PRODUCTIVITY AND CREDIT ACCESS AMONG SMALLHOLDER DAIRY FARMERS: CASE OF NYANDARUA COUNTY, KENYA.

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF ECONOMIC THEORY IN THE SCHOOL OF BUSINESS, ECONOMICS AND TOURISM IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ECONOMICS, KENYATTA UNIVERSITY.

OCTOBER, 2025

DECLARATION

This research project is my original work and has not been presented for an award or a degree

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DEDICATION

To my parents, brothers, husband, and children, Mitchell and Mike, for their unwavering support.

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First, the efforts of many individuals have contributed to the success of this endeavor. First and foremost, I am grateful to the Almighty God for his kindness and good health. I also owe a debt of gratitude to my supervisor, Dr. Gachanja, for his academic guidance, suggestions, and unending patience in reading my manuscripts. I greatly value his willingness to mentor, his extensive expertise, and his encouragement to strive for excellence in this field.

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ACRONYMS AND ABBREVIATIONS

GDP	Gross Domestic Product
KDB	Kenya Dairy Board
KNBS	Kenya National Bureau of Statistics
CIDP	Nyandarua County Integrated Development Plan
SACCO	Savings and Credit Cooperative
SDF	Small Holder Dairy Farmer

ABSTRACT

Agricultural financing plays a vital role in enhancing productivity and improving the livelihoods of rural households. In Kenya, the government has implemented various initiatives, including the Agricultural Finance Corporation, credit guarantee schemes, and cooperative-based lending, to expand credit access to smallholder farmers. Despite these efforts, many smallholder dairy farmers continue to face financial exclusion due to high interest rates, collateral requirements, and complex loan procedures, which undermine productivity. This study investigated the relationship between credit access and productivity among smallholder dairy farmers in Nyandarua County, Kenya. Guided by the Cobb-Douglas Production Function, the study employed descriptive statistics, linear regression, and binary logistic regression to analyze both primary and secondary data collected from 400 farmers selected through stratified and simple random sampling. The results showed that farmers with access to credit produced, on average, 2.09 liters more milk per cow daily compared to those without credit, demonstrating that financial resources significantly improve productivity. However, only 28 percent of farmers accessed credit, while the majority (72 percent) remained excluded. Analysis further revealed that membership in Savings and Credit Cooperative Organizations significantly increased the likelihood of accessing credit, with members being three times more likely to obtain loans than non-members. On the other hand, demographic and resource-based factors such as gender, age, farm size, and farming experience were not significant determinants of credit access. In terms of productivity drivers, the regression results indicated that feed quality ($\beta = 0.255$, $p < 0.001$) had the strongest positive effect, followed by credit access **(**$\beta = 0.203$, $p < 0.001$**)**. Farm size, farming experience, and veterinary visits did not significantly influence output. The study concludes that limited access to affordable credit continues to constrain the productivity of smallholder dairy farmers in Nyandarua County. Policy implications suggest the need to strengthen farmer cooperatives, reduce lending costs, expand credit guarantee schemes, and enhance extension services to unlock the full potential of the dairy sector. By addressing these financial barriers, the government and financial institutions can enhance efficiency, improve rural livelihoods, and support national food security goals.

CHAPTER ONE

INTRODUCTION

1.1 Background

Agricultural financing is crucial for enhancing productivity and living conditions among smallholder farmers. Agricultural credit, in particular, plays a key role in sustaining agricultural growth (Olagunju & Ololade, 2013). Their study found that in middle-income countries, agricultural credit access had a 92.2 percent positive effect on produce, meaning that nations with guaranteed credit tend to achieve higher agricultural output. Credit is widely recognized as a critical component of agricultural and rural development programs and serves as a key driver in boosting the income of small-scale farmers and business owners.

The smallholder farmers' worldwide demand for agricultural credit was approximately USD 450 billion, but only 3 percent of this demand was met (Hanson, 2015). According to a report by Commercial Agriculture for Smallholders and Agribusiness (CASA) (2022), smallholder agricultural credit access and finances had been limited because of structural issues and a mismatch of funding and purpose. This forced Smallholder Dairy Farmers (SDFs) to seek credit through informal channels. Notably, the challenge of agricultural credit accessibility by SDFs was mainly pronounced in Africa (Odhiambo & Upadhyaya, 2021). Most commercial banks in Africa provided secured loans, making SDFs underserved since they had small farm sizes that were required to be used as collateral for loans. Also, most commercial banks viewed the agriculture sector as a risky investment

because there was a lack of investments, leading to a high loan default rate. There is also high dependence on rainfall and poorly skilled farmers, factors that are not positive for the banks. These factors prevented banks from offering agricultural credit to the sector. Those banks that provided financing only did so to the large-scale farmers who could afford collateral.

Balana et al. (2022) identified several supply-side and demand-side factors affecting the total loans granted by commercial banks to SDFs, including risk aversion, financial illiteracy, limited access to credit sources, and high credit facility charges. To address these challenges, Mukabane (2021) suggested that while agricultural financing is essential for improving farm productivity, many farmers are often forced to seek credit from informal sources due to these barriers.

1.1.1. Credit Accessibility for Small Holder Dairy Farmers

Many rural Kenyan households utilize various financial services ranging from formal to informal institutions. Despite approximately 25 percent of the rural households in Kenya having a bank account, 70 percent have dependable mobile phones and mobile money (M-Pesa), which is a commonly used financial service (Odhong et al. 2019). Also, more than 50 percent of the households in rural Kenya are members of informal institutions where they make weekly/monthly payments. These institutions are beneficial in making savings that are useful during emergencies and in making lumpy investments. Figure 1.1 below shows a snapshot of how farmers' access to credit is distributed across different sources.

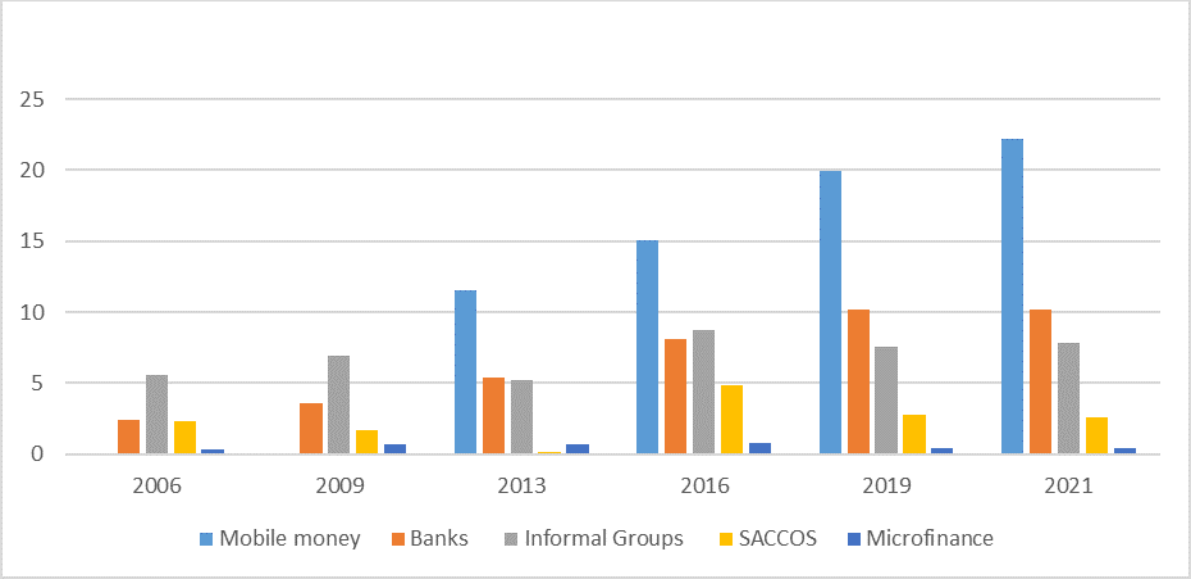

Figure 1.1: Source of Credit and Uptake

Source: (Kenya, Financial Sector Deepening (FSD) 2021)

Figure 1.1 above shows that farmers' reliance on mobile services has increased since its launch in the late 2000s and has become the dominant source as of 2021. Microfinance institutions have the smallest share despite having the prospect of offering higher loan amounts with lower interest rates for farmers. As highlighted by Odhong et al. (2019), households that sell milk in rural areas are likely to save with Savings and Credit Cooperative Organization (SACCOS) or Accumulating Savings and Credit Association (ASCA) as compared to other households in rural areas. About 77 percent of the sampled households, mostly in rural areas, have never taken a loan from financial sources like government funds, Mshwari, SACCO, or micro-finance institutions. The SDFs also prefer informal credit providers such as dairy cooperatives because they also market the milk on behalf of the farmers. Due to their relatively lower interest rates, moneylenders, self-help groups, and friends or family are the most popular sources of credit (Ongwech et al., 2020).

Credit facilities are one of the most critical inputs in enhancing production in agriculture, specifically in smallholder agriculture. However, for financial institutions to offer credit, farmers are required to have a form of obligation (Njuguna & Nyairo, 2010). Consequently, agricultural credit can be defined as loans that are availed to SDFs mainly to help them purchase inputs in farming and for expenditure on capital in the farm so as to facilitate the various processes involved in farming (Dethier & Effenberger, 2012; Musembi, 2019). SACCOs mainly offer credit to SDFs, who often borrow in small amounts, while most commercial banks focus on large and medium-scale farmers and SMEs (Odhong' et al. 2019). This is because they offer more affordable loans and are more flexible in terms of lending terms and eligibility criteria. Figure 1.2 below offers an overview of where farmers acquired their financing to run operations as of 2021.

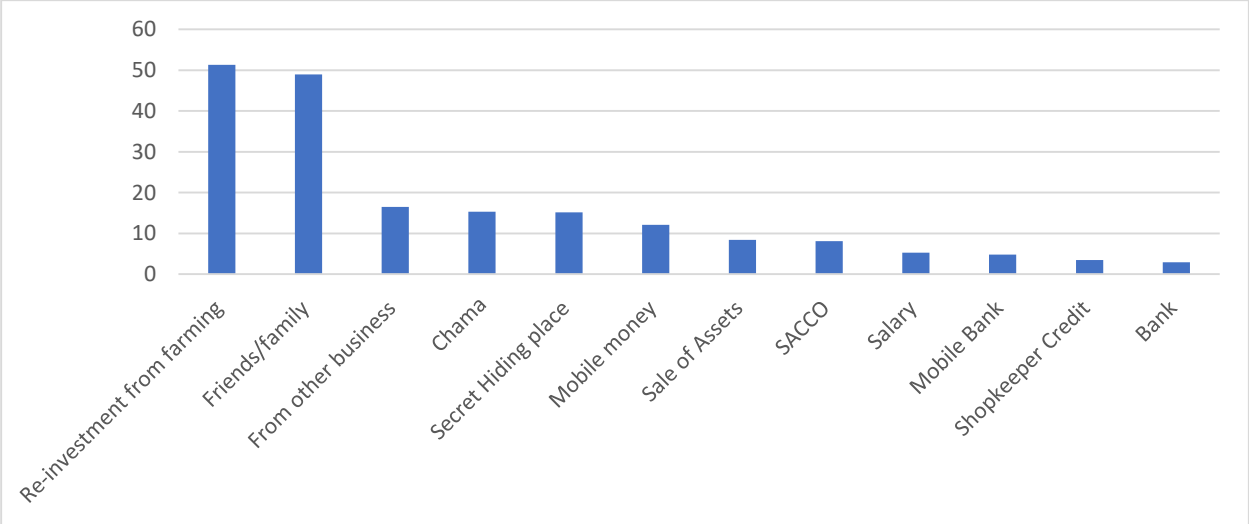

Figure 1.2: Source of Finance for Agriculture

Source: (Kenya, F. S. D. 2021)

Figure 1.2 shows that reinvestments of earnings and family were the primary revenue sources for farmers seeking financing. Sacco's and banks were least likely to offer

financing for farmers despite their flexibility. As to the findings of Murungi et al. (2022), the loan portfolio of commercial banks comprised only 3.6 percent of agricultural loans. Despite the commercial banks in Kenya being legally required to direct approximately 20 percent of all their loans to the agriculture sector, only 10 percent or less of the aggregate credit issued goes to smallholder agriculture (Ndungo et al., 2016). This means that the large-scale farmers are funded with over 90 percent of the national agriculture credit, as the small-scale farmers struggle with 10 percent or less for their credit needs. Banks and other finance companies provide only approximately 3 percent. This chronic underinvestment in Kenya's agricultural sector highly undermines the productivity of smallholder farming.

Notably, credit accessibility occurs when financial institutions have no credit rationing (Conning, 2005). This is the restriction on the availability of credit. Thus, accessibility to credit can be defined as a situation where an SDF can obtain some amount of financing, either in kind or cash, despite their willingness to pay a higher interest from a certain source of capital. Hence, this study defines a situation where the SDF can borrow the full amount, whether it is more than or less than the amount applied for, as having access to agricultural loans. Nevertheless, if a farmer's financing application is completely rejected, they will not have access (Vincent et al., 2011; Mukabane, 2021).

1.1.2. Milk Production in Kenya

Milk production in Kenya surpasses all East African countries. According to the Kenya Dairy Board (KDB) (2023), the industry's compounded annual growth rate stands at 4

percent. The industry also accounts for 4 percent of the national Gross Domestic Product (GDP). Approximately 1.8 million SDFs draw livelihoods from the industry. The dairy value chain employs 500,000 indirectly and about 750,000 persons directly. The statistics indicate that the industry employs fewer people in the value chain than in the actual production. It adds to the understanding that dairy milk production is predominantly an SDF affair. The smaller-scale dairy enterprises and smallholder farmers account for 4.6 billion liters per year. According to the United States Agency for International Development (USAID) (2022), the changes observed over the years in milk production have been a function of the number of cows owned rather than changes in productivity.

The average milk production for one cow is about 1017 liters, which translates to 6 liters per day for a 270-day lactation with an intercalating interval of 600 days (USAID, 2022). This observation pointed to the cultural attachment to the possession of cows as opposed to their commercial links. Additional observations of the breeds kept in Kenya indicate the gravitation of farmers towards longevity in dairy farming based on the longevity of the breeds and susceptibility to diseases. The predominant breeds in areas of high milk production, such as the Central region, include the Ayrshire, the Guernsey, Jersey, Friesian, and the indigenous Zebu cattle. Farmers often crossbreed the Zebu cattle with exotic breeds to increase milk production. An artificial insemination study by Lawrence et al. (2015) showed that Kenya has been able to directly increase the percentages of its cow variety. Cow breeds with high yield potential are mostly crossed. According to Lawrence et al. (2015), the local zebu accounts for 24.6 percent, the Ayrshire cross accounts for 42.06

percent, and the Holstein-Friesian cross accounts for 15.87 percent. The percentages indicate that farmers choose to crossbreed.

However, despite the crossbreeding efforts and growth in herd numbers, Kenya faces a persistent problem of low productivity compared to the global average. The low productivity per dairy animal raises concern that the country has not yet achieved the potential targets required for sustainable dairy productivity. In counties such as Nyandarua, SDFs still grapple with limited access to affordable credit, which constrains their ability to invest in breeds, veterinary services, feeds, and modern equipment and practices. These issues have had a negative impact on the overall productivity. Whereas the country's milk production surpasses most East African countries, it remains below potential. An examination into the link between productivity and credit access is thus needed.

1.1.3. Smallholder Dairy Farming and its Challenges

The main institutional obstacles that SDFs in Kenya face are listed by Otieno et al. (2021). The primary cause of this is incorrect SDF categorization. Otieno et al. (2021) believe that there are three types of dairy farmers: those with moderate resources and moderate commercialization, those with moderate resources and low commercialization, and those with high resources and high commercialization. These three categories represent 59.21 percent, 35.26 percent, and 5.53 percent of the entire nation, respectively. There are also differences in needs. The first category is often less productive, averaging 2.3 acres, 11.2 liters of milk produced daily, and 1.8 liters consumed at home each day. The farm records showed that they spent the least amount of money on running their dairy operation at Ksh

7,530, while for farm operation and labor, they spent Ksh 3,585. With an average of 3.2 acres and up to 4 dairy cows, the second category produces 17.2 liters of milk on average and consumes 2.2 liters of milk for each family. The third category had five dairy cows on average, producing 24.5 liters of milk per day for home use of 2.2 liters. Failure to account for these variations results in generalized policy interventions that do not adequately improve productivity among different SDF groups.

Financial institutions also face various challenges when offering credit to SDFs. Most financial institutions decline loan applications since most farmers (borrowers) need to demonstrate financial track records. This is because the SDFs do not have any proper track records of their dairy enterprises (Odhong' et al. 2019). While banking institutions do not have access to this information, milk cooperatives may have some information on the amounts of milk sold. The majority of the other non-SACCOs end up having higher incidences of poor records as compared to SACCOs. SACCOs are better placed to obtain the financial profiles of SDFs since they are affiliated with cooperatives. This gap in financial records directly hinders farmers' ability to access loans.

The low productivity of SDFs and the absence of formal off-take agreements, including long-term contracts for milk supply, are additional barriers to financial institutions lending to farmers. Due to the possibility of insufficient cash flow from their dairy businesses, the low productivity suggests that dairy farmers will default on loans when they are due. Milk production fluctuation remains another concern that affects farmers' loan repayment capabilities, based on Odhong et al. (2019). Therefore, most farmers require technical

assistance to increase production and stabilize yields. In addition to having bad credit histories, SDFs frequently need more collateral or guarantors, which makes it difficult for them to get loans. This creates a cycle where limited credit access constrains productivity improvements, and low productivity in turn increases credit risk. The table below presents challenges that farmers face when accessing credit.

Table 1.1: Challenges Facing Smallholder Farmers in Credit Access

Challenge category	Specific Challenges
Institutional challenges	Incorrect grouping of SDFs leads to insufficient acknowledgment of their diverse needs. - Low resource-endowed and low commercialized SDFs dominate (59.21 percent) the specific needs and characteristics groups. - Moderate and high resource-endowed SDFs are wrongly accounted for (35.26 percent and 5.53 percent), neglecting their specific needs.
Financial institution challenges in delivering credit	Limited access to milk sales data by financial institutions, impacting their capacity to assess credit scores. - Non-SACCO institutions fail to maintain reliable credit-relevant records compared to SACCOs. - SDFs' low productivity and lack of developed off-take arrangements affect loan approvals.
Production technology challenges	-Value addition technology is underdeveloped. - Limited diversity in marketed dairy products, with only 79 percent of farmers cooling milk before selling due to financial challenges. - Suppressed value addition utilization (e.g., only 7 percent selling yogurt, 3 percent selling pasteurized milk) due to poor access to expansion credit.

1.1.4. Challenges facing Smallholder Dairy Farming in Nyandarua County

Smallholder dairy farming includes low-income farming, subsistence farming, and family farming, where the SDF owns one to three dairy cows (Tarus et al., 2013). A smallholder dairy farmer is a farmer who has less than 5 acres of land whereby he/she uses a maximum of 8 heads of cattle to produce milk for household use, and about 40 percent of the produced milk is sold for income generation (Mutura et al., 2015). This individual can also rear other livestock on the farm. These SDFs barely have access to agricultural credit and form a large proportion of the population. This inaccessibility to credit and financial services is thus a major cause of rural households living in the vicious cycle of poverty (Tarus et al., 2013).

Nyandarua County in Kenya is enumerated among the counties in Central Kenya that produce a large amount of milk daily because of large herds of dairy animals compared to other counties in the region, accounting for 31.98 percent (Republic of Kenya, 2021). Nyandarua County is found in the former Central Province of Kenya. To the north of this County is Laikipia County, to the South is Kiambu County, to the East is Nyeri County, and to the west lies Nakuru County. The County has five sub-counties. These include Kinangop, Kipipiri, Ol Jororok, Ndaragwa, and Ol Kalou (Republic of Kenya 2021). The main sources of livelihood activities are livestock keeping, crop farming, retailing, tourism, and industry. The County has a population of 638,289, 179,686 households, a household size of 3.5, and a land area of 3285.7 sq. km (Republic of Kenya, 2021).

The agricultural sector provides a working base for 69 percent of the population. It contributes 73 percent of the households' income, with the dairy sector employing 61

percent to 80 percent of the employee population (Nyandarua County Integrated Development Plan [CIDP], 2018). According to Chipeta (2015), 63 percent of adult men, 88 percent of adult females, and 63 percent of youth in the County are employed in livestock and crop production. The main breeds of cattle that are reared are crossbreeds, Ayrshire, Friesian, and Jersey. More so, these farmers sell their output to cooperatives, middlemen, and local markets. The small-scale processors are Muki, Delight, and Umoja, whereas the large-scale processors are KCC and Brookside (CIDP, 2018).

According to CIDP (2018), Nyandarua's dairy industry characteristics mirror the national characteristics. There is smallholder dominance within the industry, as farmers typically own 2 to 10 cows (Njarui et al., 2016). The most common breed in Nyandarua County is the indigenous zebu. However, SDFs have gradually embraced other high-yield breeds, such as the Friesians and Ayrshires. The funding for most of the dairy farming in Nyandarua is from milk cooperatives. The value chain encompassing collection, processing, and marketing is done by cooperatives. Farmers prefer selling their milk to cooperatives because of competitive prices. The feeding practices include a mix of grazing and stall feeding. Commercial dairy meal, Napier grass, and maize silage are the most common.

The milk production estimates place the County at 500 million liters per annum per cow. The daily yield per cow is about 8 to 12 liters per day for SDFs. Commercial farms within the country have reported yields of 20 liters or more per cow per day (Muia et al., 2011). The challenges that SDFs grapple with, as reported by the county board of agriculture, are

feed availability, market access, and infrastructure. The infrastructure part involves the need for cooling plants and over-dependence on commercial ones owned by cooperatives. Bad roads directly affect the prices of milk because they hinder the meeting of demand at a particular point in time.

With a cattle population of 346,000 and an annual milk production of 344 million litres, the County can produce over 700 million litres annually (CIDP, 2018). Currently, farmers in this area produce a daily average of 7.5 liters per household (CIDP, 2018). However, these farmers have the potential to produce a daily average of over 10 liters. This indicates that Nyandarua County is operating below its potential by more than 30 percent. Nationally, based on the Kenya Vision 2030 National Dairy Master plan dairy productivity targets of 15-20 litres per cow per day. Nyandarua SDFs average less than half the set benchmark, despite the fact that it is among the top producing country. The reasons for failure to reach the productivity targets can be attributed to limited access to affordable credit. Without affordable credit, SDFs are incapable of improving the breed at their disposal. They are also more likely to use common and cheaper feeds, and also sustain their herd with poor infrastructure.

Most of the SDFs in Nyandarua County still maintain poor genetic stocks, and the few that are rearing improved breeds are worse off in feeding them properly or going through the recommended routine management procedures. A large majority of the SDFs possess small pieces of land where the average land holding is as low as 2.96 acres per individual, and practically all of them have large families. They, therefore, have the biggest problem

achieving credit since they cannot offer securities. Their farming methods are also less intensive, as they cannot afford the capital to go for more intensive farming. SDFs lack economies of scale and have low productivity, which is often associated with seasonal fluctuations. More so, they lack adequate resources to expand and modernize their farming enterprises, leading to low milk productivity (Rademaker et al., 2016). This persistent productivity gap, despite Nyandarua's natural comparative advantage in dairy production, necessitates the need to investigate credit accessibility and its impact on productivity among SDFs in Nyandarua County.

1.2. Statement of the Problem

Despite the substantial role the agricultural sector played in Kenya's economy, contributing approximately 34 percent of the GDP and employing 11 percent of the labor force, the dairy subsector, accounting for 12 percent of the agricultural GDP, encountered pressing challenges that impeded its development (KNBS, 2020; KNBS, 2019). Approximately 1.7 million Kenyans depended on the dairy sector for their livelihoods, and its expansion rate reached 5 percent annually (Agong et al., 2021).

The Government of Kenya, through the Economic Recovery Strategy for Wealth and Employment Creation, introduced a strategic framework meant to enhance credit for farmers. As a result, Nyandarua County experienced a significant inflow of credit service providers aiming to extend credit to farmers. Despite these interventions to increase credit access to SDFs, large-scale farmers continued to benefit more from bank loans, leaving SDFs, who formed the majority, marginalized due to high interest rates and complicated loan application procedures. The problem was more amplified in Nyandarua County, where

the dairy sector supported 61-80 percent of the population, with 238 million liters adding a substantial amount to the economy (CIDP, 2020).

The CIDP (2018) stated that one of the main obstacles facing SDFs in Nyandarua County was their limited access to financing. Low daily milk yields and the inability to add value to products to grow businesses were the results of farmers' ongoing struggles with inefficient loan access (Njuguna & Nyairo, 2010; Zulfiqar et al., 2021). Currently, farmers in this region produce a daily average of 7.5 litres of milk, which is way below the potential daily average of over 10 litres (CIDP, 2018). According to Njuguna and Nyairo (2010), credit is one of the major drivers of agricultural production, especially in smallholder agriculture. However, for credit to be offered, farmers are required to have a form of obligation. Most of these farmers operate on a small scale, and the main obstacle they face is the lack of credit (Zulfiqar et al., 2021), which hinders the purchase of land, farm inputs, farm machinery, and animal feeds, thus limiting SDFs from maximizing their potential level of milk production.

While previous analyses have examined aspects affecting credit access in various Kenyan counties like Busia, Uasin Gishu, and Githunguri Sub-County in Kiambu County, there remains a critical gap in Nyandarua, a dairy-heavy county with unique challenges that require targeted research (Tarus et al., 2013; Nyaga & Nzulwa, 2017; Mukabane, 2021). The present study is inspired by a gap recognized in a 2011 study on credit accessibility among SDFs in Nyandarua District. Vincent et al. (2011) sought to examine the challenges of credit access in the Nyandarua district. Vincent et al.'s relevance lies in its temporal focus on Nyandarua District, where, over the years, there have been significant shifts in economic policies, technological advances, and agricultural support by the government, all

of which can affect the credit access situation for SDFs. The need for current research on credit access in Nyandarua creates a compelling gap and case to perform a fresh investigation, given that occasions and challenges faced by SDFs may have continually evolved. New advancements in financial inclusion and external aspects such as climate change, market dynamics, and global economic shifts have modified the credit access situation, and re-evaluating the topic may provide revamped and pertinent information that can guide policymakers, financial organizations, and other stakeholders about the current landscape impeding SDFs' access to credit in Nyandarua County.

1.3. Research Questions

i. What is the effect of credit access on the productivity of SDFs in Nyandarua County?

ii. What are the factors affecting SDFs in accessing credit in Nyandarua County?

1.4. Objectives of the Study

The main objective of the study was to investigate how credit access affects productivity among smallholder dairy farmers.

The specific objectives were to:

i. Evaluate the effect of credit access on the productivity of SDFs in Nyandarua County.

ii. Examine the factors that affect SDFs in accessing credit in Nyandarua County.

1.5. Significance of the Study

Since dairy is an essential component of the global food chain and greatly contributes to improving nutrition, lowering poverty, and improving living conditions for rural populations, it is imperative that production be improved. SDFs in Nyandarua County will gain from the study since they will be better equipped to comprehend the opportunities and difficulties of dairy farming and make timely decisions about how to increase their access to financing, which will ultimately raise their level of living. The study offers crucial insights and information to financial institutions on the potential opportunities in financing agricultural activities. Policymakers and government agencies will also benefit from this research when making decisions on smallholder dairy farming. The results will also offer guidance not only to the agricultural sector but also to academic institutions and the government on the importance of increasing finances for agriculture.

1.6. Scope of The Study

This study primarily focused on SDFs in Nyandarua County, assessing their access to agricultural credit from financial institutions. The research aimed to identify the factors influencing credit availability and how SDFs sought financial support. Data was collected through questionnaires, with participants categorized into various groups for analysis. Given that Nyandarua County was the central area of interest, the study was conducted within the County.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This chapter reviewed the literature relevant to the investigation. The chapter comprised the theoretical literature, empirical literature, and an overview of the literature.

2.2. Theoretical Literature

2.2.1. Neoclassical Production Theory

Solow and Trevor Swan were credited for developing the neoclassical production theory in 1956. According to Gallaway and Shukla (1974), the theory provided a framework that modeled the production function based on the assumption that firms operated on the frontier. The theory focused on how individuals/firms utilized capital accumulation as a determinant of economic growth. Nyagaka (2009) understood production as a procedure of changing inputs into outputs in the form of final consumer goods or as intermediate products required in other production processes. This was achieved through the utilization of resources such as labor and capital entrepreneurship in agriculture and land.

Gallaway and Shukla (1974) proposed that a production function represents the relationship between input quantities and output levels, making the neoclassical production function essential for analyzing equilibrium and economic growth. Battese and Tessema (1993) further defined it as the technically efficient output derived from a given set of inputs under specific technological conditions. Mathematically, it expresses output as a function of inputs, illustrating how production depends on resource allocation.

It is illustrated as follows;

$Y_i = f(X_1, X_2, ...X_n \mid X_k)$

Where Y_i = output of firm i X_n is the matrix of variable inputs

X_k is the matrix of fixed inputs in a given period.

The production function can be represented in two ways as follows;

$Y = F(K, AL)$ ……(2.1)

Y= Output K= Capital

L= Labour A= level of technology

The above equation shows the dynamic relationship between technology and labor. It shows that technology augments labor, and workers' productivity level depends on the level of technology.

$Y = AF(K, L)$ …… (2.2)

Y= output K= capital

L= Labour A= Total factor productivity

The above equation assumes that technology augments all factors (K, L). According to Gallaway and Shukla (1974), the growth process using equation (ii) can be explained in intensive form as illustrated below;

$\frac{Y}{L} = AF(\frac{K}{L}, \frac{L}{L})$…… (2.3)

Assuming there is no technological progress, equation (iii) reduces to

$\frac{Y}{L} = f(\frac{k}{L},)$…….…… (2.4)

Graphically;

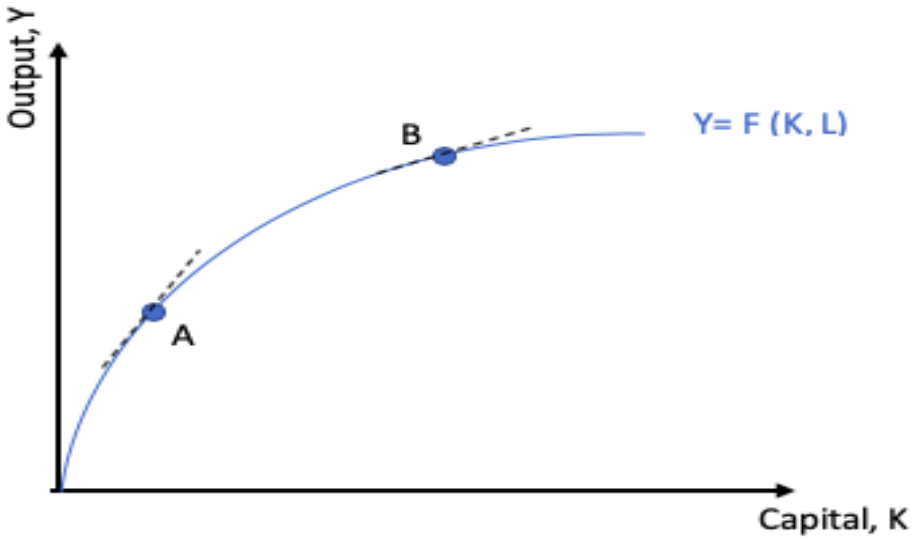

Figure 2.1: Cobb-Douglas production Function showing diminishing marginal returns to capital

Source: Douglas (1976)

The neoclassical production theory made various assumptions. According to Irmen and Maubner (2017), the theory assumed constant returns to scale, which exhibited diminishing returns to labor and capital separately. It also assumed that savings and planned investment were equal due to the immediate adjustments in price (interest). Capital was also subject to diminishing returns, assuming a closed economy. Notably, Hayami and Ruttan (1985) postulated that there were only two ways through which agricultural output mainly increased. One was the technological dynamic, which held that growing levels of output could be obtained through a decreasing or constant stock of resources. Secondly, through an increase in resources such as capital, labor, intermediate inputs, and land.

2.2.2. The Tradeoff Theory of Capital Structure

The tradeoff theory of capital structure states that firms determine their optimal debt level by balancing bankruptcy costs with the tax advantages of debt (Myers, 1984). According

to Myers (2003), firms seek to maximize value by substituting debt for equity until they achieve optimal leverage. Financial distress arises from factors such as asset specificity, earnings volatility, and profitability (Mwihaki, 2015). In agriculture, farmers encounter production risks, including weather shocks, necessitating credit access for inputs like quality breeds and animal feed. They evaluate loan costs against potential productivity gains to make financing decisions. SDFs in Nyandarua mainly rely on credit from cooperatives and informal sources. Like firms, they face a tradeoff between the benefits and costs of borrowing. Credit enables farmers to buy better feeds, improve breeds, and invest in production infrastructure, all of which enhance productivity. However, the relationship between credit and productivity depends on access levels. Optimal credit maximizes output without exposing farmers to unsustainable debt. Overborrowing increases financial risk and repayment stress, while underborrowing limits investment and can still create repayment pressure. In Nyandarua, credit access must be balanced: inadequate, affordable credit lowers productivity, while excessive reliance on costly credit may trap farmers in poverty cycles, undermining long-term growth and sustainability.

2.2.3. The Pecking Order Theory

Leverage theories were described by Myers (1984), and one of the theories was the pecking order theory. The theory focused on the role of information asymmetries. This arose mainly from the difficulties in adverse selection, where firms tended to avoid external financing and opted for internal financing. According to Myers (1984), businesses tended to utilize internal funds, which were cheaper than external funds. When a firm had minimal internal funds, it considered external sources. In agriculture, the theory is more evident, especially

in dairy farming, as farmers prefer saving as their funding source. When their internal sources are insufficient, they borrow from financial institutions to finance their farm investments. The dairy farmers' preference for obtaining credit from financial institutions such as cooperative societies is dependent on their evaluation of their financial needs. In Nyandarua, dairy productivity often dictates the loans advanced to SDFs. When yields per cow remain low and stagnant, financiers limit credit, trapping farmers between underinvestment due to low credit uptake and over-indebtedness from costly loans. Targeted optimal loans can transform this financing hierarchy. By improving productivity and earnings, farmers may increasingly rely on internal funds such as savings, retained earnings, and family contributions. Equity, often the last financing resort, may also evolve as productivity growth fosters partnerships. Currently, most Nyandarua farmers depend on personal savings and prefer lenders with minimal collateral and flexible terms, making equity financing rare. Targeted financing could shift reliance from informal credit to structured institutions like banks.

2.3. Empirical Literature

Vincent et al. (2011) examined the realities of agricultural credit unavailability to the farmers of Nyandarua District in Kenya. In order to do this, it was necessary to identify the different social and economic elements that exist within a household, as well as the institutional elements that affect smallholder farmers' ability to obtain credit in Nyandarua District. The study's findings demonstrated that the primary socioeconomic characteristics affecting agricultural credit were household size, age, gender, collateral, household awareness, and farm income (Vincent et al., 2011). The study recommended that financial

institutions reduce credit costs and implement less stringent credit requirements to increase the affordability of credit. The current study deviates from Vincent et al (2011) by investigating the same relationship under different economic policies and technological advances. Nyandarua is no longer a district, but a county, which indicates that administrative elements in agriculture have been recalibrated by county laws. Whereas the socioeconomic activities were featured, they are subject to changes over time.

Tarus et al. (2013) examined factors influencing credit access among SDFs in Uasin Gishu County, assessing both formal and informal credit sources and their impact on animal performance. Using data from 64 dairy farmers across Eldoret North, South, and East, the study employed descriptive statistics to identify credit determinants. Findings showed that loan availability improved animal performance and household income, with commercial banks as the primary lenders, followed by friends, relatives, neighbors, and moneylenders. The study concluded that collateral and socioeconomic factors were key to financing access. The present study builds on previous findings by adding credit sources as a measure of access. It examines not only the impact of financing on productivity but also farmers' knowledge of credit types. Conducted in Nyandarua, which differs geographically from Uasin Gishu in market access and exposure, the study also considers variables like farmer group membership. Such associations influence borrowing capacity within circles and reflect the level of financial sophistication among SDFs.

Wachekeh (2013) embraced essential components that identified and evaluated the factors that influenced the SDFs' selection of the agricultural credit source in Githunguri Division,

Kiambu County. The study aimed to determine if farmers' characteristics and credit attributes influence the choice of agricultural credit by SDFs (Wachekeh, 2013). The study employed both primary data that was administered to 347 farmers in the Githunguri Division. The variables that were established as significant in this study included the farmers' characteristics and credit attributes, revealing that these attributes played a highly influential role in the determination of the choice of credit. In the conducted study, the author noted that in order for the farmers to upscale credit to the generally accepted level, there was a call for loan products to be repriced to suit farmers and financial institutions (Wachekeh, 2013). The current study differs primarily in the variables involved. It adds variables such as Farm size, collateral requirements, and farming experience. Whereas it does not capture credit attributes as the research does, the added variables are often observed as antecedents to determining the attribute of credit.

Wainaina (2013) studied the challenges faced by dairy farmers in Kenya, as per the case of Kiambu County. The study evaluated the internal, external, and industry constraints facing dairy farmers in Kiambu County (Wainaina, 2013). The study used a study population of 14,000 dairy farmers from Kiambu County. The data collected were both quantitative and qualitative, and they were collected and assigned to the set of questionnaires utilized in this study. Out of the indicated studies, it was found that more than 60 percent of the farmers in Kiambu County were experiencing obstacles in availing financial services. The farmers also faced high production costs, which resulted from insufficient access to essential production factors. They also had challenges such as limited access to banking services, resource constraints, and lack of market information (Wainaina, 2013). This study was

limited to Kiambu County and relied on data collected ten years ago, which may not capture recent developments such as mobile credit platforms and county-level interventions. The present study deviates by focusing on Nyandarua County, where dairy production plays a comparatively larger economic role, and by examining the direct link between credit access and productivity among SDFs using recent data.

Nyaga and Nzulwa (2017) investigated the factors experienced by SDFs in accessing credit facilities to fund their activities in the Githunguri Sub-County of Kiambu County. The research was of a descriptive nature based on farmers who reared not more than ten dairy animals for the purpose of increasing income from the sale of milk. Data were collected using self-administered questionnaires. The study's findings showed that financial information awareness, collateral availability, credit requirements, and the level of managerial competency affected the ability of SDFs to access credit. The study concluded that financial institutions should innovate financial products, lower financial charges, simplify the end-to-end credit process, and have alternative communication channels compatible with SDFs to increase their credit access (Nyaga & Nzulwa, 2017). Nyaga and Nzulwa (2017) examined factors influencing credit access, like managerial skills, financial awareness, and collateral, but not their impact on productivity. Their Kiambu-based descriptive design limits wider application. This study shifts focus to Nyandarua, employing a causal approach with recent data to link credit access and productivity.

Njiru and Kaibui (2020) analyzed factors influencing agricultural credit availability for small-scale dairy farmers (SDFs) in Githunguri Sub-location, Kiambu County. The study

examined how farm management skills, interest rates, and collateral affected credit access. Findings showed a positive correlation between farm management practices, collateral possession, and credit availability. However, there was a negative correlation between interest rates and access to agricultural credit, indicating that higher interest rates limited borrowing. The present study also applies a causal approach to establish the effect of credit access on productivity, going beyond the correlational focus of Njiru and Kaibui (2020).

Mukabane (2021) examined factors influencing formal credit acquisition among small-scale farmers in Busia County, focusing on farmers' characteristics and economic factors affecting credit access. Using a sample of 375 households from 15,705, the study applied linear and descriptive regression analysis. Findings revealed that 67.1 percent of farmers lacked access to credit, while only 32.9 percent obtained financing. Gender disparities were evident, with 74.4 percent of male farmers accessing credit compared to only 25.6 percent of female farmers. Limited land size and capital constraints hindered agricultural productivity. However, the study did not specifically analyze how credit access influences productivity in dairy farming, and its findings may not be directly transferable to Nyandarua County, where dairy farming dominates the local economy. The present study deviates by focusing on the relationship between credit access and productivity among SDFs in Nyandarua, thus filling a contextual and thematic gap.

2.4. Overview of Literature

This study was anchored on the Tradeoff Theory of Capital Structure, the Pecking Order Theory, and the Cobb-Douglas Production Theory. The Tradeoff Theory highlights how

farmers balance the benefits of external financing, such as credit, against the costs, including interest rates and risk of default. The Cobb-Douglas Production Theory links key inputs (credit, land, feed, and labor) to agricultural productivity (Douglas, 1976). These theories explain how access to credit influences dairy productivity by enabling investment in improved breeds, quality feeds, and modern farm technologies.

Empirical studies show varied determinants of credit access among SDFs. Wainaina (2013) highlighted internal and external challenges in Kiambu, including high production costs and poor banking access. Nyaga and Nzulwa (2017) emphasized collateral, financial awareness, and managerial skills in Githunguri. Njiru and Kaibui (2020) found that farm practices and collateral improved access, while high interest rates discouraged borrowing. Mukabane (2021) noted that farmer characteristics (gender, land size, and capital limitations) shaped formal credit access. However, these studies largely emphasized determinants of access, overlooking the credit–productivity nexus and relying on descriptive or correlational designs that limit causal inference.

CHAPTER THREE

METHODOLOGY

3.1. Introduction

The research methodology was described in this chapter. It included research design, sample, sample size, type, and data source, as well as the theoretical framework, empirical model specification, and operationalization and description of the variables.

3.2. Research Design

Since it permits the application of descriptive statistical research methods, the study's research design was descriptive. According to Mugenda and Mugenda (2003), it offers a broad summary of the respondents' traits in terms of their beliefs, actions, and expertise in a certain circumstance.

Thus, the research design was helpful in analyzing the primary data collected from SDFs in Nyandarua County.

3.3. Theoretical framework

Neoclassical Production Theory emphasizes efficient allocation of resources to maximize output. The Cobb-Douglas Production Function operationalizes this by modeling input-output relationships in a multiplicative form for productivity analysis. The study used a Cobb-Douglas Production function to demonstrate the relationship between a firm's output and its ability to obtain loans (Kidali,2020; Batool and Zulfiqar,2013). According to the Cobb-Douglas Production function, a firm's production (Y) is determined by its labor (L) and invested capital (K).

This is illustrated as;

$Y = A.\ K^{\alpha}\ L^{\beta}$ …… (3.1)

Where α and β are the output elasticities

A is the total factor productivity

Y is output, K is capital

L is labor

The elasticity of K and L is constant and dependent on the existing technology.

According to Kidali (2020), the invested capital (K) is broken down into the average level of credit per SDF (z) and the input capital (k). This converts equation 1 into a three-factor production process. The credit capital (z) and the physical capital are separated. The equation becomes:

$Y = A.\ (zk)^{\alpha}\ L^{\beta}$ ……..…..…….3.2

Equation 2 is converted into the following in terms of each unit of capital input:

$\frac{Y}{K} = A.\ (\frac{z}{K})^{\alpha}\ (\frac{L}{K})^{\beta}$ ……..……3.3

Due to the nonlinear nature of the production function, equation 3 is converted into the following using natural logs:

$Ln\ \frac{Y}{K} = \ln A + \alpha \ln (\frac{z}{K}) + \beta \ln (\frac{L}{K})$……3.4

The above equation assumes that the total elasticity is unity because the production function limits how inputs can be substituted during the manufacturing process. However, the elasticity of credit capital (z) is not limited to being similar to that of K and L. The log-transformed production function suggests that the production of SDFs is influenced by loan availability. The equation indicates that farmers' access to credit boosts capital, which is necessary for facilitating the production process (Kidali, 2020). According to Pierri and

Manaresi (2018), a firm's outputs and inputs rise in proportion to an increase in the credit supply for a given level of inputs.

3.4. Empirical Model Specification and Estimation

3.4.1. Effect of Credit Access on the Productivity of SDFs in Nyandarua County

To adapt the theoretical model to this study, broad inputs of labor and capital are decomposed into dairy-specific variables. Labor is represented by family and hired labor, while capital includes credit access, land size, and feed expenditure. Total factor productivity accounts for unobserved factors like technology and farming experience. The resulting transformation would yield a linearized equation of the form;

$Y_i = B_0 + B_1X_i + B_2X_i + B_3X_i + B_4X_i + B_5X_i + u_i$…… (3.5)

$Y_i = milk\ yield\ per\ cow$ for farmer i

B_0= Intercept

$X_2 = \begin{cases} 1\ if\ SDF\ has\ credit\ access \\ 0\ if\ SDF\ has\ no\ credit\ access \end{cases}$

X_3= Feed Quality

X_4= Years of experience in dairy farming

X_5=Farm size

X_6= Frequency of veterinary visitation

The term productivity encompasses various variables. To tie it to the research subject, productivity was synonymous with milk yield per cow (Mwihaki, 2015). The identified

variables included the productivity of SDFs, with milk yield per cow per day as the dependent variable and access to credit as the independent variable. As a variable, credit access would be a binary. That means that an SDF may either have access to credit or otherwise.

3.4.2. The Factors Affecting SDFs in Accessing Credit in Nyandarua County

Gujarati (2003) notes that a binary logistic model is used in a situation where the dependent variable is dichotomous. The logit model deals with the dependent variable (credit accessibility) and independent variables (socioeconomic characteristics, together with other institutional constraints in credit accessibility). Taking access to credit as the dependent variable, the equation becomes;

$Y_i = \beta X_i + \mu_i$ ……. 3.6

The above equation shows that the dependent variable is an unobserved dependent dummy variable.

Y_i takes on the values of either 1 or 0.

Where 1 denotes an SDF with credit access

0 denotes an SDF with no credit access

This becomes;

$$ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \beta_6 X_{6i} + \beta_7 X_{7i} + \beta_8 X_{8i} + \beta_9 X_{9i} + u_i \quad \text{……3.7}$$

Where,

P_i is the probability of farmer I accessing credit

X_1 Age (years)

X_2 Gender (1= Male, 0 = female)

X_3 Education Level (Years of schooling)

X_4 Membership of association of farmers group (1= Yes, 0= Otherwise)

X_5 Farm size

X_6 Marital status of the SDF (1= Married, 0= Otherwise)

X_7 Collateral requirements (1 = Credit access depends on collateral, 0 = otherwise)

X_8 Farming experience

X_9 Information on the sources of credit

3.5 Description and Measurement of Variables

Variable included in the study and their measures were captured as follows;

Table 2 Variable and their measures

Variable	Definition	Measurement
Age	Age of the Farmer in Years	Years
Gender	Biological Sex of the Farmers	Equals 0 for a female farmer and 1 for a male farmer.
Education Level	The education level of the farmer	Equals 1 if the farmer has completed secondary school or further, and 0 otherwise.
Membership of the Association of Farmers' group	The participation of an SDF in a farmer's group	Equals 1 in the event that the farmer belongs to a farmer's organization and 0 otherwise.
Farm size	The total land owned by the farmer in acres	Acres of land

Marital status of the SDF	The Marriage status of the SDF	Equals 1 if married and 0 if otherwise
Collateral requirements	The requirements by the financial institutions for SDFs to access credit	Equals 1 in cases when collateral is required for credit access and 0 in otherwise.
Farming experience	Number of years the farmer has practiced farming	Years in farming
Information on sources of credit	The accessibility of information on various credit sources by the SDF	Equals 1 in the event that the farmer has access to credit source information and 0 in the absence of it.

3.6. Target population

A population, according to Creswell (2009), is a group of data whose characteristics have been examined and evaluated. The SDFs in Nyandarua County were the study's target population. SDFs in the county sub-counties, such as Ndaragwa, Kinangop, Ol'Kalou, Kipipiri, and Ol'Joro Orok, were included in this study (See APPENDIX II). The population of Nyandarua was 638,289, according to KNBS (2020). SDFs, who comprised between 61 to 80 percent of the County's population, were the study's primary focus.

3.7. Sampling and Sample Size

In data collection, the study employed stratified and simple random sampling (SRS) methods. Hence, under stratified sampling, the sample frame was used to sort out the SDFs according to sub-counties. Each sub-county formed a stratum. SRS was used to select the final samples within the strata that were in proportion to the required sample size. Yamane (1967) defines that the sample size of a finite population could be conferred by;

$$n = \frac{N}{1+Ne2}$$

Where e is the level of precision

n is the sample size

N is the study population

The population of the study is 445,201 smallholder dairy farmers in Nyandarua County. Therefore, at a 95 percent confidence interval, the resize is obtained as follows;

$$n = \frac{445,201}{1+445,201(0.05)2}$$

$$n = \frac{445,201}{1+1113.0025} = 400 \text{ farmers}$$

3.8. Data Type and Sources

The study used structured questionnaires, both open-ended and closed, to collect quantitative data. These data included various socioeconomic factors and institutional factors affecting SDFs in the County. The data sources were the sample farm households (female and male-headed).

3.9. Data Analysis

The quantitative data were analyzed using regression analysis and descriptive statistics, incorporating measures of central tendency and dispersion in the study of secondary data. Logit models were estimated using regression analysis. Various graphical techniques, including graphs, bar charts, pie charts, percentages, and frequency tables, were used to summarize the data. Additionally, diagnostic tests were conducted to identify econometric issues.

3.9.1. Diagnostic tests

To ensure the validity and reliability of the regression results, several diagnostic tests will be conducted in line with the assumptions of the regression models. Multicollinearity among the independent variables will be tested using the Variance Inflation Factor (VIF). The study will also test for autocorrelation of residuals using the Durbin–Watson statistic and also assess the overall model fit. For the multiple regression model, this will be done through the F-test, the coefficient of determination (R^2), and the adjusted R^2.

CHAPTER FOUR

EMPIRICAL FINDINGS

4.1. Introduction

The study began its data analysis with descriptive statistics of key variables, presented in tables and histograms following standard reporting formats. Linear regression was used to evaluate the effect of credit access on SDF productivity. Credit access was coded into two equations for comparative analysis. Additionally, binary logistic regression was applied to identify factors influencing credit access.

4.2. Descriptive Statistics

4.2.1. Social demographic factors

Age

The study identified three primary age groups of farmers: those aged 18 to 40, those aged 40 to 60, and those aged 60 and more. Two hundred-eight farmers (52.13 percent) were between the ages of 18 and 40, 128 (32.08 percent) were between the ages of 40 and 60, and 63 (15.79 percent) were over the age of 60. According to this information, most farmers in Nyandarua are between 18 and 40 years old. Younger people are more actively involved in agricultural activities than older age groups, as seen by the progressive drop in farming participation with increasing age. The following is a graphical representation of the results;

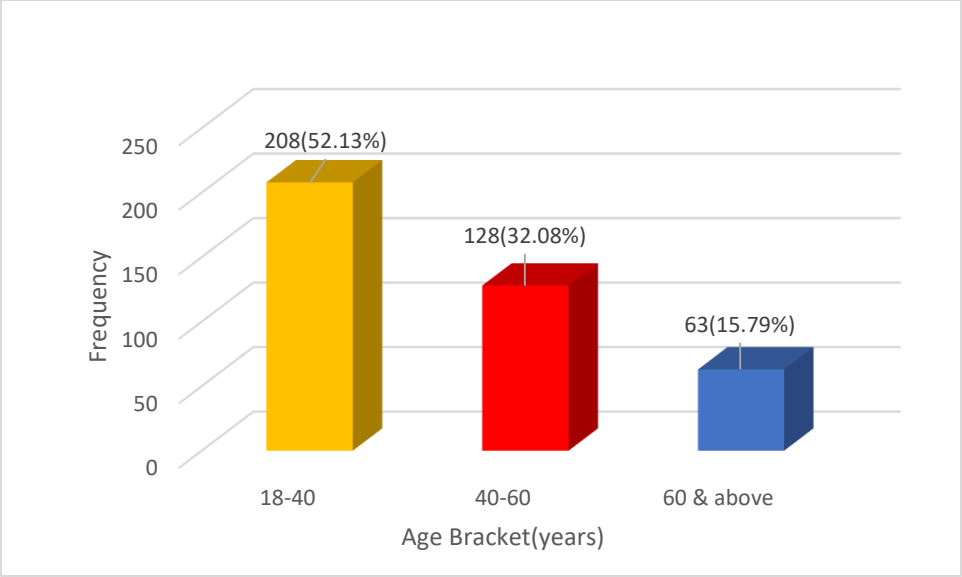

Figure 4.1: Age of Farmer

Source: Field data (2025)

The biological sex of farmers

The study divided farmers into two groups based on gender: male and female. Of the farmers, 145 (36.34 percent) were classified as female and 254 (63.66 percent) as male. According to this data, men make up the majority of farmers in Nyandarua, suggesting that men are more likely than women to be involved in farming. The following is a

graphical representation of the results.

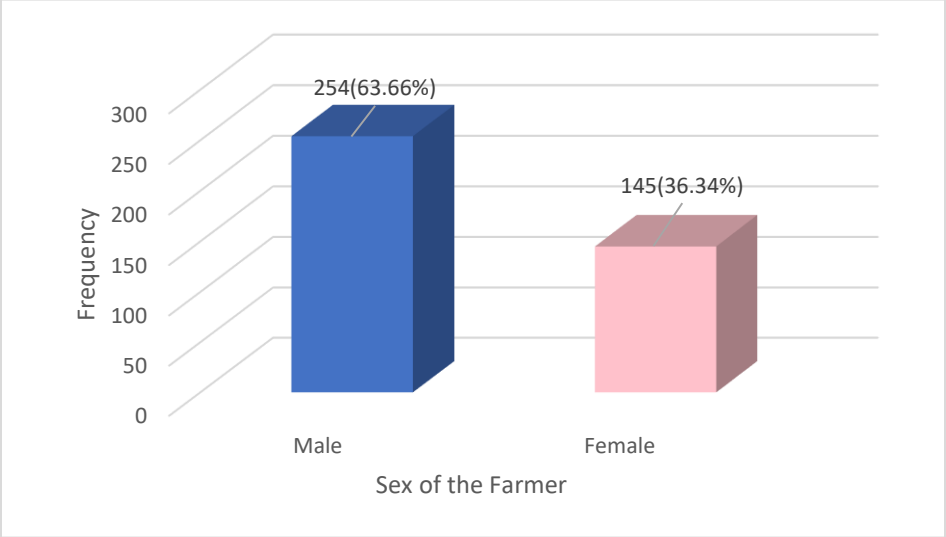

Figure 4.2: Biological Sex of Farmers

Source: Field data (2025)

The education level of the farmer

The study divided the educational attainment of farmers into five categories: adult education, primary, secondary, university, and no education. According to the results, 13 farmers (3.26 percent) obtained adult education, and ten farmers (2.51 percent) had no formal education. There were 125 farmers (31.33 percent) who had only completed primary school, 163 farmers (40.8 percent) who had finished high school, and 88 farmers (22.05 percent) who had completed university. This data shows that while only a small percentage of farmers in Nyandarua lack formal or adult education, the majority have secondary-level education, with a sizable portion having either primary or university education. The following is a graphical representation of the results.

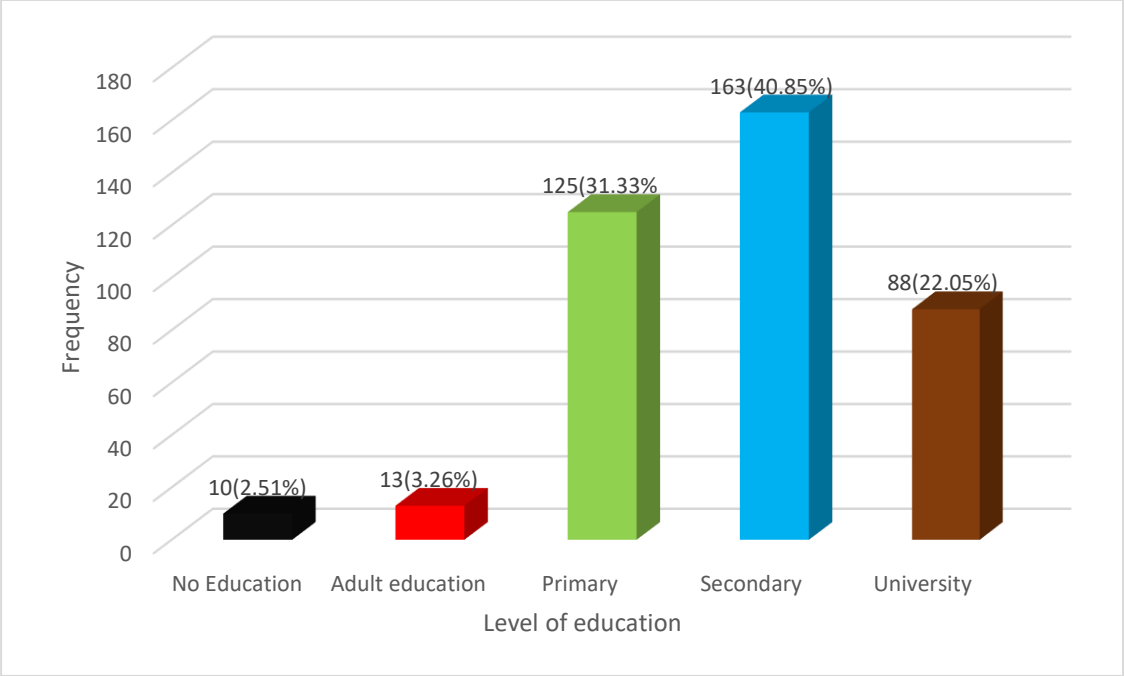

Figure 4.3: Farmer's Level of Education

Source: Field data (2025)

Marital Status

The study divided Farmers' marital status into four categories: widowed, divorced, married, and single. According to the findings, 281 farmers (70.43 percent) were married, 18 farmers (4.51 percent) were widowed, six farmers (1.50 percent) were divorced, and 94 farmers (23.56 percent) were single. According to this data, married farmers make up the majority of farmers in Nyandarua, while single farmers make up the second-largest category. The percentage of farmers who are widowed or divorced is relatively low. The graphical representation of the marital status distribution was as follows.

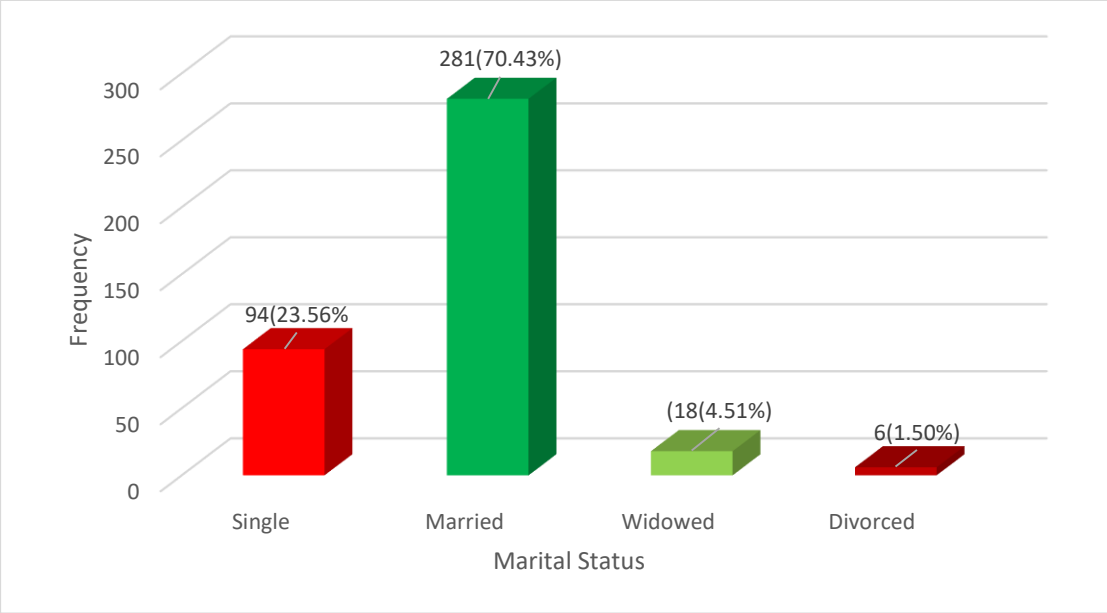

Figure 4.4: Marital Status

Source: Field data (2025)

Size of household (Everyone in the home sharing meals, including the responder).

The distribution of household sizes among the participants reveals a varied range of family structures. The majority of households, 23.31 percent, consist of 3 members, making it the most common household size in the sample. Following this, 17.04 percent of households have four members, and 15.04 percent have five members. Smaller households are also relatively common, with 9.77 percent having only one member and 11.78 percent having two members. These smaller households (comprising 1 or 2 members) constitute a significant portion of the sample, accounting for 21.55 percent of all households. Larger households, particularly those with seven or more members, are rare. Only 4.2 percent of households have seven members, and the frequency decreases further with households of 8 members (3.76 percent) and nine members (0.75 percent). Households with ten or more members are even rarer, with 1.50 percent of households comprising ten members and less than

1 percent having 11, 12, 14, or 15 members. Notably, no households in the sample reported having 13 members. This finding suggests that while smaller household sizes are the norm, larger families are less frequent within the study population. The data reflects a general trend towards smaller households in Nyandarua. The graphical representation of the household size distribution was as follows.

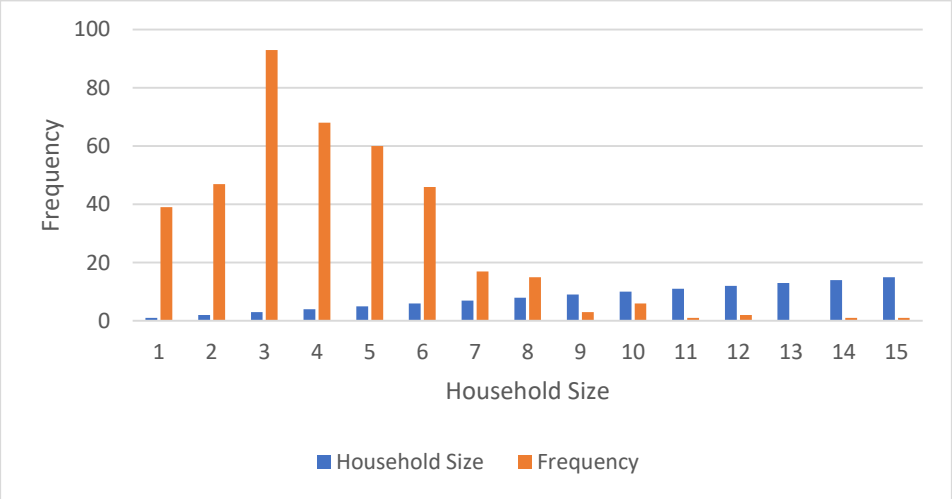

Figure 4.5: Household Size

Source: Field data (2025)

Source of Income

Employment, farm income, and other business revenue were the three primary groups into which the research divided sources of income. Three hundred thirty-nine respondents, or 84.97 percent of the total, stated that their principal source of income was farm revenue. Just 12 (3.00 percent) of the respondents said that their primary source of income was employment, but a lesser percentage of 48 (12.03 percent) said that their primary source of income came from other business ventures. The graphical representation of the source of income was as follows.

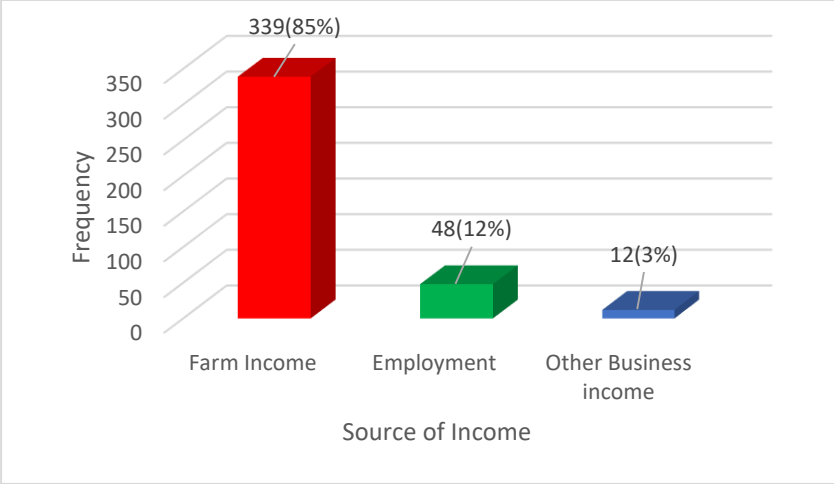

Figure 4.6: Source of Income

Source: Field data (2025)

4.2.2. Number of Dairy Cows possessed by farmers

The study divided Dairy cow ownership into two groups: those with one to eight cows and those with nine or more. Three hundred ninety-two farmers, or 98.2 percent, owned one to eight dairy cows. On the other hand, only seven farmers (1.8 percent) reported owning nine or more dairy cows. This suggests that most farmers own dairy cows on a smaller scale. The graphical presentation of the number of dairy cows possessed by farmers is as follows.

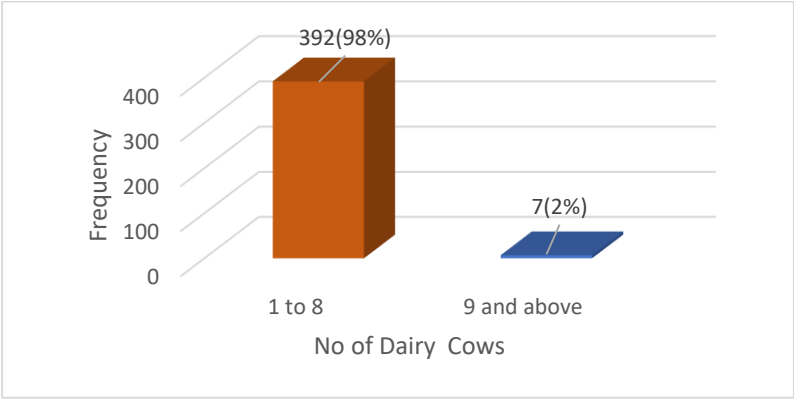

Figure 4.7: Number of Dairy Cows

Source: Field data (2025)

4.2.3. Farm Characteristics

Table 4.1: Farm Characteristics

	Category	Frequency	Percentage
No dairy cows possessed	1 to 8 cows	392	98.2%
	Nine and above	7	1.8%
Experience in dairy farming	Below 6 years	143	36%
	6 to 14 years	84	21%
	Over 14 years	172	43%
Size of Arable land	Small-up to 5 acres	389	97.5%
	Large-over 5 acres	10	2.5%
Form of land tenure	Lease	71	18%
	Owner	328	82%
Possession of title deed	Yes	360	90%
	No	39	10%
Source of labor on farm labor	Hired labor	49	12.3%
	Family	153	38.3%
	Both (family & hired)	197	49.4%
Time spent on the farm	Part-time	119	30%
	Full time	280	70%
Cattle breed reared	Local	73	18.3%
	Cross Breeds	41	10.3%
	Hybrids	285	71.4%
Practice of any other form of farming	Yes	327	82%
	No	72	18%
Approximate monthly dairy farming income	0-15,000	309	77%
	15000-25000	58	15%
	25000-35000	19	5%
	Over 35000	13	3%
Sustainability of households by dairy farming	Yes	191	48%
	No	208	52%
Approximate cost of dairy farming on the farm	Less than 1000	44	11%
	Between 1000 and 20000	278	70%
	Over 20000	77	19%

The table above provides insights into the structure and difficulties of the dairy industry by identifying important traits and practices among dairy farmers. Due to the region's prevalence of small-scale dairy farming, most farmers (97.5 percent) work on small landholdings, typically no more than 5 acres. With 90 percent of farmers possessing title deeds and 82 percent owning their farms, land ownership is shared. This solid land tenure supports stability and long-term investments in farming operations. On dairy farms, family and paid labor comprise the majority of labor (49.4 percent), with family work accounting for 38.3 percent of all labor. This implies that most farmers use family resources to supplement hired assistance, thereby balancing cost control and efficiency.

The majority (71.4 percent) of cow breeds are hybrids, which are known to produce more milk, followed by crossbreeds (10.3 percent) and local breeds (18.3 percent). This suggests that farmers prioritize production, even though some may opt for local breeds to prioritize affordability or resilience. In addition, 82 percent of farmers cultivate other crops in addition to dairy, according to the report. Given the difficulties of depending on dairy farming, this diversification demonstrates initiatives to reduce risks or augment household incomes. Furthermore, 70 percent of farmers dedicate their time to their farms, highlighting the primary occupation's economic significance. However, financial challenges persist for many farmers. 52 percent of farmers said that dairy farming only partially supports their households, even though 77 percent make less than 15,000 shillings per month from the industry. Although 19 percent have higher expenses, most farmers (70 percent) handle moderate operating costs (1,000–20,000 shillings per month).

4.2.4. Loan Accessibility

Table 4.2: Loan Accessibility

	Category	Freq	%
Do you possess credit data	Yes	199	49%
	No	200	51%
Do you have credit currently	Yes	109	28%
	No	282	72%
Have you ever taken a loan to finance dairy farming activities	Yes	138	36%
	No	250	64%
How much time did the payback period last	Less than 6 months	21	14%
	1 year	85	59%
	2-5 years	33	22%
	Above 5 years	8	5%
Was it from the same financier	Yes	131	86%
	No	21	14%
Describe the process of obtaining credit from the financier	Very hard	63	21%
	Hard	88	30%
	Easy	127	43%
	Very Easy	16	6%
Which of the following institutions finances your credit	Commercial banks	22	12%
	Friends and Family	24	13%
	SACCO	136	72%
	AFC	2	1%
	Profits from business	4	2%
Which of these factors influenced your choice of financier	Collateral	16	7%
	Interest rate	102	39%
	Repayment period	40	15%
	Loan Review Period	102	39%
Which source provided information on the lending institution that was available	Family and friends	112	65%
	Media and public agricultural forums	22	13%
	Learning institutions	27	16%
	Agricultural extension officers	11	6%
Have you ever used your land as collateral for a loan	Yes	20	5%
	No	352	95%
Was the size of the land proportional to the loan you got	Yes	9	13%
	No	61	87%
Are you aware of the current interest charged on agricultural credit	Yes	142	46%
	No	170	54%
If yes, what do you think about them	Low	10	6%
	Relative	54	38%
	High	48	34%
	Very high	31	22%
Can the amount of interest charged on agricultural credit influence whether you will ask for a loan or not	Yes	316	87%
	No	46	13%
	Processing Machinery	44	13.2%

What are some of the farm implements that you use as loan security	Tractor	3	0.90%
	Vehicle	49	14.8%
	Hired machinery	8	2.4%
	Hand implements	228	68.7%

From table 4.2 above, nearly half of the farmers (49 percent) had credit data, although a slightly more significant percentage (51 percent) did not. This suggests a substantial need for more awareness or access to financial information, which may make it more challenging to make well-informed lending decisions. Despite this, 28 percent of farmers had credit, compared to 72 percent who did not. This shows that most farmers are either unwilling or unable to obtain credit, which may restrict their capacity to make significant investments in their farming operations.

Just 36 percent of the farmers said they had taken out loans expressly for dairy production, while 64 percent said they had not. Given that a sizable portion of farmers characterized the loan acquisition process as "hard" (30 percent) or "very hard" (21 percent), this low loan uptake may be related to the difficulties encountered during the process. Some farmers, however, thought the process was manageable; 43 percent said it was "easy." This variance in experiences could be influenced by the farmer's unique financial situation or circumstances.

According to the research, the majority of farmers (72 percent), friends and family (13 percent), and commercial banks (12 percent) mainly obtained their credit from SACCOs. This implies that because of their accessibility and possibly advantageous lending terms, SACCOs continue to be the favored financial institution. On the other hand, conventional financial organizations like banks seem less well-liked due to their perceived rigidity or more stringent regulations. One crucial factor influencing farmers' decision-making and

loan accessibility is interest rates. 54 percent of farmers needed to be made aware of the current interest rates on agricultural credit, compared to 46 percent who were. A sizable percentage (56 percent) of those who knew thought the interest rates were excessive or extremely high. As evidenced by the 87 percent of respondents who said that the interest rate directly affects their decision to take out a loan, this notion probably deters many farmers from applying for loans.

Farmers also needed help with collateral obligations. Just 5 percent of farmers said they had pledged their land as security for a loan, and of those who had, 87 percent said the loan amount was out of proportion to the size of their field. Due to their limited assets, most farmers used hand tools (68.7 percent) or cars (14.8 percent) as collateral. This lack of collateral may further limit their investment ability, preventing them from obtaining more substantial loans. Family and friends were the most popular informal source of information about lending institutions (65 percent), followed by educational institutions (16 percent), the media, and public agricultural forums (13 percent). With only 6 percent of the information provided, agricultural extension officers made a minimal contribution. This dependence on unofficial networks highlights a need for more official distribution of credit information to farmers.

According to the findings, the majority of loans had a one-year repayment duration (59 percent), although lesser percentages had payback periods of two to five years (22 percent) or less than six months (14 percent). Most loans are short-term since just 5 percent of farmers reported loans with payback periods longer than five years. The usefulness of such credit in increasing production may be limited since this short-term structure might need

to align with the long-term investment requirements of dairy farming. Overall, the results indicate that although some small dairy farmers in Nyandarua obtain loans for their operations, a sizable percentage encounter difficulty because of high interest rates, collateral requirements, credit knowledge, and laborious loan acquisition procedures. Their capacity to employ financial resources to grow their dairy operations is restricted by this circumstance, which emphasizes the need for more easily accessible financing and farmer-focused financial solutions.

4.2.5. Farmer information

Table 4.3: Farmer Information

	Category	Freq	%
Do you belong to any farmer's union /SACCO, /Cooperative	Yes	214	54%
	No	185	46%
Are you in a leadership role within the Farmers Union?	Yes	19	5%
	No	380	95%
How often does the ministry veterinary officer visit your farm?	Weekly	10	3%
	Monthly	21	5%
	Quarterly yearly	51	13%
	Half-yearly	51	13%
	Never visited	253	66%
What types of feed do you provide for your dairy cows?	Napier grass	310	78%
	Maize silage	68	17%
	Hay	4	1%
	Concentrates	3	0.7%
	Mineral Supplements	3	0.7%
	Other	11	2.6%
Where do you obtain your feed?	Own farm	340	85.5%
	Local Market	24	6%
	Feed suppliers	16	4%
	Cooperative society	4	1%
	Other	14	3.5%
Do you grow any of the feed on your farm?	Yes	386	97%
	No	13	3%

According to the research analysis findings on table 4.3, 46 percent of farmers in Nyandarua are not members of a farmer's union, SACCO, or cooperative, compared to 54 percent who are. Even with this high number of members, just 5 percent of farmers are in leadership positions in these groups, indicating little participation in decision-making. This could result from members' disinterest in leadership or systemic obstacles. There is a noticeable lack of veterinary support. Sixty-six percent of farmers said a ministry veterinary officer had never visited their farms. Just 3 percent of those who had visits did so regularly, 5 percent did so monthly, and 26 percent did so quarterly or semi-annually. This low frequency of veterinary visits indicates limited professional support for addressing health issues and improving productivity in dairy farming.

According to farmer feed management techniques, 78 percent of farmers utilize Napier grass, making it the most common feed type. Other forms of feed were much less prevalent, including hay (1 percent), concentrates (0.7 percent), mineral supplements (0.7 percent), and maize silage (17 percent). The percentage of farmers who used alternative feeds was 2.6 percent. Dairy cow production and nutritional intake may be constrained by an overreliance on Napier grass, which emphasizes a need for more diversification in feeding practices. Since most farmers (85.5 percent) get their feed straight from their farms, self-sufficiency is highly valued. Just 6 percent buy feed from nearby marketplaces, compared to 4 percent buying from feed suppliers and 1 percent buying from cooperative organizations. Remarkably, 97 percent of farmers stated that they cultivate feed of some kind on their properties, demonstrating extensive attempts to guarantee feed supply for their dairy operations. Feed management techniques might be improved to increase dairy productivity and

resilience, as seen by the limited use of alternative feed types and dependence on conventional sources.

4.2.6. Financier choices and SACCO involvement

The research had five open-ended questions that sought to establish the position of farmers on the change of financiers (question E in the question), credit attributes affecting the choice of financier, primary obstacles faced when applying for credit, and farmers' involvement in credit organizations. Sampled responses on why farmers changed their financiers included "high interest rates," I don't want debts I can't pay," "I looked for a more financially stable financier," "Due to change in interest rates," "due to high interest rates," and "unfavorable interest rates." The thematic analysis would reveal that the interest rate increase is the predominant theme of the reasons for the change of financier. This signifies that the interest rate offered to SDF is high while the agricultural finance industry is unstable. The instability of the farming financial institution was apparent from sample responses on the credit attribute of the chosen financier. Common responses included "most favorable interest rate," "adjustable repayment schedules," "could not large amount," and "no collateral needed." The emerging themes suggest that the favored financiers rely on low interest rates as an incentive but mainly offer unsecured loans with measured credit facilities. The merging themes on the primary obstacles facing credit application by farmers were "lack of guarantors," collateral and high interest rates," "amount on ordinary shares," and "guarantors are not easily found." The thematic analysis would reveal that most financiers require guarantors as a standard for issuing loans. Also, the difficulty in finding a guarantor is necessitated by the determination of guarantor candidates' fear of failure to pay the loan

by the person they guarantee. Therefore, the overall picture is that the agricultural finance sector is fragile and has minimal involvement with farmers.

The farmers do not hold influential positions in their SACCOs. Sampled responses include "secretary" and "local area advisor." However, those who are members of the agricultural sector list "easy loan access," "Dividends," and "access to lump sum money for development" as the most significant benefits of joining SACCOs. There are many other functions of agricultural SACCO, but in the case of Nyandarua, they offer no agricultural extension services.

4.3. Empirical Findings

4.3.1. Effect of Credit Access on the Productivity of SDFs in Nyandarua County

Table 4.4. shows the model summary of the regression analysis conducted to check the effect of credit access on productivity.

Table 4.4: Model Fit Summary

Model Summary[b]										
					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.375[a]	.140	.129	4.847335995444213	.140	12.834	5	393	.000	1.861
a. Predictors: (Constant), creditaccessdummy, FVV, Farming experience, Farm Size, Feed quality										
b. Dependent Variable: Milk yield per cow										

The table presents the multiple regression analysis findings, examining the relationship between milk yield per cow (dependent variable) and credit access, frequency of veterinary visits (FVV), farming experience, farm size, and feed quality (independent variables). The

model's R-value of 0.375 indicates a moderate positive association between the predictors and milk yield. The R^2 value of 0.140 shows that the model explains 14 percent of the variation in milk yield per cow, while the Adjusted R^2 of 12.9 percent accounts for sample size and predictor count. In studies dealing with household-level agricultural data and social sciences, R^2 values below 50 percent are common because productivity is affected by many unobserved and heterogeneous factors. Although a significant portion of variance remains unexplained, the predictors meaningfully contribute to explaining milk yield differences among sampled farms. The low R^2, therefore, does not invalidate the model but instead highlights the complexity, where numerous variables interact in determining output.

The standard error of the estimate (4.847) represents the average deviation between the observed and predicted milk yield values, indicating some forecast inaccuracy. However, the model remained statistically significant, as shown by the F statistic of 12.834 ($p < .001$). This confirms that the combined independent variables have a significant impact on milk yield per cow.

Furthermore, the residuals showed no alarming autocorrelation, as evidenced by the Durbin-Watson value of 1.861, indicating that the regression's independence of errors assumption was satisfied. This makes the model results more reliable. The results show that, while the model explains a moderate amount of the variability, the combination of loan access, FVV-frequency of veterinary visits, farming experience, farm size, and feed quality considerably affects milk yield per cow. These findings highlight the significance of these elements while also indicating that variation in milk yield may be further explained by

additional variables not included in the model. The table below provides a summary of the regression model's ANOVA test findings.

Table 4.5: Analysis of Variance

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1507.806	5	301.561	12.834	.000[b]
	Residual	9234.190	393	23.497		
	Total	10741.996	398			
a. Dependent Variable: Milk yield per cow						
b. Predictors: (Constant), creditaccessdummy, FVV, Farming experience, Farm Size, Feed quality						

According to the Total Sum of Squares (SS), the overall variation in milk yield per cow was 10,741.996. The residual or unexplained variance was 9,234.190, of which the regression model could explain 1,507.806. These figures show that the model does not account for a significant milk yield variability. The regression's mean square was 301.561, and the residuals were 23.497. This resulted in a highly substantial F statistic ($p < .001$) of 12.834. This indicates that the independent variables—credit access, FVV frequency of veterinary visits, farming experience, farm size, and feed quality—collectively explain a statistically significant variance in milk yield per cow.

The ANOVA results confirm the overall significance of the regression model. According to the significant F statistic ($p < .001$), the model's predictors substantially affect the dependent variable. However, the huge residual variance suggests that changes in milk yield per cow may be significantly influenced by factors not included in the model. The results highlight the significance of variables affecting milk output, such as farm size, feed quality, experience, and credit availability. However, more research that includes more variables

or interaction effects could improve the model's ability to explain phenomena. These findings offer a strong basis for creating focused interventions to alleviate dairy farming's limitations and raise milk yields. The table below presents the regression coefficients for factors hypothesized to affect productivity.

Table 4.6: Regression Coefficients

Coefficients[a]										
		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	4.592	1.616		2.841	.005	1.414	7.770		
	Feed quality	.000	.0000	.255	5.191	.000	.000	.000	.910	1.099
	Farming experience	-.020	.055	-.017	-.367	.714	-.129	.088	.988	1.013
	Farm Size	.942	.578	.077	1.630	.104	-.194	2.078	.969	1.032
	FVV	.030	.020	.073	1.500	.134	-.009	.070	.928	1.078
	creditaccessdummy	2.109	.494	.203	4.270	.000	1.138	3.080	.966	1.036
a. Dependent Variable: Milk yield per cow										

The effects of feed quality, farming experience, farm size, frequency of veterinary visits (FVV), and loan availability on milk yield per cow were investigated using regression analysis. The findings show that feed quality and credit availability are two factors that significantly affect milk output. With a statistically significant t-value of 5.191 ($p < .001$) and a standardized coefficient (Beta) of 0.255, feed quality was shown to be the most crucial variable. This highlights the vital role of adequate nutrition in raising dairy productivity by showing a substantial positive correlation between feed quality and milk yield. With an unstandardized coefficient of 2.109 and a standardized coefficient (Beta) of 0.203 ($p < .001$), loan availability also had a significant impact on milk yield. This suggests that farmers with access to credit produced, on average, 2.109 units more milk per cow than

those without credit. This finding highlights the importance of financial resources in improving farm operations and productivity. Since all Variance Inflation Factors (VIF) values were less than 10, the multicollinearity check revealed no serious problems. The findings highlight the importance of enhancing feed quality and guaranteeing credit availability to increase milk production. At the same time, additional research may be necessary to understand other factors fully. A study conducted in Kinangop Sub-County in Kenya also had similar findings (Ongwech et al., 2020). The study employed a propensity score matching approach to determine whether credit access affected farm income. The study found that farm incomes are highly reliant on credit access because profits come from the ability to buy productivity-enhancing equipment and technologies (Sidika et al., 2023). In a similar study conducted in Trans-Nzoia, access to credit effectively increased farming capacity.

4.3.2. Factors that affect SDFs in accessing credit in Nyandarua County

The table below shows the results for omnibus test conducted to check on the suitability of the independent variables as predictors.

Table 4.7: Omnibus Tests of Model Coefficients

Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	40.253	8	.000
	Block	40.253	8	.000
	Model	40.253	8	.000

The outcomes of the Omnibus Tests of Model Coefficients gave an initial evaluation of the logistic regression model's overall significance. With eight degrees of freedom (df), the model's chi-square value was 40.253, as indicated in Table 4.1. Compared to the null

model, which had no predictors, the model's fit was considerably better with the predictor variables included, as evidenced by the associated p-value (Sig.) being less than 0.001. This result demonstrates that at least one predictor variable helps explain the variance in the dependent variable and that the logistic regression model is statistically significant. This outcome supports more investigation into the individual variables and how they affect the prediction power of the model.

The Model Summary table below provides important metrics for evaluating the overall effectiveness of the logistic regression model.

Table 4.8: Model Summary

Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	512.876[a]	.096	.128
a. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.			

The model's fit to the observed data was shown by its -2 Log Likelihood value of 512.876. Lower values of the -2 Log Likelihood show better model fit because the model more successfully reduces the unexplained variation. Furthermore, the estimation process ended at the third iteration because the parameter estimates stabilized with variations of less than 0.001, suggesting that the model effectively converged.

Two pseudo-R-squared values are shown to assess the model's explanatory capacity. The Nagelkerke R Square and Cox and Snell R Square values were 0.128 and 0.096, respectively. According to these figures, the model's predictors account for between 9.6 percent and 12.8 percent of the variance in the dependent variable. Pseudo-R-square values are a

helpful indicator of the model's efficacy, even if they cannot be directly compared to standard R-square values in linear regression. The comparatively low values found here imply that more predictors or different model specifications could be required to increase explanatory power. The table below shows results for the Hosmer and Lemeshow Test that was used to assess the goodness-of-fit of the logistic regression model.

Table 4.9: Hosmer and Lemeshow Test

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	3.921	8	.864

The results showed a Chi-square value of 3.921, eight degrees of freedom (df), and a non-significant p-value ($p = 0.864$, $p > 0.05$). Since the p-value is not significant, the null hypothesis—stating that the model fits the data well—cannot be rejected. This indicates that the model's predicted probabilities align well with observed outcomes, confirming its suitability for the dataset. These findings support the validity of the logistic regression model, complementing insights from the Model Summary. Using a cut-off probability of 0.500. The classification table below assesses the logistic regression model's accuracy in correctly classifying cases into the two binary outcomes of interest.

Table 4.10: Classification table

Classification Table[a]					
			Predicted		
			ca1		Percentage
	Observed		No	Yes	Correct
Step 1	Credit access	No	121	79	60.5
		Yes	67	132	66.3
	Overall Percentage				63.4
a. The cut value is .500					

Predicted probabilities less than or equal to 0.500 are categorized as "No," while those more than 0.500 are classified as "Yes." The program accurately classified 121 instances as "No" or real negatives based on the data. Seventy-nine cases were mistakenly categorized as "No" when they were actually "Yes," resulting in false negatives. In a similar vein, the model misclassified 67 examples as "Yes" when they were actually "No," indicating false positives, while accurately identifying 132 cases as "Yes," showing true positives. In terms of accuracy, the model achieved a correct classification rate of 60.5 percent for the "No" category and 66.3 percent for the "Yes" category. The overall classification accuracy for the model is 63.4 percent.The table below shows the coefficients and the significance of the variables.

Table 4.11: Table of Coefficients

Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	gend1(1)	-.004	.224	.000	1	.985	.996	.642	1.545
	Age	-.010	.010	1.044	1	.307	.990	.970	1.010
	Farm Size	.058	.251	.053	1	.818	1.059	.648	1.733
	Farming experience	-.004	.029	.022	1	.881	.996	.941	1.054
	le1(1)	-.344	.237	2.114	1	.146	.709	.446	1.127
	maf (1)	1.132	.216	27.491	1	.000	3.102	2.032	4.736
	ms (1)	-.123	.241	.260	1	.610	.885	.552	1.417
	col (1)	.222	.331	.450	1	.503	1.248	.653	2.386
	Constant	-.100	.761	.017	1	.895	.905		
a. Variable(s) entered on step 1: gend1, Age, Farm Size, Farming experience, le1, maf, ms, col.									

The only statistically significant predictor that significantly increases the chance of the outcome among the variables included in the model is maf (1): Membership in the Association of Farmers' group. This predictor is statistically significant ($p<0.001$) and exhibits a substantial positive correlation with credit access (B=1.132). The strength of the effect is confirmed by the odds ratio (3.102), which shows that people who belong to a

farmers' club have a more than threefold chance of obtaining credit, with a confidence interval ranging from 2.032 to 4.736. There are no statistically significant correlations between access to credit and other variables, including gender, age, farm size, farming experience, education (le1), marital status (ms), or loan availability (col). As a result, these variables do not influence credit availability. Even though some variables show slight trends, their confidence intervals include 1, indicating that their impacts are unreliable. The findings on credit accessibility by the research are corroborated by Njiru and Kaibui (2020), who found that in the Githunguri Sub Location in Kiambu County, collateral availability common through peer referrals played a significant role in the overall small-scale farming. According to Njiru and Kaibui (2020), the lack of acceptable collateral and high interest rates were the primary obstacles hindering farmers from obtaining necessary financial services. In Trans Nzoia, Mole and Namusonge (2016) found that collateral value, application procedures, and approval terms influence credit accessibility.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND POLICY IMPLICATIONS

5.1. Introduction

This chapter presents a summary of the findings, a discussion of the results, conclusions, recommendations, study limitations, and suggestions for future research.

5.2. Summary of findings

The study examined the relationship between productivity and credit access among SDFs in Nyandarua County using descriptive statistics, binary logistic regression, and linear regression. The goal was to analyze how credit access influences milk yield and identify factors shaping accessibility. The findings reveal critical insights into the socio-economic and structural aspects of dairy farming in the region.

Demographically, the majority of farmers were young: 52.13 percent were aged 18–40, while 32.08 percent fell within 40–60 years, and only 15.79 percent were above 60. Male dominance was notable, with 63.66 percent of respondents being men. Education levels showed that 40.8 percent had secondary education, 31.33 percent had primary, 22.05 percent had university, and only 2.51 percent had no formal schooling. Most farmers (70.43 percent) were married, and household sizes clustered around three members (23.31 percent). Farming was the main livelihood, with 84.97 percent relying on agriculture, predominantly dairy, though ownership remained small-scale as 98.2 percent kept one to eight cows.

Farm characteristics showed land constraints, with 97.5 percent operating on fewer than five acres, though 90 percent held secure title deeds. Leasing was rare (18 percent). Labor

was split between family and hired help (49.4 percent), while 70 percent worked full-time on farms. Farmers mostly reared hybrid cattle (71.4 percent), while 18 percent kept local breeds. However, diversification into other agricultural activities was common, suggesting dairy alone was insufficient. Indeed, 52 percent reported dairy could not sustain their households. Earnings were especially low, with 77 percent making less than 15,000 shillings per month from dairy activities.

Concerning credit accessibility, the knowledge about credit and credit facilities has not permeated enough into the SDFs of Nyandarua County. About 49 percent of the farmers knew about credit facilities. Of those who knew credit facilities, only 28 percent had credit, and 36 percent had taken loans to facilitate dairy farming. There is difficulty in accessing loans. Combined, 51 percent saw taking a loan as very hard or complicated. Farmers who had credit stated that they acquired it from SACCOs. Commercial banks did not advance loans to farmers, as only 12 percent of farmers indicated that they acquired loans through commercial banks. Farmers see high interest rates as a hindrance to obtaining loans. Eighty-seven stated that the loan interest rate was so high, and the collateral needed in case of a possible default was very costly. Five percent of the farmers indicated that they had used land as security. For credit information, farmers mostly turned to unofficial sources like friends and relatives (65 percent), with government agricultural agents making a negligible contribution (6 percent). Only 5 percent of loans had payback periods longer than five years, while 59 percent were repaid within a year.

Regression analysis revealed that credit access, feed quality, farming experience and membership in the Association of Farmers' significantly influenced milk yield per cow. The

model showed a correlation of 0.375 and an R^2 of 0.14, meaning these variables explained 14 percent of the variation in milk yield. Credit access increased milk production by 2.109 liters per cow, while feed quality was the strongest predictor ($\beta = 0.255$), emphasizing the critical role of nutrition in dairy farming. The results confirm that financial resources enable farmers to purchase quality feeds, improved breeds, veterinary services, and modern production technologies that improve efficiency and output.

The binary logistic regression model revealed that among the variables tested, only membership in farmers' associations had a statistically significant effect on credit access. Farmers who belonged to farmer groups were about three times more likely to obtain credit compared to non-members. This meant that institutional and social capital factors, particularly farmer group membership, are more important than individual characteristics in determining credit access among SDFs in Nyandarua County.

5.3. Conclusions

The first objective of the study was to evaluate the effect of credit access on the productivity of SDFs in Nyandarua County. The regression analysis showed that access to credit significantly improved dairy productivity, with farmers who had access to credit producing milk yields that were on average 2.109 liters higher than those without access. This finding underscores the critical role of financial resources in enhancing productivity. Farmers with access to credit are able to invest in improved feeds, veterinary services, and modern farming practices, which in turn raise their output levels. In addition, credit access indirectly

supports farming activities by enabling farmers to access complementary services and technologies that would otherwise be unaffordable. Thus, credit access is both a direct and indirect driver of dairy productivity.

The second objective sought to examine the factors influencing SDFs' access to credit. Results from the binary logistic regression indicated that membership in farmers' SACCOs was the only significant determinant of credit access. Farmers who belonged to SACCOs were nearly three times more likely to obtain credit compared to their non-member counterparts. This suggests that SACCO membership serves as a form of social and financial capital that improves farmers' credibility and bargaining power with lenders. By pooling resources and mitigating default risks, SACCOs act as effective intermediaries between farmers and credit providers, tailoring financial products to members' agricultural activities and repayment capacities. The findings, therefore, highlight the central role of cooperatives in improving financial inclusion and supporting the credit needs of SDFs in Nyandarua County.

5.4. Recommendations

From the research findings and the corroborating literature, the research recommendation would be that stakeholders strengthen farmer associations. From the results, farmers within their associations are more informed and more likely to access credit. The study found that in Nyandarua, being a member of a farming association can influence creditworthiness, which is an eye-opener and could mean the same for all farmers across Kenya. On the part of the financial institution, there is a need for reforms in the collateral policies. Most SDFs have tiny land or heavily depend on the land, which they must put as collateral. Developing

flexible lending criteria that accommodate the unique circumstances of the farmers would suffice as reasonable. Policymakers should rein in financial service providers to issue loans that align with the law. There must be a distinction between commercial loans and specific agricultural loans. The rates should be based on a particular determined level of productivity.

5.5. Suggestion for future study

Given the limitations of the study, the recommendation for future research would be to conduct a longitudinal study on the same or similar variables. Expanding the geographical scope is also a good way of covering all the information needed. A comparative study would also suffice in understanding regional differences in credit access and dairy farming practices. Granted that farmers do not necessarily take credit from SACCOs, future research should assess credit models such as mobile-based lending, government-backed loans, and microfinance institutions.

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APPENDIX I: QUESTIONNAIRE

Questionnaire

Dear respondent,

My name is Lilian W. Kiarie, and I am a Kenyatta University Master of Economics student studying loan availability among small-scale dairy producers in Nyandarua County. This study aims to examine the ways in which Nyandarua County's smallholder dairy producers get loans. You have been chosen at random to take part in the research as a smallholder dairy farmer in the County. The findings and recommendations of this study will be utilized in the formulation of government policies to improve the productivity of the dairy sector. All collected data will be kept private and utilized exclusively for educational purposes. I sincerely hope you will be willing to help in this study.

Please tick (√) where appropriate and do not write your name in the questionnaire. If any question is unclear, please seek clarification. Thank you.

SECTION A: SOCIAL DEMOGRAPHICS

1. Gender

   Female ☐ Male ☐

2. Age bracket

   18 to 40 ☐ 40 to 60 ☐

   60 and above ☐

3. Your marital status

   Single ☐ Married ☐

   Widowed ☐ Divorced ☐

4. Your level of education

No education ☐ Primary ☐

Secondary ☐ University ☐

Adult education ☐

5. Size of household (Everyone in the home sharing meals, including the responder).

Age	Male	Female	Total
Below 18			
18 to 40 years			
40 to 60 years			
60 years and above			

6. Your sources of income

Employment ☐ Farm income ☐

Other business incomes ☐

SECTION B: FARM CHARACTERISTICS

I. How many dairy cows do you have?

1 to 8 ☐ 9 and above ☐

II. For how many years have you practiced dairy farming?

Below 6 years ☐ 6 to 14 years ☐

Over 14 years ☐

III. Size of the arable land

Small-up to five acres ☐

Large-over five acres ☐

IV. What is your current form of land tenure?

Lease ☐ Owner ☐

V. Ownership of title deed

Yes ☐ No ☐

VI. What is your source of labor on the farm?

Hired labour ☐ Family ☐

Both ☐

VII. How much time do you spend on the farm?

Part-time ☐ Full time ☐

VIII. Which type of cattle breeds do you rear?

Local breeds ☐ Crossbreeds ☐

Hybrids; Friesian ☐

Ayrshire ☐

Jersey ☐

Guernsey ☐

IX. Do you practice any other form of farming?

Yes ☐ No ☐

If the answer to question (IX) above is No then, kindly answer the following questions

X. What is the approximate income that you get from dairy farming every month?

0 to 15,000 ☐ 15,000 to 25,000 ☐

25,000 to 35,000 ☐ Over 35,000 Shillings ☐

XI. Does dairy farming sustain your household?

Yes ☐ No ☐

XII. What is the approximate cost of dairy farming on your farm?

Less than 1000 ☐

Between 1000 and 20000 ☐

Over 20000 ☐

SECTION C; LOAN ACCESSIBILITY

A. Do you possess access to credit data?

Yes ☐ No ☐

B. Do you have credit currently?

Yes ☐ No ☐

C. Have you ever taken a loan to finance Dairy farming activities?

Yes ☐ No ☐

D. How much time did the payback period last?

i. Less than 6months ☐

ii. 1 year ☐

iii. 2-5 years ☐

iv. Above 5 years ☐

E. Was it from the same financier?

Yes ☐ No ☐

If the answer to question (E) above, kindly give a reason for the change of financier.

……

……

……

F. Describe the process of obtaining credit from the financier

Very Hard ☐ Hard ☐

Easy ☐ Very Easy ☐

G. Which of the following institutions finances your credit?

Commercial banks ☐ Friends and family ☐

SACCO ☐ Agricultural Finance Corporation ☐

Profits from the Business ☐

H. Which of these factors influenced your choice of financier?

Collateral ☐ Interest rate ☐

Repayment period ☐ Loan review period ☐

Repayment flexibility ☐

I. Briefly explain how the above credit attribute affected the choice of your financier.

……

……

……

J. What are the primary obstacles you face while applying for credit?

……

……

……

K. Which source provided information on the lending institution that was available?

i. Family and friends ☐

ii. Media and public agricultural forums ☐

iii. Learning institutions ☐

iv. Agriculture extension officers ☐

L. Have you ever used your land (if you own it) as collateral for an agricultural loan?

Yes ☐ No ☐

M. Was the size of the land proportional to the amount of the loan you got?

Yes ☐ No ☐

N. Are you aware of the current interest charged on agricultural credit?

Yes ☐ No ☐

O. If yes, what do you think about them?

Low ☐ Relative ☐

High ☐ Very High ☐

P. Can the amount of interest charged on agricultural credit influence whether you will ask for a loan or not?

Yes ☐ No ☐

Q. What are some of the farm implements (that you currently have) that you could use as loan security?

Processing Machinery ☐ Tractor ☐

Vehicle ☐ Hand implements ☐

Hired machinery ☐

SECTION D: FARMER INFORMATION

a. Do you belong to any farmers' unions/SACCO/cooperatives?

Yes ☐ No ☐

b. Are you in a leadership role within the Farmers Union?

Yes ☐ No ☐

c. If yes, specify the position

……

.

d. What are the costs and benefits of belonging to a farmer's union?/SACCO,/Cooperative?

Costs……

……

Benefits……

……

e. How often does the Ministry Veterinary officer visit your farm?

i. Weekly ☐ ii. Monthly ☐

iii. Quarter yearly ☐ iv. Half-yearly ☐

v. Never visited ☐

f. What is each cow's typical daily milk output on your farm? ☐ (Specify in liters) ☐

g. What is the highest milk yield per cow you have recorded in a day? ☐ (Specify in liters)

h. What is the lowest milk yield per cow you have recorded in a day? ☐ (Specify in liters)

i. What types of feed do you provide to your dairy cows? (Check all that apply)

a. Napier grass ☐

b. Maize silage ☐

c. Hay ☐

d. Concentrates ☐

e. Minerals and supplements ☐

f. Other (please specify) ☐

ii. Where do you obtain your feed? (Check all that apply)

a. Own farm ☐

b. Local market ☐

c. Feed suppliers ☐

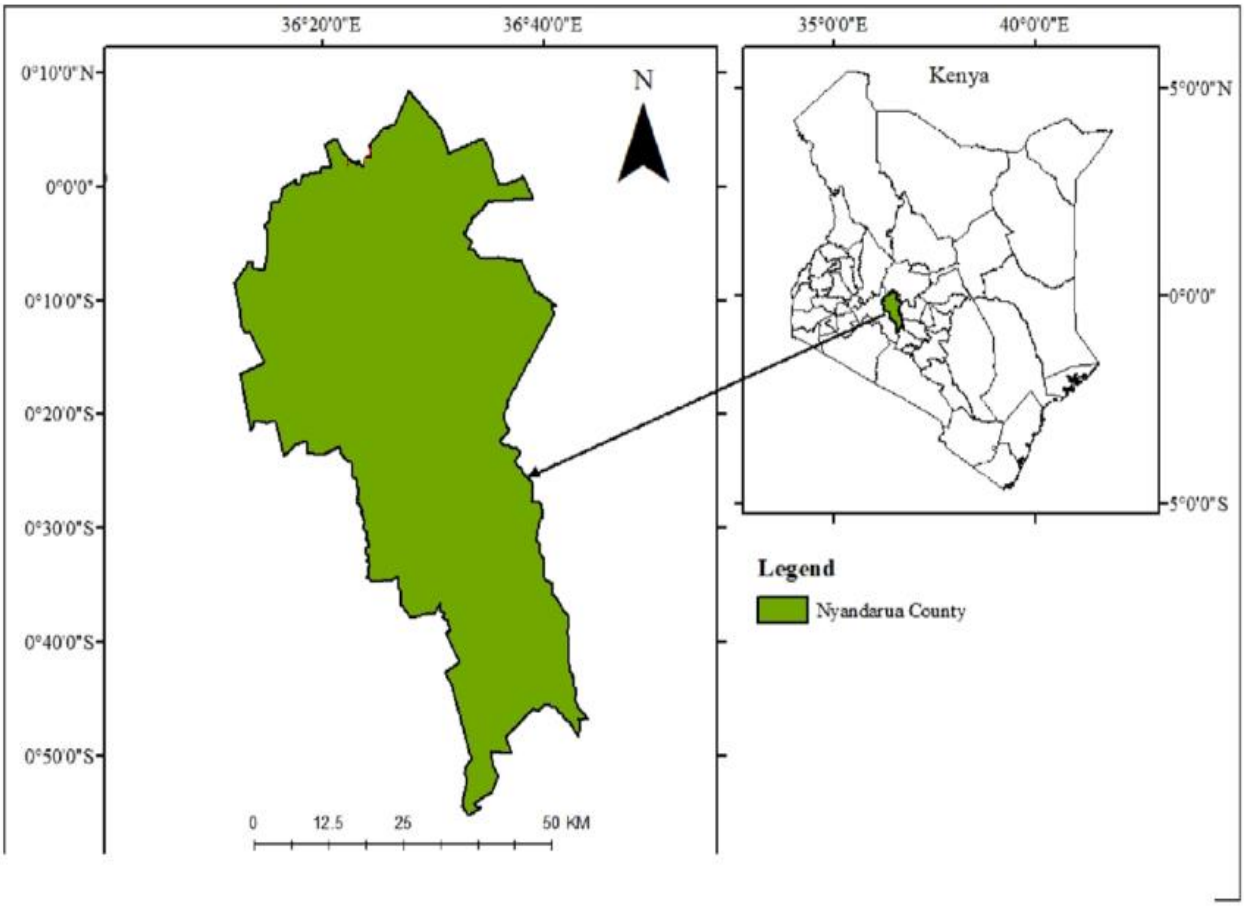
d. Cooperative society ☐

e. Other (please specify) ☐

- Do you grow any of the feed on your farm? Yes ☐ /No ☐
- If yes, what types of feed do you grow?.....

Thank You. The End

APPENDIX II: MAP OF NYANDARUA COUNTY



APPENDIX III: STATA OUTPUT

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.375[a]	.140	.129	4.847335995444213	.140	12.834	5	393	.000	1.861

a. Predictors: (Constant), creditaccessdummy, FVV, Farming experience, Farm Size , Feed quality

b. Dependent Variable: Milk yield per cow

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1507.806	5	301.561	12.834	.000[b]
	Residual	9234.190	393	23.497		
	Total	10741.996	398			

a. Dependent Variable: Milk yield per cow

b. Predictors: (Constant), creditaccessdummy, FVV, Farming experience, Farm Size, Feed quality

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	4.592	1.616		2.841	.005	1.414	7.770		
	Feed quality	.000	.0000	.255	5.191	.000	.000	.000	.910	1.099
	Farming experience	-.020	.055	-.017	-.367	.714	-.129	.088	.988	1.013
	Farm Size	.942	.578	.077	1.630	.104	-.194	2.078	.969	1.032

	FVV	.030	.020	.073	1.500	.134	-.009	.070	.928	1.078
	creditaccessdummy	2.109	.494	.203	4.270	.000	1.138	3.080	.966	1.036

a. Dependent Variable: Milk yield per cow

$$Milk\ yield\ per\ cow$$

$$= 4.592 + 0.00216feedquality - 0.02farmingexperience$$

$$+ 0.942farmsize + 0.030veterinaryvisit + 2.019creditaccess$$

Assuming a unit increase in all independent variables and credit access to farmers, the milk yield per cow would be as follows;

$$Milkyieldpercow$$

$$= 4.592 + (0.00216 \times 1) - (0.02 \times 1) + (0.942 \times 1) + (0.030 \times 1)$$

$$+ (2.019 \times 1) = 7.56516$$

Assuming a unit increase in all independent variables and no credit access to the farmer, the milk yield per cow would be as follows;

$$Milkyieldpercow$$

$$= 4.592 + (0.00216 \times 1) - (0.02 \times 1) + (0.942 \times 1) + (0.030 \times 1)$$

$$+ (2.019 \times 0) = 5.54616$$

So, on average, farmers with credit access had 2.09 liters more milk yield than those without credit access. The impact of credit access is an increase of 2.09 litres in milk yields.

Factors that affect SDFs in accessing credit in Nyandarua County

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	40.253	8	.000
	Block	40.253	8	.000
	Model	40.253	8	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	512.876[a]	.096	.128

a. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	3.921	8	.864

Classification Table[a]

Observed			Predicted ca1 No	Predicted ca1 Yes	Percentage Correct
Step 1	Credit access	No	121	79	60.5
		Yes	67	132	66.3
	Overall Percentage				63.4

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	gend1(1)	-.004	.224	.000	1	.985	.996	.642	1.545
	Age	-.010	.010	1.044	1	.307	.990	.970	1.010
	Farm Size	.058	.251	.053	1	.818	1.059	.648	1.733
	Farming experience	-.004	.029	.022	1	.881	.996	.941	1.054
	le1(1)	-.344	.237	2.114	1	.146	.709	.446	1.127
	maf(1)	1.132	.216	27.491	1	.000	3.102	2.032	4.736
	ms(1)	-.123	.241	.260	1	.610	.885	.552	1.417
	col(1)	.222	.331	.450	1	.503	1.248	.653	2.386
	Constant	-.100	.761	.017	1	.895	.905		

a. Variable(s) entered on step 1: gend1, Age , Farm Size , Farming experience, le1, maf, ms, col.