial institutions often consider small-scale farmers for facilities because of substantial risk due to lack of collateral and formal income records.

Integration of financial literacy with extension services is of great help to the farmers, as this will help build confidence among the farmers on how to benefit from the credit facilities, improve access to the facilities, help in managing records for bargaining power and how to manage the finances to avert any risk that might occur in the processes. All this will be enhanced through literacy training for the farmers.

5.3.4 Influence of Agricultural Institution

The document review revealed that existing agricultural institutions in Makueni County play a leading role in facilitating knowledge sharing and improving the quality of mango production. These institutions serve as key channels through which farmers access technical information, training, and support services**.**

The reviewed documents indicate that these institutions provide structured platforms for disseminating agronomic knowledge, such as pest and disease management, post-harvest

handling, market standards, and climate-smart agricultural practices. Through periodic training sessions, farmer field days, demonstration plots, and extension visits, institutions help bridge information gaps and strengthen farmers' capacity to adopt improved production techniques. This institutional support has contributed significantly to enhancing product quality and aligning farming practices with market requirements.

Additionally, the review highlights that institutional collaboration fosters the exchange of expertise between government agencies, NGOs, research bodies, and farmer groups. Such partnerships enhance access to updated technologies, facilitate collective problem-solving, and encourage innovation within the mango value chain. The presence of strong institutional frameworks has therefore improved communication networks, reduced knowledge asymmetry, and promoted consistency in the application of quality standards among farmers.

The identified gaps included.

Insufficient Use of Digital Platforms for Knowledge Dissemination, While ICT tools are increasingly important for agricultural knowledge sharing, documents reveal limited digital adoption among institutions in Makueni. Most knowledge dissemination still relies on physical meetings and traditional extension, which restricts access, especially for youth and remote farmers. This shows a gap in digital integration for real-time information sharing.

Weak Linkages Between Research Institutions and Farmers

Research institutions generate valuable agricultural innovations, yet the review shows limited translation of these findings into farmer-friendly formats. The gap lies in weak research-extension-farmer linkages, resulting in slow adoption of improved practices.

Limited Focus on Value Addition and Market-Oriented Knowledge

While institutions provide agronomic training, documents reveal less emphasis on market information, quality standards, grading, branding, and value addition areas critical for mango profitability. The gap lies in comprehensive value chain knowledge-sharing.

Un inclusive Exclusion in Knowledge Platforms

Some institutions unintentionally exclude women, youth and farmers who are far from the training centers hence miss training due to the distance timing of meetings, cultural norms, or lack of targeted programs. This creates a gap in inclusive knowledge-sharing processes that reach all farmer categories.

5.4 Conclusions

Integrating social networks, Information and Communication Technology (ICT), financial and agricultural institution support, and adopting a working model is critical in enhancing knowledge sharing among farmers. Social networks, both formal (like cooperatives and SACCOs) and informal (like farmer groups and community networks), facilitate peer learning, trust-building, and quick dissemination of agricultural knowledge.

Affordability remains a structural barrier to knowledge sharing; it is through knowledge access that enables digital agriculture. The Farmers interviewed overwhelmingly stated that if digital tools were cheaper or paid off financially, they would use them more often. The challenge is not just access, but sustained use. Addressing this requires coordinated efforts from governments, NGOs, and private companies to subsidize costs, build cost-effective models, and provide financial support tailored to farmers' realities.

The adoption of ICT tools such as mobile phones, SMS platforms, radio programs, mobile apps, and social media has significantly bridged the information gap, enabling farmers to access timely, relevant, and localized farming advice, weather updates, and market prices. ICT

empowers even smallholder farmers with real-time insights that improve productivity and decision-making. The use of emerging technologies can enhance knowledge sharing in agriculture by making information more accessible, timely, interactive, and inclusive. Artificial Intelligence (AI) & Machine Learning (ML) foster knowledge sharing, through personalized recommendations on farming practices, offer real-time advice in local languages, and Blockchain Technology helps farmers verify sources of advice and inputs, avoiding misinformation which was one of the major challenges experienced by farmers, and builds trust by recording shared practices, and performance data which can be used to make informed decisions. Augmented Reality (AR) and Virtual Reality (VR) foster knowledge sharing by providing immersive, hands-on training for farmers and extension agents who help in training youth and new entrants into farming.

Financial institutions, through credit facilities, savings platforms, and insurance schemes, enable farmers to invest in modern farming inputs, post-harvest technologies, and knowledge-based practices. Their collaboration with ICT providers and farmer organizations ensures that financial literacy and agricultural advisory services are delivered and shared more efficiently. Together, these three pillars social capital, digital technology, and financial support create a synergistic model that ensures sustainable knowledge sharing. This ultimately leads to improved farm productivity, income security, and resilience among farming communities and at large sustainable economic development for the county, hence Kenya at large.

The document review demonstrates that agricultural institutions in Makueni County play a significant role in enhancing knowledge sharing and improving the quality of mango production. However, their impact is limited by challenges such as weak institutional coordination,

inadequate extension capacity, low digital integration, insufficient farmer feedback mechanisms, and weak linkages between research, extension, and farmers. Addressing these constraints requires strengthening institutional collaboration, investing in extension services, embracing digital tools, improving funding structures, and enhancing inclusive and market-oriented knowledge systems. By strategically addressing these gaps, institutions can significantly enhance knowledge dissemination, improve production quality, and promote sustainable agricultural development in Makueni County.

5.5. Recommendations

1. Strengthening and formalizing farmer groups to support the formation and registration of farmer groups and cooperatives will be of foremost importance, promoting centralized leadership and of immense help in negotiations with group leaders with professional marketing functions, where real-time knowledge sharing will be applicable and shared to the relevant audiences.

2. Promote inclusive network participation by developing community strategies to ensure women, youth, and marginalized farmers are represented in group activities and market linkage programs. Use quotas or rotating leadership in farmer groups to reduce exclusion. This can be achieved by supporting information sharing Hubs by training selected "market champions" to collect and distribute real-time market data within their networks. Equip them with access to digital tools and training.

3. Integrating digital communication in Group dynamics will facilitate the use of WhatsApp, SMS, and USSD services within farmer networks for price sharing, transport coordination, and buyer alerts. Partner with Agri-tech companies to provide training and tools that link farmer networks to institutional buyers and connect cooperatives and farmer groups to formal

buyers like exporters, processors, or supermarkets. Support contract farming agreements through capacity building and third-party facilitation.

4. Develop mobile-based agricultural advisory services to be attained through the Creation of SMS and USSD-based platforms for sharing tips on planting, weather forecasts, pest control, and market prices. According to the findings, many farmers own a phone for networking, which ensures networking without the internet.

5. Establish innovation and knowledge hubs equipped with trained personnel who can share and disseminate real-time and accurate information to the farmers. These centers serve as knowledge points for farmers to access training materials, videos, and expert consultations, promote digital literacy among farmers, and the personnel can run basic and planned digital skills training programs to foster agricultural practices which will run basic digital skills.

6. Encourage partnerships with tech startups and NGOs to support farmers which can be achieved through collaborative initiatives with the county government. The initiative can bring forth low-cost and innovative ICT solutions to farmers. This is because local startups understand context-specific needs and can scale solutions faster.

7. Joining or Forming Farmer Groups or Cooperatives was strongly encouraged. This was because being part of a cooperative increases bargaining power, access to group loans, training, and bulk purchasing of inputs, hence leading to access to financial support.

Seeking Microloans from Agri-Focused Financial Institutions was likely to offer loans tailored for smallholder farmers rather than the big establishments, whose demand may be beyond the reach of most smallholder farmers.

Ensuring the Mango Crop, Weather-based crop insurance will protect the investment against drought, floods, or disease. Farmers are highly recommended to get the right insurance in cases of disasters and advance weather conditions to curb losses.

Participating in financial literacy and agribusiness training to understand money management, budgeting, and loan use helps prevent misuse and promote profitability. This training can be provided by NGOs, SACCOs, or the Ministry of Agriculture.

8. According to the research findings, the model of knowledge sharing should be adopted by the county government. This is because the model will facilitate organized dissemination of information, reduce misinformation, promote collaboration, and enhance policy effectiveness. The research highly recommends a local mechanism to monitor and evaluate the effectiveness of sharing knowledge mechanisms and strengthening areas with weak penetration of knowledge which will enhance inclusivity, Strengthen weak links, Assess effectiveness of social networks, Identify gaps in knowledge dissemination and Support adaptive management which includes continuous evaluation allowing improvement of programs and ensuring that knowledge-sharing initiatives remain relevant and practical.

Čelik-Memić, et al. (2025) "Knowledge sharing plays a critical role in sustainable development by enabling the exchange of information, skills, and best practices among individuals and communities. It fosters innovation, builds capacity, improves decision-making, and ensures that resources are used efficiently, ultimately promoting economic, social, and environmental sustainability."

5.6 Future Directions

1. The research highly recommends further research on how open science and community science integration can promote both scientific and indigenous knowledge sharing in agriculture for economic empowerment and sustainability.
2. The researcher noted a disconnect from the different platforms of knowledge sharing, hence calling for further research on how knowledge professionals can help bridge the gap of information to promote knowledge sharing.
3. According to the literature reviewed, and findings from the respondents, factors influencing the intention to use social networks as knowledge-sharing platforms warrant investigation to help users understand the power of social networks if applied appropriately.

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APPENDICES

Appendix I: Consent to Collect Data

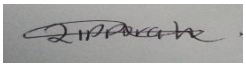
My name is Zipporah Kalekye Kimote, a PhD student at Kirinyaga University, School of Pure and Applied Sciences, Adm PA302/S/17876/22, undertaking a study in Examining Knowledge sharing dynamics among Mango Farmers for Economic Sustainability in Makueni County, Kenya. I hereby request your consent to collect data in the county community. The data will be used for academic reasons.

The information provided will be treated with confidentiality and utmost anonymity.

Thank you.

Faithfully

Zipporah Kalekye Kimote



Researcher.

Appendix ii: Research Questionnaire

Section 1: Questionnaire for Socio-Demographic and Farming Character of the Respondent

1. Personal Information

i. Gender (please tick as appropriate):

- Male _____
- Female _____

ii. Age (Years) tick appropriately

- Less than 30
- 30-39
- 40-49 Above 50

2. Education

Education levels (tick appropriately)

- No formal education
- Not finished primary school
- Primary school
- Vocational training
- College /University Degree
- Master's degree
- Doctor of Philosophy (PhD)

3. Farming Experience

How many years have you been farming mangoes?

- Less than a year
- 1-5 years
- 6-10 years

More than 10 years

4. Farming Details

i. Whichtype of mango do you farm (please tick as appropriate)

Wards Represented	Apple	Kent	Keitt	Ngowe	Vandyke	Haden	Sabine	Turpentine	Tommy Atkin	Peach
Ukia										
Kisau										
Kako										
Kilima										
Ilima										
Tulima										
Kiteta										

ii. How many acres of land do you use for mango Farming (Please tick appropriately)

Less than 1 acre.

1-5 acres

6-10 acres

More than 10 acres

5. Economic Information

i. What is your average annual income from mango farming?

- Less than $ 1000
- $1000- $5000
- $5000-$10,000
- More than $10,000

PART 2:

Social Networks Impact on Knowledge Sharing and Access to Market

Kindly answer the following questions

i. Which social networks do you use for knowledge-sharing?

ii. How frequently do you use these social networks to share agricultural knowledge? Please specify

- Daily
- Weekly
- Monthly
- Never used

iii. What types of agricultural information do you share on social networks?

vi. How has using social networks improved your access to agricultural knowledge?

v. Can you provide examples of specific knowledge or techniques you learned through social

networks that you have applied?

viii. What challenges do you face when using social networks for knowledge sharing?

ix. How do you overcome these challenges?

x. How can social networks be improved to better support agricultural knowledge sharing?

PART 3:

Farmers on the Role of ICT in Knowledge Sharing

i). Do you have experience using Information and communication technology (ICT) in your farming practices?

- Yes
- No

if yes

ii). What types of ICT tools do you use to access information?

iii) . How often do you use ICT tools to access agricultural information?

iv). What are some of the challenges experienced in integrating ICT and farming?

v) . Which platforms or applications do you use for agricultural knowledge sharing?

vi) . How has the use of ICT tools improved your farming practices?

vii). Can you provide examples of specific information or techniques you learned through ICT for which you have applied?

viii). What challenges do you face in using ICT knowledge-sharing tools? (e.g., connectivity issues, lack of training)

ix) . What additional features or support would you like to see in ICT tools for agriculture?

PART 4

Mango Farmers and Agricultural Institutions on Financial Support Initiatives

1. What types of financial services do you currently use? (e.g., loans, savings accounts, insurance)

2. How easy is it for you to access these financial services?

3. Have you participated in any training programs organized by financial institutions?

4. How useful did you find these training sessions in improving your farming practices.

5. How has access to financial services impacted on your farming practices?

6. Can you provide examples of specific improvements or innovations you have adopted due to financial support?

7. What challenges do you face in accessing financial services for agricultural purposes?

8. What suggestions do you have for financial institutions to improve their support for agricultural knowledge sharing?

Appendix iii: Interview Guide

4. Mango Farmers and Agricultural Institutions on Financial Support Initiatives

1. What types of financial services do you currently provide for the farmers (e.g., loans, savings accounts, insurance)

2. What criteria do farmers use to access financial support?

3. Have often do you organize training programs for farmers?

4. How useful did these training sessions improve your farming practices?

5. How has access to financial services impacted your farming practices in the county?

6. Can you provide examples of specific improvements or innovations farmers adopted due to financial support?

7. What challenges do farmers face in accessing financial services for agricultural purposes?

8. What suggestions do you have for financial institutions to improve their support for agricultural knowledge sharing?

Appendix iv: Observation schedule

1. The innovation caused by social networks

2. The challenge experienced in accessing internet services

3. Efforts made by the county government to unite farmers toward formation of cooperative. societies.

4. Types of groups and networks in place.

5. Communication and interaction patterns

6. The kind of information shared by the county government officers with the lead farmers to communicate with the farmers.

7. Middlemen and brokers are underestimating the price of the mangoes.

8. Uneven distribution of mango prices.

9. Innovations brought about by integrating ICT into farming.

10. Several types of mango trees planted in the county

Appendix v: Example of a Filled Questionnaire Research

Instruments

With this questionnaire, I aim to collect your views and insights regarding how knowledge-sharing can help find economic value in mango farming. Your feedback will give insight into how value can be attained.

Please feel free to give your honest views. The information you provide will be treated with utmost confidentiality.

Section 1: Questionnaire for Socio-Demographic and Farming Characteristics of the Respondent

1. Please share with me the following information about you

i. Gender (please tick as appropriate): Male _**X**___x_____Female

_____

ii. Age (Years) tick appropriately

Less than 30

30-39 **X**

40-49

Above 50

iii. Education levels (tick appropriately)

No formal education

Not finished primary school

Completed primary school Completed high school.

Higher than high school x

iv. Size of agriculture land (ha) No Land Less than half 0.5 to 1

1 to 2

2 to 3

3 to 4

More than 4 X

v. Which type of mango do you farm (please tick as appropriate)
Ngowe ___X____ Apple_____**X**___Tommy _____Kent _____ Van dyke

_____

Sensation_____Boribo_____Batawi_____Other Improved Varieties

Sabre kienyenji (tick appropriately)

Peach Kienyenji _____.

vi. What is the Percentage of yearly income from Mango farming activities (tick appropriately)

Less than 25**% X**

25% to 50%

50% to 75%

More than 75 %

vii. What are the experiences when doing mango farming?

It is more drought-resistant compared to some other fruits

Grows quite fast compared to some other fruits.

viii. What are the main challenges you face in your farming practices?

Pest control, Marketing, short shelf life, Transport challenges, large surface area occupied by the crop per tree.

ix. How do you address these challenges currently?

Regular spraying, Aggressive marketing, and regular pruning

part 2: Interview questions for the farmers on how social networks impact knowledge sharing

Kindly answer the following questions (tick where appropriate)

i. Which social networks do you use for knowledge sharing? (e.g., Facebook, WhatsApp, Twitter)

a) Facebook (b) WhatsApp X (c) Twitter (d) None (e)**Any other-Mkulima Young Platform and Jiji platform**

ii. How frequently do you use these social networks for sharing agricultural knowledge?

Whenever I am marketing or looking/Sharing information about the crops

iii. How do you prefer to receive new agricultural information? (e.g., workshops, printed materials, mobile apps)

Mobile Apps or Facebook and Youtube Channels

iv. Have you participated in any farmer-to-farmer knowledge-sharing sessions?

YES

v). What types of agricultural information do you share on social networks?

A) pest control methods, B) **crop management techniques X** C) **market X** D) Any other(specify)

vi. How has using social networks improved your access to agricultural knowledge?

Ability to get knowledge within seconds, free of charge and have varieties of sources.

Can you provide examples of specific knowledge or techniques you learned through social networks that you have applied?

On Pruning, if you do not prune the mango tree well, it will not give a guild yield of mangoes.

vii. What challenges do you face when using social networks for knowledge sharing? (e.g., a) connectivity issues **b) misinformation** X, c) lack of know how d) no gadgets any other(specify)

viii. How do you overcome these challenges?

Getting multiple views from various sources for validation of the information

ix. How can social networks be improved to better support agricultural knowledge sharing?

Creation of farmer specific networks for knowledge sharing through which large scale farmers give testimonials.

Part 3: farmers on the Role of ICT in Knowledge Sharing

i). Are you technology literate? **YES**

ii). What types of ICT tools do you have access to? (e.g., **smartphones**, computers, internet)

Smartphone, Computer, Internet

iii). How reliable is your access to these tools?

Very dependable

iv) . How often do you use ICT tools to access agricultural information?

Regularly

v) . Which platforms or applications do you use for agricultural knowledge sharing? (e.g., WhatsApp groups, agricultural apps, websites)

Websites- Mukulima young and WhatsApp

vi) . How has the use of ICT tools improved your farming practices?

Ability to get relevant information on various farming e.g., disease control.

Vii). Can you provide examples of specific information or techniques you learned through ICT for which you have applied?

Control of wasps which are harmful to mango fruits.

VIII). What challenges do you face in using ICT tools for knowledge sharing? (e.g., connectivity issues, lack of training)

Connectivity in the village

ix) . What additional features or support would you like to see in ICT tools for agriculture?

Link up with government extension services for support. Text messages shared on emerging diseases or issues

X) How can training programs be improved to help you better use ICT for knowledge sharing?

Training farmers on ICT applications of benefit

Part 4: Mango farmers and agricultural institutions on financial support initiatives

1. What types of financial services do you currently use? (e.g., loans, savings accounts, insurance)

Own savings

2. How easy is it for you to access these financial services?

Needs personal budgeting plan.

3. Have you participated in any training programs organized by financial institutions?

No

4. How useful did you find these training sessions in improving your farming practices.

Not applicable

5. How has access to financial services impacted on your farming practices?

Access to financial services can help me scale up my operations.

6. Can you provide examples of specific improvements or innovations you have adopted due

to financial support?

I do not get any external support apart from own savings.

7. What challenges do you face in accessing financial services for agricultural purposes?

Low access to credit due to poor record keeping.

8. What suggestions do you have for financial institutions to improve their support for agricultural knowledge sharing?

Introduction of farmer financial literacy plans. Introduce farmer education platforms on social media. Facilitate workshops for information sharing.

Appendix vi: NACOSTI License

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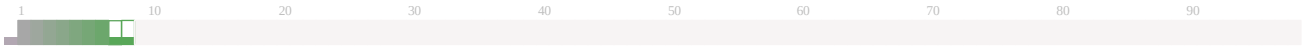

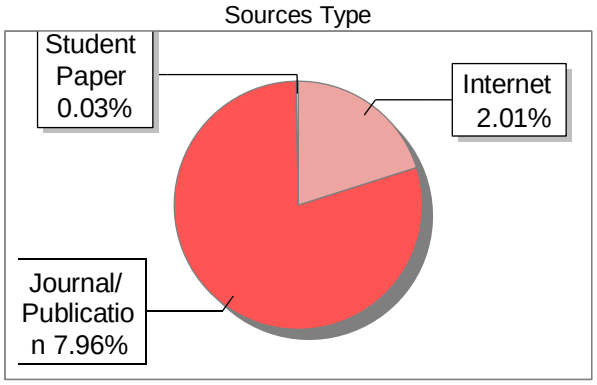

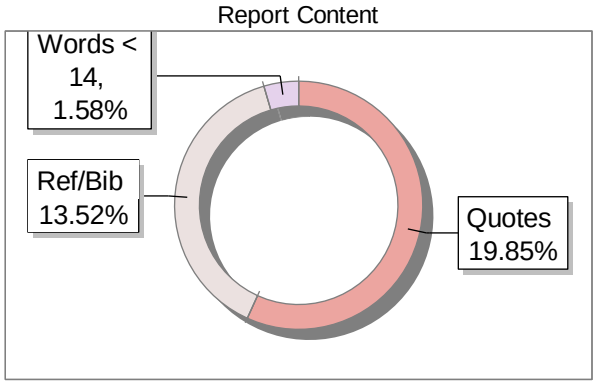

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