# SMALLHOLDER DAIRY FARMERS' TYPOLOGIES, COLLECTIVE ACTION, AND COMMERCIALISATION IN KENYA

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# Smallholder Dairy Farmers' Typologies, Collective Action, and Commercialisation in Kenya

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## DECLARATION

This thesis is original work and has not been presented for a degree in any other University.

Signature……. Date: …….

**Geoffrey Ochieng' Otieno**

This thesis has been submitted for examination with our approval as University Supervisors.

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## DEDICATION

I dedicate this work to my late parents, Mr. Joshua Otieno and Mrs. Sophia Aoko. May their souls rest in peace.

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| **AI** | Artificial Insemination |
| **ASDSP** | Agricultural Sector Development Support Programme |
| **ATE** | Average Treatment Effect |
| **CA** | Cluster Analysis |
| **COOP** | Cooperative Society |
| **FAO** | Food and Agricultural Organisation |
| **FBO** | Farmers Based Organisations |
| **GDP** | Gross Domestic Product |
| **Ha** | Hectare |
| **IFCN** | International Farm Comparison Network |
| **ILRI** | International Livestock Research Institute |
| **IMR** | Inverse Mills Ratio |
| **JKUAT** | Jomo Kenyatta University of Agriculture and Technology |
| **KDB** | Kenya Dairy Board |
| **KMO** | Kaiser-Meyer-Olkin |
| **KSh** | Kenya Shillings |
| **MFI** | Micro Finance Institution |
| **MoALF** | Ministry of Agriculture Livestock and Fisheries |
| **NGOs** | Non-Governmental Organisations |
| **NIE** | New Institutional Economics |
| **OLS** | Ordinary Least Squares |
| **PCA** | Principal Components Analysis |
| **PSM** | Propensity Score Matching |
| **RoK** | Republic of Kenya |
| **SACCO** | Savings and Credit Cooperative Organisation |
| **SAPs** | Structural Adjustment Programmes |
| **SHG** | Self Help Group |
| **SSA** | Sub-Saharan Africa |
| **USAID** | United Stated Agency for International Development |

## ABSTRACT

Smallholder farmers in Kenya are the majority players in the dairy sector and need consideration in generation of policies to improve economic performance. The problem is smallholder dairy farmers in Kenya have continued practising subsistence farming without transitioning to commercial enterprises, hence the observed poor economic status. The objective of this study was to analyse smallholder dairy farming typologies, collective action, and commercialisation in Kenya. The study was conducted in Nyandarua and Nakuru counties, where there are a large number of smallholder dairy farmers. The study used a multistage sampling technique to select a random sample of 380 dairy farmers. Structured questionnaires and focus group discussions were the tools for data collection. The data was analysed using principal component analysis, cluster analysis, propensity score matching, and household commercialisation index models. The results showed that there were three significantly different types of smallholder dairy farmers i.e. low resource endowed and low market oriented, moderate resource endowed and moderate market oriented, and high resource endowed and high market oriented. The distinguishing factors for these dairy farming typologies were output, land, household assets, and infrastructure. Resources, capital, infrastructure, and extension service related challenges characterised the smallholder dairy sector. The majority of the smallholder dairy farmers practiced collective action, with most being in self-help groups. Farmers joined groups depending on group leadership, education of leaders, leadership period, age of group, conduct of members, and execution of rules and regulations. Factors that affected group performance were type of group, gender of leaders, motivation to leaders, approach to absenteeism, years of group existence, and the reasons for lending to the group members. The study revealed moderately high level of commercialisation in the study area even though there was low level of commercialisation in Nakuru County compared to Nyandarua County. Major constraints to smallholder dairy commercialisation included poor quality and quantity of inputs, low output prices, poor dairy related infrastructure, and inadequate extension services. The study concluded that milk production was relatively low among the farmers, who were heterogeneous in demographic and socio-economic characteristics. There was moderate farmer group membership in the study area, and also a substantial increase in milk sales for farmers who belonged to groups. Even though farmers practised commercialization, the levels varied across the study area. The study proposes a revision of policies to improve land accessibility, feed availability, extension, physical infrastructure, financial resources, and technological innovations, which are important to improve dairy production. The policies need to be accustomed to the needs of smallholder dairy farmer typologies. Farmer groups membership need to be emphasised to address the challenges of production and marketing. Policies should focus on group sensitisation and capacity building. Deliberate efforts should be made to improve group membership and management for sustainable cooperative mentality among members. Smallholder dairy commercialisation needs improvement in marketing infrastructure, adequate and quality marketing information and institutional support to lower the transaction costs.

# CHAPTER ONE

# INTRODUCTION

## 1.1 An Overview of World Dairy Economics

Internationally, around 118 million farms keep dairy cattle (IFCN Dairy Research Network, 2019). Sixty-five percent of these farms are situated in Sub-Saharan Africa (SSA), South Asia, Eastern Europe and Central Asia (FAO, GDP, & IFCN, 2018). In 2019, the global dairy production estimation was 859 million tonnes, which was an improvement of 1.9% over the previous year. This increment resulted from increased number of dairy stock, improved productivity per cow, collection processes, and production efficiency (FAO, 2019; Bedford *et al.,* 2019). Productivity in some countries however has decreased due to reduced farms, low profitability levels, and low farm gate prices (FAO, 2019). World dairy trade grew to 1.3 million tonnes in 2019 at a growth rate of 1.8%, this being significant drop from the growth rate of 2.8% estimated for 2018 (Bedford *et al.,* 2019). The world dairy sector has also exhibited high unpredictability in farm gate prices. FAO Dairy Price Index Worldwide indicated that in 2018, all dairy prices declined by approximately 4.6% compared to 2017 (FAO, 2019). Unpredictable weather, drought, floods, and diseases, which result in volatility of price, milk yield, and cow inventory, have constrained the world dairy sector. The sector also faces constraints at the farm level, especially those occasioned by management (FAO & OECD, 2018).

Sub-Saharan Africa (SSA) is characterised by low-income livestock producers. Dairy production is by mixed crop-livestock systems and varies from low farming input use, extensive grazing, to more specialised intensive enterprises (Mcdermott *et al.,* 2010). Other than South Africa, other countries in Africa report low outputs and struggle to meet domestic milk demand (Nyameasem *et al.,* 2013). Milk produced is for consumption at home or sale at local markets, with only 5% being commercialised (USAID, 2013). The estimation for Africa dairy production in 2018 did not change significantly from the production of 2016 (FAO, 2018). An analysis of dairy production

data during the same period, however, showed a decrease of 8.1% for Africa. This reflected a 0.74% annual decrease rate for Africa. This decline was partially due to the negative impact of climate change on animal feeds as most of dairy farmers depend on rain fed feeding systems for their production. Deterioration of genes accountable for dairy output could also explain this observation (Hidosa & Guyo, 2017; Safefood, 2017; Angel *et al.*, 2018). Low dairy production in SSA has led to increased importation of dairy products by many countries to supplement their domestic supplies (Linh *et al.*, 2019).

In SSA, a large number of local breeds, with low milk-yielding capacity, dominate the dairy sector (USAID, 2013). Dairy productivity varies depending on the location, socio-economic settings, and agro-ecological zone (Ndambi *et al.*, 2008; Gizaw *et al.*, 2016; Bosire *et al.*, 2019). The majority of farm sizes are less than two hectares (Bosire *et al.*, 2019; Lowder *et al.*, 2016). Low nitrogen and high fibre content of natural pastures and crop residues, which are the major sources of dairy nutrition, limit animal productivity. The low dairy productivity worsens when pastures, cereal residues, and maize stover are limited especially during the dry season (Maleko *et al.*, 2018). Farmers also have low credit worthiness posing challenges to financial and credit accessibility, thereby limiting their dairy productivity (Linh *et al.*, 2019; Chandio *et al.*, 2017).

### 1.2 An Overview of Kenyan Dairy Sector Economics

Kenya's dairy sector is one of the largest and most successful in Africa. The sector is dynamic and critical to the country’s economy, contributing to rural livelihoods in addition to food and nutrition security. Table 1.1 shows the various contributions of the dairy sector in Kenya.

**Table 1.1: Overview of Economic Contribution of the Kenyan Dairy Sector**

| Indicator | Estimated Value |
|---|---|
| Dairy contribution to the overall gross domestic product (GDP) | 4 – 8% |
| Dairy contribution to agricultural GDP | 14% |
| Dairy contribution to the livestock sector output | 40% |
| Annual growth rate of dairy by product volume | 3.5% |
| Total annual milk production from all livestock (2011) | 5.2 billion litres |
| Total annual milk production (cows) 2014 | 3.9 billion litres |
| Average milk yield (litres) per cow per day | 7 – 8 litres |
| Amount (litres) of raw milk produced by smallholder dairy farmers | 80 – 90% |
| Raw milk marketed through informal small business enterprise channel | 84% |
| Processed milk volumes in 2016 (excluding ATM/mini-processing) | 625 million litres |
| Number of jobs at farm level, mostly family farm labour | 1.2 million |
| Direct waged employment | 0.5 million people |
| Jobs created in dairy support services | 0.75 million people |

Adapted from Kilelu *et al.* (2018)

The dairy sector value chain comprises of input and services suppliers, farmers, transporters, traders, dairy farmers' cooperative societies, milk processors, distributors, and retailers. Increase in domestic milk production (5.3% per year), processing capacity (7% per year), and per capita consumption of milk (5.8% per year) are the basis for dairy sector growth. The annual mean per capita consumption of milk is 115 litres per person. It is anticipated to grow to 220 litres per person per year by 2030 as a result of improved incomes and marketing (Rademaker *et al.*, 2016). Milk demand and value-added dairy products grow by approximately 5.8% annually. This growth rate is associated with strong tradition of milk in diets, growing urbanisation, an increase in middle class, and export prospects. By the year 2030, Ministry of Agriculture Livestock and Fisheries

(MoALF), through the *Kenya National Dairy Master Plan* endeavours to improve the per capita milk consumption to 220 litres annually (MoALF, 2010).

The informal sector is predominant in milk trading in Kenya with about 75% of milk being traded outside the processing sector. Milk sold aggregates to 55% of the total production whereas milk consumed at home and fed to calves account for 45%. The bulk (88%) of the marketed milk is sold directly to consumers through informal market channels as raw fresh milk. The dairy sector continues attracting both domestic and international private investors. It is however mostly characterized by non-compliance with the regulatory safety and quality standards and collection of statutory revenues in the informal marketing channels (Nyokabi *et al.,* 2018; Roesel & Grace, 2015). Kenya's dairy sector has a huge export opportunity in Eastern and Southern Africa regions (Reardon *et al.,* 2015).

Four themes that explain the dairy sector are land size, wealth, commercialization, and the degree of risk and vulnerability. A smallholder farmer is one with limited capital, low quantity and quality of land, inadequate skills and labour, inappropriate technology, survival oriented, and highly risk prone. Although all these dimensions of smallness may not occur simultaneously to a farmer. The major limitations in Kenya's milk production and marketing include seasonality in production and inadequate quantities of animal feeds characterized by low quality and limited feed supplements. Other factors are inefficient animal husbandry and farm management, poor animal breeding services, poor animal welfare, limited access to credit services, and high cost of artificial insemination (AI) services. Most dairy production areas also have to contend with poor roads and electricity infrastructure, inadequate milk collection and marketing systems, poor research priority and dissemination, extension and training, and limited involvement of farmers in the output markets (Joshua & Augustine, 2018; Benard, 2016; Rademaker *et al.,* 2016).

### 1.3 Subsistence Characterisation of Smallholder Dairy Farming in Kenya

Smallholder farmers are the majority in the dairy sector in Kenya. They predominantly practice subsistence agriculture and do not realize income benefits occasioned by formal market system participation (Hazell *et al.*, 2020). As the economic environment becomes more dynamic, new challenges emerge compromising the capability of subsistence to sustain livelihoods (Pingali, 2015; Zhou *et al.*, 2013). The new environment characterised by increasing population, urbanisation, income, globalisation, policy changes, technology, food industry reform, and climate change calls for transformation of subsistence farming (Barrett, 2008; Pingali & Aiyar, 2018).

Subsistence dairy farming closely links to low level of economic development. The practice is characterised by limited use of purchased input and low dairy productivity per land size and/or per labour. The term subsistence could mean traditional, small-scale, peasant, low income, resource-poor, low-input, or low technology farming (Abele & Frohberg, 2003). Subsistence dairy farming is inefficient in resource use due to several reasons. First, priority is to satisfy subsistence needs, implying forfeiture of comparative advantage benefits such as labour division and specialisation, resulting in poor standards of living. Secondly, formal credit and external inputs are rarely applicable in subsistence production. Hence, lack of basic technologies, poor entrepreneurship, and minimal specialisation keep land and labour production low. Thirdly, dairy market supplies are available only if there are surpluses from subsistence production. Surpluses occur mainly in good harvest seasons. Subsistence agriculture, therefore, cannot provide a continuous supply of dairy products. Such production patterns could trigger price instability of dairy products. Fourth, subsistence agriculture manifests low uptake of policies and it is therefore difficult for developmental policies to influence them. Subsistence dairy farming is also reflected in the lack of machinery and credit inaccessibility due to collateral requirement by funding agencies and high transaction costs (Kislev, 2001). There is therefore need for transformation of smallholder dairy farming.

Smallholder dairy transformation would be achieved through commercialisation, which entails shifting production practices from subsistence to market orientation (Mbowa *et al.,* 2012; Omore *et al.,* 2015). Smallholder commercialisation is a pillar to household livelihoods, a foundation for rural improvement and poverty reduction, and a crucial path to economic growth (Muriithi & Matz, 2015). Subsistence oriented smallholders need to commercialise in order to sustain growth in demand and benefit from the resulting revenues (Kirsten *et al.,* 2013; Rubhara *et al.,* 2019; Dube & Guveya, 2016). Commercialisation of smallholder dairy farming would lead to value addition to commodities, local and international market accessibility, improved welfare and living goals, exportation and input usage, increased incomes, food security, additional prospects for rural employment, and accelerated agricultural growth (Fredriksson *et al.,* 2016).

### 1.4 Smallholder Dairy Transformation: From Subsistence to Commercialisation

Agricultural commercialisation arises when agricultural enterprises depend on the market for the sale of produce and for the purchase of production inputs. Commercialisation requires an environment of market transformation, infrastructure development, and improved legal and contractual environment in which farmers and processors coexist (Fischer & Qaim, 2014). Technological changes in farming, improvement of market infrastructure, effective integration of farms into cooperative schemes, attention to land tenure and allocation problems are critical aspects that have been identified for transformation of farming from subsistence to commercialisation (Abele & Frohberg, 2003; Fan *et al.,* 2013). This study focused on the effective integration of the small household farm into cooperative arrangements (hereafter referred to as Collective Action) as an avenue for the shift from subsistence to commercialisation. Theory and experience suggest that collective action establishments make up for failure in markets. Market failure occurs when private entrepreneurs fail to operate efficiently and equitably leading to farmers not realising their economic desires (Lerman & Sedik, 2009). Collective action solves the problems of smallholders by

granting individual farmers the benefits of collective operational economies including access to supplies, markets, and achievement of market power through size.

Collective Action is a voluntarily undertaking by a group of individuals to achieve common objectives and is useful in farming and agricultural production (Fischer & Qaim, 2014; Roelants & Salvatori, 2018). Cooperative organisations for instance have sustained family farms in developed countries by addressing issues related to farm size and bargaining power (Giagnocavo *et al.,* 2018). In developing countries, family farms are constrained by several forms of market failure, which are specifically severe in areas with poor roads and other communication infrastructure. Smallholders in these areas endure high transaction costs that significantly compromise their motivations for market involvement (Poulton *et al.,* 2010; Fischer & Qaim, 2014). Collective Action as a strategy has become instrumental in keeping smallholders competitive in rapidly changing markets in developing countries and is a possible institutional solution for overcoming high transaction costs and other failures in markets (Fischer & Qaim, 2014).

Promotion of Collective Action among farmers has of late gained prominence around the globe in the context of the agro-food system transformation to commercialisation (Dias Pereira, 2018; Chlebicka & Pietrzak, 2018). Cooperation leads to efficient use of resources and optimisation of farm production gains in addition to benefits of economies of scale (Fischer & Qaim, 2012). Expectation of higher returns is the motivation for a farmer to join a cooperative (Gezahegn *et al.,* 2018). A sound appreciation of useful and viable conditions for effective Collective Action is however necessary because farmer groups do not always succeed (Fischer & Qaim, 2014; Poulton *et al.,* 2010). Farmer organisations at times incur high transaction costs that justify individuality in operations (Hellin *et al.,* 2009). Crucially, low participation of members in joint initiatives compromises the viability and successfulness of a group.

## 1.5 Statement of the Problem

In Africa, smallholder farmers account for the overwhelming majority and should be central in any development policy agenda (Diao *et al*., 2010). Smallholder farmers in Africa operate in difficult environments with very few purchased inputs, inadequate credit access, high transaction costs, imperfect competition and inconsistent public policy (Steve, 2013). Studies by Muriithi and Matz (2014); Kirsten *et al.* (2013) indicated the need to develop agricultural production with commercialisation orientation to achieve increased household income and food security. In Kenya, the problem is that smallholder dairy farmers have continued practising subsistence farming with only few transitioning to commercial enterprises, hence the observed poverty levels. Deficiency in input acquisition and use, inadequate enterprise and product management, and inappropriate post-production activities explains this observation. The markets smallholder dairy farmers operate in persistently exhibit high transaction costs, inadequate production, poor market information flows, and inadequate institutional developments (Mbeche & Dorward, 2014).

Agricultural commercialisation is a critical catalyst for fast-tracking transformation, sustainable growth, and development thereby reducing poverty (Agwu *et al.*, 2013). To free farmers from poverty and enable them contribute to economic growth, there is need for infrastructural improvement, education, technology, and producer and marketing organisations to link them to market chains (Diao *et al.,* 2010). Several studies have fronted collective action in form of farmer group as a means of transformation of farming from subsistence to commercialisation. Farmer groups operate on the assumption that individual farmers have shared goals and aim at finding solutions to common challenges (Markelova & Mwangi, 2010).

## 1.6 Objectives of the Study

The critical inquiry of this study was to analyse the smallholder dairy farming typologies, collective action, and commercialisation levels in Kenya. The specific objectives of the study were:

1. To characterize smallholder dairy farming typologies and the socioeconomic factors determining the typologies;
2. To assess smallholder dairy collective action and its socioeconomic determinants;
3. To determine the level and the determinants of smallholder dairy commercialization

## 1.7 Research Hypotheses

The study sought to test the following hypotheses:

1. Smallholder dairy types do not differ in characteristics, and socioeconomic factors do not affect the types of smallholder dairy farming;
2. There are no variations of collective action, and socioeconomic factors do not affect collective action among smallholder dairy farmers;
3. There are no variations in the levels of smallholder dairy commercialization, and there are no socioeconomic factors affecting smallholder dairy commercialization.

## 1.8 Justification of the Study

In Kenya, knowledge on smallholder dairy farm management, production, and commercialization is still inadequate. Through a holistic approach, the dairy sector has potential for growth and success. The study therefore focused on smallholder dairy farmers with the goal of improving their productivity and commercialization. It aimed at enhancing accessibility and efficient use of economic and social resources by the

smallholder dairy farmers. This would increase their engagement by reducing transactional costs, in addition to improving dairy commercialization. Moreover, the study looked into factors that would motivate smallholder dairy farmers to join groups, by analysing differences in economic performance between those enjoined to groups and those operating individually. The study also highlighted intervention points for government policies and research for development to improve the dairy subsector's performance in the economy. Finally, the study made valuable contribution to the ongoing academic research for development in the field of New Institutional Economics (NIE) in agriculture and agribusiness.

### 1.9 Organisation of the Study

The thesis is organised in eight chapters. Chapter I presents the background of the dairy subsector in Kenya, statement of the problem, main and the specific objectives, research hypotheses and significance of the study. Chapter II provides the conceptual foundational on which the study objectives are based. The chapter also presents a summary of selected prior studies relevant to the study. Chapter III covers the theoretical foundations, research methodology, and empirical tools applicable to the study. The chapter provides econometric specifications and hypothesis testing of the proposed analytical procedures. The chapter also details data collection methods, data types, and the analytical models for the study. Chapter IV provides an in-depth socioeconomic description of the smallholder dairy farmers in the study area. Chapter V focuses on smallholder dairy farmers' typologies. It explains the predominant smallholder dairy farm types and their descriptions in the study area. It also discusses factors that affect smallholder dairy farming types. Chapter VI discusses smallholder dairy Collective Action. It focuses on the level of smallholder dairy Collective Action and finally the factors affecting the initiative. Chapter VII focuses on assessment of socioeconomic structure, level, and determinants of smallholder dairy commercialisation. Chapter VIII provides a summary of the study findings, conclusions, and policy recommendations.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Introduction

This chapter reviews relevant literature and the conceptual frameworks that form the basis of empirical and descriptive analysis for the study. It provides the foundational economic concepts, which are the basis of the study objectives and hypotheses presented in Chapter 1. The chapter also presents the conceptual framework used by the researcher to analyse the empirical data collected for the economic concepts used. Finally, the section also provides a summary of selected prior studies of similar economic concepts.

## 2.2 Farming Characterisation

Farming classification is useful in deciding and implementing defined and operational policy options. Farm typology appreciates the uniqueness of each farmer. Ojiem *et al.* (2006) explained that farmers variations are due to a host of factors including biophysical (soil fertility, climate, slope, among others) as well as socioeconomic (preferences, production objectives, prices, among others). Farmers also vary in terms of limitations during their farming operations. Even though farmers and farms are distinctive in nature, grouping them in different categories is possible. Classifying farms is important for assessment of limitations and prospects of the farmers, and helps in designing of relevant technical solutions and policy interventions (Vanclay, 2005). Classification is also useful in comprehending the factors explaining adoption or non-adoption of new technologies (Mahapatra & Mitchell, 2001). Institutions such as markets and agencies, farm resources like labour and cash, technological level, and organisation practices have been studied and used by researchers to categorise farms (Tittonell *et al.,* 2006; Tittonell *et al.,* 2007; Tittonell & Giller, 2013; Tittonell *et al.,* 2005). Besides, combination of factors have also been used by other researchers to explain heterogeneity of farming systems (Ojiem *et al.,* 2006; Goswami *et al.,* 2014;

Tittonell *et al.*, 2010; Guto *et al.*, 2012). Factors defining farm typology therefore differ critically from study to study.

### 2.2.1 Conceptual Framework for Farm Characterisation

Studies have used less of economic factors in classifying smallholder farms (Briggeman *et al.*, 2007; Andersen, 2009). At the micro level, farmers' grouping would facilitate technological solutions and extension support. Research and extension patterns suggest that farmers operating in similar conditions should have common appropriate recommendation domains (Harrington & Tripp, 1985). This will result in informed decisions and incorporation of better technology in smallholder arrangements. A description of farm typologies is useful for rapid dissemination of applicable extension support, technology, and development of a policy environment that is sufficient for diversity in smallholder farms.

According to Radulovic (2005), recent focus on institutions for economic growth has embraced the study of appropriate technology and skill transfer. New Institutional Economics (NIE) explicitly considers an institutional plan which reduces transaction costs while improving economic effectiveness (Birner, & Anderson, 2007). Nevertheless, the application of NIE usually centres on financial limitations, institutional development, and markets (Pal *et al.*, 2003). Therefore, an approach for characterising the types of smallholder farms for specific policy directive and technological intervention is useful for institutional arrangements. This will reduce the cost of transactions in smallholder agriculture through relevant technology.

### 2.2.2 Prior Studies on Farm Characterisation

Birner and Anderson (2007) conducted a study on how to make the agricultural extension focus on the needs of all farmers in India. The study reviewed market, policy framework inadequacies, and the community failures for the current extension services in the subcontinent. Three extension types were featured namely public sector, private

sector (also referred to as market-based), and third sector (NGOs and FBOs). The market mechanism that appreciates demand-driven services defined the private sector extension systems. The public sector extension was not receptive to demands of farmers. Improving the public sector extension that was more receptive to the demands of farmers called for new public management, emphasising on sensitivity to customers together with adopting hands-on extension approaches. Extension services from the third sector were not demand-driven, either. Strategies to make them more demand-driven included improving their management capability and internal obligation mechanisms.

Abraham *et al.* (2010) carried out a comparative study on socio-economic profile of fish farmers in West Bengal and Andhra Pradesh, the two leading fish producing states in India. The study employed cross-sectional interview-based survey. Findings revealed that farmers in both states had varying farm characteristics including training orientation and fish disease was the single most common problem among them. The magnitude of problems varied in the two states. Stakeholders were not able to influence the farmers on aquaculture development because of the many uncommon problems. The study recommended a strong commitment from the government and non-government organisations in terms of relevant cooperation, training, and technological extension.

Emtage *et al.* (2007) did a study on landholder profiling and typologies for natural resources management. A review of the landholder typologies revealed the theories guiding them, their focus, scope, and potential applications adopted for widening their use in addition to the classification basis used for the typology creation. The study showed that typology was based on single or multiple industries, the temporal and geographic scale of the typology, and how easily the typology associated with the supporting data. The researchers concluded that while there were many suggestions for demand driven agricultural extension strategies, they were less specific in solving the farming households' challenges identified. The study recommended creation of ideal ways of integrating personality, cultural, and attitudinal factors into frameworks of natural resource management behaviour.

Chatterjee *et al.* (2015) conducted a study on identification and characterisation of farming systems for irrigated agriculture in the West Bengal state of India. The study used cluster analysis (CA) and multivariate techniques of principal component analysis (PCA). The study recognised four dissimilar farm types namely, fishery diversification and animal husbandry, jute and food grain farms, fruits and vegetables growing farms, and farms with off-farm activities varied with crop-based income. Such typology description facilitates the formulation of distinguished extension interventions to deal with the need for the various identified farm typologies. It also reduces the cost of transactions in the agricultural extension and research system. The study recommended a precise extension system targeting advisory services, agricultural inputs, critical information, and credit access for the different described farm types. Farm typology can be the basis for many selections of public extension programmes for beneficiaries.

Ojiem *et al.* (2006) researched on legume integration in smallholder farming systems in western Kenya. The study used a socio economic niche concept methodology in exploring the framework for smallholder legume adoption. The study established that a wide variety of socio-economic factors (prices, production objectives, preferences, etc.) and biophysical variables (climate, soil fertility etc.) affected legume use in smallholder systems. Several of these variables restricted the adoption of legumes, while others offered incentives for beneficial use of other legumes in the same system. Extensive legume adoption in smallholder systems is feasible through simultaneous identification and resolving all significant biophysical and socio-economic constraints. The socio-ecological niche created by the integration of agro-ecological, socio-cultural, economic, and environmental factors describes a multi-faceted framework for forecasting technical suitability.

Using cluster analysis for identifying identical farm groups, Tariq *et al.* (2015) studied the structural characterisation of dairy production in Pakistan. The results showed four distinct production systems. The systems were first, smallholder-mixed systems (SSM) that operated semi-commercially and which integrated livestock and crop production. Second was a smallholder dairy producer (SSD) that operated semi-commercially, had

few cattle, buffaloes, and had low returns. Third was a commercially operated smallholder dairy producer (CSD) which mostly did well and produced significant milk quantities throughout the year. Fourth were commercially operated large-holder dairy farms (CLD) whose input and output levels were the highest. Breeding negligence, wastage of buffaloes whose yields were high, unfavourable marketing system, high feedstuff costs together with lack of diversity in the dairy value chain were the main limitations for the production systems. The study recommended an enhancement in resource usage efficiency, particularly with regard to animal nutrition and genetics. This could gratify the need for milk production for the market, thereby meeting the increasing milk demand in urban areas, as well as generation of income for the farmers.

Vanclay (2005); Van Herzele and Van Gossum (2008) conducted studies on trees and forestry in Australia using cluster analysis. They focused on tree farming typologies based on the motivation for tree ownership to guide in forestry extension. The studies revealed evolving heterogeneity of forest ownership and the need to adopt policies and communications to the various types of forest owners. An inherent typology for farm forestry illustrated how extension strategies varied to reach the various groups in a cost-effective manner. The types of tree growers identified included for lifestyles', for additional income, and for generation of primary income. The studies concluded that the nature of extension effort should targeted information needs within each grower type.

In conclusion, relevant interventions to assist farmers require a clear understanding of the variations in farming systems. There is therefore need for characterisation and grouping of farmers so that the treatment of the groups and appropriate policy regulations focus on their particular features. This study employed a nonconventional approach of economic classification of dairy farming systems in Kenya applying both non-economic and economic classification parameters. Additionally, the study used statistical objectivity of multivariate procedures, which allowed for identification of numeric based farm types.

## 2.3 An Overview of Collective Action in Agriculture

For Africa to grow economically and be food secure, smallholder agriculture, need improvement through commercial orientation. However, most smallholder farmers currently experience numerous challenges requiring interventions for achieving commercialisation. Most development studies have pointed out that smallholder commercialisation has myriad of challenges. These include market inaccessibility, improper smallholder coordination leading to low prices, low volumes of output, and non-competitiveness (Poulton *et al.,* 2010; Boka & John, 2017). In addition, small farms are incapable of accessing technology, capital, and mechanisation which are critical for commercialisation (Pingali *et al.,* 2019).

The challenges of inadequate production and low investments experienced by smallholder farmers have perpetually led to low-level equilibrium poverty trap (Barrett *et al.,* 2016). Theoretical exploration, founded on comparative equilibrium framework, indicates that markets in low-income economies suffer from institutional imperfections. These markets experience challenges such as weak contract enforcement, high transaction costs, information imperfection, and adverse economic situations (Bardhan, 2000; Dorward *et al.,* 2005; Shirley, 2008). These institutional problems combine to make profitability and competitiveness difficult for an individual approach.

Using New Institutional Economics (NIE), market actors can reduce the transaction costs and eventually eliminate the low-level equilibrium trap. This is possible through the coordination of non–market mechanisms that reduce transaction costs and strengthen institutional environment hence increase investment prospects (Doh & Saka-helmhout, 2017; William & Thawatchai, 2012). Solutions to the numerous problems in smallholder agriculture therefore call for institutional reforms to enhance service provision, market growth, and establishment of infrastructure. These will help in responding to the farmers' needs, which include market access, market information, and intelligence for the achievement of commercialisation. Collective Action has been fronted as a potential strategy for reducing the challenges relating to transaction costs in addition to achieving

the benefits of large scale production and market involvement (Fischer & Qaim, 2012; Shiferaw *et al.,* 2008; Narrod *et al.,* 2009).

Markelova and Mwangi (2010) studied Collective Action by demonstrating the understanding of platforms as a process of bringing together stakeholders on a particular issue. The platform for studying Collective Action performs three different but interrelated functions namely, creating learning space and joint innovation, governance function within the chain, and reducing transaction costs. A platform can also enhance policy change or its influence on smallholder farmer groups (Vellema *et al.,* 2013). Collective Action through farmer groups can increase income and economic growth (Tolno *et al.,* 2015; Tefera *et al.,* 2017). Collective Action is an initiative where group individuals invest in resources to achieving common goal while addressing common problems (Markelova & Mwangi, 2010). It is also described as unified group behaviour toward a shared purpose or interest (Meinzen-dick *et al.,* 2004). Despite the benefits, Collective Action can be bedevilled with challenges (Bijman *et al.,* 2016; Iliopoulos *et al.,* 2016). Enactment of policies and rules that enforce accountability to members can minimise these difficulties.

### 2.3.1 Conceptual Framework of Collective Action

Figure 2.1 shows the framework of Collective Action as developed by Kruijssen *et al.* (2009). In the diagram, the right-hand side is the beginning of the Collective Action framework. Collective Action is based on the concept of social capital, which describes the relationship among the group members. Social capital, is the foundation on which exchanges between players in a collective activity is founded. Clusters of people (or stakeholders) work together to specify problems, find and apply solutions, and evaluate the worth of a solution for a particular practice (Bhandari & Yasunobu, 2009; Portes, 2009).

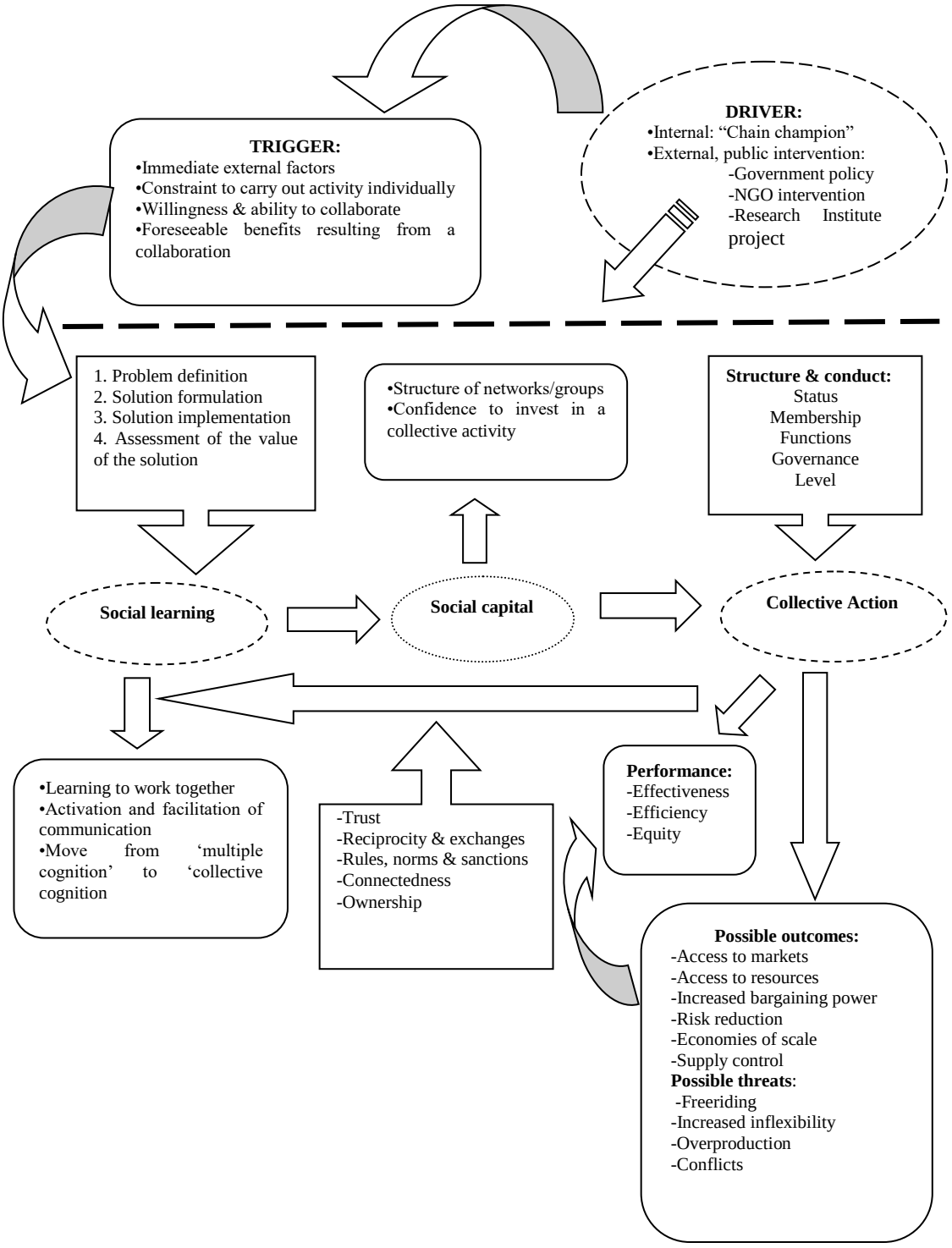


**Figure 2.1: The process of collective action**

Source: Adopted from (Kruijssen *et al.*, 2009)

Collective Action is a process entailing the movement from ‘multiple cognition' to ‘collective cognition'. This implies that individuals in the group shift from being separate cognitive agents having multiple views, to a collective unit with common attributes, values, and beliefs. The concept also suggests that the individuals in group can realise insights that none can attain alone. The interactions that occur within Collective Action also cycle back into the communal process of learning and modify the form of social capital with time (Meinzen-dick *et al.,* 2004; Bhandari & Yasunobu, 2009; Portes, 2009).

A trigger normally initiates Collective Action. This could be an external factor, which is out of an individual’s control. Collective Action will mostly occur when the capacity of an individual to respond to challenges is inhibited and there is an option of taking action as a group. This is shown by a certain degree of motivation, interconnectedness, and capacity (Meinzen-dick *et al.,* 2004). Moreover, the possible merits of Collective Action should be evident to participants. The driver which stimulates the process could be external (such as government, research institutes or NGOs), or internal (farmer or other supply chain player).

Factors that necessitate Collective Action include transaction costs, contract enforcement, and information imperfection.

***Transaction cost as a motivator of collective action***

Transaction costs refer to general principle, which consists of expenses of administrative nature, those relating to ethical hazardous behaviour, opportunity costs, and costs linked to adverse choice of borrowers. They are costs other than money price incurred while trading or exchanging goods and services. The main elements of transaction costs are first, information search about the distribution of quality of inputs and products, and price. Second is the quest for potential sellers and buyers in addition to pertinent information about their circumstances and behaviour. Third, the bargaining that is needed to find the true position of buyers and sellers when prices are endogenous.

Fourth is the establishment of contracts. Fifth is the evaluation of contractual partners to determine whether they abide by the contract terms. Sixth is the contract enforcement when associates breach their contractual obligations. Seventh is property rights protection against encroachment by third-parties (Allen, 1999; Cordella, 2014). Theoretical works on agrarian markets indicate that transaction costs within them are high and this erodes the capacity of smallholder dairy farmers to be efficient in exchange of labour, product, and credits. This distorts order in such markets (Eswaran & Kotwal, 1985; Basu, 1986).

High transaction costs in rural markets impact negatively on effective farmer participation. Rural markets bear high risks and high costs when screening small participants spread over isolated areas. Many smallholder farmers are therefore unable to participate efficiently and competitively. The fear that such costs might reduce expected earnings also motivate farmers to create groups (Shiferaw *et al.,* 2008). Group engagement reduces costs of administrative nature since members are familiar with one another and follow up is easy. Collectively, members apply for the loans and reduce administrative costs. Moreover, members exert pressure and impose sanctions on suspected defaulters through regular meetings and this enhances the efficiency of groupings. Leaders of the groups assess the creditworthiness of potential borrowers further lowering the possibility of defaults. Transaction costs are minimal in group-based lending (Ab-Rahim & Shah, 2019; Haldar & Stiglitz, 2016).

Moral hazardous behavior arises from hidden conducts. Costs linked to moral hazardous behavior arise when two parties share market risks. However, if one party to the agreement fails to provide all the information required the probability of distribution of the outcomes remain unknown to the other party. Farmer groups mitigate moral hazard problems by availing information about member's contributions and past performance. During membership screening, hazardous behavior would be identified and consequently membership and benefits thereof denied (Ab-Rahim & Shah, 2019; Haldar & Stiglitz, 2016).

Peer selection, monitoring, pressure, and dynamic incentives account for most of the disparity in the occurrence of moral hazardous behaviour. Organisations that adopt joint liability rely on social strength and dynamic incentives for improving outreach, performance, and sustainability (Simtowe *et al.,* 2006). Adverse costs of selection refer to those that arise from hidden information. This is when one party to an agreement has adequate information about some pertinent variable in a transaction relative to the other party. In case the said party fails to disclose this information, the probable loss to the aggrieved player becomes a cost due to adverse selection. At certain information asymmetry levels, no transaction may occur at all, resulting in total market failure.

Lending through groups involves low costs of information since mechanisms such as neighbourliness, kinship, similar workgroups, professions, and similar financial activities encourage adoption of frequent interactions. This strategy is termed as common pool resource administration for transformation (Ostrom, 2014). Individuals engage in intensified interactions resulting in enriched data about one another. The practice also enhances information flow with regard to best practice, enabling adoption of new technologies, thus enhancing productivity levels (Baerlein *et al.,* 2015). Group lending is thus helpful in minimising information asymmetry challenges. It improves the capacity of potential borrowers to commit to a group's collective responsibilities like joint credit in mitigating adverse selection.

***Contract enforcement as a motivator for collective action***

Another challenge facing smallholder farmers in developing economies is costly contract enforcement. This is where borrowers with the means to repay wilfully default. Most credit agreements in smallholder financial markets in developing nations are not enforceable through courts because written contracts do not exist. The agreements are often verbal, commonly referred to as ‘gentleman’s agreements’. Theorists have narrowed in on two approaches to providing repayment incentives. The first involves the self-enforcement of agreements where, for example, future loans depend on the effective repayment of existing loans. The second method relates to the adoption of social

penalties or sanctions by the group network or community against those who default (Udry, 1994).

Social sanctions within group structures play an important role in enforcing contracts. Nevertheless, the sanctions can only be effective if groups are reasonably cohesive (Nugent & Sukiassyan, 2009). Thus, there is a fairly higher tendency for transacting credit with low membership groups of farmers as well as those closely related such as family, friends, neighbours, and workgroups. Nugent & Sukiassyan (2009) observed that contract enforcement problems among smallholder business motivate the formation of associations which relevant institution and legal authorities can recognise their activities.

***Information asymmetry as a motivator for collective action***

Asymmetric information is a situation in which an individual in a transaction has information that another involved in the same transaction. Economics holds that markets that exhibit asymmetric information are imperfect and inefficient. In a competitive market, information asymmetry causes a variety of challenges and inefficiencies. Imperfect information exposes the uninformed party in a transaction to possible exploitation by rent seekers. Prices are likely to be influenced, resulting in reduced number of transactions that would otherwise be appropriate to sellers or buyers (Jackson & Jabbie, 2019; Mazzucato & Penna, 2015).

Information asymmetry leads to adverse selection of an economic trading partner. If consumers know the quality of goods intended for sales, they will avoid sham, poor quality, and useless commodities or services. Consumers would be willing to pay relatively higher prices for goods that are of better quality, hence stronger motivations for good performance. Good quality sellers on the other hand would benefit from actions that curb information asymmetries, leading to improved market performance (Crawford *et al.,* 2018). Knowledgeable sellers may offer unreasonably high quality (overtreatment) or unsatisfactorily low quality (under treatment), or they might charge for a quality higher than what is provided (overcharging) (Kerschbamer & Sutter, 2015).

To overcome market imperfection due to asymmetric information, it is necessary to provide consumers with a precise picture of their purchases. Economics theorists believe that imperfect markets suffer great efficiency challenges unless traders are legally responsible for their actions (Kerschbamer & Sutter, 2015). Effective administration of liability and other aspects of state regulations are usually poor in Low and Middle-Income Countries (LMICs), which are identified with governance standards that are below or at the global medium (Kaufmann *et al.*, 2005). Findings in theoretical literature affirm that verifiability guarantees efficiency in products markets. Verifiability applies when buyers are in a position to analyse and validate the quality of goods they purchase so that sellers do not charge for a quality they have not provided. Where verifiability thrives, sellers would settle for equal-mark-up prices. Different sellers would therefore earn the same returns independently for the same quality in the market (Kerschbamer & Sutter, 2015).

In summary, the problems discussed above are the key challenges facing smallholder dairy farmers in developing nations. In addition, they are trigger elements for Collective Action in form of farmer groups. The conceptual issues outlined also indicate a shift to institutional focus on entrepreneurial and managerial problems as illustrated in the NIE.

### 2.3.2 Prior Studies on Collective Action

Kimutai (2016) conducted a study on the determinants of decision by small-scale horticulture farmers to join Farmer Based Organizations (FBOs) in Kenya. Using logistic regression and chi-square test, the study established that membership level of horticultural FBOs was very low. While farmers had different reasons for joining FBOs, education level, marital status, gender, and horticultural farm size significantly influenced these decisions. The study recommended education of farmers on the merits of FBO membership. It also recommended the need by government to develop programmes that train farmers and provide information on establishment of successful FBOs.

Adong *et al.* (2013) studied factors determining farmer group membership in Uganda. The study used a Linear Probability Model (LPM) for analysis. The results showed that there was low membership both at household and individual levels and there were variations in regional participation. Parameters established for influencing farmer group participation included the distance to the extension service, education, and the quality of road infrastructure. For there to be an increase in farmer group membership, development partners and government need to focus more resources towards farmers who are less educated and those located far away from extension services. The use of local language was also necessary for improving group participation by the illiterate and the lowly educated.

Institutions supporting groups were crucial in ensuring that groups had access to agricultural technologies. This would result in noticeable outcomes, and encourage more farmers to join groups. Group membership by smallholder farmers would improve accessibility to the best agricultural technologies and better produce markets. In addition, groups would enhance financial security, produce transport, and household investments. It would also increase accessibility to credit facilities, as group members would provide collateral for each other. Farmers would therefore be able to participate in value addition in agriculture as well as rural infrastructural development such as power generation projects, roads, health facilities, schools, as well as conservation and management of natural resources (Mwaura *et al.*, 2012; Mbowa *et al.*, 2012).

Tolno *et al.* (2015) investigated the role of farmer organisations in boosting the income of smallholder potato farms in Central Guinea. Using Tobit model for analysis, the study established that farmers' age, land possession, credit accessibility, extension service and off-farm income correlated positively with group membership. Educational level and gender on the other hand negatively influenced farmer group membership. The study found that farm income depended mainly on labour used, farm size, market price, and sales proportion. The study concluded that farmer groups could be a pivotal foundation for smallholder farming transformation, increased productivity, and incomes. Since the farmers had inadequate resources and their organizations were limited by technical,

institutional, and investment restrictions, the study advised that policies should focus on smallholder agriculture success.

Fischer and Qaim (2012) conducted a study on gender, agricultural commercialisation, and Collective Action in Kenya using small-scale banana producers' survey data. The study used a Tobit model for analysis. The research established that groups played a role in rising male control over banana production and commercialization. The study also revealed that adverse gender effects on farmer groups could be resolved if women joined groups. Group membership by women revealed positive effect on income share controlled by the females. The study concluded that farmer groups were capable of stimulating smallholder commercialisation in a manner that was gender sensitive. The study noted the need to appreciate trends in various situations to assist policy instruments towards mainstreaming of gender in Collective Action.

A study by Ngigi (2013) evaluated the role of farmer groups in improving market participation among smallholder producers of sweet potatoes in Kenya. The study explored the triggers of group membership, as well as factors that influenced decisions on sweet potato marketing. Using Tobit model, the research showed that the age and gender of the household head, market distance, and access to credit determined group membership. Market participation correlated positively and significantly with the age of the household head and credit accessibility of the household. Gender and market distance negatively affected decision to join farmer groups. The study established factors that positively influenced market participation namely, group membership, farming experience, education level, source of market information, and land holding. The results further indicated that market information accessed through farmer organisations positively impacted market participation. The study recommended farmer group initiatives in promoting market access and bargaining power of smallholders.

In conclusion, a Collective Action initiative is important in minimising poverty and unemployment and improves farmers' welfare. Collective Action, which is very dynamic, serves as a vital tool to achieve various socioeconomic objectives. The

highlighted studies have indicated that households have varied motivations for group membership. Individual priority and motivation for group membership varies from person to person. Market accessibility and social insurance are the most common motivating reasons for group membership. The studies also suggest that where institutions and policies that promote individual and sector growth are inadequate, Collective Action is the option for overcoming challenges while connecting individuals for common good.

### 2.4 An Overview of Agricultural Commercialisation

Market signals and output markets are the basis of production decisions of agricultural commercial transformation (Hagos *et al.*, 2019). Agricultural commercialisation refers to proportion of agricultural production set aside for marketing and involves a shift from absolute domestic use to market predominance (Sokoni, 2008). Commercialisation is the proportion of agricultural output for marketing ranging from zero (for total subsistence) to unitary for total output sold (Osmani *et al.*, 2015; Bekele *et al.*, 2010). Agricultural commercialisation is realised when production decisions focus on maximising profit and increasing market transactions (Afework & Endrias, 2016). Hazell *et al.* (2020) emphasis that agricultural commercialisation is the extent of output market participation focused on revenue and profitability. In agricultural commercialisation, there is a shift from subsistence to market orientation with regard to both output product and the use of inputs. In output production, commercialisation results in high marketed surplus, while on the inputs side it involves more application of purchased inputs (Boka & John, 2017; Jaleta *et al.*, 2009).

Gebreselassie and Sharp (2008) conducted a study in Ethiopia that categorised farmers' commercialisation into four broad categories corresponding to potential "pathways" for commercialisation policy. The first category was *smallholder family farms*. This category included farmers found in low potential or drought-prone areas. They were generally subsistence-oriented and interacted with markets both as customers and as vendors. The policy orientation for this group should majorly focus on improving their

terms of engagement with markets in addition to improving productivity and diversity. The second category was *smallholder family farms with commercialisation orientation.* These were small-scale farmers with an already established market orientation. Their output was wholly or partly for the market. These farmers were mostly located in areas with favourable marketing and crop production conditions and their focus was specifically on commodities of high value. The third category was s*mall investor farmers.* This category included farmers who collaborated in small groups and resided mostly in urban environments. Also included in this group were professionals in agriculture with a background in governmental or developmental agencies or previous state firms. Their investment in farming was secondary activity. They were also "emerging commercial farmers" projecting towards big agribusiness. The fourth category was *large-scale agribusiness.* This category was quite capital-intensive. It included enterprises that also created employment. They were either private or state owned.

According to Dutta (2014); Lawin and Zongo (2016), there are three different levels of commercialisation in production. The first level is subsistence systems. In this level, the farmer's objective is mainly self-sufficiency. The household mainly provides the inputs used to produce a wide range of product mix and agriculture is the predominant source of household income. The second level is semi-commercial systems. This level has surplus production as the key objective of the farmers. The inputs are obtained from a mix of traded and non-traded sources and are used to produce moderately specialised commodity mix. Income for the household is from both non-agricultural and agricultural activities. The third level is commercial systems where profit maximisation objective defines the level of farming. The basis of the various systems is objective of the farm household's production, source of inputs, sources of income, and product mix. This approach of categorising farms has many similarities to the systems of production for smallholder-dominated economies in developing countries. However, it may not be applicable in its simplest form across many nations (Martey *et al.,* 2012; Hailua *et al.,* 2015; Zhou *et al.,* 2013).

### 2.4.1 Conceptual Framework of Commercialisation

Commercial agricultural transformation is critical to economic growth and development for many countries that depend on agriculture (Binswanger-Mkhize *et al.,* 2011). Shifting from subsistence to commercialisation in agriculture would significantly improve smallholder farmers' welfare and income hence reduction of poverty (Lerman, 2004; Zhou *et al.,* 2013). Commercialisation involves input and output market orientation and participation (Jaleta *et al.,* 2009). To attain commercialisation, there is need to address the limiting factors including inadequate farming and entrepreneurial skills, low capital, high transaction costs, poor infrastructure, inadequate information, and lack of education.

Measurement of commercialisation level is necessary for the analysis of commercialisation determinants. Different indicators, which emanate from the conceptualisation of commercialisation, are useful in evaluating the level of household commercialisation. The use of econometric models is important in evaluating household decisions to allocate resources to produce for home consumption or for the markets. Some scholars adopt basic indices for analysing resources or income from marketing. For particular scenarios, these indices concentrate on either output or input side of commercialisation, while in others, they integrate the two and consider overall farm household's market transactions (Jaleta *et al.,* 2009).

There are several dimensions for estimating commercialisation. The dimensions involve factors that induce or intensify commercialization. This study employed a proportion of output sold in markets expressed as a range of indices between zero (0) and one (1). Zero (0) index would imply total degree of subsistence while one (1) would imply total degree of commercialisation.

### 2.4.2 Prior studies on Smallholder Commercialisation

Muriithi and Matz (2014) conducted a study on welfare effects of vegetable commercialisation in Kenya. They used ordinary least squares (OLS) estimation, taking commercialisation as an exogenous variable. Their findings evidenced a positive relationship between income per adult equivalent and commercialisation. However, commercialisation had a mixed effect on welfare. While export production related to higher income, commercialisation capacity in reducing poverty was restricted because of assets holding mixed evidence. The study recommended enactment of policies that encourage agricultural commercialisation together with strategies that enhance access to savings and credit accessibility for facilitation of asset accumulation. The study also recommended an establishment of intra-household allocation and use of income derived from vegetable commercialisation.

Agwu *et al.* (2013) researched on socio-economic determinants of commercialisation among Nigerian smallholder farmers. The study used household commercialisation index (HCI) and multiple regression model. The study established that the level of commercialisation was low. The results also revealed that society membership, household size, income, distance to the market, farm size, farming experience, and access to credit were significant determinants of commercialisation at different probability levels. The study recommended creation of market, storage facilities, employment of business management and enhancement of capacity development, packaging, and provision of necessary processing facilities for improvement and success of commercialisation.

Omiti and Mccullough (2009) studied the factors influencing intensity of participation in markets among Kenyan smallholder farmers. Data used was from a household survey and rapid rural appraisal. The analysis used truncated regression model (TRM). Results showed that most rural farmers produced low quantities of less perishable and low-value marketed surpluses compared to those in sub-urban areas. Similarly, farmers primarily sold in rural markets and at their farm gates. The study also established that distance to

selling point from the farm was a key constraint to market participation intensity. The study also noted that better market information and output price were important incentives for improved sales. The study recommended urgent need to reinforce delivery systems for market information, upgrade roads in both sub-urban and rural areas, encourage market amalgamation activities, and launch more retail channels with enhanced market infrastructure in isolated rural villages. This would encourage production and exchange of commodities of high value by rural farmers.

Ele *et al.* (2013) studied household commercialisation index (HCI) determinants in Cross River State, Nigeria. The objectives were to identify variations in commercialisation levels for households in the three agricultural zones (Southern, Central and Northern), as well as describing micro-level factors affecting commercialisation levels. The study adopted a binary choice and Tobit regression models to evaluate household market participation level. Findings showed moderately high level of commercialisation. Results from the Southern Zone showed that cooperatives membership increased households' level of commercialisation. Larger household family size also saw reduced commercialisation. This was due to households' preference for consumption rather than market. Results from the Central Zone indicated that household commercialisation level increased with farm size and extension services. In the Northern Zone, the volume of crop productivity and farming experience significantly and positively correlated with the degree of commercialisation. In general, total output volume of food crops, agricultural extension service access, farming experience, cultivated land size, household family size, and cooperative membership were important determinants of commercialisation level for smallholder farms.

Oteh and Nwachukwu (2014) examined commercialisation of cassava production in Abia state, Nigeria. The study analysed the commercialization index and socioeconomic factors that influence marketing of cassava produced by households. The study used multiple regression analysis with household commercialisation index (HCI) being the dependent variable. The study found that, on average, cassava farmers lacked the inputs required to increase production and marketing. This was because rural cassava farmers'

were mainly producing for subsistence with very few farmers embracing high commercialisation. To sustain and improve productivity among farmers, a review policy issues relating to land tenure and capital was necessary. The study recommended support policies for farmers in rural areas, linkages between farm households and markets, and increased access and exchange of information on markets.

Hailua *et al.* (2015) analysed the impact of commercialisation on livelihoods of smallholder farmers and household factors affecting the intensity of crop commercialisation in the Tigray Region, Ethiopia. The study used propensity score matching (PSM) method for analysis. The results indicated that smallholders' decision to participate in crop commercialisation was constrained by crop pests and diseases, unreliable rainfall, lack of access to irrigation, and socioeconomic factors such as farmland size, drought, and family labour. Agricultural input and output markets were also major constraints to crop commercialisation. Low quantity and quality of produce, absence of market, transportation challenges, price fluctuation, and rising prices of inputs like labour, fertilizer, and associated inputs were bottlenecks for crop commercialisation. The average commercialisation index was low and extent of crop commercialisation essentially subsistence. The level of crop production, drought resistance, and training on marketing had positive and significantly affected the intensity of crop commercialisation. Furthermore, family size, lack of price information, distance to local market, and expensive farm inputs reduced the intensity of crop marketing. Despite challenges and constraints, the study established that crop commercialisation helped improve livelihoods of smallholder farmers. The study recommended rural infrastructural development and capacity building of institutions in addition to use of cross-sectional data instead of panel data to reveal the dynamics of agricultural commercialisation.

In summary, commercialisation of agriculture can either occur on product or input side. Transaction costs experienced by the various farmers affect their commercialisation decision. Commercialisation influences income positively leading to improvement in welfare of households that are primarily subsistent. Various long-term and short-term socioeconomic factors determine the decision and level of commercialisation among farmers.

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter discusses the analytical approaches adopted for the study. It provides the theoretical framework, econometric models, and considered variables for the research objective to guide in the estimation and hypothesis testing. It also provides an overview of the study area. This section therefore explores the theories explaining farming characterisation, Collective Action, and commercialisation of smallholder dairy farmers. Comprehensive understanding of these three components would be useful in improving production and commercialisation of smallholder dairy enterprises through farmer groups.

## 3.2 Household Dairy Farming Characterisation

### 3.2.1 Theoretical Framework for Household Farming Characterisation

Farm characterisation forms the basis for analysis of the study Objective One. Household theory explains that farmers focus on household economic stability with an objective of maximising utility. Farmers therefore make decisions regarding production, consumption, and marketing. Smallholder households use varying quantities and qualities of resources during production, consumption, and marketing of their dairy produce and they face varied challenges. There is therefore need to identify the different categories of farms and farmers for more targeted interventions to achieve maximum utility.

Smallholder dairy intensification is important in utility maximisation hence the economic performance of smallholder farmers. Intensification refers to an increment of production per unit of input use. To achieve this a logical and comprehensive knowledge of the smallholder dairy farming structure is important. Socio-economic and biophysical

characteristics mostly related to dairy farming, and resources and management capacities differ among farmers. Smallholder dairy farming therefore vary among farms. Farm typology would create a critical step in any feasible assessment of the limitations and prospects that exist within farms.

### 3.2.2 Econometric Specification of Household Farming Characterisation

Identification of smallholder dairy farm typologies in this study used two successive multivariate statistical techniques of Principal Component Analysis (PCA) and Cluster Analysis (CA). These techniques are statistical procedures often used in identifying various household farm typologies and classifications especially for a comprehensive database (Andersen *et al.,* 2006; Goswami *et al.,* 2014). Principal Component Analysis is usually used to reduce the interdependent variables information to a smaller group of factors (Kuivanen *et al.,* 2016; Bidogeza *et al.,* 2009). The PCA reduces the information of interrelated variables and collapses them to fewer key variables. Key assumptions in PCA are its dependence on the normality of the data used, sampling adequacy, and overall factorability of the matrix (Suhr, 2006). The purpose of PCA is to decrease dimension more accurately, so as to define the difference in a group of correlated parameters in terms of a separate set of uncorrelated parameters each being a combination of variables that is linear (Jolliffe *et al.*, 2016). The Principal components are equal to or less than the quantity of the original set of variables. The PCA applies an orthogonal alteration in transforming a set of correlated observations into a group of values of linearly unrelated variables referred to as principal components.

In the study, the PCA used socio-economic variables from different smallholder dairy farmers. The principal components were identified by the use of orthogonal rotation varimax approach in order to put the highly correlated variables into a factor for easier interpretation as explained by Yong & Pearce (2013). The study also conducted the Kaiser-Meyer-Olkin (KMO) test to assess adequacy of the sample. In addition, the study tested the correlation matrix as an identity matrix using Bartlett's sphericity test. If Bartlett's Test of Sphericity (BTS) is significantly large and the Kaiser-Meyer-Olkin

(KMO) measure of sampling adequacy is more than 0.6, then factorability is implied (Yong & Pearce, 2013).

The econometric procedure for a random variable X using Principal Component Analysis provides a matrix of diverse observations from individuals as,

$$X = \begin{pmatrix} X_1 \\ X_2 \\ \vdots \\ X_p \end{pmatrix}$$ ……... Equation 3.1

The population variance-covariance matrix would then be,

$$Var(X) = \Sigma = \begin{pmatrix} \sigma_{11} & \sigma_{12} \cdots \cdots & \sigma_{1p} \\ \sigma_{21} & \sigma_{22} \cdots \cdots & \sigma_{2p} \\ \vdots & \vdots & \vdots \\ \sigma_{p1} & \sigma_{p2} & \sigma_{pp} \end{pmatrix}$$ …….. Equation 3.2

Then the linear combinations would be,

$$Y_1 = e_{11}X_1 + e_{12}X_2 + \cdots\cdots + e_{1p}X_p$$

$$Y_1 = e_{11}X_1 + e_{12}X_2 + \cdots\cdots + e_{1p}X_p$$

$$\vdots$$
$$\vdots$$

$$Y_p = e_{p1}X_1 + e_{p2}X_2 + \cdots\cdots + e_{pp}X_p$$

…….. Equation 3.3

These equations can be represented individually in the form of linear regression that predicts $Y_i$ from $X_1$, $X_2$..... $X_p$, with no intercept while $e_{i1}$, $e_{i2}$..... $e_{ip}$ are regression coefficients. Since $Y_i$ is a function of a random data, it is also random. Representation of the population variance would be,

$$Var(Y_i) = \sum_{k=1}^{p}\sum_{l=1}^{p} e_{ik}e_{il}\delta_{kl} = e_i' \sum ei \quad \text{..... Equation 3.4}$$

$Y_i$ and $Y_j$ will have a population covariance represented as,

$$Cov(Y_i, Y_j) = \sum_{k=1}^{p}\sum_{l=1}^{p} e_{ik}e_{jl}\delta_{kl} = e_i' \sum ej \quad \text{..... Equation 3.5}$$

Collection of the vector coefficients $e_{ij}$ representation is,

$$e_i = \begin{pmatrix} e_{i1} \\ e_{i2} \\ \vdots \\ e_{ip} \end{pmatrix} \quad \text{..... Equation 3.6}$$

*The first Principal Component, PCA1 ($Y_1$)* is a combination of x-variables that are linear and have a maximum variance amongst all the linear combinations. The data in this component includes as much difference as possible. Considering the constraints that the sum of the squared coefficients is equal to one, the coefficients $\boldsymbol{e}_{11}$, $\boldsymbol{e}_{12}$.....$\boldsymbol{e}_{1p}$

define the components for the variance maximisation. This constraint necessitates the obtaining of distinctive answer. More correctly, choose variables $\boldsymbol{e}_{11}$, $\boldsymbol{e}_{12}$..... $\boldsymbol{e}_{1p}$ that maximises:

$$Var(Y_i) = \sum_{k=1}^{p}\sum_{l=1}^{p} e_{1k}e_{1l}\delta_{kl} = e_1' \sum e1 \quad \text{..... Equation 3.7}$$

The above equation is subject to the constraint defined as;

$$e_1'e_1 = \sum_{j=1}^{p} e_{1j}^2 = 1 \quad \text{..... Equation 3.8}$$

*The second Principal Component, PCA2 ($Y_2$)* is the combination of the x-variables that are linear and which account for the remaining variations as much as possible. The control of this component is that the correlation between the second and first component is zero. Considering coefficients $\boldsymbol{e}_{21}$, $\boldsymbol{e}_{22}$..... $\boldsymbol{e}_{2p}$ that maximise the variance of this new component, the expression of variance would be:

$$Var(Y_i) = \sum_{k=1}^{p}\sum_{l=1}^{p} e_{2k}e_{2l}\delta_{kl} = e_2' \sum e2 \quad \text{..... Equation 3.9}$$

This equation is subject to the constraint that the sums of squared coefficients must add up to one such that:

$$e_2' e_2 = \sum_{j=1}^{p} e_{2j}^2 = 1$$ ……... Equation 3.10

Additionally, another constraint is that the components would be uncorrelated with one another such that:

$$Cov(Y_1, Y_2) = \sum_{k=1}^{p} \sum_{l=1}^{p} e_{1k} e_{2l} \delta_{kl} = e_1' \sum e2 = 0$$ ……... Equation 3.11

The successive principal components must also be linear and must explain the remaining dissimilarities as much as possible. The Principal components also would not correlate with one another. This pattern would be repeated for every additional component such that *the $i^{th}$ The $i^{th}$ Principal Component, PCAi ($Y_i$)* involves selection of coefficients $\boldsymbol{e}_{i1}$, $\boldsymbol{e}_{i2}$..... $\boldsymbol{e}_{ip}$ that maximises the equation below such that:

$$Var(Y_i) = \sum_{k=1}^{p} \sum_{l=1}^{p} e_{ik} e_{il} \delta_{kl} = e_i' \sum ei$$ ……..Equation 3.12

Equation 3.12 is constrained such that the sums of squared coefficients must add up to one. The additional constraint is that the new principal component must be uncorrelated with all the principal components defined previously.

$$e_1' e_1 = \sum_{j=1}^{p} e_{1j}^2 = 1 \quad \text{..... Equation 3.13}$$

$$Cov(Y_1, Y_i) = \sum_{k=1}^{p} \sum_{l=1}^{p} e_{1k} e_{il} \delta_{kl} = e_1' \sum ei = 0 \quad \text{.....Equation 3.14}$$

$$Cov(Y_2, Y_i) = \sum_{k=1}^{p} \sum_{l=1}^{p} e_{2k} e_{il} \delta_{kl} = e_2' \sum ei = 0 \quad \text{.....Equation 3.15}$$

$$\vdots$$

$$\vdots$$

$$Cov(Y_{i-1}, Y_i) = \sum_{k=1}^{p} \sum_{l=1}^{p} e_{i-1,k} e_{il} \delta_{kl} = e_{i-1}' \sum ei = 0 \quad \text{..... Equation 3.16}$$

All the principal components are therefore uncorrelated with one another.

Upon establishing the principal components, the study then employed cluster analysis (CA). The CA is an approach that involves use of extensive range of methods for explaining clusters or groups in data sets (Sharma, 1996; Hennig, 2015). The approach was preferred to other alternatives such as artificial neural networks, discriminant

analysis, and logistic regression. This was because there was no prior knowledge of the farmers, farming types, and their features. The cluster categories established using distinct set of variables would then be objectively heterogeneous between one another and homogeneous within themselves (Bidogeza *et al.,* 2009). The analysis computes the likeness between any pair of observations by using a distant coefficient. This provides an efficient way of testing their validity. The aim of cluster validity indices was for prompt selection of the most suitable number of clusters in the data with respect to the prior selected conditions.

### 3.2.3 Estimation Procedure for Household Farming Characterisation

The varimax matrix method was applied to identify the principal factors for the study using orthogonal rotation as demonstrated by Osborne (2015) and Forina *et al.* (2005). This method provides for mutually exclusive but highly correlated parameters for each factor for easier analysis. When the number of variables is less than 30, Kaiser's criterion advises that all the factors above an Eigenvalue of one be retained (Field, 2005).

The study used Euclidean Distance and Ward's technique to identify principal factors adopted for the classified clustering. The analysis resulted in the agglomeration schedule, which provided the necessary sequence and produced coefficients. The aim of the schedule was to attain an appropriate number of clusters that fitted the data set best. A check on the agglomeration schedule and scree plot helped in deciding on the applicable and reasonable clusters. The cluster categories were relatively homogeneous within and heterogeneous without on a distinct set of variables. Individuals in a specific cluster were different from the individuals in other clusters as explained by Bidogeza *et al.* (2009).

### 3.2.4 Hypothesis Testing for Household Farming Characterisation

The study used Hierarchical and K-means methods to obtain the number of clusters. Ward's computation and Euclidian distance methods are preferred for hierarchical clustering (Hennig, 2015; Mining, 2009). The number of clusters obtained from Ward's method was the starting values for the K-means method used to allocate cases to the default number of clusters. Consequently, the number of clusters retained was appropriate for the result. This study used Pseudo F Index to provide for Hierarchical clustering. The Pseudo F statistic explains the quotient in the inter-cluster variance to variance within a cluster. Large values of Pseudo F indicate strong and differentiated clusters, hence greater cluster separation. In addition to CA, identifying the differences in variance between clusters was through a one-way Analysis of Variance (ANOVA) test. The variables identified explained the major dissimilarities between the clusters. The hypothesis tested in this study was that smallholder dairy types do not differ in characteristics, and socioeconomic factors do not affect the type of smallholder dairy farming types.

### 3.2.5 Dairy Farming Characterisation Variables and their Hypothesised Effect

Table 3.1 gives the different categories of variables that the study analysed with respect to smallholder dairy farming typology.

**Table 3.1: Farm Characteristics Variables**

| Variable | Definition and Units | Hypothesised Effects |
|---|---|---|
| *Household Characteristics* | | |
| Age of the Head | Years attained by Head of Household | (+,-) |
| Household size | Number of family members | (-) |
| Gender of the Head | Male = 1, Female =2 | (+, -) |
| Education attainment | Years of schooling of the head | (+) |
| Experience | Number of years in dairy farming | (+ -) |
| Livestock size | Total number of dairy livestock | (+) |
| Other Household assets | Value of electronics, furniture, etc in Ksh. | (+-) |
| *Farm Characteristics* | | |
| Farm size | Farm size in acres | (+) |
| Land ownership | 1 = Own, 2 = Rental | (-) |
| Labour type | 1 = Family, 2 = Hired | (+) |
| Farm employees | Number of employees | (+) |
| Intermediate Assets | Value of equipment and machinery in Ksh. | (+) |
| Distance to mkt | Distance to the nearest market | (+) |
| Distance tmk | Distance to the nearest tarmac road | (+) |
| Distance ext | Distance to the nearest extension service | (+) |
| *Group Dynamics* | | |
| Group membership | 1 = Yes, 2 = No | (-) |
| Group size | Number of group members | (+) |
| Years of existence | Number of years the group has existed | (+) |
| Group activities | Activities done by the group: 1= Production 2 = Processing, 3 = Marketing, 4 = Production and processing, 5 = Processing and marketing, 6 = All | (+) |

### 3.3 Collective Action in Smallholder Dairy

#### 3.3.1 Theoretical Framework for Collective Action

The New Institutional Economics (NIE) incorporates the concept of Collective Action. The concept embraces a wider economics that explains the choices of people while simultaneously allowing for factors like evolution of norms, pervasiveness of information and people's willingness to create bonds and trust (Matthews, 2000; Nabli & Nugent, 1989). Individuals operate as an institution through Collective Action, and this enhances economic growth. In turn, the growth and development of the economy acts to influence change in the institutions. By reducing information asymmetry and transaction costs, groups can enhance economic growth. Institutions are principles of conduct such as norms, shared values, traditions, kinships, affiliations, religions, and cultural trends that enhance relationships between specific individuals. Institutions address societal problems and focuses on the environment in which groups of people with shared interests choose and act to achieve the common interest. It allows for more certainty in interactions between humans, thereby shaping behaviour and influencing outcomes (Runge, 1984; Nabli & Nugent, 1989; Hout & Lawler, 2014).

The NIE and by extension, the principle of Collective Action explains the functioning of institutions, their change process, and influence on individual performances (North, 1990; Kingston & Caballero, 2009; Buendía, 2003). Collective Action through farmer groups would improve access to production and marketing inputs and efficient management with an aim to benefit group members' entrepreneurial enhancement. Collective Action is a specific example of the role of institutional approach to societal problems, and forms the basis of the study. The mid 1990s and early 21$^{st}$ century produced many researches based on Collective Action. Paxton *et al.* (2000) adopted Collective Action Approach when evaluating the success of group loan repayment in Burkina Faso. Postelnicu *et al.* (2014*)* focused on Collective Action as social capital for group borrowing. Shiferaw *et al.* (2008) employed the concept of Collective Action when evaluating rural market imperfections. Researches focusing on development and

decision-making tended to use the concept more. Collective Action approach is also reliable in studying utility maximisation (Morcol, 2015; Dixit & Levin, 2017).

In this study, Collective Action formed the basis for analysing Objective Two. Collective Action occurs when individuals combine their efforts due to constraints and make decisions to accomplish an outcome that encompasses their interests (Czech, 2016; Sandler, 2015). There is no production of public good if the group members act in their material self-interest and therefore all are worse off. There is interdependence among participants in a Collective Action initiative, so that individual effort or contribution influences that of others. Collective Action is dependent on cooperation of different persons, as well as the effect of externalities on group behaviour. The success of Collective Action is determined by group characteristics, technical, economic and political environments (Okumu & Muchapondwa, 2017; Vorlaufer, 2012). Collective Action consists of collective decisions in a group and implemented individually in the independent organisations operating based on delegated group decisions. Group institutions including customs and conventions induce cooperative solutions intended to overcome the group challenges thereby enhancing efficiency in resource use (Sandler, 2010). In developing countries, the presence of higher number of resource poor farmers with desire to increase their production and marketing scope is a justification for farmers to operate on the principle of Collective Action.

Collective Action begins with decision theory where individuals engage in activities that benefit them. Mathematical interpretation of this idea results to five key elements as shown in Equation 3.17. First, is outcome model $G_i$, representing the net gains to an individual $i$. Second is the cost of contribution to the common good (which varies with individuals) referred to as contribution $r$, whereas $C_i$ is the cost incurred by the individual making the contribution $r$. Additionally, $R$ represents the contributions of all others. The third represents the total collective good to everyone represented as $P$ based on the overall contribution ($R + r$ if $i$ contribute, and $R$ if $i$ do not contribute). However, there are varied levels of provision for each individual, so we could name $V_i$ the value of $P$ to an individual. Lastly, is the allowance for discriminatory incentives, $I$, that stand for

the value of any private incentives extended to contributors (Oliver & Myers, 2002). These elements were combined together by Oliver (1980) into a general model as:

$$G_i(r) = V_i [P(R + r) - P(R)] + I - C_i(r) \quad \text{.....Equation 3.17}$$

Hence, the net gain to individual *i* could be a function of the value $V_i$ accruing from their contribution level *r* plus selective incentives, minus the costs incurred. We then need a rule to show how an individual behaviour affected the net payoff $G_i(r)$.

A "determinate" decision rule common in economics says that a person will choose the action with the highest payoff. Determinate decision rules are easy to represent and manipulate in equations. Using the simpler determinate decision model, cooperation from an individual is predictable if the net payoff is greater than zero, i.e. $G_i(r) > 0$. Using elementary algebra it can be shown that $G > 0$ if $[P(R+r) - P(R)] > (C_i(r) - I) / V_i$. The term $[P(R + r) - P(R)]$ represents a function of production, giving the difference in payoff *P* produced by a contribution r. If r makes no difference in *P*, this term will be zero, and no level of contribution is ever rational unless $0 > (Ci(r) - I)/V_i$ which is true only for a selective incentive is greater than the cost $(I > C_i(r))$. This is precisely the situation Olson (1971) analysed, where the collective good $(P)$ has no difference in the result, only the nexus between the cost and the inducement. Nevertheless, if $P(R+r) > P(R)$ then Collective Action might be rational without incentives, depending on the price (Oliver & Myers, 2002).

Determinate individual decision models are useful as part of sophisticated models of mutual decisions, which involve various heterogeneous persons. It is necessary to develop extra rules in modelling of multiple actors to show how their actions affect one another. People's decisions are sequentially made, and individuals or homogeneous groups would behave differently compared to heterogeneous groups (Dixit & Levin,

2017; Sprenger & Dougherty, 2012). Researchers have focused on changing the fundamental decision rule from a probabilistic to a determinate model in solving Collective Action problems. Collective Action therefore occurs when numerous actors cooperate probabilistically to obtain good results. Different results occur based on the premise of motivation and compensation systems. Results indicate that 'hypocritical cooperation' causing others to cooperate while one defects privately can invoke joint action. This causes 'altruist's dilemma' where actions for the good of others generate worse consequences compared to those conducted with selfish behaviour. People are likely to modify their interests, and assume that others will change as well (Oliver & Myers, 2002).

### 3.3.2 Profit Maximisation as a Justification for Collective Action

This study used profit maximisation concept to analyse the contribution of Collective Action to smallholder dairy farmers. Smallholders attempt to maximise their profits through increased purchase of inputs or sale of outputs until revenue from marginal product equals opportunity cost. Similarly, they provide their farms with labour by balancing out the returns from providing a marginal unit of labour with the disutility of labour itself, which refers to loss of leisure. They therefore have to choose marginal units resulting to demand and supply theories for production factors and products.

Smallholder dairy farmers aim at maximised profits through a set of consumption items ($x_a$). The consumed items can be from own farm i.e. own produced output, purchased goods ($x_m$) and leisure ($l$) (Equation 3.18). The maximisation of smallholder dairy farmer profit is however subject to cash, time, and output limitations as indicated in Equations 3.18, 3.19, 3.20 and 3.21.

$$\underset{C_f, C_{nf}}{Max}\, U(\chi_m, \chi_a, l, \Omega_{hh}) \quad \text{..... Equation 3.18}$$

Subject to,

Cash constraint: $P_m x_m = P_a(p_a - \chi_a) - P_l(l - f) - P_v v + i$ …... .....Equation 3.19

Time Constraint: $l + f = t$ …….....Equation 3.20

Output Constraint: $Q_a = f(v, l|a, k)$ …….....Equation 3.21

where $p_m$ and $p_a$ are price vectors of the purchased product $(x_m)$ and staple $(x_a)$ respectively, $q_a$, is a vector of smallholder dairy farmer staple production, $q_a — x_a$ is the vector of saleable surplus, $p_l$ is the wage, $l$ is the total labour input, and $f$ *is* the family labour input. Thus $l — f$, if positive, is hired labour and if negative, off-farm labour; $v$ is a vector of farm inputs; $p_v$ is variable input market price vector and $i$ is any non-labour income such as transfers and remittances.

A smallholder dairy farmer, if constrained by cash, needs $p_m x_m$ as cash equivalent to buy products that he/she cannot produce. $P_a$ $(q_a - x_m)$ is the cash obtained from marketable surplus. The farmer has to pay for the hired labour $P_l$ $(l — f)$, material inputs $(p_v v)$ and purchased marketed consumed products $(p_m x_m)$ from the surplus income of the farm. In case of insufficient surplus income, the smallholder dairy farmer relies on external financial services such as borrowings and transfers. Hence, in a single decision making period, the income of smallholder dairy farmer comprises of net farm earnings from production and exogenous income such as borrowing and transfers. Effectively, credit becomes an element of the farmer's profit maximisation function because of the cash constraint. The smallholder dairy farmer's profit maximisation is also subject to time constraint (Equation 3.19) because farm production, leisure, and off-farm employment share the total income available. In effect, management is included indirectly, in buying out leisure by hiring labour, into the time-constrained function of the smallholder dairy farmer.

Smallholder dairy production is also subject to technical constraint and production capacity, which are determined by the available variable and fixed inputs as represented in Equation 3.21 where *a* and *k* are fixed quantity of land and fixed stock of capital respectively. The three constraints collapse into a single one as illustrated in equation 3.22

$$p_m x_m + p_a x_a + p_l x_l = p_l t + \prod + i \quad \text{……..……. Equation 3.22}$$

where $\prod = p_a q_a(l, v, a, k) - p_l l - p_v v$ measures the farm's profits. In Equation 3.22, the left-hand side shows the total smallholder dairy farmer expenses on three items namely the purchased commodity ($p_m x_m$), own output purchase ($p_a x_a$), and own time purchase in the form of leisure ($p_l x_l$). In line with Becker's concept, the right-hand side indicates full income, in which the value of stock of time ($p_l t$) owned by the smallholder dairy farmer is recorded as labour income (Becker, 1965). Expressing the full income y gives Equation 3.23.

$$p_m x_m + p_a x_a + p_l x_l = y \quad \text{……..... Equation 3.23}$$

In a well-functioning market, farm production and consumption decisions run separately. The smallholder dairy farmer then maximises net farm earnings subject to the expenditure and technology constraints. Earnings as well as other income are then assigned among consumption goods. Separation of smallholder famer's production and consumption decisions is not however possible in imperfect markets. In essence, the left hand side constraints in Equation 3.23 are reduced into output influencing factors such

as smallholder dairy farmer specific characteristics, $\Omega_{hh}$, farm-specific characteristics, $\Omega_{f}$, market characteristics, $\Omega_{mk}$, and credit constraint, $\Omega_{cr}$, see Equation 3.24.

$$\phi = f(\Omega_{hh}, \Omega_{f}, \Omega_{mk}, \Omega_{cr}) \quad \text{……..……} \quad \text{Equation 3.24}$$

Input leads to a problem of selectivity, hence imposing intercept, and slope effects. The effect of input on production can then be best estimated using endogenous switching regression models which have sample selection correction (Society, 2019; Greene, 2003; Millimet, 2003). Propensity Score Matching econometric model is appropriate for correcting for the selection bias and in estimating the average effect of input use on smallholder dairy farmer's economic performance.

### 3.3.3 Econometric Specification of Propensity Score Matching

The Propensity Score Matching (PSM) method evaluates the average effect of a decision on a participant's outcome, subject to his/her pre-participation. The PSM is applicable in two cases. First, it is applicable where the non-treatment elements are comparable with the treatment elements. Second, it is applicable where selection of the units to compare with the treatment unit is difficult among a set of pre-treatment characteristics. Matching is then done to the characteristic that differentiates treatment and control group to try to make them look alike. It is preferable due to its ability to balance treatment and control groups on a large number of covariates when retaining a significant number of observations. Its major shortcoming however is that it explains observed covariates only. Parameters that influence assignment to treatment and outcome but not observable cannot be explained in the matching procedures. The procedure is effective for larger samples with significant overlap amongst the treatment and control groups.

For this study, estimation of Propensity Matching Score was first accomplished using Probit model following Johnston & DiNardo (2007) as follows:

$$\Pr ob[y_i = j] = \frac{\exp(\beta_j x_i)}{s(j = 0 - j)\exp(\beta_j x_i)}, j = 0,1.....,J \quad \text{……..…….. Equation 3.25}$$

The left-hand side of the expression represents the probability of participation in a dairy farmer group for $j^{th}$ dairy farmer and $x_i$ is observed variable characteristics of the farmer, similar across all outcomes.

The Probit model was useful because the dependent variable (group membership) had a value of either 1 or 0. This study defined the dependent (limiting) variable as decision to join a group or otherwise by a farmer. If a farmer was in a group, Yes = 1 and Otherwise = 0. Variable X, whose coefficients the study estimated, was a set of independent demographic and socioeconomic independent variables. The strength of the Probit model in this study was its cognisance to a normal distribution and a normal multivariate distribution of the collected data. The assumption of normality distribution justified the study to jointly estimate several response variables simultaneously and apply adjustments to the covariance matrix (Madala, 2008; Gujarati, 2004; and Greene, 2003). Another advantage of the model was its ability to resolve the heteroscedasticity problem. The use of an OLS (Ordinary Least Square) regression was not preferred as it would lead to biased and inconsistent coefficient in the data (Greene, 2003). In linear form, Equation 3.25 reduces to,

$$D(0,1) = \beta_0 + \beta_{ij} x_{ij} + \varepsilon, pscore(mypscore), [blockid(myblock), com\sup ....\text{Equation 3.26}$$

Where D indicates group participation, and D = 1 if a dairy farmer was a group participant otherwise D was equal to 0 and $x_i$ represents socioeconomic vector for group participation covariates.

This was followed by generation of propensity score index (*mypscore)*, generation of blocks of propensity scores (*myblock)*, and generation of a dummy variable, which identifies farmers who meet the matching condition (*comsup)*. Finally, a variable is created with numeral '1' representing subjects that meet the matching condition and '0' for those that do not meet the condition. The general formulation of the empirical model was as follows:

$$Command: y = \beta_0 + \beta D + \beta_i x_i + \varepsilon, pscore(mypcore), com\sup, \log it \ldots.$$ Equation 3.27

Where *command* is a matching estimation (attns, attr, atts, attk), y the outcome of output, $x_i$ a vector of participation covariates, followed by the propensity score option, then the common support option which results to a group average effect of participation (AEP). Computation of AEP was through propensity score index (i.e. outcome differences between group and non-group participants) for participants similar in personal characteristics. Common support was a mandatory option to ensure matching with controls that are similar to participants.

### 3.3.4 Endogenous Switching Regression and Group Performance

To establish the economics and benefits of group involvement decisions on smallholder dairy farming, this study adopted the self-selectivity modelling method for the assessment of benefits. The model was originally developed and applied by Roy in 1951 in assessing the effects of participation in various selected professions on individual gains (Madala, 2008). The general hypothesis of the model is that an individual's performance differs and is the key determinant of choice. The general model for the effect of group participation on outcome with respect to other farming factors as explained by Madala (2008); Gujarati (2004) and Greene (2003) is represented as:

$$y = x_i \beta_i + \alpha D + \varepsilon_i$$ ..... Equation 3.28

where $y$ is the returns, $x_i$ a vector of exogenous factors (including purchased factors) and D a dummy variable for group membership (D = 1 if farmer is a group member, D = 0 otherwise). Estimator $\alpha$ is a measurement of the effect of group membership decision. Since $\alpha$ is a dummy measure of group participation, it indicates that group participation is endogenous to $y$ and exogenous to some farming factors. If the variable D is only endogenous to $y$ and not exogenous to some other $x_i$ factors, then Equation 3.28 calculation is by Two Stage Least Squares (TSLS), where D is equipped with a correct variable or through treatment model. In this study however, group participation was exogenous to other purchased factors, such as feed and hired labour hence the justification of endogenous switching regression model.

With separate equations for participants and non-participants as well as the selection problem, a participating function has to precede in the first stage to correct for sample selection problem (Society, 2019; Madala, 2008; Greene, 2003). The model expression is as follows:

$$\left.\begin{aligned} y_1 &= \beta_{1i} x_{1i} + \varepsilon_{1i} \\ D &= y_i z_i + \varepsilon_i \end{aligned}\right\} iff D > 0$$ for farmer group participants …….....Equation 3.29

$$\left.\begin{aligned} y_2 &= \beta_{2i} x_{2i} + \varepsilon_{2i} \\ D &= y_i z_i + \varepsilon_i \end{aligned}\right\} iff D \leq 0$$ for non-group participants .....Equation 3.30

where, $y_1$ and $y_2$ are the results for farmer group participants and non-group participants sub-samples respectively. The factors that affect outcome functions for group participants and non-group participants are $x_{1i}$ and $x_{2i}$ respectively. D is a dummy (D = 1, for group participant and D = 0, otherwise), $Z_i$ is a vector of conditional covariates that influence the probability of participating in the farmer group decision. The outcome $y$ variables are the observed conditions determined by the D function, whose approximation via a Probit model yield $y_i$ estimates. The advantage of regime switching model is explicit approximation of the relationship between the two counterfactual

situations and its ability to avoid identification problem as in two-stage least squares. An alternative to switching regime model is Two-Stage Method of Moments (TSM). The two approaches yield similar results, and none is superior to the other (Miranda & Rabe-hesketh, 2006).

Several studies have employed Endogenous Switching Regression model. For instance, Adego *et al.* (2019) used it in Northwest Ethiopia to assess the effect of adaptation strategies on crop productivity using time series climatic data. La *et al*. (2013) applied the model while studying the efficiency of extension programme of dairy groups funded by the government using farm level data to assess their economic influence in Ireland. Ngeno (2018) used the model in studying the dairy hub participation influence on rural household welfare evaluated by farm yields and net gains in Kenya.

### 3.3.5 Endogenous Switching Regression Model and Group Membership Effect

The first stage involved a probit model to predict the probability of improved dairy marketing status. The probit estimation generates the correct Inverse Mills Ratio (IMR), which is then included as an estimator of parameters in the second stage of the structural equations. This procedure solved the sample selection and endogeneity problem, thus allowing for comparison of the coefficients between the two categories of smallholder farmers in the original sample. Marketing effects do not show up as a dummy variable but the constant terms and the betas that differ from the group members and non-group members sub-samples are the ones shown. The difference in the betas showed that marketing in smallholder dairy varied by group membership status, while the difference in the constant term provided the difference in average production and marketing if a group member and non-member have not considered any other production or marketing factor. In a simplified form, the structural equations and participating equation would be:

$y_1 = x_{1i}\beta_{1i} + u_{1i}$ ------ group member structural function ……..... Equation 3.31

$y_2 = x_{2i}\beta_{2i} + u_{2i}$ ------non-group member structural function ……Equation 3.32

$D = z_i\lambda + \varepsilon_i$ ----------group membership function ……..…….… Equation 3.33

By breaking the expressions in Equations 3.31, 3.32, and 3.33, the estimation for group membership function in its first stage becomes:

$pr(D) = z_i y_i + \varepsilon_i$ ……..... Equation 3.34

The left-hand side denotes the effect of farmer group membership as a dummy depending on the sample evaluated. Vector of factors that affect farmer group membership is represented by $z_i$.

In stage two, structural equations for group membership and non-group membership are then split as below:

$\ln y_1 = \sum lnx_i + IMR_{li}$ for group membership sub-sample …….. Equation 3.35

$\ln y_2 = \sum lnx_i + IMR_{2i}$ for non-group membership sub sample….. Equation 3.36

where $y_1$ and $y_2$ are marketing for group members and non-group members respectively, $x_i$ is a vector of marketing factors. These are the same in both regressions while $IMR_{1i}$ and $IMR_{2i}$ are vectors of inverse mills ratios for group members and non-group members generated from first stage of Probit estimates. Essentially, this estimation procedure allowed for the full set of interaction terms between group membership status and factors of marketing. It is useful in the analysis of the dairy commercialisation and

marginal differences between coefficients in accessible factors attributed to the significant contribution of group membership.

The assumptions made in this modelling were that the random term was always positive and had a mean of zero, otherwise the model would produce negative outputs, violating the theory. Moreover, the model assumes that the elasticity of substitution among the marketing factors is unity. This though theoretical, is not correct because factors like farm dairy size and distance to market cannot be substitute for each other on a one-to-one basis. Additionally, this study was not interested in factor substitutions but rather contribution of the factors to the total marketing.

This study majored on how group membership affected milk sales for those in farmer groups. Hence, there was need to evaluate the Average Treatment Effect (ATE) on those treated. The study used non-group members as the control group and utilised them as a counterfactual. Due to non-random self-selection into farmer groups, the study could not simply compare outcomes of members and non-members, but needed to account for self-selection bias. Considering this, there were two potential sources of bias. First, farmers who were members of a group could differ from farmers who are not in group with regard to observable characteristics like education and age. The study controlled for these observed characteristics by utilising propensity score matching (PSM). The primary idea of PSM was to create an appropriate comparison group with non-group individuals who share similarities with farmers in groups in all pertinent observed characteristics (Marco Caliendo, 2005; Heckman *et al.*, 1998). Secondly, group members could differ with regard to unobserved characteristics like motivation. The PSM cannot control for bias because of unobservable characteristics hence the need to undertake the robustness of the effect results via alternative model specifications and by applying different matching algorithms.

The PSM method was used to estimate group membership effect through two stages. In the first stage, propensity scores were generated P(X) from a Probit model, which demonstrated the probability that a farmer is a group member. The second stage was

then the construction of a control group by comparing farmer group members with farmers not in farmer group based on their propensity scores. In the subsequent analysis, the study dropped farmer group members and farmers not in-group who did not have appropriate matches. In the second stage for farmer group membership, the value of ATE was calculated on the outcome of variable Y using matched observations of non-group farmers and farmer group members. The PSM estimator of the ATE is the variation in outcomes between the treatment and control group suitably matched using the propensity score. The study undertook a wide set of result variables to understand group effects and dynamic potentials from a broader perspective.

Heckman *et al.* (1998); Lane and Gibbs (2015) argued that variables used in PSM Probit model should not be trimmed and should instead be excluded in case there was consensus that they were either unrelated to the outcome or were not proper covariate. Caliendo and Kopeinig (2008) further revealed that including non-significant variables in a PSM Probit model would not bias the estimated values or make them inconsistent. Nevertheless, instead of restricting the approximation to farmers in the treatment group, the study used a full sample that included non-group farmers and group members in treatment. This allowed for the analysis from a bigger set of control observations that represented potential matches for group members.

### 3.3.6 Hypotheses Testing for Collective Action

This study tested the hypothesis that Collective Action does not affect milk sales, and socioeconomic factors do not affect Collective Action among smallholder dairy farmers. Group and non-group membership of smallholder dairy farmers give rise to two clusters. The study used Chow test to ascertain the difference in the coefficients between group membership and non-group member sub-samples. It tested the hypothesis of non-significant difference between coefficients of two sample regressions. Commonly, Chow test examines the structural variation of a model's parameter(s) in cases where the disturbance terms are equal. It applies F-test and sum of squared errors from the three

regressions - one for each sample period and one for the pooled data. The expression of Chow test is,

$$Chow = \frac{(RSS - RSS_1 - RSS_2)/k}{(RSS_1 + RSS_2)/(n_1 + n_2 - 2k)} \quad \text{.....Equation 3.37}$$

where RSS represents the Residual Sum of Squares for the pooled regression for both group members and non-group members. $RSS_1$ and $RSS_2$ are the residual sum of squares for regressions of farmers' group members and non-group members' sub-samples respectively. The k represents number of parameters in the regression equations, while $n_1$ and $n_2$ are the number of farmer group members and non- group members respectively. The test statistic is distributed as, F (k, $n_1 + n_2$ -2k) degrees of freedom.

The study also used univariate analysis of variance (ANOVA) for independence of means in comparing the typologies of Collective Action of smallholder dairy farmers. ANOVA is a statistical method applied in the analysis of variance where the response is subject to its different components consistent with the identified sources of variation. Therefore, the study tested the equality of the sample means of the types of Collective Action, using an F test for confidence level. The test statistic expression is,

$$F = \frac{MSC}{MSE} = \frac{Mean\ Square\ between\ the\ Categories}{Mean\ Square\ Error\ within\ the\ Categories} \quad \text{.....Equation 3.38}$$

Additionally, the study used Chi square statistics to demonstrate differences between the clusters.

### 3.3.7 Collective Action Variables and the Hypothesised Effects

Table 3.2 provides the different categories of variables that the study analysed with respect to the objective of collective action.

**Table 3.2: Hypothesised Effects of Variables on Marketing**

| Variable | Variable Definition and Unit | Hypothesised Effect |
|---|---|---|
| *Household characteristics* | | |
| Household Head Age | Years of the Household head | (+,-) |
| Household size | Number of family members | (-) |
| Head Gender | Gender of the Household Head 1 = Male, 2 = Female | (-) |
| Head Education | Level of Head Schooling 1 = Pri, 2 = Sec, 3 = Ter | (+) |
| Main economic activity | 1 = Dairy, 2 = Non dairy | (+) |
| Experience | Number of years in dairy farming | (+, -) |
| Dairy Size | Total number of dairy livestock | (+) |
| Other House hold assets | Value of furniture, electronic etc in Ksh. | (+,-) |
| *Farm Characteristics* | | |
| Farm size | Farm size in acres | (+) |
| Land ownership | 1 = Own, 2 = Rental | (-) |
| Labour type | 1 = Family, 2 = Hired | (+) |
| Family labour | Family labour non remunerated (hours) | (+) |
| Hired labour | Hired labour in the Farm (Hours) | (+) |
| Distance Mkt | Distance between the farm and the nearest market | (+) |
| Distance ext | Distance to the nearest extension service provider | (+) |
| *Group dynamics* | | |
| Group membership | 1 = Yes, 2 = No | (-) |
| Group Size | Number of group members | (+) |
| Group Years | Number of years the group has been inexistence | (+) |
| Group activities | Group activities: 1= Production 2 = Processing, 3 = Marketing, 4 = Production and processing only, 5 = Processing and marketing, 6 = All | (+) |

### 3.4 Commercialisation of Household Dairy

#### 3.4.1 Theoretical Framework for Household Commercialisation

Agricultural commercialisation is the practise of enhancing the quantity of agricultural produce sold by farmers. Household commercialisation can happen on the input side where purchased inputs are greatly used, or on the output side with greater marketed surplus. Commercialisation results from concurrent decisions of farming households with regard to production and marketing. Fast tracking transformation, sustainable growth and development for reducing poverty requires a critical approach of investing in agriculture and commercialisation (Agwu *et al.*, 2013).

Household commercialisation focuses on the theory of the firm, where firms are competitive. The dominating assumption of this theory is that the basic aim of farmers is to maximise profits. Profit maximisation is subject to the technical limitations created by physical production functions (Varian, 1992). Firms make their operational choices based on input and output prices. There are two approaches of modelling agricultural production, the direct and the dual approach. The direct approach holds that specification of production function is necessary to derive input demand and product supply functions. The dual approach on the other hand is founded on the belief that specification of cost or profit function is important for derivation of input demand or the output supply functions. The dual approach is more popular due to its advantages. It is convenient in deriving supply and demand equations consistent with the primal economic theory. It is also able to generate a functional description for supply and demand equations for econometric estimation. Finally, the approach is advantageous in its theoretical approach for using price and cost data for estimating a reliable set of factor demand equations (Just, 2000; Karagiannis & Mergos, 2000).

The level of farmers participation in product markets can be measured either by regarding the proportion of output sold by the commercialisation index or by the total output value sold (Gebreselassie & Sharp, 2008). This percentage can be calculated as a

commercialisation index or the total output value sold (Jaleta *et al.*, 2009). Alemu *et al.* (2006) acknowledged the different methods of commercialisation from four distinct approaches and valued their occurrence at the household level using the following ratios:

1. $$Commercialisation\ of\ agriculture\ (output\ side) = \frac{Value\ of\ agricultural\ sales\ in\ markets}{Agricultural\ production\ value}$$ ……..Equation 3.39

2. $$Commercialisation\ of\ agriculture\ (input\ side) = \frac{Value\ of\ inputs\ acquired\ from\ markets}{Agricultural\ production\ value}$$ ……..Equation 3.40

3. $$Commercialisation\ of\ rural\ economy = \frac{Value\ of\ goods\ and\ services\ acquired\ through\ market\ transaction}{Total\ income}$$ ……..Equation 3.41

4. $$Degree\ of\ integration\ into\ the\ cash\ economy = \frac{Value\ of\ goods\ and\ services\ acquired\ by\ cash\ transaction}{Total\ income}$$ ……..Equation 3.42

Other methods for studying the level of household commercialisation as discussed by Gabre-madhin (2001) include sales to income and sales to output ratios. Additional approaches are absolute and net market positions (either as a net seller or as a net buyer) or level of differentiation in agricultural output.

### 3.4.2 Econometric Specification of Household Commercialisation

Objective Three of the study involved an analysis of smallholder dairy commercialisation. To achieve this, the study first analysed the level of commercialisation and secondly the household characteristics determining the smallholder household participation in commercialisation. For this objective, the study focused only on micro-level factors upon which the dairy farmers operate.

In measuring particular Household Commercialisation Index level (HCI), the study used Equation 3.39, which is a ratio of the gross value of all dairy output sales to gross value of output production. This would therefore, give a range between zero and one. The expression used for analysis was,

$$\mathrm{HCI_I} = \frac{\text{Gross Value of an Output Sales by } i^{th} \text{ Household in year j}}{\text{Gross Value of all Output production by } i^{th} \text{ Household in year j}}$$

…….…….. Equation 3.43

where HCI was the level of dairy commercialisation of the *i*th household and was a measure of the extent to which the household sold its dairy output to the market. An index of zero signifies entire subsistence-oriented household whereas an index of one hundred implies full commercialisation oriented household.

To establish factors that define the smallholder farmer decision to commercialise, the research employed Probit regression model. Commercialisation (dependent variable)

was assumed to be binary hence the justification of the Probit model. Accordingly, the Probit model was as explained by equation 3.44;

$$\Pr ob[y_i = j] = \frac{\exp(\beta_j x_i)}{s(j = 0 - j)\exp(\beta_j x_i)}, j = 0,1.....,J \quad \text{……. Equation 3.44}$$

The left hand side of the equation indicates the individual household commercialisation probability $y_i$ or control group $y_j$. The $x_i$ variables are the observed individual variables. The model representation is,

$$Y_i = \beta X_i + u_i \quad \text{……..…..……Equation 3.45}$$

where $y_i$ represents commercialisation level, x the explanatory variables, and *u* the error term distributed independently.

To establish the household characteristics influencing the commercialisation level of smallholder farmers, the study used double Log regression mode. The specification of double log regression was;

$$Log\, Y = \beta_0 + \beta_1 log X_1 + \beta_2 log X_2 + \beta_3 log X_3 + \cdots\cdots\cdots\cdots + \beta_n log X_n \text{…..Equation 3.46}$$

where: Y is the level of commercialisation, X is the factor that determine the level of commercialisation and ß represent estimable parameters

### 3.4.3 Estimation Procedure of Household Commercialisation

The Household dairy Commercialisation Index was computed as shown in Equation 3.47

$$HCI = \frac{Quantity\ (Lts)\ of dairy\ products\ sold\ by\ household_i in\ year_j}{Quantity\ (Lts)\ of\ all\ dairy\ products\ produced\ by\ household_i in\ year_j} \times 100$$

…….. Equation 3.47

The HCI calculation was a ratio of the total value of dairy products sold by a household to the total value of dairy products produced by the same household expressed as a percentage in Kenya Shilling. The index measures the level of market intended by the smallholder dairy producers. Measurement of commercialisation was set as percentage with a zero-value representing total subsistence and an index of one hundred implying total commercialisation.

The study used a decomposition of the Blinder-Oaxaca Model to analyse the HCI. This model provides a counterfactual decomposition method promoted by Blinder (1973) and Oaxaca (1973). Generally, the procedure studies group differences in any (continuous and unbounded) outcome variable. It is widely used in explaining mean outcome differences between groups. Oaxaca (1973) explains the groups variances by first focusing on the observable characteristics dissimilarities between the groups and secondly by focusing on the dissimilarities in the estimated coefficients (Hlavac, 2014). For continuous observable outcome, this method is easy to apply because it requires only the estimates of linear regression and covariates of sample means only. Several works of literature have adopted Blinder–Oaxaca model in a generalised form to nonlinear models like Logit, Probit and Tobit models (Sinnig, 2008; Fairlie, 2005).

Studies on outcomes in the labour market and other fields have used this methodology intensively (Bonnal *et al.*, 2013; Aristei, 2013).

This study used Blinder-Oaxaca model through a three-fold decomposition in establishing group variations predictors' contribution to the overall outcome variation in Nakuru and Nyandarua counties. The outcome difference analysis has three components. The first component provides a summation of quantities that are part of the differential caused by group dissimilarities in the predictors (the endowments effect). The second component predicts the influence of dissimilarities in the coefficients (including dissimilarities in the intercept). The third component provides an interaction term that accounts for variations in coefficients and endowments existing concurrently between the two groups (Jann & Zurich, 2008).

In using this model for the study, Nakuru and Nyandarua were treated as two independent groups. The model divided smallholder dairy farmers commercialisation into a part that was explained by differences in socioeconomic, and a residual portion that could not be explained by such differences in commercialisation socioeconomic determinants. This unexplained portion was as a measure of discrimination, though it also considered the effects of variations in unobserved predictors. In the study, analysis of decomposition was from the viewpoint of Nyandarua County, which also provided predictors weighted coefficients for group. Stated differently, the endowment effect component measured the mean of Nyandarua's commercialisation outcome, due to its observed characteristics. For the second component, the variations in coefficients were analysed by Nyandarua's predictor levels and provided the anticipated change in Nyandarua's mean outcome, if Nyandarua had Nakuru's coefficients. Naturally, the analogous differentials from the perspective of Nakuru yielded the inverse three-fold decomposition of the endowments effect amounts to the anticipated change of Nakuru's mean outcome, if Nakuru had Nyandarua's predictor levels. The coefficients effect therefore quantified the expected change in Nakuru's mean outcome, if Nakuru had Nyandarua's coefficients.

### 3.4.4 Hypotheses Testing for Household Commercialisation

This study tested the hypothesis that, there are no variations in the levels of smallholder dairy commercialisation, and there are no socioeconomic factors affecting smallholder dairy commercialisation. In testing commercialisation hypotheses, Equation 3.46 was estimated using one-tailed t-test because of the truncation and unidirectional nature of the commercialisation variable. The model showed the characteristics of the household and farm characteristics probably influencing commercialisation. Part of the research interest was testing whether observations were common across the study area. The study estimated models for individual and merged samples from the two counties. These included variables for the two counties (Nakuru and Nyandarua). County variables explained the probable differences that might have arisen due to diversity in economic, human, and ecological conditions of households located in the different counties.

Three actions in the selection and specification of models for use in specific situations were carried out. First, heteroscedasticity within limited-dependent models in unpredictable estimators must be resolved (Brown & Moffitt, 1983; Long & Ervin, 2000; Klein *et al.*, 2016). The study therefore used likelihood ratio tests to assess the homoscedasticity of error terms in the Probit models that consider commercialisation as an exogenously determined variable. These tests also considered heteroscedasticity that may have arisen due to the farm size in individual county sample models, and due to farm size and county characteristics samples in the whole sample of study. The study therefore tested the null hypothesis that the error terms are homoscedastic. Thus, the test would proceed using White's heteroscedasticity consistent covariance matrix estimators. Secondly, an important step was the analysis to establish variables for commercial engagement measured sales-orientation. The aim was to select variables that were appropriate and effective, uncorrelated with the error term and appropriate. Factors that commonly explained market participation included human factors, capital appropriations, and infrastructure. Third, (Wooldridge, 2010) specifies that OLS estimators are more effective than 2SLS when the independent variable is exogenous.

The study used the test of Smith-Blundell in justifying the use of OLS as opposed to 2SLS.

### 3.4.5 Commercialisation Variables and their Hypothesised Effects

Table 3.3 shows the different categories of variables that the study analysed with respect to objectives focusing on commercialisation.

**Table 3.3: Socioeconomic Variables for Commercialisation**

| Variable | Variable Explanation | Expected sign |
|---|---|---|
| Household head | 1 = Male; 0 = Female | (+) |
| Age of Household head | Years attained by the respondent | (-) |
| Household head level of education | 1 = Primary; 2 = Secondary; 3 = Tertiary | (+) |
| Household size | Number of household members | (+) |
| Marital status | 1 = Married; 0 = Not married | (+) |
| Dairy cattle in the farm | Number of dairy cows in the farm | (+) |
| Dairy farming experience | Years of dairy farming | (+) |
| Total land size | Total land available | (+) |
| Distance to Extension services | Distance in Kilometres | (+) |
| Milk produced per day | Milk in litters produced per day | (+) |
| Milk consumed per day | Milk in litters consumed per day | (-) |
| Milk sold per day | Milk in litters sold per day | (+) |
| Group membership | 1 = Member; 0 = Not a member | (+) |
| Distance to the tarmac road | Distance in Kilometres | (+) |
| Years of group Membership | Actual years of a group membership | (+) |
| Market distance | Distance to the nearest market | (-) |

## 3.5 Research Design

### 3.5.1 The Study Area

The study covered Nyandarua and Nakuru counties. Nyandarua County is in the former Central province whereas Nakuru County is in the former Rift Valley province. These two counties border each other. Nyandarua is the largest milk-producing county in Kenya, while Nakuru ranks third. The two counties account for the highest percentage of dairy activities ranging from production, processing, and to consumption. While the dairy system in Nakuru County is mostly semi-intensive, that of Nyandarua is predominantly extensive. The two counties thus constitute a reasonable representation of the dairy production industry in Kenya.

***Socioeconomic characteristics of Nyandarua County***

Nyandarua County covers an area of about 3,245 $km^2$. It is divided into five administrative sub-counties namely, Kipipiri, Kinangop, Ol`kalou, Ol`jorok, and Ndaragwa. These sub-counties have 25 divisions and 70 locations. The county population stands at 638,289 (315,022 male and 323,247 female) (Nyandarua County Government, 2013; KNBS, 2019). Agriculture is the major economic occupation and source of income in Nyandarua. It is the main source of household food and raw materials for agro-based industries in the county. The county has two rainy seasons, with long rains reaching a maximum of 1700mm and the short rains recording a maximum of 700mm. The highest temperature is recorded in the month of December, with a mean of $21^0$C while the coldest month is July, with an average of $7^0$C. The main livestock reared include indigenous and exotic species of cattle and goats, sheep, rabbits, poultry, bees, and fish. The county's Agricultural Sector Development Support Programme (ASDSP) identified dairy, Irish potatoes, and fish as the priority value chains to spur development. The county received an income of KSh. 17 billion from crops with Irish potato accounting for 72% of the figure. Income from livestock was KSh. 7 billion with dairy

accounting for KSh. 6.3 billion, beef KSh. 423 million, poultry KSh. 173 million and fish KSh. 1.2 million (Nyandarua County Government, 2013).

A major challenge to agriculture in the county is poor road network that also affects various economic sectors. There is also a declining production and productivity because of reduction and underutilisation of arable land in addition to increasing costs of production. Prices of inputs have been high, their distribution not well coordinated, and manufactured feeds for cattle and poultry are expensive across the county. Another challenge is poor marketing systems. Due to the poor marketing infrastructure, farmers have resorted to selling their farm produce to the intermediaries at very low prices, making farming an unprofitable venture. Lack of market information and poor technological knowledge have made farmers unaware of better markets for their products and the various seasons when they could fetch good prices. Lack of value addition by local producers is also a challenge. This is due to the unavailability of power in many rural areas, and inadequate skills and knowledge (Nyandarua County Government, 2013).

***Socioeconomic characteristics of Nakuru County***

Nakuru County covers an area of 7,495.1 km². It borders seven other counties namely, Kericho to the west, Baringo and Laikipia to the north, Nyandarua to the east, Narok to the south-west, and Kajiado and Kiambu to the south. The County has eleven administrative sub-counties namely, Naivasha, Gilgil, Nakuru town east, Nakuru town West, Rongai, Subukia, Njoro, Molo, and Kuresoi North, and Kuresoi South. In terms of political units, the county has 11 constituencies and 55 Wards. The total population of Nakuru County is 2,162,202 comprising of 1,077,272 male and 1,084,835 female (Nakuru County Government, 2013; KNBS, 2019). The agriculture sector plays an important role in the provision of food and creation of employment in Nakuru County. The main food crops produced in the county include maize, beans, Irish potatoes, and wheat. The county also grows fruits and vegetables including tomatoes, peas, carrots, onions, French beans, citrus fruits, peaches, apples, cabbages, strawberries, asparagus,

and leeks. Cash crops grown include tea, flowers, wheat, barley, and pyrethrum. The main livestock kept include dairy and beef cattle, pigs, goats, sheep, poultry, rabbits and bees, and fish.

Major challenges to agricultural production in Nakuru County include high level of insecurity, high household poverty levels, poor infrastructure, rural to urban migration, inaccessibility to health services, and inadequate access to clean energy, environmental pollution, and gender inequality. HIV/AIDS, reliance on rain-fed agriculture, inadequate extension services, and laxity in enforcement of land use regulations leading to catchment degradation and soil erosion, poor market access, and limited access to accurate and timely market information also affect agriculture in the county (Nakuru County Government, 2013). Figure 3.1 shows the study area location in Kenya.

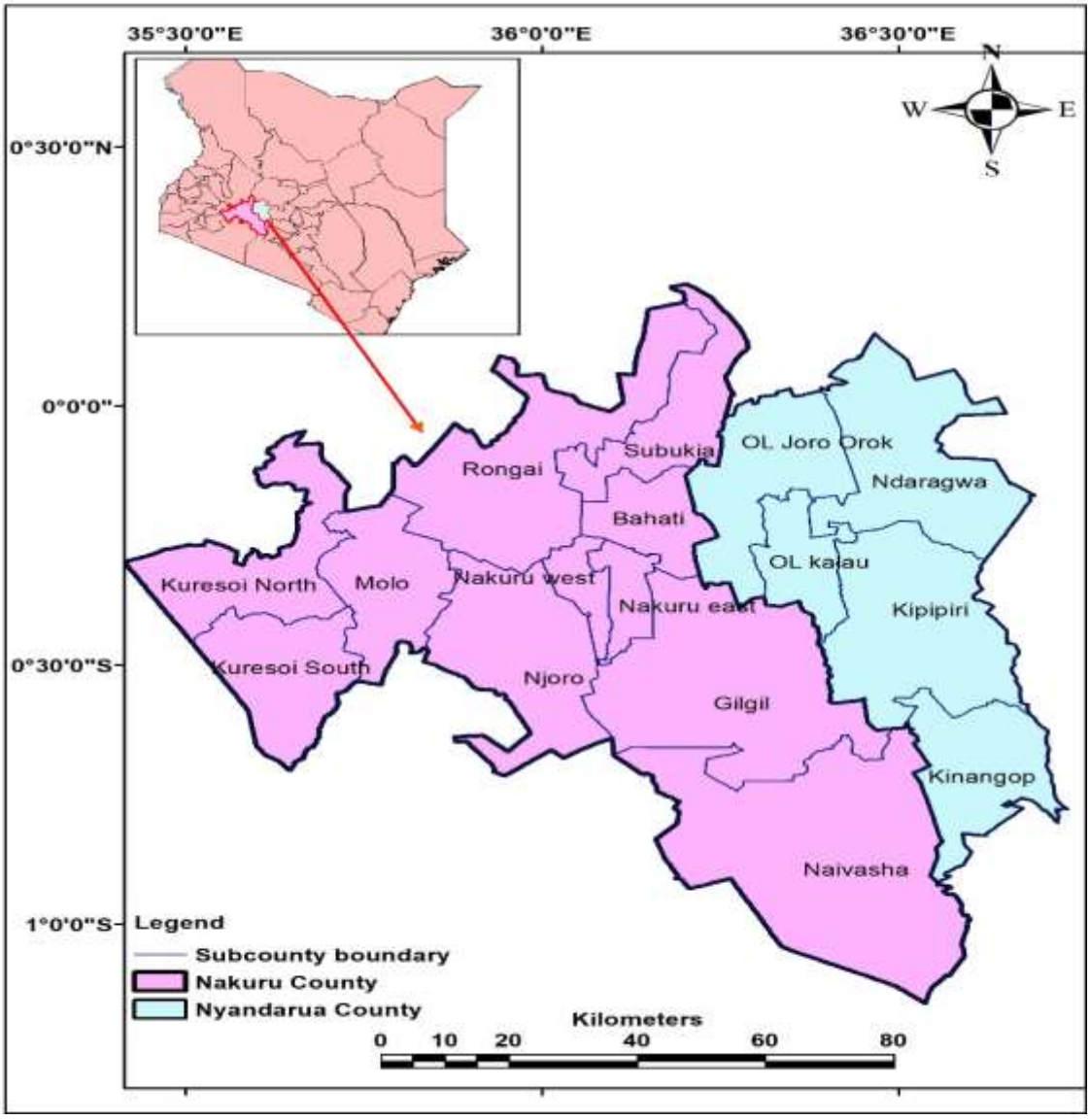


**Figure 3.1: Map of Nakuru and Nyandarua Counties**

### 3.5.2 Research Population

The population of interest was smallholder dairy farmers. The study used both quantitative and qualitative techniques. Qualitative and quantitative data were obtained through Focus Group Discussions (FGDs) and a survey questionnaire administered to the smallholder dairy farmers. FGDs conducted provided additional information on dairy farming and farmer group dynamics of the smallholder dairy farmers. Individual smallholder dairy farmers and farmer groups provided information required for this study.

### 3.5.3 Sampling Procedure and Data Collection

A list of smallholder farmers identified by local leaders provided the study population. The list comprised of all smallholder dairy farmers in the study area. The study used cross-sectional survey approach and multi-stage sampling procedure in selecting the sample of smallholder dairy households who provided data for the study. Purposively, the study identified Nyandarua and Nakuru counties because of their large number of smallholder dairy producers. The administrative sub-counties of the two counties formed strata for sampling. Three sub-counties were selected purposively from each county to be included in the study because of their unique features such as their milk production levels, geographical location, diversity of dairy activities, and their large scope of small-scale dairy production. These were Rongai, Bahati and Molo from Nakuru County, and West Kinangop, South Kinangop and North Kinangop from Nyandarua County.

The sample size was determined by use of the formulae sampling specified by Groebner *et al*. (2005) i.e.

$$n = \frac{(Z^2 PQ)}{d^2}$$ ……..……..Equation 3.48

where, $n$ is the sample size, $Z$ =1.96, $P$ is the proportion of the population of interest. Given that approximately half of dairy farmers are smallholder farmers, $P$ was set to 0.5. Statistically a population proportion of 0.5 results in a sufficient and reliable sample size, particularly when the population proportion is unknown with certainty. Variable $d$, is the significance level set at 5%, as this was adequate to address 95% bias in sampling. This also leads to $Z$ value of 1.96. Variable $Q$ computed, as 1-$P$ is the weighting variable. Based on the above sampling formula, the sample size proposed was:

$[1.96^2 \times 0.5 \times 0.5] / [0.05^2] = 385$. This figure was rounded to 400 smallholder dairy farmers. Simple random sampling was then used to select dairy farmers for the study.

The survey tools, structured questionnaires (Appendix ii) and Focus Group Discussion (FGDs) (Appendix iii) guide were pretested and adjusted accordingly to align with the research objectives. Structured questionnaires administered to the smallholder dairy farmers were to obtain various elements relating to the individual smallholder farmer information. Twelve sessions (two from each sub-county) of FGDs provided more information on smallholder dairy farming. The different sessions of FGDs sessions involved questions focusing on farming systems, farmer group involvements, and dairy commercialisation.

### 3.6 Reliability and Validity of Research Instrument

Perneger *et al.* (2015) recommends a pre-test sample size of at least 30 to discover objectively predominant problems in the research instrument. The study selected fifty respondents from Githunguri Sub-county of Kiambu County purposely to test the questionnaire. Kiambu County was selected for the exercise because it shares almost similar environmental and socioeconomic conditions of the study area. The responses to the research questions were observed and adjustments done accordingly to conform to the research objectives. The pilot test considered the questionnaire content completeness and appropriateness in addition to duration. The researcher sought permission from local leaders to carry out the exercise.

Reliability of the instrument is imperative for keeping the accurateness of the data collection tool (Heale & Twycross, 2015). This study tested the reliability of the questionnaire through the computation of Cronbach's alpha. The acceptable reliability of Cronbach's Alpha is between 0.71 and 0.99 (Mohd *et al.*, 2015). The tested questionnaires revealed a Cronbach's alpha test of 0.83, which qualified the reliability of the instrument. Validity is the meaningfulness and accuracy of inferences based on the research results (Heale & Twycross, 2015; Kimberlin & Winterstein, 2008). It indicates the extent to which results obtained from the analysis of data truly represent the phenomenon being investigated. Certain measures were conducted during the research to ensure validity. First, the survey tools focused on the literature reviewed. Secondly, pretesting of the survey tools were carried out through a pilot survey. Thirdly, there was a review of the research questionnaire and FGD schedule to ensure clarity. Finally, data collection was within a month after the pilot test to avoid the likelihood of major changes that would occur in the dairy industry that would influence the attitudes and opinions of the respondents in the period of the study. In conclusion, the research was conscious to the importance of the quality of the questionnaire and Focus Group Discussions instruments.

### 3.7 Ethical Considerations

Jomo Kenyatta University of Agriculture and Technology (JKUAT) provided the required approval of the study. The research invoked the principle of voluntary participation during the research (Vanclay *et al.*, 2013; Brevik, 2013). The researcher sought consent from prospective research participants by providing full information about their involvement in the research. The researcher ensured that the respondents contributed willingly and freely during the surveys. The study also guaranteed information confidentiality of the respondents and used the obtained information for the research purposes only.

### 3.8 Data Analysis Techniques

The data was analysed and interpreted using both quantitative and qualitative methods of analysis. Descriptive and quantitative analysis was conducted using STATA version 21.0 to obtain inferences using appropriate econometric models and tests. Conclusions arrived at were after careful verification and interpretation of the data.

# CHAPTER FOUR

# CHARACTERISTICS OF SMALLHOLDER DAIRY FARMING

## 4.1 Introduction

This chapter provides a statistical summary of smallholder dairy farming in the study area. It explains household headship characteristics, incomes and expenditures, assets and their values, and a summary of the perceived challenges facing the subsector. Qualitative analysis of the Focus Group Discussions enabled the research to explain the current socioeconomic observations of the smallholder dairy farmers.

## 4.2 Socioeconomic Characteristics of Smallholder Dairy Farmers

Table 4.1 presents the socioeconomic characteristics of smallholder dairy farmers in percentages. The results show that on overall, 83.6% of households were male-headed while female-headed households made up 16.4%.

**Table 4.1: Characteristics of Household Heads and Income Sources**

| Characteristic | Category | Nakuru | Nyandarua | Chi-Sq | Overall |
|---|---|---|---|---|---|
| Gender of head | Male | 83.7 | 83.6 | 0.022 | 83.6 |
| | Female | 16.3 | 16.4 | 0.022 | 16.4 |
| Education level of the head | Primary | 47.5 | 39.3 | 1.667* | 43.4 |
| | Secondary | 38.6 | 50.2 | -2.36** | 44.4 |
| | Tertiary | 13.4 | 10.4 | 0.903 | 11.9 |
| | University | 0.5 | 0.0 | 0.998 | 0.2 |
| Household head residence | Within homestead | 95.0 | 94.5 | 0.235 | 94.8 |
| | Town/other village | 5.0 | 5.5 | -0.469 | 5.2 |
| Employment status of the head | Otherwise | 92.1 | 87.0 | 1.649* | 89.6 |
| | Employed | 7.9 | 13.0 | -1.649* | 10.4 |
| Occupation of the household head | Farming | 86.1 | 76.0 | 2.703*** | 81.1 |
| | Non farming | 4.0 | 1.5 | 1.521 | 2.7 |
| | Farming and non-farming | 9.9 | 22.5 | -3.449*** | 16.2 |
| Main source of family income | Farming | 81.1 | 78.1 | 0.6400 | 79.6 |
| | Non farming | 1.0 | 0.5 | 0.5740 | 0.7 |
| | Farming and non-farming | 17.9 | 21.4 | -0.9016 | 19.7 |

***P < 0.01, **P < 0.05, *P < 0.1

Results also show that the majority of household heads (87.8%) had attained either primary or secondary education, with only 12.1% attaining post-secondary education level. Nyandarua County had significantly ($P < 0.05$) higher proportions of households whose heads had acquired secondary education as their highest education level compared to Nakuru County at 50.2% and 38.6% respectively. In contrast, Nakuru County had significantly ($P < 0.1$) higher number of heads with primary education as the highest level of education compared to Nyandarua at 47.5% and 39.3% respectively. The majority of heads (94.8%) also resided within their homesteads. Overall, the majority of household heads (89.6%) were not engaged in formal employment. Nyandarua County had significantly ($P < 0.1$) higher proportions of household heads in formal employment compared to Nakuru at 13.0% and 7.9% respectively. Similarly, 81.1% of household heads were exclusively involved in farming as their main occupation while 16.2% combined both farming and non-farming activities as their primary occupation. Nakuru County had significantly ($P < 0.01$) higher proportions of households whose heads exclusively relied on farming as their primary occupation at 86.1% compared to 70.0% in Nyandarua. Overall, 79.6% relied on farming as the major family income source while 19.7% relied on both farming and non-farming activities for income.

Table 4.2 provides the t-test results indicating the differences between various socioeconomic characteristics of smallholder dairy farmers in Nakuru and Nyandarua counties.

**Table 4.2: Household Characteristics and Land Ownership Status**

| Characteristic | Nakuru | Nyandarua | t-test | Overall |
|---|---|---|---|---|
| Age of household head | 56.2 | 48.0 | 6.55*** | 52.1 |
| Age of spouse | 51.9 | 43.5 | 6.39*** | 47.7 |
| Number of household members | 6.0 | 5.0 | 1.92* | 5.0 |
| Number of children in school | 2.0 | 2.0 | 0.47 | 2.0 |
| Days in a month the head is available | 28.0 | 28.0 | -0.95 | 28.0 |
| *Distance in Kilometres* | | | | |
| Distance to nearest market | 4.5 | 3.6 | 3.06*** | 4.0 |
| Distance to nearest tarmac road | 2.7 | 4.5 | -3.79*** | 3.6 |
| Distance to nearest extension service provider | 4.7 | 5.0 | -1.01 | 4.9 |
| *Land Ownership* | | | | |
| Total acres owned | 2.8 | 2.6 | 0.54 | 2.7 |
| Total acres rented in | 0.4 | 0.6 | -2.40** | 0.5 |
| Total acres rented out | 0.2 | 0.1 | 1.34 | 0.1 |
| Total acres communally owned | 0.2 | 0.1 | 1.23 | 0.1 |
| Total land accessed | 3.6 | 3.4 | 0.55 | 3.5 |

***P < 0.01, **P < 0.05, *P < 0.1

The results indicate that household heads and their spouses in Nyandarua County were significantly (P < 0.01) younger, with mean ages of 48 and 44 years respectively compared to 56 and 52 years respectively in Nakuru. Nakuru County had significantly (P < 0.1) larger households compared to Nyandarua, with mean household size of 6 members. Households in Nyandarua County were significantly (P < 0.01) closer to markets, with mean distance to the closest market being 3.6 km compared to 4.5 km in Nakuru. Households in Nakuru County were significantly (P < 0.01) closer to tarmac roads compared to those in Nyandarua County the mean distance being 2.7 km and 4.5 km respectively. In the study area, land defined the size of live dairy stock, dairy feed availability and amount of labour required. Overall, smallholder dairy farmers owned an average of 2.7 acres and had access to an average of 3.5 acres of land. Even though there

was no significant difference in total land accessed or owned, households in Nyandarua County on average rented in significantly ($P < 0.05$) more land (0.6 acres) than to those in Nakuru County (0.4 acres).

Table 4.3 presents the t-test results outlining the differences between various sources of monthly income and expenditures of smallholder dairy farmers in Nakuru and Nyandarua counties in Kenya Shillings.

**Table 4.3: Average Monthly Household Incomes and Expenditures**

| | **Nakuru** | **Nyandarua** | **t-test** | **Overall** |
|---|---|---|---|---|
| *Major Income source* | | | | |
| Employment | 18,448 | 14,002 | 0.878 | 6,942 |
| Other businesses | 6,850 | 13,483 | -3.08*** | 8,990 |
| Dairy enterprise | 6,839 | 12,565 | -4.91*** | 10,044 |
| Sale of other farm produce | 17,656 | 30,561 | -2.86*** | 23,977 |
| Sale of livestock | 23,086 | 59,717 | -3.22*** | 37,488 |
| Compost manure | 5,125 | 1,000 | 0.546 | 4,300 |
| Land rented out | 3,000 | 1,067 | 1.124 | 22,109 |
| *Major Expenditure* | | | | |
| Livestock feeds | 5,283 | 13,014 | -4.718*** | 9,465 |
| Veterinary services | 2,933 | 2,482 | 1.139 | 2,694 |
| Farming labour | 7,096 | 10,580 | -1.575 | 8,938 |
| School fees | 50,682 | 43,574 | 0.928 | 47,005 |
| Household Food | 4,288 | 4,871 | -0.830 | 4,589 |
| Household clothing | 6,205 | 3,532 | 6.285*** | 4,749 |
| Household health | 2,107 | 667 | 5.889*** | 1,371 |
| Household transport and fuel | 1,707 | 1,266 | 2.479** | 1,498 |
| Gifts and weddings | 1,293 | 780 | 2.603** | 1,038 |

***P < 0.01, **P < 0.05, (1 $ = KSh 103)

The results show that households in Nyandarua County earned significantly ($P < 0.01$) higher incomes from other business, dairy enterprise, the sale of other farm produce, and sale of livestock compared to households in Nakuru County. In the respective categories, households in Nyandarua County earned KSh 13,483, KSh 12,565, KSh 30,561, and KSh 59,717 while households in Nakuru received KSh 6,850, KSh 6,839, KSh 17,656, and KSh 23,086. The results also show that the sale of livestock and dairy substantially contributed to overall farm incomes in both Counties.

Household expenditure on livestock feed was significantly ($P < 0.01$) higher in Nyandarua at KSh 13,014 compared to KSh 5,283 in Nakuru. Conversely, expenditure on clothing and health were significantly higher in Nakuru compared to Nyandarua. Expenditure on transport and gifts were significantly ($P < 0.05$) higher in Nakuru compared to Nyandarua. Overall, school fees (KSh 47,005), fertilizer (KSh 10,619), livestock feed (KSh 9,465), and seeds (KSh 7,816) were consecutively the largest expenditure items for the households. In Nakuru County, school fees and fertilizer were the major expenditure items while school fees, livestock feeds, labour, and fertilizer were the major expenditure items in Nyandarua. Even though households in the study area spent least on weddings and gifts, households in Nakuru County spent significantly ($P < 0.05$) more on them than households in Nyandarua County.

Table 4.4 indicates household assets and their corresponding values in the study area in Kenya Shillings (KSh). The results indicate that the mean value of dairy cattle was significantly ($P < 0.1$) higher in Nyandarua (KSh 137,535) compared to Nakuru County (KSh 120,035). Farm implement values like hoes and slashers in Nyandarua were significantly ($P < 0.05$ and $P < 0.01$) higher, at KSh 1,726 and KSh 1,066, respectively compared to Nakuru County, at KSh 1,338 and KSh 547 respectively. Households in Nakuru recorded significantly ($P < 0.1$) higher mean values for local cattle (KSh 54,075), wheelbarrows (KSh 3,147), television (KSh 10,960), and bicycles (KSh 9,725) compared to households in Nyandarua County, which recorded KSh 26,867, KSh 2,633, KSh 8,422, and KSh 4,991 for the respective assets. The overall mean household asset value was KSh 2,019,108, a mean value of KSh 2,172,066 in Nyandarua and KSh

1,624,530 in Nakuru. The total value of household assets was higher in Nyandarua than Nakuru. The observed difference was from the values of dairy cattle, poultry, carts, ploughs, hoes, slashers, radios, and mobile phones that were higher in Nyandarua.

**Table 4.4: Household Assets and Values**

| Asset | Nakuru | Nyandarua | t-test | Overall |
|---|---|---|---|---|
| Oxen or Bull | 34,134 | 27,560 | 1.016 | 29,685 |
| Dairy cattle | 120,035 | 137,535 | -1.821* | 129,502 |
| Local cattle | 54,075 | 26,867 | 1.731* | 45,202 |
| Donkey | 15,804 | 12,130 | 1.603 | 14,044 |
| Goat | 25,444 | 20,000 | 0.688 | 24,383 |
| Sheep | 38,900 | 27,540 | 0.631 | 33,699 |
| Poultry | 9,769 | 11,583 | -0.350 | 10,724 |
| Carts | 11,454 | 17,923 | -1.357 | 14,569 |
| Tractors | 1,000,000 | 840,000 | 0.200 | 880,000 |
| Plough | 17,331 | 20,000 | -0.551 | 18,666 |
| Wheel barrow | 3,147 | 2,633 | 2.236** | 2,872 |
| Hoes / Jembes | 1,338 | 1,726 | -2.068** | 1,536 |
| Pangas / slashers | 547 | 1,066 | -5.955*** | 807 |
| TV | 10,960 | 8,422 | 2.516** | 9,841 |
| Radio | 2,148 | 2,234 | -0.279 | 2,189 |
| Bicycle | 9,725 | 4,991 | 1.979* | 7,570 |
| Computer | 38,250 | 33,250 | 0.303 | 35,750 |
| Furniture | 31,029 | 25,117 | 1.193 | 28,168 |
| Mobile phone | 6,369 | 6,739 | -0.636 | 6,554 |
| **Total** | **1,624,530** | **2,172,066** | | **2,019,108** |

***P < 0.01, **P < 0.05, *P < 0.1  1 $ = KSh 103

Dairy production is a resource-intensive venture and quite dependent on the production system adopted. Farmers sought for financial resource boost from financial institutions. Decisions on the sources of financial resource were dependent on resource availability, convenience of access, and other personal reasons that varied by individuals and time. Table 4.5 reveals (in percentages) the behaviour of farmers in Nakuru and Nyandarua counties in relation to the most common financial sources for dairy venture.

Majority of farmers in Nakuru (58.1% of zero grazers, 41.5% of open grazers, and 66.7% of those who tether) accessed financial assistance from self-help groups (SHGs). On the other hand, farmers in Nyandarua mainly utilised the services of commercial banks, cooperatives, and input stores. Generally, the SHGs, cooperatives, commercial banks, and input stores topped the list of financial sources for dairy production in the two counties. Family credit was least among the options available for dairy farming households in both counties.

**Table 4.5: Smallholder Dairy Financial Sources**

| | **Nakuru** | | | **Nyandarua** | | | **Overall** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Zero grazing** | **Open grazing** | **Tethering** | **Zero grazing** | **Open grazing** | **Tethering** | **Zero grazing** | **Open grazing** | **Tethering** |
| ***Financial Sources*** | | | | | | | | | |
| Banks | 6.5 | 10.6 | 0.0 | 29.6 | 23.4 | 0.0 | 17.2 | 15.8 | 0.0 |
| AFC | 3.2 | 1.1 | 0.0 | 0.0 | 3.1 | 0.0 | 1.7 | 1.9 | 0.0 |
| Coop | 12.9 | 8.5 | 0.0 | 25.9 | 25.0 | 28.6 | 19.0 | 15.2 | 15.4 |
| MFI | 3.2 | 8.5 | 8.3 | 3.7 | 1.6 | 14.3 | 3.4 | 5.7 | 11.5 |
| NGO | 3.2 | 5.3 | 0.0 | 3.7 | 0.0 | 0.0 | 3.4 | 3.2 | 0.0 |
| Input-store | 3.2 | 0.0 | 0.0 | 18.5 | 17.2 | 35.7 | 10.3 | 7.0 | 19.2 |
| SHG | 58.1 | 41.5 | 66.7 | 3.7 | 14.1 | 14.3 | 32.8 | 30.4 | 38.5 |
| FG | 6.5 | 8.5 | 0.0 | 7.4 | 7.8 | 0.0 | 6.9 | 8.2 | 0.0 |
| Neighbours | 0.0 | 1.1 | 8.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 3.8 |
| Friends | 3.2 | 8.5 | 16.7 | 3.7 | 7.8 | 7.1 | 3.4 | 8.2 | 11.5 |
| Family | 0.0 | 6.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.8 | 0.0 |
| ***Collateral Needed*** | | | | | | | | | |
| Savings | 45.2 | 53.1 | 36.4 | 51.9 | 67.2 | 7.1 | 48.3 | 59.2 | 20.0 |
| Assets | 9.7 | 16.0 | 54.5 | 22.2 | 13.1 | 50.0 | 15.5 | 14.8 | 52.0 |
| Land | 3.2 | 3.7 | 9.1 | 7.4 | 1.6 | 7.1 | 5.2 | 2.8 | 8.0 |
| Guarantor | 41.9 | 27.2 | 0.0 | 18.5 | 18.0 | 35.7 | 31.0 | 23.2 | 20.0 |

Overall, farmers who practised tethering accessed finances mostly from cooperatives. To access finances from the enlisted sources, surety or guarantee on capacity to pay was a requirement by the financial providers. Savings, asset, land, and guarantors were among the collaterals listed. Most farmers in both counties used savings or guarantors as collaterals. Very few farmers attached land as collateral to access credit for dairy production.

### 4.3 Smallholder Dairy Production Systems

Table 4.6 provides results of commonly practiced dairy production systems in the study area. On overall, the predominant systems were zero grazing and open grazing represented by 31.7%, and 54.3% respectively. Only 14.0% of households practised tethering. In Nakuru, 34.1%, 55.0%, and 10.9% of households practised zero grazing, open grazing and tethering respectively, while 30.2%, 53.8%, and 16.1% practised the three systems respectively in Nyandarua.

**Table 4.6: Smallholder Dairy Systems**

| Category | Nakuru | | | Nyandarua | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | Zero grazing | Open grazing | Tethering | Zero grazing | Open grazing | Tethering | Zero grazing | Open grazing | Tethering |
| ***Dairy system (%)*** | 34.1 | 55.0 | 10.9 | 30.2 | 53.8 | 16.1 | 31.7 | 54.3 | 14.0 |
| ***Type of dairy housing structure used (%)*** | | | | | | | | | |
| **Permanent** | 52.3 | 11.3 | 14.3 | 27.9 | 9.4 | 6.3 | 38.1 | 10.1 | 8.7 |
| **Semi-permanent** | 47.7 | 47.9 | 57.1 | 72.1 | 49.5 | 28.1 | 61.9 | 48.9 | 37.0 |
| **No structure** | 0.0 | 40.8 | 28.6 | 0.0 | 41.1 | 65.6 | 0.0 | 41.0 | 54.3 |
| ***Type of grazing land used (%)*** | | | | | | | | | |
| **Own** | 95.1 | 89.9 | 92.3 | 98.4 | 92.6 | 62.4 | 97.0 | 91.5 | 71.1 |
| **Community** | 4.9 | 5.8 | 7.7 | 0.0 | 0.9 | 0.0 | 2.0 | 2.8 | 2.2 |
| **Leased** | 0.0 | 1.4 | 0.0 | 0.0 | 2.8 | 6.3 | 0.0 | 2.3 | 4.4 |
| **Roadside** | 0.0 | 2.9 | 0.0 | 1.6 | 3.7 | 31.3 | 1.0 | 3.4 | 22.3 |
| ***Main source of labour for dairy (%)*** | | | | | | | | | |
| **Family** | 75.0 | 95.8 | 100 | 86.9 | 92.5 | 90.6 | 81.9 | 93.8 | 93.5 |
| **Non family** | 25.0 | 4.2 | 0.0 | 13.1 | 7.5 | 9.4 | 18.1 | 6.2 | 6.5 |
| ***Current number of dairy animals kept*** | | | | | | | | | |
| | 3 | 3 | 1 | 3 | 3 | 2 | 3 | 3 | 2 |
| ***Years of practicing dairy farming*** | | | | | | | | | |
| | 11 | 13 | 9 | 12 | 14 | 11 | 11 | 14 | 10 |
| ***Main feeding methods used (%)*** | | | | | | | | | |
| **Natural pasture** | 76.4 | 81.7 | 78.8 | 60.8 | 72.0 | 68.8 | 71.4 | 75.7 | 71.7 |
| **Fodder** | 9.1 | 7.3 | 7.1 | 24.6 | 7.5 | 25.0 | 18.1 | 7.3 | 19.6 |
| **Crop stocks** | 10.0 | 3.8 | 9.1 | 6.6 | 12.1 | 3.1 | 6.7 | 8.4 | 4.3 |
| **Dairy meal** | 4.5 | 7.2 | 5.0 | 8.0 | 8.4 | 3.1 | 4.8 | 8.6 | 8.7 |
| ***Frequency of daily dairy meals & concentrates feeding (%)*** | | | | | | | | | |
| **Once** | 15.9 | 22.5 | 21.4 | 21.3 | 36.5 | 59.4 | 19.1 | 30.9 | 47.9 |
| **Twice** | 40.9 | 28.2 | 64.3 | 68.9 | 60.7 | 40.6 | 57.1 | 47.8 | 47.8 |
| **Thrice** | 43.2 | 49.3 | 14.3 | 9.8 | 2.8 | 0.0 | 23.8 | 21.3 | 4.3 |
| ***Who treats dairy animals (%)*** | | | | | | | | | |
| **Veterinary officer** | 97.7 | 95.7 | 78.6 | 96.7 | 99.1 | 87.5 | 97.1 | 97.7 | 84.8 |
| **Self** | 2.3 | 4.3 | 21.4 | 3.3 | 0.9 | 12.5 | 2.9 | 2.3 | 15.2 |
| ***Source of veterinary services (%)*** | | | | | | | | | |
| **Agrovet store** | 34.1 | 44.3 | 50.0 | 86.7 | 76.6 | 59.4 | 64.4 | 63.8 | 56.5 |
| **Veterinary** | 61.4 | 37.1 | 42.9 | 13.3 | 19.6 | 34.4 | 33.7 | 26.6 | 37.0 |
| **Cooperative / Group** | 4.5 | 18.6 | 7.1 | 0.0 | 3.8 | 6.2 | 1.9 | 9.6 | 6.5 |
| ***Source of dairy breeding (%)*** | | | | | | | | | |
| **Own bull** | 4.6 | 5.7 | 35.7 | 0.0 | 5.6 | 0.0 | 1.9 | 5.6 | 10.9 |
| **Borrowed bull** | 6.8 | 8.6 | 7.2 | 4.9 | 5.6 | 18.7 | 5.7 | 6.8 | 15.2 |
| **AI** | 88.6 | 85.7 | 57.1 | 95.1 | 88.8 | 81.3 | 92.4 | 87.6 | 73.9 |

In both counties, open grazing was the most widely used dairy feeding system. Dairy management practices studied included housing, feeding livestock and health. More farmers in Nakuru practised zero grazing with permanent structures than in Nyandarua at 52.3% and 27.9% respectively. Across the three dairy systems, farmers had semi-permanent dairy housing structures with 61.9%, 48.9%, and 37% representing zero grazing, open grazing, and tethering grazing respectively. Overall, 97%, 91.5%, and 71.1% of the farmers practising zero grazing, open grazing, and tethering respectively used own land for dairy farming. Most households owned between 1-3 cows with a few owning more than three dairy cows. Overall, the average dairy farming experience in years was 11, 14, and 10 for zero grazing, open grazing, and tethering respectively.

Dairy production is a labour intensive enterprise in Kenya and the farmers utilise both family and non-family labour to meet the requirements. Results presented in Table 4.6 further indicate that households practising the different production systems relied minimally (6.5%) on casual/hired labour. This suggests that dairy producing households in the study areas relied heavily on family labour (93.5%) in their operations. It also underlines importance of family labour in dairy production in Kenya.

Smallholder dairy farmers mainly served their dairy cattle with fresh natural pasture across the three dairy systems. Overall, 71.4%, 75.7%, and 71.1% of farmers practising zero grazing, open grazing, and tethering respectively confirmed that they use fresh natural pasture as the main feeding method. In addition to natural pasture, farmers used crop residues to supplement their animals. The residues mainly comprised of stalks of maize, sorghum, and millet, and rice straws. Households in the study area mostly grew less than a hectare of napier grass, and other grasses for the dairy animals. The low acreage was due to land inadequacy, and intensive land subdivision coupled with the need to grow food crops for human consumption. Even though napier grass was preferred, households also grew minimum star grass and rhodes grass. Quantities of these feeds grown or stored for cattle were however mostly insufficient because of drought, soil infertility, and overgrazing. To supplement the pasture served to animals, most farmers within the study area fed their livestock twice a day with dairy meal and

concentrates. Overall, only 23.8%, 21.3%, and 4.3% of the farmers fed their livestock thrice a day for zero grazing, open grazing, and tethering respectively. Households fed concentrates mostly during milking times. Both the quality of feed concentrate and frequency were dependent on individual farmers purchasing ability. Most of the households purchased inadequate quantities of concentrate due to high prices and long distances from suppliers.

In all the three dairy systems, more than 84% of the farmers in both counties engaged veterinary officers for treatment of dairy animals. Farmers who treated their animals themselves sought drugs and related services from agrovet stores, veterinary officers, or cooperatives/groups. Of the farmers who treated their animals themselves, 64.4%, 63.8%, and 56.5% of zero grazers, open grazers, and tethering respectively got the drugs and veterinary services from agrovet stores. On the other hand, 33.7%, 26.6%, and 37% of zero grazers, open grazers, and tethering respectively relied on veterinary officers. Smallholder dairy cows were mainly sewed naturally using own bull, borrowed bull, or artificial insemination (AI). The AI was the most preferred method at 92.4%, 87.6%, and 73.9% of the zero grazing, open grazing, and tethering farmers respectively.

### 4.4 Motivation and Perception of Smallholder Dairy farming

Table 4.7 presents the various possible motives for undertaking dairy farming in percentages.

**Table 4.7: Reasons for Dairy Farming**

| | Category | Nakuru | Nyandarua | Overall |
|---|---|---|---|---|
| *Reasons for dairy farming* | | | | |
| For prestige | | 2.6 | 1.0 | 1.8 |
| To produce milk for consumption | | 83.4 | 84.6 | 84.0 |
| For income generation | | 87.6 | 91.5 | 89.6 |
| Availability of technology | | 11.9 | 8.5 | 10.2 |
| The dominant economic activity | | 24.9 | 70.6 | 48.2 |
| No any other work | | 19.7 | 2.5 | 10.9 |
| Dairy farming is easy | | 13.5 | 8.0 | 10.7 |
| *Planning to continue with dairy venture for the next 5 years* | Yes | 90.7 | 99.5 | 95.2 |
| *Reasons for intention to exit dairy farming* | Expensive | 22.2 | 100 | 26.3 |
| | Unprofitable | 11.1 | 0 | 10.5 |
| | Risky | 66.7 | 0 | 63.2 |

The results showed that milk production for home consumption (84%) and income purposes (89.6%) were the main reasons why households practiced dairy farming in both counties. Approximately 48.2% of the farmers engaged in the enterprise because it was the dominant economic activity in their area of residence. In Nyandarua, the main reasons for dairy investment included income generation (91.5%), milk production for home consumption (84.6%), and the fact that it was dominant economic activity in the area (70.6%). In Nakuru County, 87.6% of households practiced dairy farming to generate income, 83.4% to obtain milk for subsistence consumption, and only 25% of households reported practising dairy farming because of its dominance as an economic activity.

Results presented in Table 4.7 also shows that the majority (overall 95.2%, 90.7% in Nakuru and 99.5% in Nyandarua) of the households were planning to continue with dairy production. The few farmers who were planning to exit dairy farming cited varying reasons. The reasons were the enterprise being risky (63.2%), expensive (26.3%), and (10.5%) unprofitable. Whereas in Nyandarua, all the households (100%) planning to quit dairy enterprise pointed out that it was expensive, in Nakuru, 66.7% of the respondents believed it was risky, 22.2% believed it was expensive, and 11.1% indicated that dairy farming was not profitable.

### 4.6 Challenges Facing Smallholder Dairy Subsector

The study also sought to unearth the challenges that faced the smallholder dairy subsector in the study area. The challenges varied by geographical location and socioeconomic variables within the area of study. Table 4.8 presents the challenges in percentages. First, milk losses were generally high among those who practiced open grazing followed by tethering, and least in zero grazing. Four milk loss pathways identified by the farmers were loses at the point of milking, transportation, storage, and delayed milk delivery resulting to spoilage. Overall, 44.7%, 48.7%, and 41.4% farmers reported losing milk in the farm during harvesting for zero grazing, open grazing, and tethering farmers respectively, while 19.7%, 23.9%, and 17.3% lost milk during transportation for zero grazers, open grazers, and tethering respectively. Approximately, 21.1%, 12.4%, and 17.2% milk was lost during storage for zero grazers, open grazers, and tethering respectively, while 14.5%, 15.0%, and 24.1% lost milk due to delivery failure for zero grazers, open grazers, and tethering respectively. There was inadequate and inappropriate investment in cold storage facilities and other essential dairy equipment requiring electricity. In rural areas, electricity was expensive and often unreliable due to frequent blackouts.

**Table 4.8: Smallholder Dairy Farming Challenges**

| Challenge | Nakuru | | | Nyandarua | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | Zero grazing | Open grazing | Tethering | Zero grazing | Open grazing | Tethering | Zero grazing | Open grazing | Tethering |
| *Milk Loss and Point of loss* | | | | | | | | | |
| During milking | 55.0 | 50.0 | 44.4 | 41.1 | 47.8 | 40.0 | 44.7 | 48.7 | 41.4 |
| During transportation | 10.0 | 25.0 | 11.2 | 23.2 | 23.2 | 20.0 | 19.7 | 23.9 | 17.3 |
| During storage | 30.0 | 9.1 | 11.1 | 17.8 | 14.5 | 20.0 | 21.1 | 12.4 | 17.2 |
| Delivery Failure | 5.0 | 15.9 | 33.3 | 17.9 | 14.5 | 20.0 | 14.5 | 15.0 | 24.1 |
| *Financial Accessibility* | | | | | | | | | |
| Not accessible | | 78.6 | | | 83.7 | | | 81.4 | |
| Accessible | | 21.4 | | | 16.3 | | | 18.6 | |
| *Extension Services (Information and Training)Accessibility* | | | | | | | | | |
| Not accessible | | 79.5 | | | 88.7 | | | 84.4 | |
| Accessible | | 20.5 | | | 11.3 | | | 15.6 | |
| *Input and Output Price Satisfaction* | | | | | | | | | |
| Not satisfied | | 97.7 | | | 94.5 | | | 95.9 | |
| Satisfied | | 2.3 | | | 5.6 | | | 4.1 | |
| *Infrastructure* | | | | | | | | | |
| A Problem | | 78.8 | | | 94.4 | | | 87.3 | |
| Not a problem | | 21.2 | | | 5.6 | | | 12.7 | |
| *Veterinary Services Availability and Accessibility* | | | | | | | | | |
| Not accessible | | 71.1 | | | 81.8 | | | 81.8 | |
| Accessible | | 29.9 | | | 8.2 | | | 18.2 | |
| *Dairy Production Technology and Equipment* | | | | | | | | | |
| Not adequate | | 73.7 | | | 54.8 | | | 63.0 | |
| Adequate | | 26.3 | | | 46.2 | | | 37.0 | |

The study confirmed that smallholder dairy farmers had inadequate cooling facilities, resulting in large quantities of the reported milk loss. This study agrees to the finding of Bingi and Tondel (2015) that inadequate and inefficient storage and processing facilities limited the marketability of dairy milk, as it is highly perishable.

Second, dairy operations are capital intensive, need appropriate technology, and good farm infrastructure (Olwande *et al.,* 2015; Mpandeli & Maponya, 2014). Effective and efficient dairy farming therefore requires substantial amounts of financial resources. The results showed that 78.6% and 83.7% of the smallholder dairy farmers in Nakuru and Nyandarua counties respectively attested to the fact that finance was a challenge to them. In the study area, even though farmers had access to loans, the amounts received were inadequate, irregular, and untimely. Smallholder dairy farmers were also prone to using borrowed funds for the unintended purposes instead of financing the dairy enterprise. Due to inadequate finances, farmers had to use inappropriate technologies and poor farm infrastructure. As a result, drudgery was evident in operational activities leading to increased cost of transactions. Ultimately, this slowed down production and commercialisation.

Third, smallholder dairy farmers also cited poor contact with the extension services. The results showed that 79.5% and 88.7% of dairy farmers in Nakuru and Nyandarua counties respectively cited extension services as a challenge. In the study area, poor road network and inaccessibility of many locations limited extension coverage. Motorcycles were the main means of transport used by extension service providers when reaching out to farmers. The motorcycles were however expensive in terms of maintenance and fuel and frequently broke down during field visits. This concurs with the findings of Hailua *et al.* (2015); Mpandeli & Maponya (2014) and Olwande *et al.* (2015) that inadequate accessibility to production and marketing information, inadequate skilled household labour, higher input and distance from local markets negatively affects agricultural development. Farmers also argued that the linkages between research, extension, and training were not adequate for their dairy activities. On average, Kenya expends less than 0.7% of agricultural GDP on research in comparison to developed countries who

devote up to 3% (Karugia *et al.*, 2009). This study result agreed with the assertion by Suttie and Benfica (2014) that African agricultural extension services and innovative research in the smallholder dairy subsector had collapsed and was ineffective for sectorial transformation.

The fourth problem experienced by smallholder farmers was related to input and output market prices. Improved accessibility to input and output resource is a key prerequisite for smallholder dairy transformation. The results indicated that 97.7% and 94.5% of dairy farmers in Nakuru and Nyandarua counties respectively were dissatisfied with the input and output prices. They argued that input prices were high while the output price was low. In the study area, smallholder dairy farmers also experienced persistent volatile input and output prices. To be competitive, smallholder farmers need more efficient markets and local based value addition (Margaret *et al.*, 2015; Ruhangawebare, 2010). Lack of produce markets, high transaction costs, low market technology and information, frequency of diseases, and poor agro-ecological conditions limit agricultural commercialisation (Nalubwama *et al.*, 2018; Hahlani & Garwi, 2014). A study by Hailua *et al.* (2015) showed that the price of animal feeds and limitations in land size, negatively affect dairy production and hence commercialisation.

The fifth challenge was poor road network. The results indicated that 78.8% and 94.4% of the dairy farmers in Nakuru and Nyandarua respectively attested that this challenge hindered their operations. The study revealed that on average, most farmers were located three kilometres away from the market and milk collection centres. Farmers reported irregular road maintenance even after the heavy rainy seasons which damage the few existing all weather roads in the counties. Roads servicing some areas were also not accessible. This greatly affected dairy inputs availability and delivery of milk. The results of this study agree with Mpandeli & Maponya (2014) who found out that dairy farming effectiveness was affected by poor road infrastructure. Input and output supplies and their prices, market accessibility, veterinary services, and education and information dissemination necessary for dairy farming are dependent on road infrastructure (Suttie & Benfica, 2014).

## 4.7 Conclusions and Recommendations

### 4.7.1 Conclusions

The findings of this study led to a number of key conclusions. Land, household income, and market were key elements in smallholder dairy farming. Smallholders used both own and leased land for dairy activities. Land defined the size of dairy stock kept, dairy feed availability and amount of labour required. The study observed that household income was important in smallholder dairy farming. It determined a farm's capital investment level in addition to farm input purchase, necessary appropriate technology adoption, and intensification of dairy production. The study revealed that milk produced by farmers in the two counties was for household consumption or sale. While zero grazing was the most productive system, open grazing was the dominant one. An additional key finding from the study was that socioeconomic factors, which varied in the two counties, affected smallholder dairy enterprise. Results also showed that a majority of the smallholder households were planning to continue with dairy enterprise. The few who intended to exit the venture cited risk, high cost, or non-profitability as the reasons for wanting to quit dairy farming. Productivity, infrastructural, and institutional related impediments affected smallholder dairy farming. Major challenges encountered by smallholder dairy farmers were milk losses, inadequate resources, poor extension services, poor road infrastructure, inadequate inputs, inadequate capital, and inaccessible credit.

### 4.7.2 Recommendations and Policy Implications

Dairy productivity improvement requires review of land policy to address land related challenges that include accessibility, subdivisions, and land use practices. The study recommends improvement in the quality and quantity of animal feeds. Commercialisation and conservation of fodder and concentrates would promote quality assurance systems and standardisation of dairy feed. There is also need to enhance accessibility and reliability of veterinary and insemination services.

Road infrastructure needs improvement to aid in accessibility of inputs and output markets. Expansion of electrification in milk producing areas and downward reviewing of electricity tariffs will improve the sector performance. Alternative sources of energy such as solar, wind, and biofuel need promotion to reduce the high dependence on hydroelectricity. As improvements on cold storage facilities are undertaken, it is also necessary to explore alternative methods of milk preservation.

Dairy farming requires enhancement of relevant institutions. The three relevant institutions identified by the study are first, Collective Action initiatives (such as SACCOS) to promote financial accessibility. Second, involves enhancement of on-farm entrepreneurial, and management ability, involving dairy hygiene, nutrition, marketing, and extension services, to improve the dairy farmer's efficiency. Third, involves relevant research agenda to guide technological innovations accustomed to the specific needs of dairy sector.

# CHAPTER FIVE

# TYPOLOGIES OF SMALLHOLDER DAIRY FARMING

## 5.1 Introduction

This chapter presents and discusses results emanating from Objective One of the study. It determines and explains the predominant types of smallholder dairy farming and socioeconomic factors influencing them. In addition, the chapter suggests recommendations to improve the different types of smallholder dairy farming.

## 5.2 Principal Components Analysis (PCA) Results

The Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity (BTS) for Principal Components Analysis (PCA) were undertaken and results obtained are presented in Table 5.1. The results showed that BTS was 4144.31 with a p-value of 0.0000, indicating the appropriateness of the data for PCA. The KMO value was 0.6870, indicating sufficiency of items for each factor. The tests therefore supported the appropriateness of the application of PCA to the analysis.

**Table 5.1: KMO and Bartlett's Test of Principal Components**

| **Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy** | **0.6870** |
|---|---|
| **Bartlett Test of Sphericity (Chi-Square)** | 4144.31 |
| **DF** | 666 |
| **P-value** | 0.0000 |

This study applied the 'elbow' criteria (Ledesma *et al.*, 2015) in explaining the PCA results. The Kaiser rule for Principal Component Analysis provide for retention of only factors with Eigenvalues greater than one (Pugno & Verme, 2012). In this study, twelve components met this requirement and accounted for 61.58% of the total variance (Table 5.2).

**Table 5.2: Components and Total Variance Explained**

| Component | Eigenvalue | Proportion | Cumulative | Variance | Proportion | Cumulative | Variance | Proportion | Cumulative |
|---|---|---|---|---|---|---|---|---|---|
| Comp1 | 4.5862 | 0.1147 | 0.1147 | 4.42217 | 0.1106 | 0.1106 | 3.72647 | 0.1007 | 0.1007 |
| Comp2 | 3.4697 | 0.0867 | 0.2014 | 3.22095 | 0.0805 | 0.1911 | 3.6253 | 0.098 | 0.1987 |
| Comp3 | 2.5083 | 0.0627 | 0.2641 | 2.55394 | 0.0638 | 0.2549 | 2.57077 | 0.0695 | 0.2682 |
| Comp4 | 2.1546 | 0.0539 | 0.3180 | 2.52167 | 0.063 | 0.318 | 2.18405 | 0.059 | 0.3272 |
| Comp5 | 1.9705 | 0.0493 | 0.3672 | | | | | | |
| Comp6 | 1.7660 | 0.0441 | 0.4114 | | | | | | |
| Comp7 | 1.6621 | 0.0416 | 0.4529 | | | | | | |
| Comp8 | 1.5167 | 0.0379 | 0.4908 | | | | | | |
| Comp9 | 1.3245 | 0.0331 | 0.5240 | | | | | | |
| Comp10 | 1.2921 | 0.0323 | 0.5563 | | | | | | |
| Comp11 | 1.2331 | 0.0308 | 0.5871 | | | | | | |
| Comp12 | 1.1487 | 0.0287 | 0.6158 | | | | | | |
| Comp13 | 0.9984 | 0.0250 | 0.6408 | | | | | | |
| Comp14 | 0.9733 | 0.0243 | 0.6651 | | | | | | |
| Comp15 | 0.9157 | 0.0229 | 0.6880 | | | | | | |
| Comp16 | 0.8702 | 0.0218 | 0.7097 | | | | | | |
| Comp17 | 0.8182 | 0.0205 | 0.7302 | | | | | | |
| Comp18 | 0.8084 | 0.0202 | 0.7504 | | | | | | |
| Comp19 | 0.7863 | 0.0197 | 0.7701 | | | | | | |
| Comp20 | 0.7349 | 0.0184 | 0.7884 | | | | | | |
| Comp21 | 0.7236 | 0.0181 | 0.8065 | | | | | | |
| Comp22 | 0.6780 | 0.0170 | 0.8235 | | | | | | |
| Comp23 | 0.6675 | 0.0167 | 0.8402 | | | | | | |
| Comp24 | 0.6499 | 0.0162 | 0.8564 | | | | | | |
| Comp25 | 0.6042 | 0.0151 | 0.8715 | | | | | | |
| Comp26 | 0.5866 | 0.0147 | 0.8862 | | | | | | |
| Comp27 | 0.5545 | 0.0139 | 0.9000 | | | | | | |
| Comp28 | 0.5074 | 0.0127 | 0.9127 | | | | | | |
| Comp29 | 0.4632 | 0.0116 | 0.9243 | | | | | | |
| Comp30 | 0.4353 | 0.0109 | 0.9352 | | | | | | |
| Comp31 | 0.4101 | 0.0103 | 0.9455 | | | | | | |
| Comp32 | 0.4012 | 0.0100 | 0.9555 | | | | | | |
| Comp33 | 0.3509 | 0.0088 | 0.9643 | | | | | | |
| Comp34 | 0.2880 | 0.0072 | 0.9715 | | | | | | |
| Comp35 | 0.2699 | 0.0067 | 0.9782 | | | | | | |
| Comp36 | 0.2551 | 0.0064 | 0.9846 | | | | | | |
| Comp37 | 0.2007 | 0.0050 | 0.9896 | | | | | | |
| Comp38 | 0.1698 | 0.0042 | 0.9938 | | | | | | |
| Comp39 | 0.1461 | 0.0037 | 0.9975 | | | | | | |
| Comp40 | 0.1003 | 0.0025 | 1.0000 | | | | | | |

Source: Calculations by author based on the 2017 survey data.

The results of the scree plot (Figure 5.1) showed that the first four factors (accounting for 32% of the total variance) showed substantial variation from each other and hence retained for this study. Additionally, the Cronbach's alpha test yielded a coefficient of 0.7369 on all items indicating that the scale was reliable. The four retained components also had Cronbach's alpha values of greater than six ($\alpha > 6$) indicating that the classifications were highly reliable (Gliem & Gliem, 2003).

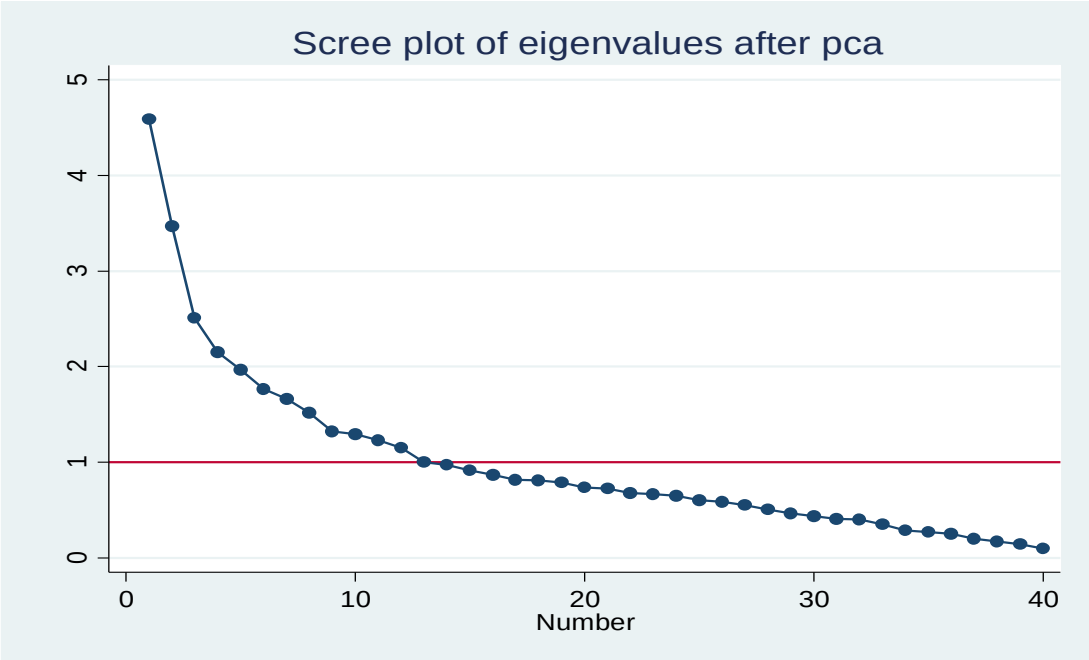


**Figure 5.1: Scree Plot for the Eigen Values**

Table 5.3 provides the results of the components selected and retained.

**Table 5.3: The Principal Components Factor Loading**

| Factor and Item Description | Factor Loadings | % Variance Explained | Cronbach Alpha Test |
|---|---|---|---|
| *Factor 1: Milk Output Factor* | | *11.47* | *0.7659* |
| Highest amount of milk produced per day | 0.4025 | | |
| Lowest amount of milk produced per day | 0.4049 | | |
| *Factor 2: Land Control Factor* | | *8.67* | *0.9295* |
| Owned acres | 0.3989 | | |
| Total acres accessed | 0.3912 | | |
| *Factor 3: Household Income Factor* | | *6.25* | *0.8881* |
| Occupation of the household head | 0.4915 | | |
| Source of Household Head income | 0.4962 | | |
| *Factor 4: Physical Infrastructure Factor* | | 5.39 | 0.5770 |
| Distance to Market | *0.3696* | | |
| Distance to Extension service | 0.4033 | | |
| *Total Variance Explained* | | 31.78 | |

The first retained component had Cronbach's alpha value of 0.7659 and it accounted for 11.47% of the variance. The component included two items namely, the highest quantity of milk produced daily (0.4025) and the lowest quantity of milk produced daily (0.4049). This component was labelled as *'Milk output factor'*. The second retained component had a Cronbach's alpha value of 0.9295 and accounted for 8.67% of the total variation. The component had two items namely owned acres and total acres accessed with factor loadings of 0.3989 and 0.3912 respectively. This component was labelled as *'Land control factor'* as it only included land variables. The third retained component had a Cronbach's alpha value of 0.888 and accounted for 6.25% of the variation. It included two items namely, the occupation of the head (0.4915) and the source of household income (0.4962). The third component was labelled *'Household income factor'* since it was characterised by income-related variables. The fourth retained

component had a Cronbach's alpha value of 0.577 and accounted for 5.39% of the variation. The component was labelled as *'Physical infrastructure factor'* and contained two items namely, distance to market and distance to the nearest extension with factor loadings of 0.3696 and 0.4033 respectively. Therefore, based on the Eigenvalues and factor loadings results output, land, income, and infrastructure were the most important considerations in the characterisation of smallholder dairy households.

## 5.3 Cluster Analysis (CA) Results

### 5.3.1 Smallholder Dairy Farming Typologies

Table 5.4 presents the results of Cluster Analysis (CA) for the smallholder dairy farmers. The different clusters provide different typologies. The results showed that dairy farmers were not homogeneous and they differed based on various socioeconomic characteristics. The results from ANOVA indicated that three distinct types of smallholder dairy farmers exist as shown.

***Typology 1: Low resource endowed and low commercialisation***

Cluster 1 was composed of 225 households, representing 59.21% of the sample. The study categorised this cluster as Typology 1. Households in this cluster had access to relatively less land. They owned an average of 2.3 acres and had an access to a total of 3.2 acres. They were relatively less experienced in dairy farming, having practised for 11 years on average. They owned an average of 2 dairy cows. These farmers exhibited less resource endowment with an average total asset value of KSh 128,502 and an average monthly income of KSh 38,865. The households were also relatively less productive, with the highest average amount of milk produced per day being 11.2 litres and daily household consumption of 1.8 litres. Their monthly dairy operation cost was lowest, at KSh 7,530 and KSh 3,585 for farm operations and labour respectively. This cluster reported no permanent employee. These households are the least commercialised with Household Commercialisation Index (HCI) of 0.691.

**Table 5.4: Characteristics of Clusters Based on Means**

| Socioeconomic Characteristics | Cluster 1 | Cluster 2 | Cluster 3 | F | Prob > F |
|---|---|---|---|---|---|
| Household commercialisation (HCI) | 0.691 | 0.781 | 0.819 | 8.63 | 0.0002 |
| Gender of head | 0.804 | 0.888 | 0.905 | 2.54 | 0.0799 |
| Age of head (Years) | 51.853 | 52.269 | 53.333 | 0.14 | 0.8702 |
| Household size | 5.538 | 5.134 | 6.048 | 1.76 | 0.1737 |
| Distance to market (Km) | 4.078 | 4.049 | 3.143 | 1.07 | 0.3436 |
| Distance to tarmac (Km) | 3.499 | 4.079 | 3.098 | 0.74 | 0.4779 |
| Distance to extension (Km) | 4.832 | 4.681 | 5.976 | 1.17 | 0.3119 |
| Owned acres | 2.311 | 3.212 | 4.660 | 8.75 | 0.0002 |
| Total acres | 3.164 | 3.936 | 5.886 | 7.06 | 0.0010 |
| Dairy years | 11.283 | 14.119 | 12.476 | 3.32 | 0.0372 |
| Current number of cows owned | 2.044 | 3.567 | 4.952 | 55.87 | 0.0000 |
| Number of permanent employees | 0.076 | 0.254 | 0.476 | 10.42 | 0.0000 |
| Number of casual employees | 0.502 | 0.530 | 0.762 | 0.63 | 0.5307 |
| Group membership | 0.676 | 0.597 | 0.571 | 1.37 | 0.2559 |
| Household income (KSh) | 38865.19 | 45357.35 | 123704.8 | 20.13 | 0.0000 |
| Asset value (KSh) | 128502.4 | 294054.0 | 1242476.0 | 179.53 | 0.0000 |
| Number of pure breeds | 1.173 | 2.187 | 2.952 | 26.05 | 0.0000 |
| Amount of milk consumed (Ltr) | 1.804 | 2.168 | 2.214 | 5.24 | 0.0057 |
| Highest milk produced (Ltr) | 11.202 | 17.168 | 24.524 | 23.34 | 0.0000 |
| Operation costs (KSh) | 7530.013 | 9634.433 | 14439.52 | 3.61 | 0.0279 |
| School fees (KSh) | 35488.94 | 30828.33 | 35173.33 | 0.26 | 0.7726 |
| Labour costs (KSh) | 3585.556 | 6961.194 | 10800.000 | 4.65 | 0.0101 |
| *Cluster frequency* | *225* | *134* | *21* | | |
| *Cluster distribution* | *59.21%* | *35.26%* | *5.53%* | | |

1$ = 103 KSh

***Typology 2: Moderate resource endowed and moderate commercialisation***

Cluster 2 was composed of 134 households representing 35.26% of the sample. The study categorised this cluster as Typology 2. Smallholder dairy farmers' commercialisation in this cluster was moderate with HCI of 0.781. Households in this

cluster had a moderate landholding, owning an average of 3.2 acres and accessed a total of 3.94 acres. They were the most experienced in dairy farming, with 14 years on average and owned an average of 4 dairy cows. These farmers were moderately resource endowed, with an average total asset value of KSh 249,054. They also had an average monthly income of KSh 45,357. The households exhibited moderate milk production, with the highest average quantity of milk produced per day of 17.2 litres. Their daily household milk consumption was 2.2 litres. Their monthly expenditures were KSh 9,634 and KSh 6,961 on farm operations and labour respectively. This cluster also reported no permanent employees.

***Typology 3: High resource endowed and high commercialisation***

Cluster 3 was composed of 21 households representing 5.53% of the sample. The study categorised this cluster as Typology 3. Households in this cluster were accessible to relatively greater land ownership, at an average of 4.7 acres and access to a total of 5.9 acres. They were moderately experienced in dairy farming with 12.5 years on average and owned an average of 5 dairy cows. The farmers in this cluster were more resource endowed. They had an average total asset value of KSh 1,242,476 and average monthly income of KSh 123,704. The households were also relatively more productive with the highest average amount of milk produced per day of 24.5 litres and a daily household consumption of 2.2 litres. Their monthly expenditure was also higher at KSh 14,440 and KSh 10,800 on farm operations and labour respectively. This cluster registered no permanent employees. These households were highly commercialised with HCI of 0.819.

### 5.3.2 Determinants of Smallholder Dairy Farming Typologies

Tables 5.3 and 5.4 provide results from PCA and Cluster Analysis, of the distinctive factors that determine smallholder dairy typologies. These results indicated that:

*Land factors* were key in smallholder dairy farming. Smallholders in the study area used both own land and leased land for dairy activities. The results indicated that own land acreage and total acres of land both significantly ($P < 0.01$) determined smallholder dairy farming types. Land dictated the stock of the dairy reared, the availability of dairy feed, and the amount of work required. Dairy farmers who had access to less land or who depended on rented in land were restricted in dairy enterprise decisions. Conversely, farmers who rented-in land emphasised on making profit in the short run hence intensified production. They were also constrained in carrying out some specific activities including installation or upgrading of dairy infrastructure and mechanisation because they would vacate the land upon expiry of tenancy. The size of land coupled with the type of ownership influenced intensity, type of dairy system, and extent of dairy production. In the study area, small land holding compromised productivity of enough quality fodder hence increased the cost of production. This study finding agrees with Wily (2012) who found that accessible land could highly be divided into smaller and inefficient units. This would result in land fragmentation, inefficient production systems, and reduced production in smallholder dairy subsector. The study finding agrees that decreasing size of land holdings is a major threat among smallholder dairy farmers as argued by Makoni *et al.* (2013) and van der Lee *et al.* (2016). Land was also important as a collateral when soliciting finance. Hence, it dictated the financial ability in smallholder dairy farming.

*Dairy farming experience* affected dairy operations. The experience is achievable through formal education and training, relationship with informal networks, and learning by practice time. Experience expressed in years significantly ($P < 0.05$) determined smallholder farming typology. The dairy farming typologies differed considerably with farming experience. The findings indicated that there were variations in farmers' years of experience. Experience led to differences in dairy management under different environmental and economic situations. Farmers with greater experiences managed and fed their dairy stock relatively better, realised more milk production, and therefore received higher revenues. Farms run by more experienced farmers stood out in four

ways. First, they manifested better dairy farming management, which included cleaner stables, more organised milking practices, and better water accessibility. Secondly, they had better dairy nutrition that included more feed resources such as, corn silage, grass silage, and dry Leucaena leaves. These provided high nutritional value especially during times of scarcity also characterised by difficult economic times. Thirdly, they had better dairy health care due to enhanced knowledge of common diseases. They seldom call veterinarians to assist, thus minimising costs as explained by Yeamkong *et al.* (2010). Fourth, practical skills acquired over time enabled smallholder dairy farmers to adopt proper feeding, housing, calf rearing, fertility management, and record keeping practices. These were vital for improving productivity and reduction in the cost of production for greater profitability as previously noted by Ettema (2012). Experience therefore improves efficiency, through adoption of suitably dairy production resources decisions, and management. Variations in dairy farming experience and hence dairy husbandry resulted in the observed differences in the farming typologies.

*Dairy breed stock* determined smallholder farming typology. Dairy herd stock varied significantly ($P < 0.01$) among the typologies. In the study area, farmers used crossbreeding as the main breeding strategy in improving milk production. However, crossbreeding resulted in the loss of native breeds and the subsequent loss of their unique genetic traits that enable their adaptation to local environments, resistance to local disease as well as the capacity for thriving on low-quality feed and inadequate water. Strategies for crossbreeding need appropriate assessment of the local economic, cultural and social conditions, as well as the role of farm animals (Groot & van't Hooft, 2016). Farmers in the study area kept local breeds, cross breeds, and exotic breeds. Farmers with bigger herds purchased more dairy farming inputs like concentrate and dry feed composed of crop residues as well as the need to provide more water. The daily feed requirement of dairy cattle always varied for various stock ages, level of production, and quality of feed (FAO & IFCN, 2018). Smallholder dairy farmers therefore had to harmonise the feed supply and animal demand in such ways that the desired milk production is realised. Hence the need to match the resources and the needs

of the animals kept. The number of dairy animals kept therefore determined the amount of resources and the way the farm was managed which varied from typology to the other.

*Cost of labour* significantly ($P < 0.05$) determined smallholder dairy farming typology. Optimisation of dairy farm performance requires labour management (Panda & Samanta, 2018). In the study area, family labour was used for smallholder dairy farming and for off-farm economic activities. Some farmers stated that they hired labour for dairy farms as family members engaged in non-dairy or off-farm jobs. Dairy farming is labour intensive and was therefore highly dependent on labour quality, quantity, availability, and wage rate. These labour factors affected dairy farming decisions. Carson (2018) and Migose *et al.* (2018) argued that production systems that are dependent on relatively low wages to be profitable would face challenge for their commercial survival. Labour factors determined the timing of all the dairy daily activities. In the study area, every day work in a dairy farm included feeding the cows, watering and cleaning, maintaining cowshed, checking the health of cow, milking the cow, processing, and marketing of the produce. A dairy farmer with off-farm engagements would be relatively less available to provide decisions or do the dairy activities. The size of the dairy herd determined the variation in labour input requirement. As the number of dairy animals increased, there was need for more labour.

*Household income* was a significant ($P < 0.01$) determinant of smallholder dairy typology. In the study area, income defined the ability of a household to finance farm capital and secure required dairy inputs. It also determined the level of capital investment of a farm in addition to the purchase of farm inputs, appropriate technology adopted, and intensification of milk production. These findings agreed with those reported by Bórawski *et al.* (2020) and Kebebe (2017). Income could also be a collateral in sourcing for credit as found by Vrolijk and Poppe (2019). Available income determined the purchase of farm equipment that substituted the human labour and reduction of human labour demanded. Additionally, income could reduce income risk for households practicing smallholder dairy farming as it increased the incentive of

adoption of risky but profitable farm technologies besides commercialisation of smallholder dairy (Abbas *et al.,* 2019). More household income could facilitate increment in use of the factors of production in dairy production (Bórawski *et al.,* 2020).

*Dairy output and consumption levels* defined the type of smallholder dairy farming. Both the quantity of milk produced and the amount consumed by the smallholder dairy farmers significantly ($P < 0.01$) affected the farming typology. Dairy growth, as it relates to inputs of labour, feed, land, or size of herd, has been the major trajectory of change in the dairy system and hence increased milk output (Mairi & Munir, 2007). Improving productivity, through increasing efficiency to increase revenue continually, provides a foundation on which dairy system policies are based (McGregor & Houston, 2018). In the study area, production, seasonality, quality and quantity of animal feed compounded by the use of supplement feeds affected milk production and consumption. Inappropriate farming and animal husbandry practices, inadequate and costly animal health services, poor access to breeding stock, and credit services in addition to high artificial insemination (AI) service costs were some of the main limitations. The study area had poor dairy infrastructure like cold storage, poor milk marketing and collection systems, and limited farmers' involvement in the output and input market. Poor collaborations and priority setting between training, research, and extension also limited output and consumption.

*Dairy farming assets* affected smallholder farming typology. The dairy farming assets varied significantly ($P < 0.01$) among the typologies. Farming assets like fodder cutter, knapsack sprayers, milking cans, treatment equipment, transportation equipment, and other relevant production equipment owned by the farmers defined competency in smallholder dairy enterprise. Availability of equipment facilitated timely dairy production related decisions. This varied from farm to farm. Even though investments in dairy assets result in improvements in animal welfare, this process needs capital (Bórawski *et al.,* 2020). For effective dairy transition, farm practices require innovation in housing, feeding, and marketing which are determined by the changes and dynamics in the process of production and value addition (Kilelu *et al.,* 2017). More inputs

necessary for pre and post production need adequate resources and services from the farmers (Oosting *et al.,* 2014). The ability of farmers to transition from subsistence to commercialisation depends on their access to production, resource base, conduciveness of relevant factors, and presence of service arrangements. Resource endowments explain the variability of farmers' participation in various chains. Non-optimal framework and market conditions could delay the transition to commercialisation from subsistent orientation (van der Lee *et al.,* 2018).

*Operational costs* significantly ($P < 0.05$) determined smallholder farming typology. Global food product market and food safety determine the structure and level of production costs (Langrell *et al.,* 2012). In the current study area, the price per litre of milk varied with average costs of production an observation that was also noted by Staal *et al.* (2014) and Ojango *et al.* (2011). The observed cost variations were because of geographical location and intensity of production as observed by Baltenweck (2013). In the study area, concentrate feed for dairy animals were inadequate in quality despite being highly priced. Inadequacy and highly priced feed was due to reliance on imported feed ingredients, high cost of feed, and rampant trade malpractices in the feed industry. Besides the feeds, the AI was also expensive and unreliable and smallholder dairy farmers incurred high cost in attaining improved and pure breeds. Dairy animals were subject to several health complications and involved costs. In high inputs dairy farming systems, farmers invested in farm and dairy equipment such as feed mixers, dryers, and milk-cooling equipment, whose costs were high. To achieve sustainable milk production, estimation of the unit cost of milk produced is important. The study agrees with Viira *et al.* (2015) who noted that production costs are significantly important in making necessary changes in input utilisation.

## 5.4 Conclusion and Recommendations

### 5.4.1 Conclusions

The study revealed that there were three significantly different smallholder dairy farming typologies. They were low resource endowed and low commercialisation, moderate resource endowed and moderate commercialisation, and high resource endowed and high commercialisation. The determinants of smallholder dairy typologies were land factors, experience in dairy farming, stock of dairy animals, labour engaged, household income, farming assets, dairy output and consumption levels, and costs of production.

Ownership, accessibility, and management of land are critical in smallholder dairy farming. There were uncertainties about accessibility to and ownership of land posing a significant limitation to the smallholder dairy farmers. Land dictated the dairy stock size, dairy feed availability, and amount of labour required. Decisions on dairy businesses were a challenge to farmers who had less land or who relied on rented land. Land was also widely used as a collateral when sourcing for finance and therefore dictated financial capability in smallholder dairy farming.

Income determined the level of investment in capital of a farm, purchase of farm inputs, and the intensification of dairy production. Income could reduce risk for smallholder dairy farming by being an incentive of adoption of risky but profitable farm technologies besides enhancing dairy commercialisation. Small-sized dairy farmers relied on informal money lending besides own sources with minimum dependency on family and friends. Smallholder dairy farmers cited inadequate capital and expensive credit as a factor behind the low productivity and marketing for dairy.

Relevant and efficient dairy farming assets and resources were key to enhancing performance in the study area. Assets could be used as collateral, and hence determined income and capital besides being used during production and marketing processes.

Assets quantity and quality also influenced smallholder dairy farmer investments and thus smallholder dairy farming typology. Seasonality in production, inadequate quality and quantity of animal feed, and use of supplement feeds were key features noted in the study area. Inappropriate farming management and animal husbandry practices, animal health, poor access to breeding, credit services, and high cost of dairy services were cited as the draw-backs for the sector success. Substantial quantities of their milk produced tend to go bad and not marketed. Farmers on their own could not meet the expected quantity, safety, quality, and delivery schedules demands to enable them to have a competitive advantage in the markets.

Infrastructure played a significant part in smallholder dairy farming in the study area. Distance to markets determined how opportunities and new investments could result to the desired revenue. Market distance defined the exchange relations between smallholder dairy producer and other stakeholders in the sector including extension service providers. Distance also dictated the extent of price stability or volatility and was key in defining the overall relationship between the farmers and other players.

### 5.4.2 Recommendations and Policy Implications

Based on the conclusions above, the study fronts several recommendations. Increase in land through land reform processes is necessary. Security of land tenure is also necessary for the smallholder dairy farmers, through execution of strategies on sustainable control of land tenure, ownership, and accessibility. There is also the need to put in place appropriate governance on utilisation of common property resources as in such practices as open grazing.

There is the need for improvement in smallholder access to financial resources. This involves easing monetary transactions for instance promoting phone based money transfers, facilitating safe deposits to encourage saving, low-cost credit through joint group borrowing, and lending. The policies should not only seek to promote long-term investments, but also lower transaction costs and minimise associated risks.

Adequate public goods access on both the input and output sides are important for smallholder dairy farmers. Enacted policies need to emphasise on investment in infrastructural development such as roads and electricity, health services, education, sanitation, and social amenities. This is critical in enhancing dairy welfare and operational effectiveness.

Also needed are policies that refocus on extension and research systems accustomed to the needs of smallholder dairy farmer typologies. Interventions should target the dairy subsector stakeholders with an aim of addressing systemic problems that hamper the growth and development. They should address systemic issues related to low quantity and poor quality of raw milk, cost of production, feeding/fodder, and total farm management.

# CHAPTER SIX

# COLLECTIVE ACTION IN SMALLHOLDER DAIRY FARMING

## 6.1 Introduction

This section presents and discusses results for Objective Two of the study. It looks into characterisation of smallholder dairy farming groups and the factors influencing smallholder dairy farming group decision. It also presents a summary of the perceived challenges facing the farmer groups and proposes policies that would improve dairy farmer groups' performance.

## 6.2 Smallholder Dairy Collective Action Characterisation

Table 6.1 highlights the characteristics of farmer groups in the study area in percentages. The study revealed an overall group membership of 66% in the study area. Majority (82%) of households in Nakuru belonged to groups compared to Nyandarua at 50%. In the whole study area, Self-Help Groups (SHG) were the most dominant (56.1%), followed by Farmer Based Organisations (FBOs) (31.8%), Cooperative Societies (6.4%), and Savings and Credit Cooperatives (SACCOs) (5.7%).

**Table 6.1: Group Membership, Distribution, and Existence**

| | | Nakuru | Nyandarua | Overall |
|---|---|---|---|---|
| Group Membership | Yes | 82 | 50.2 | 66.1 |
| | No | 18 | 49.8 | 33.9 |
| Group Distribution | SHG | 57.3 | 54.0 | 56.1 |
| | FBO | 32.3 | 31.0 | 31.8 |
| | COOP | 4.3 | 10.0 | 6.4 |
| | SACCO | 6.1 | 5.0 | 5.7 |
| Years of Group Existence | 0 - 5 | 46.7 | 32.3 | 41.3 |
| | 6 - 10 | 43.6 | 36.4 | 40.9 |
| | 11 - 15 | 9.7 | 21.2 | 14 |
| | 16 - 20 | 0 | 8.1 | 3 |
| | 21 - 25 | 0 | 1.0 | 0.4 |
| | Over 25 | 0 | 1.0 | 0.4 |
| Group Objectives Achieved | Yes | 99.4 | 99.0 | 99.2 |

Results shown in Table 6.1 reveals that majority of groups (90.3% in Nakuru and 68.6% in Nyandarua) had been inexistence for a maximum period of 10 years. The groups achieved their primary objectives with a response rate of 99.4% and 99% in Nakuru and Nyandarua respectively.

The study revealed three types of activities that the groups focused on namely, backward linkages, forward linkages, and hybrid linkages. Backward linkages involved activities before milk production. These included provision of production inputs such as dairy feed and concentrates, veterinary services, and extension services such as animal husbandry. Forward linkages undertook activities carried out after milk production. These activities were processing, packaging, storage, cooling, selling, and negotiating for better terms in the market for the dairy outputs. Hybrid linkage involved one or more activities of both the backward and forward linkages.

Table 6.2 demonstrates (in percentages) that in Nakuru, Self Help Groups, Cooperatives, and SACCOs were mostly engaged in backward linkages with minimal forward or hybrid linkages. In Nyandarua however, SACCOs led in hybrid linkages at 80% while cooperatives and Farmer Based Organisations were involved in forward linkages. Overall, both Farmer Based Organisations and Cooperative societies displayed active participation in the three linkages.

**Table 6.2: Group Type versus Distribution of Activities**

| Group type | Activities | Nakuru | Nyandarua | Overall |
|---|---|---|---|---|
| Self-help group | Backward linkage | 62.8 | 53.7 | 59.5 |
| | Forward linkage | 5.3 | 40.7 | 18.2 |
| | Hybrid linkage | 31.9 | 5.6 | 22.3 |
| Farmer Based Organisation | Backward linkage | 39.6 | 0.0 | 25.0 |
| | Forward | 13.2 | 71.0 | 34.5 |
| | Hybrid linkage | 47.2 | 29.0 | 40.5 |
| Cooperative society | Backward linkage | 71.4 | 10.0 | 35.3 |
| | Forward linkage | 14.3 | 60.0 | 41.2 |
| | Hybrid linkage | 14.3 | 30.0 | 23.5 |
| SACCO | Backward linkage | 90.0 | 0.0 | 60.0 |
| | Forward linkage | 10.0 | 20.0 | 13.3 |
| | Hybrid linkage | 0.0 | 80.0 | 26.7 |

Table 6.3 presents key attributes considered for groups' leadership in percentages. The results show that group members directly did election of leaders in the majority of the groups (92.2% in Nakuru and 87.9% in Nyandarua). It was observed that majority of leaders in the groups were males (53.7% and 62.8% for Nakuru and Nyandarua respectively). Fifty percent of the groups in Nakuru considered primary education as the minimum educational requirement for leadership compared to Nyandarua where majority of the groups (71.4%) considered secondary education as the minimum requirement.

**Table 6.3: Dairy Farmers Groups Leadership Characteristics**

| Variable | Category | Nakuru | Nyandarua | Overall |
|---|---|---|---|---|
| How are leaders selected | Consensus | 6.1 | 8.1 | 6.8 |
| | Election | 92.1 | 87.9 | 90.5 |
| | Nomination | 1.2 | 4.0 | 2.3 |
| | Job Interviews | 0.6 | 0.0 | 0.4 |
| Majority of the leaders | Male | 53.7 | 62.8 | 57.0 |
| | Female | 46.3 | 37.2 | 43.0 |
| Minimum education | Primary | 50.0 | 27.6 | 41.6 |
| | Secondary | 39.0 | 71.4 | 51.1 |
| | Tertiary | 11.0 | 1.0 | 7.3 |
| Age consideration | Yes | 14.6 | 19.2 | 16.3 |
| | No | 85.4 | 80.8 | 83.7 |
| Age of chairperson | 20-30 years | 6.1 | 0.0 | 3.8 |
| | 31-40 years | 13.4 | 17.2 | 14.8 |
| | 41-50 years | 19.5 | 36.3 | 25.9 |
| | above 50 years | 61.0 | 46.5 | 55.5 |
| Age of secretary | 20-30 years | 1.8 | 11.1 | 5.3 |
| | 31-40 years | 21.4 | 50.5 | 32.3 |
| | 41-50 years | 30.5 | 29.3 | 30.1 |
| | above 50 years | 46.3 | 9.1 | 32.3 |
| Age of treasurer | 20-30 years | 1.8 | 4.0 | 2.7 |
| | 31-40 years | 13.4 | 26.3 | 18.3 |
| | 41-50 years | 37.2 | 33.3 | 35.7 |
| | above 50 years | 47.6 | 36.4 | 43.3 |
| Period of leaders to be in service | One year | 18.3 | 30.3 | 22.8 |
| | Two years | 36.0 | 40.4 | 37.7 |
| | Three years | 39.6 | 19.2 | 31.9 |
| | Above three years | 6.1 | 10.1 | 7.6 |
| Leaders changed after term ends | Yes | 100.0 | 86.9 | 95.1 |
| Are leaders Motivated | Yes | 36.6 | 15.2 | 28.5 |
| | No | 63.4 | 84.8 | 71.5 |
| How are leaders Motivated | Money | 58.3 | 71.4 | 60.8 |
| | Non money | 41.7 | 28.6 | 39.2 |
| Which leader is rewarded | All leaders | 93.3 | 100 | 95.5 |
| Leaders have other jobs | Yes | 52.4 | 25.3 | 42.5 |
| | No | 47.6 | 74.7 | 57.5 |
| If yes, Which jobs? | Teacher | 52.3 | 8.6 | 39.7 |
| | Business | 37.2 | 71.4 | 47.1 |
| | Religious leader | 10.5 | 20.0 | 13.2 |

Age was not a major consideration for group leadership. Nevertheless, the majority of chairpersons in the groups were above 50 years old. Group secretaries in Nakuru (46.3%) fell in the 50 years and above age category while in Nyandarua they were younger with the majority being between 31 and 40 years old. Overall, group leaders stayed in service for between 2 and 3 years, and were replaced after their terms expired. Majority of the groups did not motivate their leaders. Those who did however used money (60.8%).

Table 6.4 indicates leadership attributes (in percentages) considered by group members in selection of their leaders. The attributes cited were activeness in the groups (80.8%), trustworthiness (77.2%), ability to represent members in external meetings, and ability to enforce rules and regulations (each at 65.5%). Other considerations were ability to motivate group members (63.7%), good communication skills (62.6%), ability to coordinate activities (58.4%), good work ethics (51.6%), and ability to initiate activities (50.5%). Age and economic status were least considered attributes in selection of group officials, accounting for 10% and 12% respectively.

**Table 6.4: Group Leadership Attributes**

| Variable | Nakuru | Nyandarua | Overall |
|---|---|---|---|
| Activeness in the group | 77.1 | 87.3 | 80.8 |
| Trustworthiness by members | 78.2 | 75.5 | 77.2 |
| Ability to coordinate activities | 62.6 | 51.0 | 58.4 |
| Ability to initiate activities | 58.1 | 37.3 | 50.5 |
| Good work ethics | 55.9 | 44.1 | 51.6 |
| Good communication ability | 57.5 | 71.6 | 62.6 |
| Motivating group members | 63.7 | 63.7 | 63.7 |
| Attending external meetings | 69.8 | 57.8 | 65.5 |
| Enforcing rule and regulations of the group | 64.2 | 67.6 | 65.5 |

### 6.3 Effect and Determinants of Smallholder Dairy Farmer Group Participation

Table 6.5 presents findings of the Propensity Score Matching (PSM) using the Kernel matching method. In the study, the famers in group(s) represented the treated. The results showed a positive and a significant ($P < 0.001$) effect of the treatment effect. An addition of 2.6 litres in milk sales (on the treated) resulted due to the treatment effect. This means that those in groups sold significantly more milk relative to households not in groups.

**Table 6.5: Treatment Effect on Milk Sales Using Kernel Matching**

| Treatment | Control | ATT | Bootstrapped SE | t |
|---|---|---|---|---|
| 243 | 134 | 2.570 | 0.826 | 3.112 |

*t-score >1.960 is significant

Table 6.6 presents predicted milk sales for households not in groups given their current situation and the counterfactual i.e. had they been in groups.

**Table 6.6 Predicted Milk Sales and Counterfactuals**

| | Non-group households | |
|---|---|---|
| **Statistics** | **Observed** | **Counterfactual** |
| Mean sales | 3.37503 | 11.17386 |
| SE (mean) | 0.3710125 | 0.6873485 |

The results indicated that households not belonging to groups recorded a mean milk sale of 3.4 litres per day. Had the farmers been in group(s), they would have recorded higher milk sales, averaging 11.2 litres daily. This suggests that group(s) membership played an

important role in improving smallholder dairy sales. This study agrees with others (Hoken & Su, 2018; Chagwiza *et al.,* 2016; Mojo, 2015; Michalek *et al.,* 2018) that Collective Action is a viable avenue for smallholder farmer enterprise improvement and commercialisation. Thus, smallholder farmers stand a better chance of improving on their dairy commercialisation when in groups. Otherwise, they would miss out the benefits if operated individually.

The farmers had to make decisions on group membership participation given the number of farmer organisations in dairy producing areas. A farmer's decision to join a group relied on individual comparative advantage judgment of the perceived benefits and costs. Table 6.7 presents the estimations of the factors of group participation among the smallholder dairy producers using the PSM model.

Gender is important in describing labour supply in a household. Results showed that gender was a key determining factor of household decision to join groups. The effect of gender was positive and significant ($P < 0.05$). Male headed household increased chances of being in a farmer group relative to households headed by females. Godquin & Quisumbing (2006) and Huyer (2016) showed that the male had an increased probability of joining groups than women. Men decide on responsibilities like production alternatives, marketing actions, community organisation membership, and political participation. Women's activities are limited to household and involve childcare, food preparation, and subsistence agriculture (Nakazi *et al.,* 2017).

## Table 6.7: Determinants of Smallholder Dairy Group Participation

| | Selection | | Non-group | | Group | |
|---|---|---|---|---|---|---|
| **Variables** | **Coefficient** | **P-value** | **Coefficient** | **P-value** | **Coefficient** | **P-value** |
| Gender of head (male=1) | 0.447** | 0.1023 | -2.625*** | 0.0003 | 0.00509 | 0.9943 |
| Zero grazing | -0.00286 | 0.9902 | 0.424 | 0.6574 | 0.774 | 0.3304 |
| Open grazing | -0.115 | 0.6021 | 0.323 | 0.7237 | 0.920 | 0.2298 |
| Highest quantity of milk produced | -0.0135* | 0.0517 | 0.533*** | 0.0000 | 0.592*** | 0.0000 |
| Family Income | -0.386 | 0.6131 | 0.108 | 0.9720 | 1.575 | 0.5595 |
| Primary school | 0.00278 | 0.9589 | 0.353 | 0.7245 | -0.912 | 0.2557 |
| Secondary school | 0.123 | 0.0569 | 0.0725 | 0.9401 | -0.629 | 0.4161 |
| Number of pure breeds kept | -0.222** | 0.004357 | 0.355* | 0.0976 | 0.389** | 0.0496 |
| Number of cross breeds kept | 0.124 | 0.3905 | -0.239 | 0.3897 | -0.00910 | 0.9632 |
| Family labour | 0.00418 | 0.5490 | 0.616 | 0.5999 | -0.831 | 0.3542 |
| Coop as market (Yes =1) | 0.0152 | 0.9247 | 0.677 | 0.2276 | 0.801 | 0.1208 |
| Years of dairy farming | 0.00000428 | 0.8977 | -0.0296 | 0.2723 | -0.0118 | 0.6516 |
| Permanent employees | 0.0000954 | 0.2193 | -0.0428 | 0.9547 | 0.133 | 0.7899 |
| Health cost per year | 0.447 | 0.1023 | 0.00000559 | 0.9672 | -0.0000911 | 0.4256 |
| Cost of labour per year | -0.00286 | 0.9902 | -0.0000339 | 0.3376 | 0.0000304 | 0.1063 |
| Primary | 0.101 | 0.6686 | | | | |
| Married (Yes =1) | -0.276** | 0.03469 | | | | |
| Single (Yes =1) | 0.259 | 0.4242 | | | | |
| Divorced (Yes =1) | 0.861 | 0.1600 | | | | |
| Farming as main occupation (Yes =1) | 0.0870 | 0.7835 | | | | |
| Non farming as main occupation (Yes =1) | -0.490 | 0.3414 | | | | |
| *_cons* | *0.570* | *0.5341* | *-1.489* | *0.6739* | *-0.325* | *0.9173* |
| *lns1* | *1.308**** | *0.0000* | | | | |
| *lns2* | *1.287**** | *0.0000* | | | | |
| *r1* | *-0.0879* | *0.8497* | | | | |
| *r2* | *-1.342**** | *0.0012* | | | | |
| *N* | *380* | | | | | |

LR test of indep. eqns: $chi^2(1) = 23.80$ Prob > $chi^2 = 0.0000$ ***P < 0.01, **P < 0.05, *P < 0.1

Compared to men, women tend to have different prospects, incentive, and abilities to participate in Collective Action (Meier, 2016; Kaaria *et al.,* 2016). As a result of their reproductive duties in addition to farming, women may tend to experience higher opportunity costs in terms of time, which may negatively affect their incentives for group membership (Huyer, 2016; Fischer & Qaim, 2012a).

The quantity of milk produced at household level significantly ($P < 0.01$) affected group membership negatively. As households improved on milk production, they tended not to join groups. A 1% increment in milk production resulted to 1.4% decline of group membership. There are two probable reasons that could explain this behaviour. First, it could be because as smallholder dairy farmers harvest more milk, they tended to be contented with the level of their enterprise performance. They saw no reason to be in groups, because they were achieving their farming objectives. Secondly, it could be that as output increased, additional time was required to ensure performance of the entire dairy farming responsibilities. Hence, there was reduced motivation and time for participating in farmer groups. This was a deception of self-reliance while actually there were potential incremental benefits if a farmer participated in a group. Farmers with higher production ability depended less on cooperatives to access markets, and often considered exiting cooperative arrangements (Cechin, 2013). This finding agrees with those of Francesconi and Wouterse (2015); Cechin (2013) who argued that larger producers have better bargaining power and reduced transaction costs and therefore tend to depend less on cooperatives.

The number of pure breed and cross breed positively and significant ($P < 0.01$) affected group membership. As the number of dairy stock increased by 1%, there was an increase in the chances of being in a farmer group by 22.2%. The farmers fronted two reasons for this observation. First, the dairy stock required increased care and they could get guidance on various dairy management issues conveniently from the group members. Secondly, as dairy stock increased, there was an increase in milk output realised by the farmers, as previously noted by Florence *et al.* (2018); Kimenchu *et al.* (2015). The study results also indicated the need for training on dairy husbandry and access to AI

services. Access to training and AI services and their availability increases the chances of improving dairy management. Kurgat *et al.* (2019) argued that group membership not only increased the collective acquisition of resources and marketing but also the sharing of dairy production and marketing knowledge and learning experience between members. Group membership also provided an avenue for group marketing and its related benefits. Similar arguments were fronted by Omondi and Njehia (2014); Olwande and Mathenge (2012); Mwaura (2014).

Marital status exhibited a negative and significant ($P < 0.05$) result. This implied that the correlation between group membership and being married was negative. Being married lowered the chances of group membership by 27.6%. Three probable reasons could explain this observation. First, being married increased commitment to family matters at the expense of group affairs. Second, spouses could also dictate group participation and compromise their spouse's commitment to group participation. Third, couples were to consult and reach a consensus on a project participation, which would require some time. This observation agrees with the findings by Etwire *et al.* (2013), Oladejo and Olawuyi (2011). Single or divorced persons however, have higher chances of group membership as a result of freedom and reduced relationship demand as argued by zu Selhausen (2013). This result was however contrary to Nnadi & Akwiwu (2008) who argued that married farmers would participate more in an agricultural project for improvement. This is because of increased concern for food security and household welfare.

### 6.4 Factors Influencing Choice of Groups by Smallholder Dairy Farmers

Dairy farmers who decided to participate in farmer organisations had also to make decisions on which group types to join. Table 6.8 provides the Multinomial Logit econometric results for the factors that affected a smallholder dairy farmer decision on which group to be a member of relative to SHG. There are different reasons for choosing different types of groups to join (Adong *et al.,* 2013). The study considered Self-Help

Group (SHG) as the basis of comparisons of groups. The Pseudo $R^2$ value of 0.5828 indicated that the model explained 58.28% of the total variation.

The number of leaders positively and significantly ($P < 0.1$) affected choice of SHG relative to Cooperatives/SACCO by a factor of 1.74. In the study area, SHGs had relatively fewer leaders compared to Cooperatives and SACCOs. Groups in the study area mostly selected their leaders through a democratic process of free and fair election. Specifically, age and socioeconomic status determined the chairperson's selection. Secretary position was often the preserve of individuals with higher education while treasurer position was often left for female members due to their perceived trustworthiness, as argued by Ochieng *et al.* (2018). Smallholder dairy farmers preferred fewer group leaders to minimize the challenges of power structures and free riding. Free riding occurs when self-interested individuals do not act jointly to achieve the group or shared interest, making it difficult for Collective Action initiatives to be effective. Also in the study area, fewer group leaders were preferred for leadership cohesion. The finding of this study however differs from that of Tallam *et al.* (2016) and Foys (2014) who found out that a group's ability to meet their objectives increases as leadership increases in size.

**Table 6.8: Group choice influencing factors: Multinomial Logit Model Results**

| Base=Self Help Group (SHG) | Farmer Based Organisation | | Cooperative / SACCO | |
|---|---|---|---|---|
| **Variables** | **Coef** | **P > \|t\|** | **Coef** | **P > \|t\|** |
| Achievement objectives (Frequent=1) | 0.293 | 0.7027 | 0.142 | 0.9564 |
| Achievement of objectives (Not frequent=1) | -17.11 | 0.9943 | -5.159 | 0.9986 |
| Number of meetings in a month | 0.146 | 0.1037 | 0.0226 | 0.9526 |
| Group meeting frequency (Very regular=1) | -3.190 | 0.1317 | 5.383 | 0.9981 |
| Group meeting frequency (Regular=1) | -2.654 | 0.1819 | 9.984 | 0.9965 |
| Number of leaders in the group | 0.100 | 0.4113 | 1.742* | 0.0689 |
| Gender of majority of leaders (Male=1) | -0.697 | 0.2176 | -4.446 | 0.2328 |
| Minimum education of leaders (Secondary=1) | -0.230 | 0.7129 | 5.706* | 0.0754 |
| Age consideration in leader selection (Yes=1) | -0.0685 | 0.9235 | 10.32 | 0.1006 |
| Leadership period (2 years) | 3.294*** | 0.0001 | 4.127 | 0.2324 |
| Leadership period (3 years) | 2.072** | 0.0186 | 4.915 | 0.2299 |
| Leadership period (4 years and above) | 3.586** | 0.0216 | 13.84* | 0.0679 |
| Leaders changed after term (Yes=1) | 0.949 | 0.4860 | 17.99 | 0.9892 |
| Leaders rewarded (Yes=1) | -0.347 | 0.5818 | -4.982 | 0.1094 |
| Popularity (Yes=1) | 0.472 | 0.4523 | 2.890 | 0.3901 |
| Activeness in the group (Yes=1) | 1.626** | 0.0267 | 12.45 | 0.4955 |
| Age of the group | -2.389** | 0.0140 | 0.580 | 0.8593 |
| Education level (Yes=1) | 1.519** | 0.0255 | 3.347 | 0.2216 |
| Economic status (Yes=1) | -1.316 | 0.1372 | -1.905 | 0.4485 |
| Trustworthiness to members (Yes=1) | 1.530** | 0.0347 | 4.665 | 0.1433 |
| Ability to coordinate activities (Yes=1) | 0.867* | 0.0964 | 5.369 | 0.1312 |
| Ability to initiate activities (Yes=1) | -0.574 | 0.2700 | 4.231 | 0.1824 |
| Good work ethics (Yes=1) | -1.564** | 0.0176 | -0.318 | 0.8699 |
| Tolerance to different views (Yes=1) | 0.802 | 0.1830 | -2.688 | 0.3925 |
| Good communication ability (Yes=1) | -1.054* | 0.0611 | -4.155 | 0.1018 |
| Outstanding reputation in community (Yes=1) | -1.215** | 0.0450 | 1.538 | 0.5197 |
| Recruiting of new members (Yes=1) | 0.718 | 0.2564 | 8.274* | 0.0556 |
| Motivating group members (Yes=1) | 1.121* | 0.0565 | 0.732 | 0.7590 |
| Attending of external meetings (Yes=1) | -0.508 | 0.3554 | -4.170* | 0.0912 |
| Finding buyers for member's produce (Yes=1) | -0.774 | 0.1782 | 3.793 | 0.2572 |
| Negotiating produce price (Yes=1) | 2.137*** | 0.0008 | -2.708 | 0.4139 |
| Enforcing rules and regulations (Yes=1) | -1.842*** | 0.0024 | -5.151* | 0.0956 |
| Understanding of sanctions (Yes=1) | 1.344 | 0.5479 | -2.633 | 0.2911 |
| Understanding payment of group dues (Yes=1) | -0.453 | 0.5720 | -3.711 | 0.9970 |
| Meeting attendance (Very frequent=1) | 0.876 | 0.8759 | 7.956 | 0.9955 |
| Frequency of meeting attendance (Frequent=1) | -0.240 | 0.2634 | 11.91 | 0.4623 |
| Penalty for absenteeism limit(Fines=1) | -2.944*** | 0.0011 | 5.656 | 0.3603 |
| Penalty for absenteeism limit (Warnings=1) | -1.358* | 0.0880 | 4.510 | 0.6329 |
| Behaviour of the group (Very much=1) | 0.497 | 0.5675 | -0.201 | 0.9480 |
| Behaviour of the group (Affect=1) | 0.0231 | 0.9726 | 1.339 | 0.4364 |
| _cons | 1.738 | 0.6714 | -78.71 | 0.9815 |
| ***N*** | **255** | | **255** | |

***P < 0.01, **P < 0.05, *P < 0.1

Leadership period affected the choice of SHG relative to FBO. Leadership period of 2 years significantly ($P < 0.01$) affected the choice SHG by a factor of 3.29, whereas 3 and 4 years of leadership period significantly ($P < 0.05$) affected the choice of SHG by a factor of 2.07 and 3.59 respectively. In addition, in the case of leadership period of 4 years and above, smallholder farmers significantly ($P < 0.1$) preferred SHG to Cooperative by a factor of 13.8. The results indicated that smallholder dairy farmers preferred groups where leaders served for fewer years. Members cited that leadership was better if held in a manner that members had a chance of leading the group at any capacity hence a sense of belonging and ownership. Most farmers underlined the importance of group constitution stipulating leaders' selection process. They also noted that re-election of leaders was possible for more terms due to few or no member expression of interest. This was because leadership was majorly voluntary and could be extremely involving yet mostly not rewarded.

Activeness of the group significantly and positively ($P < 0.05$) affected the choice of SHG to FBO by a factor of 1.6. The results showed that smallholder dairy farmers preferred SHG because of their activeness and multipurpose nature. Activeness of a group was dependent on the members' involvement and strength of their commitment and this was determined by the level of benefits and incentives they enjoyed courtesy of leadership style. SHGs had members with different socioeconomic backgrounds and varying intentions. Production, marketing, and socioeconomic challenges differed from farmer to farmer and this presented complexities that the groups would solve. The principal-agent problem in farmer groups is that individual group members expect that the group do something for them. They expect help in either backward linkage, forward linkage or during non-agricultural socioeconomic distresses. Members therefore needed some guarantee from their groups to achieve their objectives. Conversely, the groups also expect members to perform their group roles effectively through provision of good quality and quantity of outputs, attending and contributing to meetings, and financing the group if need be.

The period (years) of group existence was found to negatively and significantly ($P < 0.05$) affect the preference of SHG to FBO by a factor of 2.4. The findings indicated that considering group age, farmers preferred FBO because they had been in existence for long compared to SHG. They therefore viewed them as a brand in their undertakings by smallholder dairy farmers. The study findings agree with that of Ochieng *et al.* (2018) who observed that group age had an effect on smallholder marketing. Older farmer groups tended to be successful relative to the younger ones because they were better in mobilising resources and were likely to manage and develop market prospects. Older groups also tended to have established adequate market linkages from recurrent transactions and operational group activities. However, studies by Sonam & Martwanna (2012) and Tallam *et al*. (2016) observed that age of group did not affect the capacity of groups to achieve objectives. Performances of the older and younger groups were not statistically different. Younger groups benefited from the high commitment by members and effective group structures. On the other hand, older groups could have members who were not committed or had poor organisational frameworks, thus hindering the achievement of objectives.

The education level of the leaders significantly ($P < 0.05$) and positively affected SHG preference to FBO group choice by a factor of 1.5. The study observed that quality group governance was vital for effective farmer group activities and management for progressive production and marketing. Well-educated leadership would be better in management and skills acquisition from trainings. However, in the study area, educated members with potential of leadership preferred other formal engagements other than being a group leader an observation also noted by Ochieng *et al.* (2018). Most of the trainings for the group members were mostly through their leaders. Leader's literacy in the study area was important in enhancing the ability to acquire most of the skills during trainings before disseminating them to the members. Smallholder groups were much concerned about their leaders' skills, motives, and commitments towards the groups rather than the processes of leadership. Trust to conduct Collective Actions coupled with

reliable knowledge sharing by the group members explains this observation (Townsend *et al.,* 2016; Mcdonald & Warburton, 2003).

Trustworthiness of leaders positively and significantly ($P < 0.05$) affected choice of SHG relative to FBO with a factor of 1.53. In the study area, smallholder dairy farmers were concerned with the conduct of the group leaders, with much concern on corruption. Anti-corruption Collective Action especially of bribe demands depends on the participation of the group leadership. Storey (2016) contended that, a group leader's preference to be corrupt is exogenous when carried out in a systemic corruption environment because of the predominant complex power structures. Rothstein (2011) and Radin (2018) argued that trying to handle corruption issues in such environments by applying the typical principal-agent paradigm would be ineffective in case an individual's desires are not determined endogenously. Achievement of efficient and functional group require members to take ownership sense and leadership to be trustworthy as observed by Frank and Buckley (2012).

Ability of leaders to coordinate group activities significantly and positively ($P < 0.1$) affected the choice of SHG preference to FBO by a factor of 0.86. Group members considered coordination as an important element for success. Competency and ability to handle both known and unknown risks adequately is a feature and expectation of today's leaders (Faulkner, 2019). The leaders therefore need genuine intentions towards groups and network goals. They need to ensure regular meetings to update group members on relevant emerging issues and deciding on the plans of actions. The results confirm that organisations face diversified activities and challenges that call for coordination as observed by Mpandeli & Maponya (2014) and Pujara (2016). Organisational environments are dynamic and evolve hence the need for strategic planning and coordination (Rodríguez 2007; Adeola, 2016). Effective coordination calls for explicit definition of roles and accountabilities. Coordination provides timely advice needed for organisational improvements. Generally, attaining collective good requires group agreement and coordination. Coordination therefore, tries to answer the questions of why, how, when, and who in an organisation. Coordination has links to trust and

performance and therefore facilitates realisation of performance through networking (Radin, 2000).

Good work ethics and reputation of the leaders in the community negatively and significantly ($P < 0.05$) affected the choice of SHG preference to FBO by a factor of 1.6 and 1.2 respectively. The results indicated that smallholder farmers in the dairy sector preferred FBO because the leaders tended to have good ethics and reputation in the community compared to SHG leaders. The study agrees with Kutsyuruba & Walker (2016); Albu and Flyverbom (2019) who observed that inappropriate group management practices and ethics by the group leaders would result in disregard to accountability, transparency, mismanagement of authority, and group resources. Unethical behaviour results to mistrust and incompetence in groups (Sanyal & Hisam, 2018). Ethics results from ownership by members, orderly separation of work, and accountability in records, sound marketing strategies, and quality achievements championed by organised leadership. Successful groups effectively realise their goals through adherence to the established procedures and motivation systems focusing on pricing, payments, quantity, and quality requirements that are appropriate for members, and value chain collaborators (Ruengdet & Wongsurawat, 2010).

Ability to communicate was found to negatively and significantly ($P < 0.1$) affect the preference of SHG to FBO by a factor of 1.05. Smallholder dairy farmers in the study area opined that communication was important for the success of group activities. Groups are social entities comprising of individuals with norms and behaviours whose relationship is determined by the power of communication (Mohanty & Mohanty, 2018; Hargie, 2016; Kauffeld & Lehmann-Willenbrock, 2012). The suggested group norms, goals, and feelings that define the group are possible through communication. Group effectiveness needs inside and outside communication, conflict resolution, decision-making, and leadership. The group process has four stages. The first stage is the *group processes stage,* which involves internal performance of group activities. The achievement of this stage is through communication where group members obtain the group behaviour rules and all solution ways. Second is the *conflict stage*, which controls

the individual and group activities and it results to group improvement. Third is *decision-making stage*, which defines the precise and effective group decision making process. Fourth stage is the *leadership stage.* Leaders represent the group and also protect the group's interests, and hence provide the group's cohesion by directing the individuals and their activities thereby keeping them together (Saim, 2015).

Motivating group members significantly ($P < 0.05$) and positively affected the preference of SHG to FBO by a factor of 1.12. Motivation of members is crucial for accomplishing group success. Motivation requires constant nurturing and collaboration to sustain high performance throughout (Faulkner, 2019). Majority of the farmers in the study area preferred the SHG because members had access to emergency and small loans from their monthly savings. This was important in tackling urgent cash issues for their farming and non-farming activities. This study agrees that members' involvement in group activities is determined by the benefits and motivations obtained through membership as explained by Sonam and Martwanna (2012). Most groups respondents admitted that their leaders were devoted to supporting them in achieving group objectives. This support was in the form of training group members' on what leaders learnt during the seminars. Group leaders also made follow-ups to ensure that members implemented what they learnt. It was therefore imperative for the groups to emphasise on fulfilling the members' needs and expectations. Similarly, the ability to offer economic benefits to members is essential to sustain any farmer group (Juliana, 2015; Tolno *et al.,* 2015). One of the most important motivating factors for farmers to engage in associations is the hope that they would get benefits due to their membership. Ultimately, the key motivation of any organisation is to provide collective goods to their members.

Negotiation of produce prices by the groups significantly ($P < 0.01$) and positively affected the preference of SHG to FBO by a factor of 2.137. Knowledge of market prices minimises uncertainties associated with it (De Toni *et al.,* 2017; Ito *et al.,* 2013). Quantity and reliability of market linkages for an individual product is likely to improve participation and sales value from the market. Smallholder dairy farmers could flourish

in the global economy by improving their culture of entrepreneurship (Devi & Ramachandran, 2014; Prasetyo, 2019). Shifting production interventions to focus on commercialisation is key. This has caused renewed interest in institutions of Collective Action like farmer groups, as an effective pathway for improving marketing. The success of a farmer organisation depends largely on its capacity for integrating into the wider economy and effectively participating in the appropriate market chain. As suggested by Proctor and Vorley (2008), market inclusion is not only about access to markets but also needs stronger linkages between consumers, producers as well as other players along the market chain. Production also needs to be responsive to the needs and potential of the market. Good business rationale should be anchored on commercially viable activities as well as strong associations with the private sector if farmer organisations are to succeed in achieving their market and economic goals.

Enforcing rules and regulations by the leaders significantly ($P < 0.1$) and negatively affected preference of SHG to FBO by a factor of 1.8. Smallholder dairy farmers preferred FBO because of their rules and regulation enforcement. Groups are social networks, which are self-governing systems during the members' interaction. Groups tend to be more stable and efficient when social capital in form of effective working rules are in place. Groups' social systems tend to develop and preserve the networks created and norms adopted by members. Determination and adherence of practical rules however takes time and learning them is through experience when things go wrong (Creelman *et al.,* 2016). Similarly, penalties for group meeting absenteeism affected group membership. Fines and warnings negatively and significantly ($P < 0.01$ and $P < 0.1$ respectively) reduced the preference of SHG to FBO by the smallholder dairy farmers by a factor of 2.9 and 1.3 respectively. Gavrilets & Richerson (2017) explained that any group that punishes free riders but emphasises less on the group objectives realises strong norm adoption with concurrent increment in production and punishment. Increasing the size of the group has a robust adverse effect on norm development, implementation, and penalty. If both development and punishment of free riders are encouraged, all efforts generally increase the costs of penalty and ultimately output.

Smaller groups characteristically have greater norm of penalty and production efforts than larger groups. Bigger groups can have greater performance if they retreat to less members and hence less or no efforts in punishment and development.

### 6.5 Factors Affecting Smallholder Dairy Group Performance

Analysis of the group dynamic factors that affect milk sales for the group members was by Ordinary Least Squares (OLS) model and the results were as presented in Table 6.9. The $R^2$ value for the model was 0.3107 implying that the model explained 31.07% of the total variation. Michalek *et al.* (2018) observed that aiming at members' desires and prospects propel group involvement of the smallholder dairy farmers. Groups that are of economic benefits to members would therefore inspire participation in Collective Action. However, there is little evidence that proves optimal type of farmer organisation that is efficient in solving member needs.

**Table 6.9: Group Dynamic Effects on Members Dairy Sales: OLS Results**

| **Variable** | **Coef** | **P > \|t\|** |
|---|---|---|
| Cooperatives and SACCO | 4.892* | 0.0680 |
| Number of group meetings in a month | -0.356 | 0.1610 |
| Number of group leaders | 0.248 | 0.4900 |
| Gender of group leaders (male=1) | 3.181* | 0.0890 |
| Minimum education of group leaders (Secondary=1) | -0.697 | 06850 |
| Period of service for leaders (2 years) | -1.876 | 0.3890 |
| Leaders motivated (Yes=1) | 3.053* | 0.0840 |
| Age of the group leaders | -0.721 | 0.7350 |
| Finding buyers for members' produce (Yes=1) | -0.587 | 0.6810 |
| Enforcing rules and regulations of the group (Yes=1) | 0.616 | 0.6780 |
| Frequency of attending meetings (Very frequent=1) | 2.152 | 0.6040 |
| Penalty for exceeding meeting absenteeism (Warning=1) | -3.853* | 0.0770 |
| Years of group existence (6 – 10) | -4.055** | 0.0190 |
| Years of group existence (16 – 20) | -8.216* | 0.0630 |
| Size of the group | -0.765 | 0.4340 |
| Number of groups by a member | -0.700 | 0.4850 |
| Gender of majority of members (Female=1) | -0.108 | 0.9530 |
| Reason for financial borrowing (Improve production) | 5.107** | 0.0160 |
| Reason for financial borrowing (Value addition) | 8.687** | 0.0130 |
| Reason for financial borrowing (Personal development) | 3.839* | 0.0670 |
| *_cons* | *7.991* | *(9.987)* |
| *N* | *236* | |

*** P < 0.01, ** P < 0.05, * P < 0.1

The results show that the type of farmer group affects group performance. Cooperative/SACCO membership significantly ($P < 0.1$) and positively affected the group performance by a factor of 4.89. This implies that households in cooperative membership sold more milk compared to those in other group types. Members perceived cooperatives as their establishments to respond to negative market conditions common to them. Their shared desires revolved around marketing of dairy produce at higher farm-gate prices, supply of good quality, and reasonably priced dairy inputs, together with supply of sufficient and cheap credit. Besides their formation to meet specific member's objectives, cooperatives adapt to members changing needs. Cooperatives in the study area were establishments formed and controlled by the members for producing, value adding, and selling members dairy produce, with the members sharing risks and profits. This study finding is in agreement with (Alho, 2015) who found out that farmer groups differed in types and benefits to members.

Gender of group leadership significantly ($P < 0.1$) and positively affected a group performance by a factor of 3.2. Groups with a majority of male leaders performed better relatively to groups with a majority of female leaders. Male and female farmers participated in group leadership at varied levels. In the study area, even though more women joined farmer groups compared to men, their proportion in leadership was low. Females exhibited limited capacity, especially in leadership, because of low self-confidence in the presence of men. Multiple barriers also hindered the possibility for group involvement by women and hence leadership. FAO (2011) noted that women participation in producer organisation faced more constraints compared to men. This is because of limitations of time and mobility posed by cultural norms, domestic and reproductive household responsibilities. The barriers include socio-cultural norms and gender perceptions, involving group structure and governance. They are therefore not able to influence decisions of the group. Information on how and whether participation in groups plays a role or fails in participation of women in leadership is still limited (Nakazi *et al.,* 2017). While farmer groups remain critical in smallholder dairy subsector, women composition and leadership in socioeconomic groups reveals biasness

in favour of men (Gipson *et al.,* 2017; Torre *et al.,* 2019; Dhatt *et al.,* 2017). In the study area, farmer groups' were ignorant about gender equity objectives and laws, and lacked the strategies and willingness to apply them.

Motivation of group leaders significantly ($P < 0.1$) and positively affected group performance by a factor of 3.1. Motivation is critical for any sustained organizational performance and success (Nguyen, 2017). In the study area, 58% of the leaders did not have any job and only 29% of the groups motivated their leaders. The main form of motivation was money at 61%. The capacity of the farmer group leaders to be efficient in managing the group required absolute personal commitment. There was usually a trade-off among the leaders between their personal priorities and those of the group. This tradeoff was dependent on motivation to leaders, which varied from group to group. Stumpf *et al.* (2013) stated that, organizations control motivations ranging from pay and benefits, work location, working conditions, and advancements. Motivated leaders are able to articulate vision, provide members with support and intellectual stimulation and encouraging acceptance of group goals (Zebral, 2017). This behaviour stimulates success of groups.

Penalty for absenteeism affected group performance. Results indicated that issuance of warnings as a penalty for exceeding absenteeism limits had a negative and significant ($P < 0.1$) effect on group performance by a factor of 3.9. This implies that as much as strict rules on absenteeism are well intended, their enforcement demotivates members and affected their group engagement. Empirical evidence suggests that farmer organisational structure and governance affect members performance and may lead to inefficiencies in both organisation and public resource allocation (Alho, 2015; Francesconi & Wouterse, 2015; Falkowski & Ciaian, 2016). In the study area, penalty for absenteeism was a form of punishment to influence group members' behaviour. The intention of penalty was to transmit norms and values to individuals for the common good of the group by controlling free riding problems. Group members are supposed to act according to a certain norm in order to achieve the group objective or avoid social sanctions (Gavrilets & Richerson, 2017). Culture and social factors affect norm internalisation and may

change during the life span of an individual (McDonald & Crandall, 2015; Wach, 2015; Gavrilets & Richerson, 2017).

Years of group existence had a negative and significant ($P < 0.05$) effect on group performance by a factor of 4.1 for groups with ages between 6 to 10 years. Groups with ages between 16 to 20 years also exhibited negative and significant ($P < 0.1$) effect on group performance by a factor of 8.2. The results indicated that performance of groups declined with the age of the group. Younger groups were still enthusiastic to achieve their objectives. They dedicated their resources for common good, and were more cohesive in their operations relative to the older groups. This finding contradicts those of Nakazi *et al.* (2017) and Barham & Chitemi (2009) who found that older groups had better management practices and were able to mobilise resources, hence performed better than younger groups.

Reason for member borrowing affected the group performance. Financial borrowing by groups had a positive and significant ($P < 0.05$) effect on improving production by a factor of 5.1, value addition was significant ($P < 0.05$) by a factor of 8.7, and personnel development was significant ($P < 0.1$) by a factor of 3.8. Smallholder dairy farmers in the study area were mostly limited in resources. Their dairy operations were constrained by institutional, investment, and technical resources. The study confirms that economic benefits, mainly financial, is the key motivator for farmers to join farmer groups as observed by Tolno *et al.* (2015). In pursuing alternatives to subsistence and seeking wealth, smallholder dairy farmers in the study area sought financial resources formally or informally. The smallholder dairy farmers therefore resorted to various alternatives to enhance dairy production and marketing to improve their well-being. One alternative was joining groups and working together as members to acquire resources. Such resources targeted at improving dairy production, value addition, and personal development. These findings agree with those of Petcho *et al.* (2019); Adekunle (2018), and Ma & Abdulai (2017) who concluded that membership to organisations increases production, yield economic benefit, and promote welfare of farmers.

## 6.6 Conclusion and Recommendations

### 6.6.1 Conclusions

The study found that 66% of smallholder dairy farmers in the study area were members of groups. There were more households in Nakuru belonging to groups than in Nyandarua. Self-Help Groups (SHG) were the most dominant form of Collective Action. Majority of groups in the study area had been in existence for a period of 10 years or less. Most of the groups achieved their primary objectives with group activities being backward linkages, forward linkages, and hybrid linkages. Election of the leaders in majority of the groups was done directly by group members through democratic voting process. In addition, most leaders in the groups were males and they served for a period of 2 to 3 years. Upon expiry of the terms, fresh elections were held, with high possibility of those who had served well being re-elected. Majority of the groups did not motivate their leaders and the ones who did majorly used money. Members considered social factors when choosing group leaders.

The study established that group membership led to a substantial increase in milk sales. Households with members in groups sold significantly ($P < 0.001$) more milk relative to those who were not in groups. Farmers however had to decide whether to join groups. Key factors for group membership were marital status, gender of the household head, quantity of milk produced, number of animals kept, grazing system used, education level, labour, and the main source of family income.

This study also revealed heterogeneity of smallholder dairy farmers groups. Farmers had to make decisions on the type of group(s) to join. Group leadership, leaders educational level, leadership period, age of group, members' behaviour, communication by leaders, motivation of group members, negotiation of prices, enforcement of rules and regulations, and penalty for absenteeism affecting this decision. The study also revealed that the factors that affected group performance included, type of group, gender of

leaders, motivation to leaders, approach to absenteeism, years of group existence, and reason for borrowing by the group members.

The study results indicated that farmer organisations would be more influential in minimising the challenges and the numerous market imperfections faced by smallholder dairy farmers in accessing output and input markets. Farmers main objective of joining groups was to pool their resources for profitable dairy value chain activities that are difficult to achieve at individual level, due to high transaction costs, risks, and economies of scale. Farmer groups therefore provided institutional frameworks enabling yield-enhancing technologies, market orientation strategies, and linking of members to markets for effective commercialisation.

### 6.6.2 Recommendations and Policy Implications

The study revealed Collective Action practice as a means to boost production and commercialisation for the smallholder dairy farmers operating in imperfect market structures and perpetual market failures. The success of Collective Action requires institutional arrangements comprising of locally accustomed simple rules and an effective monitoring and sanctions systems. Collective Action also needs social capital (trust, mutuality and other collective relations), human capital (knowledge resources), and political capital to be effective. These conclusions led to several recommendations.

Group membership sensitisation and capacity building is necessary for improved group performance. There should be a deliberate attempt to continuously train and sensitise farmer groups on successful Collective Action initiatives. This should involve training them on the five key elements that are important for effective joint impact initiatives namely, collective agenda, shared measurement system, common reinforcing activities, constant communication among members, and government support through relevant ministries.

Emphasis on the quality of farmer group leadership is important. Group leadership is core to successful Collective Action initiatives. Deliberate efforts should be in place to guide on how to choose the right individuals for leadership of groups. Good leadership will create and sustain the cooperative mentality among the group members and thus overcome farmer individualism. It will also improve participatory methodologies, programs, and strategies that enhance members' participation and cooperation. There is also need to consider an elaborate public-private partnership in enhancement of Collective Action. This involves bringing together all stakeholders in the dairy subsector to form a cross-sector program. This will in turn help smallholder dairy farmers to build strong Collective Action partnerships that will work collaboratively to attain their goals. This requires a well-designed and functional partnership between the smallholder farmers, government, NGOs, and financial institutions.

# CHAPTER SEVEN

# COMMERCIALISATION OF SMALLHOLDER DAIRY

## 7.1 Introduction

This section focuses on Objective Three of the study. It specifically deals with the assessment of the structure and the determinants of smallholder dairy commercialisation. It emphasises on characterisation of smallholder dairy commercialisation, level of commercialisation and the micro-level factors explaining the observed differences in the levels of smallholder dairy commercialisation in Nakuru and Nyandarua counties. Analysis of results on commercialisation was done using Household Commercialisation Index (HCI) model.

## 7.2 Description of Smallholder Dairy Production and Sales

Milk produced by smallholder dairy households was for household consumption, sale, or both. Table 7.1 shows results for smallholder dairy market orientation in the study area.

**Table 7.1: Market Orientation of Smallholder Dairy Farmers**

| Category | Nakuru | | | Nyandarua | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | Zero grazing | Open grazing | Tethering | Zero grazing | Open grazing | Tethering | Zero grazing | Open grazing | Tethering |
| *Milk produced per day (litres)* | | | | | | | | | |
| Highest | 10 | 10 | 7 | 22 | 17 | 10 | 17 | 14 | 9 |
| Lowest | 4 | 4 | 2 | 9 | 8 | 4 | 7 | 6 | 3 |
| Mean | 10.3 | 11.0 | 8.3 | 17.4 | 14.6 | 8.0 | 13.8 | 13.1 | 8.1 |
| *Milk sales* | | | | | | | | | |
| Average price /litre (KSh) | 35 | 36 | 33 | 35 | 34 | 31 | 35 | 35 | 32 |
| Mean sales / day (Litres) | 7.5 | 7.1 | 3.8 | 14.4 | 11.6 | 6.2 | 10.8 | 9.4 | 5.4 |
| County Mean sales / day (Litres) | | 6.9 | | | 11.6 | | | 9.4 | |
| Commercialisation Index | 0.73 | 0.64 | 0.46 | 0.83 | 0.79 | 0.77 | 0.78 | 0.72 | 0.66 |
| County Commercialisation Index | | 0.66 | | | 0.80 | | | 0.73 | |

Zero grazing was the most productive system in the study area with cows yielding a maximum of 17 and minimum of 7 litres/day. Tethering was the least productive, with households realising maximum of 9 and minimum of 2 litres/day. Nyandarua County produced substantially higher milk quantities than Nakuru County across the three production systems. Producers using zero grazing registered the highest milk production of 22 litres/day in Nyandarua compared to 10 litres/day for those in Nakuru. Open-grazing and tethering systems reported 17 and 10 litres/day respectively in Nyandarua as Nakuru recorded 10 and 7 litres/day respectively. In Nyandarua, zero grazers produced an average of 14.4 lit/day while open-grazers and those undertaking tethering produced an average of 11.6 and 6.2 lit/day respectively. In Nakuru, zero grazers produced an average of 10.3 lit/ day while open-grazers and those on tethering produced 11.0 and 8.3 lit/day respectively. Zero grazers in Nyandarua sold an average of 14.4 lit/day compared to 11.6 lit/day and 6.2 lit/day for open grazers and tethering systems respectively. In Nakuru, zero grazers sold an average of 7.5 lit/day compared to 7.1 lit/day for open

grazers and 3.8 lit/day for tethering system. Nyandarua recorded mean sales of 11.6 lit/day whereas for Nakuru it was 6.9 lit/day. On overall, mean sales were 9.4 lit/day. The average sales price was KSh. 34 in Nyandarua and KSh. 35 in Nakuru. Farmers in Nyandarua sold more of their milk than those in Nakuru in all the categories of dairy systems.

Milk sales was characterised by a number of different buyers. The dairy farmers chose their buyers on reasons which varied from one producer to another. The study explored seven types of buyers namely individual, milk traders, dairy cooperatives, group members, processors, institutions, and brokers. The results (in percentages) are as shown in Table 7.2.

**Table 7.2: Smallholder Dairy Sales and Modes of Dairy Delivery**

| | **Nakuru** | | | **Nyandarua** | | | **Overall** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Zero grazing** | **Open grazing** | **Tethering** | **Zero grazing** | **Open grazing** | **Tethering** | **Zero grazing** | **Open grazing** | **Tethering** |
| ***Buyer*** | | | | | | | | | |
| Individual | 29.2 | 27.8 | 33.3 | 3.3 | 12.3 | 19.4 | 14.8 | 20.4 | 22.7 |
| Milk traders | 10.4 | 16.7 | 16.7 | 10.1 | 2.6 | 5.6 | 10.2 | 10.0 | 8.3 |
| Cooperatives | 43.7 | 42.7 | 25.0 | 48.3 | 49.1 | 33.3 | 46.3 | 45.7 | 31.3 |
| Group members | 4.2 | 5.6 | 0.0 | 5.0 | 7.0 | 2.8 | 4.6 | 6.3 | 2.2 |
| Processors/ cooling plants | 2.1 | 0.0 | 8.3 | 0.0 | 3.5 | 2.8 | 0.9 | 1.7 | 4.2 |
| Institutions | 2.1 | 1.6 | 0.0 | 10.0 | 0.9 | 0.0 | 6.5 | 1.3 | 0.0 |
| Brokers | 8.3 | 5.6 | 16.7 | 23.3 | 24.6 | 36.1 | 16.7 | 14.6 | 31.3 |

The particular buyers smallholder dairy farmers chose to sell to depend on various attributes the buyer exhibited. The attribute results in percentages are as indicated in Table 7.3.

**Table 7.3: Smallholder Dairy Producer Satisfaction for Dairy Buyers**

| Buyer Attribute | Satisfaction | Nakuru | Nyandarua | Overall |
|---|---|---|---|---|
| Reliability in milk purchase | Unsatisfied | 2.4 | 1.0 | 1.6 |
| | Neither satisfied nor unsatisfied | 5.9 | 10.1 | 8.2 |
| | Satisfied | 74.0 | 66.8 | 70.0 |
| | Very satisfied | 17.7 | 22.1 | 20.2 |
| Better credit terms | Unsatisfied | 10.7 | 6.7 | 8.5 |
| | Neither satisfied nor unsatisfied | 20.7 | 22.1 | 21.4 |
| | Satisfied | 52.0 | 51.0 | 51.5 |
| | Very satisfied | 16.6 | 20.2 | 18.6 |
| Better prices | Unsatisfied | 48.5 | 52.4 | 50.7 |
| | Neither satisfied nor unsatisfied | 45.0 | 25.0 | 34.0 |
| | Satisfied | 5.9 | 17.3 | 12.2 |
| | Very satisfied | 0.6 | 5.3 | 3.2 |
| Buyer readily available | Unsatisfied | 5.8 | 2.4 | 4.0 |
| | Neither satisfied nor unsatisfied | 17.2 | 10.1 | 13.2 |
| | Satisfied | 59.8 | 61.1 | 60.5 |
| | Very satisfied | 17.2 | 26.4 | 22.3 |
| Presence of legal contract | Unsatisfied | 15.4 | 5.8 | 10.1 |
| | Neither satisfied nor unsatisfied | 21.3 | 26.9 | 24.4 |
| | Satisfied | 48.5 | 42.8 | 45.4 |
| | Very satisfied | 14.8 | 24.5 | 20.2 |
| Communication & information sharing | Unsatisfied | 8.9 | 2.9 | 5.6 |
| | Neither satisfied nor unsatisfied | 17.2 | 19.7 | 18.6 |
| | Satisfied | 50.9 | 46.2 | 48.3 |
| | Very satisfied | 23.1 | 31.3 | 27.6 |

The six attributes explored included reliability in milk purchase, better credit terms, better prices, buyer availability, presence of legal contract, and communication and information sharing. Overall, 90.2% of the farmers were satisfied/very satisfied with their buyers. This was due to their reliability and predictability in purchasing milk thus giving the farmers confidence and guarantee in milk purchase. Only 2.4% and 1% of the dairy farmers in Nakuru and Nyandarua respectively indicated unreliable milk buyers. Majority (70.1%) of the farmers practicing smallholder dairy farming indicated that they were satisfied/very satisfied with their credit relationship with milk buyers. The buyers were timely in honouring their credit pledges. This attribute assured dairy farmers of financial certainty and hence proper planning. Only 10.7% and 6.7% of the smallholder dairy farmers in Nakuru and Nyandarua respectively viewed their buyers as credit unworthy. With regard to better prices, 84.7% of the farmers felt that milk prices were not good, citing poor prices as a disincentive in their dairy farming engagement.

Majority (82.8%) of the smallholder dairy farmers were of the opinion that their milk buyers were readily available which guaranteed them ready market for their produce. Most farmers (65.6%) in the two counties noted that trading with their buyers was legally binding and secure. However, 15.4% and 5.8% of farmers from Nakuru and Nyandarua respectively opined that their trading were not legally binding, and they merely relied on good will from the buyers to honour their engagements, and thus they felt unsecure. The majority (75.9%) of the farmers were satisfied/very satisfied with communication and information sharing with their buyers.

### 7.3 Smallholder Dairy Household Commercialisation Index (HCI)

As discussed in Chapter III, the study computed Household Commercialisation Index (HCI) for each household as a ratio of the gross value of all dairy output sales to gross value of output production. The HCI used the Blinder-Oaxaca Model to provide a counterfactual decomposition. The counterfactual decomposition explained the mean outcome differences between groups by focusing on observable characteristics and differences in the estimated coefficients.

Table 7.4 provides the results of commercialisation level by respective counties and their differences. The results indicate that both counties practiced dairy commercialisation. However, reliance on dairy enterprise was more dominant in Nyandarua as an economic activity compared to Nakuru. The mean commercialisation index for Nakuru and Nyandarua counties were 0.498 (49.8%) and 0.661 (66.1%) respectively. Abera (2009) opined that households selling up to 25% are low commercial farmers; those selling between 26% and 50% are medium commercial farmers while those above 50% are high commercial farmers.

**Table 7.4: Smallholder Dairy Commercialisation: Blinder - Oaxaca Decomposition**

| | **Overall** | |
|---|---|---|
| | **Coefficient** | **Standard Error** |
| Nakuru | 0.498*** | (0.021) |
| Nyandarua | 0.661*** | (0.016) |
| Difference | -0.163*** | (0.026) |
| Endowments | -0.102*** | (0.035) |
| Coefficients | -0.0601 | (0.059) |
| Interaction | -0.000525 | (0.065) |

*** P < 0.01, ** P < 0.05, *P < 0.1

The study results therefore indicate moderate commercialisation in Nakuru County and relatively high commercialisation in Nyandarua County. There was a significant (P < 0.01) difference of 0.163 (16%) in commercialisation between the two counties. The results also showed that household dairy commercialisation in Nyandarua would significantly (P < 0.01) decline by 0.102 (10.2%) if the households had the same socioeconomic endowments as those in Nakuru. However, the reduction of 0.0601 (6.0%) in commercialisation would not be significant if coefficients of Nakuru households were applied to Nyandarua households. Commercialisation in Nyandarua

would also decline by 0.053% due to simultaneous interaction in endowments and coefficients in the two counties. Varied socioeconomic factors in both counties affected the observed level of smallholder dairy commercialisation.

Table 7.5 showed the Blinder-Oaxaca Model results of the socioeconomic factors that influenced the probable observed difference in dairy commercialisation between Nakuru and Nyandarua counties. Results showed that if households in Nyandarua had the same characteristics as those in Nakuru then their commercialisation would reduce. The key factors that would significantly intensify the reduction of commercialisation level would be, the number of dairy animals kept ($P < 0.01$), the dominance of the dairy enterprise as an economic activity ($P < 0.05$), amount of milk consumed per day ($P < 0.1$), and the amount of milk produced per day ($P < 0.01$). The probable reduction in commercialisation however would not be significant if the variable coefficients for Nakuru households applied to Nyandarua. Factors that would significantly determine the probable reduction in dairy commercialisation would include distance to market ($P < 0.1$), distance to tarmac road ($P < 0.1$), distance to extension services ($P < 0.05$), type of grazing land ($P < 0.01$), total assets value ($P < 0.1$), and means of transport ($P < 0.1$).

**Table 7.5: Factors influencing Dairy Commercialisation Level Variations**

| | Endowments | | Coefficients | | Interaction | |
|---|---|---|---|---|---|---|
| **Endowments** | **Coef** | **P > \|z\|** | **Coef** | **P > \|z\|** | **Coef** | **P > \|z\|** |
| Gender of head | -0.00116 | 0.8032 | 0.0729 | 0.1893 | 0.000824 | 0.8059 |
| Age of head | -0.0104 | 0.4748 | 0.000264 | 0.9981 | 0.000048 | 0.9981 |
| Education level | 0.000889 | 0.6424 | 0.0882 | 0.1786 | -0.00198 | 0.6141 |
| Household size | -0.00284 | 0.4902 | -0.0355 | 0.5105 | -0.00345 | 0.5335 |
| HH Head Occupation | -0.0137 | 0.1155 | -0.0577 | 0.4210 | 0.0115 | 0.4309 |
| Source of family income | 0.000734 | 0.8389 | 0.00314 | 0.9616 | -0.000275 | 0.9616 |
| Distance to market | -0.00521 | 0.4277 | 0.0839* | 0.0350 | 0.0198* | 0.0868 |
| Distance to tarmac road | 0.000636 | 0.8941 | -0.104* | 0.0354 | 0.0403* | 0.0639 |
| Distance to extension | -0.00239 | 0.3799 | -0.147** | 0.0018 | 0.0120 | 0.2891 |
| Total land owned | 0.00454 | 0.3485 | -0.0412 | 0.1364 | -0.00473 | 0.3837 |
| Years of dairy farming | -0.00180 | 0.5167 | -0.0225 | 0.5467 | 0.00200 | 0.5969 |
| Grazing system used | -0.00173 | 0.4835 | 0.0558 | 0.2784 | 0.00238 | 0.5147 |
| Type of grazing land | -0.000274 | 0.8510 | -0.239*** | 0.0094 | -0.00126 | 0.8488 |
| Source of labour | -0.000830 | 0.6757 | -0.0276 | 0.7464 | 0.000977 | 0.7580 |
| Number of dairy animals | 0.0820*** | 0.0093 | -0.0346 | 0.9526 | -0.0190 | 0.9622 |
| No. of casual employees | 0.0106 | 0.1357 | -0.0126 | 0.2162 | -0.0103 | 0.2474 |
| Member of a group | 0.00539 | 0.5708 | -0.0128 | 0.6566 | -0.00734 | 0.6573 |
| Group size | 0.000107 | 0.9030 | 0.000895 | 0.9487 | -0.000147 | 0.9490 |
| Household income | -0.00170 | 0.5828 | -0.000199 | 0.9944 | 0.0000502 | 0.9944 |
| Asset value | -0.000607 | 0.8425 | 1.029* | 0.0406 | -0.00993 | 0.2028 |
| Produce for consumption | 0.000794 | 0.6181 | 0.0682 | 0.2576 | 0.00265 | 0.4739 |
| Dominant activity | -0.0375** | 0.0257 | -0.0176 | 0.7070 | 0.0109 | 0.7072 |
| Number of pure breeds | -0.00343 | 0.4296 | 0.00283 | 0.9437 | -0.000397 | 0.9438 |
| Number of cross breeds | -0.00470 | 0.4184 | 0.0198 | 0.1963 | 0.00942 | 0.2618 |
| Number of local cows | 0.0000216 | 0.9773 | 0.00187 | 0.7360 | 0.000368 | 0.8042 |
| Dairy housing structure | 0.000246 | 0.8815 | 0.00180 | 0.9760 | 0.0000733 | 0.9761 |
| Milk consumed | 0.0105* | 0.0986 | 0.0322 | 0.5442 | -0.00476 | 0.5535 |
| Operation cost | -0.000412 | 0.8552 | -0.267 | 0.2847 | -0.00351 | 0.4291 |
| Milk produced | -0.0532*** | 0.0001 | 0.0421 | 0.4921 | -0.0175 | 0.4941 |
| Road condition | -0.000635 | 0.8501 | 0.00509 | 0.9027 | 0.000602 | 0.9034 |
| Type of buyer | -0.00324 | 0.7383 | 0.0967 | 0.1056 | -0.0320 | 0.1130 |
| Means of transport | 0.00795 | 0.1759 | 0.0985* | 0.0952 | -0.0162 | 0.1352 |
| ***Constant*** | ***-0.645*** | | | | | |
| ***Observations*** | ***380*** | | ***380*** | | ***380*** | |

*** P < 0.01, ** P < 0.05, * P < 0.1

Similarly, the probable reduction in commercialisation in Nyandarua would not be significant if the simultaneous effects of differences in endowments and coefficients applied. The simultaneous effect would then be because of the distance to market ($P < 0.1$) and distance to tarmac road ($P < 0.1$) as the factor explaining the probable reduction in commercialisation.

### 7.4 Factors Influencing Smallholder Dairy Commercialisation

Table 7.6 presents the double log model results of the factors influencing smallholder dairy commercialisation. The observed $R^2$ were 0.3907, 0.4817, and 0.4190 for the whole sample, Nakuru and Nyandarua respectively. Studies in various parts of the globe have revealed the determinants of commercialisation. Commercialisation differ within a country and across countries due to the varied socioeconomic environments upon which the smallholder farmers operate (Kabiti *et al.*, 2016; Abu, 2015).

**Table 7.6: Factors Influencing Smallholder Dairy Commercialisation**

| | Whole sample | | Nakuru | | Nyandarua | |
|---|---|---|---|---|---|---|
| **Variable** | **Coef** | **P > \|t\|** | **Coef** | **P > \|t\|** | **Coef** | **P > \|t\|** |
| Household Gender head (Male=1) | -0.0562* | 0.084 | -0.0431 | 0.443 | -0.118*** | 0.007 |
| Age of head | -0.00117 | 0.263 | -0.000797 | 0.634 | -0.00111 | 0.487 |
| Education level of head | 0.0288 | 0.931 | 0.0432 | 0.506 | 0.0374 | 0.551 |
| Household size | -0.00966* | 0.05 | -0.0120 | 0.109 | -0.00618 | 0.448 |
| Distance to tarmac road | -0.000619 | 0.817 | -0.0227** | 0.042 | -0.000409 | 0.886 |
| Distance to extension | -0.00149 | 0.698 | -0.0223** | 0.011 | 0.00444 | 0.289 |
| Total land owned | 0.00187 | 0.63 | 0.000444 | 0.937 | 0.0115* | 0.072 |
| Years of dairy farming | 0.0233 | 0.133 | 0.00142 | 0.957 | 0.0181 | 0.442 |
| Production system | 0.0137 | 0.747 | 0.0633 | 0.431 | -0.000978 | 0.985 |
| Grazing land used | -0.148 | 0.141 | -0.681** | 0.017 | -0.0442 | 0.678 |
| Main source of labour | -0.00594 | 0.895 | 0.0480 | 0.552 | 0.00819 | 0.894 |
| Number of Dairy stocks | 0.0481 | 0.625 | -0.0195 | 0.899 | 0.0317 | 0.848 |
| Group membership | 0.00725 | 0.788 | -0.0162 | 0.742 | 0.00910 | 0.789 |
| Total asset value | 0.0388* | 0.056 | 0.0964*** | 0.005 | 0.00387 | 0.884 |
| Dairy enterprise dominant (Yes=1) | 0.0741*** | 0.008 | 0.0584 | 0.316 | 0.0788** | 0.043 |
| Operation cost | -0.0314** | 0.027 | -0.0343 | 0.139 | -0.00730 | 0.725 |
| Daily milk production | 0.00714*** | 0.001 | 0.00961*** | 0.005 | 0.00707*** | 0.000 |
| Daily milk consumption | -0.0314** | 0.01 | -0.0245 | 0.224 | -0.0342** | 0.045 |
| Buyer (Milk trader=1) | -0.0340 | 0.448 | -0.0930 | 0.123 | 0.194** | 0.033 |
| Buyer (Cooperative=1) | 0.0877** | 0.037 | 0.00508 | 0.936 | 0.144** | 0.033 |
| Buyer (Group members=1) | 0.189*** | 0.002 | 0.143 | 0.171 | 0.228** | 0.014 |
| Buyer (Institutions=1) | 0.106 | 0.207 | 0.105 | 0.495 | 0.235** | 0.038 |
| Buyer type (Brokers=1) | 0.107** | 0.016 | 0.0755 | 0.394 | 0.133** | 0.045 |
| *Constant* | *0.319* | *0.321* | *0.199* | *0.717* | *0.395* | *0.365* |
| *Observations* | *380* | | *180* | | *200* | |
| *Prob > F* | *0.0000* | | *0.0000* | | *0.0000* | |
| $R^2$ | *0.3907* | | *0.4817* | | *0.4190* | |

***P < 0.01, **P < 0.05, *P < 0.1

This study found that gender of the head affected the level of commercialisation. Households headed by males in the whole sample and Nyandarua County exhibited negative and significant ($P < 0.10$ and $P < 0.01$ respectively) effect on commercialisation. The level of commercialisation was less for the households headed by males relative to households headed by females. The findings indicate that households headed by males reduced the level of commercialisation by 5.6% in the overall study area and reduced by 11.8% in Nyandarua County. Partial explanation to this observation was that male heads did not often engage directly in dairy production activities including marketing leaving the responsibility to other household members. The observed results are in harmony with Hailua *et al.* (2015) and Olwande & Mathenge (2012) who established that gender of the head of household influenced the level of participation in smallholder dairy marketing. The results also agree with the findings of Onoja *et al.* (2012), who observed that households with female heads had greater commercialisation. However, Hill andVigneri (2011) observed contradicting findings by pointing out that women in general exhibit lower participation in the market because they do not have access to productive resources.

Household size had a negative and significant ($P < 0.10$) effect on dairy commercialisation on the overall sample. This observation implied that the level of commercialisation reduced as size of the household increased. The results indicated that as household size increased by one member, the likelihood of participating in the dairy marketing reduced by 0.9%. Household size is synonymous to increased demand for output as well as for other needs. This result agrees with the studies by Enete & Igbokwe (2009); Martey *et al.* (2012); Zamasiya *et al.* (2014); Dangia *et al.* (2019) which established that for large households, a larger portion of output is for household consumption, hence little is left for the market. As smallholder household number increases, land subdivisions were inevitable and decisions on dairy enterprise become challenging due to reduced land size available to each household. This result was as expected given that the majority of the farmers practised subsistence farming. The finding however contradicts those of Dube and Guveya (2016); Onoja *et al.* (2012);

Aderemi *et al.* (2014) who found that household size significantly and positively affected smallholder commercialisation level.

Distance to tarmac road was significant ($P < 0.05$) and negative for Nakuru County. As tarmac road distance to the nearest market increased by one kilometre, the level of commercialisation reduced by 2.2%. Thus, longer distances to road infrastructure reduced the level of smallholder dairy commercialisation. This result indicates the importance of road infrastructural development in the promotion of dairy commercialisation. Households accessible to roads were more likely to commercialise since the roads linked the market and the farm as observed by Kabiti *et al.* (2016); Akinlade *et al.* (2016). Increase in distance to the market results in increased transport and transaction costs. Distance to tarmac road indicates travel time and has cost implications to the smallholder dairy farmer. Poor road conditions in most locations in the study area constrained the level of smallholder dairy commercialisation. Poor road conditions also compromised availability of necessary dairy resources for improvement of yield and commercialisation. This agrees with the findings by Hailua *et al.* (2015); Olwande and Mathenge (2012) who noted that marketing costs increase with the distance and road condition and hence the decision to participate in marketing.

The distance to extension service provider indicates intensity of contact between the dairy farmer and extension services. The distance to extension service providers in Nakuru County exhibited a negative and significant ($P < 0.05$) effect to smallholder commercialisation. As the distance to the extension service increased by 1%, commercialisation reduced by 2.2%. This implies that as interaction with extension agents decreased due to distance, the extent of the smallholder dairy farmer's participation in the market reduced. This was explained by two reasons. First, access to extension service requires resources and time. With long distances, many farmers tend to get discouraged from seeking professional support on dairy output. Second, the primary purpose of the extension service in the study area was dissemination of dairy health care, husbandry, and training of farmers on technologies for animal production. The extension roles did not include connecting farmers to milk and live animals markets or

encouraging them to commercialise. Studies by Awotide *et al.* (2016); Kiptot and Franzel (2015) also observed a similar pattern. However Olwande and Mathenge (2012); Musah *et al.* (2014) found out that distance to extension service providers affected farmers level of commercialisation positively and significantly.

Land size was also a determinant for smallholder dairy commercialisation. The effect of land size to smallholder commercialisation was positive and significant ($P < 0.1$) in Nyandarua County. A 1% increase in land size in Nyandarua led to an increase in smallholder commercialisation by 1.15%. In the whole study area, increasing the land size by 1% led to a 0.1% increase in smallholder dairy commercialisation. Land availability to a smallholder dairy farmer determined the amount of dairy feed, collateral for credit acquisition, amount of dairy stock kept, and the type of dairy husbandry. This also determined milk produced and sold by the smallholder dairy farmers. These findings are in agreement with studies by Hailua *et al.* (2015) and Abera (2009) that observed that land size was a major determinant of agricultural production and commercialisation. As the size of the farm increases, so does the prospect of commercialisation. Farm size influences the extent of agricultural commercialisation through the potential surplus yield for the market (Sebatta *et al.*, 2014; Oteh & Nwachukwu, 2014; Olwande & Mathenge, 2012).

Household assets influenced dairy commercialisation in the study area. In the whole sample, assets value significantly ($P < 0.1$) increased the level of smallholder dairy commercialisation. A 1% increase in total assets value increased the level of smallholder commercialisation by 3.9%. For Nakuru County, total assets value also significantly ($P < 0.01$) increased the level of smallholder dairy commercialisation. A 1% increase in total assets value increased the level of smallholder dairy commercialisation by 9.6%. The results implied that commercialisation increased with the household asset endowment. Increased assets endowment by the smallholder dairy farmer could improve acquisition of high quality dairy animals, necessary dairy inputs, and access credit facilities. Assets comprise of dairy stock, land, and income (Rubhara & Mudhara, 2019). Livestock is a part of capital asset that if sold during emergencies could provide the needed cash (FAO,

2015). Assets can also provide for improved quality and quantity of the dairy stock, feeds, drugs, husbandry, and other requirements for dairy enterprise. Land is an impelling factor on profitability (Hoop *et al.,* 2015). Household income provides access to large farm sizes and increased inputs use that promote higher productivity thus more marketable surpluses (Abu, 2015). Owning communication equipment such as television radio, and/or phone among others improves sales. Communication equipment improves access to market information from varied sources thereby enhancing the quantity of milk sold (Olwande & Mathenge, 2012). Possession of transportation equipment reduces transaction costs by reducing the travel time and transportation costs especially for perishable products such as milk to the market (Balirwa *et al.,* 2016)

Dominance of dairy enterprise was a factor in determining smallholder dairy commercialisation. The results revealed a positive and significant ($P < 0.01$) effect for the sample studied from the two counties. The results showed that there was a likelihood of 7.4% possibility to engage in smallholder commercialisation due to domination of dairy farming as the major economic activity in the study area. The study observed that undertaking dairy farming and the related value chains is a pathway to sustainable mixed crop–livestock systems often for smallholders as explained by Kilelu *et al.* (2017); Oosting and Viets, (2014). Dairy commercialisation needs intensification, specialisation, and innovation of the dairy farms to increase productivity and value addition (Kilelu *et al.,* 2017; Udo *et al.,* 2011; Burke *et al.,* 2015). Market-integrated dairy is achievable through three types of factors. First factor involves biophysical environment. This includes land-use patterns, infrastructure, climate and weather, disasters, pests and diseases, seasonality, and environmental impact on farming (Omiti *et al.,* 2009; Odhong *et al.,* 2014). Second factor involves institutional factors including frameworks of regulatory such as policies, access to finance, subsidies, standards, and property rights (Kebebe *et al.,* 2015; Veldwisch *et al.,* 2013; Arias *et al.,* 2013; Zeleke & Awulachew, 2014). The third factor involves the social environment comprising of farming history and social identity (Poole *et al.,* 2015).

The effect of dairy operational costs was negative and significant ($P < 0.05$) in the study area. A 1% increment in operational costs reduced smallholder dairy commercialisation by 3.1%. This implied that operational costs affected smallholder dairy commercialisation negatively. Major costs incurred by the smallholder dairy farmers in the study area included extension services, land rented in, livestock feed, farming labour, and transport expenditure. Dairy farms used different quality and quantity of supplementation feeds which resulted in increment of production costs. Production costs also increased when land was rented in for dairy activities and when farmers travelled long distances to seek extension services. Dairy farmers incurred heavy costs because dairy products are perishable, difficult to store, and transport was a challenge. Dairy products require handling at a suitably low temperature, quick transportation, and processing which involves costs (Piotr *et al.,* 2020). The study finding agrees with Cabrera *et al.* (2010), who argued that present dynamics in the dairy sector affect farm profitability, efficiency, and the long-term economic sustainability. Dairy farmers incur additional costs to sustain better farming conditions, maintain market competitiveness, enhance technology adoption, and improve productivity of labour as observed by Pouch and Trouvé (2018). Dairy farm need investments to facilitate application of new technologies including benefits related to increase in efficiency, decrease in costs, improvement of product quality, and reduction in negative environmental impact, and animal welfare improvement (Kramer *et al.,* 2019; Bewley, 2010).

Milk produced had a positive and significant ($P < 0.001$) effect on dairy commercialisation in the study area. A 1% increase in milk produced by the smallholder dairy farmers per day resulted in an increment of commercialisation by 0.7% for the whole sample, 0.96% for Nakuru County, and 0.7% for Nyandarua County. As milk production increases at the farm, the quantity available for the market also increases. Therefore, improving milk production at the household level was key to commercialisation. The study finding agrees with that of Kabiti *et al.* (2016) who found that an improvement in household productivity resulted to an increase in the household level of commercialisation. With the constantly changing global environment, dairy

producers need necessary investments and utilisation of emerging opportunities, accept new technologies by improving technical efficiency to be competitive (Moreira & Bravo-ureta, 2010; Asres *et al.,* 2013; Mor *et al.,* 2016). Dairy farm sustainability considers production as a contributor to dairy life cycle affecting production and consumption. Factors relating to institutions, policy, economy, and environment affect dairy cycle durations in the market (Olipra, 2019; Repar *et al.,* 2018). One concern in milk production is diseconomies of scale experienced by smallholder dairy farmers. They have higher unit production costs, and are inefficient and less competitive to survive (Osheim & Lovell, 2009; Florence *et al.,* 2018). Daily milk consumption also affected the household commercialisation level. The amount of milk consumed by households in the study area significantly ($P < 0.05$) and negatively affected the level of commercialisation of the smallholder dairy farmers. A 1% increase in household milk consumption per day reduced the level of commercialisation by 3.1%. For Nyandarua, the amount of milk consumed significantly ($P < 0.05$) and negatively affected the smallholder dairy commercialisation. A 1% increase in household consumption reduced the level of commercialisation by 3.4%. This was due to the reduced surplus that the household could subject to marketing. Increase in demand, dietary changes, and mechanization stimulate milk production (Bernard *et al.,* 2011).

Smallholder dairy farmers preferred different buyers for varying reasons in their commercialisation. Farmers in Nyandarua positively and significantly ($P < 0.05$) preferred milk traders as their buyers which led to a 19.4% increment in commercialisation. Cooperative marketing exhibited a positive and significant ($P < 0.05$) effect on commercialisation in the whole study area and in Nyandarua County. Cooperative dairy marketing increased the possibility of smallholder dairy commercialisation by 8.8% and 14.4% for the study area and Nyandarua County respectively. Group membership showed a positive and significant ($P < 0.01$ and $P < 0.05$) effect for smallholder dairy commercialisation for the whole study area and Nyandarua County respectively by increasing commercialisation by 18.9% and 22.8% respectively. Institutional buyers significantly ($P < 0.5$) increased smallholder dairy

commercialisation by 23.5%. Selling to brokers positively and significantly ($P < 0.05$) and positively affected the level of commercialisation by 10.7% and 13.3% for the study area and Nyandarua County respectively. Transaction costs are important for market participation by smallholder farmers. Farmers make selling decisions by balancing transaction costs, farm gate prices and welfare gains (Barrett, 2008; Germain *et al.*, 2018; Okoye *et al.*, 2016). Dairy farmers who preferred milk traders was because of immediate and regular cash payment as noted by MINAGRI (2013). Farmers who favoured cooperatives approach had reduced transaction costs such as bargaining costs, monitoring and control cost, coordination costs, enforcement cost and maintenance cost (Krstevska, 2008; Okoye *et al.*, 2016; Agete, 2014).

## 7.5 Conclusions and Recommendations

### 7.5.1 Conclusions

The purpose of this chapter was to assess the level of smallholder dairy commercialisation and its determinants. The study employed Household Commercialisation Index (HCI) using the Blinder-Oaxaca model to provide a counterfactual decomposition. The results showed a considerably lower milk productivity in the study area. Zero grazing was the most productive system whereas tethering was the least. Even though commercialisation level was moderately high in the study area, Nakuru County exhibited relatively low level of commercialisation compared to Nyandarua County.

Informal spot-market structure dominates the marketing of milk in the study area. This structure offers less opportunity for dairy commercialisation. There were several buyers of milk in the study area, and most of the farmers preferred selling their milk to cooperatives, individual consumers, brokers, and milk traders. Dairy farmers opined that sales price per litre offered by the buyers was low. The farmers sold milk to particular buyer for various reasons including reliability in milk purchase, conducive credit terms,

good prices, availability of the buyers, presence of legal contract, and communication and information sharing.

There were varied socioeconomic factors affecting the level of commercialisation of smallholder dairy farmers in both counties. Key among them were gender of the household head, household size, distance to the tarmac road, distance to extension service providers, land size, household assets, dominance of the enterprise, dairy operation cost, quantity of milk produced and consumed, and the type of milk buyer.

### 7.5.2 Recommendations and Policy Implications

In line with the findings, this study suggests intensification of milk production to enhance commercialisation. There is need to employ different dairy upgrading strategies. This study suggests process and product upgrades. This implies improving the performance of farmers dairy enterprises by adopting better technology and management practices. Process upgrading involves raising dairy productivity and/or reducing production costs. Product upgrading includes enhancing product quality through certification, health and safety standards, traceability, or producing to more advanced goods/products through manufacturing and packaging.

Conducive institutional environment is key to dairy commercialisation. This study advocates for elimination of institutional vacuums that limit dairy commercialisation by promoting support services, legal, and policy frameworks. Dairy extension services are critical in enabling farmers to make productive use of inputs. Periodic upgrading of extension agents on effective technologies and management skills is essential. Extension agents need to be motivated and facilitated well to visit and monitor the dairy farmers frequently. Their services should also include marketing, thus they need to train and transfer marketing knowledge and information to dairy farmers. Improving farming and marketing infrastructure like roads and dairy facilities such as cold storage will lower transaction costs, and enhance market participation.

Successful dairy commercialisation requires information about market and marketing through continuous research. Research will provide relevant, adequate, effective, and timely information to dairy farmers. Accessibility and dissemination of market related information will enhance farmer knowledge on markets and facilitate decisions on market involvement. Accessibility to information could be through social gatherings, television, radio, mobile phones, and social media.

Dairy value chain coordination is also key to commercialisation. Horizontal coordination, vertical coordination, and hierarchical dairy structures are important for integrating smallholder farmers into dairy commercialisation. Horizontal coordination entails farmers' collaboration with non-chain actors such as development organisations to facilitate additional economic outcomes like reduction of poverty, enhancement of equity, and sustainability. Vertical coordination will strengthen the linkages of farmers with input and output market actors. Vertical coordination will result in long-term business relations between different dairy actors in the value chain. The varied contractual arrangements among the producers, traders, and processor will be sustainable and effective. The improved coordination will effectively enable smallholders to act and invest in process upgrading and product upgrading strategies that will result in more market value. Hierarchical dairy value chain structures are necessary for better dairy marketing. The dairy lead firms or actors in the dairy sector such as processors and large traders will link the smallholder dairy farmers to better markets. They will thus provide a binding arrangement to enable farmers' access services and inputs necessary for promotion of processes and upgrading of products.

# CHAPTER EIGHT

# SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## 8.1 Introduction

Kenya's dairy farming is one of the largest and most successful in Africa. Smallholder farmers are the majority in the Kenyan dairy sector. However, most of these farmers are subsistence oriented hence their poor economic status. The purpose of this study was to analyse smallholder dairy farming typologies, collective action, and commercialisation in the country. The specific objectives were to assess determinants of smallholder dairy farming typologies, to assess the determinants of Collective Action among smallholder dairy farmers and to assess the level and variations in smallholder dairy commercialisation. The study used a mixed method approach in Nyandarua and Nakuru counties, where dairy activities are predominant. The study undertook cross-section survey to collect data using a structured questionnaire and Focus Group Discussions. The survey data was collected from 380 smallholder dairy farmers identified using stratified random sampling. Analysis of farmers' typologies was through principal component analysis (PCA) and cluster analysis (CA) models. Analysis of Collective Action was through propensity score matching (PSM) model and analysis of household commercialisation was through household commercialisation index (HCI) through the Blinder-Oaxaca Model. The models and descriptive statistics were run using STATA 21.0 software. This chapter presents summary of the results, conclusions, and recommendations of the study.

## 8.2 Summary of Study Results

The socioeconomic characteristics findings of the study showed that the predominant feeding systems in the study area were zero grazing, open grazing, and tethering. Smallholder dairy farming relied majorly on family labour. The farmers mainly served their dairy with fresh natural pasture and used concentrates minimally. Nyandarua

County produced higher quantities of milk than Nakuru County. Zero grazing was the most productive system, yielding a maximum of 17 litres/day and tethering was the least productive, with a maximum of 9 litres/day. Dairy production was primarily carried out to provide milk for home consumption and income generation. Majority of the farmers were planning to continue with dairy production. The households that were not planning to continue cited the venture as either risky, expensive, or unprofitable. Low productivity and marketing were noted and this was due to challenges which differed by geographical location and socioeconomic variations within the study area.

Five major challenges identified in the study area were high milk losses, limited capital and credit facilities, poor extension services, poor road network, and limited access to dairy inputs. There was also limited land access for dairy activities and smallholder farmers used both own and leased land to carry out dairy activities. Dairy activities require resources such as farming assets and labour which results in costs. Majority of the farmers exhibited low level of asset endowment and as a result, they experienced low production, limited processing, and limited involvement in the output market.

Principal Components Analysis (PCA) and Cluster Analysis (CA) results identified major typologies of smallholder dairy farmers. The major components that explained the established typologies were dairy output, land, income, and infrastructure. There were three major smallholder dairy farmers typologies, which differed significantly from one another. The first type was, low resource endowed and market-oriented accounting for 59.2%. The second type was, moderate resource endowed and market-oriented accounting for 35.3% and the third type was, high resource endowed and market-oriented accounting for 5.5% of the sampled farmers. The determinants of the typologies were land factors, years of dairy farming, stock of dairy animals kept, labour engaged, household income, farming assets, dairy output and consumption levels, and costs of production.

Results revealed moderate overall group participation by smallholder dairy farmers. More farmers in Nakuru were members of groups compared to Nyandarua. The major

groups were Self Help Group (SHG), Farmer Based Organisations (FBO), Cooperative Societies (CooP), and Savings and Credit Cooperative Organisations (SACCO). The majority of the groups had existed for a period of 10 years or less, and they achieved their primary objectives. This study revealed three types of group linkages namely, backward linkage, forward linkage and hybrid linkage. Backward linkage provided the group's members with input supplies to facilitate dairy production. Forward linkage enabled group members to provide the market with demand driven dairy output. Hybrid linkage enabled the members with resources that combined both the backward and forward linkage. The success of a group was dependent on its institutions. Majority of leaders in the groups were males whom group members elect democratically. Critical attributes considered by group members in selection of their leaders were activeness, trustworthiness, ability to represent members in external meetings, ability to enforce rules and regulations, ability to motivate group members, good communication skills, ability to coordinate activities, good work ethics, and ability to initiate activities.

The findings of Propensity Score Matching showed a positive and a significant effect of group membership. Smallholder farmers in groups sold significantly ($P < 0.001$) more milk than farmers not in groups. The counterfactual results showed that households not belonging to groups recorded lower milk sales per day. Had the farmers been in group(s), they would have recorded higher milk sales. This suggests that group membership played an important role in improving smallholder commercialisation. Group members extended their smallholder dairy enterprises substantially more than non-group members, through improving productivity and commercialisation activities. Thus, Collective Action is a prerequisite for better networking of smallholders to develop dairy value chains.

The study also indicated that the key factors for group membership included, marital status, gender of the household head, quantity of milk produced, number of animals kept, grazing system used, education level, labour, and the main source of family income. Factors that affect farmers decision on choice of group included number of group leaders, education of leaders, leadership period, age of the group, members'

behaviour, communication by the leaders, motivation of the group members, negotiation of prices, enforcement of rules and regulations, and penalty for absenteeism. In addition, the factors that affected group performance included type of group, gender of leaders, motivation to leaders, approach to absenteeism, and years of group existence.

Dairy commercialisation is an important phenomenon in Nakuru and Nyandarua counties. Majority of the farmers felt that milk prices were low and hence a disincentive. The main milk buyers in the study area were individuals, milk traders, dairy cooperatives, group members, processors, institutions, and brokers. Dairy farmers sold milk to particular buyers for various reasons, which varied, from one farmer to another. In the study area, there was moderately high level of smallholder dairy commercialisation. Smallholder dairy commercialisation level for Nakuru County was however significantly ($P < 0.01$) less compared to that of Nyandarua County. Household commercialisation in Nyandarua would significantly ($P < 0.01$) decline if the households had the same socioeconomic endowments as those in Nakuru. However, reduction in commercialisation would not be significant if coefficients of Nakuru households' characteristics applied to Nyandarua households.

The study revealed that socioeconomic factors varied in the two counties and affected smallholder dairy commercialisation level. The factors that influenced observed differences in dairy commercialisation between Nakuru and Nyandarua were the number of dairy animals kept, dominance of the dairy enterprise as an economic activity, and daily amount of milk produced and consumed. The factors that influenced smallholder dairy commercialisation included household size, gender of household head, distance to tarmac road, distance to extension service provider, land size, asset endowment, dairy enterprise dominance, dairy operational costs, amount of milk produced and consumed, and the type of milk buyer.

## 8.3 Conclusions of the Study

The study concluded that ownership, accessibility, and management of land are critical to smallholder dairy farming. Land dictated the size of dairy stock, dairy feed availability and amount of labour required and could be a collateral when sourcing for finance. Household income defined financial ability to access farm capital, secure dairy inputs, and access credit. Relevant and efficient dairy farming assets and resources are key to improving performance in the subsector. Assets other than those for production and marketing can serve as collateral when sourcing for financial resources. Asset quality, quantity, and nature also affected dairy investments of a smallholder farmer, hence dairy farming typology.

Inappropriate farming management, husbandry practices, animal health, breeding, financial services, and high transaction costs were cited as drawbacks to expansion of the smallholder dairy enterprises. Majority of the farmers studied manifested non-optimal production and significant quantities of the milk produced tended to go bad due to market constraints. Infrastructure plays a significant role in the dairy subsector. Road infrastructure determined dairy opportunities and investment through commercialisation. Distance to tarmac road determined the exchange relations between smallholder dairy producers and other stakeholders including extension services providers. It also dictates the extent of price stability or volatility.

Collective Action in the form of farmer groups could boost production and marketing activities for the smallholder dairy farmers operating in imperfect market structure and perpetual market failures. Farmer group membership resulted in a significant rise in milk sales. Smallholder dairy farmer groups were heterogeneous and operated differently because of their demographic and socioeconomic circumstances. Farmer groups were helpful in minimising challenges and market imperfections faced by smallholder dairy farmers in accessing input and output markets. The key strategy in farmer groups is pooling resources for profitable value chain activities that would not have been possible for individual operation. Individual approach to value chain activities involved high

transaction costs and risks, and limited economies of scale. Farmer groups depend on institutional mechanisms, which create environment for enhancing technologies, market-oriented strategies, while also connecting members to market. The success of Collective Action requires institutional framework that involve simple, locally devised rules, effective monitoring, and sanction systems. Collective Action also needs social capital defined by trust and mutuality, intellectual capital defined by knowledge resources, political capital defined by capacity for Collective Action, and material capital defined by resources.

Transformation of smallholder dairy commercialisation entails production decisions based on market signals and selling of substantial proportion of their production. Based on the results, the study concluded that there was relatively low level of commercialisation of dairy enterprise in the study area. The smallholder dairy commercialisation differed substantially in the study area. Dairy production and potential challenges faced by the farmers determined capacity to exploit available market opportunities. Demographic and socioeconomic factors including household size, gender of the household head, distance to tarmac road, distance to market, distance to extension service, land size, assets endowments, dairy operation cost, quantity of milk produced and consumed per day, and the type of dairy buyer affected commercialisation decisions. Erratic and high prices for inputs, labour cost, low output prices, and transportation problems were the main constraints for dairy commercialisation mentioned by the farmers. The challenges facing dairy farmers included inability to access potential markets, lack of knowledge necessary to improve dairy quantity and quality, add value, make innovations, and invest in new dairy technology, infrastructure, production, and processing assets.

### 8.4 Recommendations of the Study

Based on the conclusions drawn from smallholder dairy typologies and characterisation, the study fronts several recommendations in an attempt to improve the sector. The study suggests land policy review to address land-related challenges including accessibility,

subdivisions, and practices to improve productivity. Land policies should focus on strategies that promote responsible control of land tenure ownership and accessibility. There is also the need of appropriate procedures to advance governance and cooperation in controlling shared property resources. The study also recommends improvement in the quality and quantity of animal feeds. Commercialisation and conservation of fodder and concentrates will promote quality assurance systems and standardisation of dairy feed. Additionally, there is need to promote accessibility and reliable veterinary and artificial insemination services.

Infrastructural impediments hinder dairy operations. The study suggests improvements in road infrastructure to aid in accessibility of inputs and output markets. There is need to improve electrification in milk producing areas by reviewing electricity tariffs. Alternative sources of energy such as solar, wind, and biofuel need promotion to reduce the high dependence on hydroelectricity. Even though there is need to improve on cold storage facilities, it is also necessary to explore alternative methods of milk preservation.

The study suggests improvement in smallholder access to financial resources. This involves encouraging savings, easing of monetary transactions such as mobile phone-based money transfers, and facilitating low-price credit through group lending. Enacted policies should intend to lower transaction costs, minimise financial risks, and promote long-term investment models like Collective Action initiatives. The study also recommends facilitation of enhanced smallholder dairy entrepreneurial and extension services to help improve dairy hygiene, nutrition, and marketing. Farmers need to adopt technological innovations appropriate to the specific needs of the dairy sector.

Policies need to refocus on extension and research systems accustomed to the requirements of smallholder dairy farmer typologies. Interventions should target stakeholders in the dairy industry with an aim of addressing systemic issues that limit the growth of smallholder dairy in the respective typologies. Piloting innovations and best practice solutions is important for the sector. This will address issues relating to milk productivity, transaction costs, as well as the subsector governance.

The study revealed that Collective Action through groups was a viable means of improving milk production and hence commercialisation. The study recommends group membership sensitisation and capacity building initiatives. There should be deliberate attempts to continuously train and sensitise farmer groups on successful Collective Action practices. Groups need training on the five key elements that are important for effective joint impact initiatives namely common agenda, measurement system, mutual reinforcement actions, communication, and governance.

Leadership is the core to successful Collective Action. There is need to intensify awareness on farmer groups leadership. Deliberate efforts should be exerted to sensitise members on how to choose the right individuals to be leaders of the groups. Good leadership creates and sustains cooperative mentality among group members and hence overcomes farmer individualism. Good leadership also improves participatory methodologies, programs, and strategies for the good of individual membership.

An elaborate public-private partnership in the dairy sector is invaluable for enhancing Collective Action. This involves bringing together all the stakeholders in the dairy subsector to form cross-sector programs. This will help smallholder dairy farming communities to build strong Collective Action partnerships that can work collaboratively toward the goals of smallholder dairy farmers. This requires a well-designed and functional partnership between the smallholder farmers, the government, the NGOs, and financial institutions.

The study raises several recommendations in an attempt to enhance commercialisation in the study area. Commercialisation requires improved milk production and there is therefore need for process and product upgrades. Process upgrading will enhance farming activities by adoption of better technologies and management practices. It will improve productivity and boost sales while reducing production costs. Upgrading the product includes enhancing product quality through certification, health and safety standardisation, and traceability, or switching to more value added outputs.

Conducive institutional environment is key to marketing of dairy products. Institutional improvements will promote support services, legal, and policy frameworks important for marketing of dairy products. Dairy extension services are critical in enabling farmers improve on the use of dairy inputs. Extension agents need motivation and facilitation to regularise their visits and monitor dairy farmers. The dairy extension service should also include marketing services by effectively training and transferring marketing knowledge and information to the dairy farmers. Improvement in farming and marketing infrastructure like roads and cold storage facilities will lower transaction costs and enhance market participation.

Successful dairy commercialisation requires information about market and marketing. Research on dairy markets and marketing will provide relevant, adequate, effective, and timely information to dairy farmers. Accessibility and dissemination of market related information would enhance dairy knowledge of farmers on markets and facilitate decision on market involvement. Accessibility of information could be through social gatherings, television, radio broadcasts, mobile phones, and social media. This will lead to increased dairy output, increased marketable surplus, and increased commercialisation

Dairy value chain coordination through farmer groups, market groups, and cooperatives is key to dairy commercialisation. Horizontal coordination, vertical coordination, and hierarchical dairy structures are important steps for integrating smallholder farmers into dairy commercialisation. Vertical coordination will strengthen linkages of farmers with input and output market actors. Vertical coordination would result to longer-term business relations between the farmers and other dairy actors in the value chain. Hierarchical dairy value chain structures will result in better dairy marketing where lead firms or actors such as processors or large traders would link the smallholder dairy farmers to better markets. They would provide a binding arrangement to enable farmers access services and inputs necessary to promote process and upgrading product.

## 8.5 Limitations of the Study

Among the limitations of the study was that it focused on smallholder dairy farmers. It would be of value to compare the transaction costs incurred by the smallholder dairy farmers and thereof large-scale dairy farmers. This would provide an in-depth view of the dairy sector enterprises for an inclusive policy for the sector improvement. Due to resource and time constraints, the research had a challenge of getting all the intended information from some Cooperatives, Savings and Credit Cooperatives (SACCOs), and Farmer Based Organisations (FBOs). Obtaining information on their functioning and handling of affairs of farmers who are members was not easy. In addition, the study envisioned Collective Action as a means of improving production and commercialisation of smallholder dairy farming. However, the study acknowledged that some form of Collective Actions like collusion among elites could undermine development in the dairy subsector. Networking among elites and coalition formation may unintentionally encourage the 'wrong' type of Collective Action. This study also did not analyse probable regulations (if any) designed with Collective Action theory in mind to establish their effectiveness due to the limitation of resources to involve regulating agencies.

## 8.6 Areas for Future Research

The focus of this study was analysis of typologies, collective action, and commercialisation of smallholder dairy farmers in Kenya. The interest of smallholder farmers to invest in dairy farming does not only depend on production and commercialisation, but also on the comparative advantage relative to other sectors of agriculture. Since dairy farming has to compete for resources, its performance compared to other agricultural sectors would motivate or discourage involvement. This study proposes a comparative study to determine the potential and competitiveness of the dairy sector relative to other agricultural sectors.

Shocks and stresses in the environment can result in vulnerabilities and risks in dairy farming. Droughts, floods, unreliable rainfall patterns, use of chemicals, pollution due to nutrient surpluses, and loss of agro-biodiversity have resulted in the observed climate change. With time, farmers need to adjust their dairy farming in terms of the risks associated with these environmental dynamics. This study proposes a study to analyse the effects of environmental stresses and shocks on dairy farming that can vary significantly across the dairy farmers and the dairy farming regions.

The dynamics in the input markets such as feeds, land, labour, and capital play a critical role in influencing the prospects for equitable, profitable, and environmentally sustainable dairy production and commercialisation. Fodder and feed markets are important input markets since they make up major parts of production costs. High prices of land may result in high fodder prices and can be an indicator of stiff competition for land among different sectors. This study proposes a study to analyse the effect of public capital, from donors or the government, in promoting dairy inputs capital investments for improved production and commercialisation.

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# APPENDICES

## Appendix I: Letter of Introduction

Geoffrey Ochieng Otieno,

P.O Box 62000 – 00200,

Nairobi.

Dear Sir/Madam,

**Re: REQUEST TO PARTICIPATE IN RESEARCH SURVEY**

I am a doctoral student of Agricultural and Applied Economics in the school of Agriculture and Environmental Sciences at Jomo Kenyatta University of Agriculture and Technology. I am conducting a research study that analyses **Smallholder Dairy Farmers Typologies, Collective Action, and Commercialisation in Kenya**. The research intends to help understand various critical issues in smallholder dairy sub sector in Kenya.

This letter is to request for your participation in filling out a household survey questionnaire and will take you utmost 20 minutes to complete. Your selection for this survey is by chance and your participation is voluntary. As the researcher, I assure you that any information that you give is purely for the research and will be treated with utmost confidentiality. The findings of the research will be disseminated to the stakeholders through report publications.

Kindly contact **0720950760** in case you have any questions concerning the research study. If you agree to participate, kindly answer the questions in the questionnaire with utmost honesty as possible as guided by the instructions therein.

Thanks in advance.

Yours Faithfully,

**Geoffrey Ochieng Otieno**

## Appendix II: Questionnaire

### Questionnaire for Smallholder Dairy Farmers

### Introduction

I am a researcher from Jomo Kenyatta University of Agriculture and Technology (JKUAT). I am pursuing a study to help understand critical issues in smallholder dairy sub sector in Kenya. You have been identified as one of the respondents and hopefully you will participate voluntarily. We assure you that any information that you give is purely for the research and will be treated with utmost confidentiality.

***1) Identification Data***

| Item | Response | Item | Response |
|---|---|---|---|
| Date of Interview | | Name of County | 1=Nakuru [ ]<br>2=Nyandarua [ ] |
| Enumerator's Name | | Name of Sub-county | |
| Name of the Respondent | | Name of Ward | |
| Mobile Number | | | |

***2) Demographic and Socioeconomic Data***

| Question | Indicator | Response |
|---|---|---|
| Sex of the respondent | 1=Male; 2=Female | |
| Age of the respondent | Actual number of years | |
| Sex of household head | 1=Male; 2=Female | |
| Age in years of the household head | Actual number of years | |
| Marital status of the household head | 1=Married; 2=Single; 3=Divorced; 4=Widowed | |
| Age of the spouse | Actual number of years | |
| Education level of the household head | 1=Primary; 2=Secondary; 3=Tertiary; 4=University | |
| Education level of the spouse | 1=Primary; 2=Secondary; 3=Tertiary; 4=University | |
| Number of household members | Actual number | |
| Where does the household head reside | 1=Within homestead; 2=Town or other village | |
| Number of own and adopted children | In preschool ……. | |

| | | |
|---|---|---|
| | In primary school …….<br><br>In secondary school ……..<br><br>In tertiary / university ……. | |
| Days in a month that the household head is available to make decisions on farming | Actual number of days | |
| Employment status of the head | 1=Employed; 0=Otherwise | |
| Occupation of the household head | 1=Farming; 2=Non-farming; 3=Farming &Non-farming | |
| Employment status of the spouse | 1=Employed; 0=Otherwise | |
| Occupation of the spouse | 1=Farming; 2=Non-farming; 3=Farming &Non-farming | |
| Main source of family income | 1=Farming; 2=Non-farming; 3=Farming &Non-farming | |
| Distance to the nearest market | Actual distance in Km | |
| Condition of the roads | 1=Good; 2=Bad | |
| Distance to the nearest tarmac road | Actual distance in Km | |
| Distance to the nearest extension service provider | Actual distance in Km | |
| Major source of farming information | 1=Friends; 2=Family members; 3=Government officials; 4 = SACCO | |
| Medium for sharing farming information | 1=face to face; 2=Social media; 3=Radio; 4=Television | |

***3) Land Ownership (acres)***

| Total size | Tenure system (acres) | | | | Total land |
|---|---|---|---|---|---|
| | Owned | Rented in | Rented out | Communal | |
| Acres | | | | | |

***4) Household Income Sources in KSh***

| **Type of earning per year** | **Amount (KSh)** |
|---|---|
| Employment income (per month) | |
| Profit from business (per month) | |
| Income per month from dairy produce | |
| Income per month from other farm produce sales | |

| | |
|---|---|
| Income from sale of livestock and other assets e.g. land, vehicle | |
| Income from compost manure | |
| Income from relatives, sons, daughters etc | |
| Value of gifts | |
| Land rented out income | |
| Buildings rented out income | |
| Other structures rented out income | |
| Motor vehicle rented out income | |
| Other income (specify) | |

***5) Household Expenditures in KSh***

| Category | Amount | Category | Amount |
|---|---|---|---|
| Expenditure on fertilizer | | Expenditure on School fees | |
| Expenditure on manure | | Expenditure on Foods per month | |
| Expenditure on seeds | | Expenditure on clothing | |
| Expenditure on livestock feeds | | Expenditure on rental assets per month | |
| Expenditure on veterinary drugs | | Expenditure on Health per month | |
| Expenditure on Extension services | | Expenditure on Transport & fuel per month | |
| Expenditure on crop chemicals | | Expenditure on entertainment per month | |
| Expenditure on labour | | Expenditure on gifts, weddings | |

***6) Household Asset endowments and value***

| Asset | Number | Value in KSh | Asset | Number | Value in KSh |
|---|---|---|---|---|---|
| Oxen/Bull | | | Tractors | | |
| Dairy Cattle | | | Plough | | |
| Local Cattle | | | Wheel barrows | | |

| | | | | | |
|---|---|---|---|---|---|
| Donkeys | | | Hoes/Jembes | | |
| Camels | | | Pangas /Slashers | | |
| Goats | | | TV | | |
| Sheep | | | Radio | | |
| Pigs | | | Bicycles | | |
| Poultry | | | Computer | | |
| Carts | | | Furniture | | |
| Vehicle | | | Mobile phone | | |

***7) Why do you do dairy farming? (Choose as applicable)***

| **Reasons** | **Tick** |
|---|---|
| For prestige | |
| To produce milk for consumption | |
| To get income and reduce poverty | |
| Availability of dairy production technology and market | |
| It is the dominant economic activity in the area | |
| There is no any other work | |
| Dairy farming is easy | |

| | | |
|---|---|---|
| Are you planning to continue engaging in dairy production in the next five years? | 1 = Yes<br><br>2 = No | |

| | | |
|---|---|---|
| If No (above), what is the major reason | 1 = It requires a lot of resources hence expensive<br><br>2 = It is not profitable<br><br>3 = There is a lot of risk involved | |

***8) Dairy farming Data***

| Question | Indicator | Response |
|---|---|---|
| Years of practicing dairy farming | Actual number of years | |
| Number of dairy animals began with | Actual number | |
| Current number of dairy animals kept | Actual number | |
| How many pure breeds of milk cow currently kept | Actual number | |
| How many cross breeds of milk cows currently kept | Actual number | |
| How many indigenous milk cows currently kept | Actual number | |
| Grazing system used by the dairy farmer | 1=Zero grazing; 2=Open grazing; 3=Tethering | |
| Highest amount of milk produced per day | Actual amount in litres | |
| Lowest amount of milk produced per day | Actual amount in litres | |
| Amount of milk consumed by family per day | Actual amount in litres | |
| Compare milk produced this year from last year | 1=More; 2=Less; 3=Same | |
| Compare expected milk production next year | 1=More; 2=Less; 3=Same | |
| How many permanent employees do you have | Actual number | |
| How many casual employees do you have | Actual number | |
| The main source of labour for your dairy activities | 1=Family; 2=Non family labour | |
| Type of dairy housing structure | 1= Permanent; 2= Semi-permanent;<br><br>3= No structure | |
| Frequency of daily feeding | 1=Once; 2=Twice; 3=Thrice | |
| Other than grazing, other method of feeding used<br><br>*(Tick as appropriate)* | Natural pasture served fresh<br><br>Natural pasture served dry<br><br>Crops stalks served fresh | |

| | | |
|---|---|---|
| | Crops stalks served dry<br><br>Purchased dairy meal and concentrates | |
| Major type of grazing land used | 1=own; 2=community; 3=leased; 4=roadside | |
| Where do you source for veterinary services? | Agrovet store<br><br>Market/ hawker<br><br>Human medicines pharmacy<br><br>Veterinary / animal health worker<br><br>Cooperative / group owned | |
| When your dairy is sick, who treats them | 1 = Myself; 2 = Specialist | |
| Major source of dairy breeding | 1= Own bull; 2= Other bull; 3=Artificial Insemination | |

***9) Major milk products produced***

| Fresh Milk product | Quantity produced per day (Lts) | Do you sell the product?<br><br>1=Yes; 2=No | Quantity sold (Litres) | Average price per litre (KSh.) |
|---|---|---|---|---|
| | | | | |

***10) Do you do value addition to your produced*** | Yes | | No | | ***milk?***

***11) If yes above, what value addition do you do? (Fill the table below as appropriate)***

| **Value Added Product** | **Average Quantity produced per day (Lts)** | **Do you sell the product?**<br><br>**1=Yes; 2=No** | **Quantity sold (Litres)** | **Average price per litre (KSh)** |
|---|---|---|---|---|
| | | | | |

| | | | | |
|---|---|---|---|---|
| Yoghurt | | | | |
| Mala/ Fermented milk | | | | |
| Cheese | | | | |

***12) Costs incurred in dairy operations (Respond where applicable)***

| **Cost Item** | **Amount (KSh)** | **Frequency** | **Trend over the last few years** | | |
|---|---|---|---|---|---|
| | | | **Increasing** | **Constant** | **Decreasing** |
| Wages | | | | | |
| Power | | | | | |
| Fuel | | | | | |
| Water | | | | | |
| Forage and hay | | | | | |
| Veterinary services and drugs | | | | | |
| Concentrates/ supplements | | | | | |
| Transportation | | | | | |

(NB: frequency: 1= Daily; 2= Weekly; 3= Bi-weekly; 4= Monthly)

***13) Buyers of the milk products produced and frequency of buying milk***

| Type of buyer | Distance (Km) | Transport means<br><br>1=Foot<br><br>2=Bicycle<br>3=Motorcycle<br><br>4=Vehicle | Cost of transport (KSh) | Who delivers the product<br><br>1=self;<br>2=middleman;<br>3=broker;<br>4=customer | Frequency of buying milk<br><br>1=Regular;<br>2=Irregular |
|---|---|---|---|---|---|
| Individual customers | | | | | |
| Milk traders | | | | | |
| Cooperatives | | | | | |
| Group members | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Processors/cooling plants | | | | | |
| Institutions e.g. schools, | | | | | |
| Brokers | | | | | |

***14) Reason for trading with the milk buyers***

a) Individual Customers

| **Reason item** | **Unsatisfied** | **Neither satisfied Nor unsatisfied** | **Satisfied** | **Very satisfied** |
|---|---|---|---|---|
| Reputation of the buyer | | | | |
| Reliability in milk purchase | | | | |
| Better credit terms | | | | |
| Better prices | | | | |
| Readily available | | | | |
| Personal relations and contact | | | | |
| Presence of legal contract | | | | |
| Communication and information sharing | | | | |
| Quality demanded | | | | |

b) Milk traders

| **Reason item** | **Unsatisfied** | **Neither satisfied Nor unsatisfied** | **Satisfied** | **Very satisfied** |
|---|---|---|---|---|
| Reputation of the buyer | | | | |
| Reliability in milk purchase | | | | |
| Better credit terms | | | | |
| Better prices | | | | |
| Readily available | | | | |
| Personal relations and contact | | | | |
| Presence of legal contract | | | | |

| | | | | |
|---|---|---|---|---|
| Communication and information sharing | | | | |
| Quality demanded | | | | |

c) Cooperatives

| **Reason item** | **Unsatisfied** | **Neither satisfied Nor unsatisfied** | **Satisfied** | **Very satisfied** |
|---|---|---|---|---|
| Reputation of the buyer | | | | |
| Reliability in milk purchase | | | | |
| Better credit terms | | | | |
| Better prices | | | | |
| Readily available | | | | |
| Personal relations and contact | | | | |
| Presence of legal contract | | | | |
| Communication and information sharing | | | | |
| Quality demanded | | | | |

d) Farmer group members

| **Reason item** | **Unsatisfied** | **Neither satisfied Nor unsatisfied** | **Satisfied** | **Very satisfied** |
|---|---|---|---|---|
| Reputation of the buyer | | | | |
| Reliability in milk purchase | | | | |
| Better credit terms | | | | |
| Better prices | | | | |
| Readily available | | | | |
| Personal relations and contact | | | | |
| Presence of legal contract | | | | |
| Communication and information sharing | | | | |

| | | | | |
|---|---|---|---|---|
| Quality demanded | | | | |

e) Processors/cooling plants

| **Reason item** | **Unsatisfied** | **Neither satisfied Nor unsatisfied** | **Satisfied** | **Very satisfied** |
|---|---|---|---|---|
| Reputation of the buyer | | | | |
| Reliability in milk purchase | | | | |
| Better credit terms | | | | |
| Better prices | | | | |
| Readily available | | | | |
| Personal relations and contact | | | | |
| Presence of legal contract | | | | |
| Communication and information sharing | | | | |
| Quality demanded | | | | |

f) Institutions e.g. schools

| **Reason item** | **Unsatisfied** | **Neither satisfied Nor unsatisfied** | **Satisfied** | **Very satisfied** |
|---|---|---|---|---|
| Reputation of the buyer | | | | |
| Reliability in milk purchase | | | | |
| Better credit terms | | | | |
| Better prices | | | | |
| Readily available | | | | |
| Personal relations and contact | | | | |
| Presence of legal contract | | | | |
| Communication and information sharing | | | | |
| Quality demanded | | | | |

g) Brokers

| Reason item | Unsatisfied | Neither satisfied Nor unsatisfied | Satisfied | Very satisfied |
|---|---|---|---|---|
| Reputation of the buyer | | | | |
| Reliability in milk purchase | | | | |
| Better credit terms | | | | |
| Better prices | | | | |
| Readily available | | | | |
| Personal relations and contact | | | | |
| Presence of legal contract | | | | |
| Communication and information sharing | | | | |
| Quality demanded | | | | |

***15) Sources of market price information and the extent of usefulness***

*Please tick as appropriate using the scale: 1 = Not useful; 2= a little useful; 3= useful; 4= very useful*

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Source of information** | **Not useful** | **A little useful** | **Useful** | **Very useful** |
| Neighbours | | | | |
| Other producers | | | | |
| Traders and buyers | | | | |
| Government | | | | |
| Media (TV, Radio, Newspapers, Social Media, online) | | | | |
| Farmer groups | | | | |
| Cooperatives | | | | |

***16) Provide information on your buyers by filling as appropriate in the table***

| Type of buyer | Quantity in Litres per day | Average Price per Litre | Price over the last one year | | Quantity sold under different sales methods per day | | Credit sales | |
|---|---|---|---|---|---|---|---|---|
| | | | Low | High | Cash | Credit | Average Duration of credit time in Days | Is duration of time honoured? 1= Yes; 2= No |
| Neighbours | | | | | | | | |
| Hotel | | | | | | | | |
| Milk bar/ kiosk | | | | | | | | |
| Cooperatives | | | | | | | | |
| Groups members | | | | | | | | |
| Processors | | | | | | | | |
| Mobile traders | | | | | | | | |
| Brokers | | | | | | | | |

***17) If you were to increase the quantity of milk produced, how much would you be able to sell successfully? (Please tick one)***

| | |
|---|---|
| I would be able to sell all of it | |
| I would be able to sell part of it | |
| I would not be able to sell at all | |
| I don't know | |

***18) How often do you experience shortages and excess milk production in your enterprise over the last year? (Tick as appropriate)***

| | **Always** | **Sometimes** | **Rarely** | **Never** |
|---|---|---|---|---|
| Shortage supplies | | | | |
| Excess supplies | | | | |

***19) How serious are each of the following problems to your dairy trade. Indicate by ticking using a scale of 1- very serious, 2-serious, 3-moderate and 4- Not a problem.***

| **Problem item** | **Very serious** | **Serious** | **Moderate** | **Not a problem** |
|---|---|---|---|---|
| Milk not collected on time | | | | |
| Milk goes bad while being transported | | | | |
| Inadequate market for dairy products | | | | |
| Buyers fail to pay on time | | | | |
| Prices are unsatisfactory | | | | |
| Inadequate dairy stock | | | | |
| Poor dairy breeds | | | | |
| Inadequate value addition to dairy products | | | | |
| Inadequate dairy supplements and feeds | | | | |
| Inadequate veterinary services /Dairy diseases | | | | |
| Inadequate land | | | | |
| Dairy production equipment's/ assets | | | | |
| Credit services accessibility | | | | |
| Inadequate dairy information/training | | | | |
| Inadequate finance | | | | |

***20) Milk wasted on average at each of the following points and the frequency level***

| Point of milk loss | Quantity wasted/ lost per day in Litres | Frequency: 1=Very frequent; 2=Frequent; 3=Moderate; 4=Not frequent |
|---|---|---|
| On farm and during milking | | |

| | | |
|---|---|---|
| During transportation | | |
| During storage | | |
| Failure to collect/deliver milk | | |

***21) Source of household financial borrowing***

| | | Borrowed<br><br>1=Yes;<br><br>0= No | Cash/equivalent) borrowed (Ksh.) | Collateral required<br><br>1=Savings;<br>2=Asset<br><br>3=Land;<br>4=Guarantors | Amount saved with (Ksh.) |
|---|---|---|---|---|---|
| Formal | Commercial banks | | | | |
| Semi-formal | AFC | | | | |
| | Cooperatives | | | | |
| | MFI | | | | |
| | NGO project | | | | |
| Informal | Input-store | | | | |
| | Self-help Groups | | | | |
| | Famer group | | | | |
| | Moneylender | | | | |
| | Neighbours | | | | |
| | Friends | | | | |
| | Family | | | | |

***22) Group membership***

| **Question** | **Indicator** | **Response** |
|---|---|---|
| Are you a member of any group? | 1= Yes; 2= No | |
| If yes, how many group (s)? | 1=1; 2= 2; 3=More than 2 | |
| Name of the group(s) | | |
| Which type of group (s) do you belong to? | 1=Self-help group; 2=Farmer Based | |

| | | |
|---|---|---|
| *Choose as appropriate* | Organisation (FBO); 3=Cooperative society; 4= SACCO | |
| Main type of activities provided by the group | 1=Backward linkage (dairy inputs, credit facilities, extension services, production skills)<br><br>2=Forward linkage (production facilities, value addition, dairy processing, marketing and market information)<br><br>3=Hybrid linkage (both backward and forward linkages activities) | |
| Years of group membership | Actual number of years one has been a group member | |
| Number of members of the group | Actual number of group members | |
| Majority members of the group | 1=Male; 2=Female | |
| Number of meetings in a year | Actual number | |
| Your frequency in attending group meetings | 1=Very regular; 2=Regular; 3=Not regular | |
| Does group engage in welfare activities | 1=Yes; 2=No | |
| If Yes (above), which welfare activities | 1=Education; 2=Hospital bill payment; 3=Funeral; | |
| Are you intending to leave the group | 1=Yes; 2=No | |
| If "Yes" above, give reasons | *Tick the appropriate reasons* | |
| | Rules of the group are not followed | |
| | There in favouritism and biasness in the group | |
| | Group membership is demanding and time consuming | |
| | The group is not achieving its objectives | |

| | | |
|---|---|---|
| | Corruption in the group | |
| | Want to join another group | |
| | Decisions of the members are not implemented | |
| | Group fees and other payments are too expensive | |
| Do you access financial support as a group member? | 1=Yes; 2=No | |
| If "Yes" above, the financial support is as a group or individual | 1=Group; 2=Individual | |
| The reason(s) for borrowing<br><br>*(Choose the appropriate)* | 1=Improve production; 2=Add value to my produce; 3=Improve marketing; 4=Personal development | |
| Do you use the finances borrowed for the intended use? | 1=Yes; 2=No | |
| What did you use the finance for?<br><br>(Tick as appropriate) | To buy fixed farming assets | |
| | To buy/rent in land | |
| | To buy transport facility | |
| | To value add products | |
| | To pay for farmer trainings' | |
| | To pay for veterinary services/drugs | |
| | To buy dairy feeds/supplement | |
| | To add the dairy stock | |
| | To buy better dairy breeds | |
| | To pay for farmers training | |
| | To transport the produce to the market | |
| Why borrow finances through group membership? (Tick as appropriate) | Get reduced interest rates for the borrowings | |
| | Group members are guarantors for each other | |
| | Amount of borrowings given are | |

| | | |
|---|---|---|
| | higher | |
| | No collateral required | |
| | The process of borrowing is easier | |
| | It is faster to get the borrowed finance | |
| | Longer time for repayment of the borrowing | |
| What other benefits to you get as a group member (Tick as appropriate) | Farmers trainings' | |
| | Attend agricultural shows | |
| | Get information on farming and marketing | |
| | Go for farming field trips | |
| | Get extension services | |
| | Cheaper production and processing inputs | |
| | Negotiated fair prices for the produce | |
| | Marketing for the produce | |

***23) Group dynamics***

| **Question** | **Indicator** | **Response** |
|---|---|---|
| Year of group existence | 1=0-5years; 2= 6-10 years; 3=11-15 years; 4=16-20 years; 5=21-35years; 6=more than 35 years | |
| Does the group achieve its objective(s) | 1=Yes; 2=No; | |
| If "Yes" above, how frequent | 1=Very frequent; 2=Frequent; 3=Not frequent | |
| Number of meetings in a month | Actual number | |
| Frequency of members attending group meetings | 1=Very regular; 2=Regular; 3=Not regular | |

***24) Group leadership***

| Item | Indicator | Response |
|---|---|---|
| How many leaders are in the group | Actual number | |
| How are leaders selected | 1=Consensus; 2=Election; 4=Nomination; 5=Job Interviews | |
| Sex of majority of the leaders | 1=Male; 2=Female | |
| Minimum education level for leaders | 1=Primary; 2=Secondary; 3=Tertiary; 4=University | |
| Is age considered in selecting leaders | 1=Yes; 2=No | |
| What is the age of the chairperson | 1=20-30 years; 2=31-40 years; 3=41-50 years; 4=above 50 years | |
| What is the age of the secretary | 1=20-30 years; 2=31-40 years; 3=41-50 years; 4=above 50 years | |
| What is the age of the treasurer | 1=20-30 years; 2=31-40 years; 3=41-50 years; 4=above 50 years | |
| Period of leaders to be in service | 1=One year; 2=Two years; 3=Three years; 4=Four years; 5=Five years; 6=Over five years | |
| Are leaders changed after term ends | 1=Yes; 2=No | |
| If "No" above, why | 1=They meet members expectations; 2=Lack of resources to recruit new leaders | |
| Are the leaders rewarded | 1=Yes; 2=No | |
| If "Yes" above, how | 1=Money; 2=Gifts e.g. farm produce; 3=Support e.g. labour | |
| Which leader is rewarded | 1=All leaders; 2=Only chairperson | |
| Do the leaders have other jobs | 1=Yes; 2=No | |
| If "Yes" above, which one | 1=Teacher; 2=Business; 3=Religious leaders | |
| Are group members involved in group leadership selection | 1=Yes; 2=No | |

***25) Group leadership dynamics***

| | | |
|---|---|---|
| Factors influencing the choice of a leader<br><br>(tick as appropriate) | Popularity | |
| | Activeness in the group | |
| | Age | |
| | Education level | |
| | Economic status | |
| Characteristics sought for to be a group leader<br><br>(tick as appropriate) | Trustworthiness by members | |
| | Ability to coordinate activities | |
| | Ability to initiate activities | |
| | Good work ethics | |
| | Tolerance to different views | |
| | Good communication ability | |
| | Outstanding reputation in the community | |
| Role of leaders in the group<br><br>(tick as appropriate) | Recruiting of new members | |
| | Motivating group members | |
| | Attending external meetings on behalf of the group | |
| | Finding buyers for the members produce | |
| | Negotiating produce prices on behalf of the members | |
| | Enforcing rules and regulations of the group | |

***26) Group management***

| **Management item** | **Indicator** | **Response** |
|---|---|---|
| Source of group rules and regulations | 1=Group members; 2=External agents | |
| Does the group have a constitution | 1=Yes; 2=No | |
| Do all members have the constitution copies | 1=Yes; 2=No | |
| Level of members understanding the group constitution | 1=Understand fully; 2=Moderately understand; 3=Do not understand | |
| Language used during meetings | 1=Local; 2=English; 3=Kiswahili | |

| | | |
|---|---|---|
| What are the contents of the constitution<br><br>(tick as appropriate) | How to become a member | |
| | How to select leaders | |
| | Duties of the leaders | |
| | Responsibilities of the members | |
| | How group decisions are made | |
| Do you understand provisions for group meetings | 1=Yes; 2=No | |
| Do you understand provisions voting procedures | 1=Yes; 2=No | |
| Do you understand the sanctions and penalties for non-compliance of rules and regulations | 1=Yes; 2=No | |
| Do you understand how often to pay group dues | 1=Yes; 2=No | |
| How often do you attend meetings | 1=Very frequent; 2=Frequent; 3=Not frequent | |
| Reason by members for not attending meetings and group activities | 1=Inadequate rules;<br><br>2=Laxity to implement rules;<br><br>3=Lack of motivation | |
| Maximum allowed absenteeism for meetings in a month | 1=Nil; 2=Once; 3=Twice | |
| Penalty for exceeding the meeting absenteeism limit | 1=Fine determined by the rules; 2=Warnings; 3=Expulsion from the group | |
| Penalty for exceeding the group work absenteeism limit | 1=Fine determined by the rules; 2=Warnings; 3=Expulsion from the group | |
| Number of members expelled last year | Actual number | |

***27) How does each of the following social attributes affect your group performance? Indicate by ticking using a scale of 1- very much affect, 2-Affect, 3-Does not affect.***

| **Social Attribute** | **Very much** | **Affect** | **Does not Affect** |
|---|---|---|---|
| Size of the group | | | |
| Age of group members | | | |
| Objective of the group | | | |
| Trust to other members | | | |
| Involvement and responsibility of the group members | | | |
| Expectation of the group members | | | |
| Believes and perceptions of the members | | | |
| Information and knowledge of the members | | | |
| Rules and their enforcement in the group | | | |
| Punishments of the group members | | | |
| Communication to members | | | |
| Cooperation of members | | | |
| Monitoring of members | | | |
| Political influence | | | |
| Members level of education | | | |
| Corruption in the group | | | |

**Thank you. Your participation in this survey is highly appreciated.**

**Appendix III: Focus Group Discussion Guide**

Date:

Subcounty:

FGD Team:

**Introduction:**

Good afternoon/morning and welcome to our focus group session. I am Geoffrey Ochieng Otieno a PhD candidate from Jomo Kenyatta University of Agriculture and Technology (JKUAT). I am pursuing research on **Smallholder Dairy Farmers Typologies, Collective Action, and Commercialisation in Kenya**. The research intends to help in understand critical issues in smallholder dairy sub sector in Kenya. Thank you for taking the time to come here.

There are no right or wrong answers but rather divergent views. Please feel free to share your view even if it differs from what others will said. Please keep in mind also that I am also interested in negative comments as positive comments, and at times, the negative comments are the most helpful. The session would last for at most one and a half hours.

Before we begin, let us find out some more about each other.

**Discussion Themes**

***Theme 1: Smallholder Dairy Farming Systems***

***Guide Questions***

i. Dairy animals' inventory, species kept and key reasons behind the chosen species

ii. Dairy housing, feeding method adopted and reasons for the adopted method
iii. Type, quantity and frequency of feeds (including supplement) given to dairy animals
iv. Dairy health management, AI, veterinary services
v. Dairy labour management
vi. Perception and challenges of dairy farming

***Summary and Remarks***

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***Theme 2: Smallholder Dairy Collective Action***

***Guide Questions***

i. Identify different group types and their activities and justifications by farmers for their group choices
ii. Groups composition dynamics
iii. Leadership composition and dynamics
iv. What are the roles of farmers' organisations/groups in smallholder dairy farming? What are the general feelings about farmers' organisations/groups?
v. What are characteristics of a successful farmers' organisation /groups?
vi. What are the major conflicts/challenges faced by farmer groups? what are the probable solutions to the conflicts/challenges

***Summary and Remarks***

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***Theme 3: Smallholder Dairy Commercialisation***

***Guide Questions***

i. What is your opinion about dairy as a business venture?
ii. What is your comment on dairy infrastructure development in relation to dairy commercialisation?
iii. In your opinion, what do you comment about the following issues with regard to dairy commercialisation?

    a) Operational issues affecting dairy commercialisation with regard to capital
    b) Production and marketing infrastructure,
    c) Extension support, insecurity of land tenure, and social capital
    d) Dairy standards and quality assurances and their relation to dairy commercialisation success

iv. At the farm level what are the barriers that may prevent your optimum dairy sales/marketing goals?
v. Who are your dairy marketing competitors?

vi. What do you do to address your dairy commercialisation shortcomings in order to sustain competition?

vii. Are there any market barriers (legal, economical, language, etc.) you encounter during your dairy commercialisation?

***Summary and Remarks***

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**Thank you. Your participation in this discussion is highly appreciated.**