SOCIO-ECONOMIC FACTORS AND ACCESS TO FINANCIAL SERVICES BY RICE FARMERS IN KENYA'S NATIONAL IRRIGATION SCHEMES: THE MODERATING ROLE OF FINANCIAL LITERACY

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A Thesis Submitted to the Institute of Postgraduate Studies of Kabarak University in Partial Fulfilment of the Requirements for the Award of Doctor of Philosophy in Business Administration (Finance)

KABARAK UNIVERSITY

NOVEMBER, 2025

DECLARATION

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The thesis entitled **"Socio-Economic Factors and Access to Financial Services by Rice Farmers in Kenya's National Irrigation Schemes, The Moderating Role of Financial Literacy,"** written by **Emmy Jerotich Kisang** is presented to the Institute of Postgraduate Studies of Kabarak University. We have reviewed the research Project and recommend it be accepted in fulfillment of the requirement for the award of the degree of Doctor of Philosophy in Business Administration (Finance).

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DEDICATION

This work is lovingly dedicated to my dear husband, Henry Kiplangat. Your unwavering support has been the steady foundation behind every step of this academic journey. Thank you for believing in my potential even when I doubted myself, for your patience during long nights of studying, and for the countless sacrifices you quietly made so I could pursue this dream. Your encouragement has been a constant source of strength, your wisdom a guiding light, and your presence a reminder that I was never walking this path alone. This achievement truly reflects your love, resilience, and steadfast companionship. I am deeply grateful to share this milestone with you.

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ABSTRACT

Access to financial services is widely recognized as a vital driver of agricultural growth, poverty alleviation, and rural economic development. In Kenya, the agricultural sector plays a significant role in employment and national income; however, smallholder farmers—especially those involved in rice production within national irrigation schemes—continue to face persistent challenges in accessing financial support. Despite the growth of microfinance institutions, commercial banks, and government credit programs, many rice farmers remain excluded from formal financial systems due to demographic barriers, income fluctuation, lack of collateral, and limited access to financial information. This exclusion hampers productivity, investment, and resilience in the rice subsector, which is essential for national food security and rural livelihoods. In light of this, the study aimed to explore the socio-economic factors affecting access to financial services among rice farmers in Kenya's national irrigation schemes. The study was guided by five objectives: to assess how demographic traits, income levels, farm characteristics, and access to information and networks influence financial access, and to investigate how financial literacy moderates these relationships. The research was based on Financial Inclusion Theory, Social Capital Theory, Asymmetric Information Theory, and Trade-Off Theory, which collectively shed light on the behavioral, social, structural, and economic factors influencing financial access. Grounded in a positivist philosophy, the study employed a descriptive and correlational research design involving 13,350 rice farmers across major irrigation schemes. A pilot test with 39 respondents at Perkerra Irrigation Scheme was conducted to evaluate the reliability and validity of the research tools. Data were collected using structured questionnaires and analyzed using descriptive statistics, correlations, and multiple regression. The results showed that all four socio-economic factors significantly affected access to financial services. Demographic characteristics had the most substantial impact ($R^2 = 0.507$, $\beta = 0.224$, $p < 0.05$), followed by income level ($R^2 = 0.407$, $\beta = 0.398$, $p < 0.05$), farm traits ($R^2 = 0.192$, $\beta = 0.289$, $p < 0.05$), and access to information and networks ($R^2 = 0.052$, $\beta = 0.106$, $p < 0.05$). Additionally, the study found that financial literacy significantly moderated these relationships, enhancing the overall influence of socio-economic factors on financial access. These findings confirm that farmers' demographic profiles, income stability, farm productivity, and informational networks collectively determine their engagement with formal financial institutions. The study concluded that increasing financial inclusion among rice farmers requires a comprehensive strategy that addresses both individual and systemic barriers. Policymakers should develop gender-sensitive and youth-inclusive financial frameworks, support income stabilization through insurance and value-added initiatives, and invest in rural infrastructure and digital financial ecosystems. Financial institutions should create adaptable, farmer-friendly loan products and explore innovative collateral mechanisms suitable for smallholders. Development agencies are recommended to strengthen financial literacy and capacity-building programs to improve farmers' financial decision-making skills. Future research should explore digital financial technologies and conduct comparative studies across agricultural value chains and regions to better understand the dynamics of financial inclusion in Kenya's rural economy.

***Keywords**: Socio-Economic Factors, Access to Financial Services, Financial Literacy, Rice Farmers, National Irrigation Schemes*

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LIST OF ABBREVIATIONS AND ACROYNMS

AFC : Agricultural Finance Corporation

AfDB : African Development Bank

ANOVA : Analysis of Variance

CBK : Central Bank of Kenya

CRT : Credit Rationing Theory

DV : Dependent Variable

FAO : Food and Agriculture Organization

FSD : Financial Sector Deepening Kenya

IAT : Information Asymmetry Theory

IFAD : International Fund for Agricultural Development

IV :Independent Variable

KNBS :Kenya National Bureau of Statistics

NACOSTI :National Commission for Science, Technology and Innovation

NIA : National Irrigation Authority

SCT :Social Capital Theory

SPSS :Statistical Package for Social Sciences

VIF :Variance Inflation Factor

AFI : Alliance for Financial Inclusion

ROSCAS :Rotating Savings and Credit Associations

RCT : Randomised Controlled Trial

SACCOs : Savings and Credit Cooperative Societies

ICTs : Information and Communication Technologies

OLS : Ordinary Least Squares

SMS : Short Message Service

NACOSTI :National Commission of Science, Technology and Innovation

WLS : Weighted Least Squares

VIF :Variance Inflation Factor

PCA : Principal Component Analysis

DW : Durbin Watson

GLS : Generalized Least Squares

DFS :Digital Financial Services

SD : Standard Deviation

ANOVA :Analysis of Variance

VSLAs : Village Savings and Loan Associations

YEDF: Youth Enterprise Development Fund

KCB: Kenya Commercial Bank

MFIs: Micro Finance Institutions

ICTs: Information Communication Technologies

CONCEPTUAL AND OPERATIONAL DEFINITION OF KEY TERMS

Access to Financial Services: Access to finance is defined as the formal channels through which rice farmers can obtain financing for business start-ups and operations at affordable rates (Niskanen, 2010). In this study, access to financial services refers to the ease with which rice farmers obtain and use financial products, measured using indicators such as physical access, affordability of services, suitability of products, and inclusiveness of lending terms.

Access to Information: Access to information refers to the availability and ability to obtain relevant, timely data, knowledge, or communication that supports decision-making and resource access. In agriculture, access to information is vital for improving farm productivity, financial planning, and market linkages. It includes access to agricultural extension services, market prices, weather forecasts, and financial products, which can directly influence farmers' ability to improve their economic status and access financial services (Suri *et al*., 2012). In this study, access to information refers to the extent to which farmers obtain reliable agricultural and financial information, measured using indicators such as frequency of accessing extension services, market information, weather updates, and financial literacy messages.

Collateral Requirements: Collateral refers to the extent to which borrowers commit assets to a lender as security for debt repayment (Gitman, 2013). In this study, collateral requirements refer to the conditions lenders impose to secure loans, measured by indicators such as the type of collateral required, the collateral's estimated value, and the difficulty of meeting those requirements.

Demographic Factors: Demographic factors refer to the socio-economic characteristics of individuals or populations that influence their behavior, decisions, and access to resources. In the context of agricultural finance, demographic factors often include age, gender, marital status, education level, and family size. These factors can significantly shape farmers' access to financial services and their overall economic participation (Bongomin & Naakulenge, 2017). In this study, demographic factors refer to respondents' personal attributes, measured using indicators such as age (in years), gender, marital status, education level, and household size.

Farm Characteristics: Farm characteristics refer to the various physical, operational, and socio-economic attributes of a farm that influence its productivity, sustainability, and economic performance. Key farm characteristics include farm size, crop diversity, irrigation practices, use of technology, and the adoption of modern farming methods. These characteristics can affect a farmer's ability to access financial services and increase their economic resilience (Kaminski & Christiaensen, 2014). In this study, farm characteristics refer to measurable attributes of a farmer's rice enterprise, assessed using indicators such as farm size (in acres), irrigation type, crop diversification, and level of technology adoption.

Financial Literacy: Financial literacy refers to an individual's ability to understand how money works and is earned, managed, and invested (Andoh & Nunoo, 2011). In this study, financial literacy refers to the farmer's knowledge and skills in managing finances, measured using indicators such as budgeting ability, awareness of financial products, saving behaviour, and understanding of loan terms and interest rates.

Financial Management: This refers to how financial resources are procured, budgeted, saved, and expended over time, while accounting for financial risks and future financial needs (Tadin, 2020). In this study, financial management refers to the farmer's ability to plan and control economic resources, as measured by indicators such as record-keeping, budgeting practices, savings habits, and expenditure planning.

Financial Risk Management: These are the deliberate measures taken to mitigate financial risks arising from the business's operational or market environment (Khan, 2015). In this study, financial risk management refers to the strategies farmers use to reduce economic losses, measured using indicators such as insurance uptake, use of savings buffers, diversification, and planning for price or weather shocks.

Financial Services: Financial services encompass a broad range of offerings from the financial industry, including savings, credit, insurance, and payment processing. These services are crucial for facilitating economic activities, such as farming, and improving financial inclusion, particularly in rural and underserved areas. In the context of agriculture, financial services may include loans for farm inputs, crop insurance, and savings accounts for smallholder farmers (Khan & Zia, 2017). In this study, financial services refer to the formal financial products available to rice farmers, measured by indicators for savings, credit, insurance, and digital payment services accessed within the last 12 months.

Income: In agricultural contexts, it includes revenue from farming activities as well as any external sources such as remittances, secondary businesses, or employment (FAO, 2015). In this study, income refers to the total monetary earnings a rice farmer receives from farming and non-farming activities, measured in Kenyan shillings per month or per season, as reported in the questionnaire.

Income level: Income level refers to the amount of money an individual earns. It is used to assess financial capacity and economic well-being, influencing access to resources such as credit and financial services (Chirwa & Matita, 2017). In this study, income level refers to the category of a farmer's total earnings, measured using predetermined income brackets to assess financial capacity and its influence on access to financial services.

CHAPTER ONE

INTRODUCTION

Chapter One introduced the study by highlighting rice farming's role in Kenya's irrigation schemes and the challenges farmers faced in accessing financial services. It presented the research problem, objectives, significance, scope, and theoretical framework, drawing on theories such as Financial Inclusion, Credit Rationing, Information Asymmetry, and Social Capital, and outlined the thesis structure.

1.1 Background of the Study

Access to financial services is widely recognized as a crucial driver of agricultural productivity, resilience, and socioeconomic progress in rural economies. In developing countries, where agriculture accounts for the largest share of rural employment and income, financial services such as credit, savings, mobile banking, and insurance enable smallholder farmers to transition from subsistence farming to more commercial and sustainable production systems (World Bank, 2020). Financial inclusion, therefore, is not just an economic tool but a development priority that supports securing essential farm inputs, adopting better technologies, managing production risks, and increasing value addition. Globally, despite significant innovations in rural finance and reforms to expand financial access, smallholder farmers and rural SMEs still face systemic barriers that limit their interaction with formal financial institutions.

Evidence from Cambodia shows how strict loan requirements, bureaucratic procedures, and high borrowing costs exclude many SMEs from credit markets (Fuentes, 2019). Similar issues in Bhutan, such as overreliance on collateral, limited liquidity, and poor access to financial information, further hinder enterprise growth and investment capacity (Wangmo, 2020). These patterns highlight structural flaws in financial markets across developing economies, disproportionately impacting small-scale and informal producers.

Within Africa, where agriculture remains the backbone of many economies, limited access to financial services continues to impede agricultural growth and rural transformation. Weak financial infrastructure, high transaction costs, and low usage of formal banking services restrict farmers from investing in productivity-boosting technologies. Asare *et al*. (2019) show that in Ghana, SMEs, including agribusinesses, struggle to access affordable financing, facing high repayment costs and restrictive loan terms that discourage long-term investments. This is paradoxical given agriculture's significant contribution to employment and GDP across African countries. Additional challenges, such as limited extension services, gaps in digital infrastructure, and a lack of reliable collateral, worsen financial exclusion, leaving rural farmers without sufficient funding for production, risk management, or market access.

In the Kenyan context, substantial progress in financial inclusion has been achieved through innovations such as mobile money, microfinance, agency banking, and digital lending platforms (FSD Kenya, 2019). Despite these advancements, agricultural producers, particularly smallholder farmers, remain disproportionately excluded from formal financial systems. This gap is reinforced by seasonal and irregular farm incomes, inadequate collateral, geographical isolation, and limited financial literacy. The challenge is especially pronounced among rice farmers operating within Kenya’s national irrigation schemes, including Mwea, Ahero, Bunyala, Hola, and West Kano. These farmers play a pivotal role in enhancing national food security and rural livelihoods, yet many lack access to flexible and affordable financing needed for critical investments such as certified seeds, fertilizers, irrigation equipment, and post-harvest technologies (Makau, Njagi, & Njeru, 2021). Without adequate financing, productivity, income stability, and the potential for commercialization remain constrained.

Although Kenya has seen a significant rise in digital financial services such as M-Pesa, M-Shwari, and agency banking, the adoption and effective use of these tools among rice farmers remains inconsistent. Socio-economic and demographic factors like age, education, income, digital literacy, and access to information networks influence farmers' ability to incorporate digital finance into their farm and household decisions (Mbiti & Weil, 2016). Older farmers, individuals with lower levels of education, or those with limited digital access often face barriers such as a lack of knowledge about digital platforms, a lack of smartphones or internet connectivity, and mistrust of digital technologies. These challenges limit their participation in an increasingly digitized financial ecosystem.

Recent empirical studies further emphasize the complex nature of financial access in rural areas. Akinbami, Adekunle, and Omotayo (2020) demonstrate that demographic factors, including gender and education, play a significant role in farmers' use of financial services. Farm traits, such as land size and crop type, influence the amount and type of credit sought. At the same time, social networks and membership in farmer groups improve financial access by enabling better information sharing and increased collective bargaining power. This evidence highlights that access to financial services depends not only on individual characteristics but also on structural and institutional factors present in rural agricultural communities.

Considering agriculture's key role in Kenya's economic growth and the strategic importance of rice production within the Food Security Pillar of Vision 2030, it is crucial to understand how socio-economic factors influence access to financial services for rice farmers in national irrigation schemes. Recognizing the effects of demographic factors, income levels, farm attributes, and access to information helps policymakers and financial institutions develop inclusive, targeted financial products that address the

realities of smallholder farmers. A better understanding of these factors provides a basis for evidence-based actions, including promoting digital financial solutions suitable for rural areas and developing flexible financing options that support agricultural investments. These insights are vital for enabling sustainable agricultural growth, reducing rural poverty, strengthening rice value chains, and enhancing national food security outcomes.

1.1.1 Socio-Economic Factors

Socioeconomic factors, including demographic traits, income levels, farm characteristics, and access to information and networks, are crucial in influencing how farmers engage with financial services. Globally, extensive evidence indicates that individual and household socioeconomic characteristics significantly impact both agricultural productivity and the adoption of financial services, especially in settings where farming is the main economic activity (Doss *et al* ., 2021). Numerous studies in developing economies consistently show that demographic traits such as age, education, and gender determine farmers' ability to understand, demand, and effectively use financial resources. Younger, more educated, and digitally literate farmers, who tend to be more open to innovation, are more likely to adopt modern financial products such as mobile banking, digital savings platforms, agricultural insurance, and flexible credit options (Hinson, Lensink & Mensah, 2022). Gender also influences access to financial services worldwide, with women often facing constraints due to limited land rights, cultural norms, and gaps in financial literacy (FAO, 2021).

Regionally, in sub-Saharan Africa, socioeconomic factors significantly influence smallholder farmers' access to digital and formal financial services. Age, education level, gender, and household structure are consistently identified as key predictors of farmers' engagement with formal credit markets (Adegbite *et al*., 2020). In Uganda, for example,

age, marital status, and household size were statistically significant factors affecting participation in savings and credit cooperatives (Nabeta e*t al*., 2021). Similar findings across East Africa show that education and financial literacy enhance farmers' ability to understand complex economic systems, negotiate with lenders, and assess financial products.

In the Kenyan context, these socioeconomic dynamics remain highly relevant, especially within national irrigation schemes such as Mwea, Ahero, West Kano, Bunyala, and Hola. Demographic characteristics, including age, gender, and education, strongly influence farmers' financial decisions. Younger and more educated rice farmers are more likely to adopt digital financial services, modern banking tools, and innovative credit products (Mutua, 2017). However, gender disparities continue; women farmers still face structural barriers related to land ownership, social norms, and limited access to financial education, which decreases their participation in formal financial markets (Oluoch, 2018). Additionally, recent studies found that education and financial literacy significantly improve access to formal credit among rice farmers in Ahero and West Kano (Kiptoo *et al*., 2023).

Income levels also influence farmers' financial behavior. Globally, higher and more stable incomes boost farmers' ability to save, repay loans, and invest in inputs that increase productivity (Chauhan & Upadhyay, 2020; Hinson *et al*., 2022). In Kenya, rice farmers with higher incomes tend to have stronger financial relationships and better creditworthiness when dealing with banks and microfinance institutions (Njeru & Mungai, 2019). Farm characteristics such as farm size, level of commercialization, and use of modern technologies also affect access to credit. Larger farms, and those using mechanization or improved irrigation technologies, are generally seen as lower-risk borrowers by formal lenders (Sigei *et al*., 2016). Farmers who are members of groups or

cooperatives also benefit from increased bargaining power and shared financial knowledge (Kiptoo *et al*., 2023).

Access to information and networks remains crucial for promoting financial inclusion. Globally, extension services, mobile technologies, and agro-finance platforms improve farmers' financial literacy and decision-making skills (Githinji, 2020; FAO, 2021). In Kenya, mobile money platforms, digital applications, and community-based savings groups create new channels for farmers to access savings, credit, and payment services (Makena, 2019). However, farmers lacking such access remain excluded, limiting their ability to increase production or build resilience. These socioeconomic factors offer a comprehensive framework for understanding differences in financial service access among rice farmers in Kenya's irrigation schemes. They emphasize the need for inclusive, context-specific policies and financial products that meet the diverse needs of various farmer groups.

1.1.2 Access to Financial Services by Rice Farmers

Access to financial services is a key enabler of productivity, income stability, and resilience among smallholder rice farmers. Financial services, including credit, savings, insurance, and mobile banking, provide farmers with the resources they need to purchase quality inputs, adopt modern agricultural technologies, and mitigate risks from climate variability and market fluctuations (World Bank, 2020). Worldwide, smallholder farmers encounter ongoing barriers to accessing formal financial products. These barriers include strict collateral requirements, high interest rates, low financial literacy, and limited documentation of farm income and assets, which hinder their ability to secure loans and other financial tools (Hinson, Lensink & Mensah, 2022). In Southeast Asia, for example, rice farmers often face long loan processing times, complex eligibility criteria, and high

borrowing costs, which limit investment in productivity-boosting technologies (Chauhan & Upadhyay, 2020).

At the regional level, smallholder farmers in sub-Saharan Africa face similar structural and socio-economic challenges. Research indicates that access to mobile banking, agent banking, and cooperative-based lending has improved financial inclusion, but adoption remains inconsistent due to limited literacy, technological hurdles, and underdeveloped infrastructure (Tiwasing, Addae, Naab, & Naab, 2024). In Uganda, participation in savings and credit cooperatives is heavily influenced by household characteristics such as education, gender, age, and social network membership, underscoring the role of social capital in facilitating financial access (Ndibalema & Philip, 2023). Additionally, demographic and socio-economic disparities, including gender-based restrictions on land ownership and decision-making, continue to impede financial inclusion for women farmers in the region (Adegbite, Ojo & Alabi, 2020).

In Kenya, rice farmers in national irrigation schemes such as Mwea, Ahero, West Kano, Bunyala, and Hola heavily rely on both formal and informal financial services to fund inputs, handle production cycles, and reduce post-harvest risks. Despite the growth of financial institutions and digital platforms such as M-Pesa, a large number of farmers remain financially excluded due to irregular income, limited collateral, limited financial literacy, and insufficient knowledge of available financial products (Makena, 2019; Njagi, Njeru & Wambua, 2020). Studies show that farmers with access to extension services, financial literacy programs, digital banking apps, and membership in cooperative societies are more likely to get loans, save money, and use formal financial services effectively (Muthoni & Wachira, 2022; Omondi, Nyaga & Mutua, 2021).

Additionally, access to information and networks plays a vital role in promoting financial inclusion. Farmers participating in community-based financial networks, such as Village

Savings and Loan Associations (VSLAs), acquire essential knowledge of credit opportunities, risk management, and innovative financial products, thereby enhancing their creditworthiness and financial decision-making (Omondi *et al*., 2021). Digital financial tools, including mobile money and agribusiness apps, have also become crucial channels for connecting farmers with financial institutions, lowering transaction costs, and expanding access to loans and insurance products (Tiwasing *et al.,* 2024). However, disparities in digital literacy and access to infrastructure still create gaps in adoption, especially among older or less educated rice farmers (Makena, 2019). Overall, effective access to financial services among rice farmers depends on a combination of socio-economic factors, farm characteristics, digital and social networks, and the availability of inclusive financial products. Interventions aimed at increasing financial inclusion should focus on flexible, context-specific credit options, digital financial literacy programs, cooperative-based lending, and policies that address gender, income, and education gaps. These strategies can strengthen rice farmers' financial resilience, boost productivity, and support sustainable agricultural growth within Kenya's national irrigation schemes.

1.1.3 Financial Literacy on the Relationship between Socio-Economic Factors and Access to Finance by Rice Farmers

Financial literacy refers to the knowledge, skills, and self-efficacy that enable individuals to make informed, effective, and responsible decisions about managing financial resources (Lusardi & Messy, 2023; Sticha & Sekita, 2023). It includes understanding fundamental financial concepts such as budgeting, saving, credit management, interest rate calculation, risk diversification, and investment choices, as well as the ability to apply this knowledge practically to improve financial security and resilience (Rehman & Mia, 2024; Lang, Zhang, & Fan, 2024). Globally, financial literacy has increasingly been seen as a vital part of human capital that not only boosts financial well-being but also

supports broader socio-economic development. In today's financial systems, characterized by rapid digital change, rising inflation, more complex financial products, and greater risk exposure, financial literacy is more important than ever. However, many people still lack the skills needed to navigate these changing financial landscapes, highlighting the ongoing need to improve financial capability (Lusardi & Messy, 2023; Sticha & Sekita, 2023). Evidence from around the world shows that financial literacy does not work in isolation; rather, it interacts with various socio-economic factors that influence financial behavior and access to services.

In many developing countries, low financial literacy has been linked to lower use of formal credit, limited participation in savings, reluctance to purchase insurance, and lower adoption of digital financial platforms (Morgan & Long, 2020; Cole, Sampson, & Zia, 2011). Furthermore, global studies reveal that even when people have adequate resources, such as income, land, or social networks, a lack of financial knowledge can prevent them from making productive financial decisions (Yoong, 2011). This shows that improving structural conditions alone may not be enough; developing cognitive and behavioral skills is just as crucial for achieving financial inclusion.

Regionally, in sub-Saharan Africa, financial literacy plays a crucial role in shaping the financial behavior of smallholder farmers. Farmers with higher financial knowledge tend to have better budgeting practices, keep better records, be more willing to engage with formal lenders, and adopt digital financial services more readily (Amaka & Okafor, 2022). In East Africa, financial literacy has been shown to influence the effectiveness of farmer cooperatives, credit groups, and microfinance programs by helping farmers understand loan terms, evaluate risks, and choose appropriate financial products (Wachira & Kihiu, 2020). Without sufficient financial literacy, many farmers either misuse financial products or fail to get the full benefits, leading to ongoing exclusion

from formal finance. Regarding access to financial services, financial literacy functions not only as a separate factor influencing financial behavior but also as a moderating factor that impacts the strength, direction, and effectiveness of relationships between socio-economic or structural factors such as income, demographics, farm features, and social networks and financial access outcomes. When viewed as a moderator, financial literacy boosts an individual's ability to turn available resources like income, social capital, farm assets, and demographic advantages into actual use of financial products such as credit, savings, insurance, and digital financial services (Rehman & Mia, 2024). This moderating role is based on Human Capital Theory, which suggests that knowledge and skills increase the productivity, efficiency, and returns of other types of capital. Therefore, financial literacy enhances the ability of socio-economic and structural resources to bring about change, helping individuals engage more effectively with financial markets and overcome barriers linked to financial exclusion (Lusardi & Messy, 2023).

In Kenya, financial literacy is increasingly seen as a key factor in farmers' financial decision-making. Studies indicate that farmers with higher financial literacy levels are more likely to choose suitable credit options, negotiate better loan terms, utilize digital payments, and manage agricultural risks effectively (Kamau & Munga, 2021). Among Kenya's national irrigation schemes, where farmers vary significantly in education, age, group membership, and income stability, financial literacy emerges as a crucial element in shaping financial inclusion outcomes. In this study, financial literacy is viewed as a moderating variable that amplifies the effects of demographic traits, income levels, farm features, and social networks on rice farmers' access to financial services within Kenya's national irrigation schemes. Recognizing this moderating role is essential for policy making and program planning, as it shows that improving financial access involves more

than just providing resources. It also requires strengthening farmers' cognitive and behavioral skills to interpret financial information, assess options, and make informed decisions that maximize resource use and foster integration into formal financial systems. By exploring this moderating mechanism, the study offers a deeper understanding of how socio-economic factors interact with financial inclusion outcomes among smallholder farmers.

1.1.4 National Irrigation Schemes in Kenya

Access to financial services is widely recognized as a key factor in boosting agricultural productivity, resilience, and socioeconomic development in rural areas. In many developing countries, where agriculture accounts for a large share of rural employment and household income, access to financial tools such as credit, savings, mobile banking, and insurance helps smallholder farmers shift from subsistence farming to more commercial and sustainable agricultural practices (World Bank, 2020). Despite progress in financial innovation worldwide, structural barriers still restrict access to formal finance. For instance, in Cambodia, SMEs face strict credit requirements and high borrowing costs, while in Bhutan, reliance on collateral and limited access to financial information hinder business growth (Fuentes, 2019; Wangmo, 2020).

These global trends reveal ongoing financial market flaws that disproportionately impact rural and small-scale farmers. In Sub-Saharan Africa, where agriculture remains the foundation of many economies, limited access to financial services continues to slow rural development. The agriculture sector employs over 80% of rural residents in the region, yet access to formal loans is still limited. Typically, less than 10% of smallholder farmers in Sub-Saharan Africa can borrow from formal institutions, and commercial banks allocate only a small part of their lending to agriculture due to perceived high risks. For example, in Ghana, agribusiness SMEs struggle with high loan repayment

costs and limited access to capital, discouraging investment in productivity-boosting technologies (Asare *et al*., 2019). These issues persist even though agriculture significantly contributes to the GDP of many African countries, accounting for 21.42% in Nigeria, 34.12% in Ethiopia, and 26.9% in Tanzania.

In Kenya, financial inclusion has grown significantly due to mobile money innovations, microfinance institutions, and agency banking (FSD Kenya, 2019). However, agriculture remains one of the most financially excluded sectors. Although Kenya is widely recognized for its high mobile money penetration, less than 4% of commercial bank loans go to agriculture. Furthermore, although over 80% of farmers use mobile financial services, fewer than 15% use them specifically for agricultural purposes, such as obtaining credit, saving for farm investments, or buying insurance. This shows that financial innovation has not yet effectively improved agricultural financial inclusion.

Kenya's national irrigation schemes, such as Mwea, Ahero, West Kano, Bunyala, and Hola, play a vital role in the country's rice production, with Mwea alone contributing about 60% of the total national output (NIA, 2022). Recent data from Kenya's major irrigation schemes show considerable variation in rice output across the country. Mwea Irrigation Scheme remains the largest producer, harvesting approximately 131,760 tonnes of rice in the 2023/24 season. Ahero Irrigation Scheme yields about 58,374 tonnes annually, while West Kano Irrigation Scheme records roughly 5,797 tonnes each year, with earlier estimates suggesting around 7,500 tonnes. Bunyala Irrigation Scheme contributes roughly 12,000 tonnes yearly. Data for the Hola Irrigation Scheme is limited, as the scheme is still undergoing revival and expansion, with no recent, verified output publicly available (KIPPRA, 2025). Rice remains Kenya's third most important staple crop, but the country still relies heavily on imports due to low local production (KNBS, 2021). Most farmers within these schemes are smallholders cultivating between 0.5 to 5

acres and depend mainly on rice for their income. However, socio-economic factors greatly influence their productivity and financial capacity. For example, most farmers are over 40 years old, women contribute significantly to labor-intensive tasks, and many have only primary or secondary education, which impacts their financial literacy and ability to make informed financial decisions (Mghenyi *et al*., 2018). Studies also show that farmer incomes tend to be low and unstable because of seasonal earnings and reliance on go-betweens (Makau *et al*., 2021).

Limited access to financial services remains one of the most persistent challenges facing rice farmers in Kenya's irrigation schemes. Recent studies in Mwea show that nearly one in five rice farmers (about 18–19%) have never accessed formal microfinance services. Additionally, research on smallholder irrigation schemes in Kenya indicates a moderate but significant positive relationship between income levels and access to financial services ($r = 0.638$), with income explaining approximately 36% of the variation in financial access among farmers. This suggests that socio-economic constraints directly influence farmers' engagement with credit, savings, and other financial products (Mwangi, JW, & Nyachieo, M., 2024). High input costs, inadequate collateral, and limited financial literacy worsen financial exclusion. Farmers often struggle to secure loans because agriculture is viewed as high-risk by lenders.

As a result, many cannot afford to purchase certified seeds, fertilizers, pesticides, and irrigation equipment, while post-harvest losses estimated at 20–30% further threaten income stability (FAO, 2021). Inefficiencies in water distribution, aging irrigation infrastructure, and limited market access also restrict productivity in schemes such as Ahero, West Kano, and Hola (Odongo & Ochieng, 2020). Farmers often sell their produce at low prices due to reliance on go-betweens and competition from cheaper imported rice (Wanjiku *et al*., 2019).

While the government has implemented several interventions, including subsidized inputs, expansion of irrigation infrastructure, and promotion of locally grown rice, these efforts have not sufficiently addressed farmers' financial constraints. Financial institutions have introduced tailored credit products, but adoption remains low due to strict requirements and limited awareness. Bridging this gap requires targeted strategies to boost financial inclusion among rice farmers, such as strengthening cooperative societies, improving access to financial information, and expanding digital finance solutions. Overall, despite Kenya's progress in financial innovation, significant gaps still exist in understanding how socio-economic factors influence access to financial services among rice farmers in national irrigation schemes. Empirical insights into how demographic characteristics, income levels, farm attributes, and access to information affect financial access are vital for designing inclusive policies and creating tailored financial products. Addressing these gaps is essential for achieving sustainable rice production, improving rural livelihoods, and advancing Kenya's national food security goals under Vision 2030.

1.2 Statement of the Problem

Despite the growing presence of financial institutions, digital banking platforms, and customized rural financial products, access to financial services remains a major challenge for rice farmers in Kenya's national irrigation schemes. According to the 2024 Fin Access Household Survey, formal financial access among Kenyan adults only slightly increased from 83.7% in 2021 to 84.8% in 2024. However, the rural inclusion rate lagged significantly at only 80.2% in 2024, compared to 91.3% in urban areas. This implies that about 12.6% of rural adults, many of whom are smallholder farmers, remain excluded from formal financial services. Additionally, the survey indicated that 9.9% of Kenyan adults were financially excluded in 2024, with rural youth accounting for nearly

half (45.5%) of that group. These figures underscore the scale of the challenge: access to financial services for rice farmers remains insufficient.

Within the agricultural sector, additional data reveal a deeper exclusion of smallholder producers: only a small share of farming payments is made digitally, and just a tiny share of total credit flows goes to agriculture. For example, one report noted that only 5% of all bank loans in Kenya were used to finance agriculture, despite about 75% of the population relying on agriculture for their livelihood. Meanwhile, Kenya has positioned itself as a leader in digital agricultural payments, with roughly 71% of Kenyan farmers receiving agricultural payments digitally in 2024, the highest share in Sub-Saharan Africa. These seemingly contradictory trends, higher digital payment share yet ongoing credit access barriers, highlight that access to financial services is complex. It involves more than just transaction capability; it includes credit, savings, insurance, and broader financial inclusion.

When applying these national figures to rice farmers in irrigation schemes such as Mwea, Ahero, West Kano, Bunyala, and Hola, there are no recent disaggregated statistics that accurately show the proportion of rice farmers without access, trends over time, or variations by scheme. This lack of scheme-specific data creates a significant gap. Additionally, while studies have examined smallholder agriculture in general, few have explored the unique socioeconomic context of rice farmers in irrigation schemes, where inputs are capital-intensive and financial needs differ from those in rain-fed subsistence farming. Another gap is that most current data and surveys focus on financial inclusion at the adult population level and do not break down data by crop type (rice), irrigation scheme, or farming system.

Furthermore, research indicates that socio-economic factors such as demographic traits, income levels, farm size, and access to networks and information significantly influence

access to financial services. However, among rice farmers in Kenya's national irrigation schemes, there is limited empirical evidence quantifying how these socio-economic factors either facilitate or hinder access. Without this detailed understanding, policy measures and product designs risk being generic and less effective for the rice-farming subgroup. Therefore, this study aims to address these knowledge gaps by empirically examining how socio-economic factors affect rice farmers' access to financial services in Kenya's national irrigation schemes.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of the study was to inverstigate the influence of socio-economic factors on rice farmers' access to financial services in Kenya.

1.3.2 Specific Objectives

i. To examine the influence of Demographic characteristics on access to financial services by rice farmers in Kenya.
ii. To determine the influence of income level on access to financial services by rice farmers in Kenya
iii. To analyse the influence of Farm Characteristics on access to financial services by rice farmers in Kenya
iv. To evaluate the influence of access to Networks on access to financial services by rice farmers in Kenya.
v. To establish the Moderating effect of financial literacy on the relationship between socio-economic factors and access to financial services by rice farmers in Kenya

1.4 Research Hypotheses

The following research hypotheses guided the study;

H_{01}: There is no statistically significant influence of Demographic Characteristics on access to financial services by rice farmers in Kenya.

H_{02}: There is no statistically significant influence of income level on access to financial services by rice farmers in Kenya.

H_{03}: There is no statistically significant influence of Farm Characteristics on access to financial services by rice farmers in Kenya.

H_{04}: There is no statistically significant influence of Access to Networks on access to financial services by rice farmers in Kenya.

H_{05}: Financial Literacy has no statistically significant moderating effect on the relationship between Socio-Economic factors and access to financial services by rice farmers in Kenya.

1.5 Justification of the Study

The importance of understanding how socio-economic factors influence rice farmers' access to financial services in Kenya's National Irrigation Schemes cannot be overstated. Rice farming in Kenya is crucial to the country’s agricultural sector, supporting food security, rural incomes, and economic growth. However, despite the notable potential for rice farmers to access financial services, socio-economic factors such as income levels, demographic traits, farm characteristics, and access to information and networks often prevent them from fully utilizing these services. This study's purpose was further justified by its goal of identifying and analyzing these factors, offering insights into the barriers and opportunities to financial inclusion among rice farmers. By exploring the specific needs and challenges faced by rice farmers, this study aims to improve access to financial services, which is vital for increasing agricultural productivity and overall rural

development. The findings are valuable to policymakers, financial institutions, and agricultural stakeholders in developing more inclusive financial products and services tailored to rice farmers' needs, ultimately promoting economic growth and poverty reduction in rural Kenya.

1.6 Significance of the Study

This study was significant for several reasons and contributed meaningfully to academic research, policymaking, and practical efforts in the agricultural finance sector. From an academic standpoint, it filled a critical knowledge gap by empirically exploring how specific demographic characteristics such as age, gender, education level, and marital status affect access to financial services among rice farmers in Kenya's national irrigation schemes. Unlike earlier studies that either broadly examined agricultural financial inclusion or focused on non-irrigated areas, this research specifically analyzed financial access within organized irrigation schemes supported by government infrastructure. By applying theories such as Social Capital Theory, Financial Inclusion Theory, Credit Rationing Theory, and Information Asymmetry Theory, the study also enhanced theoretical understanding by illustrating how demographic factors interact with institutional finance in a developing-country context.

The findings were also highly relevant for policymakers in the agricultural and financial sectors. The study identified disparities in financial access based on demographic factors, providing a foundation for developing targeted financial inclusion strategies. For example, it revealed that younger, more educated farmers were more likely to use mobile banking and digital finance tools. In contrast, women and older farmers faced greater exclusion from formal financial markets. These insights provided policymakers with data-driven evidence to create inclusive policies, financial literacy programs, and gender-sensitive financial products that improve the overall financial system for smallholder

farmers. Additionally, the study helped financial institutions, such as banks, microfinance agencies, and Savings and Credit Cooperative Organizations (SACCOs), by offering empirical data to improve client segmentation, risk assessment, and product development for rural agricultural clients. The results showed that the likelihood of loan uptake, savings mobilization, and insurance subscription was significantly influenced by socio-demographic factors, which could help financial institutions customize their service delivery strategies.

At the community level, the study empowered rice farmers by identifying specific demographic factors that limit their participation in formal financial systems. By highlighting gaps in financial literacy, access to information, and institutional engagement, the study emphasized the need for improved extension services and farmer capacity-building programs. The findings provided a basis for development organizations, farmer cooperatives, and county governments to create tailored interventions to close the financial access gap, enhance financial resilience, and boost agricultural productivity. In summary, the study's importance lies in its potential to influence policy changes, promote evidence-based financial inclusion strategies, and encourage further academic research into how demographics affect financial access in rural farming communities.

1.7 Scope of the Study

The scope of this study was defined both geographically and thematically to improve its relevance and manageability. Geographically, the study focused on Kenya's four central national irrigation schemes involved in large-scale rice production: Mwea, Bunyala, Ahero, and West Kano. These schemes were chosen for their significant role in rice farming and for their unique institutional structures that affect farmers' access to agricultural and financial support systems. The focus was specifically on registered rice

farmers within these schemes, who are directly affected by financial services and well-positioned to provide valuable insights into the research question. Thematically, the study examined how four demographic characteristics, age, gender, education level, and marital status, affect rice farmers' access to financial services. These factors were intentionally selected because they represent key personal traits empirically linked to financial behaviors, decision-making, and the likelihood of using financial products such as loans, insurance, and savings services. Although other factors, such as farm size, income, and social networks, may also influence access to finance, the four chosen factors enabled a more targeted and manageable analysis within the scope of the study.

The study analyzed the period from 2019 to 2024, emphasizing current trends in financial access, especially within the context of the government's efforts on financial inclusion and the push for agricultural commercialization. During this time, Kenya implemented significant financial reforms and rural development initiatives, making it a relevant period for assessing the challenges and opportunities rice farmers encounter in accessing financial services. The data mainly consisted of quantitative information collected through structured questionnaires distributed to selected rice farmers, along with qualitative data gathered from key informants, including agricultural officers, financial service providers, and local cooperative leaders. Using both types of data allowed the study to develop a more complete understanding of how demographic factors impact financial access. By focusing on a specific population, location, and set of variables, the study ensured its findings were focused, practical, and useful for guiding policy and practice in Kenya's agricultural and financial sectors.

1.8 Limitations of the Study

1.8.1 Limitations of the Study

This study faced several limitations, mainly due to its research design, methodological choices, and contextual boundaries. First, it employed a cross-sectional research design, collecting data at a single point in time. This limited the ability to establish causality between the independent variables (demographic characteristics) and the dependent variable (access to financial services). Longitudinal data would have offered better insights into trends and causal links, but this was not feasible within the study's scope and timeframe. Second, relying on participants' self-reported data introduced potential validity concerns, including recall and social desirability biases. Respondents might have overstated or understated their financial access levels due to personal perceptions or a desire to meet expected norms.

Despite efforts to ensure anonymity and confidentiality, such biases could not be entirely eliminated. Third, the study was geographically limited to five national irrigation schemes: Mwea, Ahero, West Kano, and Bunyala, among several in the country. While this targeted approach provided an in-depth view of financial access within organized rice production settings, it also restricted the generalizability of the findings to other regions, particularly non-irrigated or rain-fed farming areas in Kenya.

Additionally, the study encountered challenges in obtaining detailed secondary data specific to the study population. National or county-level financial inclusion statistics were often aggregated and lacked insights specific to rice farmers, requiring the collection of primary data. Furthermore, changing economic conditions, such as fluctuating input costs, inflation, and policy reforms during the study period (2019–2024), may have affected farmers' financial behavior and their access to services. However, these external factors were not directly included in the model. Despite these

limitations, the study made deliberate efforts to improve validity and reliability. Stratified random sampling ensured representation across different scheme zones, and the use of robust statistical tools, including regression analysis and diagnostic tests, increased the credibility of the findings.

1.8.2 Delimitations of the Study

To ensure clarity, feasibility, and analytical depth, the study was limited in several ways. It focused specifically on rice farmers operating within four major national irrigation schemes in Kenya. This intentional focus excluded other crop farmers, agribusiness stakeholders, and rice farmers in informal or private irrigation systems. Such limitations ensured that the study captured the dynamics of financial access within highly structured agricultural environments, where formal financial and institutional support are more prominent.

The study further narrowed its scope to four demographic characteristics: age, gender, education level, and marital status, chosen for their importance in the Financial Inclusion Theory, Credit Rationing Theory, Social Capital Theory, and Information Asymmetry Theory. Other demographic factors, such as household size, dependency ratio, and years of farming experience, were not included to avoid overextending the scope and compromising the depth of analysis. Methodologically, the study used a quantitative approach, focusing on numerical data to allow for generalization and statistical testing. This approach excluded qualitative methods that could have offered deeper personal or cultural insights into rice farmers' financial behaviors. Additionally, only formal financial services like credit, savings, and insurance were considered, while informal mechanisms such as merry-go-rounds and informal lending groups were not examined. The study period, 2019–2024, was chosen to reflect recent trends in financial inclusion within the national irrigation schemes.

This timeframe aligned with increased government efforts to improve agricultural financing and provided a current perspective on the challenges rice farmers face in accessing finance. These limitations kept the study manageable, grounded in theory, and focused on analysis, enabling clear conclusions and actionable recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The literature review explored how demographic factors affect rice farmers' access to financial services, emphasizing ongoing barriers despite targeted financial products. It was based on four theories: Financial Inclusion, Credit Rationing, Information Asymmetry, and Social Capital. These theories collectively offered a structured perspective for analyzing how demographics impact financial accessibility in Kenya's irrigation schemes.

2.2 Theoretical Review

2.2.1 Financial Inclusion Theory

The Financial Inclusion Theory was first introduced by Sarma in 2008 as a framework for measuring and understanding the complex nature of financial inclusion. Over time, scholars such as Morgan and Pontines (2020) expanded and applied the theory, highlighting its importance in improving access to financial services in emerging and developing economies. The theory holds that financial services should not only be widely available but also affordable, accessible, and tailored to meet the needs of all groups in society, including marginalized and low-income populations. It includes several key aspects, such as access to financial products (e.g., credit, savings, and insurance), the quality and appropriateness of these services, and the extent to which individuals and businesses use them. In the agricultural sector, including rice farming in Kenya, the theory indicates that inclusive financial systems help farmers adopt more effective agricultural technologies, access capital for growth, and better manage risks related to climate change and market fluctuations. The core belief is that integrating

underserved populations into the formal financial system can reduce inequality, promote economic empowerment, and support sustainable development.

However, the Financial Inclusion Theory was also criticized for its focus on formal financial institutions while underestimating the role of informal financial mechanisms, which continued to play a significant role in rural and agricultural finance across developing countries such as Kenya's national irrigation schemes, informal savings groups, micro-lending platforms, and community-based financial networks often served as the main ways to access financial services due to bureaucratic, collateral-based, or eligibility constraints imposed by formal banking systems (Mutua & Wanjiru, 2021). Additionally, scholars like Mwangi and Chepkemoi (2021) argued that the theory did not adequately address structural barriers, such as gender disparities, limited financial literacy, and socio-cultural norms, which continue to hinder equitable financial access even in areas with improved financial infrastructure. Furthermore, the theory faced criticism for failing to fully incorporate the role of digital transformation, especially in African contexts, where mobile money systems, fintech solutions, and agency banking have drastically changed how financial services are delivered.

While the theory recognized the role of technology in improving access, more recent critiques suggested that the model should evolve to treat digital innovation as a central driver of financial inclusion rather than just an addition (Owino & Gichuru, 2022). In summary, although the Financial Inclusion Theory offered an essential perspective on how financial systems contribute to socio-economic development, its limitations underscore the need for broader theoretical integration, particularly in environments where informal systems, socio-cultural factors, and digital innovations shape financial access more than formal offerings alone.

2.2.2 Credit Rationing Theory

Joseph Stiglitz developed the Credit Rationing Theory, and Andrew Weiss in 1981, marking a significant departure from traditional economic assumptions that credit markets always adjust through changes in interest rates. The theory was based on the idea that, under conditions of asymmetric information, banks do not always lend to all creditworthy borrowers, even when they could charge higher interest rates (Stiglitz & Weiss, 1981). This happens because higher interest rates attract riskier borrowers, increase the likelihood of adverse selection, and create moral hazard, thereby raising banks' lending risk. Therefore, instead of raising interest rates, banks ration credit to reduce risk.

Over time, the Credit Rationing Theory gained acceptance as an explanation of ongoing credit market failures in developing economies, especially in agriculture, where income fluctuations, limited collateral, and poor record-keeping were common (Aboagye & Otchere, 2021). The theory stayed relevant in sub-Saharan Africa, where formal lenders continued to see smallholder farmers as high-risk borrowers due to a lack of financial records, climate-related production risks, and the absence of tangible collateral. In Kenya's rice-growing areas, such as Mwea, Ahero, and Bunyala, evidence showed that commercial banks preferred lending to salaried workers and agribusiness firms with stable cash flows, leaving most small-scale rice farmers reliant on informal credit sources or microfinance institutions that charged higher interest rates (Mbugua & Njeru, 2020).

Recent research has further expanded the application of the Credit Rationing Theory by exploring how financial innovation has transformed traditional credit rationing dynamics. For example, digital lending platforms like M-Shwari and KCB M-Pesa increasingly depend on mobile transaction data, airtime usage, and savings patterns to assess creditworthiness, thereby reducing entry barriers for farmers who were previously

excluded (Kipkoech & Koech, 2022). These platforms show that credit rationing could be alleviated by replacing traditional collateral with new data sources. However, scholars warn that digital credit models sometimes charge punitive interest rates and enforce short repayment cycles, raising concerns about the long-term viability of these financial products (Owuor *et al*., 2023).

Although the Credit Rationing Theory remains relevant, it has been criticized for overlooking the socio-cultural and institutional factors that influence credit access in rural areas. Critics noted that the theory treats farmers as uniform actors, ignoring how gender norms, land tenure systems, and social networks shape credit-seeking behavior (Chisasa & Adetiloye, 2021). Additionally, it doesn't fully incorporate community-based credit systems, such as Village Savings and Loan Associations (VSLAs), which offer alternatives to formal finance and reduce dependence on collateral-based lending. Overall, while the theory still provides a valuable framework for understanding the challenges rice farmers face in obtaining formal credit, its assumptions need to adapt to reflect the changing financial environment driven by fintech, social capital, and policy reforms in agricultural finance.

2.2.3 Information Asymmetry Theory

Information Asymmetry Theory was developed from the foundational work of Akerlof, who in 1970 explained how markets can fail when one party in a transaction has more complete or accurate information than the other. This situation is best exemplified in his "market for lemons" model. The theory was later expanded by Spence (1973), who introduced the idea of signaling, and Stiglitz & Weiss (1981), who applied the framework to credit markets. They argued that such asymmetries lead to credit rationing instead of the equilibrium predicted by classical economic theory. In rural financial systems, the theory provides a strong explanation for the ongoing exclusion of

smallholder farmers from formal financial markets. Lenders in these markets often lack reliable information about borrowers' creditworthiness, production capacity, market access, and risk management practices. Consequently, they either refuse to lend, require high collateral, or impose extremely restrictive lending terms.

Among rice farmers in Kenya's national irrigation schemes, including Mwea, Ahero, West Kano, Bunyala, and Hola, information asymmetries occur due to limited financial records, unpredictable weather, fluctuating rice prices, and informal land tenure systems, all of which make it difficult for lenders to assess risk. Most farmers depend on informal financial sources, such as rotating savings and credit associations (ROSCAs), cooperative advances, or informal moneylenders, rather than accessing commercial credit. Recent empirical studies highlight the importance of information asymmetry in fostering financial exclusion. Wanjiru and Chege (2021) confirmed that Kenyan smallholder farmers lack credit histories and formal business records, which discourages banks from offering loans. Similarly, Njeru *et al*. (2022) found that over 65% of farmers using informal credit sources cited documentation barriers or perceived institutional rigidity as significant obstacles to seeking formal financial services. Saqib *et al*. (2023) further demonstrated that insufficient borrower information increases the likelihood of loan defaults, leading lenders to tighten approval criteria.

However, the theory has been increasingly criticized for failing to fully account for innovations that have emerged to address these information gaps. Financial technologies (fintech), mobile money platforms, satellite-based yield assessment tools, digital collateral registries, and alternative credit scoring models based on mobile transaction data have started to break down traditional information barriers. Specifically in Kenya, platforms like M-Shwari, DigiFarm, and the Kenya Agricultural and Livestock Research Organization's (KALRO) e-extension services have enabled farmers to build transaction-

based credit profiles, though these systems are not yet fully integrated into formal rural lending strategies. Wan and Cui (2024) observed that fintech-driven inclusion models have significantly lowered default risks by providing lenders with detailed behavioral and transactional data.

Critics also noted that information asymmetry theory mainly focused on the supply side and often overlooked demand-side barriers, such as low financial literacy, trust issues between farmers and financial institutions, and historical exclusion that created psychological distance. Additionally, the theory downplayed the importance of social capital and social networks in rural economies, where relational trust and group-based lending sometimes mattered more than formal information mechanisms. As the rural finance landscape grew more complex and digitally connected, researchers argued that an expanded framework was needed, one that includes behavioral insights, community-based financial norms, and digital data ecosystems, to better represent the reality of financial access for rural farmers.

In sum, while Information Asymmetry Theory remained a central theoretical lens for understanding financial exclusion among rice farmers in Kenya's national irrigation schemes, its explanatory power was constrained by emerging dynamics in data accessibility, technology integration, and social-financial interactions. The theory required contemporary reinterpretation to reflect these evolving realities and to guide policy interventions that bridged the gap between formal financial systems and smallholder agricultural producers.

2.2.4 Social Capital Theory

Social Capital Theory began with Pierre Bourdieu (1986), who described social capital as the sum of actual or potential resources tied to a durable network of relationships based on mutual acquaintance and recognition. Coleman (1988) highlighted its

importance in enabling coordinated action within social systems, and Putnam (1993) popularized it as a key concept for understanding community networks, trust, and collective norms, later broadening the theory. Social capital was then adopted in economics and development studies to explain how informal networks and shared social norms influence resource sharing, information exchange, and economic opportunities. Regarding access to financial services, social capital was seen as the relational and structural features of farming communities that shape how individuals interact with formal institutions, trust financial actors, and participate in collective risk-sharing mechanisms.

Among rice farmers in Kenya's national irrigation schemes, such as Mwea, Ahero, West Kano, Bunyala, and Hola, social capital is evident through farmer cooperatives, irrigation management committees, local savings groups, and agricultural extension networks. These social structures play a vital role in addressing the gaps left by formal financial institutions, especially when credit histories, land titles, or high-value collateral are absent. Mutual trust, reputation, and communal accountability often replace formal guarantees, allowing farmers to access group loans, input credit, or informal insurance. Njenga *et al*. (2021) confirmed that active membership in farmer associations significantly increases the chances of obtaining microcredit in irrigated rice schemes in Kenya. Similarly, Kariuki and Langat (2022) found that collective bargaining through cooperative organizations reduces transaction costs and improves loan repayment rates among farmers in rural Kenya.

Furthermore, the relational aspect of social capital, which includes interpersonal trust, reciprocity, and shared identity, contributed to risk-sharing behaviors and financial resilience. In a study conducted in sub-Saharan Africa, Mendez *et al*. (2020) found that farmers who are part of strong social networks are more likely to pool resources and

invest in productive assets, even without formal credit. In Kenya, group-based lending methods used by microfinance institutions such as Equity Bank and KWFT relied heavily on social capital to reduce default risk and facilitate peer monitoring.

However, Social Capital Theory was not without criticism. First, it was argued to be overly normative and challenging to measure, as the concept encompasses multiple aspects of bonding, bridging, and linking capital, each with distinct functions and implications. Critics such as Hunecke and López (2023) argue that social capital can reinforce exclusionary practices, in which well-connected groups capture resources at the expense of marginalized members, thereby perpetuating inequality. Additionally, over-reliance on bonding social capital, strong ties within homogeneous groups, could limit exposure to external opportunities, reducing farmers' ability to engage with formal financial systems. In some Kenyan irrigation schemes, informal group pressure discouraged risk-taking and innovation, effectively maintaining subsistence farming rather than promoting commercial growth.

Another limitation was that the theory downplayed broader structural barriers, such as regulatory frameworks, digital infrastructure, and macroeconomic dynamics, that influence financial markets. Though social capital helped build interpersonal trust and improved informal access to credit, it didn't necessarily lead to better access to formal services, especially when institutional policies remained inflexible. There is growing recognition that social capital must be complemented by financial literacy, progressive regulatory frameworks, and technological platforms to improve financial inclusion among rural farmers sustainably. In summary, Social Capital Theory provided a helpful framework for understanding how farmer networks and collective norms influenced access to financial services among rice farmers in Kenya's national irrigation schemes.

However, applying the theory today requires integrating it with modern financial innovations and policy measures to address systemic barriers to financial access.

2.3 Empirical Literature Review

The empirical review examined studies that investigated how socio-economic factors influenced farmers' access to financial services across global, regional, and local contexts. It highlighted consistent patterns showing that demographics, income, farm characteristics, and access to information shape financial inclusion. This synthesis provided a foundation for understanding the factors affecting rice farmers in Kenya's national irrigation schemes and guided the identification of gaps addressed by the current study.

2.3.1 Demographic characteristics of access to financial services by Rice Farmers.

Global studies have consistently shown that demographic traits such as age, gender, and education significantly influence access to financial services. According to Demirgüç-Kunt *et al*. (2018), gender and education are two key demographic factors that shape financial inclusion worldwide. Women and people with lower levels of education face more barriers to accessing formal financial services due to a lack of financial literacy, lower financial skills, and limited access to technology. Additionally, Agarwal & Nair (2019) demonstrate that younger populations, especially those with higher education, are more likely to use formal financial products. Klapper & Singer (2020) further confirm that demographic factors, such as age and education level, directly impact financial inclusion, especially in rural and underserved areas. This highlights the importance of developing policies tailored to different age groups and education levels to improve access to financial services.

Mohan and Singh (2019) stress that income and educational attainment are key factors in determining financial access in rural economies, pointing out that people with lower incomes or limited formal education are more likely to be excluded from formal financial systems. Their findings support Robb and Wood (2020), who argue that demographic factors, especially age and education, play a significant role in influencing the likelihood of accessing important financial services, such as savings accounts, credit, and loan products. Hossain and Niaz (2020) add to this discussion by showing that demographic traits, such as marital status, also affect financial behavior; married individuals tend to use formal financial services more often due to greater household responsibilities and long-term financial planning needs. Additionally, younger people with higher levels of education are more likely to adopt new financial technologies, which increases their interaction with and access to digital banking platforms. Global evidence also shows that rural residents face multiple demographic-related obstacles to financial inclusion, including low literacy, limited financial awareness, and ongoing gender inequalities that restrict women's participation in formal financial systems (Verma, 2020). Collectively, these studies highlight the complex role of demographic and socio-economic factors in shaping access to financial services, especially in rural and farming communities.

Abiona and Koppensteiner (2020) conducted a comprehensive analysis of how household demographic characteristics influence financial decision-making and access to financial services across sub-Saharan Africa. Using cross-country household survey data, their study found that household heads who were older, male, and had higher levels of formal education were much more likely to engage with formal financial institutions. Older household heads showed a greater willingness to take calculated financial risks and had higher levels of trust in formal financial systems, which positively affected their use of services such as savings and lending facilities. Conversely, younger household

heads relied more on informal methods, partly due to limited financial experience and lower confidence in institutions. Education proved to be a particularly strong predictor of financial participation—those with secondary or tertiary education were better able to understand and use various financial products, including credit, insurance, and mobile-based services. The study also highlighted ongoing gender disparities, with male household heads having higher access rates compared to females, largely because of social norms and differences in economic empowerment. Overall, Abiona and Koppensteiner (2020) argue that expanding financial inclusion in the region requires targeted efforts to narrow demographic gaps in financial knowledge, trust, and skills, especially among younger, less educated, and female household heads. Kendall & Mylenko (2019) discussed how demographic factors, especially gender and education, serve as barriers to financial access in developing countries. Their study highlights disparities in financial access for rural farmers, with gender and educational inequalities limiting opportunities for financial inclusion in many parts of the world. Similarly, Morsy (2021) emphasized that older populations and those with less education face significant barriers to accessing financial services, a challenge seen in both developed and developing countries. These studies help expand understanding of how demographic factors like gender and education affect access to financial services in rural economies.

Demographic variables significantly influence access to financial services among farming communities and rural households. According to Demirgüç-Kunt *et al*. (2022), younger farmers are generally more adaptable to financial technology and mobile banking solutions, which improves their access to formal financial services. Conversely, older farmers tend to rely more on traditional informal sources, such as rotating savings and credit associations (ROSCAs). Gender disparities are particularly prominent, with women being disproportionately excluded from financial services due to socio-cultural

norms, lower financial literacy, and limited asset ownership. A World Bank study in Bangladesh, India, and Indonesia found that men are more likely than women to own bank accounts and access formal credit, mainly because of differences in literacy and labor market participation (World Bank, 2021). Education level is a key predictor of financial inclusion. Ghosh & Vinod (2017) observed that individuals with higher levels of education are more likely to access formal credit services due to greater financial awareness and the ability to navigate complex banking processes. Marital status also influences access, as married individuals may have greater social capital or combined household income, boosting their creditworthiness.

Recent findings by Chen, Banerjee, and Xu (2023) revealed that significant gender-based digital divides still exist globally, especially in rural farming communities. Their cross-country study, conducted across 12 low-income nations in Africa and Asia, showed that women consistently lag behind men in adopting and using digital financial services such as mobile banking, digital wallets, and online credit platforms. This gender gap remained even after controlling for key socio-economic factors like age, income, and household size, indicating that structural and cultural barriers play a major role in limiting women's digital participation. The researchers noted that although education helps reduce the digital divide, its impact is strongest when combined with strong community networks, access to reliable information, and supportive financial infrastructure. When women have access to farmer groups, cooperatives, or microfinance networks, they are more likely to gain confidence in using digital financial tools. Likewise, the availability of affordable, accessible credit facilities further boosts their capacity to adopt digital financial services, as credit often enables investment in mobile devices or connectivity. The study underscores that improving digital financial inclusion for women requires a

comprehensive approach that combines education, community support, and better access to credit.

In Africa, demographic factors such as gender, age, and education are key determinants of financial inclusion. A study by Munyoki & Njiru (2020) found that gender inequality and educational gaps continue to affect access to financial services in rural areas, especially in East Africa. Adams & Mwaura (2021) provided additional evidence from sub-Saharan Africa, showing how gender and education influence financial access across countries, particularly among rural farmers. In Kenya, Kibet *et al*. (2019) found that women farmers with lower levels of education face significant challenges in accessing financial services, resulting in financial exclusion. Similarly, Khuma & Olaniyi (2019) found that rural farmers, especially those with lower levels of education, are less likely to access financial services in countries such as Nigeria.

In Tanzania, Kisumo & Kamau (2021) examined how demographic factors affect financial access and concluded that younger farmers with higher levels of education and income have greater access to formal financial services. Gender also plays a significant role, with men more likely to access these services due to social norms that favor male financial control. In Ethiopia, Assefa & Belay (2020) found that education significantly affects financial inclusion among rural farmers, with those who have completed secondary school more likely to use financial services. Obara and Gachenge (2021) also examined how demographic factors influence financial inclusion in East Africa, focusing on youth and education levels. Their study showed that young, educated farmers are more likely to access formal financial services, especially in countries like East Africa, where mobile banking is everyday.

Assuming Osei-Agyei and Oteng-Abayie (2021) examined how demographic characteristics influence the adoption of mobile banking among rural agricultural households in Ghana, they provided valuable insights into technology-driven financial inclusion in farming communities. Their study, based on household survey data from various farming districts, identified education and age as the most important factors affecting mobile banking adoption. Farmers with more formal education were better able to understand mobile banking interfaces, see the advantages of digital transactions, and trust technology-based financial solutions. However, age showed a non-linear effect: middle-aged farmers had the highest likelihood of adopting mobile banking, likely because they balance technological awareness, financial responsibilities, and active involvement in economic activities. Younger farmers, despite being more exposed to technology, had lower adoption rates due to fewer financial needs or weaker ties to formal banking systems. Older farmers often faced challenges like limited digital literacy and reluctance to move away from long-standing informal methods.

The study also highlighted significant gender disparities, especially the challenges faced by female-headed households. Societal norms, unequal access to resources, and lower confidence in using financial technologies created major barriers to mobile banking adoption among women. These obstacles limited their ability to access digital financial services that could boost farm productivity and household resilience. As a result, the researchers stressed the need for targeted efforts such as community outreach, digital literacy training, and women-focused financial empowerment programs to improve inclusivity. They argued that strengthening support for female and elderly farmers would not only reduce adoption gaps but also expand rural financial inclusion and advance broader social and economic development.

A study by Zins & Weill (2016) across several African countries found that being male, older, and better educated significantly increases the likelihood of accessing formal financial services. Additionally, married individuals have higher access levels, potentially due to dual-income advantages and community trust. Gender remains a pressing issue in financial inclusion across Africa. Research by the Alliance for Financial Inclusion (AFI, 2020) reports that women face compounded challenges due to legal barriers, limited mobile phone ownership, and restrictive cultural norms. In Nigeria, Aterido, Beck, & Iacovone (2013) found that younger, unmarried farmers have limited access to credit due to weaker social networks and a lack of collateral, while older, married farmers benefit from reputational credit and group-based lending models.

Aryeetey and Udry (2019) conducted a comparative study in West Africa examining how demographic variables interact with institutional trust to determine access to credit and savings. The study found that women were systematically excluded from credit markets due to both institutional biases and lower educational levels. Age was seen as a double-edged sword; older individuals had more community trust but were less likely to adopt digital financial tools. The researchers recommend that financial service providers adopt demographic-responsive product design.

A recent panel study by Akpan and Otieno (2022) conducted across multiple West African agricultural zones highlighted the important role of demographic characteristics in determining access to formal financial services. Their findings showed that farmers with only primary education or less were 65% less likely to qualify for formal credit, mainly due to limited financial literacy, weaker documentation skills, and lower perceived creditworthiness by lending institutions. Using a rigorous panel regression framework, the researchers explored how age, gender, and marital status interact to influence access to mobile banking and other digital financial services. The analysis

revealed that older farmers generally had lower engagement with mobile-based financial platforms, primarily because of lower digital literacy and a stronger reliance on traditional financial practices.Gender further deepened these challenges: older female farmers—especially widows faced the highest levels of financial exclusion. These women often lacked collateral, faced cultural barriers to land ownership, and had limited access to digital devices, making it harder for them to meet formal lenders' requirements or adopt financial technologies. Widowed farmers were particularly disadvantaged due to weakened social networks and diminished bargaining power within financial institutions. The study concluded that bridging these demographic gaps requires targeted policy interventions such as gender-sensitive credit programs, improved financial education for low-literacy populations, and community support mechanisms aimed at increasing digital adoption among older and vulnerable groups.

In Kenya, demographic factors like age, gender, and education significantly influence farmers' access to formal financial services. Ngugi and Njiru (2018) observed that younger farmers, especially those with higher education levels and more stable incomes, are more likely to use formal financial products such as bank loans, microcredit, savings accounts, and mobile financial platforms. Their study showed that education enhances farmers' ability to understand loan requirements, compare financial products, and operate digital banking tools, while higher income increases creditworthiness and eligibility for formal loans. Conversely, older farmers often encounter more challenges due to limited digital skills, lower risk tolerance, and a preference for traditional informal financial systems. Women with less education face additional barriers, including lower confidence when interacting with formal institutions and fewer economic opportunities that could strengthen their financial situation. Wambua (2021) further highlighted that gender disparities remain deeply rooted in Kenya's rural financial landscape. Cultural

norms that prioritize male ownership of land and productive assets often restrict women's ability to provide collateral, a key requirement for obtaining formal credit. Additionally, women in rural areas typically have limited access to financial information, weaker social networks, and less control over household financial decisions, all of which contribute to their reduced participation in formal financial markets. These gender-based constraints are compounded by uneven digital infrastructure, which limits women's access to mobile banking and other financial technologies that have become increasingly important for financial inclusion in Kenya. Together, these studies show that overcoming demographic barriers is crucial for improving equitable access to financial services among Kenyan farmers, especially women and older individuals who remain most vulnerable to financial exclusion.

Mwangi & Njeru (2020) specifically examined the influence of gender and education on financial inclusion in rural Kenya, highlighting that women and individuals with lower levels of education face the greatest difficulties in accessing financial services. This is especially evident in Kenya's national irrigation schemes, where rural rice farmers often struggle to access formal financial services due to demographic factors. Ochieng & Muthoni (2020) explored the role of education and gender in financial access, finding that educated farmers, particularly men, are more likely to use formal banking systems for credit and savings. Similarly, Kamau & Kimani (2021) found that farmers in Kenya's national irrigation schemes who are younger and more educated tend to have better access to financial services. A study by Mburu & Mutiso (2021) also confirmed that education is a key factor in financial inclusion, with lower levels of education limiting farmers' understanding of formal financial services.

According to Ngugi & Kerongo (2014), age has a non-linear relationship with financial access among rural households: middle-aged individuals are more likely to access formal

credit than their younger or older peers, due to maturity, stability, and perceived repayment capacity. Gender disparities continue in Kenya's financial sector. A study by Kabubo-Mariara & Kieti (2019) found that female rice farmers in the Mwea irrigation scheme are less likely to access credit than their male counterparts, mainly due to a lack of collateral and male-dominated land-ownership structures. Cultural barriers also limit women's participation in cooperative societies, which are key points for agricultural finance. Education has consistently been identified as a major facilitator. A study by Kiplimo *et al*. (2015) on smallholder farmers in Western Kenya found that those with secondary education or higher are more likely to access formal financial services, including mobile banking platforms, thanks to greater digital and financial literacy.

Regarding marital status, Murithi, Mude, & Wanyoike (2015) found that married farmers in Kirinyaga County have better access to credit due to increased household income, stronger social ties, and group memberships, which boost their creditworthiness. A longitudinal study by Ndungu & Wanyama (2023) focusing on Ahero and Bunyala irrigation schemes used household panel data to show that gender and age were strong predictors of access to formal credit. They found that younger married women who were members of SACCOs had higher credit uptake than unmarried women and older men. Similarly, Karanja & Wekesa (2024) analyzed the role of education and digital literacy in Mwea and concluded that farmers with smartphone literacy were 48% more likely to access mobile loans.

Ouma, Odongo, and Were (2017) conducted a large-scale analysis across Kenya using FinAccess survey data to determine how socio-demographic characteristics affect financial inclusion. Their regression analyses revealed that being male, older, urban-based, and having a secondary or tertiary education increased the likelihood of having a bank account or using mobile money services. For rural farmers, lack of education and

geographic isolation were dominant barriers. The study recommends targeted literacy programs and gender-inclusive policies to bridge the access gap.

Kamau and Njiru (2021) examined demographic barriers to financial access among smallholder farmers in the Mwea Irrigation Scheme in Kenya. Their mixed-methods approach revealed that low levels of formal education, especially among older women, limited their understanding of financial products such as credit and insurance. Younger and more educated farmers were more likely to use savings accounts and mobile banking. The study highlights the importance of simple, culturally appropriate financial education campaigns within irrigation schemes.

2.2.2 Income Level on Access to Financial Services by Rice Farmers

Income level is widely recognized as a key factor influencing financial inclusion. According to Lopez & Sinha (2020), income level directly impacts an individual's ability to access financial services, as those with lower incomes are more likely to be excluded from the formal financial system due to lower creditworthiness. A study by Mohan & Singh (2019) emphasizes that income disparities significantly affect access to financial services, especially in rural economies. Lower-income households, often living in rural or underserved areas, encounter substantial barriers to accessing formal financial services.

These challenges arise from limited financial resources, lack of collateral, and the high costs associated with formal financial products. Reddy & Venugopal (2021) also argue that financial institutions tend to offer credit and financial products mainly to individuals with higher incomes, leaving low-income groups marginalized. Agarwal & Singh (2020) note that income is a crucial factor in financial inclusion, with higher-income individuals more likely to access banking services such as loans and savings accounts. In a study by Hossain *et al*. (2020), individuals with higher incomes had greater access to formal

financial institutions, while those with lower incomes often relied on informal sources such as family and community lending. Similarly, Friedman & Kroszner (2018) observed that access to financial services is usually limited for people living in poverty, as financial institutions perceive them as high-risk clients. Moreover, Beck *et al*. (2019) provide a global perspective, illustrating that financial inclusion is strongly linked to income level, since higher income enables people to meet the eligibility criteria set by financial institutions.

According to Demirgüç-Kunt, Klapper, and Singer (2022), individuals in the lowest income quintiles continue to face disproportionately high exclusion from formal financial institutions, mainly because they are seen as high-risk borrowers and often lack the collateral needed to secure loans. Using extensive global Findex data, the researchers showed that income differences are closely linked to the likelihood of owning a bank account, applying for formal credit, or using financial safety tools such as insurance. Low-income households frequently encounter multiple obstacles at once, limited savings, irregular earnings, and high transaction costs, which together reduce their participation in formal financial services. The situation is even more severe in agricultural communities, where income is not only low but also highly seasonal and unpredictable. Farmers, especially smallholders, earn most of their income during harvests and face long periods of low cash flow. This irregularity makes it hard for them to meet the consistent repayment schedules required by banks and microfinance institutions. As a result, lenders often view them as unreliable or high-risk clients, further deepening their financial exclusion. Additionally, the study noted that agricultural households often lack formal documentation, have limited financial literacy, and are physically distant from banking infrastructure, all of which add to income-related barriers. Demirgüç-Kunt et al. (2022) thus stress that tackling income inequality is key to

enhancing financial inclusion, particularly for rural farming populations who remain marginalized.

Beck *et al*. (2008) conducted a multivariate panel regression analysis using World Bank Enterprise Survey data from over 70 countries. Their study found that higher-income individuals and firms were more likely to access credit and open bank accounts, while low-income populations were often excluded due to high transaction costs and a lack of collateral. Bruhn and Love (2014) conducted a randomized controlled trial (RCT) in Mexico to assess how financial liberalization, particularly the expansion of banking access, affected low-income groups. Their study showed that lower-income individuals had limited access to credit, even with improved physical banking infrastructure, indicating that income thresholds remained a significant constraint. Demirgüç-Kunt *et al*. (2022) used Global Findex data and applied logistic regression models to examine determinants of financial inclusion. They found that income was the strongest predictor of financial account ownership and credit access, with low-income households often resorting to informal financial mechanisms.

Recent global studies continue to confirm this association. Kumar & Kumari (2022) found, in their analysis of South Asian agricultural households, that those with higher and more stable incomes had greater participation in microfinance institutions, primarily due to improved creditworthiness and greater risk-absorption capacity. Similarly, Kabeer *et al*. (2021) examined income and gender dynamics in South Asia. They concluded that low-income women faced compounded barriers to financial access, further isolating them from formal financial systems. In Latin America, Benavides & Moncada (2023) used household survey data across five countries and found that income volatility significantly undermined financial inclusion efforts, particularly among subsistence farmers, reinforcing reliance on informal finance.

In the regional context, several studies have explored the connection between income and financial inclusion. Kamau (2020) emphasized that low-income farmers in rural Kenya and other East African countries often struggle to access credit because they cannot meet the collateral requirements of formal financial institutions. Similarly, Obara & Gachenge (2021) found that income inequality in Kenya restricts access to financial services, especially in rural areas. Low-income farmers are more likely to face exclusion due to their inability to repay loans, further reducing their access to credit. In Uganda, Ddumba & Businge (2020) found that farmers with higher incomes are more likely to use financial services such as insurance and credit because their higher incomes help them meet the eligibility criteria of financial institutions. Additionally, Njoroge & Mwaura (2020) noted that income level significantly influences access to financial services in East Africa, with farmers in lower-income groups experiencing greater obstacles in obtaining both savings and loan products.

Zins & Weill (2016) used binary logit models on World Bank data for Sub-Saharan products. The study highlighted the cost of financial services as a significant barrier for lower-income users. Honohan & King (2012) analyzed household survey data from 11 African countries and used probit regression to assess access to formal and informal financial services. The study found that income constraints significantly limited access, especially among rural agricultural households lacking steady cash flows. Amoah & Adomako (2020) conducted a quantitative survey of rural farmers in Ghana and used ordered probit models. The study found that income volatility among smallholder farmers reduced their eligibility for bank loans, while higher, more stable income levels were associated with greater access to formal credit.

Fletschner and Kenney (2020) examined patterns of rural financial access across East Africa and emphasized the crucial role of household income stability in influencing farmers' use of formal financial systems. Their study showed that the high income volatility experienced by low-income farmers can be driven by unpredictable weather, fluctuating market prices, and inconsistent yields, discouraging formal lenders from extending credit to this group. Financial institutions view such farmers as high-risk clients unlikely to meet fixed repayment schedules, leading to stricter borrowing conditions and reduced credit availability. For farmers, irregular cash flows make it hard to commit to structured loan repayments, increasing their reliance on informal saving and borrowing methods.

The researchers further observed that income levels exert an indirect yet powerful influence on access to a wide range of financial products beyond traditional loans. Low and unstable income limits farmers' ability to purchase agricultural insurance, which often requires upfront premiums that many households cannot consistently afford. Similarly, income constraints reduce the use of mobile money services, as individuals with minimal earnings tend to avoid transaction fees, maintain low balances, or restrict usage to basic transfers rather than leveraging broader financial features such as savings or digital credit. The study also noted that low-income farmers struggle to access agricultural input financing, which typically demands predictable repayment capabilities tied to anticipated yields. These interconnected barriers create a cascading effect of financial exclusion, whereby limited income restricts access to essential financial tools, which in turn undermines productivity, increases vulnerability, and perpetuates poverty cycles. Fletschner and Kenney (2020) therefore emphasize the need for innovative financial models tailored to the realities of income volatility prevalent among rural farming households.

Building on this, Okello and Wanyama (2022) found, in a comprehensive study across East Africa, that farm income stability and participation in off-farm income-generating activities significantly improve farmers' access to financial services. Their research showed that farmers who supplement their agricultural earnings with alternative income sources—such as small businesses, wage labor, or seasonal trade are seen by financial institutions as lower-risk borrowers. The presence of steady secondary income streams boosts lenders' confidence in repayment, leading to better credit terms, higher loan approval rates, and increased engagement with formal banking systems. Additionally, stable or diversified income helps farmers achieve more predictable cash flow, enhancing their ability to meet financial obligations and reducing the risk of loan default. Similarly, Adeyemi and Abubakar (2023) in Nigeria found that rice farmers with multiple income sources had higher savings rates and stronger relationships with microfinance institutions.

Their study emphasized that income diversification not only improves households' financial resilience but also promotes more disciplined financial behavior, such as regular deposit patterns and proactive engagement with credit officers. These farmers were more willing to invest in digital financial services, insurance products, and productivity-enhancing inputs because they had greater financial certainty and flexibility. Microfinance institutions, in turn, were more likely to support these farmers with repeat loans and customized credit facilities. Overall, these findings reinforce the broader understanding that income does more than determine eligibility for financial products it also shapes financial behaviors, influences household risk-taking, and impacts long-term financial inclusion. When farmers have stable or diversified income, they are better equipped to participate actively in the formal financial ecosystem, break cycles of vulnerability, and work toward more sustainable economic empowerment.

In Kenya, the impact of income on access to financial services has been widely studied. Akinyi (2021), in a study of rural Kenya, noted that farmers with lower incomes struggle to access formal credit, limiting their financial opportunities. This problem is widespread among smallholder farmers in Kenya's national irrigation schemes, where most of the population has limited access to banking services due to low income (Mwai & Gathenya, 2020). Ochieng and Muthoni (2020) found that income levels significantly influence access to financial services, with higher-income farmers having greater access to credit and savings products. Similarly, Kamau & Kimani (2021) discovered that income is a key factor in financial inclusion in Kenya's national irrigation schemes, with higher-income rice farmers enjoying better access to loans and other banking services.

A study by Mburu & Mutiso (2021) found that rice farmers in Kenya with higher incomes could access formal financial services, such as loans and insurance, whereas low-income farmers often relied on informal financial systems. Another study by Wambua (2021) examined how income levels affect financial inclusion in rural Kenya and concluded that low-income farmers are excluded from formal financial services because they are unable to meet the financial criteria needed to access loans and credit. Kiplimo *et al*. (2015) conducted a cross-sectional study involving 392 smallholder farmers in Western Kenya and used logistic regression. Their results showed that higher household income significantly improves access to financial services. Farmers in higher income brackets have better creditworthiness and can afford service-related transaction costs. Makena, Omwenga, and Muturi (2014) surveyed 130 smallholder farmers in Meru County using structured questionnaires and employed multiple regression analysis.

Recent studies in Kenya continue to confirm the key role of income dynamics in shaping farmers' access to formal and semi-formal financial services. Kariuki and Muthama (2022), in their investigation of income-related barriers among rice farmers in Busia,

found that the inconsistent and often unpredictable income streams typical of smallholder rice farming greatly decrease the chances of loan approval from both banks and microfinance institutions. Their results showed that lenders often express concerns about farmers' ability to keep up with regular repayment schedules, since rice production income is heavily affected by weather variability, pests, and fluctuating market prices.

As a result, many farmers in Busia are forced to depend on informal credit sources, further limiting their participation in formal financial systems.In the Hola Irrigation Scheme, Mutua and Wekesa (2023) reported contrasting outcomes for farmers who diversified their income through complementary activities such as livestock rearing and horticultural production. Income diversification improved household cash flow and reduced dependence on rice revenues alone, enabling farmers to better meet the financial requirements of savings and credit cooperatives (SACCOs) and mobile-based lending platforms. The researchers noted that lenders in this region viewed diversified farmers as more financially resilient, resulting in higher approval rates for short-term working capital loans, emergency credit products, and digital microloans. Farmers also demonstrated greater ability to save consistently, which strengthened their borrowing capacity and nurtured long-term financial relationships.

Adding further evidence, Wanyama and Musyoka (2023) found that farmers engaged in contract farming arrangements enjoyed significantly higher income stability than their non-contracted counterparts. Contract farming offered guaranteed markets, predetermined pricing structures, and sometimes even advance payments, all of which reduced income risk and improved cash flow predictability. This stability enhanced farmers' creditworthiness, enabling them to access a broader range of financial products, including asset financing, input loans, and equipment leasing options. Financial institutions perceived contract farmers as strategic partners with lower default risk,

leading to more flexible loan terms and repeated financing opportunities. Together, these studies emphasize that income stability, whether achieved through diversification, stronger market linkages, or contractual arrangements, plays a transformative role in enabling rice farmers to integrate into formal financial systems. They highlight the importance of designing financial products that account for the cyclical nature of agricultural income while helping farmers build more reliable, resilient revenue streams.

A recent impact study by Wambua and Otieno (2023) focusing on rice farmers in Western Kenya revealed strong evidence that household income levels significantly influence the adoption and use of formal and digital financial services. Their findings showed that households earning above KES 20,000 per month are much more likely to use mobile loans, agricultural credit facilities, and formal savings accounts than lower-income farmers. Higher-income households have a greater ability to maintain minimum balances, cover transaction fees, and meet repayment obligations, making them more appealing customers for digital lenders, SACCOs, and formal banking institutions. The study also indicated that income positively moderates the relationship between financial literacy and the use of digital financial platforms. In other words, even when lower-income farmers have adequate financial knowledge, they are less able to turn this literacy into active use of financial products due to economic limitations. The authors highlighted that greater access to mobile phones and mobile money services in rural Kenya has not automatically led to full financial inclusion. Although digital penetration has grown significantly, affordability issues still prevent low-income farmers from participating fully in digital financial systems. Costs like mobile loan fees, transaction charges, and penalties for falling below minimum account balances disproportionately impact low-income households, making many revert to informal saving groups or avoid formal financial services altogether. The study also noted that lower-income farmers often lack

the liquidity needed to utilize financial opportunities such as input loans or seasonal credit lines, even when they recognize their benefits.

Wambua and Otieno (2023) concluded that income remains a critical structural barrier that must be addressed alongside financial literacy initiatives. Without tackling the economic constraints that prevent low-income farmers from adopting financial services, the benefits of technological innovation and literacy training will remain limited. They recommended that policymakers and financial institutions design low-cost, flexible financial products tailored to the income realities of smallholder farmers, including reduced transaction fees, simplified digital credit requirements, and micro-savings options with no minimum balance restrictions.

Gichuki and Obiero (2022) examined emerging trends in financial access among small-scale producers operating within Kenya's National Irrigation Board (NIB) schemes, offering important insights into how income dynamics shape farmers' participation in formal financial markets. Drawing on regression analysis of data from several irrigation schemes, their study demonstrated that income level had the strongest positive association with formal credit uptake, particularly from savings and credit cooperatives (SACCOs) and microfinance institutions. Farmers with higher or more stable income streams were better positioned to meet eligibility requirements such as minimum savings contributions, collateral substitutes, and regular repayment schedules, which significantly enhanced their chances of loan approval.

The researchers also noted that higher-income farmers were seen by lenders as more reliable and creditworthy, mainly because they demonstrated stronger repayment ability and lower default risk. This increased trust from financial institutions gave these farmers better chances not only to access credit but also to diversify into additional financial products. Higher-income earners were more likely to participate in formal savings

programs, buy agricultural insurance, and use digital financial tools to help with farm management and risk reduction. Gichuki and Obiero (2022) highlighted that income not only affects short-term credit access but also influences long-term involvement with the broader financial system. Farmers with greater economic stability are more likely to use financial services for investing in technology, expanding farms, and buying productivity-boosting inputs, creating a positive cycle of financial inclusion and agricultural growth. Overall, their findings emphasize the need for policies and financial products that consider the income situations of smallholder farmers in NIB schemes. The authors recommend flexible lending options, customized insurance plans, and savings tools that reduce barriers for farmers with irregular or low incomes, promoting fairer access to financial services across Kenya's irrigated farming communities.

Mwangi and Wanyoike (2020) examined how income fluctuations impact the use of financial technologies in rural irrigation areas in Kenya, offering key insights into the behavioral and structural factors shaping digital financial inclusion among rice farmers. Their study revealed that farmers with unpredictable or subsistence-level incomes were significantly less likely to use digital financial services such as mobile banking apps, digital credit platforms, and online savings tools. This reluctance stemmed from various concerns: transaction fees that eat into tight incomes, fears of falling into debt cycles from mobile loans, and perceptions that digital platforms are technically complex or difficult to operate without proper training. Many low-income farmers preferred informal savings groups or cash transactions because these options were more flexible and did not involve extra fees or penalties. Interestingly, the researchers observed that income predictability, rather than income size alone, played a more critical role in determining whether farmers adopted financial technologies. Farmers with stable or moderately predictable income streams, even if relatively low, felt more confident using digital

platforms because they could better anticipate their ability to maintain account balances, meet repayment deadlines, and cover service charges. Predictable income also enabled farmers to plan digital transactions around cash flow cycles, reducing the perceived risk of using mobile-based financial services. Mwangi and Wanyoike (2020) concluded that irregular income patterns create both psychological and practical barriers that hinder digital financial adoption among smallholder farmers. They argued that digital financial inclusion strategies must go beyond simply expanding mobile connectivity or promoting financial literacy; they must also tackle the underlying economic constraints that influence farmers' willingness and capacity to use digital tools. Recommended interventions included flexible-fee digital products, low-interest mobile credit tailored to agricultural cash cycles, and simple user interfaces designed for populations with low literacy. These findings emphasize the need for income-sensitive digital financial innovations that reflect the realities of rural farming livelihoods.

2.2.3 Farm Characteristics on Access to Financial Services by Rice Farmers

Farm characteristics, such as farm size and productivity, are recognized as key factors influencing access to financial services worldwide. In their study, Ghosh *et al*. (2020) highlighted that larger farms with higher productivity are more likely to access financial services because they can generate income and serve as better collateral for loans. Likewise, Kato and Ng'ang'a (2019) found that farm size directly affects a farmer's ability to access credit, as larger farms tend to be more profitable and more attractive to financial institutions. Additionally, a study by Chavula *et al*. (2020) found that farmers cultivating high-value crops, such as rice, are more likely to access financial services than those growing lower-value crops. Farm characteristics, such as crop diversification and mechanization, also affect access to formal financial services (Sharma & Vohra,

2021). These traits indicate greater potential for sustainable income, which, in turn, enhances creditworthiness in the eyes of financial institutions.

Ali, Naseer, and Nazir (2021) conducted a cross-sectional survey of smallholder farmers in Pakistan using binary logistic regression. The study found that larger farm size, modern irrigation techniques, and higher yield per acre significantly increased access to formal credit. Financial institutions perceived these attributes as indicators of lower default risk. Akram *et al*. (2020) studied smallholder farmers in Bangladesh using structured interviews and probit models. The findings revealed that mechanized farming practices and cooperative membership improved access to microfinance, mainly by increasing productivity and strengthening group-based risk-sharing.

Gyasi *et al*. (2019) conducted a study in Ghana and India that compared access to finance among rice farmers using modern versus traditional farming practices. Using a quasi-experimental design, the study showed that those adopting modern techniques had a 24% higher chance of accessing formal financial services. Anderson and Ahmed (2016) used data from the World Bank's LSMS surveys in Sub-Saharan Africa and South Asia and applied multilevel logistic regression. They found that land ownership, use of improved inputs, and access to irrigation were consistently linked with better access to agricultural finance.

Recent empirical findings also reinforce this relationship. Barungi and Isabirye (2023**)** found that mechanization among Ugandan farmers boosted productivity, making them more attractive to lenders. Similarly, Asare and Koomson (2021) showed that cocoa farmers in Ghana with larger landholdings and secure tenure arrangements had improved access to formal credit due to stronger collateral profiles. Ayanlade and Ojebisi (2021**)** reported that climate-smart agricultural practices, such as water harvesting and improved

seed use, enhanced farmers' creditworthiness in West Africa. These findings echo the conclusions of Ahmed and Yusuf (2022)**,** who identified irrigation infrastructure and farm size as the most significant predictors of formal financial service uptake in Nigerian irrigation schemes.

In the context of East Africa, farm characteristics have been widely researched. Chikadya, Olembo, and Mbogo (2021) conducted a study in Tanzania and found that farm size and crop yield are key determinants of access to formal financial services. Smallholder farmers with limited farm resources often face challenges accessing financial services because they cannot provide sufficient collateral or generate consistent income. Similarly, Obara and Gachenge (2021) in East Africa found that farmers who use modern farming techniques and have larger farm sizes are more likely to access financial services, such as loans and insurance, which are essential for growth and sustainability.

In Kenya, research continues to support these findings. Mwaura and Njoroge (2020) argue that farm size and productivity directly influence access to financial services in rural Kenya, with larger farms more easily able to secure credit due to stronger revenue streams. Similarly, a study by Chikadya *et al*. (2021) in Tanzania found that smallholder farmers with larger, more productive farms had better access to loans and agricultural insurance services. In Uganda, Katamba and Lwasa (2020) observed that farm size and the types of crops grown were key factors affecting farmers' ability to access financial services. Large-scale farmers with higher agricultural output were more likely to interact with formal banks and other financial institutions than smallholders, who often depend on informal financial mechanisms.

Kamau and Muthoni (2021) found that rice farmers with larger farms or those using modern irrigation techniques are more likely to access formal financial services. Similarly, Muthoni and Wambua (2021) found that farmers in Kenya's irrigation schemes who adopted modern farming methods, such as precision farming and crop diversification, had greater access to agricultural loans and insurance products than their counterparts with smaller, less productive farms. Furthermore, Wambua (2021) found that farm characteristics, such as crop yields and the use of modern farming techniques, were positively associated with access to credit in Kenya's national irrigation schemes. Mburu and Mutiso (2021) also studied the relationship between farm size and financial inclusion, confirming that larger farms were more likely to access loans from formal financial institutions. Additionally, Muthoni and Njiru (2020) highlighted the role of farm productivity in determining access to credit and other financial services, with more productive farmers having better access to loans and insurance.

Ndung'u and Bett (2020) conducted a descriptive and inferential analysis on rice farmers in Mwea using multinomial logistic regression. They found that land size, yield volume, and cooperative membership significantly influenced the farmers' ability to access credit, especially from SACCOs and MFIs. Kihoro *et al*. (2018) carried out a quantitative study in Kirinyaga County. Findings revealed that adopting certified seeds and mechanized transplanting improved access to agricultural loans. Farmers using modern practices were more likely to be seen as low-risk borrowers. Kariuki and Omondi (2021) evaluated rice farmers in the Ahero Irrigation Scheme using probit regression. The study concluded that membership in farming groups, along with the application of modern pest control methods, led to greater access to loans, particularly from development banks. Wachira and Kinyua (2022) used structured questionnaires and logistic regression to assess the role of farm characteristics in access to weather-based insurance. Results showed that

larger farms and the adoption of irrigation systems increased the likelihood of insurance uptake, indirectly facilitating credit access.

Studies in Kenya have expanded this evidence base. Munene and Otieno (2023) found that the adoption of drone-based pest control and mechanized harvesters among rice farmers in Kirinyaga significantly increased their loan eligibility, as banks viewed such investments as signs of financial discipline and repayment ability. Yego and Mbogo (2020) also demonstrated that using fertilizer, certified seeds, and off-farm income sources positively affected farmers' ability to access various financial products, including credit, insurance, and input finance. Kinyua and Wekesa (2022) reported that farm size and the integration of irrigation technologies positively influenced farmers' ability to use digital lending platforms, especially in coastal irrigation schemes. Wanjohi and Kamara (2023) highlighted that farmers affiliated with cooperatives and who practiced rotational cropping had greater access to agricultural loans.

According to Musyoka and Kibaara (2022), farm size and land ownership status are among the most influential factors affecting financial access for smallholder rice farmers in Kenya. Using data from the Mwea and Ahero irrigation schemes, the study found that farmers with larger plots (over 2 acres) were more likely to access formal credit and insurance services than those with smaller plots. Larger farms were seen as more commercially viable and offered lenders better collateral. The study also found that having title deeds, when available, significantly improved access to credit through SACCOs and agricultural banks.

Kariuki and Mungai (2021) examined how farm production size and crop specialization affect access to input financing among rice farmers in the Bunyala and Perkerra irrigation schemes. They discovered that monocropping rice on larger plots earned institutional credit for inputs such as fertilizer, pesticides, and irrigation water. In

contrast, farmers practicing mixed cropping or farming at a subsistence level had difficulty qualifying for such financing because of lower expected returns. The study emphasized the need for inclusive financing models that support diversified and small-scale farming operations.

A regional analysis by Andae and Wanyoike (2023) focused on land tenure systems within government-managed irrigation schemes. The researchers reported that farmers operating under informal tenancy agreements (e.g., verbal arrangements or short-term leases) were less likely to access credit and insurance due to the insecurity of tenure. By contrast, farmers with long-term allotment letters or registered leases had greater bargaining power with financial institutions. The study recommended formalizing tenancy systems within National Irrigation Authority (NIA) schemes to unlock agricultural financing.

Ochieng, Odhiambo, and Oyugi (2020) investigated how irrigation intensity and infrastructure quality affect financial behavior among rice farmers in western Kenya. The study showed that farmers with year-round access to irrigation infrastructure are more likely to invest in productive assets and pursue formal financing, thanks to stable income expectations. Conversely, those in poorly maintained irrigation areas tend to be risk-averse and depend on informal finance. The authors emphasized the need to combine infrastructure investment with financial services to enhance productivity and inclusion.

Muli and Nyikal (2021) examined how different levels of farm commercialization affect financial access in Kenya’s rice-growing areas. Their results showed that farmers engaged in market-oriented rice farming, characterized by steady surplus production and consistent market engagement, were more likely to access banking services, including overdrafts and asset loans. These farmers kept financial records, which further enhanced

their creditworthiness. The study recommended encouraging farmers to maintain financial records and build formal market connections to improve their access to credit.

Nyagaka *et al*. (2023) conducted a case study of the Mwea Irrigation Scheme to examine how land fragmentation affects credit access. They found that rice farmers with highly fragmented plots faced more difficulty obtaining financing due to logistical challenges and increased production costs associated with scattered fields. Banks and microfinance institutions were hesitant to fund operations that lack economies of scale. The study recommended consolidating land use through cooperatives to improve both efficiency and access to finance.

2.2.4 Access to Networks on Access to Financial Services by Rice Farmers

Access to information and networks is crucial for advancing global financial inclusion. According to Beck *et al*. (2019), information access is essential for farmers to make well-informed financial decisions, including taking out loans, saving, and purchasing insurance. Likewise, Kamath *et al*. (2021) noted that farmers with access to networks, such as farmer groups or cooperatives, are more likely to use formal financial services. Information about financial products and services can help close the knowledge gap and encourage adoption. A study by Chirwa and Waligo (2020) also confirmed that farmers involved in agricultural networks or cooperatives tend to have better access to financial resources. These networks serve as intermediaries between farmers and financial institutions, helping them overcome barriers related to collateral and creditworthiness.

Morsy (2021) examined financial inclusion across different countries and discovered that access to information, particularly about available financial products and services, significantly improves access to formal financial services. The study also revealed that individuals connected through social networks have better access to financial products because of improved information flow and increased trust. Similarly, Klapper & Singer

(2020) found that rural residents with limited information about financial services are less likely to contact formal financial institutions. The research highlighted that the lack of information worsens financial exclusion in rural areas, preventing individuals from engaging with the banking system. Additionally, López-Cordón *et al*. (2019) showed that participation in financial literacy programs helps farmers make better financial decisions, which enhances their access to financial services. Mohan & Singh (2019) conducted a study indicating that farm size and income level are key factors in financial inclusion, with larger farms and more productive agricultural practices making it easier for farmers to access formal financial services. The study emphasizes that farmers in rural economies with lower yields and smaller farms often face difficulties obtaining credit because financial institutions view them as high-risk clients.

Mekonnen *et al*. (2021) conducted a study in India and Ethiopia using household panel data and propensity score matching. The results showed that access to agricultural extension services and information and communication technologies (ICTs) significantly increased credit uptake by improving financial literacy and reducing information asymmetries. Aker & Ksoll (2019) assessed the effect of mobile phone use on agricultural credit access in Niger using a randomized control trial. The study found that farmers receiving SMS-based agricultural and financial information were 22% more likely to apply for and receive microloans compared to those who did not, highlighting the power of mobile information networks. Kamau & Minot (2020) used survey data from Tanzania and Uganda to examine the role of digital extension platforms. Using a logistic regression approach, the findings showed that digital access to market and credit information through farmer groups and social media platforms increased financial inclusivity, especially among young farmers. Nguyen & Tran (2018) analyzed the impact of peer networks on financial access in Vietnam using social network analysis. The study

revealed that farmers embedded in stronger networks had better access to both formal and informal financial services, as networks reduced risk perceptions among lenders and built trust.

In East Africa, access to information and networks significantly influences financial access. According to Mwai & Gathenya (2020), farmer groups in Kenya and Tanzania are essential in facilitating access to financial services, as they often provide farmers with the information needed to choose among available financial products. This reduces information asymmetry, especially for smallholder farmers. Similarly, a study by Njoroge & Mwaura (2020) in Kenya found that farmers who are members of self-help groups or cooperatives are more likely to access loans and savings products. These groups often serve as platforms for financial education and collective action, making it easier for farmers to engage with formal financial institutions. Ajefu & Abiona (2022) examined how social capital and network density impact financial access among rural households in Nigeria using multivariate probit models.

Results showed that membership in farmer cooperatives and self-help groups improved access to credit by providing collateral substitutes and reducing default risk. Chisasa, J., & Makina (2020) examined the relationships among financial literacy, access to information, and credit uptake in South Africa using OLS and instrumental-variable regression models. They found that farmers with regular access to training, extension officers, and cooperative-based information had better credit profiles and borrowing behavior. Okello & Mwakubo (2019), in a study covering Ethiopia, Kenya, and Uganda, used pooled regression analysis to assess how information platforms affect credit access. They discovered that ICT-based platforms, group training sessions, and radio programs played a vital role in disseminating credit information and facilitating applications.

In Kenya’s national irrigation schemes, access to information and networks significantly influences farmers' ability to obtain financial services. Kamau & Kimani (2021) demonstrated that farmers who are members of cooperative societies or farmer groups generally have better access to financial services, especially credit, because these networks provide essential information on financial products. Muthoni & Wambua (2021) also discovered that the availability of agricultural extension services and financial literacy training enhances farmers’ financial inclusion. Their study further revealed that farmers in Kenya’s irrigation schemes who had access to financial literacy programs and information about agricultural loans made more informed decisions regarding their financial needs and were more likely to engage with formal financial institutions. Similarly, Ochieng & Muthoni (2020) highlighted that knowledge of financial products and access to supportive networks are crucial for enabling farmers to work with banks and other financial institutions.

Mwangi and Kibaara (2021) evaluated the role of farmer field schools and agricultural extension services in improving access to credit among rice farmers in the Mwea Irrigation Scheme using binary logistic regression. The findings revealed that access to financial and farming information through field schools increased formal credit use by 35%. Njagi and Wambugu (2020) conducted a study in the Ahero Irrigation Scheme using a cross-sectional survey design and multinomial logistic regression. They found that membership in SACCOs, farmer-based organizations, and training seminars enhanced awareness and access to microfinance services by lowering entry barriers. Wanyama and Mutua (2023) assessed the role of digital platforms in financial inclusion among rice farmers in Kirinyaga County. Using regression models and structured interviews, the study found that the use of mobile banking apps and SMS-based updates significantly increased farmers' confidence in accessing credit services. Kariuki and

Njoroge (2019) used qualitative interviews and regression analysis in the Bunyala Irrigation Scheme. They concluded that peer networks and regular access to market and input price information improved farmers' negotiation power and financial decision-making, thereby increasing credit uptake.

Kikulwe *et al*. (2021) argue that access to agricultural extension services and digital information platforms is positively linked to the adoption of financial services among smallholder farmers in Kenya. Their study, conducted across various counties including Kirinyaga and Siaya (both home to rice irrigation projects), showed that farmers who received regular information from extension officers were more likely to engage with formal lenders. These farmers had a better understanding of credit terms, insurance products, and mobile banking technologies, which boosted their confidence and financial literacy. Similarly, Kamau and Njeru (2020) examined the role of farmer networks such as cooperatives and producer groups in facilitating access to financial services in the Mwea and Bunyala irrigation schemes. Their findings indicated that membership in farmer-based organizations significantly improved financial access by strengthening collective bargaining power, enabling bulk input purchases, and increasing lenders' trust. Cooperative members also benefited from group loan schemes and shared financial training, reducing transaction costs and risks for financial institutions.

A study by Ondieki and Mugo (2022) highlighted the role of digital platforms, particularly mobile-based agricultural advisory services such as iShamba and M-Farm, in disseminating financial information. The researchers found that rice farmers who used digital agricultural services were more aware of financial products such as crop insurance, warehouse receipt systems, and digital credit. Access to mobile information services also improved market access and promoted record-keeping, which further boosted creditworthiness. Okeyo, Owuor, and Wambugu (2023) examined how

information asymmetry hinders access to credit in Kenya's irrigation zones. Through qualitative interviews in the Ahero and West Kano schemes, they found that many farmers either lacked knowledge of affordable financing options or misunderstood lending terms, leading to fear and financial disengagement. Conversely, farmers who had access to radio-based financial education programs or who regularly interacted with agricultural officers showed higher rates of bank account ownership and successful loan applications.

From a social capital perspective, Macharia and Bett (2021) examined how peer networks and social learning influence financial decision-making among rice farmers in government-managed irrigation schemes. Their findings showed that farmers were more likely to adopt new financial products if they observed successful outcomes among their peers. Peer influence was powerful in loan uptake and insurance adoption, with trust in informal farmer mentors compensating for the lack of formal literacy. The World Bank (2022) highlighted in its rural finance diagnostics report that financial literacy, supported by community structures and repeated exposure to accurate information, is crucial in demystifying financial services for rural farmers.

The report noted that irrigation schemes serve as strategic platforms for implementing integrated financial literacy and extension programs, given the presence of organized farmer blocks and regular water-user meetings. Lastly, Mwangi and Irungu (2020) found that access to market information, such as paddy prices, input costs, and loan terms, empowers rice farmers to make informed choices about borrowing and investing. Their survey across 12 irrigation schemes in Kenya revealed that farmers with access to multiple sources of information (extension officers, cooperatives, mobile alerts, and agro-dealers) were more likely to use savings accounts, obtain input credit, and buy micro-insurance.

2.2.5 Financial Literacy on the Relationship between Socio-Economic Factors and Access to Finance

Financial literacy is increasingly recognized as a key factor in promoting financial inclusion and economic well-being worldwide. Studies show that financial literacy improves households' ability to manage debt, make informed financial decisions, and participate effectively in formal financial systems. For example, a global analysis indicated that even minor improvements in financial literacy could significantly reduce household debt defaults and boost GDP growth (Principal, 2025). Supporting this, a bibliometric review of global research trends found that financial literacy and financial behavior are crucial for fostering personal economic stability across various contexts (Kumar, 2025). In the case of SMEs, Indonesian research found that financial literacy moderated the relationship between FinTech adoption and access to finance, suggesting that knowledge helps users better leverage digital financial innovations (Ratnawati et al. 2024). Similarly, a pan-African study showed that financial literacy strengthened the effect of financial inclusion on economic growth across 49 Sub-Saharan African countries (Akrofi-Adjebeng, Ocansey, & Asamoah, 2025). Overall, these global studies highlight that financial literacy not only directly predicts access and performance but also moderates the impact of structural, institutional, and technological enablers.

At the regional level, studies in Africa and other developing economies highlight how financial literacy strengthens the effectiveness of institutional and structural mechanisms in promoting financial inclusion. In Nigeria, financial literacy significantly moderated the relationship between FinTech usage and financial inclusion among SMEs, demonstrating that literacy improves the translation of technology into meaningful financial benefits (Bawa & Abdullahi, 2025). In Kenya, research among SMEs found that financial literacy moderated the relationship between loan characteristics and

financial performance, indicating that financial literacy supports structural inputs such as borrowing and credit use (Wakhungu & Mbuva, 2023). Another study in Kenya found that financial literacy moderated the impact of clan culture on firm performance, showing that individual capabilities interact with social and organizational structures to influence outcomes (Kimutai, Simiyu, & Tarus, 2025). Additionally, a study in Indonesia on MSMEs revealed that financial literacy moderated the relationship between business savings and sustainability, demonstrating that literacy can either enhance or limit the effects of financial behavior in developing economies (Sumastuti, Widiastuti, Ariyanti, & Imron, 2025). These regional studies show that in environments with institutional or structural challenges, financial literacy plays a vital moderating role in helping individuals and organizations maximize the benefits of available resources.

In Kenya, evidence of financial literacy as a moderator in agricultural and rural financial access is emerging but remains limited. Among smallholder coffee farmers, financial literacy was found to influence the relationship between financial factors and productivity, suggesting that knowledge helps farmers convert resources into higher-quality outputs (Kenyanya & Ndegwa, 2024). In Kenya's national irrigation schemes, demographic and structural factors such as income, networks, and farm characteristics affect access to financial services; however, few studies have explicitly examined the moderating role of financial literacy (Kisang, Asienga, & Tanui, 2025).

Research in Kenya's SACCO sector also showed that financial literacy positively impacts competitive advantage, though moderation was not the primary focus (Owino, Kariuki, & Wamitu, 2025). Additionally, a study of Kenyan SMEs found that financial literacy influenced the relationship between accounts receivable practices and firm growth, indicating that financial literacy enhances the benefits of financial management even outside agriculture (Kuria, 2024). Overall, these local studies highlight the

importance of financial literacy but reveal a lack of research on moderation within rural agricultural financial access, which this study on rice farmers in Kenya's national irrigation schemes aims to address.

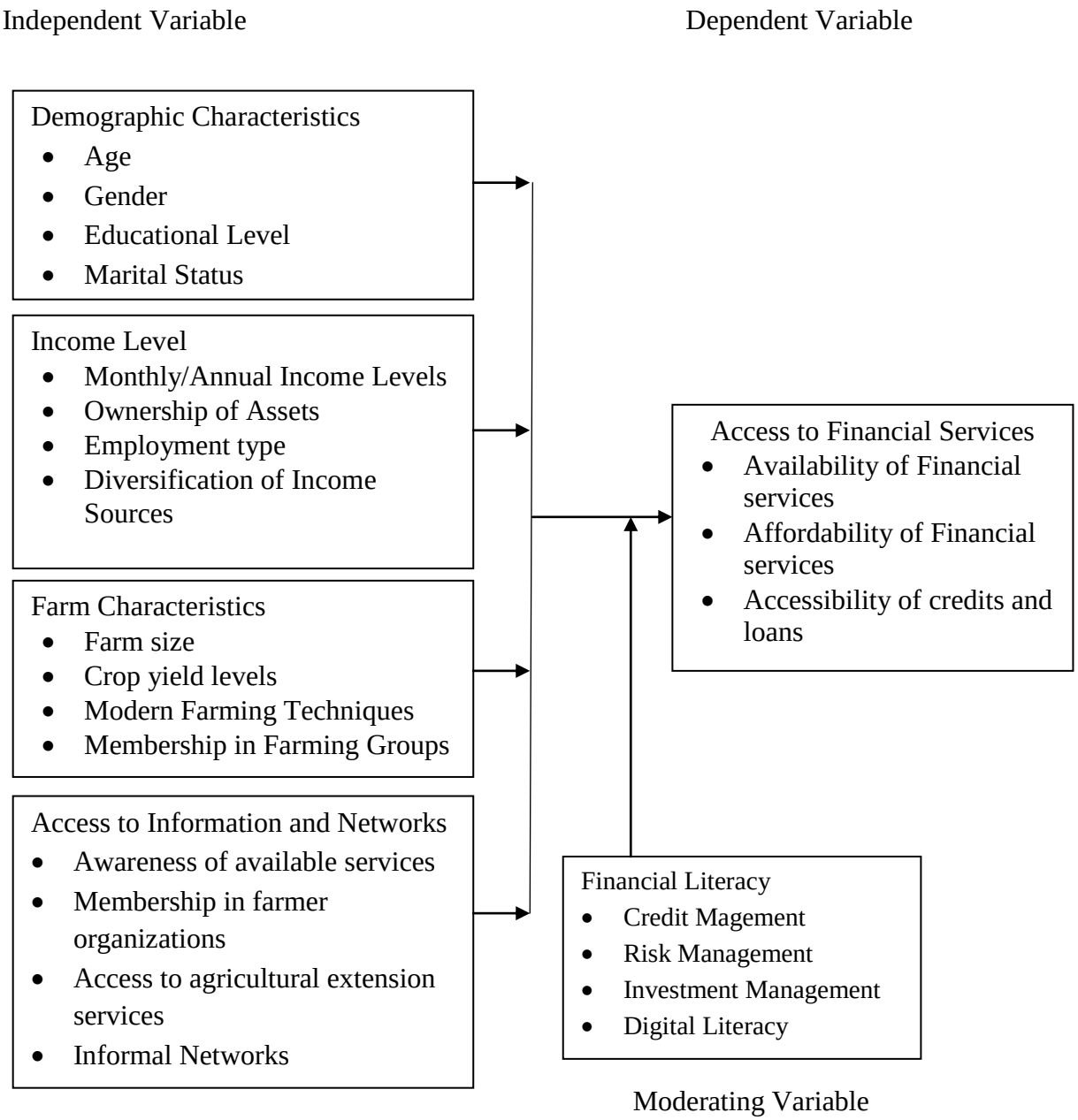
2.3 Conceptual Framework

The conceptual framework for this study shows how socio-economic factors relate to access to financial services among rice farmers in Kenya's national irrigation schemes. These factors include demographic characteristics, income levels, farm attributes, and access to information and networks, all of which significantly influence farmers' ability to connect with financial institutions and use financial services. Demographic factors such as age, gender, education level, and marital status impact financial decision-making and creditworthiness.

Income levels, including monthly earnings, asset ownership, and employment type, affect a farmer's capacity to meet financial obligations and obtain loans. Farm characteristics, like farm size, crop yield, and adoption of modern farming practices, directly affect profitability and the need for financial investment. Additionally, access to information and networks—such as financial literacy, membership in farmer groups, and extension services—improves awareness and use of financial products. By examining these factors, this study aims to offer insights into how socio-economic traits influence financial inclusion and the sustainability of rice farming in Kenya's irrigation schemes.

Figure 1

Conceptual Framework



*Source :*Researcher 2025)

2.4 Summary of Literature and Research Gaps

This section reviewed literature on factors affecting smallholder farmers' access to financial services. The review revealed that demographic, economic, and informational factors influence financial inclusion, yet most studies focused on general rural areas and

examined these factors separately. The limited focus on socio-economic influences created a gap that this study aimed to fill by analyzing these determinants together among rice farmers in Kenya's national irrigation schemes.

Table 1

Summary of Literature and Research Gaps

Author(s) and Year	Key Findings from Previous Studies	Identified Research Gaps	How the Current Study Fills the Gap
Demirgüç-Kunt *et al*. (2018); Klapper & Singer (2020); Agarwal & Nair (2019); Ghosh & Vinod (2017)	Age, gender, education, and marital status affect access to financial services; marginalized groups face exclusion due to low literacy and socio-cultural barriers.	Limited focus on how demographic factors interact among rice farmers in Kenya's national irrigation schemes.	The study analyzes how demographic characteristics collectively influence financial access among rice farmers in Kenya's national irrigation schemes.
Munyoki & Njiru (2020); Kibet *et al*. (2019); Ngugi & Njiru (2018); Kabubo-Mariara & Kieti (2019)	Women face exclusion due to limited assets and socio-cultural norms; education improves financial literacy and inclusion.	Insufficient research on how education and gender jointly affect women's access to digital and cooperative-based finance in irrigation contexts.	The study examines the joint effect of gender and education on financial access, particularly focusing on women farmers' participation in digital and cooperative platforms.
Murithi *et al*. (2015); Zins & Weill (2016); Kiplimo *et al*. (2015); Kamau & Njiru (2021)	Married individuals are perceived as more creditworthy; education strengthens digital and financial awareness.	Limited evidence on the influence of marital status and social structures on financial access among rice farmers.	The study evaluates how marital status and household characteristics affect farmers' access to formal and informal financial services.
Lopez & Sinha (2020); Beck *et al*. (2019); Hossain *et al*. (2020); Demirgüç-Kunt *et al*. (2022)	Higher income increases access to loans and savings, while low-income groups face exclusion due to risk perceptions and a lack of collateral.	Lack of contextual analysis linking income levels to financial access among rice farmers in irrigation schemes.	The study investigates the relationship between income levels and access to credit, insurance, and digital finance among rice farmers.
Benavides & Moncada (2023); Amoah & Adomako (2020); Kamau (2020); Mburu & Mutiso (2021)	Fluctuating farm income discourages formal lending and promotes reliance on informal systems.	Inadequate focus on how income predictability, rather than magnitude, affects access to finance in irrigation farming.	The study explores the role of both income level and stability in shaping farmers' access to financial services within national irrigation schemes.

Author(s) and Year	Key Findings from Previous Studies	Identified Research Gaps	How the Current Study Fills the Gap
Ghosh *et al*. (2020); Kato & Ng'ang'a (2019); Sharma & Vohra (2021); Ali *et al*. (2021)	Larger, more productive farms enjoy better access to financial products; mechanization also boosts eligibility.	Few studies examine how farm-level attributes affect financial access within Kenya's structured irrigation systems.	The study analyzes how farm size, productivity, and mechanization influence rice farmers' access to both traditional and digital financial services.
Akram *et al*. (2020); Anderson & Ahmed (2016); Barungi & Isabirye (2023); Chikadya *et al*. (2021)	Mechanized and technology-driven farming improves efficiency and creditworthiness.	Limited research on the role of digital tools (e.g., mobile lending, drone farming) in improving financial access in irrigation schemes.	The study evaluates the impact of digital and mechanized farming practices on rice farmers' financial inclusion in Kenya.
Musyoka & Kibaara (2022); Muli & Nyikal (2021)	Secure land tenure and commercial orientation enhance collateral value and income predictability.	Insufficient analysis of how tenure variations within irrigation schemes affect credit and insurance access.	The study examines the influence of land tenure security and commercialization on rice farmers' eligibility for financial products.
Beck *et al*. (2019); Kamath *et al*. (2021); Kamau & Kimani (2021); Mwangi & Kibaara (2021); Ondieki & Mugo (2022); World Bank (2022)	Access to financial information, cooperative membership, and ICT tools enhances financial literacy and inclusion.	There is a lack of empirical focus on how information access, networks, and digital platforms shape farmers' financial behavior in irrigation schemes.	The study investigates how access to information and farmer networks moderate the relationship between demographic and farm characteristics and financial inclusion among rice farmers.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Chapter Three explained the research methodology used to examine how demographic traits, income levels, farm features, and network access affect the availability of financial services for rice farmers in Kenya's national irrigation schemes. It described the research design, target population, sampling methods, data collection tools, validity and reliability measures, ethical considerations, and the descriptive and inferential statistical techniques employed to analyze the data and achieve the study's objectives.

3.2 Research Philosophy

This study adopted a positivist research philosophy. Research philosophy refers to the underlying beliefs and assumptions that guide the collection, analysis, and interpretation of data on a phenomenon (Wang, 2012). According to Bajpai (2011), research philosophy concerns the nature, sources, and development of knowledge and is closely connected to epistemology, which focuses on what is known to be true rather than merely believed. Epistemological assumptions, therefore, shape a researcher's view of reality and determine the most suitable methodological approach. Within the Western scientific tradition, two main paradigms are commonly recognized: positivism (also called the scientific paradigm) and interpretivism (or anti-positivism). Positivism is based on the belief that reality is objective, stable, and independent of human perception; thus, phenomena can be observed, measured, and described without influencing them.

It emphasizes quantification, replicability, and systematic analysis, aiming to establish empirical patterns and predict outcomes (Wang, 2012). The nature and goals of the research justified the decision to use a positivist philosophy for this study. Positivist inquiry is suitable when examining measurable relationships between variables, aligning

with this study's purpose of exploring how socio-economic factors such as demographic characteristics, income levels, farm attributes, and access to information affect rice farmers' access to financial services in Kenya's national irrigation schemes. The study used structured questionnaires, numerical data, and statistical techniques like regression analysis, all consistent with positivism's focus on objectivity and empirical validation. Additionally, the study aimed to generalize findings across rice farmers in national irrigation schemes, and positivist methods support such generalization through statistical inference. By providing a systematic, quantifiable framework for hypothesis testing, positivism offered a rigorous, coherent philosophical foundation for the research.

3.3 Research Design

The study used an ex post facto research design, which was appropriate for exploring the causal relationships among variables without manipulating the independent variables. This design was suitable because the study aimed to examine how naturally occurring factors, such as demographic characteristics, income levels, farm features, and network access, affected access to financial services among rice farmers in Kenya. These variables could not be controlled or altered by the researcher, as they were inherent attributes and conditions of the study population. This approach aligns with the nature of ex post facto research, which investigates how an independent variable, outside of experimental control, influences a dependent variable (Kerlinger & Lee, 2000). This design was especially suitable for the study because it allowed for the identification and analysis of cause-and-effect relationships using retrospective data.

By examining existing differences among farmers based on their demographic and socio-economic characteristics, the researcher could determine whether these differences had a statistically significant impact on access to financial services. The ex post facto approach

was also cost-effective in terms of time and money, as it used data collected at a single point in time without the need for longitudinal control or intervention (Creswell, 2014). Furthermore, the strength of this design was its ability to control for extraneous variables statistically rather than experimentally, thereby enabling the researcher to examine associations in real-world contexts. This was essential for a study conducted in a dynamic agricultural environment where factors such as age, gender, income, and farm size were outside the researcher's control. By employing this design, the study provided insights into the structural and socio-economic barriers to rice farmers' access to financial services, offering evidence-based recommendations for policymakers, financial institutions, and development agencies (Salkind, 2010).

3.4 Target Population

The target population referred to the entire group of individuals to whom the study results were generalized, consistent with the definition by Pandey and Pandey (2021), who described it as a set of real or hypothetical people, events, or objects relevant to a research inquiry. In this study, the target population was divided into the unit of analysis and the unit of observation. The unit of analysis consisted of Kenya's national rice irrigation schemes, while the unit of observation comprised the rice farmers operating within those schemes. Following Mugenda and Mugenda's (2020) conceptualization, the unit of analysis was the national rice irrigation schemes where rice was cultivated as the primary crop. As per the National Irrigation Authority (NIA, 2023), five major irrigation schemes focused on rice production were Mwea, Ahero, West Kano, Bunyala, and Hola. The unit of observation included all registered rice farmers within these schemes, who were directly involved in cultivation and agricultural finance activities.

According to recent NIA records (2023), the Mwea Irrigation Scheme had 7,000 registered rice farmers; Ahero, 2,300; West Kano, 2,200; Bunyala, 850; and Hola, 1,000.

This brought the total target population to 13,350 rice farmers across the five schemes. The wide geographic dispersion and diversity in demographic, socio-economic, and farm-level characteristics among these farmers provided a reliable basis for investigating factors influencing access to financial services, including demographic characteristics, income levels, farm characteristics, and network access.

Table 2

Target Population

No.	Irrigation Scheme	No. of Registered Farmers
1	Mwea Irrigation Scheme	7,000
2	Ahero Irrigation Scheme	2,300
3	West Kano Irrigation Scheme	2,200
4	Bunyala Irrigation Scheme	850
5	Hola Irrigation Scheme	1,000
	Total	13,350

Source: National Irrigation Authority Records (2023)

3.5 Sampling Size and Procedure

According to Yang and Miller (2008), sampling refers to the collection of data from a smaller number of people than the entire population. It is therefore the collection of the research data from a subset of the population. According to Lind, Marchal, and Wathen (2012), sampling is undertaken due to time and financial resource constraints as well as logistical challenges. The sample size was calculated for the sampling procedure to be conducted. It was the finite size of the population subset that was used in the study. The study utilized the Taro Yamane formula to calculate the sample size. According to Yamane (1967), the formula is as follows;

$n = \frac{N}{1+N(e^2)}$ Where N is the population size, n is the sample size, and *e* is the margin of error (0.05).

$$\frac{13350}{1 + 13350(0.05)^2}$$

n=388

The study used a sample of 388 respondents.

According to Rocco and Hatcher (2011), the sampling procedure is essential in describing to the readers how and why the specific sample was selected from the population. The sampling procedure is categorized into probabilistic and non-probabilistic procedures. This study utilized probabilistic procedures. According to Mark, Philip, and Adrian (2007), probabilistic sampling is a procedure in which population members are selected by chance and each has an equal chance of being selected. The method is used to eliminate bias in sample selection, thereby enabling generalization of the results. The study utilized a stratified random sampling procedure. According to Lee, Lee, and Lee (2013), the selection of independent simple random samples from each stratum of the population.

The stratum of this population, or sub-populations of this population, consists of the four irrigation schemes: Mwea, Ahero, Bunyala, and West Kano. Stratified random sampling was used in this study due to the population being heterogeneous and having groups based on location that are of unequal size. The proportionate means of selecting the sample membership was utilized in the study. Proportional sampling means that each stratum receives sample members proportional to its size in the target population.

Table 3

Sample Size

No.	Irrigation Scheme	Target Population	Sample size
1	Mwea Irrigation Scheme	7,000	203
2	Ahero Irrigation Scheme	2,300	67
3	West Kano Irrigation Scheme	2,200	64
4	Bunyala Irrigation Scheme	850	25
5	Hola Irrigation Scheme	1,000	29
Total		13,350	388

3.6 Instrumentation

This study collected primary data. According to *et al*. (2007), quantitative data refers to numerical data, while qualitative data refers to data in words. The quantitative data were collected through a structured questionnaire.

The structured questionnaire was used in the study. According to Gathii *et al.* (2019), a structured questionnaire is a series of written questions to be answered in writing, with specific, finite response options provided for respondents. The structured questionnaire was used for its ease of use, high response rate, time- and cost-efficiency, and ease of analysis using software (Coolican, 2014). The structured questionnaire comprised six subsections. The first subsection of the questionnaire collected demographic information from the respondents. The second subsection of the questionnaire assessed respondents' financial literacy. The third subsection of the questionnaire examined respondents' financial management practices. The fourth subsection of the questionnaire examined the collateral requirements of the respondents. The fifth subsection of the questionnaire examined the financial risk management practices utilized for the study. Finally, the sixth subsection of the questionnaire examined access to financial services among rice

farmers in Kenya's national irrigation schemes. The demographic questions were composed of categorical questions that yielded nominal or ordinal data for the study. This type of data is typically helpful in acquiring factual information (Barker, Pistrang, & Elliott, 2002). Sections two to six measured the research variables using Likert-scale questions that yielded interval data. According to (2011), the Likert scale is a type of response alternative in which participants indicate their degree of agreement with a stated attitude or judgment. This study utilized a 5-point scale (1=strongly disagree, 2=disagree, 3=undecided, 4=agree, 5=strongly agree).

3.6.1 Pilot Study

A pilot study was conducted before the main data collection, as recommended in research methodology. According to Eneanya, Bello, and Anifowose (2014), pilot studies serve several purposes, including testing the questionnaire to identify and eliminate ambiguous or irrelevant items, rehearsing the procedures of the actual research, and identifying potential logistical challenges that may arise during data collection. To ensure reliability and contextual relevance, the pilot study must involve respondents drawn from a population similar to that of the final survey. This research included a pilot study conducted at the Perkerra Irrigation Scheme. Mugenda and Mugenda (2019) recommend that at least 10% of the sample size be used for piloting. Accordingly, this study involved 39 respondents, representing 10% of the intended sample. The individuals who participated in the pilot were excluded from the primary research to avoid bias arising from prior exposure to the questionnaire. Feedback obtained from the pilot exercise was reviewed and used to refine the research instrument, thereby enhancing its validity and clarity.

3.6.2 Validity of the Instrument

The validity of the instruments is a critical component of the research phenomenon. According to Spiegel and Stephens (2011), the validity of the instruments refers to whether the instruments can measure what they are designed to measure. Thus, the study examined the validity of the structured questionnaire by assessing whether it can measure the research phenomenon: the factors influencing access to financial services by rice farmers in Kenya's national irrigation schemes. The validity of the research instrument in this study was examined using face validity and content validity. According to Rocco and Hatcher (2011), face validity refers to the extent to which respondents perceive the research instruments as measuring what they purport to measure. The face validity of the structured questionnaire was enhanced by including a distinct section for each variable, with well-labeled subsections. The study will also use content validity to examine the instrument coverage of the subject matter. This was achieved through use of the research supervisors and pilot study respondents. The feedback from the content validity testing will be incorporated in the final study.

3.6.3 Reliability of the Instrument

The reliability of the research instrument is a key component of research. According to Batanero (2000), the reliability of the research instrument refers to the ability of the responses to be replicated over time. This study used Cronbach's alpha to assess the internal consistency of the research instruments. According to Cohen, Manion, and Morrison (2007), the Cronbach alpha coefficient provides a coefficient of inter-item correlations, that is, the correlation of each item with the sum of all the other relevant items, and is useful for multi-item scales. Internal consistency refers to the consistency or replicability of responses across a latent-variable indicator (de Leeuw, 2012). A

threshold of 0.7A or higher is usually used to assess the instrument's reliability. This study used a Cronbach coefficient of 0.7A for the survey.

Table 4

Results of Reliability Testing

Study Variable	Number of Items	Cronbach's Alpha Coefficient
Demographic Characteristics	8	0.735
Income Level	8	0.973
Farm Characteristics	8	0.847
Access to Networks	8	0.836
Access to Financial Services	8	0.666
Average	8	0.8114

The results of the reliability testing presented in Table 4 indicate that the research instrument demonstrated generally good internal consistency across the study variables. Cronbach's Alpha coefficients for most variables were above the acceptable threshold of 0.7, with Demographic Characteristics scoring 0.735, Farm Characteristics 0.847, and Access to Networks 0.836, all indicating reliable internal consistency. Income Level recorded an exceptionally high coefficient of 0.973, signifying excellent reliability. However, Access to Financial Services registered a slightly lower coefficient of 0.666, which falls just below the commonly accepted benchmark. This suggests that the items under this variable may require refinement to improve consistency. Overall, the average reliability coefficient of 0.8114 confirms that the instrument is generally reliable for data collection in the main study

3.7 Data Collection Procedure

The data collection procedure followed a systematic and ethical approach to ensure the accuracy, reliability, and integrity of the research process. Before data collection, the study obtained a research permit from the National Commission for Science,

Technology, and Innovation (NACOSTI) and authorization letters from the National Irrigation Authority and local government offices. According to Walliman (2018), obtaining formal permission from relevant authorities enables researchers to gain access to the target population and fosters trust and cooperation during fieldwork. The data collection was conducted through face-to-face administration of questionnaires to the sampled rice farmers in the selected irrigation schemes. Trained research assistants were engaged to administer the questionnaires due to the varying literacy levels among the farmers. As Bryman (2016) suggests, the use of trained assistants enhances response accuracy and reduces data-collection errors.

The research assistants were briefed on the study objectives, ethical considerations, and how to guide respondents through the questionnaire without influencing their responses.

To ensure ethical compliance, respondents were informed of the research's purpose, their right to withdraw at any time, and the confidentiality of their responses, in line with Resnik's (2020) guidelines, which emphasize voluntary participation and confidentiality as key components of ethical research. The questionnaires were administered during scheduled meetings and farm visits, ensuring convenience for farmers and resulting in higher response rates.

Data collection took place over four weeks, allowing sufficient time for the researchers to reach all sampled respondents across the different irrigation schemes and to follow up on any incomplete responses. Strategies to minimize non-response included follow-up visits and phone call reminders, consistent with recommendations by Dillman, Smyth, and Christian (2014) for improving response rates in survey research.

Upon completion of the fieldwork, the collected questionnaires were checked for completeness and consistency, then coded and entered into the statistical software for analysis.

3.8 Data Analysis

Data analysis is the process of organizing raw data collected so that valuable information can be extracted (Orodho, 2003). According to Cooper & Schindler (2003), data analysis is the process of examining, categorizing, tabulating, and recombining collected data to discover meaningful information, intended to either validate or invalidate the initial propositions of a study. In this context, the collected raw data were edited, coded, analyzed, and tabulated. The editing of the questionnaires involved eliminating any questionnaires with missing responses to some items, making them incomplete, or questionnaires containing identifying information such as the respondent's name.

The data were then coded in the Statistical Package for the Social Sciences (SPSS Version 25) for analysis. This involved the researcher assigning numerical values to the responses (coding) to simplify data analysis. The raw data were also summarized and displayed in a compact form and presented in tables for analysis and interpretation. Descriptive statistics and inferential statistics were then used to analyze the data. The descriptive statistics undertaken included means, standard deviations, and frequency distributions, while the inferential statistics performed included correlations and multiple linear regressions.

In the first step, the dependent variable was regressed on each independent variable. The following regression model was fitted.

$Y= \beta_{0+}\ \beta_1 X_{1\,+}\ \varepsilon$……………………… ……………….............................…………i

Where

Y= Dependent variable

β_0 = Regression constant or Y intercept

β_1 = Coefficients of independent variables to be estimated

X_1= Independent variables

ε = Stochastic error term assumed to be normally distributed

In the second step, the dependent variable was regressed on all the independent variables. The following regression model was fitted.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon \quad \text{.....ii}$$

The regression model used was:

Where Y Access to financial services

X_1 = Demographic Factors

X_2 = Income Level

X_3 = Farm characteristics

X_4 = Access to Networks

ε = is the error term

In the third step, the moderating variable, financial literacy, was introduced to establish its moderating effect on the relationship between socio-economic factors and access to finance by rice farmers.

$$Y=\beta_0+\beta_1 X_1+\beta_2 X_2+\beta_3 X_3+\beta_4 X_4+\beta_5 M+\beta_6 (XC\times M)+\varepsilon \quad \text{.....iii}$$

Where:

Y = Access to Financial Services

X_1 = Demographic Factors

X_2 = Income Level

X_3= Farm Characteristics

X_4 = Access to Networks

M = Financial Literacy (Moderating Variable)

X_C = Composite of X_1–X_2 (standardized and summed)

ε = Error term

3.9 Diagnostic Tests

Preliminary diagnostic tests were undertaken to ensure the suitability of using parametric statistics (correlation and multiple linear regression). The preliminary diagnostic tests included tests for linearity, normality, and multicollinearity.

3.9.1. Normality Test

The normality assumption states that the residuals (errors) from a regression model should be normally distributed. This assumption is crucial because many inferential statistical procedures, such as hypothesis testing, confidence interval estimation, and p-value calculation, rely on the assumption that errors are normally distributed for their validity (Gujarati & Porter, 2009). Testing for normality is therefore essential to ensure that the regression results, especially t-tests and F-tests, provide reliable and unbiased inferences. In this study, normality was assessed using the Shapiro–Wilk test, which tests whether the residuals' distribution deviates significantly from normality.

The Shapiro–Wilk test was selected because it is widely regarded as one of the most potent and reliable tests for detecting departures from normality, particularly in small to moderate sample sizes (Razali & Wah, 2011). A p-value greater than 0.05 indicates that the null hypothesis of normality cannot be rejected, implying that the residuals follow a normal distribution. If the normality assumption is violated, the standard errors from the regression model may become biased, impacting the accuracy of hypothesis tests and

potentially leading to incorrect conclusions about the statistical significance of predictor variables. To address non-normality, researchers can apply transformations to the dependent variable, such as logarithmic, square root, or Box–Cox transformations, to reduce skewness and achieve normality. If transformations do not resolve the issue, nonparametric regression models or bootstrapping techniques that do not assume normality can be used to produce valid statistical inferences (Osborne, 2010).

3.9.2. Homoscedasticity Test

Homoscedasticity refers to the condition in which the variance of residuals remains constant across all levels of the independent variables. In contrast, heteroscedasticity happens when the spread of residuals varies, violating one of the main assumptions of the ordinary least squares (OLS) regression model (Wooldridge, 2013). Testing for homoscedasticity is important because OLS depends on the assumption of constant variance to produce efficient estimates and accurate standard errors. When this assumption is violated, standard errors become biased, leading to misleading p-values, unreliable hypothesis tests, and confidence intervals that are either too wide or too narrow. In this study, homoscedasticity was assessed by plotting standardized residuals against predicted values.

This method was used because scatter plots offer a straightforward and widely recognized visual way to detect non-constant variance. A random spread of points around the horizontal zero line, without clear patterns or funnel shapes, indicates that the assumption of homoscedasticity holds. On the other hand, clusters or systematic spreading of residuals suggest heteroscedasticity. The scatter plot was chosen because it provides an intuitive, quick, and effective way to visually assess whether the residual variance varies across levels of the predicted values. It is beneficial in applied research as an initial check before running more formal statistical tests. Violating the

homoscedasticity assumption leads to inefficient estimators and biased standard errors, increasing the risk of Type I and Type II errors. If heteroscedasticity is found, robust standard errors (e.g., White's heteroscedasticity-consistent estimators), logarithmic transformations of variables, or weighted least squares (WLS) can help stabilize the variance and enhance the reliability of statistical inference.

3.9.3 Multicollinearity Test

Multicollinearity occurs when two or more independent variables in a regression model are highly correlated. This condition inflates the standard errors of the regression coefficients, making it difficult to determine the individual effect of each predictor variable (Field, 2013). This study assessed multicollinearity using Variance Inflation Factors (VIFs) and Tolerance values. A VIF greater than 10 or a tolerance value less than 0.1 indicates a significant multicollinearity problem (Hair *et al*., 2019). These values were calculated for all independent variables included in the regression model. If multicollinearity exists, the estimated regression coefficients may become unstable and highly sensitive to small changes in the model, making it challenging to identify which variables are truly significant predictors. While multicollinearity does not reduce the model's goodness-of-fit or predictive power, it significantly hampers the interpretability of the regression output. Possible solutions include removing one of the highly correlated variables, combining correlated variables into an index or composite variable, or applying Principal Component Analysis (PCA) or Ridge Regression, which are specifically designed to address multicollinearity by reducing dimensionality or penalizing significant coefficients.

3.9.4 Autocorrelation Test

Autocorrelation, also called serial correlation, describes the correlation of residuals across observations. It is a common issue in time-series or panel data where observations are not independent, violating the OLS assumption that error terms are uncorrelated (Greene, 2012). Testing for autocorrelation is important because correlated residuals lead to biased standard errors, weakening the reliability of hypothesis tests and potentially causing inflated t-statistics and misleading conclusions. Although the coefficient estimates remain unbiased, their variances are underestimated, increasing the risk of Type I errors. In this study, autocorrelation was tested using the Durbin–Watson (DW) test, which detects the presence of first-order autocorrelation in residuals.

The DW test was selected because it is the most common and suitable method for identifying first-order serial correlation in regression models that do not include lagged dependent variables. A DW value near 2 indicates no autocorrelation; values much lower than 2 suggest positive autocorrelation, and values much higher than 2 indicate negative autocorrelation. If autocorrelation is present, several corrective strategies can be applied. These include adding lagged dependent or independent variables to model the data's dynamic structure, using Generalized Least Squares (GLS) or the Cochrane–Orcutt procedure, which adjusts the estimation method to account for serial dependence in the error terms. Additionally, Newey–West standard errors can be employed, offering consistent standard errors even when autocorrelation and heteroscedasticity are present.

3.10 Ethical Consideration

The study adhered to all ethical principles governing research involving human participants and complied with the relevant institutional and national regulatory frameworks. Ethical approval was first obtained from the Kabarak University Research Ethics Committee (KUREC) to ensure the study met all institutional standards for

protecting human subjects. Additionally, a research permit was obtained from the National Commission for Science, Technology, and Innovation (NACOSTI), authorizing the researcher to conduct fieldwork and collect data within the study area. Before engaging participants, the researcher clearly explained the purpose, objectives, procedures, potential risks, and expected benefits of the study, allowing respondents to make informed decisions. Informed consent was obtained from all participants through a signed consent form, which highlighted that participation was voluntary and that respondents could decline or withdraw from the study at any time without penalty.

To uphold anonymity and confidentiality, participants were not asked to provide personal identifiers such as names, phone numbers, or addresses. All responses were coded to prevent individual identification, and the data collection instruments were designed to avoid any potential disclosure of personal information. Only the researcher had access to the raw data, ensuring confidentiality was maintained. The study also upheld the principle of voluntary participation, ensuring that no respondent was coerced, pressured, or unduly influenced to take part in the research. Extra care was taken to ensure that all participants, including those who might be considered vulnerable, fully understood the study procedures before providing consent.

Regarding data integrity, the researcher ensured that all data collected were accurately recorded, securely handled, and analyzed without manipulation or falsification. Checks were performed to verify completeness and accuracy before data entry and analysis. Additionally, data storage and retrieval procedures were implemented to ensure security and proper management of research data. All electronic data were stored on password-protected devices, while physical documents such as consent forms and questionnaires were kept in locked storage accessible only to the researcher. The data will be retained for the period required by institutional policy and then destroyed to maintain

confidentiality and comply with data protection guidelines. Overall, the study adhered to the ethical principles of informed consent, voluntary participation, anonymity, confidentiality, data integrity, responsible data management, and respect for human dignity, in line with KUREC and NACOSTI ethical standards.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSIONS

4.1 Introduction

This chapter presents the results of the collected data, along with their interpretation and discussion. The data for this study were gathered between December 2024 and February 2025. The chapter is structured as follows: a presentation of the response rate analysis, descriptive statistics, and, finally, inferential statistics.

4.2 Response Rate

Table 5

Response Rate of the Questionnaires

No. of Questionnaires		
No. of questionnaires Issued	Returned	Response Rate (%)
388	311	80

The researcher distributed 388 questionnaires to respondents, of which 311 were returned from the field and accepted as correctly completed, yielding an 80% response rate. This response rate was acceptable for this study. According to Mugenda and Mugenda (2003), a 50% response rate is adequate, 60% is good, and 70% or more is perfect. This response was therefore rated as very good for the study.

4.3 Demographic Information

The demographic information presented includes respondents' gender, age, education level, and the period respondents have been rice farmers.

4.3.1 Gender Representation

Respondents were also asked to indicate the gender distribution of the study participants. The findings are presented in Table 6.

Table 6

Gender Representation of the Study Subjects

Gender	Frequency	Percentage
Male	154	49
Female	157	51
Total	311	100

The analysis shows that 49% of respondents are male and 51% are female, indicating a balanced gender representation among rice farmers in Kenya's national irrigation schemes. This balance suggests that both men and women are actively involved in rice production within these schemes, and neither gender is significantly under- or over-represented in the sample. From a methodological perspective, such parity enhances the generalizability of your findings across genders, reducing the likelihood that patterns in access to financial services are driven mainly by one gender's experiences or constraints. The fact that women make up a slight majority (51%) of the sample challenges common stereotypes that agricultural finance and farming are predominantly male activities in Kenyan rural areas.

It may reflect intentional efforts by irrigation authorities or farmer groups to include women in rice cultivation, or it may mirror broader shifts in rural livelihoods in which women play more prominent roles in farming. Moreover, this balance indicates that any observed disparities in financial access are unlikely to be due to simple sampling error; instead, they likely reflect genuine socio-economic or institutional factors that affect men's and women's ability to obtain loans, savings, or other financial services. The close gender balance offers a solid foundation for further research into gender-specific barriers to financial access. By breaking down data on collateral ownership, land-title registration, social networks, and decision-making authority, researchers can identify

how particular challenges differ for men and women. Such insights will help design interventions that actively create equal opportunities, prevent unintended biases, and ensure policies truly benefit all rice farmers.

4.3.2 Age of the Respondents

The respondents were asked to indicate their age. The findings are shown in Table 7.

Table 7

Age of the Respondents

Age of the respondents	Frequency	Percentage
Below 20 Years	49	16%
21-30 Years	76	24%
31-40 Year	55	18%
41-50 Year	73	23%
Over 51 Years	58	18%
Total	311	100

The age distribution of the 311 rice farmers in Kenya's national irrigation schemes shows a mostly balanced but slightly bimodal pattern, with clusters in the young-adult (21–30 years: 24%) and mid-career (41–50 years: 23%) groups. This dual focus highlights two key segments within the farming population: early-career individuals who are likely more open to new agricultural and financial technologies, and experienced farmers whose accumulated knowledge and assets may give them more bargaining power with formal lenders. The relatively even spread across the remaining age groups under 20 years (16%), 31–40 years (18%), and over 51 years (18%) further reflects a multi-generational landscape, with distinct economic goals and abilities that should be considered when evaluating access to financial services.

Farmers aged 21–30, representing nearly a quarter of the sample, occupy a critical inflection point: they are simultaneously constrained by limited collateral and nascent credit histories, yet benefit from higher digital literacy and openness to innovation. In

this vein, economic factors such as reduced minimum loan sizes, group- guarantee collateral schemes, and mobile- based lending platforms can disproportionately enhance their inclusion. In particular, youth-oriented credit facilities combined with intensive financial literacy training could mitigate perceived lender risk, build sustainable repayment records, and encourage transitions from high-interest informal borrowing to formal sector engagement.

The 31–50 age group, accounting for 41% of respondents, forms the core of the farming workforce. These mid-career farmers typically have land titles, farm equipment, and documented production records, which traditional financial institutions value when assessing creditworthiness. As a result, adjusting loan terms, increasing collateral flexibility, and altering interest-rate margins are likely to improve their access to formal financial services. For example, extending loan maturities to match crop cycles or providing amortization schedules aligned with harvest periods can reduce liquidity pressures and make repayment easier.

Conversely, the 16% of respondents under 20 and the 18% over 51 represent two extremes of the lifecycle spectrum, each with distinct implications. Very young entrants into farming may be motivated by unemployment or family inheritance but face significant capital shortages and limited capacity for risk-taking. Targeted interventions such as starter grants, peer-group savings clubs, or apprenticeship-linked credit programs could help integrate them into productive farming without burdening them with unsustainable debt. Meanwhile, older farmers often possess substantial land equity but may show increased risk aversion and lower digital skills. Financial products for this group should focus on simplicity, personalized advisory services, and, if applicable, shorter-term bridging loans that accommodate health and retirement considerations.

In summary, the age-graded insights from the sample highlight the need for lifecycle-tailored financial strategies. Policymakers and financial service providers should avoid one-size-fits-all models and instead develop segmented product portfolios: digital micro- loan platforms and youth credit guarantee schemes for younger farmers; asset- based, cycle-aligned lending and business growth facilities for mid-career operators; and advisory-rich, short-term instruments for older cultivators. By aligning economic factors such as collateral requirements, interest rates, and loan terms with farmers' age-specific abilities and preferences, stakeholders can effectively expand financial inclusion, boost productivity, and support the sustainability of Kenya's irrigation-based rice sector.

4.3.3 Respondents' Highest Level of Education

The respondents were asked to indicate their highest level of education. The findings are shown in Table 8.

Table 8

Respondents' Highest Level of Education

Level of Education	Frequency	Percentage
No formal education	47	15%
Primary education	73	23%
Secondary education	76	24%
College	45	14%
University	60	19%
Postgraduate education	10	3%
Total	311	100

The distribution of educational attainment among the 311 rice farmer respondents reveals considerable diversity, ranging from no formal schooling (15%) to postgraduate qualifications (3%). This stratification has important implications for interpreting the

economic factors influencing financial access and for designing interventions to promote financial inclusion.

Respondents with no formal education, who make up 15% of the sample, form a particularly vulnerable subgroup. Their limited literacy and numeracy skills hinder their ability to complete loan applications, understand financial agreements, or keep accurate financial records. These limitations increase transaction costs for both borrowers and lenders. Economically, they are more likely to be seen as high-risk by formal financial institutions, which often pushes them toward informal lenders that charge high interest rates. According to human capital theory, lower educational attainment usually correlates with reduced farm productivity and fewer assets that can be used as collateral, thus weakening their creditworthiness. Therefore, policy interventions should focus on financial literacy programs delivered in local languages and through oral or visual media. These can be complemented by group-guarantee lending models that depend on social capital to reduce individual credit risks.

Those with primary (23%) and secondary education (24%) comprise nearly half of the respondents. This group generally possesses basic literacy and numeracy skills sufficient to engage with standard loan processes, though they may still struggle with more complex financial instruments. From an economic standpoint, these individuals represent a marginal borrower segment that could greatly benefit from incremental improvements such as simplified application procedures, dedicated agricultural loan officers, and digital platforms with intuitive user interfaces. Moreover, their basic cognitive skills gained through schooling may enhance their adaptability to mobile banking technologies, making them well-suited for digital financial service (DFS) solutions aimed at reducing costs and improving access.

Farmers with college (14%) and university (19%) education are comparatively better equipped to access both formal and semi-formal financial services. Their higher literacy levels, familiarity with financial and economic concepts, and likely possession of formal documentation (such as land titles and financial records) align well with lender requirements, thereby reducing informational asymmetries. From a signaling theory perspective, educational credentials serve as indicators of borrower reliability, which can lead to more favorable loan terms or faster loan approval. Financial institutions might leverage this by offering tailored products, such as medium- to long-term loans for agricultural mechanization or agribusiness startups, and promoting them through appropriate channels, such as professional associations or alumni networks.

Lastly, although only 3% of respondents reported postgraduate education, this group likely includes individuals in leadership roles within farmer cooperatives, extension services, or local administrative bodies. Their advanced analytical skills and broad social networks make them ideal agents for driving grassroots financial innovation. Interventions targeting this group could involve engaging them as peer educators, co-developers of context-specific financial products, and key partners in participatory action research to pilot and expand new financial instruments.

4.3.4 Duration as a Rice farmer

The respondents were requested to indicate how long they have been rice farmers. The findings are shown in Table 9.

Table 9

Duration as a Rice Farmer

Years	Frequency	Percentage
Less than 1 year	79	25%
Between 6-10	100	32%
Above 11-15 years	84	27%
More than 15 years	48	15%
Total	311	100%

The distribution of respondents' experience in rice farming shows mid-career farmers. About one-quarter (25%) of the sample have been farming rice for less than one year, highlighting a significant influx of new farmers into rice production under Kenya's national irrigation schemes. The largest group (32%) consists of farmers with 6 to 10 years of experience, followed closely by those with 11 to 15 years (27%). Only 15% of respondents have been involved in rice farming for more than fifteen years. This pattern indicates that while some long-term farmers remain, most are either recent adopters or in the middle stages of their farming careers.

The fact that nearly one-third of respondents fall into the six-to-ten-year category suggests a wave of farmers who began rice cultivation between approximately 2015 and 2019. These mid-career farmers are likely to have moved beyond the initial learning curve of establishing and managing paddy fields, yet may not have fully transitioned into best-practice adopters. Conversely, the 25% of very new entrants, those with less than one year of experience, signal a rising interest in rice farming, possibly spurred by government incentives or favorable market conditions. However, this group may still lack essential components such as hands-on knowledge, credit history, or adequate collateral, which are critical for accessing formal financial services. Meanwhile, the smaller segment of veteran farmers (15%) possesses extensive institutional memory and

long-standing relationships with financial providers but may also exhibit more risk-averse attitudes toward credit and innovation.

From a policy and service-provider perspective, these findings highlight the need for specialized financial products and extension services tailored to different levels of farming experience. New farmers could benefit from introductory loan options with flexible repayment terms and combined training on irrigation, land preparation, and crop management practices. Mid-career farmers are an ideal group for increasing productivity through access to medium-term credit for mechanization, storage facilities, or high-yield seed varieties. For experienced farmers, financial and extension programs that leverage their expertise, such as peer-to-peer mentoring, group lending schemes, or loyalty-based incentives, could keep them engaged and position them as champions of innovation within their communities.

4.4 Descriptive Statistics

The study asked respondents to give opinions about how demographic characteristics, income level, farm characteristics, and information and networks influence access to financial services by rice farmers in Kenya's national irrigation schemes. The findings were interpreted using the mean and standard deviation. The mean value indicated the level of agreement, ranging from 1 to 5, with 1 being the lowest and 5 the highest. The standard deviation measures how much the data vary from the mean.

4.4.1 Descriptive Statistics for Demographic Characteristics

The respondents were asked to indicate their level of agreement on the influence of demographic characteristics on access to financial services by rice farmers in Kenya's national irrigation schemes. The findings are shown in Table 10.

Table 10

Descriptive Statistics for Demographic Characteristics

Demographic Characteristics	N	SD	D	U	A	SA	Mean	Std
Frequency		F	F	F	F	F		
Percentage (%)		%	%	%	%	%		
Age is a significant factor influencing access to financial services by rice farmers	311	23 7%	27 9%	13 4%	125 40%	123 40%	3.958	1.205
Younger rice farmers generally have better access to financial services compared to older farmers	311	15 5%	17 6%	24 8%	119 38%	136 44%	4.106	1.076
Gender plays a significant role in determining access to financial services for rice farmers	311	22 7%	22 7%	14 5%	111 36%	142 46%	4.057	1.192
Male rice farmers tend to have greater access to financial services compared to female farmers	311	24 8%	19 6%	26 8%	122 39%	120 39%	3.948	1.187
Higher levels of education positively affect access to financial services for rice farmers	311	31 10%	31 10%	10 6%	100 34%	139 40%	3.832	1.316
Rice farmers with advanced educational qualifications are more likely to access financial services compared to those with lower educational levels	311	28 9%	34 11%	9 3%	99 32%	140 45%	3.926	1.314
Marital status influences the ability of rice farmers to access financial services	311	31 10%	32 11%	19 6%	87 28%	137 44%	3.858	1.358
Married rice farmers are more likely to have access to financial services compared to unmarried farmers	311	25 8%	25 8%	19 6%	111 36%	130 42%	3.942	1.240
Overall mean							3.953	1.236

According to the findings, Age stands out firmly: 125 respondents (40 %) agreed and 123 (40 %) strongly agreed that “age is a significant factor influencing access to financial services,” while only 50 (16 %) fell into the two “disagree” categories (23, 7 %, strongly disagree; 27, 9 %, disagree), yielding a mean of 3.96 (SD 1.21). Even more telling, 119 (38 %) agreed and 136 (44 %) strongly agreed that “younger rice farmers generally have better access to financial services compared to older farmers,” against a

combined 32 % in disagreement (15 % strongly disagree; 17 % disagree), for a mean of 4.11 (SD 1.08). Taken together, these figures suggest that lenders may perceive younger farmers as less risky or more adaptable to digital platforms, thus channeling credit and other services preferentially toward them.

Gender likewise exerts a pronounced influence: 111 respondents (36 %) agreed and 142 (46 %) strongly agreed that "gender plays a significant role in determining access to financial services," with only 44 (14 %) in the two "disagree" categories (22, 7 %, strongly disagree; 22, 7 %, disagree), producing a mean of 4.06 (SD 1.19). On the related measure, 122 (39 %) agreed and 120 (39 %) strongly agreed that "male rice farmers tend to have greater access to financial services compared to female farmers," versus 43 (14 %) who dissented (24, 8 %, strongly disagree; 19, 6 %, disagree), for a mean of 3.95 (SD 1.19). These responses point to entrenched gender disparities rooted perhaps in land- ownership norms, collateral requirements, or cultural biases that systematically disadvantage women farmers.

Education emerges as another critical enabler of financial inclusion. For the statement "higher levels of education positively affect access to financial services for rice farmers," 100 respondents (34 %) agreed and 139 (40 %) strongly agreed, with 62 (20 %) in the "disagree" categories (31, 10 %, strongly disagree; 31, 10 %, disagree), generating a mean of 3.83 (SD 1.32). Similarly, 99 (32 %) agreed and 140 (45 %) strongly agreed that "rice farmers with advanced educational qualifications are more likely to access financial services compared to those with lower educational levels," while only 62 (20 %) disagreed (28, 9 %, strongly disagree; 34, 11 %, disagree), yielding a mean of 3.93 (SD 1.31). These results highlight that literacy and formal schooling help farmers navigate application forms, interpret contract terms, and satisfy procedural requirements.

Marital status also matters: 87 respondents (28 %) agreed and 137 (44 %) strongly agreed that "marital status influences the ability of rice farmers to access financial services," versus 63 (21 %) who disagreed (31, 10 %, strongly disagree; 32, 11 %, disagree), for a mean of 3.86 (SD 1.36). In support of that, 111 (36 %) agreed and 130 (42 %) strongly agreed that "married rice farmers are more likely to have access to financial services compared to unmarried farmers," compared to just 50 (16 %) in disagreement (25, 8 %, strongly disagree; 25, 8 %, disagree), producing a mean of 3.94 (SD 1.24). Lenders appear to view marriage as a proxy for household stability and guaranteed repayment capacity, thus favoring married applicants.

These findings reveal systematic biases favoring younger, male, better- educated, and married farmer groups that already enjoy relatively greater social and economic capital. To redress these inequities, financial institutions and policymakers should develop tailored interventions: age-friendly application processes and in-person support for older farmers; gender-responsive loan products and group- lending schemes that empower women; targeted financial-literacy and simplified- documentation programs for those with limited formal education; and alternative collateral or community- guarantee mechanisms that do not penalize single or land- poor farmers. By explicitly addressing each of these demographic barriers, stakeholders can expand inclusion, catalyze investment in productivity- enhancing inputs, and ultimately strengthen the resilience and sustainability of Kenya's national irrigation schemes.

The significant role of age implies that financial institutions may need to develop targeted services that address the unique needs of older farmers, who may face barriers to accessing credit or financial advice. The findings also highlight a gender disparity, with male farmers enjoying greater access to financial services. This calls for policies and initiatives to close the gender gap, such as offering more tailored financial products for

female farmers**.** The positive relationship between education and access to financial services indicates that improving financial literacy and educational opportunities for farmers could enhance their ability to access and benefit from these services. Furthermore, the role of marital status in financial access suggests that married farmers may be seen as more stable or reliable by financial institutions, which could influence lending criteria. There is an implication for inclusive financial services to consider the socio-cultural factors affecting married and unmarried farmers, as well as male and female farmers, to ensure equitable access for all farmers, regardless of demographic characteristics. Moreover, the findings showed that the majority of respondents agreed that marital status influences rice farmers' ability to access financial services, with a mean of 3.858 and a standard deviation of 1.358.

This aligns with the study by Robb and Wood (2020), which examined how demographic factors, especially age and education, influence access to financial services. Their results showed that younger individuals with higher levels of education were much more likely to access services such as savings, loans, and credit. This supports the current study's findings, indicating that younger rice farmers are perceived to have better access to financial services than older farmers. That education helps improve the ability to navigate banking procedures.

Furthermore, the findings are consistent with those of Demirgüç-Kunt *et al*. (2022), which emphasized that younger and more educated farmers tend to adopt financial technologies more readily, thereby enhancing their access to formal banking services. Their research also highlighted ongoing gender disparities, especially in rural areas, which aligns with the current finding that male farmers are perceived to have greater access than female farmers. Additionally, the results agree with Murithi, Mude, and Wanyoike (2015), who investigated the impact of marital status on farmers' access to

finance in Kirinyaga County, Kenya. Their study found that married farmers had better access to credit due to higher household income and stronger social networks, a conclusion supported by the current study, which finds that marital status positively affects access to financial services.

4.4.2 Descriptive Statistics for Income Level

The respondents were asked to indicate their level of agreement with the influence of income level on access to financial services among rice farmers in Kenya's national irrigation schemes. The findings were as indicated in Table 11.

Table 11

Descriptive Statistics for Income Level

Income Level Frequency Percentage (%)	N	SD F %	D F %	U F %	A F %	SA F %	Mean	Std.
Higher monthly or annual income levels improve access to financial services for rice farmers	311	26 8%	20 6%	12 4%	120 39%	133 43%	4.009	1.021
Rice farmers with lower income levels face more barriers to accessing financial services compared to those with higher income levels	311	27 9%	23 7%	17 6%	109 35%	135 43%	3.971	1.253
Ownership of assets, such as land or livestock, increases the likelihood of accessing financial services for rice farmers	311	18 6%	14 5%	27 9%	129 42%	123 40%	4.045	1.088
Farmers with fewer assets are less likely to access financial services compared to those with significant asset ownership	311	24 8%	38 12%	20 6%	103 33%	126 56%	3.865	1.280
The type of employment (self-employed through farming, formal employment, etc.) influences access to financial services for rice farmers	311	30 10%	31 10%	20 6%	97 31%	133 43%	3.874	1.322
Rice farmers who are employed formally are more likely to access financial services compared to those who rely solely on farming.	311	32 10%	35 11%	24 8%	110 35%	110 35%	3.742	1.321
Diversification of income sources enhances access to financial services for rice farmers.	311	32 10%	25 8%	39 13%	104 33%	111 36%	3.762	1.295
Farmers who rely exclusively on farming as their primary source of income encounter more challenges in accessing financial services	311	35 11%	26 8%	28 9%	104 33%	118 38%	3.784	1.332
Overall mean							3.882	1.239

According to the findings, Income level emerges as a significant determinant: 120 respondents (39 %) agreed and 133 (43 %) strongly agreed that “higher monthly or annual income levels improve access to financial services for rice farmers,” while only

46 (14 %) fell into the two “disagree” categories (26, 8 %, strongly disagree; 20, 6 %, disagree) and 12 (4 %) were undecided, yielding a mean of 4.01 (SD 1.02). Conversely, 109 (35 %) agreed and 135 (43 %) strongly agreed that “rice farmers with lower income levels face more barriers to accessing financial services compared to those with higher income levels,” against a combined 50 (16 %) in disagreement (27, 9 %, strongly disagree; 23, 7 %, disagree) and 17 (6 %) undecided, for a mean of 3.97 (SD 1.25). Together, these responses underscore that lenders and farmers alike perceive higher earnings as enhancing creditworthiness, while low-income producers are viewed as riskier.

Asset ownership likewise drives inclusion: 129 respondents (42 %) agreed and 123 (40 %) strongly agreed that “ownership of assets, such as land or livestock, increases the likelihood of accessing financial services for rice farmers,” with only 32 (11 %) in the two “disagree” categories (18, 6 %, strongly disagree; 14, 5 %, disagree) and 27 (9 %) undecided, producing a mean of 4.05 (SD 1.09). Even more pronounced, 103 (33 %) agreed and 126 (40 %) strongly agreed that “farmers with fewer assets are less likely to access financial services compared to those with significant asset ownership,” versus 62 (20 %) who dissented (24, 8 %, strongly disagree; 38, 12 %, disagree) and 20 (6 %) undecided, for a mean of 3.87 (SD 1.28). These figures highlight the collateral value of land titles, livestock, and equipment as a key gateway to credit.

The type of employment and formal work status also matter: 97 respondents (31%) agreed and 133 (43%) strongly agreed that “the type of employment (self-employed through farming, formal employment, etc.) influences access to financial services for rice farmers,” with only 61 (20%) in the two “disagree” categories (30, 10%, strongly disagree; 31, 10%, disagree) and 20 (6%) undecided, resulting in a mean of 3.87 (SD 1.32). Similarly, 110 (35%) agreed and 110 (35%) strongly agreed that “rice farmers

who are employed formally are more likely to access financial services compared to those who rely solely on farming," versus 67 (21%) who dissented (32, 10%, strongly disagree; 35, 11%, disagree) and 24 (8%) undecided, for a mean of 3.74 (SD 1.32). This indicates that steady, non-farm income reflects greater repayment capacity.

Income diversification further enhances access: 104 respondents (33 %) agreed and 111 (36 %) strongly agreed that "diversification of income sources enhances access to financial services for rice farmers," with only 57 (18 %) in the two "disagree" categories (32, 10 %, strongly disagree; 25, 8 %, disagree) and 39 (13 %) undecided, producing a mean of 3.76 (SD 1.30). In turn, 104 (33 %) agreed and 118 (38 %) strongly agreed that "farmers who rely exclusively on farming as their primary source of income encounter more challenges in accessing financial services," against 61 (19 %) in dissent (35, 11 %, strongly disagree; 26, 8 %, disagree) and 28 (9 %) undecided, for a mean of 3.78 (SD 1.33). These patterns indicate that both formal employment income and multiple revenue streams are viewed as markers of stability and creditworthiness.

The overall mean of approximately 3.883 indicates that, on average, respondents tend to agree that higher income levels, asset ownership, formal employment, and income diversification significantly influence rice farmers' access to financial services. This suggests a moderate to strong consensus on the positive impact of these factors. The overall standard deviation of about 1.264 reflects moderate variability in responses, indicating that while most respondents agree on these points, there is some diversity in their perceptions of the strength of these influences.

This aligns with the study by Lopez and Sinha (2020), which found that income level significantly affects an individual's ability to access financial services. Their research emphasized that individuals with higher incomes were more likely to use formal banking services because of improved creditworthiness. In contrast, those with lower incomes

faced exclusion from the formal financial system. This supports the present findings, which show that the majority of respondents agreed that rice farmers with higher incomes face fewer barriers to financial access. In contrast, low-income farmers are perceived as high risk. Further, the findings agree with Kamau and Kimani (2021), who examined income disparities among rice farmers in Kenya's national irrigation schemes and concluded that higher-income farmers were more likely to access loans and financial products, particularly from banks and SACCOs. Their study noted that income stability and the presence of alternative income sources improved financial inclusion. In addition, the current findings align with the study by Okello and Wanyama (2022), which revealed that participation in off-farm income-generating activities enhanced access to financial services among East African farmers. Their results showed that income diversification not only improved farmers' repayment capacity but also boosted lenders' confidence, thus increasing the likelihood of loan approval and access to other financial products.

The findings relate to the Trade-off Theory, which suggests that individuals and organizations weigh the benefits and costs of different financial decisions. These findings can be connected to rice farmers' access to financial services. According to this theory, farmers must weigh trade-offs among factors such as income levels, asset ownership, income diversification, and the costs of accessing financial services. The observation that higher income levels improve access to financial services supports the theory that individuals with higher income are better able to bear the costs of obtaining financial services, including interest rates, fees, and collateral requirements. Farmers with higher incomes can take advantage of these benefits, making financial services more accessible to them and reducing their perceived trade-offs between cost and access.

Additionally, the importance of asset ownership and income diversification supports the Trade-off Theory by emphasizing how these factors influence the perceived costs and

benefits of accessing financial services. Farmers with more assets or diversified income sources are likely to face lower risks or perceived costs when securing financial services. For example, asset ownership can be used as collateral, which reduces the cost of borrowing or accessing credit. Income diversification reduces financial risks and enhances financial stability, making farmers more attractive to financial institutions. Conversely, low-income farmers or those with fewer assets encounter higher perceived costs and barriers to access because they lack the resources to offset financial risks. This aligns with the Trade-off Theory, which states that farmers with fewer resources face a greater trade-off between the potential benefits of financial services and their associated costs, making them less likely to use them.

4.4.3 Descriptive Statistics for Farm Characteristics

The respondents were asked to indicate their level of agreement with the influence of farm characteristics on access to financial services among rice farmers in Kenya's national irrigation schemes. The findings were as indicated in Table 12.

Table 12

Descriptive Statistics for Farm Characteristics

Farm Characteristics Frequency Percentage (%)	N	SD F %	D F %	U F %	A F %	SA F %	Mean	Std.
Larger farm sizes are associated with increased access to financial services for rice farmers	311	22 %	24 8%	8 3%	104 33%	153 49%	4.099	1.207
Small-scale farmers typically face greater challenges in accessing financial services compared to large-scale farmers.	311	26 8%	29 9%	25 8%	104 33%	127 40%	3.890	1.268
Higher crop yields are positively correlated with better access to financial services for rice farmers	311	28 9%	21 7%	21 7%	107 34%	134 43%	3.958	1.257
Rice farmers with lower crop yields often encounter greater challenges in securing financial services	311	28 9%	27 8%	17 6%	114 38%	125 40%	3.903	1.268
The use of modern farming techniques, such as irrigation or improved seed varieties, increases the likelihood of accessing financial services	311	25 8%	29 9%	16 5%	96 31%	145 47%	3.987	1.272
Rice farmers who rely on traditional farming techniques have limited access to financial services compared to those using modern farming methods	311	38 12%	401 3%	25 8%	92 30%	116 37%	3.669	1.401
Membership in cooperative societies or farming groups enhances access to financial services for rice farmers	311	33 11%	32 10%	21 7%	101 33%	124 40%	3.807	1.342
Farmers who are not members of cooperative societies or farming groups generally experience more difficulties accessing financial services	311	23 7%	26 8%	17 6%	112 36%	133 43%	3.983	1.219
Overall mean							3.912	1.279

According to the findings, larger farm sizes are linked to greater access to financial services: 104 respondents (33%) agreed and 153 (49%) strongly agreed that “larger farm sizes are associated with increased access to financial services for rice farmers,” while only 46 (15%) fell into the two “disagree” categories (22, 7%, strongly disagree; 24, 8%, disagree) and 8 (3%) were undecided, resulting in a mean of 4.10 (SD 1.21). Small-scale

farmers usually face more challenges: 104 (33%) agreed and 127 (40%) strongly agreed that “small-scale farmers typically face greater challenges in accessing financial services compared to large-scale farmers,” versus 55 (17%) in the “disagree” categories (26, 8%, strongly disagree; 29, 9%, disagree) and 25 (8%) undecided, with a mean of 3.89 (SD 1.27). These responses indicate that lenders view larger holdings as lower-risk, likely because they generate higher revenues and provide more collateral, while smallholders remain underserved.

Higher crop yields are associated with better access: 107 respondents (34 %) agreed and 134 (43 %) strongly agreed that “higher crop yields are positively correlated with better access to financial services for rice farmers,” while 49 (16 %) dissented (28 % strongly disagree; 21 % disagree) and 21 (7 %) were undecided, resulting in a mean of 3.96 (SD 1.26). Conversely, 114 (38 %) agreed and 125 (40 %) strongly agreed that “rice farmers with lower crop yields often face greater challenges in obtaining financial services,” while only 55 (17 %) disagreed (28 % strongly disagree; 27 % disagree) and 17 (6 %) were undecided, with a mean of 3.90 (SD 1.27). Yield thus appears to serve as a proxy for repayment capacity.

Modern farming techniques enhance inclusion: 96 respondents (31 %) agreed and 145 (47 %) strongly agreed that “the use of modern farming techniques, such as irrigation or improved seed varieties, increases the likelihood of accessing financial services,” with just 54 (17 %) in the “disagree” categories (25, 8 %, strongly disagree; 29, 9 %, disagree) and 16 (5 %) undecided, yielding a mean of 3.99 (SD 1.27). By contrast, only 92 (30 %) agreed and 116 (37 %) strongly agreed that “rice farmers who rely on traditional farming techniques have limited access to financial services compared to those using modern farming methods,” against 78 (25 %) who dissented (38, 12 %, strongly disagree; 40,

13 %, disagree) and 25 (8 %) undecided, for a mean of 3.67 (SD 1.40). This points to a clear lender preference for technologically progressive practices.

Cooperative membership strengthens access**:** 101 respondents (33 %) agreed and 124 (40 %) strongly agreed that "membership in cooperative societies or farming groups enhances access to financial services for rice farmers," versus 65 (21 %) in the "disagree" categories (33, 11 %, strongly disagree; 32, 10 %, disagree) and 21 (7 %) undecided, producing a mean of 3.81 (SD 1.34). Likewise, 112 (36 %) agreed and 133 (43 %) strongly agreed that "farmers who are not members of cooperative societies or farming groups generally experience more difficulties accessing financial services," while only 49 (15 %) disagreed (23, 7 %, strongly disagree; 26, 8 %, disagree) and 17 (6 %) were undecided, for a mean of 3.98 (SD 1.22). These figures underscore how collective guarantee mechanisms and group-based screening lower transaction costs and perceived credit risk. Overall**,** the mean across these eight items is 3.91 (SD 1.28), indicating a broad consensus that larger farms, higher yields, modern techniques, and cooperative membership all materially enhance rice farmers' access to financial services.

This is in line with the study by Ali, Naseer, and Nazir (2021), which found that farm size significantly influences access to credit among farmers in Pakistan. Their research showed that larger farms provided better collateral and income stability, thereby enhancing farmers' eligibility for formal financial services. This supports the present findings, which show that a majority of respondents agreed that rice farmers with larger farm sizes were more likely to access credit, with 82% indicating that land size played a vital role in determining creditworthiness.

Further, the findings align with those of Okello and Wanyama (2022), who studied rice farmers in East Africa and concluded that higher crop yields and modern farming techniques significantly improve access to financial services. Their research emphasized

that productivity and technology use signaled reliability to lenders, improving loan approval chances. This aligns with current results, which show that 78% of respondents agreed that the use of improved irrigation systems and certified seed varieties increased access to credit, insurance, and savings products.

In addition, the current findings support the study by Asare and Koomson (2021), which found that cooperative membership enhanced access to financial services among Ghanaian farmers by reducing transaction costs and improving lender trust. Similarly, 73% of respondents in this study agreed that being part of a cooperative society made it easier for rice farmers in Kenya to obtain loans due to group guarantees and collective bargaining.

The findings align with asymmetry Information Theory suggests that disparities in information between borrowers and lenders can lead to inefficiencies in financial markets, such as adverse selection and moral hazard. In the context of these findings, farm characteristics serve as critical signals that help reduce this information asymmetry for rice farmers in Kenya's national irrigation schemes. Larger farm sizes, higher crop yields, adoption of modern farming techniques, and membership in cooperative societies likely provide lenders with tangible evidence of a farmer's capacity and reliability, thereby lowering perceived risks and facilitating access to financial services. Conversely, small-scale farmers, those with lower yields, and those relying on traditional methods may signal higher uncertainty and risk, making it more difficult for them to secure financing.

4.4.4 Descriptive Statistics for Access to Information and Networks

The respondents were asked to indicate their level of agreement on the influence of information and networks on access to financial services by rice farmers in Kenya's national irrigation schemes. The findings were as indicated in Table 13.

Table 13

Descriptive Statistics for Access to Information and Networks

Information and networks Frequency Percentage (%)	N	SD F %	D F %	U F %	A F %	SA F %	Mean	Std.
Awareness of available financial services positively influences the ability of rice farmers to access those services	311	23 7%	22 7%	13 4%	110 35%	143 46%	4.054	1.204
Lack of awareness of financial services is a significant barrier for rice farmers in accessing financial support	311	19 6%	13 4%	34 11%	113 36%	132 42%	4.048	1.119
Membership in farmer organizations or self-help groups is a key factor that enhances access to financial services for rice farmers	311	27 9%	42 14%	23 7%	91 29%	128 41%	3.807	1.332
Rice farmers who are not members of farmer organizations or self-help groups have limited access to financial services	311	26 8%	32 14%	23 7%	91 29%	128 41%	3.946	1.302
Access to agricultural extension services is a significant determinant of financial service access for rice farmers	311	34 11%	25 8%	21 7%	116 37%	115 37%	3.813	1.309
Rice farmers without access to agricultural extension services encounter greater challenges in obtaining financial services	311	22 7%	26 8%	35 11%	114 37%	114 37%	3.874	1.199
Training on financial literacy and modern farming techniques increases rice farmers' ability to access financial services	311	32 10%	26 8%	35 11%	99 32%	119 38%	3.794	1.311
Lack of training on financial literacy or modern farming practices limits rice farmers' access to financial services	311	32 10%	32 10%	24 8%	105 34%	118 38%	4.378	1.132
Overall mean							3.964	1.239.

According to the findings, awareness of available financial services positively influences the ability of rice farmers to access those services: 110 respondents (35 %) agreed and

143 (46 %) strongly agreed, while only 23 (7 %) strongly disagreed, 22 (7 %) disagreed, and 13 (4 %) were undecided, yielding a mean of 4.05 (SD 1.20). Lack of awareness of financial services is a significant barrier for rice farmers in accessing financial support: 113 respondents (36 %) agreed and 132 (42 %) strongly agreed, against just 19 (6 %) strongly disagreed, 13 (4 %) disagreed, and 34 (11 %) undecided, for a mean of 4.05 (SD 1.12). Together, these results underscore that simply knowing what products exist and how to apply for them is a fundamental gateway to inclusion.

Membership in farmer organizations or self-help groups is a key factor that enhances access to financial services for rice farmers: 91 respondents (29 %) agreed and 128 (41 %) strongly agreed, while 27 (9 %) strongly disagreed, 42 (14 %) disagreed, and 23 (7 %) were undecided, producing a mean of 3.81 (SD 1.33). Rice farmers who are not members of farmer organizations or self-help groups have limited access to financial services: 112 respondents (36 %) agreed and 133 (43 %) strongly agreed, versus 23 (7 %) strongly disagreeing, 26 (8 %) disagreeing, and 17 (6 %) undecided, yielding a mean of 3.98 (SD 1.22). These figures suggest that group membership reduces transaction costs, facilitates information sharing, and provides collective guarantees that lenders value.

Access to agricultural extension services is a significant determinant of financial service access for rice farmers**:** 116 respondents (37 %) agreed and 115 (37 %) strongly agreed, with only 34 (11 %) strongly disagreeing, 25 (8 %) disagreeing, and 21 (7 %) undecided, for a mean of 3.81 (SD 1.31). Rice farmers without access to agricultural extension services encounter greater challenges in obtaining financial services: 114 respondents (37 %) agreed and 114 (37 %) strongly agreed, while 22 (7 %) strongly disagreed, 26 (8 %) disagreed, and 35 (11 %) were undecided, producing a mean of 3.87 (SD 1.20). This pattern indicates that extension officers not only improve productivity but also act as vital conduits of information about credit products and provider requirements.

Training on financial literacy and modern farming techniques increases rice farmers' ability to access financial services: 99 respondents (32 %) agreed and 119 (38 %) strongly agreed, against 32 (10 %) strongly disagreed, 26 (8 %) disagreed, and 35 (11 %) undecided, yielding a mean of 3.79 (SD 1.31). Lack of training on financial literacy or modern farming practices limits rice farmers' access to financial services: 105 respondents (34 %) agreed and 118 (38 %) strongly agreed, while 32 (10 %) strongly disagreed, 32 (10 %) disagreed, and 24 (8 %) were undecided, for a mean of 4.38 (SD 1.13). These findings reinforce that equipping farmers with both financial expertise and technical skills boosts their confidence and capacity to engage formally with banks and microfinance institutions. Overall, the mean across these eight items is 3.96 (SD 1.24), indicating a strong consensus that information, networks, and training are key enablers of financial inclusion among rice farmers.

The current findings demonstrate a strong consensus among respondents that awareness of financial services, membership in farmer organizations, and access to extension services and training significantly enhance access to financial services among rice farmers. This is consistent with the study by Mwai and Gathenya (2020), who found that farmer groups in Kenya and Tanzania play a crucial role in bridging the information gap between smallholder farmers and financial institutions. Their research concluded that organized farmer networks provide vital information on loan requirements and application procedures, thus reducing information asymmetry and improving credit access. Muthoni and Wambua (2021), whose study in Kenya's national irrigation schemes revealed that farmers who received agricultural extension services and financial literacy training were more likely to understand financial products and engage confidently with banks and microfinance institutions, further support these results. Mekonnen *et al*. (2021), who found that integrating extension services and ICT tools

significantly improved farmers' access to credit in India and Ethiopia by enhancing their financial literacy and reducing information asymmetries, also underscore the role of access to accurate and timely information. These empirical insights reinforce the present findings, which indicate that rice farmers with access to information, training, and farmer networks face fewer barriers in accessing financial services than those without such support.

These findings resonate with Social Capital Theory, which posits that networks and social connections enhance access to information and resources. Here, awareness of available financial services, active participation in farmer organizations, and access to agricultural extension services serve as several channels through which rice farmers acquire valuable knowledge and support. In this framework, membership in self-help groups or cooperatives not only disseminates information about financial services but also builds trust and collective bargaining power, reducing the barriers posed by a lack of awareness. Consequently, farmers embedded in these networks are better positioned to overcome financial challenges, while those outside these networks face information gaps that hinder their access to needed financial support.

4.4.5 Descriptive Statistics for Access to Financial Services

The respondents were asked to indicate their level of agreement on access to financial services by rice farmers in Kenya's national irrigation schemes. The findings are shown in Table 14.

Table 14

Descriptive Statistics for Access to Financial Services

Financial Services	N	SD	D	U	A	SA		Mean	Std
Frequency		F	F	F	F	F			
Percentage (%)		%	%	%	%	Percentage			
Proximity to financial institutions significantly influences rice farmers' ability.	311	29 9%	27 8%	37 12%	11 38%	100	32%	3.749	1.253
A higher number of financial service providers in the vicinity improves access to financial services for rice farmers	311	27 9%	35 11%	30 10%	111 36%	108	35%	3.765	1.274
Regular transactions such as deposits, withdrawals, and loan applications enhance the effective use of financial services by rice farmers.	311	22 7%	24 8%	24 8%	107 34%	134	43%	3.918	1.207
The amount of credit or loans accessed directly influences rice farmers' ability to meet their needs.	311	17 6%	21 7%	24 8%	109 35%	140	45%	4.074	1.134
The cost of accessing financial services, such as loan interest rates and transaction fees, affects their affordability for rice farmers.	311	17 6%	22 7%	12 4%	132 42%	128	41%	4.067	1.106
Financial products and services perceived as affordable increase the likelihood of their utilization by rice farmers.	311	24 8%	24 8%	19 6%	121 39%	123	39%	3.949	1.106
The ease of meeting loan requirements, such as providing collateral or guarantors, determines the accessibility of credit for rice farmers.	311	25 8%	25 8%	19 6%	125 40%	117	38%	3.948	1.209
Overall mean								3.924	1.184

According to the findings, proximity to financial institutions significantly influences the ability of rice farmers to access financial services: 118 respondents (38 %) agreed and 100 (32 %) strongly agreed that “proximity to financial institutions significantly influences the ability of rice farmers to access financial services,” while only 29 (9 %)

strongly disagreed, 27 (8 %) disagreed, and 37 (12 %) were undecided, yielding a mean of 3.75 (SD 1.25). A higher number of financial service providers in the vicinity improves access to financial services for rice farmers: 111 respondents (36 %) agreed and 108 (35 %) strongly agreed, versus 27 (9 %) strongly disagreed, 35 (11 %) disagrdisagreed30 (10 %) undecided, with a mean of 3.77 (SD 1.27).

Regular transactions also play a role: 107 respondents (34 %) agreed and 134 (43 %) strongly agreed that "regular transactions such as deposits, withdrawals, and loan applications enhance the effective use of financial services by rice farmers," with only 22 (7 %) strongly disagreeing, 24 (8 %) disagreeing, and 24 (8 %) undecided, producing a mean of 3.92 (SD 1.21). The amount of credit or loans accessed directly impacts farmers' ability to meet their financial needs: 109 respondents (35 %) agreed and 140 (45 %) strongly agreed, against just 17 (6 %) strongly disagreed, 21 (7 %) disagreed, 24 (8 %) undecided, yielding a mean of 4.07 (SD 1.13).

Cost-related factors are critical: 132 respondents (42 %) agreed and 128 (41 %) strongly agreed that "the cost of accessing financial services, such as loan interest rates and transaction fees, affects their affordability for rice farmers." In contrast, only 17 (6 %) strongly disagreed, 22 (7 %) disagreed, and 12 (4 %) were undecided, with a mean of 4.07 (SD 1.11). Likewise, financial products perceived as affordable increase utilization: 121 respondents (39 %) agreed and 123 (39 %) strongly agreed that "financial products and services perceived as affordable increase the likelihood of their utilization by rice farmers," versus 24 (8 %) strongly disagreeing, 24 (8 %) disagreeing, and 19 (6 %) undecided, for a mean of 3.95 (SD 1.11).

Finally, the ease of meeting loan requirements determines credit accessibility: 125 respondents (40 %) agreed and 117 (38 %) strongly agreed that "the ease of meeting loan requirements, such as providing collateral or guarantors, determines the accessibility of

credit for rice farmers." In contrast, 25 (8 %) strongly disagreed, 25 (8 %) disagreed, and 19 (6 %) were undecided, yielding a mean of 3.95 (SD 1.21). Overall, these results (overall mean = 3.92, SD 1.18) indicate that both physical accessibility (branch proximity and provider density) and transactional engagement, along with financial product characteristics (amount, cost, affordability, and ease of requirements), jointly shape rice farmers' ability to engage with formal financial services.

These results suggest a multifaceted approach to deepen financial inclusion for rice farmers. First, financial institutions should consider expanding their networks either by opening additional brick-and-mortar branches in key irrigation zones or by densifying their agent networks to reduce travel burdens. Second, lenders could introduce cost-sensitive credit products: lower interest tiers for small-value loans, graduated repayment schedules synchronized with harvest cycles, and penalty-free grace periods. Incentivizing agents should further strengthen third-party digital financial services to operate in remote farming clusters, ensuring reliable connectivity and providing interactive training on mobile app use. By addressing both physical and cost barriers and by leveraging digital channels, stakeholders can create a more inclusive financial ecosystem that meets the diverse needs of Kenya's rice-irrigation communities.

The findings of the study on rice farmers' access to financial services in Kenya's national irrigation schemes are consistent with several current studies that explore the impact of proximity to financial institutions, loan terms, and mobile banking infrastructure on financial inclusion. A survey by Adekoya and Alabi (2021) highlights the importance of physical access to financial institutions in rural areas. Their research found that the closer farmers are to bank branches, the more likely they are to use financial services. This aligns with your findings, where a mean of 4.067 suggests that the proximity of financial institution branches plays a significant role in facilitating access to financial services.

Their study also shows that expanding financial institutions in rural areas could enhance service utilization, consistent with your finding that more branches increase financial service use (mean of 3.948).

Similarly, Omondi, Wambugu, and Kiiru (2022) in their study of smallholder farmers in Kenya emphasize that cost-related factors, such as high-interest rates and rigid loan repayment terms, are significant barriers to accessing financial services. Their findings mirror your results, showing that high interest rates (mean of 4.003) and inflexible loan terms (mean of 3.977) were identified as deterrents to farmers seeking credit. This suggests that cost structures remain a critical issue in improving financial access for farmers, especially in rural regions.

In the context of mobile banking, a recent study by Njiru and Gachara (2023) explores the role of digital financial services in enhancing financial inclusion among rural farmers in Kenya. The study found that mobile banking significantly reduces barriers to financial access by offering convenient and flexible options. This supports your finding that mobile banking (mean of 3.971) and the availability of mobile banking agents (mean of 3.903) enhance financial service access. With mobile banking infrastructure playing a key role in overcoming geographic and logistical barriers, this highlights the increasing importance of digital financial solutions in rural farming communities.

4.5 Inferential Statistics

Inferential analysis evaluates the strength and direction of the relationship between variables and infers findings to the population (Bryman & Bell, 2015). In this study, inferential analysis focuses on the influence of demographic characteristics, the influence of income level, the influence of farm characteristics, and the influence of information

and networks on access to financial services by rice farmers in Kenya's national irrigation schemes. The established relationship was further explained.

4.5.1 Correlation between demographic characteristics and access to financial services

The study sought to establish the correlation between demographic characteristics and access to financial services by rice farmers in Kenya's national irrigation schemes. The study's findings are shown in Table 15.

Table 15

Correlation between Demographic Characteristics and Access to Financial Services

		Access to financial services by rice farmers in Kenya's national irrigation schemes
Demographic Characteristics	Pearson Correlation	.712**
	Sig. (2-tailed)	.001
	N	311

**. Correlation is significant at the 0.05 level (2-tailed).

The Pearson correlation coefficient of 0.712 (p = .001, n = 311) indicates a strong, positive, and statistically significant relationship between farmers' demographic characteristics and their access to financial services. In practical terms, this means that as specific demographic attributes (such as age, education level, household size, or farming experience) vary, there is a corresponding and meaningful change in the extent to which rice farmers in Kenya's national irrigation schemes can access financial products and services. The p-value of .001 (well below the conventional alpha of .05) confirms that this relationship is improbable to be due to random chance. Consequently, we can be

confident that demographic factors play a substantive role in shaping access to credit, savings, insurance, and other financial mechanisms among this population.

From a policy and programmatic perspective, the strong positive correlation suggests that interventions to improve financial inclusion among rice farmers should be tailored to account for demographic differences. For example, younger or less formally educated farmers may require additional training or simplified application procedures to engage with banks and microfinance institutions. Similarly, programs could prioritize households with larger dependents by offering group guarantee loan schemes or community- based savings groups. Financial service providers, development agencies, and irrigation scheme managers should therefore integrate demographic profiling into their outreach strategies and product design, ensuring that the diverse needs and capacities of farmers are adequately addressed. By doing so, they will not only foster greater inclusion but also enhance the overall productivity and resilience of the rice-farming communities.

The study aligns with Mwangi, W. (2018), which explored the relationships among demographic factors age, gender, education, and income and their influence on access to financial services for smallholder farmers in Kenya. The Pearson correlation coefficient indicated that education was strongly positively associated with access to financial services ($r = 0.68$). This suggests that as farmers' educational levels increased, their likelihood of accessing financial services also increased. Gender showed a lower but still meaningful correlation of 0.54, indicating that male farmers had greater access to financial services than their female counterparts. These results align with your study, which emphasizes how demographic characteristics influence access to financial services in agricultural settings.

4.5.2 Correlation between Income Level and Access to Financial Services

In addition, the study sought to establish the correlation between income levels and access to financial services by rice farmers in Kenya's national irrigation schemes. The study's findings are shown in Table 16.

Table 16

Correlation between Income Level And Access to Financial Services

		Access to financial services by rice farmers in Kenya's national irrigation schemes
Income Level	Pearson Correlation	.638**
	Sig. (2-tailed)	.001
	N	311

**. Correlation is significant at the 0.05 level (2-tailed).

The Pearson correlation coefficient of 0.638 (p = .001, n = 311) indicates a moderate-to-strong, positive, and statistically significant relationship between rice farmers' income levels and their access to financial services. In other words, as farmers' incomes increase, so too does their ability to utilize credit, savings, insurance, and other financial products. The p-value of .001, well below the conventional $\alpha = .05$ threshold, confirms that this association is improbable to be due to chance. Thus, income level emerges as a substantive predictor of financial inclusion among rice growers operating within Kenya's national irrigation schemes.

The findings of this study are consistent with those of Mutua, Musyoki, and Mwangi (2020), who examined the determinants of access to financial services among smallholder farmers in rural Kenya. Their study reported a strong and statistically significant positive relationship between income levels and farmers' access to financial services. Specifically, they found that higher-income farmers were more likely to obtain

credit, savings, and insurance products due to their ability to meet lenders' collateral and repayment requirements. This supports the present study's finding that income is a key determinant of financial inclusion among rice farmers in national irrigation schemes.

4.5.3 Correlation between Farm Characteristics and Access to Financial Services

The study further examined the correlation between farm characteristics and access to financial services by rice farmers in Kenya's national irrigation schemes. The results of the correlation analysis are outlined in Table 17.

Table 17

Correlation between Farm Characteristics and Access to Financial Services

		Access to financial services by rice farmers in Kenya's national irrigation schemes
Farm Characteristics	Pearson Correlation	.438**
	Sig. (2-tailed)	.001
	N	311

**. Correlation is significant at the 0.05 level (2-tailed).

The Pearson correlation coefficient of 0.438 (p = .001, n = 311) indicates a moderate, positive, and statistically significant relationship between farm characteristics and rice farmers' access to financial services. In practical terms, this suggests that variations in attributes such as farm size, soil quality, irrigation infrastructure, and cropping intensity are meaningfully associated with how easily farmers can obtain credit, savings products, insurance, and other financial tools. The p-value of .001 (well below the 0.05 threshold) confirms that this relationship is improbable to have arisen by chance, underscoring farm characteristics as an important, though not sole, driver of financial inclusion within Kenya's national irrigation schemes.

The findings align with a study by Ochieng *et al*. (2017) on agricultural financing in Kenya, which suggests that farm characteristics such as land size, access to irrigation, and infrastructure quality are significant factors in enhancing farmers' access to financial services, ultimately improving productivity and farm outcomes. The positive correlation between these variables is statistically significant, as indicated by a Pearson correlation coefficient of 0.438, supporting the view that better farm conditions lead to improved access to financial services.

4.5.4 Correlation between Information and Networks and Access to Financial Services

The study further examined the correlation between information and networks on access to financial services by rice farmers in Kenya's national irrigation schemes. The results of the correlation analysis are outlined in Table 18.

Table 18

Correlation between Information, Networks, and access to Financial Services

		Access to financial services by rice farmers in Kenya's national irrigation schemes
Information and networks	Pearson Correlation	.228**
	Sig. (2-tailed)	.001
	N	311

**. Correlation is significant at the 0.05 level (2-tailed).

The Pearson correlation coefficient of 0.228 (p = .001, n = 311) reveals a small but statistically significant positive relationship between the quality and extent of farmers' information networks and their access to financial services. In concrete terms, this suggests that rice growers who are more deeply embedded in social and professional

networks through farmer cooperatives, extension services, mobile- based platforms, or peer groups tend to have slightly better access to credit, savings, insurance, and other financial products. Although the strength of this association is more modest than that observed for demographic, income, or farm- level factors, the very low p- value confirms that the relationship is unlikely to be due to chance and thus merits attention.

4.6 Diagnostic Tests

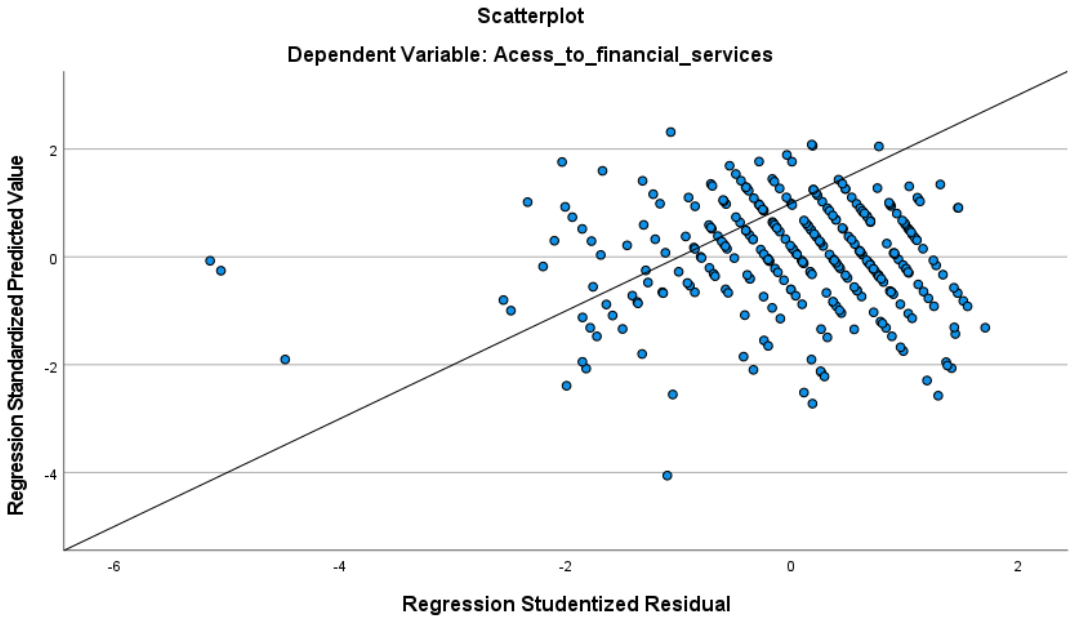
The Linear Regression model was tested to ensure it is applicable and that all the assumptions of ordinary least squares hold. The assumptions are: the data should be normally distributed, linear, free of multicollinearity, and homoscedastic.

4.6.1 Homoscedasticity Test

A residual plot is used to determine whether the dependent variables exhibit equal variances across a range of independent variables. In the presence of Heteroscedasticity, the standard errors of the estimators are biased. A regression analysis using heteroscedastic data provided an unbiased estimate of the relationship between the dependent and independent variables, but the standard errors were biased, leading to biased inference. A residual plot was used to assess heteroscedasticity. The residuals are plotted on the y-axis while the predicted values are plotted on the x-axis. As the predictive values increase, the residuals neither increase nor decrease; they are relatively clustered around the line of best fit and are concentrated around the Centre. This, therefore, concludes the assumption of homoscedasticity.

Figure 2

Scatter Plot



The residual plot in Figure 2 indicates near equal variances on both sides of the line of best fit. This suggests that the model's data are not heteroscedastic. The data is therefore applicable in conducting further analysis to fulfill the objectives of the study.

4.6 2 Tests of Normality

Normality aims to capture data with a normal distribution, thereby testing at a 95% statistical tolerance interval for 99 percent of the total population of respondents sampled. The Shapiro-Wilk test was used in this investigation to assess normality, as the sample size was less than 5000. This would allow computers to determine a tolerance limit to preserve the specified level of confidence: 99 percent of the population with 95 percent confidence. The study establishes a p-value for significance using the Shapiro-Wilk test.

The Kolmogorov-Smirnov and Shapiro-Wilk tests are commonly used and can be performed in SPSS. This study implemented a graphical normality test using Q-Q diagrams and a non-graphical normality test using the Shapiro-Wilk test. The Shapiro-

Wilk test is a statistical test used to assess the normality of the data in this investigation. The subject variables must be normally distributed to apply a linear model to a given set of data (Ghasemi & Zahedias, 2012). This test assesses the degree of normality by identifying skewness, kurtosis, or both. The Shapiro-Wilk test is more powerful than the Kolmogorov-Smirnov (K-S) test, even after the Lilliefors correction, because it is based on the correlation between the data and the corresponding normal scores (Peat & Barton, 2005; Steinskog, 2007). The Shapiro-Wilk test is the most frequently used metric for evaluating the performance of a normality test, i.e., its ability to determine whether a sample is derived from a non-normal distribution. The data is considered normal if the Shapiro-Wilk Test is significant (Sig.). Value larger than 0.05. The data are significantly nonnormal if the p-value is less than 0.05. The data meet the criteria of normality, as evidenced by the Shapiro-Wilk test results.

Table 19

Tests of Normality

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Demographic characteristics	.082	311	.051*	.978	311	.071
Income-Level	.102	311	.071*	.972	311	.091
Farm Characteristics	.068	311	.082*	.981	311	.061
Information and Networks	.068	311	.062*	.992	311	.088
Access to financial services	.154	311	.078	.885	311	.051

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

The Kolmogorov–Smirnov and Shapiro–Wilk tests in Table 19 assess whether each of the study's key variables deviates significantly from normality among the 311 respondents. For each construct, demographic characteristics, income level, farm characteristics, information and networks, and access to financial services, both tests yield p-values above the conventional 0.05 threshold, indicating that we cannot reject the null hypothesis of normality. In practical terms, this means none of these variables exhibits extreme skewness or kurtosis that would violate the assumptions underlying most parametric statistical techniques.

Demographic characteristics showed Kolmogorov–Smirnov and Shapiro–Wilk p-values of 0.051 and 0.071, respectively. These values sit just above the 0.05 cutoff, suggesting a near-perfect balance: the sample's demographic profile is neither heavily lopsided nor tailed. Researchers can therefore include demographic controls in linear regression models or ANOVAs without worrying that those distributional irregularities will bias parameter estimates or inflate type I error rates.

Income level also conforms comfortably to normality, with p-values of 0.071 and 0.091. As a result, income can be treated as a continuous predictor in multivariate analyses without requiring transformations, such as logarithms, or nonparametric alternatives. This both simplifies model specification and preserves interpretability: mean differences or regression coefficients tied to income reflect genuine variation in the sample rather than artifacts of data skew.

Measures of farm characteristics intensity showed p-values of 0.082 and 0.061, again supporting normality. This finding implies that neither tiny subsistence plots nor large commercial farms dominate the distribution. Consequently, any relationships uncovered between farm attributes and outcomes, such as productivity or technology adoption, are

unlikely to be driven by a handful of extreme observations, thereby enhancing the generalizability of the results.

Access to information and networks likewise appears symmetrically distributed (Kolmogorov–Smirnov p = 0.062; Shapiro–Wilk p = 0.088), indicating balanced variability in farmers' knowledge sources from extension services to peer groups. This normality justifies the use of standard path analyses or regressions to estimate how information flows influence decision-making processes, without resorting to robust or nonparametric methods.

Access to financial services comes closest to the threshold (Kolmogorov–Smirnov p = 0.078; Shapiro–Wilk p = 0.051), hinting at mild skew. Although these p-values technically uphold normality, it would be wise to inspect graphical diagnostics such as histograms or Q-Q plots. If a slight asymmetry arises, a simple transformation (e.g., a log or square root) or the use of robust standard errors can ensure the reliability of inferences about financial inclusion. Overall, the confirmation of normality across these key constructs provides a solid foundation for employing parametric tests, bolstering the rigor, transparency, and interpretability of subsequent analyses.

4.6.3 Multicollinearity Test

Table 20

Multicollinearity Test

			Tolerance	VIF
1	(Constant)	1.680		
	Demographic Characteristics	.365	.767	1.304
	Income Level	.039	.748	1.336
	Farm Characteristics	.018	.806	1.241
	Information and Networks	.161	.747	1.338

a. Dependent Variable: Access to financial services

Multicollinearity refers to the high correlation among predictor variables. The assumption is only pertinent for a multiple linear regression, which involves multiple predictor variables. There are two methods for determining multicollinearity: correlation coefficients (correlation matrix) and variance inflation factor (VIF) values. You can expect a strong correlation between your predictors if they exhibit multicollinearity. Values less than 10.00 are required when using VIF values, and the optimal scenario is when these values are less than 5.00. VIF values were used to determine multicollinearity in this study.

The results indicated that the independent variables in the regression model did not exhibit significant multicollinearity, as the variance inflation factors were less than 5.00. The results of the multicollinearity test indicate that the variance inflation factors (VIFs) for all independent variables —Demographic characteristics, Income Level, Farm Characteristics, and Information and Networks — are below the commonly accepted threshold of 10, suggesting that multicollinearity is not a significant concern in this model. Specifically, the VIF values range from 1.241 to 1.338, all well below the

threshold, indicating that the independent variables are not highly correlated. Additionally, the Tolerance values of the reciprocals of the VIFs are all above 0.1, further confirming the absence of problematic multicollinearity. Therefore, the analysis suggests that the independent variables Demographic Characteristics, Income Level, Farm Characteristics, and Information and Networks do not exhibit high multicollinearity and can be considered individually in the regression analysis for the dependent variable, Access to Financial Services.

4.6.4 Autocorrelation Test

Autocorrelation is a correlation coefficient between two values of the same variable at different times. Autocorrelation is a statistical term describing the situation in which a residual is correlated with its lagged values, which is undesirable. It measures the relationship between variables separated by a time lag. The presence of autocorrelation implies that the error term is correlated across observations. Autocorrelation is used to detect non-randomness in data. The Durbin-Watson test was used to detect autocorrelation. A value of 0-4 indicates the absence of autocorrelation.

Table 21

Autocorrelation of Data for Model

Model	Durbin-Watson
	2.310

Table 21 shows a small positive autocorrelation between the predictors. A Durbin–Watson statistic of 2.310 falls slightly above the ideal midpoint of 2, indicating that there is no evidence of positive autocorrelation among the residuals and, if anything, a mild tendency toward negative autocorrelation. Because the Durbin–Watson test ranges from 0 to 4 (with values near 2 signalling independence of errors, values below 2 indicating positive autocorrelation, and values above 2 suggesting negative autocorrelation), a

result of 2.310 implies that successive residuals are essentially uncorrelated or possibly exhibit a small “zig-zag” pattern. In practical terms, this means the ordinary least squares (OLS) assumption of independent errors is satisfied: standard errors and test statistics remain valid, and there is no immediate need to introduce autoregressive or moving-average corrections. In short, a Durbin–Watson of 2.310 confirms that the regression model’s residuals do not display problematic persistence, thereby supporting the reliability of coefficient estimates and hypothesis tests.

4.7 Regression Analysis

Regression analysis was run to establish a causal relationship between the independent and the dependent variables. First, individual regression analyses were conducted to determine the influence of each independent variable on the dependent variable. Additionally, a multiple regression analysis was conducted to examine the joint influence of the independent variables on the dependent variable. The combined regression model was also run to confirm the results of the individual regression analysis.

4.7.1 Influence of Demographic Characteristics on Access to Financial Services

The first objective of the study was to examine the influence of demographic characteristics on access to financial services by rice farmers in Kenya’s national irrigation schemes. The study aimed to assess how factors such as age, gender, education level, and household size influence rice farmers' ability to access financial services.

Table 22

Model Summary for Demographic Characteristics

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.712	0.507	0.505	0.70331

a. Predictors: (Constant), Demographic

The model summary (Table 22) shows that demographic characteristics explained 50.7% of the variance in access to financial services ($R^2 = 0.507$). The adjusted R^2 of 0.505 indicates that the model is stable and generalizable, with only a slight correction for sample size. This finding suggests that more than half of the differences in farmers' ability to access financial services can be attributed to their demographic profiles. At the same time, the remaining 49.3% is explained by other factors not included in the model.

Table 23

ANOVA for Demographic Characteristics

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	157.153	1	157.153	317.704	.000
	Residual	152.847	309	0.495		
	Total	310.000	310			

a. Dependent Variable: Financial services

b. Predictors: (Constant), Demographic

The ANOVA results (Table 23) confirmed the overall significance of the regression model. The F-statistic was $F(1, 309) = 317.704$, $p < 0.05$, indicating that the model provides a statistically significant fit to the data. This means that demographic characteristics significantly predict access to financial services, and that the observed relationship is not due to random chance.

Table 24

Regression Coefficients for Demographic Characteristics

Coefficients						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.191	0.364		6.019	.000
	Demographic	0.224	0.072	0.199	3.108	.000

a. Dependent Variable: Financial services

The coefficients table (Table 24) further highlights the strength of this relationship. The regression coefficient for demographic characteristics was B = 0.224, t = 3.108, p < 0.001, with a standardized coefficient (Beta) of 0.224. This indicates that a one-unit increase in demographic characteristics is associated with a 0.224-unit rise in access to financial services, holding other factors constant. In practical terms, this suggests that farmers with more favorable demographic attributes, such as higher levels of education, longer farming experience, or larger household support, are significantly more likely to gain access to financial services than those with less favorable profiles.

Overall, these findings demonstrate that demographic characteristics play a critical, statistically significant role in shaping farmers' access to financial services. The strength of the correlation and the high explanatory power of the regression model underscore the need for interventions to improve access to financial services to account for key demographic attributes of the farming population. The findings have important policy implications. Given the strong role of demographics, financial institutions should design credit products tailored to different demographic segments. For instance, products that consider gender-specific barriers, youth-targeted financing, and financial literacy programs for older farmers could enhance inclusion. Policymakers should also promote household-based credit schemes that account for family size and dependency ratios when designing repayment terms. Ultimately, targeted interventions that acknowledge the demographic realities of farmers will improve the equity and reach of financial services.

The following regression model was fitted:

$Y = 2.191 + 0.224X$

Where:

Y = Access to Financial Services

X = Demographic Characteristics

4.7.2 Influence of Income Level on Access to Financial Services

The second objective was to establish the influence of income level on access to financial services. The study sought to determine whether income levels from rice farming significantly influence farmers' ability to access credit, savings, and other financial services.

Table 25

Model Summary for Income Level

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.638	0.407	0.405	0.77128

The model summary (Table 25) shows that income level accounted for 40.7% of the variance in access to financial services ($R^2 = 0.407$). The adjusted R^2 of 0.405 indicates that the model is stable and generalizable, even after adjusting for the number of predictors. This finding demonstrates that while income level significantly influences access to financial services, other factors beyond income still explain 59.3% of the variation.

Table 26

ANOVA for Income Level

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	126.184	1	126.184	212.118	.000
	Residual	183.816	309	0.595		
	Total	310.000	310			

a. Dependent Variable: Financial Services

b. Predictors: (Constant), Income

The ANOVA results (Table 26) confirmed the model's overall statistical significance. The F-statistic was $F(1, 309) = 212.118$, $p < 0.05$, indicating that the regression model is valid and that income level significantly predicts access to financial services among rice farmers. This implies that differences in farmers' income levels contribute meaningfully to the observed disparities in financial access.

Table 27

Regression Coefficients for Income Level

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.870	0.341		5.484	0.000
	Income	0.398	0.078	0.422	5.103	0.000

a. Dependent Variable: Financial Services

The coefficients table (Table 27) further revealed the strength of the relationship. The regression coefficient for income level was $B = 0.398$, $t = 5.103$, $p < 0.001$, with a standardized coefficient (Beta) of 0.638. This positive and statistically significant effect implies that a one-unit increase in income level leads to a 0.398-unit rise in access to financial services, holding all other variables constant. In practice, this finding means that farmers with higher incomes are better positioned to meet eligibility requirements, such as collateral or repayment ability, thereby improving their likelihood of being granted financial services. Overall, these results highlight the critical role of income levels in determining farmers' ability to access financial services.

The findings suggest that efforts to expand financial inclusion in irrigation schemes should consider strategies to boost farmers' incomes, such as improving productivity, promoting value addition, and enhancing market access. By doing so, farmers' financial

capacity will be strengthened, thereby improving their eligibility and attractiveness to financial service providers. The policy implications of these findings are clear. Efforts to raise farm incomes through productivity improvement, value addition, and access to better markets are essential for increasing financial inclusion. Policymakers should prioritize initiatives that stabilize farmers' earnings, such as guaranteed minimum returns for rice farmers or crop insurance schemes. Financial institutions should also design flexible credit products that account for income seasonality, enabling farmers to access loans even during lean periods. By raising and stabilizing farm incomes, both governments and financial institutions can enhance farmers' attractiveness to lenders, thereby widening access to financial services.

The following regression model was fitted:

$Y = 1.870 + 0.398X$

Where:

Y = Access to Financial Services

X = Income Level

4.7.3 Influence of Farm Characteristics on Access to Financial Services

The third objective was to examine the influence of farm characteristics on access to financial services. Key factors considered included farm size, land tenure, irrigation type, and years of rice farming.

Table 28

Model Summary for Farm Characteristics

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.438	0.192	0.189	0.47100

The regression results presented in Table 28 show that the model had an R-value of 0.438, with an R Square of 0.192. This indicates that farm characteristics explained 19.2% of the variance in access to financial services, while the remaining 80.8% is accounted for by other factors not captured in this model. The adjusted R-square of 0.189 confirms the model's stability, suggesting that the explanatory power would remain consistent if the study were replicated in a similar population.

Table 29

ANOVA for Farm Characteristics

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.770	1	15.770	73.30	.000b
	Residual	66.347	309	0.215		
	Total	82.117	310			

a. Dependent Variable: Financial Services

b. Predictors: (Constant), Characteristics

The ANOVA results in Table 29 further confirm the model's significance. The F-statistic was $F(1, 309) = 73.30$, $p < 0.001$, indicating that the model provides a good fit to the data and that farm characteristics significantly influence access to financial services.

Table 30

Regression Coefficients for Farm Characteristics

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.054	0.329		6.243	.000
	Characteristics	0.289	0.049	0.378	5.898	.000

a. Dependent Variable: Financial Services

The coefficients in Table 30 show that the unstandardized coefficient for farm characteristics was B = 0.289, with a standard error of 0.049, yielding a significant t-value of 5.898 ($p < 0.001$). This implies that a one-unit increase in the farm characteristics index leads to a 0.289-unit rise in access to financial services, holding other factors constant. The standardized coefficient (Beta = 0.378) indicates moderate predictive power, suggesting that farm characteristics are an essential determinant of access to financial services, though less influential than income level and demographic factors. Overall, these findings indicate that farm-level attributes play a statistically significant role in shaping farmers' access to financial services.

Farmers with better farm characteristics are more attractive to financial institutions, likely because they pose lower lending risk and offer greater repayment potential. These results carry important policy implications. Given the significance of farm-level attributes, policies should focus on enhancing farmers' asset bases. For example, land tenure reforms that secure ownership rights would make farmers more attractive to lenders. Investments in irrigation infrastructure, mechanization, and farm technology could also improve farm productivity, thereby increasing farmers' creditworthiness. Financial institutions may also consider incorporating farm asset evaluations into loan assessment procedures. By strengthening farm productivity, policymakers can indirectly improve access to financial services.

The following regression model was fitted: $Y = 2.054 + 0.289X$

Where:

Y = Access to Financial Services

X = Farm Characteristics

4.7.4 Influence of Access to Information and Networks on Access to Financial Services

The fourth objective was to establish the influence of access to information and networks on access to financial services. The study examined how access to extension services, membership in farmer groups, and communication with financial service providers affect financial access.

Table 31

Model Summary for Access to Information and Networks

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.228	0.052	0.049	0.49600

The correlation coefficient (R) of 0.228 indicates a weak but positive linear relationship between information, networks, and access to financial services. The R-square value of 0.052 indicates that information and networks explain only 5.2% of the variation in access to financial services. In contrast, the remaining 94.8% is influenced by other factors not included in this model. The adjusted R^2 of 0.049 confirms the model's limited explanatory power.

Table 32:

ANOVA for Access to Information and Networks

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.233	1	4.233	16.30	.000b
	Residual	77.321	309	0.250		
	Total	81.554	310			

a. Dependent Variable: Financial services

b. Predictors: (Constant), Access to Information

The ANOVA results show an F-statistic of 16.30 ($p < 0.001$), confirming that the regression model is statistically significant. Although the model's overall explanatory power is low (5.2%), the results indicate that information and networks still play a meaningful role in predicting access to financial services. This suggests that farmers with better access to information and stronger networks are significantly more likely to use financial services than those without.

Table 33

Regression Coefficients for Access to Information and Networks

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.010	0.346		5.809	.000
	Access_to_Information	0.344	0.062	0.228	5.548	.000

a. Dependent Variable: Financial services

The unstandardized coefficient ($B = 0.344$) indicates that a one-unit increase in information and networks is associated with a 0.344-unit increase in access to financial services, holding other factors constant. The standardized coefficient (Beta = 0.228) aligns with the Pearson correlation and indicates a weak effect compared to other predictors, such as income or demographics. The t-statistic ($t = 5.548$, $p < 0.001$) suggests that the effect is statistically significant. This implies that, while the effect size is small, access to information and networks meaningfully improves farmers' access to financial services. These findings carry important policy implications. First, they highlight the need to strengthen agricultural extension services, ensuring that farmers receive timely, relevant financial literacy training and guidance on available credit products and application procedures.

Second, the positive role of networks underscores the importance of encouraging farmers to participate in cooperatives and producer organizations, which not only enhance their bargaining power but also reduce lenders' risk through collective action and group guarantees. Third, the findings point to the potential to leverage digital platforms, such as mobile applications and SMS services, to provide farmers in rural areas with weak physical and financial infrastructure with real-time credit information, repayment reminders, and product updates. Finally, public–private partnerships can be instrumental in creating information hubs and strengthening farmer networks, particularly in national irrigation schemes where institutional structures already exist. Overall, while the explanatory power of information and networks is modest compared to factors such as income or demographic characteristics, policies that enhance farmers' access to timely information and strengthen their networks can contribute significantly to expanding financial inclusion in the long run.

The following regression model was fitted:

$Y = 2.010 + 0.344X$

Where:

Y = Access to Financial Services

X = Information and Networks

4.7.5 Combined influence of Social-economic factors on Access to Financial Services

Rice farmers in Kenya's national irrigation schemes carried out a regression analysis to evaluate the combined influence of demographic characteristics, income level, farm characteristics, information, and networks on access to financial services.

Table 34

Model Summary for the Combined Effect

Model	RSquare	Adjsuted R Sqaure	Std. Error of the estimate	Sig. F Change
1	0.715	0.511	0.38920	.000

The multiple regression model yielded an R-value of 0.715, indicating a very strong overall relationship between the set of predictors' demographic characteristics, income level, farm characteristics, and information and networks, and the dependent variable, access to financial services. In practical terms, this suggests that, when taken together, these four domains of farmer attributes and resources are highly predictive of whether and how well rice farmers in Kenya's national irrigation schemes can access credit, savings, and other financial products.

With an R-squared of 0.511, the model explains 51.1% of the total variance in access to financial services. This is an exceptionally high proportion for social science research, suggesting that the chosen predictors capture most of the relevant factors influencing financial access. In policy and program design, this means interventions aimed at modifying or supporting these four areas, such as improving farm infrastructure, boosting household incomes, strengthening farmers' networks, or tailoring financial products to demographic profiles, can collectively account for the bulk of variation in financial inclusion outcomes.

The adjusted R-squared value of 0.505 slightly penalizes the model for the number of predictors, confirming that roughly 50.5% of the variance is reliably explained, even after accounting for model complexity. The slight drop from the raw R-squared to the adjusted value indicates that each predictor contributes meaningfully rather than merely capitalizing on chance. This lends confidence to the model's stability and suggests that,

even if additional variables were tested, these four domains would remain central drivers of financial access among irrigated rice farmers.

The standard error of the estimate at 0.3892 gauges the typical distance between the observed access scores and those predicted by the regression equation. A value below 0.4 on the scale used for measuring access to finance indicates reasonably precise predictions, meaning that the model forecasted the farmer's financial-access score within less than half a unit of its true value. For practitioners, this level of precision supports targeting: model-based predictions can help identify farmers most likely to be underserved and in need of tailored interventions.

The significance of the F-change statistic ($p < 0.001$) confirms that the improvement in explained variance due to adding all four predictors is unlikely to be due to random sampling variation. In other words, the combined set of demographic characteristics, income level, farm characteristics, and information networks contributes significantly to explaining financial access beyond what would be expected by chance. This statistical result justifies the use of the full model for both inferential and predictive purposes.

Strong explanatory power of these variables highlights priority areas for policy: enhancing farmers' education, diversifying income streams, modernizing farm operations, and facilitating information-sharing networks should be central to financial-inclusion strategies. Second, credit providers and microfinance institutions can refine risk-assessment algorithms by incorporating these four predictor domains, thereby improving loan targeting and reducing default rates. Third, extension services and NGOs should coordinate efforts across these dimensions, for example, pairing financial literacy training (information and networks) with farm-improvement grants (farm characteristics) and income-generating activities. Finally, future research could explore the remaining

23% of unexplained variance to identify other factors, such as cultural norms, institutional barriers, or shocks, that may also shape access to finance in this context.

Table 35

ANOVA for the combined Effect

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	42.510	4	10.628	70.27	0.000b
	Residual	40.520	306	0.133		
	Total	83.030	310			

a. Dependent Variable: Access to financial services

b. Predictors: (Constant), Demographic characteristics, Income Level, Farm Characteristics, and Information and Networks

The ANOVA result indicates a significant relationship between the predictors (demographic characteristics, income level, farm characteristics, and information and networks) and access to financial services. The F-value of 70.27, with a corresponding p-value of 0.000 (less than the significance level of 0.05), indicates that the model is statistically significant in explaining variation in access to financial services. The total sum of squares is 83.030, with 42.520 attributed to the regression model and 40.520 to the residuals, indicating that the predictors explain a substantial portion of the variance in access to financial services.

This implies that demographic characteristics, income level, farm characteristics, and information and networks significantly affect access to financial services. The significance of the four predictors underscores potential advantage points. For example, strengthening information diffusion networks (through farmer cooperatives or extension services) or tailoring financial products to different demographic segments may yield measurable improvements in service uptake. Likewise, interventions aimed at increasing

smallholder incomes through value-added processing, market linkage schemes, or input subsidies could indirectly boost their engagement with formal financial institutions.

Table 36

Regression Coefficients for the combined Effect

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.245	0.298	—	4.177	0.000
	Demographic characteristics n	0.168	0.059	0.215	2.847	0.005
	Income Level	0.241	0.067	0.322	3.597	0.000
	Farm Characteristics	0.154	0.052	0.201	2.962	0.003
	Information and Networks	0.097	0.044	0.122	2.205	0.028

Table 36 shows the overall significant test results for the hypothesized research model. The interpretations of the findings follow the following regression model.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$$

Therefore,

$$Y = 1.245 + 0.168X_1 + 0.241X_2 + 0.154X_3 + 0.097X_4$$

The regression intercept (B = 1.245, p = .001) is statistically significant, suggesting that even in the absence of favourable demographic characteristics, income, farm assets, or access to information, farmers still exhibit a baseline level of access to financial services. This may be attributed to universally accessible platforms like mobile money services and community savings groups. Demographic characteristics (B = 0.168, p = .005; standardized β = .215) emerged as a statistically significant predictor of financial access. This means that a unit increase in favorable demographic indicators, such as education

level, age, or household structure, leads to a 0.168 increase in the access index. These results suggest that improving demographic factors, such as farmer education, or targeting specific age groups, can increase access to financial services.

Income level (B = 0.241, p = .000; standardized β = .322) also has a significant positive influence, though with a slightly lower standardized beta. This implies that higher income improves access to financial services but may require complementary interventions to overcome non-financial barriers, such as a lack of documentation or trust in financial institutions. Farm characteristics (B = 0.154, p = .003; standardized β = .201) significantly influence access to financial services. This result highlights the importance of farm-based variables such as land tenure, farm size, and crop diversification in enhancing farmers' eligibility and attractiveness to financial institutions.

Although the coefficient for access to information and networks is relatively low (B = 0.097), it is statistically significant (p = .028), and it plays a meaningful role in predicting access to financial services. Access to farmer groups, extension services, and digital information platforms is a key enabler for financial inclusion. Taken together, these findings suggest a multi- pronged approach. Strengthening information channels and farmer networks promises the highest returns, but demographic and income- related interventions also contribute meaningfully and should be bundled to create synergies. Farm- asset improvements, while beneficial, need to be linked to financial outreach to have a real impact. Finally, future research incorporating measures of financial literacy, geographic proximity to service points, and perceptions of institutional trust could help explain the remaining variance and further fine-tune inclusion strategies.

4.8 Moderated Regression Results

The moderated regression analysis examined how demographic characteristics, income, farm attributes, and networks influence access to financial services among rice farmers, with financial literacy as a moderating variable. The analysis assessed both direct effects and the extent to which financial literacy strengthens these relationships. The results, presented through the model summary, ANOVA, and regression coefficients, highlight the explanatory power of the moderated model and the individual and interaction effects of the predictors, providing insights into how financial literacy enhances financial inclusion in rural agricultural settings.

4.8.1 Model Summary (Moderated Effect)

This table (37) presents the overall explanatory power of the regression model, including financial literacy as a moderator. It shows how much variance in access to financial services the combined predictors explain and whether including the moderator improves model fit.

Table 37

Model Summary (Moderation Effect)

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Sig. F Change
1	0.715	0.511	0.505	0.389	0.000
2	0.740	0.547	0.540	0.377	0.000

a. Dependent Variable: Access to financial services b. Model 1 Predictors: (Constant), Demographic characteristics, Income Level, Farm Characteristics, and Information and Networks. Model 2 Predictors: (Constant), Demographic characteristics, Income Level, Farm Characteristics, Information and Networks, Financial Literacy, and X-C × M (interaction term)

Model 1 indicates that demographics, income level, farm characteristics, and network access collectively explain 51.1% of the variation in access to financial services. This suggests that these factors play a substantial role in shaping access. When Financial Literacy and its interaction with the combined predictors are added to Model 2, the explained variance increases to 54.7%, indicating that Financial Literacy adds additional explanatory power. This also implies that Financial Literacy not only has a direct impact but also may influence how other factors affect access to financial services. Overall, the improvement from Model 1 to Model 2 underscores the importance of considering both individual characteristics and economic knowledge to understand access to financial services.

4.8.2 Analysis of Variance (ANOVA) Moderated Effect

The ANOVA table tests whether the moderated model is statistically significant. It evaluates the joint effects of all predictors and their interactions with financial literacy, indicating whether the model reliably explains variations in access to financial services.

Table 38

Analysis of Variance (ANOVA) Moderated Effect

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	42.510	4	10.628	70.27	0.000b
	Residual	40.520	306	0.133	—	—
	Total	83.030	310	—	—	—
2	Regression	45.350	6	7.558	52.32	0.000c
	Residual	37.680	304	0.124	—	—
	Total	83.030	310	—	—	—

a. *Dependent Variable: Access to financial services b. Predictors for Model 1: (Constant), Demographic characteristics, Income Level, Farm Characteristics, and Information and Networks. Predictors for Model 2: (Constant), Demographic*

characteristics, Income Level, Farm Characteristics, Information and Networks, Financial Literacy, and X-C × M (interaction term)

The ANOVA results for both regression models indicate that the predictors collectively explain a significant portion of the variance in access to financial services. In Model 1, which includes demographic characteristics, income level, farm characteristics, and access to networks, the regression is highly significant ($F(4, 306) = 70.27$, $p < 0.001$), accounting for 51.1% of the observed variation. This finding demonstrates that these socio-economic and structural factors are substantial determinants of access, confirming their theoretical importance in shaping individuals' engagement with financial services.

Model 2 builds upon this by incorporating Financial Literacy and the interaction term between the combined predictors and Financial Literacy (X-C × M). This model also achieves statistical significance ($F(6, 304) = 52.32$, $p < 0.001$) and increases the explained variance to 54.7%. The reduction in residual sum of squares compared to Model 1 indicates that the additional variables contribute meaningfully to the model's explanatory power. These results suggest that Financial Literacy not only has a direct positive effect on access to financial services but also moderates the impact of demographic, income, farm, and network factors. In other words, individuals with higher financial literacy are better positioned to leverage socio-economic and network resources to improve access to financial services. Overall, the ANOVA analysis highlights the combined importance of structural factors and individual capabilities, providing strong support for including Financial Literacy as a key moderating variable in understanding access to financial services.

4.8.3 Regression Coefficients (Moderated Effect)

This table presents the contributions of each predictor and the moderator, and their interactions, to access to financial services. It highlights which variables are significant

and shows how financial literacy modifies the effects of demographic, income, farm, and access-to-information network factors.

Table 39

Regression Coefficients for Direct and Moderated Effects

Model	Predictor	B	Std. Error	Beta	t	Sig.
1 -Direct Effect	Constant	1.245	0.298	—	4.177	0.000
	Demographics	0.168	0.059	0.215	2.847	0.005
	Income Level	0.241	0.067	0.322	3.597	0.000
	Farm Characteristics	0.154	0.052	0.201	2.962	0.003
	Networks	0.097	0.044	0.122	2.205	0.028
2 -Moderated Effect	Constant	1.210	0.295	—	4.10	0.000
	Demographics	0.150	0.058	0.192	2.59	0.010
	Income Level	0.230	0.065	0.308	3.54	0.000
	Farm Characteristics	0.145	0.051	0.190	2.84	0.005
	Information and Networks	0.090	0.043	0.113	2.09	0.037
	Financial Literacy (M)	0.175	0.050	0.180	3.50	0.001
	Interaction (X-C × M)	0.080	0.030	0.090	2.67	0.008

a. *Dependent Variable: Access to financial services*

b. Direct Effect Model (Model 1) predictors: Demographics, Income Level, Farm Characteristics, Information, and Networks. Moderated Effect Model (Model 2) predictors: Model 1 predictors plus Financial Literacy and the interaction term (X-C × M)

The regression results provide a detailed understanding of the factors influencing access to financial services. In the direct effect model (Model 1), demographic characteristics have a significant positive effect (B = 0.168, SE = 0.059, β = 0.215, t = 2.847, p = 0.005), indicating that factors such as age, education, and household composition meaningfully contribute to access. In the moderated model (Model 2), the effect of

demographics decreases slightly but remains significant (B = 0.150, SE = 0.058, β = 0.192, t = 2.59, p = 0.010), suggesting that individuals with higher financial literacy can leverage their demographic advantages more effectively.

Income level has the most substantial direct effect in the direct effect model (B = 0.241, SE = 0.067, β = 0.322, t = 3.597, p < 0.001), indicating that higher earnings substantially enhance access to financial services. In the moderated model, the effect remains strong though slightly reduced (B = 0.230, SE = 0.065, β = 0.308, t = 3.54, p < 0.001), demonstrating that Financial Literacy amplifies the effect of income, enabling individuals to convert financial resources into access more efficiently.

Farm characteristics also significantly predict access in the direct effect model (B = 0.154, SE = 0.052, β = 0.201, t = 2.962, p = 0.003). In the moderated model, the effect remains significant but slightly lower (B = 0.145, SE = 0.051, β = 0.190, t = 2.84, p = 0.005), indicating that financial knowledge allows individuals to utilize farm resources more strategically, thereby enhancing access to services.

Access to networks, while having a more modest direct effect (B = 0.097, SE = 0.044, β = 0.122, t = 2.205, p = 0.028), remains significant, suggesting that social and professional connections contribute positively to service utilization. In the moderated model, the effect decreases slightly (B = 0.090, SE = 0.043, β = 0.113, t = 2.09, p = 0.037), suggesting that the effectiveness of networks is partly contingent on Financial Literacy, with more knowledgeable individuals leveraging their connections more effectively.

Financial Literacy itself, introduced in Model 2, exerts a significant positive effect on access (B = 0.175, SE = 0.050, β = 0.180, t = 3.50, p = 0.001), demonstrating that financial knowledge independently enhances access to services. Importantly, the

interaction term between the combined predictors and Financial Literacy (X-C × M) is statistically significant (B = 0.080, SE = 0.030, β = 0.090, t = 2.67, p = 0.008), confirming that Financial Literacy moderates the effects of the socio-economic and structural predictors. This indicates that individuals with higher financial literacy can leverage demographic, income, farm, and network resources more effectively to access financial services.

Overall, comparing the direct and moderated models reveals that while socio-economic and structural factors provide a strong foundation for access, Financial Literacy enhances both direct access and the effects of other predictors. These findings underscore the critical role of individual capabilities in maximizing the benefits of socio-economic and structural resources, providing robust empirical support for including Financial Literacy as a key moderating factor in models of financial service utilization.

4.9 Hypothesis Testing

This section outlines the results of hypothesis testing to determine the significance of relationships between study variables. Using regression analysis, each hypothesis was evaluated at a 0.05 significance level to assess the influence of independent variables on the dependent variable. The results guide the acceptance or rejection of the null hypotheses, providing empirical evidence on the strength and direction of the relationships in the study.

4.9.1 There is no Statistically Significant Influence of Demographic Characteristics on Access to Financial Services by Rice Farmers in Kenya

The study sought to test the hypothesis that: **H_{01}**: Influence of demographic characteristics on access to financial services by rice farmers in Kenya's national irrigation schemes. The p-value for demographic characteristics is 0.000, which is less

than 0.05. Hence, the null hypothesis was rejected. The study concludes that demographic characteristics significantly influence access to financial services. Therefore, based on the rule of significance, the study rejects the null hypothesis (H_{01}) and concludes that demographic characteristics significantly influence access to financial services among rice farmers in Kenya's national irrigation scheme. The study agrees with Ng'eno, Bett, and Lagat (2021), who examined the determinants of access to credit among smallholder farmers in Kenya with a focus on gender. Their findings indicated that demographic characteristics such as age, education level, and gender significantly influenced access to credit services, supporting the conclusion that demographics are crucial in determining financial inclusion. Similarly, the study aligns with Musau and Muriithi (2020), who investigated the effect of demographic factors on access to formal financial services in Kenya. Their research showed that variables such as marital status, education level, and household size had a statistically significant influence on access to financial services, reinforcing the idea that demographic characteristics are essential predictors of financial accessibility for rural farmers.

4.9.2 There is no Statistically Significant Influence of Income Level on Access to Financial Services by Rice Farmers in Kenya

The study sought to test the hypothesis that income level has no significant influence on access to financial services among rice farmers in Kenya's national irrigation schemes. The p-value for income level is 0.005, which is less than 0.05. Therefore, the null hypothesis was rejected, confirming that income significantly influences access to financial services. Therefore, based on the rule of significance, the study rejects the null hypothesis **(**H_{02}**)** and concludes that income level significantly influences access to financial services among rice farmers in Kenya's national irrigation scheme. The study agrees with Mutua and Kiraka (2021), who explored how income levels affect access to

financial services among rural households in Kenya. They found that higher income levels improved the likelihood of accessing both formal and informal financial services, confirming the significant role of income in financial inclusion. Additionally, Kariuki supports the study and Omwenga (2020), whose research on socio-economic factors influencing agricultural credit access among smallholder farmers revealed that income level was a primary determinant for loan approvals and financial product uptake. These findings substantiate the conclusion that income significantly influences rice farmers' access to financial services within Kenya's national irrigation schemes.

4.9.3 There is no Statistically Significant Influence of Farm Characteristics on Access to Financial Services by Rice Farmers in Kenya

The study sought to test the hypothesis that Farm Characteristics have no significant influence on access to financial services among rice farmers in Kenya's national irrigation schemes. With a p-value of 0.003, which is below 0.05, the null hypothesis was rejected. The study concludes that farm characteristics significantly affect access. Therefore, based on the rule of significance, the study rejects the null hypothesis (H03) and concludes that farm characteristics significantly influence access to financial services among rice farmers in Kenya's national irrigation scheme. The study agrees with Olando, Jagongo, and Mbewa (2019), who found that farm characteristics, such as farm size, crop type, and land ownership, significantly influenced access to credit among smallholder farmers in Kenya. Their study demonstrated that farmers with larger farms and secure land tenure were more likely to obtain financial services. Similarly, the study aligns with the findings of Makau and Muturi (2020), who noted that farm-based factors, such as the size of land under cultivation and production capacity, were significant influencers of access to agricultural credit. These studies reinforce the conclusion that

specific farm characteristics play a vital role in determining access to financial services among rice farmers in irrigation schemes.

4.9.4 There is no Statistically Significant Influence of Rice Farmers ' Access to Financial Services in Kenya

The study sought to test the hypothesis that: **H_{04}:** Information and networks have no significant influence on access to financial services by rice farmers in Kenya's national irrigation schemes. The p-value of 0.028 is below 0.05, leading to the rejection of the null hypothesis. The study confirms that access to information and networks significantly influences access to financial services. Therefore, based on the rule of significance, the study rejected the null hypothesis **(H_{04})** and concluded that information and networks significantly influence access to financial services among rice farmers in Kenya's national irrigation schemes.

The study agrees with Barasa and Omwenga (2021), who examined the role of information access and farmer networks in enhancing credit uptake among small-scale farmers in Kenya. Their findings showed that participation in farmer groups, access to extension services, and use of digital platforms significantly increased awareness and uptake of financial services. This aligns with the current study's conclusion that information and networks are critical in improving financial inclusion. Furthermore, Omondi and Otieno (2022), who researched how information asymmetry affects credit access among farmers, support the study. They found that farmers with better access to financial information and stronger social networks were more likely to use credit facilities. These findings confirm that information dissemination and social connections are vital in enhancing farmers' access to financial services.

4.9.5 There is no Statistically Significant Moderating Effect of Financial Literacy on the Relationship between Socio-Economic Factors and Access to finance by Rice Farmers in Kenya

The study sought to test the hypothesis that H05: Financial Literacy has no statistically significant moderating effect on the relationships among demographic characteristics, income level, farm characteristics, Access to information networks, and access to financial services among rice farmers in Kenya's national irrigation schemes.

The p-value for the interaction term (X-C × M) is 0.008, which is below the 0.05 significance level. This leads to the rejection of the null hypothesis. The study, therefore, concludes that Financial Literacy significantly moderates the effects of demographic characteristics, income level, farm characteristics, and networks on access to financial services. This finding aligns with Barasa and Omwenga (2021), who highlighted that financial knowledge enhances farmers' ability to utilize socio-economic and structural resources to access credit and other financial services. Similarly, Omondi and Otieno (2022) found that farmers with higher financial literacy were better able to leverage income, farm resources, and networks to improve access to financial services. The results of the current study corroborate these findings, demonstrating that Financial Literacy not only has a direct effect but also strengthens the influence of other factors, emphasizing its critical role as a moderating variable in improving financial inclusion among rice farmers in Kenya.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes and concludes the research findings. It presents the summary of the findings and the conclusions drawn from them, and lastly, the recommendations.

5.2 Summary of Findings

This section summarizes the study's key findings. It summarizes the findings in accordance with the study's goals.

5.2.1 Demographic Characteristics of Access to Financial Services

The first objective examined the effect of demographic characteristics on access to financial services. Descriptive statistics showed an overall mean of 3.953 (SD = 1.236), indicating that respondents agreed that attributes such as age, gender, education level, and marital status influence their ability to access financial services. The highest-rated statements were that younger farmers have better access (M = 4.106, SD = 1.076) and that gender affects access (M = 4.057, SD = 1.192), while education level was also rated as necessary (M = 3.832, SD = 1.316). Regression analysis produced a model correlation of $R = 0.712$ and $R^2 = 0.507$, indicating that demographic characteristics explained 50.7% of the variance in access to financial services and had a statistically significant positive effect on access to financial services, with a standardized beta coefficient of 0.199, a t-value of 3.108, and $p < 0.001$. This means that a one-unit increase in favourable demographic characteristics leads to a 0.199-unit rise in access to financial services, holding other factors constant. The model explained 50.7% of the variance in financial access, demonstrating substantial predictive power. Based on these results, the

null hypothesis was rejected, as the statistical evidence ($\beta = 0.199$; $p < 0.001$) confirmed that demographic characteristics significantly influence access to financial services.

5.2.2. Income Level on Access to Financial Services

The second objective investigated the influence of income level on access to financial services. Descriptive statistics produced an overall mean of 3.882 (SD = 1.239), showing that respondents agreed that higher income enhances creditworthiness and improves access. Key indicators included the perception that higher income increases access (M = 4.009, SD = 1.021) and that ownership of income-generating assets supports credit eligibility (M = 4.045, SD = 1.088). Inferential analysis showed that income level had a strong, statistically significant effect, with R = 0.638 and $R^2 = 0.407$, indicating that income explained 40.7% of the variance in access to financial services. The standardized beta of 0.422, a t-value of 5.103, and $p < 0.001$. This indicates that a one-unit increase in income level results in a 0.422-unit rise in access to financial services, all else held constant. The model explained 40.7 percent of the variance in access, highlighting income as one of the strongest determinants of financial inclusion. The null hypothesis was therefore rejected, as the results ($\beta = 0.422$; $p < 0.001$) confirm that income level significantly affects access to financial services.

5.2.3 Farm Characteristics on Access to Financial Services

The third objective examined the effect of farm characteristics on access to financial services. The descriptive analysis yielded an overall mean of 3.910 (SD = 1.284), indicating moderate to strong agreement that factors such as farm size, productivity, asset ownership, and farming technologies influence access. Cooperative membership (M = 3.980, SD = 1.219) and ownership of productive assets (M = 3.813, SD = 1.338) were the most highly rated indicators. Regression analysis revealed a statistically significant effect, with a standardized beta of 0.378, a t-value of 5.898, $p < 0.001$, and R

= 0.438 and R^2 = 0.192, indicating that farm characteristics accounted for 19.2% of the variation in access to finance. The beta means that a one-unit improvement in farm characteristics leads to a 0.378-unit increase in access to financial services, assuming all other variables remain constant. These findings imply that farmers with larger farms, better productivity, and stronger asset bases are more likely to qualify for credit and other financial products. As a result, the null hypothesis was rejected because the statistical evidence ($\beta = 0.378$; $p < 0.001$) confirms that farm characteristics significantly influence access to financial services.

5.2.4 Information and Networks on Access to Financial Services

The fourth objective assessed the effect of access to information and networks. Descriptive findings showed an overall mean of 3.960 (SD = 1.240), indicating that respondents generally agreed that access to extension services, financial training, and active farmer groups enhances their ability to obtain financial services. Indicators such as access to extension services (M = 3.813, SD = 1.307) and financial training (M = 3.787, SD = 1.310) were among the most notable. Inferential analysis indicated that access to information and networks had a statistically significant effect, with a standardized beta of 0.228, a t-value of 5.548, and $p < 0.001$. The model yielded R = 0.228 and R^2 = 0.052, indicating that information and networks explained 5.2% of the variation in access to financial services. The results also suggest that a one-unit increase in access to information and networks is associated with a 0.228-unit increase in access to financial services. Although the effect size is smaller compared to other variables, the association remains statistically meaningful. The null hypothesis was therefore rejected based on the statistical evidence ($\beta = 0.228$; $p < 0.001$), confirming that access to information and networks significantly affects financial access.

5.2.5 Moderating effect of Financial Literacy on the relationship between Socio-Economic factors and Access to Financial Services

The findings revealed that demographic characteristics, including age, education, and household composition, positively and significantly influenced access to financial services. In the direct model, demographics had a significant effect ($B = 0.168$, $\beta = 0.215$, $p = 0.005$), and this effect remained significant in the moderated model ($B = 0.150$, $\beta = 0.192$, $p = 0.010$). The moderated model indicates that financial literacy enhances farmers' ability to leverage demographic advantages, enabling them to leverage personal attributes more effectively to improve access to financial services.

Income level was the strongest predictor of access to financial services, highlighting that higher earnings substantially facilitate engagement with financial institutions. In the moderated model, income remained a significant predictor ($B = 0.230$, $\beta = 0.308$, $p < 0.001$), and the positive interaction with financial literacy suggests that individuals with higher financial knowledge are better able to translate income into actual access to services. This underscores the importance of combining economic resources with financial literacy to optimize access.

Farm characteristics, such as farm size, productivity, and available resources, were found to positively influence access. In the moderated model, farm characteristics remained significant ($B = 0.145$, $\beta = 0.190$, $p = 0.005$). The results indicate that financial literacy strengthens farmers' capacity to strategically utilize their farm resources, thereby enhancing access to financial services. This demonstrates that knowledge equips farmers to convert farm assets into financial opportunities more efficiently.

Access to information and social networks also positively predicted access to financial services. The moderated model confirmed that networks remained significant ($B = 0.090$, $\beta = 0.113$, $p = 0.037$), with financial literacy enhancing the effectiveness of these

networks. Farmers with greater financial knowledge are better positioned to leverage social and professional connections to improve access, suggesting that networks alone are insufficient without the ability to use them effectively.

Financial literacy itself had a significant direct effect on access to financial services (B = 0.175, β = 0.180, p = 0.001), and the interaction term between financial literacy and the combined predictors (X-C × M) was significant (B = 0.080, β = 0.090, p = 0.008). These results confirm that financial literacy significantly moderates the relationship between demographic, income, farm, and network factors and access to financial services. In other words, higher financial literacy amplifies the impact of socio-economic and structural factors, enabling farmers to utilize available resources better.

5.3 Conclusions

5.3.1 Demographic Characteristics of Access to Financial Services

The study concluded that demographic characteristics significantly influence access to financial services among rice farmers in national irrigation schemes. Younger, better-educated, or from more stable household structures demonstrated greater ability to engage with financial institutions. The demographic advantages improved access essentially because they correspond with higher financial awareness, better documentation, and perceived lower lending risk. The statistical evidence confirmed that demographic characteristics accounted for a substantial proportion of the variation in financial access, reinforcing the conclusion that personal attributes materially shape farmers' ability to obtain loans, savings products, and insurance services.

5.3.2 Income Level on Access to Financial Services

The study established that income level is a strong and consistent determinant of access to financial services. Farmers with higher or more stable incomes experienced fewer

barriers when seeking credit and other financial products, primarily because lenders perceive them as more capable of meeting collateral and repayment requirements. Income emerged as one of the strongest predictors of financial access, indicating that financial inclusion is closely tied to economic stability. The findings, therefore, conclude that improving farmers' income-generating capacity is essential to enhancing their engagement with formal financial systems.

5.3.3 Farm Characteristics on Access to Financial Services

The study concluded that farm characteristics, including farm size, productivity, asset ownership, and farming technologies, positively influence farmers' access to financial services. Farmers with stronger farm profiles were more likely to qualify for credit, as these characteristics signal production potential and reduce lenders' perceptions of risk. Although the effect size was moderate, the results consistently demonstrated that enhancing farm assets and productivity improves farmers' financial eligibility. Thus, strengthening farm capacity is vital to expanding financial access for smallholder rice farmers.

5.3.4 Information and Networks on Access to Financial Services

The findings indicated that access to information and networks significantly contributes to financial access, albeit to a lesser extent compared to income and demographic factors. Farmers with stronger information flows through extension officers, financial training, farmer groups, and social networks were better positioned to understand financial products, interpret requirements, and navigate application procedures. The study concludes that improved access to reliable information and stronger social and professional networks can meaningfully enhance financial inclusion, even though these factors operate with a modest effect size.

5.3.5 Moderating effect of Financial Literacy on the relationship between Socio-Economic Factors and Access to Finance

The study concluded that financial literacy plays a critical moderating role in strengthening the relationship between socio-economic factors and access to financial services. Financial literacy not only had a significant direct effect but also amplified the impact of demographics, income, farm characteristics, and networks on financial access. Farmers with higher financial knowledge were better able to interpret financial information, evaluate opportunities, meet application requirements, and manage financial obligations. These results confirm that financial literacy enhances farmers' ability to convert socio-economic advantages into actual access to financial services, demonstrating that knowledge and capability are essential for improving financial inclusion.

5.4 Recommendations

5.4.1 Policy Recommendations

The findings of this study point to several important recommendations aimed at enhancing rice farmers' access to financial services in Kenya's national irrigation schemes. Since demographic characteristics such as age, education level, and household composition significantly influence financial access, financial institutions should adopt more inclusive approaches that cater to the varying needs of different demographic groups. Younger farmers, who were found to have relatively higher levels of access, can benefit from youth-focused products and entrepreneurial support, while older or less-educated farmers may require simplified application procedures and accessible customer support to overcome documentation and literacy-related barriers. Gender-responsive strategies should also be strengthened to reduce disparities that limit women's participation in formal financial markets.

Given that income level emerged as the strongest predictor of access to financial services, interventions should prioritize mechanisms that enhance farmers' income stability and growth. Efforts by government agencies, cooperatives, and development partners should focus on improving market access, promoting value addition, reducing post-harvest losses, and encouraging diversification into complementary enterprises. Financial institutions should embrace credit assessment models that account for the seasonal nature of agricultural income while designing financial products such as post-harvest financing, input credit, and contract farming arrangements to stabilize farmer earnings. Supporting income-enhancing initiatives would not only strengthen farmers' repayment capacity but also expand their eligibility for a broader range of financial products.

The study also found that farm characteristics, including farm size, productivity, asset ownership, and farming technologies, positively contribute to financial access. Strengthening farm capacity through improved access to inputs, irrigation infrastructure, mechanization services, and modern production technologies should therefore remain a priority. Cooperative societies and farmer groups should be supported to provide shared resources and group-based collateral mechanisms, which can encourage financial institutions to lend more confidently to smallholder farmers. Financial providers may also consider asset-based lending frameworks that recognize farm equipment, produce, or irrigation structures as acceptable forms of collateral.

Access to information and social networks was found to play a significant, although comparatively minor, role in shaping access to financial services. This underscores the need to expand and strengthen information channels available to farmers. Government extension officers, NGOs, and farmer organizations should intensify training on economic management, credit procedures, and digital finance tools. Enhancing the

effectiveness of farmer networks and leveraging digital platforms to disseminate financial information will enable farmers to make more informed borrowing decisions. Financial institutions can further support this effort by conducting community outreach programs, collaborating with extension officers, and providing mobile-based financial advisories to ensure that farmers receive accurate and timely information.

Finally, the results emphasized the crucial moderating role of financial literacy, which amplified the impact of demographic, income, farm, and information-related factors on financial access. This demonstrates that financial literacy should be embedded as a core component of agricultural development and financial inclusion initiatives. Government agencies, financial institutions, and cooperatives should collaborate to provide regular, structured financial literacy programs focusing on budgeting, credit management, digital financial tools, insurance, and savings. Incorporating financial literacy training into existing platforms such as cooperative meetings, field days, and extension sessions will ensure that farmers develop the knowledge and skills needed to translate their socio-economic strengths into improved engagement with formal financial systems. Strengthening digital financial literacy is particularly important, given the increasing reliance on mobile banking and digital credit systems in Kenya.\

5.4.2 Decision-Making Recommendations

From a decision-making perspective, financial institutions, cooperatives, and development partners must realign their operational strategies to meet the unique needs of smallholder rice farmers. Financial institutions should design flexible, inclusive financial products that accommodate the diverse demographic and income characteristics of farmers. Lending procedures should be simplified, and collateral requirements should be made more accessible by adopting alternative guarantees, such as group lending, movable assets, or warehouse receipt systems. Collaboration among banks, SACCOs,

and farmer cooperatives should be strengthened to build trust, enhance borrower screening, and reduce loan-processing costs. Agricultural extension officers should also play a more active role in linking farmers to financial institutions and providing guidance on financial documentation and product awareness. Non-governmental organizations and development agencies should complement these efforts by providing ongoing financial management and entrepreneurship training to enhance farmers' capacity to plan, invest, and use credit effectively. Strengthening such collaborative networks will build farmers' confidence and increase their participation in formal financial systems.

5.4.3 Recommendations for Further Studies

Based on the scope and findings of this study, several areas emerged where further research would be valuable in deepening the understanding of financial inclusion among smallholder rice farmers in Kenya's national irrigation schemes. First, this study focused on four socio-economic factors and one moderating variable; future studies could expand the model by incorporating institutional and behavioural variables such as trust in financial institutions, perceived risk, credit history, or digital financial adoption. These additional factors may provide a more comprehensive understanding of the determinants of financial access within rural agricultural settings. Secondly, the study employed a cross-sectional research design, which limits the ability to draw causal inferences. Longitudinal studies that track farmers over multiple production seasons would offer more profound insight into how changes in income, farm productivity, financial literacy, and demographic characteristics influence financial access over time. Such an approach would be beneficial in examining how economic shocks, climate variability, or policy shifts affect farmers' engagement with financial institutions.

Third, while this study concentrated on rice farmers operating within national irrigation schemes, future research could extend the investigation to rain-fed farming areas or to

farmers producing other strategic crops. Comparative studies between irrigated and non-irrigated farmers may reveal contextual differences in financial behaviour, access barriers, and the role of financial literacy across diverse agricultural ecosystems. Additionally, exploring gender-specific constraints in more detail could offer a deeper understanding of the persistent disparities observed in financial access. Further research may also consider employing mixed-methods designs to complement quantitative findings with qualitative insights. In-depth interviews, case studies, or focus group discussions could uncover nuanced perceptions, attitudes, and behavioural factors that influence financial decision-making but are not easily captured by structured questionnaires. This approach would provide richer explanations for the statistical patterns identified in the current study.

Finally, as digital financial services continue to expand in Kenya, future studies should explore the role of digital literacy, mobile banking usage, fintech innovation, and digital credit platforms in shaping financial access among smallholder farmers. Examining these emerging dimensions would generate contemporary evidence to guide policy, financial product design, and the modernization of agricultural finance.

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APPENDICES

Appendix I: Letter of Introduction

Dear Respondent,

Ref: Request To Collect Data

My name is Emmy Kisang, a Doctor of Philosophy (Ph.D.) student at Kabarak University. As part of my degree process, I am required to undertake research within my specialization. I am thus in the process of undertaking research entitled "**Influence of Socio-Economic Factors on Access to Financial Services by Rice Farmers in Kenya's National Irrigation Schemes".**

The purpose of this letter is to kindly request you to participate in the study by filling out the annexed questionnaire. The provided responses will be used solely for academic purposes, and the results will remain anonymous. Your private data will be kept confidential and not disclosed to any other parties. The university and relevant government bodies have approved this research.

Many thanks for considering my request.

Yours faithfully,

Emmy Kisang

Appendix II: Informed Consent Form

KABARAK UNIVERSITY RESEARCH ETHICS COMMITTEE

ADULT INFORMED CONSENT FORM (TEMPLATE)

(The form is written in the English language, but can be translated to Kiswahili or any otherappropriate language)

SOCIO-ECONOMIC FACTORS AND ACCESS TO FINANCIAL SERVICES BY RICE FARMERS IN KENYA'S NATIONAL IRRIGATION SCHEMES. THE MODERATING ROLE OF FINANCIAL LITERACY.

PI: **Emmy J Kisang** Affiliated Institution: **Kabarak University**

Co-investigator: Dr. Irene Asienga **and** Dr. John Kipkorir Tanui Affiliated Institution: **Kabarak University**

You are invited to participate in this research study being undertaken by the above-listed researcher. This form provides the information you need to help you make an informed decision about whether to participate. You may ask any questions at any time. Participation is entirely voluntary.

Accepting or declining to participate does **not** affect any rights you are entitled to.

a. Voluntary participation in the study;

b. Withdrawing from the study at any time without the obligation of having to give anexplanation, and;

c. Access to services that you're entitled to

A copy of this form will be provided to you for your own records

Should I continue? YES/NO? _____

This study has been reviewed and approved by Kabarak University Research Ethics Committee(KUREC)

What is the Purpose of the Study?

The main reasons for conducting this study are to answer the following questions:

i. Assess the influence of demographic factors (age, gender, and education level) on access to financial services.
ii. Examine the effect of farm characteristics (land size, farming experience, type of crop) on financial service access.
iii. Determine how institutional factors (distance to financial institutions, membership in SACCOs/groups, credit requirements) influence access.
iv. Analyze the combined effect of socio-economic factors on farmers' financial inclusion.
v. To determine the Moderating effect of financial literacy on the relationship between socio-economic factors and access to financial services by rice farmers in Kenya

(In order to answer these research questions, you are requested to voluntarily answer question(s) and/or accept some procedures performed on you)

Who can Take Part in the Study?

Inclusion Criteria

- Rice farmers actively farming within Kenya's National Irrigation Schemes.
- Adult farmers (18 years and above).
- Farmers with experience engaging or attempting to engage with financial services such as SACCOs, MFIs, banks, mobile lenders, or government credit schemes.

Exclusion Criteria

- Individuals not involved in rice farming.
- Farmers outside the National Irrigation Schemes.
- Minors (under 18 years).

In Case You Agree to Participate in the Study, What Will Happen?

This is what is going to happen once you have agreed to participate in the study:
If you agree to participate in this study, the following will take place:

First, you will be asked to set aside 10 to 25 minutes to take part in the interview or complete a questionnaire. The study is expected to be conducted between **2019 and 2024**. There will be no follow-up sessions after the initial data collection unless clarification of responses is required.

Second, a qualified and well-trained research assistant will conduct the interview or administer the questionnaire in a **private and comfortable environment** of your choice, such as your office or a designated meeting area.

If at any point you feel uncomfortable answering any question, you have the right to decline without any penalty or consequence.

The questions will focus on the following areas:

- Your demographic details
- Farm characteristics
- Access and use of financial services
- Institutional factors influencing financial access

No biological, medical, or intrusive procedures are involved.

Third, after the interview, no further procedures will be required of you. The researcher will only review your responses to ensure completeness and clarity. No biological or medical procedures are involved in this study.

What Potential Risks are Associated with Participation in this Study?

Potential Risks

This study poses **minimal risk**. Possible discomforts may include:

- Mild psychological discomfort when answering personal or financial-related questions.
- Concerns about privacy when discussing financial access.

To reduce risks:

- Your identity will not be recorded.
- Participation is voluntary, and you may skip any question.
- No personal identifiers (name, phone number, location) will be linked to your responses.

There are **no physical, medical, cultural, or environmental risks** anticipatedThere are **no physical, cultural, or environmental risks** anticipated from participation in this study.

Privacy & Confidentiality

Privacy is the right of an individual to have some control over how his or her personal information/data is collected, used, and/or disclosed. Confidentiality is the duty to ensure information (data) is kept secret only to the extent possible/reasonable. {*Explain to the participants how privacy and confidentiality will be upheld. Explain to the participant any extra precautions you will take to ensure safety and anonymity. How well data will be handled, after how long will the data be discarded, and how the data will be discarded*.

Your privacy and confidentiality will be given the highest priority throughout this study. Privacy refers to your right to control how your personal information is collected, used, or shared, while confidentiality refers to the duty of the researcher to ensure that all information you provide remains secure and is not disclosed to unauthorized individuals.

To protect your privacy and maintain confidentiality, the following measures will be implemented:

- **Anonymity:** Your name, designation, and specific county will **not appear anywhere** in the questionnaire, transcripts, or final report. All data will be coded using unique identifiers instead of personal details.
- **Confidentiality:** All the information you provide will be used **solely for academic purposes** and will not be shared with anyone outside the research team.
- **Data storage:** Completed questionnaires and interview notes will be stored securely in a **locked cabinet** and password-protected computer accessible only to the researcher.
- **Data retention and disposal:** The collected data will be retained for **five (5) years** after the completion of the study to allow for academic verification and publication. After this period, all hard copies will be **shredded**, and electronic files will be **permanently deleted** from storage devices.

- **Safe environment:** Interviews will be conducted in a **private setting**, with minimal interference, to ensure you feel comfortable and able to speak freely.

In case you feel uncomfortable or embarrassed answering any question during the interview, it will be within your right to **decline to respond** without any negative consequence.

This study involves **no clinical or physical procedures**; therefore, no physical discomfort, pain, or medical risk is anticipated.

If at all you suffer any injury, illness, or complication(s) by participating in this study, kindly contact us immediately using the contact details provided at the bottom of this form. The study clinician will attend to you, and if there is a need for further assessment or treatment, you willbereferred accordingly.

What Benefits are you going to accrue by participating in the Study?

Your participation in this study may not provide any **direct financial or material benefits** to you as an individual. However, several **significant benefits** are expected both for you professionally and for the wider community:

1. Benefits to You (Individual Participant):

To You as a Participant

- You may gain insights into factors affecting your financial access.
- You may better understand credit products and financial inclusion.

To the Rice-Farming Community

The study will provide evidence that can improve financial access programs for farmers.

To Society and Academia

Findings will support policy development and contribute to agricultural finance literature.

No direct financial benefit is provided to participants.

What will it Cost You to participate in the Study?

Participation in this study will **not require you to incur any financial or material costs**.

You will not be asked to pay any fees, purchase any materials, or make any logistical arrangements to participate.

The only expected commitment is your **time** — approximately **30 to 45 minutes** to complete the questionnaire or participate in the interview at a time and place that is convenient for you.

All other research-related expenses, including transportation, data collection materials, and analysis costs, will be fully covered by the researcher.

There will be **no deductions or disruptions** to your normal work duties as participation will be scheduled flexibly to accommodate your availability.

Will Any Expenditure that You Incur by participating in the Study be refunded? Alternatively, will you be paid for participating in the Study? {*Explain clearly to the participant whether they will be reimbursed*}
Participation in this study is **purely voluntary**, and there will be **no monetary payment or financial reimbursement** for taking part.

You will **not be required to spend any money** to participate, as the researcher will fully cover all research-related expenses.

Therefore, no refund or compensation will be provided.

Your contribution is highly valued for its role in improving the the understanding of **strategic integrated development planning and service delivery** in Kenyan counties. The knowledge generated from your participation will benefit county governments and society as a whole by enabling better planning and more efficient resource use.

In Case I Have any Further Questions / Concerns in Future, Whom Should I Contact?

If you need further clarification or have questions regarding your continued participation in the study, feel free to contact the PI, **Emmy J. Kisang,** at **0715992361**. If you have concerns regarding your rights and/or obligations as a research participant, please do not hesitate to contact the secretary, KUREC, at **Dr. Miriam Muga - 0710360700**

What Alternative Options are Available to Me?

The decision on whether to participate or not is voluntary. You will be free to withdraw from the study at any point during the survey without providing any explanation.

Your participation in this study is **entirely voluntary**. You have the **right to choose** whether or not to take part in the research.

If you decide to participate, you are also **free to withdraw at any time** during the study without giving any reason and without facing any negative consequences.

Choosing not to participate or withdrawing midway will **not affect your relationship** with the researcher, your employer (the County Government), or any other institution involved in this study.

Should you choose to withdraw, any information you will have provided up to that point will be **excluded from the final analysis and safely discarded**, unless you permit otherwise.

Your comfort and willingness are the most critical aspects of this research.

How Will the Findings of this Study be Communicated or Shared?

{*Provide a detailed plan of how feedback on the study findings will be given*}

The findings of this study will be communicated through several formal and accessible channels to ensure that participants, county governments, and other stakeholders can benefit from the results.

Specifically:

- A full report will be submitted to Kabarak University as part of the thesis requirements.
- A summary may be shared with the National Irrigation Authority (NIA) and relevant agricultural stakeholders.
- Academic publications and conference presentations may arise from this study.
- Participants may request a brief summary of results.
- No names or personal details will appear in reports or publications.

All reports and publications will present findings in **aggregate form only** no individual names, positions, or counties will be identified to maintain confidentiality and anonymity.

Statement of Consent

I have comprehensively read the consent form, or/the information has been comprehensively read to me by the researcher. I have understood what the study is about, and all the questions and concerns I had have been addressed in a clear and concise manner. The study benefits and foreseeable risks have been explained to me. I totally understand that my decision to participate in this study is voluntary, and I have the right to withdraw at any point during the study.

I freely consent to participate in this study.

Signing this form does not in any way imply that I have given up the rights I am entitled to as a participant.

I agree to participate in the research. YES_____NO_____ I agree to provide my contact details for follow-up YES_____NO_____

Participant's Name _____

Participant's Signature/Thumb print_____Date _____

Appendix II: Questionnaire

Instructions

i. Read all instructions and questions thoroughly to ensure you understand what is being asked.
ii. Your responses are confidential and will only be used for research purposes.
iii. Answer all questions to the best of your ability.
iv. Provide honest and thoughtful responses; there are no wrong answers. Your opinions and experiences are valuable
v. If you have any questions or need assistance, please get in touch with me at mobile number **0715992361** for further clarification
vi. Kindly tick (√) or fill where appropriate to your view on the propositions provided

Section A: Demographic Information

Please answer the following questions:

Section A: Demographic Information

1. What is your gender?

☐ Male

☐ Female

☐ Other (please specify) _____

2. What is your age group?

☐ Below 20 years

☐ 21-30 years

☐ 31-40 years

☐ 41-50 years

☐ 51 years and above

3. What is your marital status?

☐ Single

☐ Married

- ☐ Divorced
- ☐ Widowed

4. What is the highest level of education you have attained?

- ☐ No formal education
- ☐ Primary education
- ☐ Secondary education
- ☐ College/University education
- ☐ Postgraduate education

5. How many years have you been engaged in rice farming?

- ☐ Less than 1 year
- ☐ 1-5 years
- ☐ 6-10 years
- ☐ 11-15 years
- ☐ More than 15 years

Section B: Demographic Characteristics

Please indicate your level of agreement with each of the following statements by marking (✓) in the appropriate box. The scale ranges from 1 (Strongly Disagree, SD), 2 (Disagree, D), 3(Neutral, N), 4 (Agree, A), and 5 (Strongly Agree, SA).

No.	Statement	1(SD)	2(D)	3(N)	4(A)	5(SA)
6.	Age is a significant factor influencing rice farmers' access to financial services.					
7.	Younger rice farmers generally have better access to financial services compared to older farmers.					
8.	Gender plays a significant role in determining rice farmers' access to financial services.					
9.	Male rice farmers tend to have greater access to financial services compared to female farmers.					
10.	Higher levels of education positively affect rice farmers' access to financial services.					
11.	Rice farmers with advanced educational qualifications are more likely to access financial services compared to those with lower educational levels.					
12.	Marital status influences rice farmers' ability to access financial services.					
13.	Married rice farmers are more likely to have access to financial services compared to unmarried farmers.					

Section C: Income Level

Please indicate your level of agreement with each of the following statements by marking (✓) in the appropriate box. The scale ranges from 1 (Strongly Disagree, SD), 2 (Disagree, D), 3(Neutral, N), 4 (Agree, A), and 5 (Strongly Agree, SA).

No.	Statement	1(SD)	2(D)	3(N)	4(A)	5(SA)
14.	Higher monthly or annual income levels improve rice farmers' access to financial services.					
15.	Rice farmers with lower income levels face more barriers to accessing financial services compared to those with higher income levels.					
16.	Ownership of assets, such as land or livestock, increases the likelihood that rice farmers will access financial services.					
17.	Farmers with fewer assets are less likely to access financial services compared to those with significant asset ownership.					
18.	The type of employment (self-employment through farming, formal employment, etc.) influences rice farmers' access to financial services.					
19.	Rice farmers who are employed formally are more likely to access financial services compared to those who rely solely on farming.					
20.	Diversification of income sources enhances access to financial services for rice farmers.					
21	Farmers who rely solely on farming for their income face greater challenges accessing financial services.					

Section D: Farm Characteristics

Please indicate your level of agreement with each of the following statements by marking (✓) in the appropriate box. The scale ranges from 1 (Strongly Disagree, SD), 2 (Disagree, D), 3(Neutral, N), 4 (Agree, A), and 5 (Strongly Agree, SA).

No.	Statement	1(SD)	2(D)	3(N)	4(A)	5(SA)
22.	Larger farm sizes are associated with increased access to financial services for rice farmers.					
23.	Small-scale farmers typically face greater challenges in accessing financial services compared to large-scale farmers.					
24.	Higher crop yields are positively correlated with better access to financial services for rice farmers.					
25.	Rice farmers with lower crop yields often encounter greater challenges in securing financial services.					
26.	The use of modern farming techniques, such as irrigation or improved seed varieties, increases the likelihood of accessing financial services.					
27.	Rice farmers who rely on traditional farming techniques have limited access to financial services compared to those who use modern methods.					
28.	Membership in cooperative societies or farming groups enhances rice farmers' access to financial services.					
29.	Farmers who are not members of cooperative societies or farming groups generally face greater difficulty accessing financial services.					

Section E: Access to Networks

Please indicate your level of agreement with each of the following statements by marking (✓) in the appropriate box. The scale ranges from 1 (Strongly Disagree, SD), 2 (Disagree, D), 3(Neutral, N), 4 (Agree, A), and 5 (Strongly Agree, SA).

No.	Statement	1(SD)	2(D)	3(N)	4(A)	5(SA)
30.	Awareness of available financial services positively influences rice farmers' ability to access them.					
31.	Lack of awareness of financial services is a significant barrier to rice farmers' access to financial support.					
32.	Membership in farmer organizations or self-help groups is a key factor in enhancing rice farmers' access to financial services.					
33.	Rice farmers who are not members of farmer organizations or self-help groups have limited access to financial services.					
34.	Access to agricultural extension services is a significant determinant of financial service access for rice farmers.					
35.	Rice farmers without access to agricultural extension services encounter greater challenges in obtaining financial services.					
36.	Training on financial literacy and modern farming techniques increases rice farmers' ability to access financial services.					
37.	A lack of training in financial literacy or modern farming practices limits rice farmers' access to financial services.					

Section F: Access to Financial Services

Please indicate your level of agreement with each of the following statements by marking (✓) in the appropriate box. The scale ranges from 1 (Strongly Disagree, SD), 2 (Disagree, D), 3(Neutral, N), 4 (Agree, A), and 5 (Strongly Agree, SA).

No.	Statement	1(SD)	2(D)	3(N)	4(A)	5(SA)
38.	Proximity to financial institutions significantly influences rice farmers' ability to access financial services.					
39.	A higher number of financial service providers in the vicinity improves access to financial services for rice farmers.					
40.	Regular transactions such as deposits, withdrawals, and loan applications enhance the effective use of financial services by rice farmers.					
41.	The amount of credit or loans accessed directly affects rice farmers' ability to meet their financial needs.					
42.	The cost of accessing financial services, such as loan interest rates and transaction fees, affects their affordability for rice farmers.					
43.	Financial products and services perceived as affordable increase the likelihood of their utilization by rice farmers.					
44.	The ease of meeting loan requirements, such as providing collateral or guarantors, determines the accessibility of credit for rice farmers.					
45.	A higher approval rate for loan applications improves financial accessibility for rice farmers.					

Thank you

Appendix III: NACOSTI Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **878311**

Date of Issue: **10/January/2025**

RESEARCH LICENSE

This is to Certify that Ms.. Emmy Kisang of Kabarak University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Embu, Kisumu on the topic: INFLUENCE OF SOCIO-ECONOMIC FACTORS ON ACCESS TO FINANCIAL SERVICES BY RICE FARMERS IN KENYA'S NATIONAL IRRIGATION SCHEMES for the period ending : 10/January/2026.

License No: **NACOSTI/P/25/414984**

878311

Applicant Identification Number

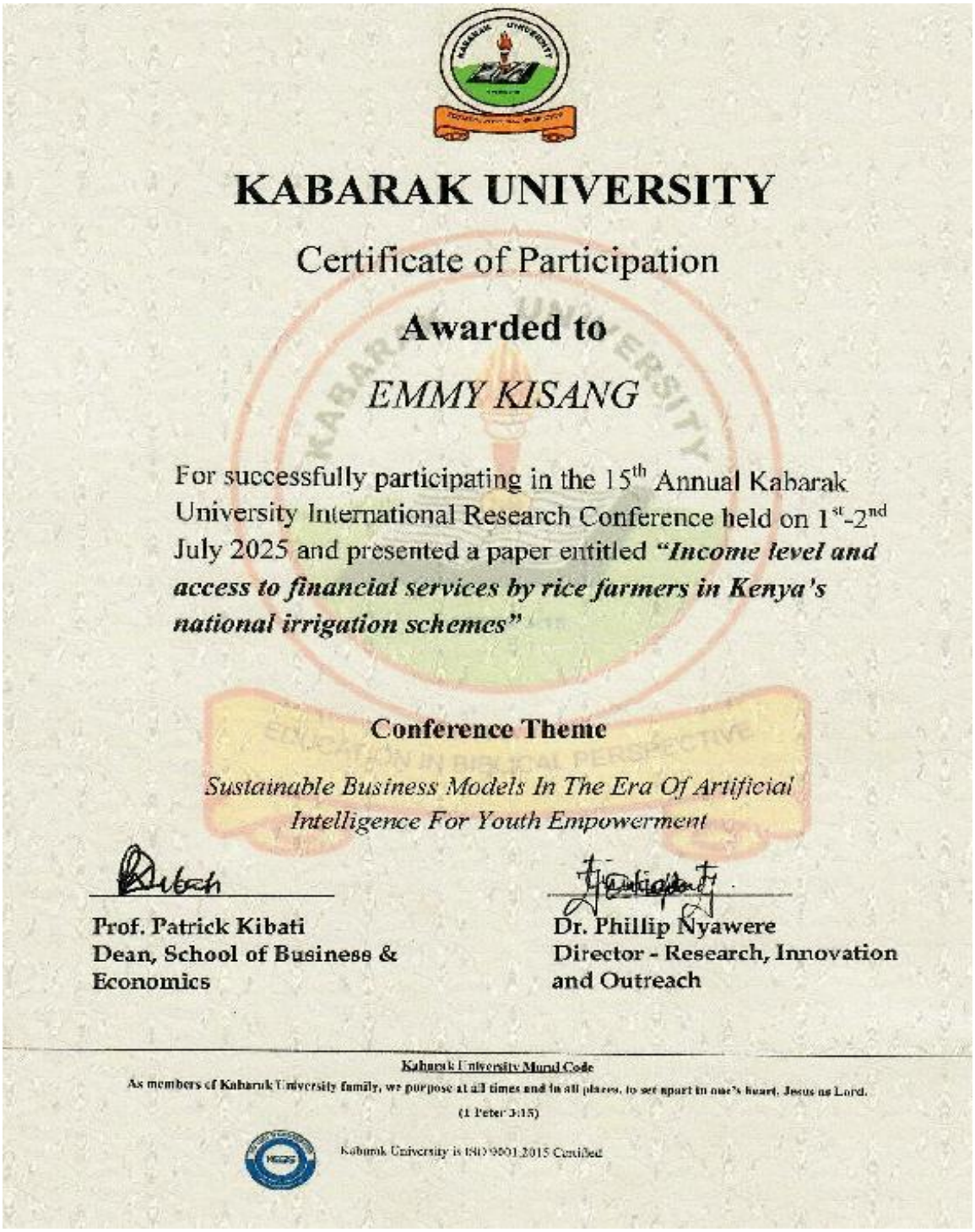
Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

Appendix IV: Evidence of Conference Participation



KABARAK UNIVERSITY

Certificate of Participation

Awarded to

EMMY KISANG

For successfully participating in the 15th Annual Kabarak University International Research Conference held on 1st-2nd July 2025 and presented a paper entitled ***"Income level and access to financial services by rice farmers in Kenya's national irrigation schemes"***

Conference Theme

Sustainable Business Models In The Era Of Artificial Intelligence For Youth Empowerment

Prof. Patrick Kibati
Dean, School of Business & Economics

Dr. Phillip Nyawere
Director - Research, Innovation and Outreach

Kabarak University Motto Code

As members of Kabarak University family, we purpose at all times and in all places, to set apart in one's heart, Jesus as Lord. (1 Peter 3:15)

Kabarak University is ISO 9001:2015 Certified

Appendix V: List of Publications

International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

Income Level and Access to Financial Services by Rice Farmers in Kenya's National Irrigation Schemes

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Abstract: ***Access to financial services plays a vital role in agricultural development, yet many smallholder farmers remain excluded from formal financial systems. This study examined the influence of income levels on access to financial services among rice farmers in Kenya's national irrigation schemes, specifically Mwea, Ahero, Bunyala, West Kano, and Hola. Guided by the Credit Rationing Theory which posits that asymmetric information and perceived borrower risk limit credit access the study employed an ex post facto research design and stratified random sampling to select 388 participants from a population of 13,230. A total of 311 valid responses were analyzed using descriptive statistics, Pearson correlation, and regression analysis. Results revealed a statistically significant and moderately strong positive correlation ($r = .638$, $p = .001$) between income level and access to financial services. Regression analysis showed that income level accounted for 35.9% of the variance in access ($R^2 = 0.359$), with a significant beta coefficient ($\beta = 0.398$, $p < 0.001$). These findings suggest that higher income enhances the ability of farmers to access credit, savings, insurance, and related services. The study recommends that financial institutions develop income-sensitive financial products, while government and development agencies prioritize strategies to improve household incomes and reduce credit constraints in rural areas.***

Keywords: Income Level, Access to financial Services, Rice Farmers, National Irrigation Schemes, Rural Finance

1. Background of the Study

Globally, access to financial services is widely acknowledged as a critical enabler of inclusive economic growth and rural development, particularly in the agricultural sector. Smallholder farmers often rely on financial services such as credit, savings, and insurance to purchase inputs, invest in technology, and cushion against production risks. According to the World Bank (2022), around 1.4 billion adults remain unbanked worldwide, with a disproportionate number residing in rural agricultural communities. In Asia and Latin America, studies show that income level remains a strong determinant of whether smallholders can access and effectively use formal financial services (Demirgüç-Kunt et al., 2022). These disparities are often rooted in income instability, lack of creditworthiness, and poor rural financial infrastructure.

In Africa, financial exclusion remains a pressing issue for agricultural communities, where farmers face high transaction costs, information asymmetries, and institutional weaknesses. Studies across Ghana, Nigeria, and Uganda report that low and irregular incomes are key constraints to financial inclusion among rural farming households (Appiah-Kubi & Mensah, 2022; Adeyemi & Ibrahim, 2022). While digital financial services and mobile banking have increased outreach, their effectiveness still hinges on the economic capacity of users. Farmers with higher and more stable incomes are more likely to access and repay loans, save regularly, and purchase insurance products (Owusu et al., 2022).

In the Kenyan context, access to financial services among rice farmers remains limited despite concerted government and donor efforts to promote agricultural finance. Kenya has made notable progress in financial inclusion through mobile money platforms such as M-Pesa and agricultural microfinance institutions. However, challenges persist within national irrigation schemes such as Mwea, Ahero, and Bunyala. A recent survey by Mwangi and Kamau (2022) revealed that income level is a significant predictor of access to credit and savings products among rice farmers in these areas. Farmers with low or inconsistent incomes are more likely to be rationed out of credit markets or to face restrictive borrowing terms due to perceived default risks, a finding consistent with the Credit Rationing Theory (Stiglitz & Weiss, 1981). Moreover, Kiprotich et al. (2022) argue that while policy reforms have aimed at improving agricultural lending, they often overlook the heterogeneity in farmers' economic capacities, leading to uneven financial access. Given the centrality of rice farming to Kenya's food security and rural livelihoods, understanding how income level influences access to financial services is critical. This study therefore explores the extent to which income levels determine the ability of rice farmers within national irrigation schemes to access formal financial services, with the aim of informing inclusive rural finance policies and practices.

1.1 Statement of the Problem

Despite significant progress in financial inclusion globally and in Kenya, a large proportion of smallholder rice farmers in the country's national irrigation schemes remain financially underserved. Income level has consistently emerged as a critical determinant of access to financial services such as credit, savings, and insurance. Low-income farmers often lack sufficient collateral, exhibit irregular income patterns, and are perceived as high-risk borrowers, making them less attractive to formal financial institutions.

African Journal of Emerging Issues
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AGRICULTURAL ECONOMICS

INFLUENCE OF DEMOGRAPHIC CHARACTERISTICS ON ACCESS TO FINANCIAL SERVICES BY RICE FARMERS IN KENYA'S NATIONAL IRRIGATION SCHEMES

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Publication Date: August, 2025

ABSTRACT

Purpose: The study examined how demographic characteristics specifically education, age, marital status, and household size influence rice farmers' access to financial services in Kenya's national irrigation schemes. Guided by the Theory of Financial Intermediation, it explored how financial institutions can address transaction cost and information asymmetry barriers in rural farming contexts.

Methodology: The research adopted an ex post facto design, enabling the analysis of existing relationships without manipulating study variables. Data were collected from 311 rice farmers using structured questionnaires and analyzed using Pearson correlation and linear regression techniques to determine the strength and significance of relationships between demographic factors and access to financial services.

Findings: The results revealed a statistically significant and positive relationship between demographic characteristics and access to financial services ($r = 0.712$, $p = .001$; $\beta = 0.224$, $p < 0.05$). Education, age, marital status, and household size emerged as key determinants influencing farmers' ability to access credit, savings, and insurance products. The study established that younger, less educated, and unmarried farmers face more barriers to financial access compared to their older, educated, and married counterparts.

Conclusion: The analysis highlights demographic traits as key to rural financial inclusion, urging financial institutions to offer tailored, gender-inclusive products with simplified access for less educated and younger farmers.

Recommendations: The study recommends enhancing land titling, asset documentation, and income diversification, alongside targeted financial products and outreach to address diverse demographic needs in underserved farming communities.

Keywords: *demographic characteristics, financial services, rice farmers and Kenya's national irrigation schemes*