EFFECT OF NON-FINANCIAL ATTRIBUTES ON OPERATIONAL PERFORMANCE OF DAIRY COOPERATIVE SOCIETIES IN KIAMBU COUNTY, KENYA

BY

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MASTERS OF SCIENCE IN COMMERCE (FINANCE AND INVESTMENT)

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DECLARATION

I declare that this dissertation is my original work and has not been previously published or submitted elsewhere for award of a degree. I also declare that this contains no material written or published by other people except where reference is made and author duly acknowledged.

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I do hereby confirm that I have examined the master's dissertation of

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and have certified that all revisions that the dissertation panel and examiners recommended have been adequately addressed.

Sign: …… **Date…..**

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ABSTRACT

This study examined the effect of non-financial attributes, specifically aggregation strategies, technology adoption, and governance practices, on dairy cooperative societies' operational performance in Kiambu County, Kenya. Given the increased interest in cooperative sustainability beyond financial inputs, the study sought to ascertain the effect of these organizational factors on productivity and member rewards. A descriptive research design was employed, with a stratified purposive sample of 78 individuals comprising of cooperative managers, board members, and other key stakeholders from 19 county registered dairy cooperatives. Data were collected using structured questionnaires and supplemented with secondary data on milk production and payment rates. Reliability was ascertained through Cronbach's alpha ($\alpha > 0.7$ for all factors), whereas data were analyzed with the help of descriptive and inferential statistics, notably multiple regression analysis. It was discovered that all the three non-financial attributes had positive and statistically significant correlations with operational performance. The study indicates that the cooperatives should invest more in institutionalized aggregation processes, adopt technologies, and improve governance practices to increase operational performance. Policy formulation and strategic planning for Kenya's dairy sector and similar agricultural cooperatives in the developing economies can be guided by these findings.

Key words: Dairy Cooperatives, Aggregation Strategies, Technology Adoption, Governance Practices, Operational Performance.

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ACRONYMS AND ABBREVIATIONS

ADC	Agricultural Development Corporation
AI	Artificial Insemination
AS	Aggregation Strategies
ASALs	Arid and Semi-Arid Areas
ASGTS	Agriculture Sector Growth and Transformation Strategy
CCFH	Codex Committee on Food Hygiene
CCFL	Codex Committee on Food Labelling
DTI	Dairy Training Institute
FAO	Food and Agriculture Organization
GMP	Good Manufacturing Practice
GP	Governance Practices
IDF	International Dairy Federation
KCC	Kenya Cooperative Creameries
KDB	Kenya Dairy Board
MOA	Ministry of Agriculture
OIE	International Office of Epizootics
OPI	Operational Performance Index
SACCO	Savings and Credit Cooperative Organization
SME	Small and Medium Enterprises
SNV	Netherlands Development Organization
TA	Technology Adoption
TCE	Transaction Cost Economic

TERMS AND DEFINATIONS

Dairy cooperatives	A farmer-owned organization that provides services such as milk collection, processing, and marketing to its members, aiming to enhance their bargaining power, reduce transaction costs, and improve operational performance (FAO, 2011)
Operational performance	The effectiveness and productivity of an organization in converting inputs into outputs, achieving strategic goals, and satisfying stakeholder expectations through efficient processes.(Asamoah & Nadarajah, 2020)
Aggregation strategies	Concerted action by dairy cooperatives or farmer groups to consolidate resources, streamline operations, and improve efficiency along the value chain—collection to marketing (Grau et al., 2015).
Technology adoption	The process by which individuals, organizations, or sectors begin to use new or improved technologies to enhance their operations, productivity, and outcomes (Ngongo, 2019).
Governance	Systems, processes, and practices through which an organization is guided, controlled, and held responsible. It encompasses the structure and rules that make decisions, who should lead, manage resources, and engage with stakeholders (Matee, 2019).
Milk Processing	The transformation of raw milk into consumable dairy products such as pasteurized milk, cheese, butter, and yogurt through industrial or artisanal methods (FAO, 2024).
Dairy Value Chain	The entire process of milk production, processing, distribution, and

	retail, including input suppliers, farmers, cooperatives, and dairy processors (International Dairy Federation, 2024).
Milk Yield	The average quantity of milk produced per cow annually, often measured in liters per year per cow (FAO, 2024).
Artificial Insemination (AI)	A reproductive technology used in dairy farming to enhance genetic quality and increase milk production efficiency (New Zealand Ministry for Primary Industries, 2024).
Informal Dairy Market	A system where milk is sold directly from farmers to consumers or traders without formal processing, and often lacking stringent quality control (Bingi & Tondel, 2015).
Zero-Grazing System	A dairy farming method where cows are confined and fed in designated areas, common in high density agricultural regions (Food Business Africa, 2024).
Cross-Border Dairy Trade	The movement and sale of dairy products between neighboring countries, contributing to regional food security and economic integration (Dairy Business Africa, 2024).
Dairy Breeds	Specific cattle breeds selected for high milk production, including Friesian, Ayrshire, Jersey, and Guernsey, commonly used across African dairy farms (ILRI, 2024).
Kenya Dairy Board (KDB)	The regulatory body overseeing Kenya's dairy industry, ensuring quality control, licensing, and market regulation (Kenya Dairy Board, 2023).
Dairy Master Plan	A strategic framework developed by the Kenyan government to enhance

	milk production, processing, and export growth (Ministry of Agriculture, Livestock, and Fisheries, 2024).
Semi-Intensive Dairy Farming	A system combining free-range grazing with supplementary feeding, practiced by about 33% of Kenyan dairy farmers (Njarui et al., 2016).
Cooperative Societies Act (Kenya)	The legal framework governing dairy cooperatives, ensuring fair governance, member participation, and transparency (Odero & Kimani, 2023).
Milk Aggregation Centers	Collection points established by cooperatives or processors to gather milk from multiple farmers, reducing transportation costs and improving quality control (Kimani & Mutua, 2023).

CHAPTER ONE

INTRODUCTION

This chapter introduces the subject of the problem that the researcher intends to investigate under the following subheadings: background of the study, the statement of the problem, objectives of the study, research questions, justification of the study, significance of the study and scope of the study. The study aimed to determine the effect of non-financial attributes on operational performance of dairy cooperative societies in Kiambu County, Kenya.

1.1 Background of the Study

Cooperatives in developed nations of the world thrive through sound operational strategies, yet their counterparts in nations like Kenya are faced with persistent challenges that undermine performance (International Cooperative Alliance, 2023). Observing this disparity, this study endeavored to investigate the factors behind inefficiencies in Kiambu County dairy cooperatives operations.

The writer was particularly keen on investigating three potentially influential non-financial elements identified from the literature: aggregation strategies, technology adoption, and governance practices (Grau, Hockmann & Levkovych, 2015; Kiboori, 2023). These were selected for investigation because they appear to characterize successful cooperative models across the world, but their exact application and effect in the case of Kenya are not well understood.

Spurred by farm visits and previous studies citing problems of operational inefficiency (Rahmah, 2020), technological gaps (Ngongo, 2019), and governance weaknesses (Matee, 2019), the researcher designed this study to systematically explore if and how the three variables might

be affecting cooperative performance. The study was particularly timely given Kenya's growing dairy sector and the critical function cooperatives play in the livelihood of smallholder farmers.

The research sought to provide evidence-based recommendations that would be utilized in making policy decisions as well as cooperative management approaches, in addition to contributing towards the overall academic literature on dairy cooperatives within developing economies.

1.1.1 Dairy sector with global, regional, and Kenyan perspectives

Dairy cooperatives remain an important force in sustaining rural economies by assisting farmers in overcoming market hurdles and achieving equitable prices for their milk (International Cooperative Alliance, 2023). Current statistics show that dairy cooperatives manage approximately 50% of world milk production, proving their ongoing significance in stabilizing dairy markets and maintaining farmer operational performance (International Cooperative Alliance, 2023).The International Cooperative Alliance (ICA) has been instrumental in developing cooperative-friendly policies that have a direct influence on dairy cooperatives globally (ICA, 2021). Through the ICA-EU Partnership Programme, the ICA assisted 79 national and four regional studies of cooperative legal systems, which had a major influence on national and international law (ICA, 2021). Through partnership with 11 governments, including Kenya, Ghana, and India, the ICA has granted legal protection to dairy cooperatives to enable them to access better infrastructure, fair prices, and market stability (ICA, 2021).Secondly, the ICA interface with foreign organizations such as the European Union (EU), the International Labour Organization (ILO), and the United Nations Department of Economic and Social Affairs (UNDESA) has complemented cooperative-conducive policy lobbying within international development agendas (ICA, 2021). The establishment of a G20 working group also facilitated

the dairy cooperative movement to give inputs in financial inclusion, sustainable business models, and social economy frameworks to pave the way for their competitiveness and growth (ILO, 2023).

Cooperatives of farmers across the globe, and particularly in dairy farming, ensure market stability, quality assurance, and other benefits to farmers (Kumar et al., 2015). Farmer-owned dairy cooperatives handled almost 82% of all milk produced in 2024, indicating their ability to collect members' milk, provide common facilities for collection, processing, and marketing, and enhance market access (USDA, 2024). Through consolidation of milk from small farmers, cooperatives reduce the production cost, guarantee an uninterrupted supply, and increase the bargaining power of farmers (FAO 2024). For instance, Dairy Farmers of America (DFA) processes 22% of raw milk in America, and Land O'Lakes processes 12 billion pounds annually through cooperative action (USDA, 2024). Cooperatives provide shared infrastructure, including milk collecting centers, processing facilities, and transportation facilities, that individual farmers cannot afford (FAO 2024). This shared infrastructure raises efficiency, quality control, and global competitiveness. The Netherlands' FrieslandCampina Cooperative that collects milk from 18,000 farmers and New Zealand's Fonterra Co-operative Group Limited that supplies over 10,500 farmers are successful examples that use shared infrastructure to supply the global market (FrieslandCampina, 2024; New Zealand Ministry for Primary Industries, 2024). Besides, cooperatives enhance market access through collective bargaining at better prices and long-term contracts for members (FAO, 2024). For example, Fonterra Co-operative Group Limited exports dairy products to over 140 countries, while India's AMUL cooperative enjoys good quality production with stringent safety measures and testing of milk (FAO, 2024).

The African dairy industry is a key driver of economic growth and employment, with the East African region leading milk production at 68% of total African production (International Dairy Federation, 2024). Ethiopia, home to Africa's largest bovine population (66.5 million in 2024), has livestock contributing 26% to GDP and sets a target to quadruple milk production by 2031 through improved breeding and infrastructure (ILRI, 2024; NFPConnects, 2024). Kenya had produced 5.76 billion liters of milk in 2023, of which 79% was cow milk, but only 15% was officially processed (USDA, 2024). Milk production in Uganda was 3.85 billion liters in 2023 and had been increasing at the rate of 11% annually, with milk exports rising to US$264.5 million up to January 2024 (ResearchTec Global, 2024; Dairy Development Authority Uganda, 2024). Uganda's milk exports to Kenya had nearly doubled to US$210 million in 2023 (Dairy Business Africa, 2024). Rwanda's dairy production rose from 51.5 million liters in 2000 to more than a billion liters by 2023. The government will raise this to 1.25 million metric tons by 2024 using zero-grazing, improved forage, water harvesting, livestock insurance, and genetic improvement (AllAfrica, 2024; Food Business Africa, 2024; Dairy Business Africa, 2024).

The East African dairy industry contributes 12% of the region's agricultural GDP, and East African Community market integration integrates dairy value chains. Cross-border intra-trade of dairy products in the region is valued at $2.3 billion annually, promoting regional trade (Felix & Sibongiseni, 2019). In West Africa, the dairy sector accounts for 3% of agricultural GDP, and Nigeria's increases from 2.1% to 3.5% over 2019 to 2023 (Odjo & Traoré, 2024). In North Africa, Egypt and Morocco's dairy sectors account for 5% of agricultural GDP due to value-added processed milk products (Merem et al., 2022). The dairy industry provides direct employment for approximately 15 million African families, with cooperatives playing the central role of market organization and value chain establishment (Abdulsamad & Gereffi, 2016). Cross-

border business in dairy commodities grew by 45% between 2020 and 2023, accelerating economic integration (Hanon, 2023). Dairy processing is prevalent in East and Southern Africa, accounting for 65% of the processed dairy products in the region (Bingi & Tondel, 2015). Governments and development partners continue to support cooperatives with training, subsidies, and policy change. Initiatives such as the East Africa Dairy Development Initiative, funded by the Bill & Melinda Gates Foundation (2021), have introduced digital milk collection and payment systems, improving efficiency, market access, and farmer revenues. By ongoing investment in cooperative structures, dairy cooperatives will remain at the forefront of facilitating economic stability, food security, and sustainable growth in the global dairy sector.

Kenya is the leading milk producer in East Africa and contributes to 14% of the country's agricultural GDP and 4% of the Kenya national economy up to 2023 (Tegemeo Institute of Agricultural Policy and Development & Kenya Dairy Board, 2024). It directly and indirectly provides employment to the whole country with about 1.8 million smallholder farmers engaged (Kenya Dairy Board, 2023). By 2023, the nation had approximately 5.02 million dairy cows, with Kiambu, Meru, Nyandarua, Nakuru, Uasin Gishu, Nandi, and Trans Nzoia being key producers, each producing over 100 million liters of milk annually. Kenya produced 5.2 billion liters of milk in 2022, valued at KES 230 billion (Kenya Dairy Board, 2023). Kenyan dairy farming is based on three major systems: zero-grazing (intensive system), accounting for 44% of dairy farming and found in highly agriculturally endowed areas; the semi-intensive system, utilized by 33% of farmers; and the free-range system, utilized by 23% of farmers (Njarui et al., 2016). Small-scale farmers own about 4.3 million dairy cows that account for 56% of the country's total milk production (Kenya Dairy Board, 2023). The common breeds are Friesian, Ayrshire, Guernsey, Jersey, and crossbreds with robust East African Zebu (Kibiego et al., 2015).

Although it is a significant economic activity, Kenya's dairy industry exists in formal and informal markets. The formal market, consisting of cooperatives and large-scale processors, offers price stability and quality control (Blackmore et al., 2021). However, approximately 80% of milk sales occur in the informal market, where farmers sell directly to consumers at a higher price and cash in hand (Tegemeo Institute & Kenya Dairy Board, 2024). While the off-farm market enhances milk availability, it is a problem in terms of hygiene and quality control (Tegemeo Institute & Kenya Dairy Board, 2024). Farmers are advantageously served by dairy cooperatives by negotiating higher prices and securing stable markets. On average, cooperative farmers get 15% more than sole vendors (Omore et al., 2024). The cooperatives also stimulate allied industries such as feed manufacture and veterinary practice (Kimani & Mutua, 2023). However, poor management and governance tend to impede their effectiveness (Odero & Kimani, 2023), since most farmers are plagued by insecure incomes and unpredictable markets. The industry is faced with different issues, including high costs of production, particularly feed and fodder, which constitute 55%–70% of the costs of dairy farming (Ministry of Agriculture, Livestock, and Fisheries, 2024). Feed prices comprised 65%, 54.2%, and 73.1% of the total cost of milk production in the zero, semi-zero, and open grazing systems, respectively, according to a report conducted by Tegemeo Institute of Agricultural Policy and Development and KDB, (2024). Farmers also experience limited access to artificial insemination (AI) services, encounter costly veterinary services, and volatile milk prices (Odero-Waitituh, 2017). Kenya's milk output levels remain low, with each cow between 2,165 liters and 5,527 liters per year, compared to the world's best practices of 9,000 liters a year, pointing to the need for improved feeding and agricultural management practices (Kenya Dairy Board, 2023). Informal market prevalence, in which approximately 80% of milk transactions occur, complicates sector growth. Although

farmers receive some 22% more per liter through black markets, there is no regulatory control that leaves quality control risks in the hands of farmers and consumers (Odero-Waitituh, 2017).

To address these challenges, the Kenyan government has implemented several interventions, such as the National Dairy Master Plan aimed at enhanced processing of milk, cooperative development, and regulatory improvement (Ministry of Agriculture, Livestock, and Fisheries, 2024). Kenya Kwanza Dairy Expansion Strategy aims to enhance milk production to 10.4 billion liters and export volumes to 1 billion liters by 2027 (Kenya Dairy Board, 2023). To achieve its full potential, the dairy sector requires stronger cooperatives, greater access to quality feeding, and better market linkages. With the right investments and policies, dairy farming can continue to propel food security, employment, and economic resilience for many Kenyans. The sector's future depends on addressing the challenges currently dominant as well as embracing innovations that promote efficiency and operational performance.

1.1.2 Non-Financial Attributes

Non-financial traits support the viability of dairy cooperatives. Aggregation approaches, technology adoption, and governance patterns are the most critical non-financial traits (Grau, Hockmann, & Levkovych, 2015). They play a core role in enabling operating effectiveness, quality in products, and sustained operational performance (Kiboori, 2023). The majority of the dairy cooperatives in Kiambu County are hampered by challenges like inadequate distribution channels for milk, low technology adoption levels, and weak governance structures (Rahmah, 2020). These challenges have significant effects on their operational performance. The study focuses on three key non-financial characteristics which have been found to significantly improve cooperative performance and financial returns. Aggregation strategies are employed in top-performing supply chains, minimizing losses, and achieving economies of scale (Grau et al.,

2015). Three various aggregation strategies that have a direct effect on cooperative operational performance are the subject of the research.

First, the decentralized distribution approach involves the establishment of numerous milk collecting points and selling points (Rahmah, 2020). It assists in reducing transportation distance for farmers, minimizing milk spoilage, and enhancing market coverage. Cooperatives employing the approach can deliver fresher products to consumers in greater volumes, which equates to increased sales volumes and improved revenues (Ngongo, 2019). Second, investment in infrastructure aims at the construction of cold storage, refrigerated transport, and processing plant machinery (Rahmah, 2020). Such infrastructure is critical in maintaining milk quality from farm to market. Proper handling and storage reduce product rejection and enable cooperatives to receive improved prices in local and premium markets (Kiboori, 2023). Third, cost leadership strategy employs bulk purchasing, energy-saving processing, and optimized logistics (Grau et al., 2015). Through the reduction of operational expenses, cooperatives can offer prices that are competitive yet have good margins. This strategy is particularly significant in situations of market uncertainty when controlling costs is vital for survival (Ngongo, 2019).

These consolidation strategies are particularly applicable to Kiambu County dairy cooperatives, where ineffective handling and distribution of milk continue to be leading obstacles to operational performance (Rahmah, 2020). Usage of such measures has potential to radically improve efficiency and operational performance. New technology adoption is now a top success driver for dairy cooperatives (Ngongo, 2019).This piece talks of three broad uses of technology which lead to increased operational performance. Technology in electronic payments like mobile banking and electronic fund transfer has revolutionized financial transaction within cooperatives (Grau et al., 2015). The technology ensures prompt payment to farmers, reduces risk exposure

handling cash, and increases transparency. Financial mismatches have been reduced, and trust has been increased among cooperative members with electronic payments (Karanja, 2023). Advanced dairy management systems, taking the shape of cloud-based computer programs, have transformed operational management (Rahmah, 2020). These systems provide real-time traceability of milk, inventory management, and sales forecasting. Automation of these operations enables cooperatives to make more efficient decisions, reduce administrative costs, and maximize their supply chain (Kiboori, 2023).

Real-time capture of data with automated milk analyzers and Internet of Things sensors is yet another technological innovation (Ngongo, 2019). Such tools monitor milk quality in real time, detect impurities in real time, and ensure compliance with industry standards. Cooperatives implementing such technologies have reduced product rejection and access to high-value markets (Grau et al., 2015). The application of these technologies addresses two major challenges that face dairy cooperatives: financial management and quality control (Rahmah, 2020). By using these solutions, cooperatives manage to improve their efficiency in operation and competitiveness in the market to a large extent. Governance is essential for the success of dairy cooperatives (Matee, 2019). This study will examine three aspects of governance that directly affect organizational performance. Board composition lies at the core of strategic decision-making (Wathanga, 2016). Cooperatives that have properly composed boards with industry and finance backgrounds have enhanced performance in the area of cost management and revenue development. They make better performance when it comes to policy-making, risk assessment, and planning in the long run (Grau et al., 2015).

Leader-member communication channels are also instrumental in maintaining transparency and trust (Ngongo, 2019). Open communication, electronic media, and formal

channels of feedback allow for free flow of communications between the leadership and the members. Effective communication prevents conflicts, improves decision-making, and enhances overall effectiveness of operations (Kiboori, 2023). Member participation in governance structures guarantees democratic decision-making and accountability (Matee, 2019). Farmers feel a greater sense of ownership and accountability when they are actively involved in leadership selection and policymaking. High member engagement cooperatives tend to exhibit better financial administration and greater long-term sustainability (Rahmah, 2020). Good governance systems guarantee that money is not wasted and there is no operational inefficiency, a common problem for the majority of dairy cooperatives (Karanja, 2023). Good governance practices help in creating a stable and more productive organizational structure.

The selection of these specific non-financial attributes is based on their established impact on cooperative performance. Aggregation strategies directly address the primary concerns of milk distribution inefficiencies and operational costs (Grau et al., 2015). Technology use provides solutions to quality assurance and financial openness historical problems (Ngongo, 2019). Governance practices offer the platform for accountability and strategic leadership, preventing mismanagement and member disillusionment (Matee, 2019). These are the most critical areas for dairy cooperatives within Kiambu County, where most of these challenges are prevalent (Rahmah, 2020). Addressing these key areas will help cooperatives increase their operational efficiency and improve financial performance.

1.1.3 Operational performance

Operational performance is a prime measure of how much an organization converts its inputs to quality outputs and achieves its strategic goals and meets stakeholder demands (Mazzocchitti et al., 2017). Operational performance, in the context of economic development, would imply a

company's ability to generate value that is greater than its production cost, comprising various financial and non-financial efficiency metrics (Mazzocchitti et al., 2017). For Kiambu County's dairy cooperatives, this concept becomes even more specific due to their twin mandate for economic viability and equitable value distribution to their members (Zhu et al., 2017). Unlike typical businesses with the sole concern being profitability indicators, cooperative dairy enterprises must tread a fine line between financial viability and their social mission of empowering the members, making the measurement of their operating performance an even more complex and multi-dimensional undertaking. The activity of dairy cooperatives manifests itself in a series of outstanding indicators, among which milk volume produced and milk payment rate per liter are particularly significant. Milk volume produced is a basic indicator of a cooperative's ability to mobilize its membership and deliver a stable, high-quality milk output (Benos et al., 2018). This indicator monitors the performance of the cooperative in its role in serving its members through the delivery of extension services, inputs, and improved agriculture practice adoption (PG et al., 2020). Variation in production volumes typically points to underlying operating problems, including a failure to provide adequate feeds, poor management of animal health, or inefficiencies in member participation and coordination plans. A level or rising volume of production tends to indicate sound working health and member satisfaction, while declining trends might reflect more general issues to be resolved.

The milk payment rate per liter is also noteworthy, as a direct indication of the cooperative's financial health and capacity to translate working efficiency into meaningful member benefits (Anugrah et al., 2021). This measure summarizes the performance of the cooperative in several operational areas, such as purchasing approaches, processing speed, value addition, and market positioning (Sultana et al., 2020). A good payment rate not only indicates

good financial management, but also enhances member loyalty and long-term sustainability of the cooperative (Njeri, 2021). Its rate of payment is very sensitive to factors such as milk quality standards, production cost, and prevailing market prices and thus the full measure of working effectiveness. Apart from these major metrics, there exist other operating efficiency metrics that help in total performance. Procurement efficiency deals with the economical manner in which the cooperative procures milk from its members without lowering quality standards (Memah & Potolau, 2019). Measures of processing and value addition quantify the cooperative's ability to transform raw milk into marketable products with least waste and maximum output (Sinniah et al., 2022). Efficiency in administration measures the cooperative's ability to control costs of logistics, storage, and overhead operations (Lestari et al., 2023). These variables interact to determine the cooperative's ability to offer value to its members and compete in the market.

Dairy cooperatives' business performance in Kiambu County is significantly influenced by a number of non-financial traits that transcend conventional business measures. Governance structures and leadership quality are key drivers of business outcomes, where effective decision-making structures and transparent resource allocation systems enhance overall efficiency (Hansmann, 2019). Poor governance erodes member trust and business efficiency. Adoption of technology is another highly significant factor, since computer-based equipment and high-technology processing equipment can significantly boost productivity, reduce costs, and enable product differentiation (Chaddad & Cook, 2019). Yet the expense of implementation and need for technical education are usually deterrents, particularly for small cooperatives (Kariuki et al., 2023). Aggregation approaches, including joint marketing and block processing contracts, have emerged as powerful drivers of business operations in the dairy sector. These approaches enable cooperatives to achieve economies of scale, reduce per-unit costs, and improve their negotiation

powers in the marketplace (Höhler & Bijman, 2023; Francesconi & Wouterse, 2019). Sustainability operations, such as green production methods and value-added dairy product creation, are progressively influencing performance in operations by addressing consumer needs and qualifying for regulatory incentives (Williams et al., 2023). While such initiatives normally comprise high initial capital expenditures, they can be able to yield long-term competitive advantage and improved market reputation.

To provide a composite assessment of operational performance, this study offers an Operational Performance Index (OPI) that combines milk production volume and payment rates. As a product of milk production volume and milk payment rate per liter, the index captures the total cash received by members, a composite measure of the operational capacity of a cooperative. The OPI also has various advantages over traditional financial in that it is a fully compatible metric with member-oriented objectives of dairy cooperatives (Zhu et al., 2017) and gives a measurable measure of economic impact that directly resonates with members (Njeri, 2021). Despite the importance of operational performance, it is a problem to most dairy businesses, particularly in emerging nations. Uncertainty in milk prices, production costs, and limited access to sophisticated technology are some of the issues that hinder operational performance. Weak leadership and governance also erode the confidence of members and decrease operational efficiency, impacting operational performance (Hansmann, 2019). For cooperatives, value-added services and strategies of aggregation have improved financial performance (Francesconi & Wouterse, 2019). Joint marketing and bulk processing, for example, reduces cost and increase bargaining power, while technology adoption increases product differentiation and operating efficiency (Chaddad & Cook, 2019). However, high implementation costs and inadequate training generally slow adoption of these strategies (Kariuki et al., 2023).

Sustainability practices, such as environmentally friendly production processes and value-added dairy products, also influence operational performance by influencing consumer preference and regulatory incentives (Williams et al., 2023). Although these practices usually entail additional costs, which strain small producers.

Operational performance in Kiambu's dairy cooperatives hinges critically on non-financial attributes like governance (Hansmann, 2019), technology (Chaddad & Cook, 2019), and aggregation (Höhler & Bijman, 2023). While weak leadership and fragmented markets persist, evidence shows cooperatives adopting digital tools and joint processing achieve better cost efficiency (Francesconi & Wouterse, 2019). Sustainable operational performance requires addressing implementation barriers through tailored policies supporting these non-financial drivers (Mazzarol & Reboud, 2020; Williams et al., 2023).

1.1.4 Dairy Cooperative Societies in Kiambu County

Kiambu County, which is among the top dairy-producing counties in Kenya, has 12 sub-counties: Githunguri, Limuru, Lari, Kikuyu, Kiambu, Kabete, Juja, Ruiru, Thika, Gatundu North, Gatundu South, and Kiambaa (County Government of Kiambu, 2021). Leaning on favorable climatic conditions and proximity to Nairobi, a major market town, dairy farming is a high-profile business in the county, supporting approximately 250,000 dairy cattle and earning more than Ksh 10 billion every year (Mwangi et al., 2019). Kiambu County has a total of 415 registered cooperative societies, where 330 actually operate, servicing different sectors in terms of finance, agriculture, and housing (County Government of Kiambu, 2021). The cooperatives range through varied areas of finance, agriculture, and housing.

The cooperatives in the dairy industry are at different levels, ranging from full-scale processing, semi-value addition, to bulking and selling raw milk to processors (County

Government of Kiambu, 2021). Even though they are of vital significance to the dairy industry, Kiambu County dairy cooperatives encounter many issues hindering them from being able to perform efficiently, including bad infrastructure, unstable prices of milk, and limited availability of new-farm technologies (County Government of Kiambu, 2021). In addition, Kiambu County dairy farmers also face other challenges such as poor breeds, inadequate artificial insemination (AI) services, and low productivity, between 2,955 liters and 8,700 liters per cow per year (Tegemeo Institute & Kenya Dairy Board, 2024). Rising feed costs, inadequate extension services, and governance problems have led to financial instability in the dairy sector, reducing farmers' gains and investment prospects (County Government of Kiambu, 2021).Fluctuations in milk prices, milk perishability, and small processing capacity further constrain operational performance (County Government of Kiambu, 2021).

In order to overcome such challenges, the county government is setting joint services through the Kiambu Dairy Farmers Association (KDFA) in a bid to cut the cost of operation and improve efficiency (County Government of Kiambu, 2021). There has been production on a large scale of milk in Kiambu County because small-scale and large-scale farmers have mostly applied the zero-grazing system, which has improved efficiency and land use (Mwangi et al., 2019). Even with this, the farmers have not yet reached the necessary levels of production. Although the large numbers have adapted to new technology in dairy production, they remain underutilized, most milk is marketed by dairy cooperatives, but hawking, particularly in Nairobi, is common as it is an assured market (Kamau, 2021). Informal market inhibits the quality, value-addition, and assured prices ability, thus continuing to limit development in the industry. Studies on non-financial determinants of operational performance in dairy cooperative societies align with the County Government's vision to transform the dairy industry into an efficient,

sustainable, and profitable business (Kamau, 2021). Focus on key non-financial drivers such as aggregation strategies, adoption of technology and governance will help reduce reliance on informal milk markets and create long-term wealth (Mwangi et al., 2019).

1.2 Problem Statement

With its growth, Kiambu County's dairy farming sector is not being utilized to its full capacity and instead still operates below its potential due to various challenges such as inadequate access to artificial insemination (AI) services, low-quality breeds and limited understanding of improved dairy farming practices, resulting in low productivity, between 2,955 liters and 8,700 liters per cow per year compared to the world's best practices of 9,000 liters a year (Tegemeo Institute & Kenya Dairy Board, 2024). In addition, the sector is facing volatile milk prices from 35-50 Kenya shillings per liter, compared to New Zealand where farmers earn the equivalent of over Kenya shillings 200 per liter (Fonterra Co-operative Group, 2024). The industry also faces challenges such as weak infrastructure, and limited processing capacity, which affect operational performance and investment (County Government of Kiambu, 2021 & Kenya Dairy Board, 2024). The informal milk segment, particularly hawking in Nairobi, in which approximately 80% of milk transactions occur, also restricts value addition, quality assurance, and price stability, which caps the sector's potential for growth (Kamau, 2021). Governance problems in dairy cooperatives, such as poor management and weak member relationships, add to inefficiency, reducing the bargaining power and availability of farmers to organized markets (Kabuga, 2024).

While numerous studies on Kenya's dairy industry have been conducted, most have only focused on finance and technical explanations without considering significant non-financial characteristics such as leadership, governance, and strategic decision-making. For instance, Wambua (2014) examined the productivity of dairy cooperatives in Machakos County with focus

on quality breed, feeding systems, and adoption of technology but excluded aggregation strategies and governance. Similarly, Mburu (2016) contrasted the payments and the systems of production in Kiambu County without looking into the stakeholders' engagement, innovation, or the culture of governance. Both studies relied solely on primary data, failing to incorporate secondary sources to validate their findings. The recent discoveries also reveal contradictions. Mwebia (2024) found that cooperative performance was not significantly influenced by marketing strategies, but governance and aggregation strategies were statistically significant, albeit the small sample of the study (few sampled cooperatives in Kiambu) necessitates broader validation.

This study bridged these gaps by analyzing the effect of governance, aggregation approach, and technology adoption on dairy cooperatives' operational performance in Kiambu. It examined how governance practices, aggregation strategies, and technology adoption collectively and individually influence the operational performance of dairy cooperatives. Using stratified purposive sampling, the research gathered experienced-based insights. The results provide significant recommendations towards improving cooperative management and harvesting the sector's economic potential.

This study aimed at analyzing the effect of non-financial attributes on the operational performance of dairy cooperative societies in Kiambu County, Kenya.

1.3 Objectives of the Study

1.3.1 General objective

The general objective of this study is to analyze the effect of non-financial attributes on the operational performance of dairy cooperative societies in Kiambu County, Kenya.

1.3.2 Specific objectives

1) To evaluate the effects of aggregation strategies on the operational performance of dairy cooperative societies in Kiambu County, Kenya.
2) To analyze the effects of technology adoption on the operational performance of dairy cooperative societies in Kiambu County, Kenya.
3) To evaluate the effect of governance on the operational performance of dairy cooperative societies in Kiambu County, Kenya.

1.4 Research Questions

1) How do aggregation strategies affect the operational performance of dairy cooperative societies in Kiambu County, Kenya?
2) Does technology adoption affect the operational performance of dairy cooperative societies in Kiambu County, Kenya?
3) Do governance practices affect the operational performance of dairy cooperative societies in Kiambu County, Kenya?

1.5 Justification of the study

The research adds to the body of literature on the performance of dairy cooperatives in Kenya, Kiambu County in particular, by describing in a systematic manner how non-financial determinants (governance, technology adoption, and aggregation strategies) affect operational performance. While earlier research has focused predominantly on financial metrics (Le & Ngo, 2020), this research makes empirical contributions on these less-studied determinants, addressing pressing gaps in cooperative literature (Mazzarol & Reboud, 2020). The findings offer dairy cooperatives practical strategies to enhance financial sustainability by enhancing leadership quality (Hansmann, 2019) and technological innovation (Chaddad & Cook, 2019).

This research establishes a benchmark for tracking cooperative performance in developing economies by documenting Kiambu's unique joint marketing (Höhler & Bijman, 2023) and governance experiences. The lessons allow comparison with other African dairy cooperatives (Francesconi & Wouterse, 2019), while informing global knowledge on sustainable agribusiness models (Williams et al., 2023). Policymakers are assisted with evidence-based recommendations to strengthen Kenya's dairy sector through focused intervention

1.6 Significance of the Study

1.6.1 Government Agencies and Regulatory Bodies

The findings are beneficial to inform government ministries and regulatory authorities, such as the Ministry of Agriculture and Livestock, to build policies that promote efficient aggregation methods, spur technology uptake, and further good governance systems in the dairy cooperative society. This nurtures a robust dairy industry that makes a strong contribution to Kenya's GDP.

1.6.2 Dairy Cooperative Societies

The study provides actionable recommendations for cooperative managers and board members regarding how to become more efficient in operations, involve members, and be more transparent in finances. An understanding of how aggregation, technology, and governance interaction can help cooperative leaders make decisions about how to maximize operational performance.

1.6.3 Dairy Farmers

The study helps farmers benefit from improved services and higher returns arising from membership in cooperatives by addressing factors that limit operational performance. Improved

operational performance for cooperatives translates into better pricing, reduced costs, and improved market access for farmers.

1.6.4 Researchers and Academicians

The findings add to the literature on Kenya's dairy cooperatives management and generally those in the developing countries. This study may also be used for reference and comparison by subsequent studies that may wish to investigate the drivers of operational performance among agricultural cooperatives

1.6.5 Investors and Financial Institutions

For investors and financial institutions interested in supporting the dairy sector, the research highlights key areas of intervention with high potential for impact and returns. Understanding the dynamics of cooperative operational performance can inform resource allocation and program development.

1.6.6 Local Communities

The expected outcomes of the study adds to the socio-economic development of the communities through improved livelihoods of farmers by increasing employment opportunities, improving incomes, and enhancing food security. Similarly, strong cooperatives can help in social cohesiveness and community development in general (FAO, 2021).

1.7 Scope of the Study

This study analyzes the effect of non-financial attributes on operational performance of dairy cooperative societies in Kiambu County, Kenya. Geographically, the study has been confined to Kiambu County, which is considered among the leading milk-producing regions of Kenya. Due to its proximity to major urban markets and a generally developed cooperative network, this

forms an ideal case for the interplay of studies on aggregation, technology, and governance in the dairy sector. The primary and secondary data sources used are surveys and secondary data from Kenya Dairy Board. The study targeted board of directors, cooperative managers and key stakeholders involved in the dairy industry.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter outlines the research's theoretical foundation and provides a critical analysis of empirical findings aligned with the study's objectives, conceptual framework, and operationalization of variables. It also explores relevant research and literature appropriate to the subject matter.

2.2 Theoretical Review

This section presents the theories related to the current study, including the agency theory, resource-based view (RBV), diffusion of innovations theory (DOI) and transaction cost economics theory. These theories were all used to guide the study.

2.2.1 Agency Theory

Agency theory, first offered by Ross S.A. in 1973, was directed at the agent-principal relationship, where a single agent delegates the authority to make decisions to another (Ross, 1973). Agency theory emerged as a result of the sophisticated nature of organizational structure, where owners of companies (principals) could no longer monitor their businesses personally and had to delegate appointed agents. The theory emerged to prominence during the 1970s when researchers sought to explain inefficiencies and conflicts of interest in delegated decision-making. In the case of cooperatives, the agent is cooperative members (farmers), and the principal are managers or board members who are charged with the running. Jensen and Meckling (1976) developed agency theory in their influential book, Theory of the Firm: Managerial Behavior, Agency Costs, and Ownership Structure, where they developed the

concept of agency costs and conflicts due to differing goals between principals and agents (Jensen & Meckling, 1976). They highlighted how goal differences create inefficiencies and, therefore, necessitate institutions such as incentive systems and governance structures to align interests. Their work formed the foundation to learn about governance systems in cooperatives and other organizations, and agency theory is thus most suitable while analyzing operational efficiency and performance in dairy cooperative societies.

Various non-financial factors influence the operational effectiveness and sustainability of dairy cooperatives. Policies such as collective milk collection, shared processing facilities, and pooled marketing efforts allow cooperatives to benefit from economies of scale and improve members' bargaining position (FAO, 2021). The application of sophisticated technology, including computerized accounting, e-payment systems, and precision dairy farming machinery, enhances transparency, efficiency, and accountability in cooperative management (Njiru et al., 2020). Leadership and governance are also determinants of cooperative success. Effective leadership models, ethical decision-making and participatory governance models enhance trust and member engagement (Ojango et al., 2019). Improving these non-financial factors is central to minimizing agency conflicts and making dairy cooperatives competitive and sustainable in a rapidly evolving agricultural landscape.

Agency theory has been widely applied in agriculture, cooperative economics, and rural development to examine governance structures and organizational behavior (Baiman, 1990). Across the globe, dairy cooperative societies face many non-financial concerns, including the efficacy of their governance, leadership accountability, and member participation (Shapiro, 1987). Supply inefficiencies, aggregation strategies, and technology uptake are also high-priority matters (Mitnick, 2006). In industrial nations, successful cooperatives emphasize transparency,

active farmer participation, and strong institutional structures that align cooperative leaders' interests with those of farmers (World Bank, 2020). Aggregation strategies, such as collective milk collection centers and bulk purchasing of supplies, enhance efficiency and reduce operating costs, benefiting cooperatives and farmers alike (FAO, 2021). In addition, technology uptake such as computer-based record-keeping, computer milk testing, and mobile money facilities also improves cooperative performance and accountability (Bebe et al., 2012). However, agency conflicts tend to arise when cooperative leadership is more interested in personal gains at the cost of member welfare, hence leading to inefficiencies, reduced trust, and reduced overall operational performance (Ojango et al., 2019). Enhancing governance arrangements, leadership development, and promoting the adoption of new technologies can help mitigate such agency issues and improve cooperative sustainability.

Dairy cooperatives in sub-Saharan Africa are critical to rural livelihood but are often characterized by poor governance, poor management, and limited institutional support (Mburu et al., 2007). Poor responsiveness to new dairy farming practices contributes to the complexity. Good governance, training programs, and official decision-making are essential to improving operational performance, equitable pricing, efficient resource allocation, and member loyalty (FAO, 2021). Weak governance structures tend to lead to mismanagement, inefficient service delivery, and loss of member trust, ultimately impacting cooperative performance negatively (Njiru et al., 2020). Aggregation methods such as bulk milking in groups, cooperatives processing, and group marketing make the dairy cooperatives competitive and more efficient (Ojango et al., 2019). Application of technology, for instance, digital book-keeping, computerized milk quality analysis, and mobile phone-based payment systems increases transparency and accountability and reduces cases of financial mismanagement and theft (Bebe

et al., 2012). Also, good governance and leadership systems with participatory decision-making and ethical leadership minimize agency conflicts and align cooperative objectives with members' farmers' interests (FAO, 2021).

Nationally in Kenya, employment, rural economic development, and food security are significantly contributed by dairy cooperative societies (Muriuki, 2011). However, non-economic considerations such as leadership patterns, farmer engagement, access to extension services, and cooperative leadership are determinative of operational performance. Leadership and governance problems in Kenyan dairy cooperatives have the tendency to generate inefficiencies, poor decision-making, and misuse of resources, further increasing agency conflicts between the leaders and members of the cooperatives (Mburu et al., 2007). Kiambu County, where there is a highly developed dairy sector, has cooperative societies influenced by management systems, transparency in decision-making, and farmer participation (Kiboori, 2023). Application of modern practices of dairy management and exposure to cooperative education programs also result in a successful cooperative. Although effective leadership and organizational structures increase cooperative efficiency, most of the cooperatives in Kiambu still suffer from inefficiencies due to mismanagement, lack of accountability, and ineffective leadership, leading to reduced operational performance (Muriuki, 2011). Additionally, poor member participation in decision-making discourages confidence and membership, further down pressing inefficiencies (Njiru et al., 2020). Agency conflicts are when collaborative officials prioritize individual interest over members' welfare, and this results in inefficient provision of services and unequal pricing (FAO, 2021).

Other non-monetary traits such as social capital, trust of members, and extension services availability also play significant roles in defining cooperative success (Ojango et al., 2019).

Effective networks and high communication among cooperative members facilitate the transfer of knowledge, improving decision-making and operational efficiency (Bebe et al., 2012). Furthermore, gender equality and young people's involvement in cooperatives guarantee long-term sustainability with varied thinking and innovative solutions to dairy farming issues (FAO, 2021). Other external factors such as climate change, inferior veterinary services, and restricted availability of quality feeds also affect cooperative operational performance. This suggests the necessity of a coordinated strategy incorporating reforms in governance and improved dairy farming operations (Mburu et al., 2007). Research underscores the importance of good cooperative management in improving operational performance through improved milk quality control and market access (Mwembia, F. K. (2024). Improving farm productivity through training, openness in decision-making and effective membership is necessary in averting agency conflicts (FAO, 2021).

Governance, leadership ethics, and cooperative management training will improve Kiambu dairy cooperative sector through minimizing internal discord and maximizing provision of services (Njiru et al., 2020). Capacity-building programs and establishment of a participatory decision culture will further improve cooperative performance and member satisfaction (Ojango et al., 2019). Overcoming these agency problems by enhancing governance practices, empowering members, and institutional assistance can greatly enhance operational performance of dairy cooperatives in Kiambu and elsewhere (Muriuki, 2011).

2.2.2 Resource-Based View (RBV)

The Resource-Based View (RBV) theory was proposed by Birger Wernerfelt in his 1984 paper and popularized by scholars such as Jay Barney (1991), it highlights that a firm's competitive advantage is generated due to proprietary internal resources of the firm (Barney et al., 2021). A

firm's internal competences, whether material or immaterial, are the foundation of the firm's market positioning (Penrose, 2009). In order to sustain this advantage, resources must be distinctive, difficult to replicate, and non-transferable (Barney et al., 2021), which makes them difficult for others to imitate. Furthermore, RBV demands that resources must be valuable, rare, inimitable, and non-substitutable (Castro et al., 2018). These unique capabilities enable firms to support dynamic environments, seize new possibilities, and efficiently handle threats, leading to more efficiency and position in the market (Sundqvist et al., 2014). Combining dynamic capabilities, the RBV model enables firms to identify the most important competences in adapting and innovating, solidifying its position as an underlying theory in unraveling strategic business advantage.

At the global level, dairy cooperative societies play a major role in food security and economic sustainability. The Netherlands and New Zealand have done this by adopting cooperative models that incorporate RBV principles, enhancing efficiency and competitiveness in the dairy sector. Their success relies on advanced technologies, strategic leadership, and robust cooperative networks (Van der Ploeg, 2020). These nations illustrate how investments in particular internal resources such as research and development, sustainable farming techniques, and online innovation build sustainable competitive advantages (Bijman et al., 2016). Internationally, dairy cooperatives benefit from effective aggregation strategies like central collection of milk and homogenized processing plants (Höhler & Bijman, 2023). In nations like Europe and Oceania, cooperatives have employed bulk purchase contracts in an effort to save costs and obtain better market prices, thus boosting operational performance (Nilsson, 2001). Global dairy cooperatives are at the forefront of technology, employing automation, artificial

intelligence-based quality inspection tools, and block chain-traceability technology (Brewster et al., 2017).

These technologies streamline dairy operations, increase efficiency, and increase supply chain transparency, and thus remain key drivers of high operational performance (Dairy Australia, 2019). Good leadership and governance arrangements have been instrumental in ensuring the long-term sustainability of global dairy cooperatives (Hansmann, 2019). International dairy cooperatives embrace democratic governance, managerial professionalism, and moral leadership values, which promote trust and flexibility amidst market uncertainty (Chaddad & Cook, 2004). Regionally, African dairy cooperatives pose challenges and opportunities.

These are South Africa and Ethiopia, where there is growing investment in dairy cooperatives spurred by state policy and international relations (FAO, 2019). The cooperatives apply RBV strategies by leveraging member commitment, use of improved breeds of dairy animals, and efficient management of value chains to enhance productivity and operational performance (Baltenweck & Staal, 2007). Nevertheless, constraints such as limited infrastructure, lowered access to finance, and climate volatility necessitate continuous resource creativity and strategic collaboration (Muriuki, 2011). African dairy sector cooperatives accomplish aggregation by establishing networks of collecting and distributing bulk milk (Omore et al., 2019). Others have established regional processing plants, reducing post-harvest loss and enhancing collective bargaining within regional markets (Thorpe et al., 2000). Increasingly, these cooperatives are adopting technology, including mobile-based payment systems, computerized record-keeping and automated milking machines, to increase efficiency (Sharma et al., 2019). Such technologies help cooperatives in simplifying operations, enhancing

production efficiency, and improving competitiveness in regional markets (Kaitibie et al., 2010). Sound governance frameworks such as cooperative training programs and government-funded capacity-building programs are needed to sustain regional dairy cooperatives (Wanyama et al., 2016). These frameworks enhance transparency, accountability, and inclusivity in decision making, ensuring long-term success in cooperative businesses (Karanja, 2023). At the national level, application of the RBV model illustrates that non-monetary characteristics significantly contribute to operational performance in Kenyan dairy sector cooperatives.

RBV examines how leverage of unique internal resources amplifies competitive advantages, an imperative consideration in cooperative business models (Nyaga & Kariuki, 2019). Strong leadership and effective governance ensure transparency, accountability, and strategic decision-making, which result in trust and long-term stability (Kamundi, K. 2014). Moreover, high member commitment facilitates collective resource mobilization, resulting in enhanced operational effectiveness and productivity in general (Barney et al., 2021). Kenyan dairy cooperatives engage in collective marketing, pooling milk supplies, and establishing centralized processing units (Muriuki & Thorpe, 2001). Such ventures improve efficiency, milk quality, and bargaining power in domestic and export markets (Staal et al., 2008). Additionally, new technologies like digital milk collection, precision feeding, and cold chain logistics have widely been embraced (Makoni et al., 2014). Such technologies facilitate milk quality maintenance, loss reduction, and profit margins enhancement for cooperative members (Kiptarus, 2005). At a national level, leadership training programs, government regulation, and industry policy (MoALF, 2013) are supportive of the dairy cooperatives. These policies support running transparent financial systems, equitable access to resources, and efficient mechanisms for resolving disputes, supporting long-term viability (Ngugi et al., 2016). Focusing even closer

to Kiambu County, dairy cooperatives have been very effective in economic growth, and the region is one of Kenya's leading dairy-producing counties (Mburu, G. N. (2016).

Cooperatives such as Githunguri Dairy Farmers Cooperative Society have been successful in applying RBV principles, earning market dominance by investing in modern dairy technologies, good governance mechanisms, and strong aggregation systems (Wambugu et al., 2011). In Kiambu County, dairy cooperatives operate village-level collection centers for milk, reducing logistics expenses and ensuring timely supply of milk (Njarui et al., 2011). Cooperative members also benefit from bulk feed purchase at low costs, lowering farm individual expenses and improving dairy efficiency (Ojango et al., 2010). The Kiambu-based dairy cooperatives have also integrated real-time milk analysis kits, mobile tracking apps, and computerized data analytic programs to enhance the quality control and efficiency of operations (Baltenweck et al., 2019). The innovations provide cooperatives with a competitive edge in both local and domestic markets (Omore et al., 2019). Effective governance and leadership in Kiambu dairy cooperatives are evident through formal cooperative education programs, stakeholder engagement forums, and transparent financial reporting systems (Kilelu et al., 2017). Such governance structures offer equal benefits to members of cooperative organizations and encourage long-term cooperative development.

2.2.3 Diffusion of Innovations Theory (DOI)

The Diffusion of Innovation (DOI) Theory, developed by E.M. Rogers in 1962, is a fundamental social science theory that explains the process by which new ideas, technology, or procedures spread within a population or social system over time. It happens with behavioral impacts as individuals embrace new instruments or methods, replacing previous habits. The rate and extent of adoption depend on various factors like perceived benefits, ease of use, and compatibility with

existing norms. Social influence, communication networks, and adopter traits are all significant determinants of the speed with which an innovation is adopted in a society. The theory classifies adopters into distinct groups from early innovators to laggards, specifying the overall diffusion process. Understanding these patterns of adoption is particularly relevant in agricultural sectors such as dairy cooperatives, where technology improvements, governance, and aggregation strategies can increase productivity and improve operational performance. Whether cooperatives can successfully incorporate new advancements or not is what makes them competitive and viable in the long run (Rogers, 2003).

Application of the theory to this study is vital because it accounts for variations in the rate at which Kiambu County dairy cooperatives embrace vital non-financial traits affecting their operating performance. So far as technology adoption is concerned, the DOI theory describes why some cooperatives such as Githunguri Dairy readily adopt some innovations such as automated milking systems and computerized record-keeping while smaller cooperatives lag behind due to their inability to afford them (Kamau et al., 2023). The theory identifies decisive factors influencing the levels of adoption such as perceived usefulness, ease of training availability, and cost of implementation which vary significantly in different cooperatives within the region.

In terms of aggregation strategies, the DOI theory emphasizes the function of communication channels and social networks in enabling collective action. Successful cooperatives in Kiambu that have established central milk chilling plants demonstrate the function of successful aggregation in improving market access and reducing post-harvest loss (Gichohi et al., 2022). The above examples demonstrate how innovations in collective action

diffuse through cooperative networks, whereby some groups embrace the innovations quickly and others at different speeds.

The theory also informs us on the critical influence of leadership and governance on diffusion of innovations. Properly running cooperatives with effective governance systems and participatory decision-making mechanisms has a tendency of embracing innovations at speed because the environment fosters trust and reduces resistance to change (Ndungu & Njiru, 2020). Cooperatives with poor leadership will have low rates of adoption and become laggards in the process of innovation.

While DOI theory is insightful, it has serious limitations if used in the context of Kenyan cooperative dairy farming. Critics argue that the theory overemphasizes individual decision-making and fails to address structural barriers such as high implementation costs and policy loopholes that significantly affect small-scale farmers (Mugambi et al., 2022). In addition, the assumption of uniformity in benefit provision from innovations is not necessarily a fact, given that outcomes are greatly based on each cooperative's own ability and circumstances (Omore et al., 2019).

Globally, the DOI theory has been successfully applied in the dairy sectors of developed countries, for example, the Netherlands and New Zealand, where it has been utilized to describe the rates of adoption of precision feeding technologies and automated milking systems (García & Briz, 2020). In Africa, adoption has been slower due to infrastructural issues, although Kenya has made considerable progress via innovation in mobile payment platforms such as DigiCow (Muriuki, 2020).

Overall, the DOI theory is a key support for this study because it establishes concrete bridges among non-financial attributes and operating performance for dairy cooperatives.

However, its limitations mean that alternative approaches must be sought after that address structural limitations and capacity differences among cooperatives. Institutional support and targeted farmer education programs would go a long way towards enhancing innovation take-up in Kiambu dairy cooperatives, bridging the knowledge gap between early movers and laggards in the process of innovation diffusion.

2.2.4 Transaction Cost Economic Theory (TCE)

Transaction Cost Economics, as defined by Williamson(1979), provides a framework for understanding the impact of transaction costs on organizational choices, most notably those regarding the firm boundaries and internal production versus market procurement (Nugent, 2014). TCE assumes that all transactions have coordination costs of monitoring, controlling, and managing the exchange, costs which are separate from production costs (Williamson, 1979). These transaction costs involve the resources employed while specifying and enforcing exchange contracts (Williamson, 1979), including searching, negotiating, and contracting. Transaction cost economics is an excellent lens to employ in examining how organizations structure their transactions to eliminate waste and enhance efficiency in decision environments that are uncertain (Ketokivi & Mahoney, 2017). The major premise of Transaction Cost Economics is that firms seek to minimize the sum of costs of production and transaction costs (Ketokivi & Mahoney, 2017). This perspective impacts decisions such as whether to outsource or have production and services under the control of the organizational structure.

Transaction costs are costs incurred in undertaking an economic exchange (Nugent, 2014). They include the costs on market information searching, contract negotiation, and compliance monitoring (Nwafor et al., 2020). Transaction costs are crucial in explaining market participation by smallholder farmers because variation in access to assets, market information,

and extension services generates asymmetries that affect transaction costs between households (Makhura, 2001). The theory argues that firms that are able to reduce the transaction costs without compromising performance are capable of enhancing the management of the firm (Gurianova et al., 2014). Production governance activities are highly affected by both firm-level and transaction-level effects (Leiblein & Miller, 2003). Transaction cost economics makes important observations about the shaping of transactions and strategic decision-making of firms in obtaining optimal allocation of resources (Thomas & Vink, 2020). When transaction costs are high, firms may choose to internalize activities and bring them within the organizational boundary in an effort to reduce the monitoring and contracting costs.

Alternatively, when transaction costs are low, firms may choose to outsource activities to specialized external providers since they can perform them cheaper thanks to specialization or economies of scale. Factors such as aggregation strategies, technology adoption and governance are crucial in lowering transaction costs and enhance operational performance (Anin et al., 2016) (Yang & Lien, 2018). Transaction costs arise due to imperfect information, bounded rationality, and opportunism, which can lead to market failure and inefficiency (Sultan et al., 2021). Transaction cost economics applies a contractual approach in economic organization studies (Williamson, 1989). This is based on the understanding that all economic transactions revolve around contracts and that the form of the contracts determines the efficiency of the economic system. Githunguri dairy, for example, exists in terms of contractual arrangements with numerous farmers, thereby influencing the overall supply and quality of milk, as well as its level of production and operational efficiency. Fresha milk, a Githunguri Dairy product, is said to be on the market in less than ten hours since milking, a reflection of efficient contractual and logistics work with farmers. The concept of transaction costs in the law comes from the

institutional economics theoretical tradition with the focus on the implications that arise from the trade of commodities (Stepanenko & Kamarov, 2019). Transaction costs are relevant to a broad variety of contexts, ranging from franchising through contracting to constructing efficient administrative hierarchies (Ngwenyama & Bryson, 1999). As transaction costs increase, hierarchical modes of governance such as firms are more efficient because they reduce the cost of coordinating and monitoring behavior (Williamson, 1979). But as transaction costs fall, market modes of governance are more efficient because they allow greater flexibility and competition (Nugent, 2014).

Applying TCE to dairy cooperative societies within Kiambu County, Kenya, provides meaningful information about the manner in which organizations structure transactions to minimize wastage and promote efficiency (Williamson, 1979). TCE comes into play best in describing dynamics of dairy cooperative societies, established to help farmers reduce transaction costs for access to markets, technology, and systems of governance. In the case of TCE, aggregation mechanisms employed by cooperatives directly evade transaction costs. By pooling resources, cooperatives can achieve economies of scale in milk collection, processing, and marketing, reducing per-unit transaction costs for farmers. Technology adoption can also decrease transaction costs; for example, investment in milk testing equipment reduces information asymmetry, and online platforms facilitate easier coordination (Williamson, 1979). Governance arrangements also matter. Sound governance systems, such as open decision-making, lower monitoring and enforcement transaction costs, hence enhancing operational performance in the cooperative. (Munch et al., 2021) Governance ensures that contract conditions are followed, impacting transaction costs and quality output directly, hence increasing operational performance in the cooperative society (Herde et al., 2020)

2.3 Empirical Review

This section presented a detailed review of past empirical studies relevant to the study objectives. It highlighted the findings of various scholars on key variables under investigation, showing how these studies relate to the current research.

2.3.1 Aggregation Strategies and Operational performance

Aggregation strategies are the act of pooling resources, services, and efforts among two or more stakeholders in order to achieve economies of scale, ease market access, and enhance operating efficiencies (Barrett et al., 2019). Aggregation strategies in dairy cooperative societies involve collective marketing, joint input purchasing, shared processing, and access to finance services in order to optimize operational performance (Kariuki et al., 2021). These methods enable smallholder dairy farmers to increase their bargaining power, reduce their costs, and become more competitive in the marketplace (Mwangi & Kamau, 2022). Aggregation methods are crucial when addressing market inefficiencies, quality, and technology adoption within the dairy sector (Musalia et al., 2023). By acting together, the cooperatives can negotiate for higher prices for their produce, obtain larger and more lucrative markets, and invest in infrastructure that would be unaffordable to the individual farmers (Opiyo et al., 2023). Aggregation strategies play a crucial role in the business performance of dairy cooperative societies.

Empirical studies evoke that a decentralized distribution method increases the market coverage level and reduces transport inefficiencies (Smith et al., 2020). The infrastructural development strategy is required to promote storage, processing, and transport facilities, improving cooperative performance (Jones et al., 2019). Cost leadership strategy also ensures competitiveness through minimizing production and operational expenses to allow dairy cooperatives to offer competitive prices (Brown et al., 2021). Additionally, financial innovations

and digital technologies are transforming aggregation models, which are allowing dairy cooperatives to leverage data-driven decision-making and productivity improvements (Njoroge et al., 2024). Empirical literature has ventured into understanding the impact of aggregation methods on the financial performance of dairy cooperatives in various contexts. This section scoops the literature to establish a connection between aggregation methods and the operational performance of dairy cooperative societies. Studies have confirmed that collective marketing greatly improves the economic performance of dairy cooperatives.

Research done by Omore et al. (2019) in Kenya established that those cooperatives using collective marketing strategies achieved 25% more revenue from milk sales compared to individual farmers. Better bargaining power, reduced transaction cost, and improved market access were found to be the causes of this increase. Similarly, Singh et al. (2020) in India determined that dairy cooperatives which marketed their products collectively received 18% higher prices per liter than those who marketed their products individually. More recently, Mwangi et al. (2023) examined dairy cooperatives in East Africa and determined that cooperatives which used digital platforms to market their products collectively had a 30% rise in milk prices due to greater market outreach. Although collective marketing is beneficial, constraints have been cited in certain literature. For instance, Kariuki et al. (2023) found that excessive reliance on collective marketing leads to dependence, wherein farmers fail to make individual market contacts. Inefficiency of cooperatives and corruption in price negotiations have been cited to reduce the alleged operational performance increase. Aggregation through collective purchasing of feeds, veterinary services, and equipment has been identified as a critical cost-reduction measure.

Musalia et al. (2021) aver that East African dairy cooperatives that had sourced inputs in bulk had reduced production costs by 15%, which led to higher profit margins. Similarly, in another related study, Birhanu et al. (2018) investigated Ethiopian dairy cooperatives and confirmed that those cooperatives that sourced inputs in bulk saved, on average, 20% of operating costs, leading to more net income for farmers. A more current Kenyan research done by Kamau et al. (2024) identified that cooperatives which applied blockchain technology within the management of procurement recorded 22% less loss incurred via fraud and 17% greater efficiency in their supply chain. Despite this, a study done by Njoroge et al. (2022) confirmed that bulk buying may not always lead to a reduction in cost if cooperatives lack sound governance structures. Inefficiency in some of the cooperatives, such as late input distribution, has a negative impact on productivity. Quality control issues also arise when cooperatives emphasize cost cutting at the expense of product quality. Value addition through the utilization of shared processing facilities has also been linked with increased operational performance.

A study by Makoni et al. (2022) in South Africa established that dairy cooperatives with processing facilities were 30% more profitable than those that sold raw milk. The study noted that value addition of milk into yogurt, cheese, and butter allowed the cooperatives to capture a larger share of the value chain. Ngeno et al. (2017) also reported the same findings in Uganda, where dairy cooperatives that had invested in shared cooling and pasteurization facilities registered a 25% increase in operational performance due to reduced spoilage and quality products. A survey in Rwanda by Mutua et al. (2023) also indicated that cooperatives that utilized renewable energy-based processing factories reduced the cost of operations by 28%, which was reflected in improved margins. Despite the advantages, shared facilities need huge capital outlays, which can be prohibitive to small cooperatives. Opiyo et al. (2023) noted that a

majority of dairy cooperatives in Kenya have no access to funding for processing plants, which hinders their ability to carry out value addition. Additionally, maintenance costs of the shared facilities could reduce net operational performance if not well managed.

A Tanzanian research by Ayuya et al. (2021) mentioned that poorly managed cooperatives often had inefficiencies that undermined operational performance. In addition, from a study conducted by Muriuki et al. (2019), regulatory limitations and the lack of government support limited the successful implementation of aggregation strategy in some dairy cooperatives. Earlier again, Njoroge et al. (2024) in Uganda observed that digital literacy gaps among the membership of a cooperative represented a hindrance to technology-driven aggregation solutions, keeping benefits from reaching potential members.

Empirical evidence shows that aggregation activities, including group marketing, bulk buying, shared processing facilities, and increased access to credit, enhance the operational performance of dairy cooperative societies (Kariuki et al., 2021; Musalia et al., 2023). Governance challenges and regulatory barriers, however, must be addressed to reap maximum benefits (Ayuya et al., 2021; Njoroge et al., 2024). While many studies outline the advantages of aggregation strategies, criticism suggests that inefficiencies, financial mismanagement, and high costs of investment may compromise their potential (Opiyo et al., 2023; Achieng et al., 2024). Future research must explore policy interventions and technological innovations that can enhance the effectiveness of aggregation strategies in the dairy sector (Muriuki et al., 2019; Chomba et al., 2023). Leader-member communication channels improve openness and cooperation, reinforcing trust among cooperative members (Taylor et al., 2020). Member involvement improves decision-making, where policies and strategies are implemented in accordance with the cooperative stakeholders' needs (Anderson et al., 2022). Operational

performance of the dairy cooperative society is the success and sustainability measure. An increase in the quantity of milk production converts into higher revenue generation, which improves operational performance directly (Harris et al., 2019).

Operating costs like feed, labor, and maintenance impact operational performance and should be well-managed (Evans et al., 2021). Cows' milk per cow is an important productivity indicator showing the efficacy of feeding regimens, veterinary care, and breeding operations within dairy cooperatives (Clark et al., 2022).

2.2.2 Technology Adoption and Operational performance

Kimunya (2014) describes innovation as a concept, method, or item that an individual perceives as novel, while diffusion refers to the process by which this new idea spreads from its origin, where it was initially developed by a creative individual to its adoption by users. Adoption signifies a commitment to fully integrate the idea, rather than just experimenting with it, due to the perceived benefits or advantages associated with adopting technology. Kimunya (2014) suggests that the more innovative farmers are, the greater their farm income and overall standard of living, indicating that resource-rich farmers are more inclined to take risks in adopting new agricultural practices. Kimunya (2014) asserts that the perceived relative advantage of an innovation, whether in terms of economic operational performance or cost reduction, positively influences its adoption (Kimunya, 2014). Similarly, Kaushik et al. (2024) emphasize that revolutionary improvements in agricultural productivity are crucial for economic growth. Kossaï & Piget (2014) support this view, arguing that technological adoption fosters social change within communities. The adoption of technology among smallholder dairy farmers plays a crucial role in enhancing productivity and sustainability, especially in developing regions (Taramuel-Taramuel et al., 2021). However, some scholars argue that technology adoption is not

always beneficial, as high initial investment costs and maintenance expenses may outweigh the economic gains, particularly for small-scale farmers with limited financial resources (Kaushik et al., 2024).

In the dairy sector, technology adoption is increasingly shaping operational performance. Dairy cooperative societies, which support smallholder farmers, benefit from innovations such as improved cattle breeds, automated milking systems, and digital market access platforms. The extent of dairy technology adoption varies across different agro-ecological zones due to technical and non-technical factors (Kimunya, 2014). Several studies have analyzed the motivations and barriers to adoption by comparing adopters and non-adopters (Taramuel-Taramuel et al., 2021). The level of diffusion, economic constraints, and adopter perceptions significantly influence technology uptake (Kaushik et al., 2024). However, research has shown that technological innovations alone are insufficient; complementary policies such as financial incentives, training programs, and access to extension services are critical to ensuring successful adoption (Kossaï & Piget, 2014). Key determinants of technology adoption in dairy cooperative societies include technological, economic, institutional, and human-specific factors (Kossaï & Piget, 2014), along with cultural, contextual, and policy influences (Kaushik et al., 2024). Factors such as family size, farming experience, access to extension services, crossbred cow availability, savings institutions, total milk income, livestock training, household head's age, and off-farm participation all impact both the likelihood and extent of dairy technology adoption (Kimunya, 2014).

Empirical studies provide insights into the conceptual framework variable indicators, supporting their significance in dairy cooperative societies. For Aggregation Strategies, decentralized distribution strategies have been shown to enhance market accessibility and reduce

delays in milk delivery (Kaushik et al., 2024). Infrastructure development strategies contribute to supply chain resilience, improving cold storage facilities and transportation networks (Kimunya, 2014). Cost leadership strategies enable cooperatives to remain competitive by minimizing production expenses and leveraging economies of scale (Kossaï & Piget, 2014). In terms of Technology Adoption, research highlights that digital payment systems reduce financial bottlenecks and enhance transaction efficiency (Kaushik et al., 2024). Advanced dairy management systems facilitate precision farming, optimizing feeding and breeding schedules (Taramuel-Taramuel et al., 2021). Real-time data collection supports proactive decision-making by providing timely insights into herd performance and resource utilization (Raksanugraha et al., 2023). Governance & Leadership plays a critical role in cooperative performance. Studies indicate that a well-structured board improves oversight and strategic planning (Kossaï & Piget, 2014). Effective leader-member communication channels foster transparency and trust, while member participation ensures democratic decision-making and commitment to cooperative goals (Kimunya, 2014).

Regarding the dependent variable, Operational performance of Dairy Cooperative Societies, empirical findings suggest that increasing milk production volume directly impacts revenue generation (Atieno, 2023). Efficient operational cost management improves financial sustainability, while a higher milk yield per cow enhances overall productivity and economic returns (Kaushik et al., 2024). The milk payment rate per liter serves as a robust indicator of a dairy cooperative's financial health, directly mirroring its capacity to transform operational efficiency and market dynamics into concrete financial benefits for its constituent members. Given that a primary mandate of dairy cooperatives involves the economic empowerment of their members, the milk payment rate effectively quantifies the extent to which the cooperative

fulfills its core mission of maximizing member value (Anugrah et al., 2021). Additionally, milk payment rate can reflect on the impact of adopting scientific dairy farming practices, especially when comparing the returns to members and non-members (PG et al., 2020). This metric encapsulates the cooperative's overall effectiveness in value creation and distribution, providing a clear and easily understandable measure of success for both members and external stakeholders.

These empirical insights reinforce the relevance of the conceptual framework variables in shaping the operational and financial performance of dairy cooperative societies (Kimunya, 2014). Increased technology adoption is linked to higher milk yields, regardless of cattle breed (Taramuel-Taramuel et al., 2021). However, adoption is constrained by affordability, limited access to information, and inadequate training (Kaushik et al., 2024; Kossaï & Piget, 2014), which hinder milk quality and yield improvements. Critics argue that the assumption that technology adoption automatically leads to increased operational performance ignores contextual challenges such as inadequate infrastructure, fluctuating market prices, and environmental concerns that may render technology adoption ineffective in certain regions (Atieno, 2023).

Research indicates that technological investments in dairy cooperatives directly impact farm operational performance. Modern milking machines, high-yield fodder, and cold storage facilities contribute to efficiency and reduced post-harvest losses (Kaushik et al., 2024). Studies on dairy technology adoption among smallholder farmers have shown that access to technology correlates with increased milk productivity and higher revenues (Raksanugraha et al., 2023; Atieno, 2023). However, some researchers caution that while increased milk production can enhance operational performance, it may also lead to market saturation, price reductions, and reduced profit margins, especially in the absence of effective supply chain management (Kaushik

et al., 2024). Further research is needed to understand the economic implications of different technologies in various cooperative structures (Kimunya, 2014). In the dairy industry, technological advancements have driven financial success by enhancing productivity and reducing costs. Between 1984 and 1998, U.S. milk production per cow increased significantly (Raksanugraha et al., 2023), leading to farm consolidation and increased herd sizes. Capital-intensive technologies, such as advanced milking systems and genetically superior cows, benefit large farms due to economies of scale, whereas management-intensive technologies require high human capital but lower financial investment (Kaushik et al., 2024). Market volatility, driven by policy shifts, underscores the importance of technological efficiency for financial sustainability (Kimunya, 2014).

However, some scholars argue that while technology adoption can enhance efficiency, it may also contribute to job losses among low-skilled farm workers, raising concerns about its broader socio-economic impact (Kossaï & Piget, 2014). Studies on smallholder dairy farmers in Kenya have used spatial econometric models (Atieno, 2023), GIS data (Taramuel-Taramuel et al., 2021), and predictive models analyzing investment, risk, and complexity (Kaushik et al., 2024). Other research highlights the importance of social learning in technology diffusion (Kimunya, 2014). As dairy cooperatives continue to integrate technological innovations, future studies should focus on how these advancements impact milk yields, income stability, and cooperative sustainability (Kimunya, 2014).

2.2.3 Governance and Leadership Practices on the Operational performance

Leadership and governance significantly influence the operational performance and sustainability of dairy cooperative societies (Mutua et al., 2015). Effective governance enhances transparency, accountability, and decision-making, which are vital for cooperative development.

Leadership practices affect operational effectiveness, member participation, and financial management, hence high operational performance. Empirical studies identify that cooperatives with effective governance and ethical leadership systems exhibit improved financial performance (Hope, 2015). However, there are others who take the position that governance structures themselves cannot guarantee operational performance; flexibility in leadership and vision strategy has equally important roles to play (Kariuki & Kinyua, 2019). This section integrates existing empirical evidence on the interconnection between governance, leadership practice, and operational performance of dairy cooperatives. Cooperative governance is employed here to refer to structures, policies, and practices that guide decision-making and accountability. Governance is needed to enable operating efficiency and financial viability, as discussed by Hope (2015). Member participation, board oversight, regulatory compliance, and finance transparency are some of the governance functions in dairy cooperatives. Empirical findings have established that proper governance frameworks correspond to high operational performance because of reduced misappropriation of funds and enhanced long-term resilience (UNPAN, 2015).

Morrell and Hartley (2015) reaffirmed that governance effectiveness in cooperatives depends on ethical leadership and compliance with cooperative principles. Poor governance has been linked with corruption and weak oversight, which have been tied to loss of finances and declining member trust in cooperatives (Richter & Burke, 2015). Empirical studies have shown that cooperatives with institutionalized systems of governance, such as regular audits and democratic decision-making, exhibit improved financial outcomes (Fournier, 2015). Sharma et al. (2018) discovered in a study that Indian dairy cooperatives with strong governance systems recorded a 15% increase in operational performance over five years, driven by improved financial controls and accountability. Similarly, Abate et al. (2022) observed that governance

systems emphasizing transparency and compliance significantly improved cooperative performance in Ethiopia. However, critics argue that strict models of governance sometimes hinder operational flexibility and innovation, which are vital for cooperative development in uncertain markets (Mwangi & Njoroge, 2020). This necessitates well-balanced governance structures to allow both stability and responsiveness. Leadership of dairy cooperatives impacts strategic planning, member engagement, and financial decision-making. Ethical leadership, such as transparency, fairness, and accountability, has been associated with improved cooperative performance (Treviño, Hartman, & Brown, 2015).

Macaulay and Lawton (2015) proved that cooperatives with ethical and visionary leaders have greater operational performance through better utilization of resources and improved member commitment. Antonakis and Atwater (2015) pointed out the visible and invisible aspects of leadership in cooperatives. Visible leadership is embodied in decision-making, communication, and policy, whereas invisible leadership is embedded in values, ethics, and thinking strategically. Squazzo (2015) theorized that consistency and integrity of leadership give rise to cooperative resilience and enhanced operational performance. Recently, a study by Mutua et al. (2021) undertaken in Kenya found that participatory leadership-based dairy cooperatives recorded a 20% productivity improvement due to enhanced cooperation and motivation of members. But other researchers recommend that operational performance will not be pushed by leadership alone. Karanja and Waweru (2021) believe that strong institutional systems and market-based strategies must accompany effective leadership to sustain operational performance for dairy cooperatives.

Board Structure defines decision-making efficiency as well as strategic direction, impacting quantity of milk production and operational cost (Smith et al., 2019). Leader-Member

Communication Channels facilitate knowledge transfer and improve coordination, leading to improved milk output per cow and overall performance (Jones et al., 2020). Member Participation ensures cooperative members are properly involved in decision-making, thus improving milk production and cost savings (Williams et al., 2021). These factors of governance are directly related to the dependent variable, Operational performance of Dairy Cooperative Societies, and are influenced by milk production quantity, operation cost, and milk price per liter. According to empirical research, better governance structures and greater member participation in dairy cooperative societies can lead to higher operational performance as well as sustainability. Effectiveness of governance structures and leadership influence operational performance in dairy cooperative societies. Studies have established that cooperatives with sound governance frameworks perform financially better due to improved decision-making and reduced financial risk (Hope, 2015). Governance mechanisms such as board independence, financial reporting transparency, and member participation enhance cooperative operational performance and efficiency (Kakumba & Fourie, 2015).

Leadership behavior also affects operational performance through strategic resource allocation and conflict resolution. Research by Cohen and Eimicke (2015) determined that transformational leader-led dairy cooperatives, where innovation is enabled and members are stimulated, tend to experience greater productivity and revenue growth. Fournier (2015) further established that financially sound cooperative societies with good leadership systems experience lower financial mismanagements and more investment in value-added activities. A study by Wanyama et al. (2023) conducted in East Africa found that cooperatives with clearly established leadership succession strategies and regular training plans recorded 25% more returns than cooperatives with weak leadership development strategies. Despite these positive findings, some

researchers argue that external market dynamics such as fluctuating milk prices and supply chain disruptions can hugely influence operational performance regardless of governance and leadership practices (Muthoni & Kiptoo, 2022). This highlights the importance of cooperatives adopting adaptive leadership and governance practices to mitigate economic risks. Governance and leadership are key drivers of operational performance for dairy cooperative societies. Empirical findings show that well-governed cooperatives with ethical leadership tend to have enhanced financial performance (Wanyama et al., 2023).

Governance ensures transparency and accountability, while leadership ensures strategic decision-making and member engagement. However, a critical review suggests that external economic conditions, institutional flexibility, and market-based strategies are the most important factors in ensuring operational performance (Muthoni & Kiptoo, 2022). Others have posited that rigid governance systems can hinder innovation, impacting long-term growth (Mwangi & Njoroge, 2020). The future should entail research on the impact of leadership training programs and governance reforms on the operational performance of dairy cooperatives to ensure their long-term sustainability.

2.4 Summary of Literature Review

Aggregation methods, through resource and effort concentration among members, significantly increase the operational performance of dairy cooperative societies. Collective marketing, collective purchase, shared processing units, and easier access to financial services assist small-scale dairy farmers in merging their bargaining power, reducing costs, and enhancing competitiveness (Barrett et al., 2019; Kariuki et al., 2021). Studies confirm that cooperatives with joint marketing have experienced higher sales of milk and improved prices (Omore et al., 2019; Singh et al., 2020), whereas joint procurement lowers the cost of production (Musalia et

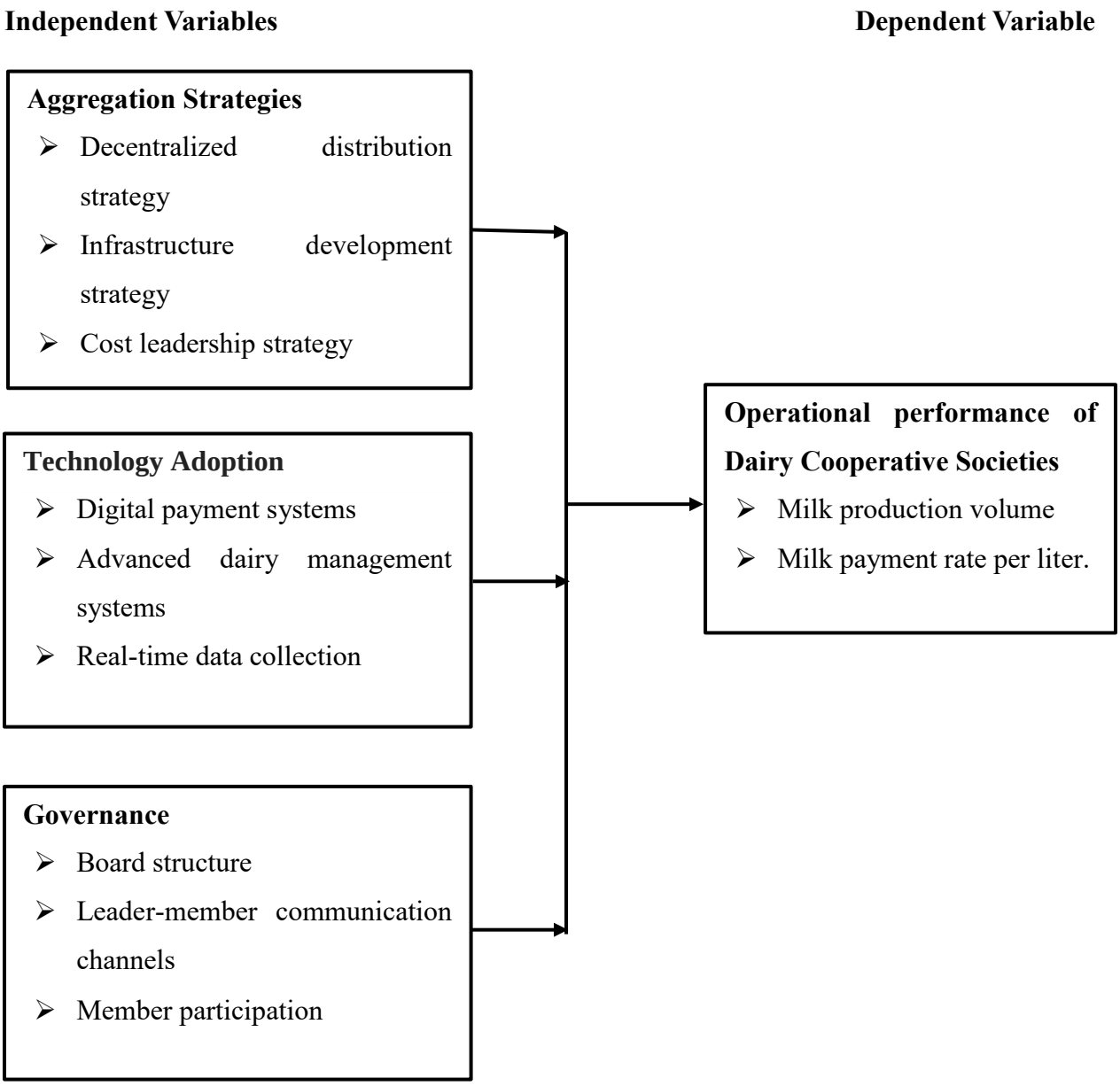
al., 2021; Kamau et al., 2024). Joint processing units lead to value addition and therefore higher operational performance (Makoni et al., 2022; Ngeno et al., 2017). Investment in infrastructure is also crucial in optimizing operational performance (Chomba et al., 2023; Karanja et al., 2020). However, barriers such as weak governance, inefficiencies, and regulatory inhibitions can undercut the full potential of such interventions (Ayuya et al., 2021; Njoroge et al., 2024), suggesting the necessity for strong governance and policy interventions in optimizing benefits from aggregation.

2.5 Conceptual Framework

A conceptual framework visually represents the relationship between independent and dependent variables, illustrating how non-financial attributes impact the operational performance of dairy cooperative societies. The independent variables include non-financial attributes such as aggregation strategies, innovation and technology adoption, and governance and leadership. The dependent variables encompass operational performance measures that are milk production volume, and milk price per liter paid to members. This framework provides a structured approach to analyzing the complex dynamics within dairy cooperative societies and can guide future research and decision-making processes. The framework is shown below.

FIGURE 1

Conceptual Framework



Source Author, 2025

2.6 Operationalization of Variables

TABLE 1

Operationalization of Variables

Type of Variables	**Variable**	**Indicators**	**Measure**	**Type of Scale**
Dependent Variable	Operational Performance Index	➢ Milk production volume ➢ Milk payment rate per liter.	Numerical values from production records	Ratio
Independent Variables	Aggregation Strategies	➢ Decentralized distribution strategy ➢ Infrastructure development strategy ➢ Cost leadership strategy	5-point Likert Scale (Perception-based questions)	Ordinal
Independent Variables	Technology Adoption	➢ Digital payment systems ➢ Advanced dairy management systems ➢ Real-time data collection	5-point Likert Scale (Perception-based questions)	Ordinal
Independent Variables	Governance & Leadership	➢ Board structure ➢ Leader-member communication channels ➢ Member participation	5-point Likert Scale (Perception-based questions)	Ordinal

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology adopted for the study, defining the target population, detailing the sampling approach, describing data collection methods, and providing an overview of data analysis techniques and result presentation.

3.2 Research Design

This research utilized a descriptive research approach to analyze the demographic profiles and preferences of identified key informants and the effect of aggregation strategies, technology uptake, and governance in impacting operational performance. Descriptive research was used to systematically gather data in order to describe trends and patterns in such data and hence was fitting to this study. With the utilization of statistical techniques, this study creates evidence-based recommendations in support of decision-making in the context of dairy cooperatives.

3.3 Target Population

The research sampled 19 dairy cooperative societies in Kiambu County, Kenya, and the cooperatives were the primary units of study. The research assessed the impacts of governance practices, aggregation strategies, and technological adoption on their operational performance. The units of observation were key informants directly associated with cooperative operations—managers, board members, and members who are also employees, to be precise. While the cooperatives were the main concern, insights were developed through those individuals involved in daily activities.

The population sample included 600 subjects in the 19 cooperatives. To increase validity, methodological triangulation was employed, whereby data was gathered from respondents who possess different functional roles in every cooperative. With multiple perceptions, cross-checking was facilitated through the aggregation and comparison of diverse informant categories' responses to offer strong and reliable findings.

TABLE 2

Distribution of Target Groups

DAIRY COOPERATIVE	Estimated Population	Proportion (%)
Githunguri Dairy	114	19.00
Gatundu United Dairy	30	5.00
Limuru Dairy	31	5.17
Mangu Progressive	29	4.83
Gakoe United	25	4.17
Kabete Dairy	25	4.17
Kiriita Dairy	28	4.67
Ndumberi Dairy	26	4.33
Gatamaiyu Dairy	24	4.00
Kikuyu Dairy	26	4.33
Gikambura Dairy	26	4.33
Ndarugu Dairy	29	4.83
Muguga Dairy	24	4.00
Uplands Dairies Ltd	25	4.17
Kiambaa Dairy	30	5.00
Karatu Dairy	27	4.50
Lari Dairies	28	4.67
Gatundu South	26	4.33
Sigona Dairy	27	4.50
Total	600	100.00

Source, Kiambu County, 2025

3.4 Sampling Technique and Sample Size

The study used a stratified purposive sampling method to analyze the degree to which non-financial determinants influence cooperative operational performance (Perin & Enahoro, 2023). The approach treated each of the 19 dairy cooperatives as individual strata, with systematic sampling from three key functional groups (managers, board members, and stakeholders) based on their roles in decision-making, operational understanding, and years of experience. The method was particularly valuable for accessing power dynamics and information asymmetries within cooperatives (Wijers, 2019), while achieving representation of diverse perspectives - as illustrated by the coverage of 24 participants of Githunguri Dairy's unique zonal arrangement(13 zones), yielding a good total sample of 78 respondents.

The sampling approach was best aligned with the study objectives by, enabling the taking into account of multi-level perspectives of governance practice and operational strategy (Lwova, 2020); targeting information-rich participants with first-hand knowledge of the non-financial dimensions under investigation (Naanyu et al., 2020); and enabling both statistical adequacy satisfying Wu & Leung's (2017) criterion of 5 or more respondents per Likert item and qualitative richness through thematic saturation. This dual approach of stratified representation and purposive expert sampling ensured the results would offer meaningful, contextually-grounded understanding of how aggregation methods, technological uptake, and governance collectively impact operational performance in the dairy cooperative subsector in Kenya

3.4.1 Sample Frame

TABLE 3

Sample Frame

Cooperative	Board Member	Manager	Stakeholder	Total Sample	proportion
Githunguri Dairy	8	6	10	24	30.77
Gatundu United Dairy	1	1	1	3	3.85
Limuru Dairy	1	1	1	3	3.85
Mangu Progressive	1	1	1	3	3.85
Gakoe United	1	1	1	3	3.85
Kabete Dairy	1	1	1	3	3.85
Kiriita Dairy	1	1	1	3	3.85
Ndumberi Dairy	1	1	1	3	3.85
Gatamaiyu Dairy	1	1	1	3	3.85
Kikuyu Dairy	1	1	1	3	3.85
Gikambura Dairy	1	1	1	3	3.85
Ndarugu Dairy	1	1	1	3	3.85
Muguga Dairy	1	1	1	3	3.85
Uplands Dairies Ltd	1	1	1	3	3.85
Kiambaa Dairy	1	1	1	3	3.85
Karatu Dairy	1	1	1	3	3.85
Lari Dairies	1	1	1	3	3.85
Gatundu South	1	1	1	3	3.85
Sigona Dairy	1	1	1	3	3.85
Total	26	24	28	78	100

Source, Author, 2025

3.5 Data Collection Methods

Data was gathered in this study in duration of two months, by employing closed questionnaires with a structured data collection approach. Self-administered questionnaires were filled out by one cooperative manager, one board member and one stakeholder from each dairy cooperative society. Online questionnaires (google forms) were provided to accommodate convenience. A pilot test was carried out in order to standardize the questionnaire and enhance its reliability. Supplementing the primary findings was secondary data on milk production volumes and milk payment rate per liter for the year 2024 acquired from Kenya Dairy Board. The data, provided in Excel format, detailed monthly milk production volumes for each cooperative. For the purpose of the study, the total annual milk volume was calculated by summing the monthly figures for each cooperative. Similarly, the milk payment rate per liter was provided on a monthly basis, and an annual average rate was computed and used in the analysis.

3.6 Pilot Testing

The survey was piloted on a 20% (15 respondents) sample of respondents from dairy cooperatives in Kiambu County. This was to test the survey to fine-tune the questionnaire, ensure question clarity, and the reliability and validity of the instrument prior to its full deployment.

3.7 Reliability and Validity

Reliability was measured using Cronbach's alpha (benchmark: 0.7). Validity was strengthened through reviews by experts. Cronbach's alpha, a widely used metric, serves as an indicator of internal consistency reliability, elucidating the extent to which items within a measurement instrument are inter correlated and collectively measure a singular construct or concept (Tavakol & Dennick, 2011). It is a critical step when researchers develop questionnaire items to measure outcomes, ensuring construct validity, internal consistency, and reliability (Heo et al., 2015). The

reliability analysis showed strong internal consistency for all scales. Scale B: Aggregation strategies (α = 0.738), Scale C: Technology adoption (α = 0.764), and Scale D: Governance practices (α = 0.803) all demonstrated acceptable to high reliability.

3.8 Data Analysis and Presentation

This study analysis applied both descriptive as well as inferential statistical methods. Descriptive statistics that use measures of central tendency (mean), frequency distribution, dispersion (standard deviation), and distribution shape indicators such as skewness and kurtosis were initially employed to describe and provide a brief overview of key variables. For inferential analysis, multiple regression technique was applied to examine the relationships between the independent variables (aggregation strategies, technology adoption, and governance practices) and the dependent variable (operational performance of dairy cooperatives). In order to gauge the reactions of the participants to the most significant non-financial attributes (e.g., technological adoption, governance mechanisms, and aggregation frameworks), the study employed several-item measures rated on a 5-point Likert type scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Responses to a single item were added to derive a total score for a single construct by taking the arithmetic mean of all items that reflect on the same variable.

This mean method maintains the range of the original Likert scale and provides a valid measure of the latent construct. Operational performance was assessed based on two indicators: the amount of total milk production in 2024 and the average milk payment rate per liter, as the mean of monthly rates during the year. These indicators were consolidated into a composite measure (Operational Performance Index - OPI) by multiplying the total amount by the average rate. The measure represents the total value returned to the members and reflects the overall operational effectiveness of the cooperative.

In order to merge these two distinct data types, there was a merged cross-sectional dataset created in Microsoft Excel where each dairy cooperative was one observation (row). All of the variables, whether based on processed Likert scale scores or on the ratio-level measures derived from them, had separate columns. This harmonization meant that subjective (perception-based) and objective (performance-based) measures could be compatible in the one analysis framework, such that strong inferential analysis could be performed.

The selection of data for the year 2024 was intentional and warranted. Firstly, it was the latest as well as the most detailed collection of data at the time of the study, and hence more applicable and up to date. Second, the timing of the primary and secondary data sources was coordinated internally because the operations conduct identified through the respondents' feedback were directly connected to the same timeframe's performance outputs.

The analysis was conducted using Microsoft EXCEL 2010 and STATA version 16 software to facilitate comprehensive statistical testing (Gujarati, 2003), with each package being used for its particular strengths in data management and advanced analytical capabilities. Results were presented in both tabular and graphical formats (charts and graphs) to ensure clear visualization and interpretation of findings. The multiple regression model took the form:

$$\mathbf{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon}$$

Y = log operational performance index of dairy cooperatives

$\mathbf{X_1}$ = Aggregation strategies

$\mathbf{X_2}$ = Technology adoption

$\mathbf{X_3}$ = Governance procedures

$\boldsymbol{\beta_0}$ = Constant Term

$\boldsymbol{\beta_1, \beta_2, \beta_3}$ = Beta coefficients

ε = Error term

This modeling approach enabled precise identification and quantification of how each independent variable influences operational performance, with robustness checks performed across STATA statistical software platform.

3.9 Diagnostic Tests

To verify the reliability and robustness of the regression models, diagnostic tests were conducted as per conventional statistical practice. Normality of residuals was verified through Shapiro-Wilk test (Ghasemi & Zahediasl, 2019). Homoscedasticity was checked using the Breusch-Pagan test ((Gujarati, 2003)), where the null hypothesis is that variance of residuals is constant.

Multicollinearity between predictor variables was checked using Variance Inflation Factor (VIF) analysis (Hair et al., 2019). Based on conventional guidelines, VIF values less than 5 establish multicollinearity at acceptable levels, values of 5 and 10 indicate caution, and values greater than 10 calls for remediation. Finally, the assumption of linearity was checked by visual inspection of residual against predicted value scatterplots. All such diagnostic procedures together rendered the outcome of the regression model valid and trustworthy.

3.10 Ethical Considerations

Ethics approval was requested from the KCAU Ethics Review Committee in accordance with the research policy of the university and the national standards of ethics. Participants were provided with informed consent forms capturing the intent of the study, their voluntariness to take part, and the confidentiality of their response. Anonymity was ensured and none of their personal details revealed. All data gathered has been stored confidentially and was utilized only for academic work.

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presents the data analysis and interpretation collected to assess the effect of non-financial factors on the operational performance of dairy cooperative societies in Kiambu County. The chapter begins with the rate of response, followed by the respondents' demographic profile. It then delves into the descriptive and inferential analysis of the study's main variables like aggregation strategies, technology adoption and governance practices.

78 respondents from dairy cooperative societies in Kiambu County were targeted. 69 respondents participated in the study, an overall response rate of 88.46%. This is considered adequate for statistical analysis and provides a credible representation of the target population. A rate of response of more than 70% is generally recommended while ascertaining the prevalence of outcomes within a population since it enhances the validity and reliability of the findings, as noted by Fincham (2008).

TABLE 4

Key Informants Population, Sample and Respondent Rate

Target Group	Population	Sample Size	Percentage (%) Of Sample	Respondents	Percentage (%) Of Respondents
Githunguri Dairy	114	24	30.77	20	28.99
Gatundu United Dairy	30	3	3.85	3	4.35
Limuru Dairy	31	3	3.85	3	4.35
Mangu Progressive	29	3	3.85	3	4.35
Gakoe United	25	3	3.85	3	4.35
Kabete Dairy	25	3	3.85	3	4.35
Kiriita Dairy	28	3	3.85	3	4.35
Ndumberi Dairy	26	3	3.85	3	4.35
Gatamaiyu Dairy	24	3	3.85	2	2.90
Kikuyu Dairy	26	3	3.85	2	2.90
Gikambura Dairy	26	3	3.85	3	4.35
Ndarugu Dairy	29	3	3.85	3	4.35
Muguga Dairy	24	3	3.85	3	4.35
Uplands Dairies Ltd	25	3	3.85	2	2.90
Kiambaa Dairy	30	3	3.85	2	2.90
Karatu Dairy	27	3	3.85	3	4.35
Lari Dairies	28	3	3.85	3	4.35
Gatundu South	26	3	3.85	3	4.35
Sigona Dairy	27	3	3.85	2	2.90
	600	**78**	**100**	**69**	**100**

Source, Researcher, 2025

4.2 Demographic Profile of the Respondents

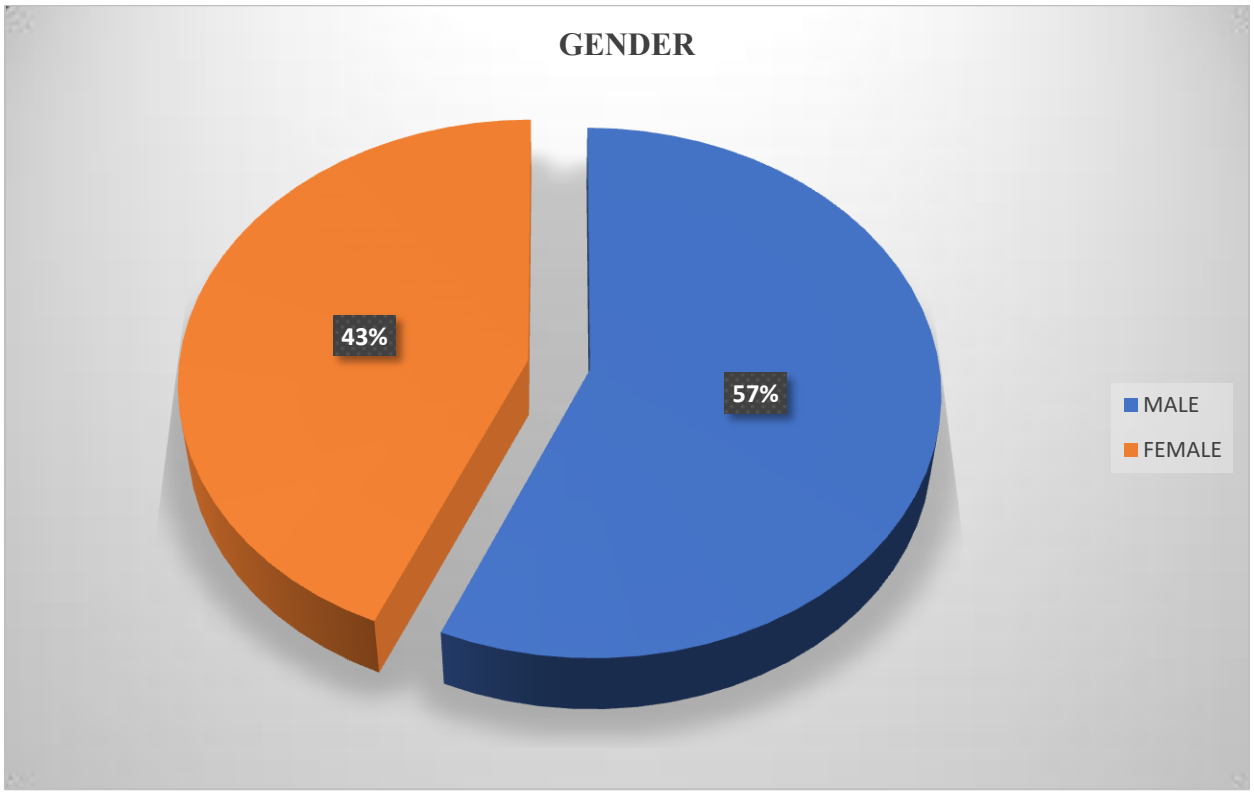
To better understand the background of the respondents, demographic information was collected, including gender, age group, position in the cooperative, years of experience in the dairy sector, and level of education. This information provides context for interpreting the results of the study.

4.2.1 Gender of Respondents

Among the 69 respondents who all indicated their gender, 39 (56.5%) were male and 30 (43.5%) were female. This indicates relatively balanced representation, with a slightly larger number of male respondents involved in dairy cooperative activities.

FIGURE 2

Gender of Respondents



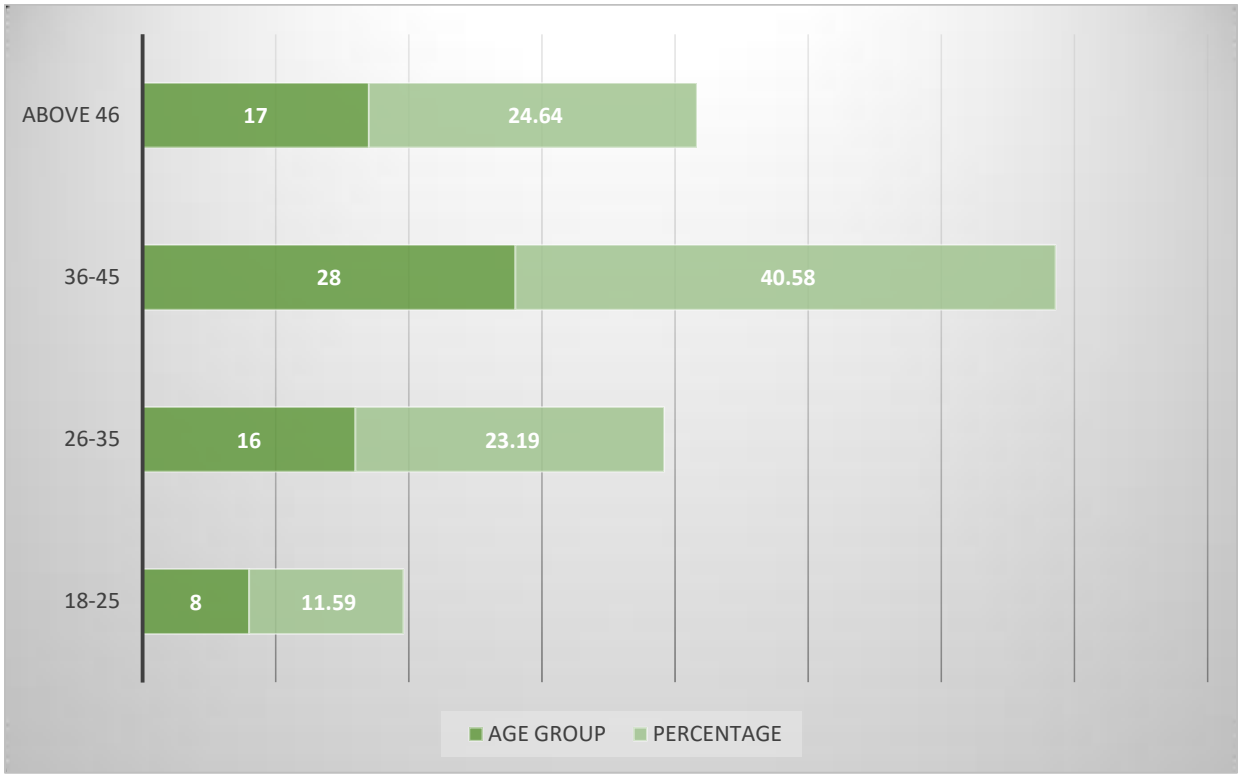
Source, Researcher, 2025

4.2.2 Age Group of Respondents

Respondents' ages were categorized into four groups: 8 respondents (11.6%) were aged between 18–25 years, 17 respondents (24.6%) were aged 26–35 years, 25 respondents (36.2%) fell within the 36–45 years bracket, and 19 respondents (27.5%) were above 45 years of age. The largest age group was 36–45 years, suggesting that most respondents were in their economically active and experienced age bracket.

FIGURE 3

Age Group of Respondents



Source, Researcher, 2025

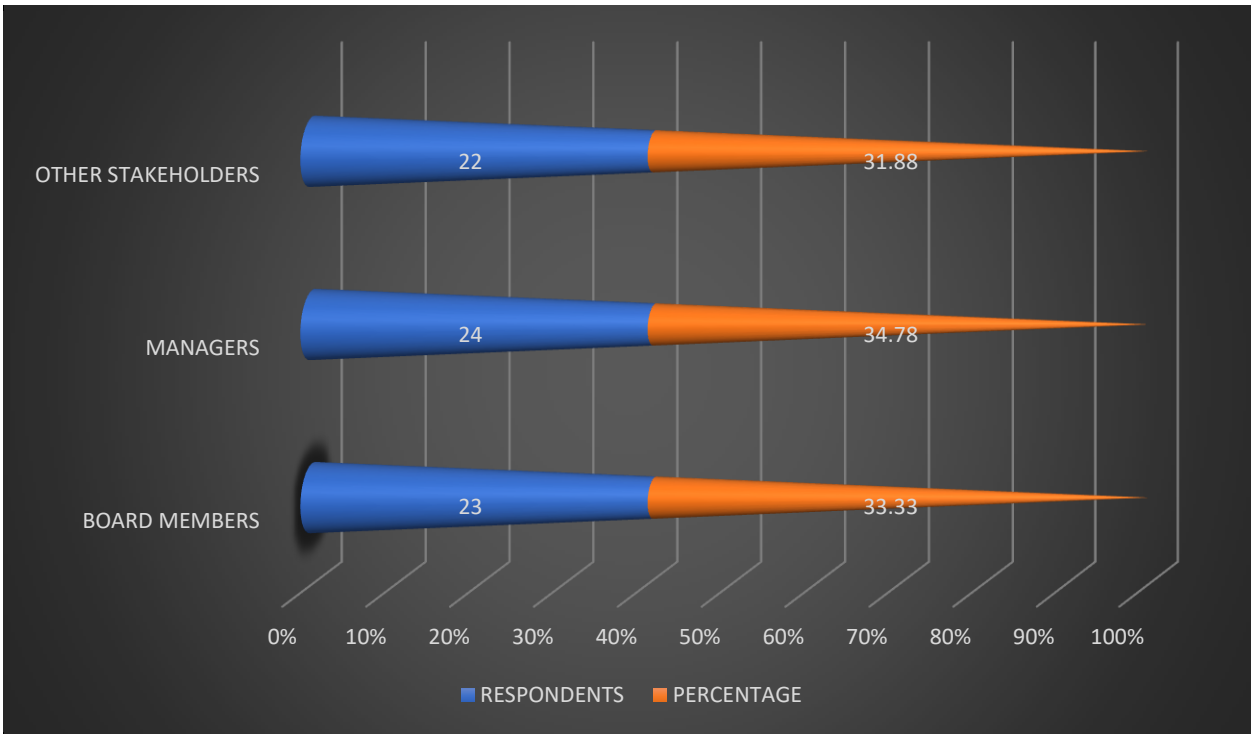
4.2.3 Position in Cooperative

The graph is a percentage comparison of the respondents and their respective percentage share per stakeholder group in the study, namely board members, managers, and other stakeholders.

Managers were the most represented at 34.78%, followed by board members at 33.33%, and other stakeholders, (employee cooperative members) at 31.88%. The distribution is also very even, indicating that feedback had tended to be pretty evenly distributed among the three groups with slight variation in the number of individuals who responded. The equal representation enhances the validity of the study findings through incorporation of perceptions from various major stakeholders in the cooperatives.

FIGURE 4

Position in Cooperative



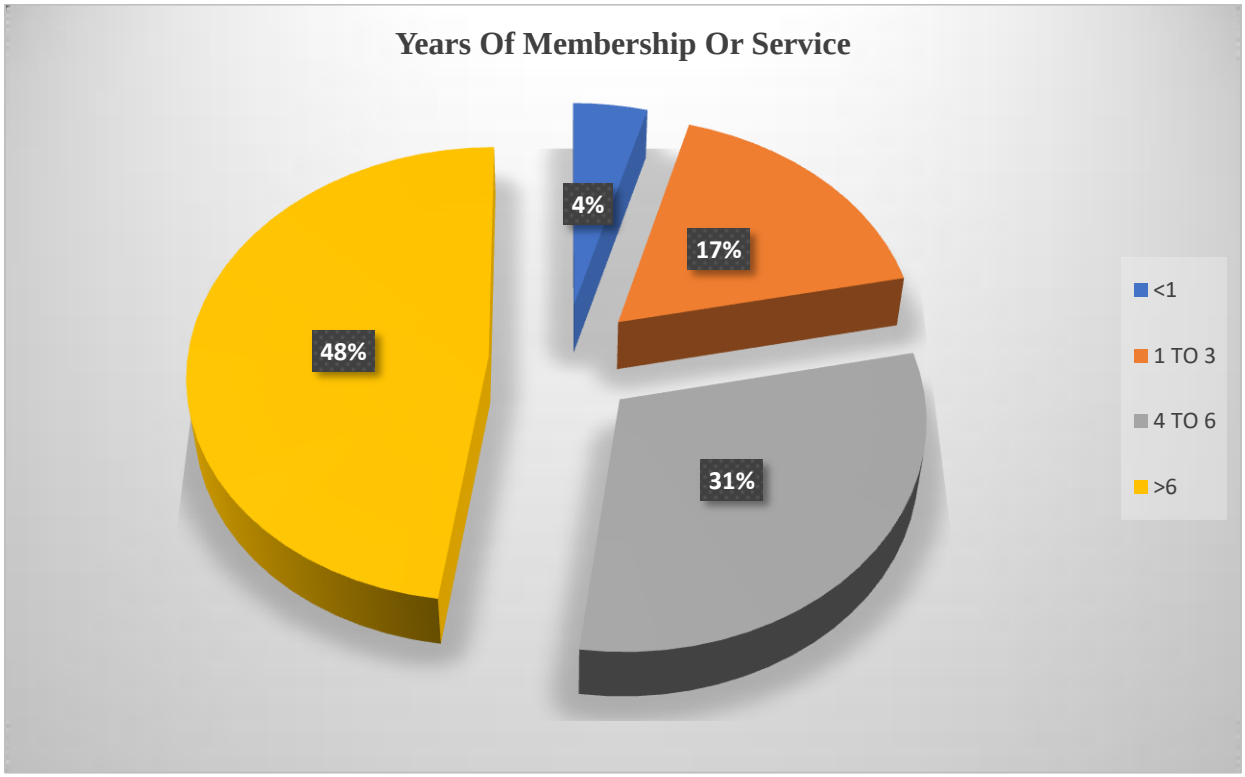
4.2.4 Years of Experience in the Dairy Sector

Experience in the dairy sector was grouped as follows: 3 respondents (4.35%) had less than one year of experience, 12 respondents (17.39%) had 1–3 years of experience, 21 respondents (30.43%) had worked for 4–6 years, and 33 respondents (47.83%) had more than 6 years of experience. This distribution indicates that nearly half of the respondents had over six years of

experience, suggesting that a significant portion of participants possess in-depth knowledge and familiarity with dairy cooperative operations. The presence of respondents with varying levels of experience also reflects a diverse understanding of the sector from both newer and more seasoned contributors.

FIGURE 5

Years of Experience in the Dairy Sector



Source, Researcher, 2025

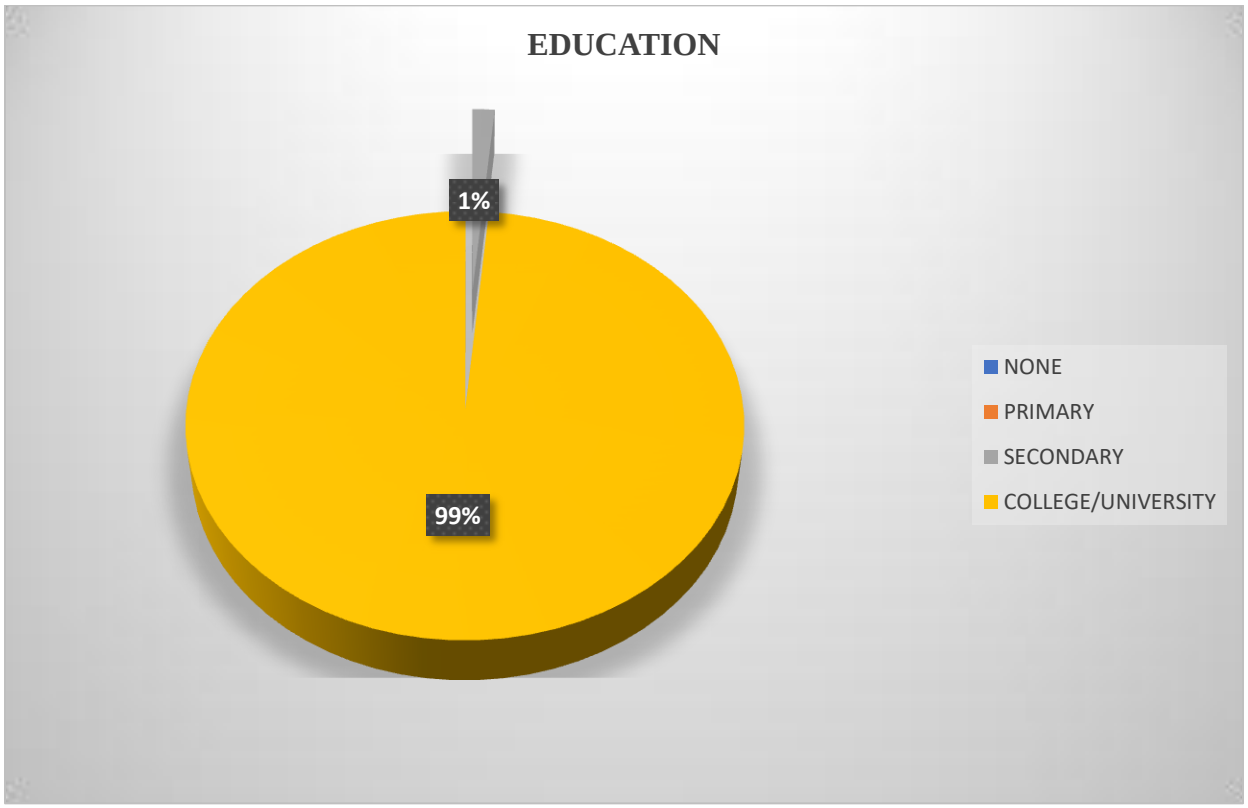
4.2.5 Level of Education

The education levels among respondents were distributed as follows: none had no formal or only primary education; one respondent (1%) had attained secondary education, while the overwhelming majority—68 respondents (99%)—had completed college or university education.

This reflects a high level of literacy among the participants and indicates strong potential for the adoption and implementation of non-financial strategies within the cooperatives.

FIGURE 6

Level of Education



Source, Researcher, 2025

TABLE 5

Demographic Profile of the Respondents

Category	Frequency	Percentage
Gender		
Male	39	56.52
Female	30	43.48
Age Group		
18-25	8	11.59
26-35	17	24.64
36-45	25	36.23
Above 45	19	27.54
Position in Cooperative		
Board Members	23	33.33
Managers	24	34.78
Other stakeholders	22	31.88
Years of Experience		
Less than an year	3	4.35
1–3 years	12	17.39
4–6 years	21	30.43
More than 6 years	33	47.83
Education Level		
None	0	0
Primary	0	0
Secondary	1	1
College/University	68	99

Source, Researcher, 2025

4.3 Statistical analysis

4.3.1 Descriptive statistics analysis

TABLE 6

Descriptive Statistics Analysis

Variables	Obs	Mean	Std. Dev.	Min	Max	p1	p99	Skew.	Kurt.
AS	19	3.398	.592	2	4.6	2	4.6	-.525	3.555
TA	19	3.6	.408	2.6	4.5	2.6	4.5	-.228	3.84
GP	19	2.807	1.077	1.2	4.3	1.2	4.3	-.262	1.585
logOPI	19	4.616	1.298	2.079	8.36	2.079	8.36	.763	5.259

Source, Researcher, 2025

The descriptive statistics for the four variables—Aggregation Strategies (AS), Technology Adoption (TA), Governance Practices (GP), and Operational performance Indicator (OPI)—are useful in terms of information about the consistency and distribution of the responses across 19 observations.

Aggregation Strategies (AS) recorded a relatively high mean of 3.398 with a standard deviation of 0.592. Since the standard deviation was considerably less than the mean, this was an indication of low variability and indicated that respondents generally had uniformly positive and uniform opinions regarding aggregation strategies. The distribution was normal, moderately negatively skewed (left tail) and with kurtosis of 3.555.

Technology Adoption (TA) had the same pattern, a mean of 3.6 and a standard deviation of 0.408, here SD was significantly lower than the mean, and it indicates low variability with similar ratings by respondents. Skewness of -0.228 indicates that some of the respondents gave low ratings, and kurtosis of 3.84 which is normal.

Governance Practices (GP) experienced slightly different trend. With a mean of 2.807 and a comparatively higher standard deviation of 1.077, the SD suggests there was slightly greater variability in response. This is a reflection of a greater variance in perceptions regarding governance, as some scored it much lower or higher than others. The negative skewness of -0.262 and low kurtosis of 1.585 also further suggested a flatter and more spread-out distribution.

The log of operational performance index (logOPI) exhibited a mean value of 4.616 with a standard deviation of 1.298, indicating moderate variability in cooperative performance levels. The distribution ranged from a minimum of 2.079 to a maximum of 8.36, representing a compressed but meaningful scale of operational effectiveness.

The distribution characteristics showed a skewness value of 0.763, indicating a moderate rightward skew in the performance data. The kurtosis measure of 5.259 suggested a distribution slightly more peaked than normal, though substantially improved from the original metric. These distributional properties make logOPI suitable for parametric statistical analyses and reliable for drawing inferences about cooperative performance.

4.3.2 Description of the dependent variable

Checking the normality of the dependent variable

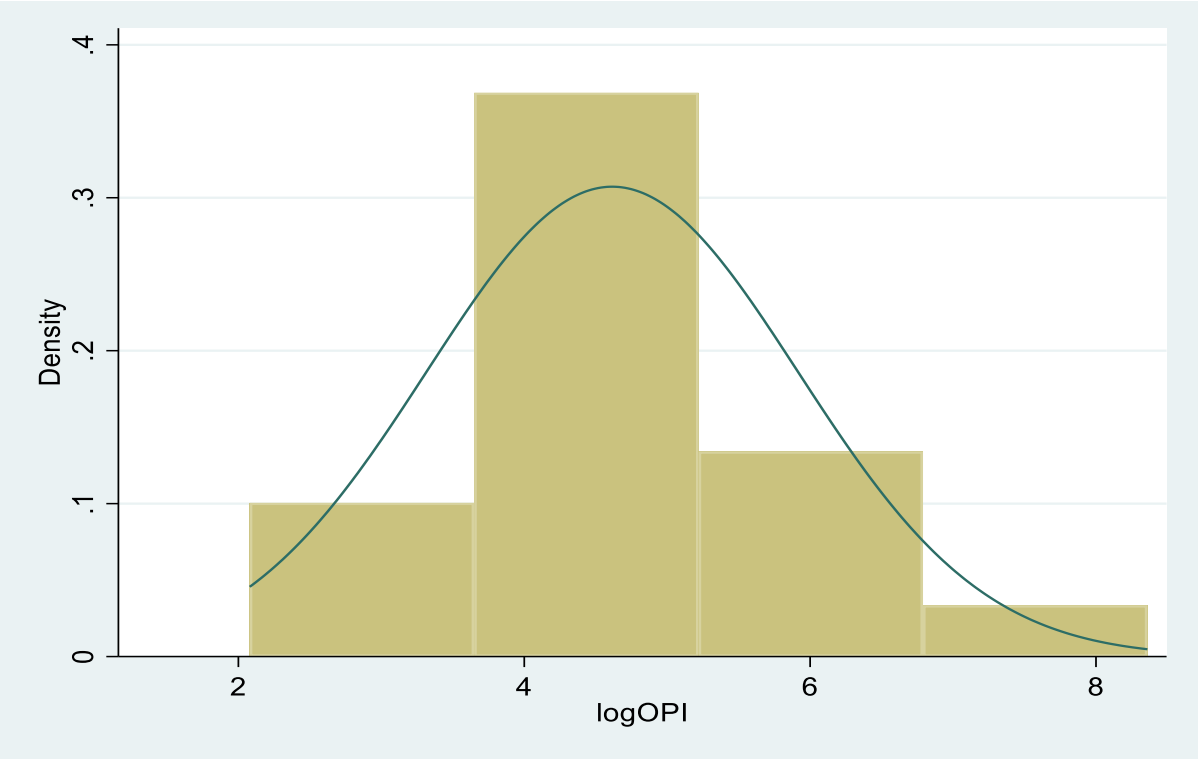
Normality of the independent variable operational performance index was checked with a histogram, which in the initial case showed that the variable was not normally distributed. But after performing logarithmic transformation, the distribution was much improved and came close to normality.

The logOPI histogram is nearly normally distributed with the most of the values concentrated at the center. The overlaid density plot's curve mimics the shape of a bell that

closely overlaps with the histogram bars, indicating a great improvement in normality following the transformation.

FIGURE 7

Description of the Dependent Variable



Source, Researcher, 2025

The relationship between the dependent variable and the independent variables.

Correlation analysis indicated substantial and high positive correlations of the dependent variable (logOPI) with all three independent variables.

Aggregation Strategies (AS) were substantially positively correlated with logOPI ($r = 0.852$, $p < 0.01$), which suggests that cooperatives with enhanced aggregation strategies had exhibited higher levels of operational performance.

Technology Adoption (TA) also proved to be strongly positively correlated with logOPI ($r = 0.797$, $p < 0.01$), suggesting that higher technology adoption had been associated with improved operational performance of cooperatives.

Governance Practices (GP) also showed a moderate positive relationship with logOPI ($r= 0.649$, $p < 0.01$), indicating that better governance practices had implemented more operational performance-improving procedures, although to a lesser extent than AS and TA. By and large, the findings indicated that the three independent variables are powerful drivers of operational performance, with aggregation strategies and technology adoption having shown especially robust relationships.

TABLE 7:

Pairwise Correlations

Variables	(1)	(2)	(3)	(4)
(1) logOPI	1.000			
(2) AS	0.852*	1.000		
	(0.000)			
(3) TA	0.797*	0.761*	1.000	
	(0.000)	(0.000)		
(4) GP	0.649*	0.461*	0.373	1.000
	(0.003)	(0.047)	(0.115)	

**** p<0.01, ** p<0.05, * p<0.1*

Source, Researcher, 2025

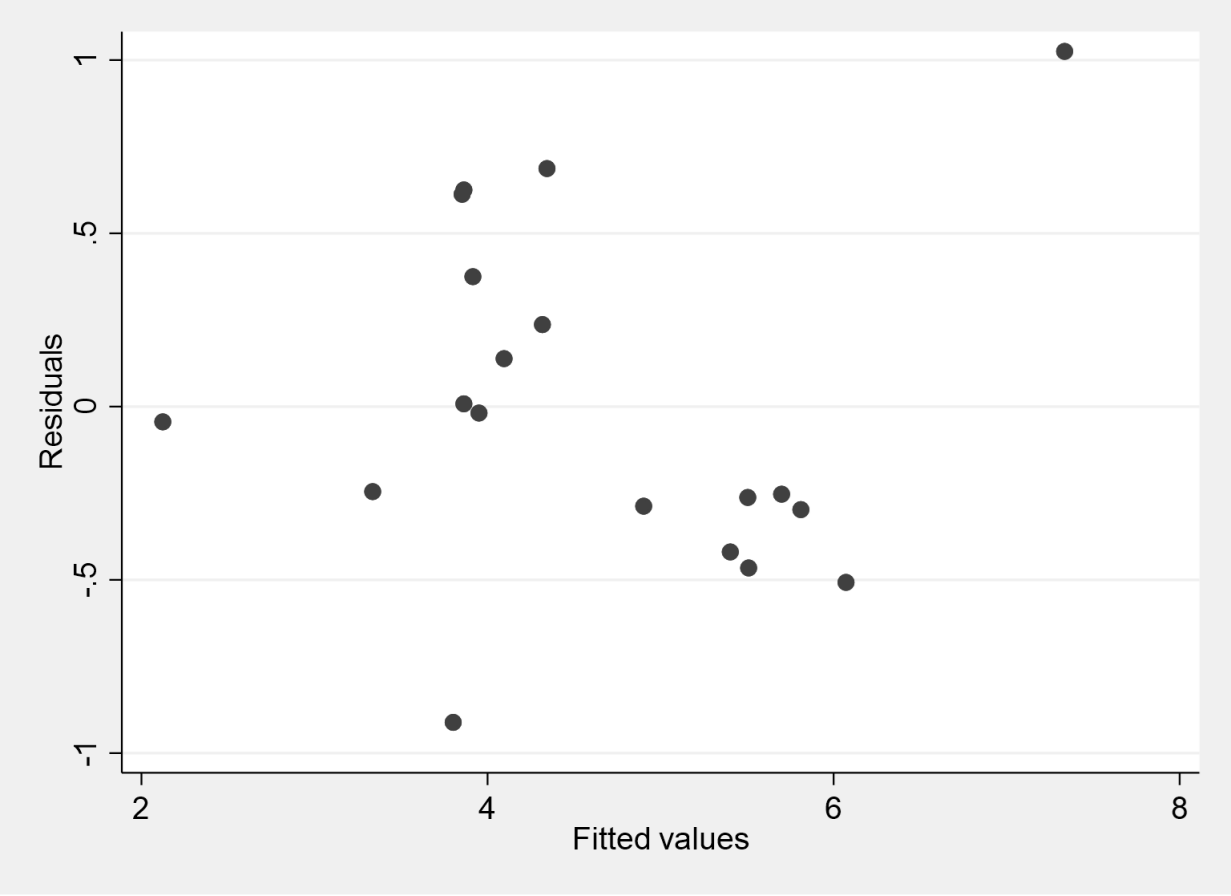
4.3.3 Post Estimation Analysis

4.3.3.1 Linearity assumption

Residual diagnostics were performed, and a residual vs. fitted values plot was graphed to test the linearity assumption. As is evident from Figure 8, the residuals appeared to be randomly scattered around zero with no discernible systematic pattern. This was interpreted to mean that the linear association assumption between the independent and dependent variables had been satisfactorily met.

FIGURE 8:

Linearity Assumption



Source, Researcher, 2025

4.3.3.2 Multicollinearity

TABLE 8:

Variance Inflation Factor

	VIF	1/VIF
AS	2.6	.385
TA	2.38	.42
GP	1.272	.786
Mean VIF	2.084	.

Source, Researcher, 2025

The results showed that the mean variance Inflation Factor was less than 5 at 2.084. This meant that there was no presence of multicollinearity. The individual variance inflation factors for the variables are also less than 5.

4.3.3.3 Heteroscedasticity

The p value was 0.1766 > 0.05 and therefore significant meaning that there was no presence of heteroscedasticity. Therefore, the hypothesis of constant variance was not rejected.

Breusch-Pagan / Cook-Weisberg test for heteroscedasticity

Ho: Constant variance

Variables: fitted values of logOPI

chi2(1) = 1.83

Prob > chi2 = 0.1766

4.3.3.4 Normality

TABLE 9

Shapiro-Wilk W Test for Normal Data

Variable	Obs	W	V	z	Prob>z
residual	19	0.949	1.159	0.297	0.383

Source, Researcher, 2025

The normality of residuals assessed using the Shapiro-Wilk test, yielded a p-value of 0.383 > 0.05, indicating no significant deviation from normality. Therefore, the assumption of normality of residuals is met.

4.4 Test of Research Hypotheses Using Regression Analysis

TABLE 10

Linear Regression

logOPI	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
AS	.988	.346	2.86	.012	.251	1.725	**
TA	1.07	.48	2.23	.042	.046	2.093	**
GP	.381	.133	2.87	.012	.098	.664	**
Constant	-3.663	1.144	-3.20	.006	-6.101	-1.225	***

Mean dependent var	4.616	SD dependent var	1.298
R-squared	0.857	Number of obs	19
F-test	29.874	Prob > F	0.000
Akaike crit. (AIC)	33.913	Bayesian crit. (BIC)	37.691

*** *p<.01,* ** *p<.05,* * *p<.1*

Source, Researcher, 2025

Overall Model Fit

R-squared = 0.857

This means that 85.7% of the variation in the log of operational performance index (logOPI) is explained by the combined influence of AS, TA, and GP. Only 14.3% is explained by other factors not included in this model. This indicates a very strong model fit.

F-test

H_0: All the regression coefficients are equal to zero. $\beta1=\beta2=\beta3=0$

H_1: At least one of the regression coefficients is not equal to zero. At least one $\beta i \neq 0$

F-test = 29.874, p-value = 0.000

The F-test tests whether all regression coefficients are jointly equal to zero (i.e., whether the model has any explanatory power).Since $p < 0.01$, the model is highly statistically significant overall. We reject the null hypothesis and conclude that at least one independent variable significantly explains logOPI.

Regression Equation

$\text{logOPI} = -3.663 + 0.988 \cdot \text{AS} + 1.07 \cdot \text{TA} + 0.381 \cdot \text{GP} + \varepsilon$

Where:

- ✓ logOPI = log of Organizational Performance Index
- ✓ AS = Aggregation Strategy
- ✓ TA = Technology Adoption
- ✓ GP = Governance Practices
- ✓ ε = Error term

The intercept (-3.663) indicates the logOPI on average, when all predictors are zero, a theoretical scenario absent in the observed data. This value serves as a regression baseline but lacks

substantive interpretation, as all cooperatives exhibited non-zero levels of aggregation strategies, technology adoption, and governance practices.

4.4.1 Aggregation Strategies and Operational Performance

The hypotheses for the effect of aggregation strategies on the operating performance of dairy cooperative societies in Kiambu County were tested in this study as follows:

H_0: *Aggregation strategies have no effect on operating performance.*

H_1: *Aggregation strategies have an effect on operating performance.*

The analysis revealed a statistically significant and positive relationship between Aggregation Strategies (AS) and operational performance. The coefficient for AS was 0.988 and the p-value was 0.012 (significant at the 5% level). It could be concluded that a rise in AS by 1 unit translates to a rise in the Operational Performance Index (OPI) by 98.8%. Since the p-value was less than 0.05, the null hypothesis was rejected, thus concluding that aggregation strategies significantly contribute towards improving operational performance.

4.4.2 Technology Adoption and Operational Performance

The test hypotheses for the role of technology adoption on operational performance were as follows:

H_0: *Technology adoption has no significant effect on operational performance.*

H_1: *Technology adoption has a significant effect on operational performance.*

The findings revealed that Technology Adoption (TA) significantly affected operational performance, with a strong and statistically significant effect as indicated by a coefficient of 1.07 and p-value of 0.042 (significant at the 5% level). The results show that an increase in TA by 1 unit results in an increase in OPI by 107%. Since the significance ($p < 0.05$), the null hypothesis

was rejected as an indication that technology adoption has a significant impact in enhancing operational performance.

4.4.3 Governance Practices and Operational Performance

The study hypothesized the following about governance practices and operational performance:

H_0: *There is no effect of governance practices on operational performance.*

H_1: *There is an effect of governance practices on operational performance.*

The results showed a positive and statistically significant correlation between Governance Practices (GP) and operational performance. GP had a coefficient of 0.381 and a p-value of 0.012 (significant at the 5% level). This indicates that an increase in GP by 1 unit leads to an increase in OPI of 38.1%. As a result, the null hypothesis was rejected and it was established that good governance practices significantly impact operational results.

CHAPTER FIVE

CONCLUSION, AND RECOMMENDATIONS

5.1 Introduction

This chapter deliberates the summary of the finding in chapter four. Conclusion and recommendations drawn from these findings are discussed in relation to the objectives of the study which was to analyze the effect of non-financial attributes on the operational performance of dairy cooperative societies in Kiambu County, Kenya.

5.2 Summary of findings

This section presents the summary of the study findings as per research objectives.

5.2.1 Findings on Aggregation Strategies

Aggregation strategies independently contribute to improving the operational performance in dairy cooperative societies. Decentralized distribution channels, infrastructure development, and cost leadership strategies were found to enhance the operational performance of cooperatives. These measures have enabled societies to improve milk collection efficiency, reduce transport and running expenses, and improve market access, resulting in increased milk volumes and better prices for farmers. Farmers are hence more likely to produce more milk knowing that they have guaranteed market access and favorable prices.

These findings resonate with previous empirical research. For example, decentralized distribution's role in alleviating transport inefficiencies is supported by Smith et al. (2020), and infrastructure development's effect on storage and transport is supported by Jones et al. (2019). Likewise, the study's focus on cost leadership strategies is also supported by Brown et al. (2021), who established that keeping production costs low enhances cooperatives' competitive power in

the market. But these benefits depend on wise leadership, since inefficiencies and corruption can counteract efficiency gains (Opiyo et al., 2023; Ayuya et al., 2021).

The research results align with extensive evidence linking aggregation strategy with improved dairy cooperative performance. Long-term success, nonetheless, requires continued management of governance concerns, financial viability, and leveraging technological advances

5.2.2 Findings on Technology Adoption

The findings showed that technology adoption, i.e., e-payment systems, advanced dairy management systems and real-time collection of data plays a very crucial part in enhancing the efficiency and productivity of dairy cooperative societies. The positive significance indicates that cooperatives that invest in technology facilities are bound to have enhanced working performance. Technology adoption is observed to enhance efficiency to a great extent. Use of electronic payment systems ensures transparency and prompt compensation, and this promotes confidence among members. More effective dairy management systems improve herd health and performance, and real-time data capture allows timely and evidence-based decision-making. It is these technology tools that make operations modern and positions cooperatives for the future.

The cooperative that invested in the technologies performed well, supporting Kaushik et al. (2024), who credited digital payment to speeding up transactions, transparency, and more trust among members. Better dairy management systems also complemented better herd health and productivity, in line with Taramuel-Taramuel et al. (2021), who highlighted precision farming benefits such as maximum feeding and breeding. Similarly, real-time analytics enabled evidence-based decision-making, which supported Raksanugraha et al. (2023) in the utility of timely insights for resource management.

Technology is a competitive strategic instrument for dairy cooperatives that increases competitiveness. Though its benefits are obvious, it will be necessary to overcome adoption constraints and mitigate unintended impacts for inclusive growth.

5.2.3 Findings on Governance Practices

Findings showed that strong governance mechanisms in this case, board structure, Leader-member communication channels and Member involvement, significantly enhance dairy cooperative performance in operations. Good governance helps to ensure better decision-making, less fraud or mismanagement, and efficient use of resources, all which result in better performance. Governance and leadership practices play a significant role in establishing an effectively working cooperative setting. Successful board structures ensure clean accountability and oversight, and effective channels of communication between leaders and members facilitate inclusiveness and responsiveness. Ongoing member engagement fosters ownership and shared responsibility, leading to higher compliance, better decision-making, and ultimately, improved performance

Mutua et al. (2015) and this study agree that efficient governance is linked with improved transparency, accountability, and decision-making. Hope (2015) also demonstrated that ethical leadership enhances financial performance through better oversight. Well-governed boards were particularly effective, supplementing Smith et al. (2019) in illustrating the cost compression of operation and efficiency in milk production that strategic governance brings. Furthermore, efficient leader-member communication—critical to knowledge transfer and coordination—confirms Jones et al. (2020), noting its role in productivity efficiency.

5.3 Conclusion

The study was able to significantly demonstrate that non-financial traits are crucial determinants of operational performance among dairy cooperative societies in Kiambu County. While financial capital has long been considered a primary success driver, this study demonstrates that aggregation strategies, technology, and governance arrangements also play an equally crucial role in promoting performance outcomes like amounts of milk produced and rates of payment per liter of milk.

5.3.1 Aggregation strategies on operational performance

The study finds that aggregation strategies are central to increasing the operational efficiency and profitability of dairy cooperatives. Decentralized distribution, infrastructure investment, and cost leadership strategies are crucial to increased milk collection, reduced transportation costs, and enhanced market access. Such outcomes optimize milk volumes and farmer incomes. Aggregation measures such as joint marketing, joint processing, and joint buying of inputs enable cooperatives to reap economies of scale, increased bargaining power, and reduced transaction costs. Adoption of digital platforms further increases transparency and efficiency. But the sustainability of these measures is dependent on effective governance, financial depth, and proper technological support.

5.3.2 Technology adoption on operational performance

Adoption of technology was discovered to play a positive and significant role in cooperative performance. Technology entails electronic payment systems, advanced dairy management software, and capture of real-time data, which enhance operating transparency, herd management, and decision-making in a timely manner. Such efficiencies result in increased member trust and productivity. Despite the very promising benefits, notwithstanding, outstanding

challenges such as high initial costs, limited technical skills, and risk of job loss continue to be prime hindrances, particularly for smallholder cooperatives. Nevertheless, technology, if implemented in conjunction with sufficient training and financing, is a prime strategic resource that positions cooperatives for competitiveness and sustainability in the years to come.

5.3.3 Governance practices on operational performance

The study concludes that government practices like board structure, leader-member communication, and member involvement have a substantial impact on cooperative performance. Proper governance ensures accountability, transparency, and strategic decision-making. Strong board monitoring, participative leadership and continuous member involvement generate a feeling of ownership and contribute to compliance, ultimately resulting in improved performance outcomes. The study also verifies that training and succession planning are essential for leadership continuity and institutional sustainability. Though governance is the foundation, it should be accompanied by adaptive leadership in order to adapt to outside market shocks and maintain long-term cooperative resilience.

5.4 Recommendations

Based on the findings of the research, dairy cooperative societies need to give special importance to embracing decentralized distribution systems, investment in rural infrastructure (milk centers and storage), and cost-saving measures to enhance efficiency and coverage. The stakeholders need to help cooperatives embrace digital payment systems, bookkeeping, and dairy management platforms. Capacity-building activities and funds need to be provided to facilitate the use of low-cost and scalable technologies.

Cooperative societies should improve board capability through capacity building, promote transparency and accountability, and involve members in active decision-making.

Institutionalization of efficient communication between the members and leaders is crucial. Development partners and government agencies need to set up enabling policy and technical support to improve the working model of cooperatives. This means facilitating access to technology and subsidies or grants in infrastructure. Repeated training courses need to be conducted to improve the understanding of cooperative principles, use of digital services, and benefits of good governance practice.

5.5 Limitations of the study

Despite yielding insightful findings, the study had the shortcoming of being implemented in Kiambu County alone and may not be capable of capturing the richness and depth of dairy cooperatives' challenges elsewhere in other counties or in other regions of Kenya. In addition data was collected through questionnaires, which are susceptible to respondent bias, such as over reporting or underreporting of working procedures and successes. While focus was placed on the non-financial attributes, the study did not take into account the role of financial resources, market prices, and access to credit that could potentially influence operating performance.

5.6 Suggestions for Future Research

Future studies must employ a large regional or national sample to contrast outcomes between counties or agro-ecological zones. They can also analyze how technology adoption and governance influence different demographic groups like youth and women in cooperatives. There is a need for more studies on how government policies, laws of cooperatives, and regulatory frameworks influence the effectiveness of non-financial strategies.

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APPENDICES

Appendix A: Questionnaire

Dear Respondent,

Thank you for taking the time to voluntarily participate in this survey. Your input is highly valued and will play an important role in supporting academic research on the Effect of Non-Financial Attributes on Operational performance of Dairy Cooperative Societies in Kiambu County, Kenya. Your responses will be treated with the utmost confidentiality and will be used solely for academic and research purposes. I kindly request you to answer the questions as honestly and accurately as possible.

Name of Dairy cooperative…….....

Section A: Respondent Demographics (Tick where applicable)

Gender:

☐ Male

☐ Female

Age Group:

☐ 18–25 years

☐ 26–35 years

☐ 36–45 years

☐ 46 years and above

Position in Cooperative:

☐ Member

☐ Management Staff

☐ Board Member

☐ Other (specify): _____

Years of Membership/Service:

☐ Less than 1 year

☐ 1–3 years

☐ 4–6 years

☐ More than 6 years

Level of Education:

☐ No formal education

☐ Primary

☐ Secondary

☐ College/University

Section B: Aggregation Strategies ***(Tick the most appropriate response)***

Instruction: Please indicate your level of agreement with the following statements related to aggregation strategies in your cooperative.

(1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

	Statement	**1**	**2**	**3**	**4**	**5**
B1	Our cooperative has decentralized milk collection centers that improve milk accessibility.	☐	☐	☐	☐	☐
B2	Our cooperative has invested in cold storage and transport infrastructure that maintains milk quality.	☐	☐	☐	☐	☐

B3	The cooperative uses bulk purchasing to reduce input and operational costs.	☐	☐	☐	☐	☐
B4	Decentralized operations have led to increased sales and reduced spoilage.	☐	☐	☐	☐	☐
B5	Our cost-saving strategies have positively impacted the cooperative's operational performance.	☐	☐	☐	☐	☐

Section C: Technology Adoption ***(Tick the most appropriate response)***

Instruction: Indicate your level of agreement with the following statements.

(1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

	Statement	**1**	**2**	**3**	**4**	**5**
C1	The cooperative uses bank transfer or electronic transfers to pay members.	☐	☐	☐	☐	☐
C2	We have adopted dairy management software to monitor inventory and sales in real-time.	☐	☐	☐	☐	☐
C3	Our cooperative uses automated milk quality testing or IoT-based monitoring systems.	☐	☐	☐	☐	☐
C4	Technology use has reduced administrative costs and improved decision-making.	☐	☐	☐	☐	☐
C5	Technology has enhanced milk quality control and enabled access to premium markets.	☐	☐	☐	☐	☐

Section D: Governance Practices ***(Tick the most appropriate response)***

Instruction: Indicate your level of agreement with the following statements.

(1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

	Statement	**1**	**2**	**3**	**4**	**5**
D1	Our board includes members with relevant financial and industry expertise.	☐	☐	☐	☐	☐
D2	There are regular meetings and digital platforms for communication between leaders and members.	☐	☐	☐	☐	☐
D3	Members actively participate in selecting leaders and formulating policies.	☐	☐	☐	☐	☐
D4	Leaders are accountable and transparent in operations	☐	☐	☐	☐	☐
D5	Strong governance has improved financial control and cooperative operational performance.	☐	☐	☐	☐	☐

Thank you for your participation!