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Research Article

Re-evaluating Small-Scale Dairy Viability: The Interplay of Management, Genetics, and Capital in Zimbabwe's Rusitu Valley

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Abstract

Small-scale dairy farming plays a crucial role in rural livelihoods and food security in sub-Saharan Africa. However, productivity remains suboptimal in many resettlement schemes, creating a direct causal pathway from low milk production to household poverty, reduced educational attainment, and limited investment capacity. This study investigated factors influencing low milk production among small-scale dairy farmers at Rusitu Dairy Project in Ward 9 of Chipinge District, Zimbabwe. Using a mixed-methods case study design, data were collected from 29 systematically sampled dairy farmers (30% of the 99 active milking farmers) through questionnaires, semi-structured interviews, and direct observations. The study revealed persistently low milk production, with average daily yields ranging from 2 to 20+ litres per farmer, and most farmers (41.4%) producing only 10 litres daily. Milk composition data were not available due to the absence of on-farm testing infrastructure, representing a limitation acknowledged in this study. However, production records from milk collection centres provided reliable estimates of total daily milk volume delivered. Key causative factors included inadequate herd sizes (28% of farmers owned only 2 cows), suboptimal breed selection, advanced farmer age (79.4% were above 44 years), limited educational attainment (52.2% had not reached ZJC level), poor management practices, inadequate feeding systems, and capital constraints. These challenges collectively perpetuated low incomes, with 52% of farmers earning less than $100 monthly. The findings underscore the need for comprehensive interventions including breed improvement programs, enhanced extension services, farmer education initiatives, and improved access to credit facilities. This research contributes to the growing body of knowledge on smallholder dairy development in Zimbabwe and offers actionable recommendations for sustainable dairy production in similar agro-ecological contexts.

Keywords

Small-scale Dairy Farming, Milk Production, Rural Livelihoods, Dairy Management, Zimbabwe, Rusitu Dairy Project

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1. Introduction

1.1. Background of the Study

Dairy farming represents a critical livelihood strategy for millions of smallholder farmers across sub-Saharan Africa, contributing to food security, nutritional outcomes, and rural economic development [1]. In Zimbabwe, small-scale dairy schemes were established as part of post-independence resettlement programs aimed at redistributing land and promoting rural development [2]. The Rusitu Small Scale Dairy Resettlement Scheme, established in 1986 by the Agricultural Rural and Development Authority (ARDA), exemplifies these initiatives, providing 4-hectare plots to smallholder farmers in the Eastern Highlands of Chipinge District.

Despite three decades of operation, the Rusitu Dairy Project has demonstrated limited developmental impact, with most farmers struggling to achieve economic viability and maintain basic household needs [3]. Records from the Rusitu Dairy Project Milk Collection Centres reveal a concerning downward trend in milk production: 250,221 litres (2010), 231,340 litres (2011), 214,450 litres (2012), 209,319 litres (2013), and 194,671 litres (2014). This progressive decline raises critical questions about the sustainability of small-scale dairy interventions and the factors constraining productivity.

The significance of this research extends beyond the Rusitu context. Smallholder dairy development has been identified as a key pathway for poverty reduction and rural transformation in Zimbabwe [3]. However, persistent productivity challenges threaten the viability of these schemes, undermining their potential contribution to national food security and economic development. Understanding the specific constraints facing small-scale dairy farmers is essential for designing effective interventions that can unlock the potential of this subsector.

1.2. Statement of the Problem

Rusitu Small Scale Dairy Project in Ward 9 of Chipinge District has been characterized by persistently low milk production, resulting in limited economic development and poor living standards among participating farmers. Despite the project's long history, most farmers continue to live below the poverty datum line, with many unable to meet basic household needs, including paying school fees as low as $40-$50 per term for secondary education. The progressive decline in milk production documented between 2010 and 2014 indicates systemic challenges that require systematic investigation.

While previous studies have examined smallholder dairy development in Zimbabwe [3], limited research has focused specifically on the Rusitu Dairy Project and the complex interplay of factors constraining productivity in this unique agro-ecological context. This knowledge gap impedes the development of targeted interventions that could enhance dairy production and improve rural livelihoods. Consequently, this study sought to assess milk production at Rusitu Small Scale Dairy Project, identify the causative factors for low productivity, and propose strategies for sustainable dairy development.

1.3. Research Objectives

1.3.1. Aim

To assess milk production at Rusitu Small Scale Dairy Project in Ward 9 of Chipinge District, Zimbabwe.

1.3.2. Specific Objectives

1) To determine the level of milk productivity (high or low) at Rusitu Small Scale Dairy Project.
2) To identify the factors influencing milk production at Rusitu Small Scale Dairy Project.
3) To propose strategies for enhancing milk production at Rusitu Small Scale Dairy Project.

1.4. Research Questions

1) What is the current level of milk production at Rusitu Small Scale Dairy Project?
2) What factors contribute to low milk production at Rusitu Small Scale Dairy Project?
3) What strategies can be implemented to improve milk production at Rusitu Small Scale Dairy Project?

1.5. Significance of the Study

This research makes several important contributions to knowledge and practice. First, it provides empirical evidence on the productivity challenges facing small-scale dairy farmers in Zimbabwe's resettlement areas, contributing to the limited body of literature on smallholder dairy development in the country. Second, the findings offer practical insights for policymakers, development practitioners, and extension services seeking to design effective interventions for enhancing smallholder dairy productivity. Third, by identifying context-specific constraints and opportunities, this research supports evidence-based decision-making for sustainable dairy development in similar agro-ecological zones across Zimbabwe and the broader sub-Saharan African region.

1.6. Definition of Key Terms

Dairy farming: Agricultural practice focused on milk production through the management of dairy cattle [1].

Milk collection centre: A designated facility where milk is delivered from individual farms, stored in refrigerated tanks, and prepared for transportation to processing facilities [4].

Small-scale dairy farming: Dairy production systems characterized by small herd sizes (typically 1-10 cows), limited capital investment, and reliance on family labor [2].

Zero grazing: A dairy management system where cattle are confined and fed harvested fodder rather than grazing on open pastures [4].

305-day milk yield: A standardized measure of milk production representing the total milk volume produced during a standard lactation period of 305 days, commonly used for comparing productivity across dairy production systems [5].

1.7. Study Area Description

1.7.1. Location

The Rusitu Small Scale Dairy Project is situated in Ward 9 of Chipinge District, Manicaland Province, in the northeastern part of Chipinge town. The study area extends from the Rusitu River to the Zimbabwe-Mozambique border, encompassing rolling hills and valleys characteristic of the Eastern Highlands.

1.7.2. Climate and Vegetation

The region experiences the highest precipitation in Zimbabwe (1,500-2,000 mm annually) and the lowest average temperatures (ranging from 10 ℃ to 25 ℃) due to its altitude of approximately 800-1,200 metres above sea level [6]. The mean monthly Temperature-Humidity Index (THI) values in this region range from 55 to 72, with the highest values typically occurring during the October-November pre-rainy season period. These THI values fall below the threshold for severe heat stress (THI > 72) reported in the literature [7] indicating that environmental heat stress is likely not a primary constraint for dairy production in this region. However, the October-November period may cause mild to moderate heat stress that could temporarily affect feed intake and milk production.

Local farmers employ several strategies to manage environmental conditions during warmer periods. These include providing shade structures for cattle during peak sunlight hours, adjusting feeding times to cooler morning and evening periods, ensuring adequate water availability, and in some cases, allowing cattle to seek natural shade in wooded areas adjacent to plots. However, these practices are not universally adopted and reflect the limited technical support available to farmers.

The area features diverse vegetation, including rolling grasslands, tropical rainforest patches in valleys, miombo woodlands on drier slopes, and unique montane flora. This ecological diversity provides both opportunities and challenges for dairy farming.

1.7.3. Socio-Economic Context

The Eastern Highlands support intensive commercial agriculture, producing high-value crops including tea, coffee, and temperate fruits [6]. However, small-scale dairy farmers in Rusitu have struggled to leverage these agro-ecological advantages, resulting in persistent poverty and limited economic development.

2. Literature Review

2.1. Introduction

This chapter reviews relevant literature on small-scale dairy farming, with particular emphasis on factors influencing milk production in developing countries. The review covers global dairy farming trends, challenges facing smallholder dairy farmers in developing countries, strategies for enhancing milk production, and the specific context of dairy farming in Zimbabwe. This theoretical foundation informed the research design and interpretation of findings.

2.2. Global Overview of Dairy Farming

Dairy farming is a global agricultural enterprise practiced across diverse production systems, from smallholder subsistence operations to large-scale commercial enterprises [1]. Large-scale dairy farms, such as Kintyre Estate in Zimbabwe, employ advanced technologies including mechanized milking systems, artificial insemination, and sophisticated herd management practices [4]. These operations typically maintain large herds of high-producing dairy breeds, with some cows producing up to 60 litres daily.

The global dairy industry is characterized by significant variation in productivity across countries and production systems. The United States and the European Union remain major milk producers, while developing countries increasingly contribute to global production [1]. Common dairy breeds include Holstein-Friesian, Jersey, Guernsey, Ayrshire, and various crossbreeds, each with specific production characteristics and adaptability to different environments [4].

The global dairy industry exhibits substantial variation in production systems, herd sizes, breed composition, and productivity levels. In the United States, the average dairy herd size has increased to approximately 300 cows per farm, with Holstein-Friesian being the predominant breed and average milk production exceeding 10,000 kg per cow per 305-day lactation [8]. In the European Union, herd sizes vary considerably, with smaller family farms (averaging 50-100 cows) in countries such as France and Germany, and larger operations in Denmark and the Netherlands [8]. Average milk production in the EU ranges from 7,000 to 9,000 kg per cow per lactation, with significant variation across member states.

While smallholder dairy farms in the United States and Europe achieve substantially greater per-cow production than reported in the present study, herd size alone does not determine productivity. Rather, breed/genetic potential, balanced nutrition, effective herd health management, appropriate environmental conditions, robust infrastructure, and access to financial and technical resources collectively contribute to production outcomes [1]. Small-scale producers in developed coun-

tries achieve high per-cow yields through intensification, technical support, and investment, demonstrating that small herd size is not inherently limiting when supportive systems are in place.

Common dairy breeds include Holstein-Friesian, Jersey, Guernsey, Ayrshire, and various crossbreeds, each with specific production characteristics and adaptability to different environments [1]. The selection of appropriate breeds for specific production environments represents a critical management decision influencing productivity outcomes.

Dairy farming contributes significantly to economic development through employment generation, income provision, and foreign currency earnings from dairy exports [9]. However, the industry faces challenges including declining profitability, labor shortages, and environmental pressures [10]. These global trends provide important context for understanding the challenges facing smallholder dairy farmers in Zimbabwe.

2.3. Challenges Facing Smallholder Dairy Farmers in Developing Countries

Smallholder dairy farmers in developing countries face a complex array of challenges that constrain productivity and economic viability. Understanding these challenges is essential for designing effective interventions to enhance dairy production and improve rural livelihoods.

2.3.1. Low Milk Production and Breed Constraints

Low milk output represents a fundamental challenge for smallholder dairy farmers across developing countries. In Nigeria, the use of indigenous Fulani cattle, which produce only 0.7 litres daily, severely limits production [11]. Similarly, Zimbabwean small-scale dairy farmers often rely on indigenous breeds or low-grade crossbreeds that lack the genetic potential for high milk production [2]. The limited availability of improved dairy breeds and the high cost of acquiring these animals perpetuate low productivity cycles.

Standardized milk production measures are essential for contextualizing the magnitude of low production in smallholder systems. In commercial dairy systems, 305-day milk yield is the standard measure for comparing productivity across production systems, breeds, and management strategies [12]. For Holstein-Friesian cows in optimal production environments, 305-day milk yields typically range from 8,000 to 12,000 kg, while Jersey and Ayrshire breeds produce 5,000 to 8,000 kg under similar conditions [4]. Based on the average daily milk yield of 10 litres observed in the present study and assuming a 305-day lactation period, the estimated 305-day milk yield for Rusitu dairy cows would be approximately 3,050 kg per cow. This estimate, however, depends on consistent lactation persistency, which is unlikely given the documented feeding and management constraints. The absence of standardized lactation records in smallholder systems complicates direct comparison with commercial production data and highlights the need for improved record-keeping systems.

2.3.2. Management and Technical Capacity

Limited management skills significantly constrain smallholder dairy productivity. Many farmers lack formal training in dairy management, including feeding practices, health management, breeding, and record keeping [11]. This knowledge deficit results in suboptimal production practices and reduced herd performance. Extension services in developing countries often face resource constraints that limit their capacity to provide adequate technical support to smallholder farmers [12].

Herd health management represents a particularly critical dimension of technical capacity. In smallholder dairy systems, disease prevalence and inadequate health monitoring contribute substantially to reduced productivity, increased mortality, and economic losses [1]. The most common health constraints in Zimbabwean smallholder dairy systems include mastitis, which reduces milk yield and quality; tick-borne diseases such as theileriosis (January disease) and anaplasmosis, which cause significant morbidity and mortality; and lameness associated with poor housing and nutrition [2]. During the present study, farmers commonly reported mastitis as a frequent problem, with some respondents estimating that 10-15% of their milking cows were affected at any given time. However, systematic health records were not available, and farmers' reports were based on observation rather than clinical diagnosis.

Calf management and health also emerged as important concerns during field observations. Preweaning mortality rates were estimated by farmers at 15-20%, with the primary causes being inadequate colostrum intake, poor hygiene in calf housing, and insufficient nutrition for growing calves. Most farmers provided limited colostrum management, with calves typically receiving only one or two feedings of colostrum compared to the recommended multiple feedings within the first six hours of life. Calf housing commonly consisted of simple wooden structures with limited bedding and poor drainage, contributing to disease transmission and reduced calf survival. These calf-rearing practices have long-term implications for herd productivity, as poorly raised heifers may have reduced milk production potential and increased health challenges in later life.

2.3.3. Feeding and Nutrition Constraints

Inadequate feeding practices represent a major constraint to dairy production in developing countries [7]. Many smallholder farmers lack the resources or knowledge to provide balanced nutrition for their dairy cattle, relying on poor-quality grazing or limited supplemental feeding. The primary feeding constraints in the Rusitu context include insufficient feed quantity, particularly during the dry season (May-October); inadequate dietary protein and energy in available forages; seasonal variation in feed quality and availability; and limited access to commercial concentrate feeds due to cost and supply chain constraints.

Most farmers in the study area employ a combination of

zero-grazing and limited grazing systems. Cows are typically confined in small paddocks or zero-grazing units for most of the year, with feed consisting primarily of natural grasses harvested from communal grazing areas, supplemented with crop residues from maize and other crops. During the rainy season (November-April), some farmers allow limited grazing on established pastures, though access to improved pastures is constrained by small plot sizes (4 hectares) and competing land uses. Commercial concentrate feeds (dairy meal) are used sparingly by most farmers due to high costs and limited availability, with only 17% of respondents reporting regular use of supplements.

The feeding approach generally does not involve total mixed rations (TMR), as farmers lack the equipment and knowledge for formulating balanced rations. Rather, forage and concentrate feeds are offered separately, often on an ad hoc basis without systematic ration formulation. This feeding system results in imbalanced nutrient intake, with cattle typically receiving insufficient energy and protein for sustained high milk production, particularly during the dry season when forage quality declines substantially. The seasonal reduction in feed quality directly translates to lower milk production during the dry season, as confirmed by production records from the Rusitu Dairy Project milk collection centres.

2.3.4. Infrastructure and Market Access

Poor infrastructure, particularly rural road networks, constrains smallholder access to markets and inputs [1]. In Kenya, poor road conditions have resulted in significant milk losses as collection vehicles fail to reach production areas [13]. Similarly, Zimbabwean smallholder dairy farmers face challenges transporting milk to collection centers, particularly during the rainy season when rural roads become impassable. Limited access to reliable electricity further compounds these challenges, affecting milk storage and quality at collection centers.

2.3.5. Financial Constraints and Credit Access

Limited access to financial services constrains smallholder dairy development. Many farmers lack collateral required for formal credit, while available financing often fails to accommodate the specific needs of small-scale dairy operations [6]. This capital constraint limits farmers' ability to invest in improved breeds, infrastructure, and inputs necessary for productivity enhancement. The high cost of veterinary medicines and specialized dairy inputs further exacerbates these financial challenges.

2.3.6. Land Tenure and Security

Unclear land tenure arrangements constrain investment in dairy infrastructure and improvements [2]. Many smallholder dairy farmers lack formal title deeds, limiting their ability to secure credit and invest in long-term improvements. In Zimbabwe, land tenure issues have been particularly contentious, affecting agricultural development across resettlement areas [2]. This uncertainty discourages investment in dairy infrastructure and herd improvement.

2.4. Strategies for Enhancing Milk Production

Despite these challenges, numerous strategies have been identified for enhancing milk production in smallholder dairy systems. These strategies encompass genetic improvement, management enhancement, infrastructure development, and policy interventions.

2.4.1. Genetic Improvement

Breed improvement through crossbreeding and artificial insemination offers significant potential for enhancing milk production [9]. The introduction of high-producing dairy breeds such as Friesian, Jersey, and Ayrshire has proven effective in increasing milk yields across developing countries [4]. However, successful breed improvement requires careful consideration of local adaptation, disease resistance, and management capacity.

2.4.2. Management Capacity Building

Training and extension services are essential for improving dairy management skills [3]. Programs focusing on feeding practices, health management, breeding, and record keeping can significantly enhance productivity. Successful dairy development programs have demonstrated the importance of participatory extension approaches that build farmer capacity while respecting local knowledge and resources [1].

2.4.3. Improved Feeding Systems

Enhanced feeding systems, including fodder production, silage making, and strategic supplementation, are critical for improving dairy productivity [7]. The cultivation of high-quality fodder crops such as Napier grass, maize silage, and legumes can provide consistent nutrition throughout the year [3]. These practices are particularly important in zero-grazing systems where cattle depend entirely on provided feed.

2.4.4. Infrastructure Development

Investment in rural infrastructure, including roads, electricity, and water supply, is essential for dairy development [1]. Improved market access through better roads and reliable milk collection systems can reduce losses and enhance profitability. Similarly, reliable electricity supply at collection centers ensures milk quality through proper refrigeration.

2.4.5. Financial and Institutional Support

Access to appropriate financial services is critical for dairy development [3]. Innovative financing mechanisms, including microfinance and agricultural credit schemes tailored to smallholder needs, can facilitate investment in dairy improvements. Supportive policy frameworks that recognize the importance of smallholder dairy development are also essential [2].

2.5. Dairy Farming in Zimbabwe

Zimbabwe has a long history of dairy farming, with both large-scale commercial operations and smallholder schemes contributing to national production. Small-scale dairy projects are concentrated in seven main areas: Marirangwe (Mashonaland East), Guruve (Mashonaland Central), Gokwe (Midlands), Umzingwane (Matebeland South), Sangano, Tsotso (Manicaland), and Rusitu (Eastern Highlands) [2]. These schemes were established as part of post-independence resettlement and development programs [2].

The Dairy Development Programme operates these smallholder schemes, providing support services including extension, training, and milk marketing [4]. However, these programs have faced significant challenges, including limited resources, inadequate extension capacity, and institutional constraints. The progressive decline in production at schemes such as Rusitu suggests systemic challenges that require comprehensive policy and programmatic responses.

2.6. Research Gap

Despite extensive literature on dairy development in Zimbabwe, limited research has examined the specific constraints facing smallholder dairy farmers in resettlement areas such as Rusitu. Previous studies provided valuable insights but predate recent economic and political developments that have affected agricultural production. Furthermore, there is limited empirical research examining the complex interplay of factors constraining productivity in specific ecological and socio-economic contexts. This study addresses this gap by providing empirical evidence on the factors influencing milk production at Rusitu Small Scale Dairy Project.

3. Research Methodology

3.1. Introduction

This chapter presents the research methodology employed in this study. It describes the research design, study population, sampling procedures, data collection instruments, and data analysis methods. The methodological choices were guided by the research objectives and the need to generate reliable and valid data on factors influencing milk production at Rusitu Small Scale Dairy Project.

3.2. Research Design

This study employed a mixed-methods case study design, integrating quantitative and qualitative approaches to provide a comprehensive understanding of the factors influencing milk production. The case study approach was selected for its capacity to investigate complex phenomena within their real-life contexts [14]. This design enables the researcher to explore multiple facets of the phenomenon through various data sources and analytical lenses [14].

The mixed-methods approach facilitated triangulation of findings, enhancing the validity and reliability of conclusions. Quantitative data from questionnaires provided statistical evidence on production levels and farmer characteristics, while qualitative data from interviews and observations offered deeper insights into the challenges and opportunities facing farmers.

3.3. Study Population and Sampling

The study population comprised 99 small-scale dairy farmers actively engaged in milk production at Rusitu Dairy Project at the time of the study. This population represented farmers who were actively delivering milk to collection centers, excluding those with non-productive cattle or those who had temporarily suspended production.

A sample of 29 respondents (30% of the population) was selected using systematic random sampling. The sampling interval of 3.3 (99/30) was used, with a random start of 2. This procedure ensured representative coverage while managing resource constraints.

3.4. Data Collection Instruments

3.4.1. Questionnaires

Structured questionnaires were administered to the 29 sampled respondents. The questionnaire included closed-ended questions covering farmer demographics, herd characteristics, milk production levels, income, and perceived challenges. Questionnaires were chosen for their efficiency, anonymity, and capacity to gather standardized data. For illiterate respondents, the researcher read questions and recorded responses to ensure comprehensive participation.

3.4.2. Semi-Structured Interviews

Semi-structured interviews were conducted with all sampled respondents to gather in-depth qualitative data. The interview schedule covered dairy management practices, challenges, decision-making processes, and recommendations for improvement. Interviews provided the flexibility to probe responses and explore emergent themes. All interviews were conducted in the local language (Shona) to facilitate clear communication.

3.4.3. Direct Observation

Direct observation was used to verify questionnaire and interview data, observing farm conditions, infrastructure, management practices, and farmer activities. An observation schedule guided systematic recording of information including number of dairy cows, feed availability, water access, and overall farm management. Observation provided valuable contextual data that complemented self-reported information.

3.5. Data Collection Procedures

Data collection occurred over a four-month period (April to October 2014). The researcher introduced himself to each respondent, presented an introductory letter from Zimbabwe Open University, and explained the research purpose. Questionnaires were administered first, followed by interviews and observations. This sequential approach allowed the researcher to build rapport with respondents and verify information across methods.

3.6. Data Analysis

Quantitative data were analyzed using descriptive statistics, including frequencies, percentages, and cross-tabulations. Data were presented in tables, bar graphs, and pie charts to illustrate patterns and relationships. Qualitative data from interviews and observations were analyzed using thematic analysis, identifying recurring themes and patterns in respondents' accounts. This mixed-methods analysis enabled integration of quantitative and qualitative findings to address the research objectives comprehensively.

3.7. Ethical Considerations

Ethical considerations guided all stages of the research. Respondents were informed of the research purpose, procedures, and their rights, including voluntary participation and confidentiality. Written consent was obtained from all participants. Anonymity was maintained through the use of identification codes rather than names. Ethical approval for this study was obtained from the Zimbabwe Open University Research Ethics Committee (Protocol Number: ZOU/2014/SOCIAL/025). The research was conducted in accordance with the university's ethical guidelines for social science research involving human participants, including provisions for protecting vulnerable populations, ensuring informed consent, and maintaining data confidentiality.

4. Results and Discussion

4.1. Introduction

This chapter presents the findings of the research, organized according to the research objectives. The results are presented in tables, figures, and descriptive narratives, followed by discussion of findings in relation to the literature. The chapter begins with demographic characteristics of respondents, followed by findings on milk production levels, factors influencing productivity, and strategies for improvement.

4.2. Demographic Characteristics of Respondents

Table 1. Gender Distribution of Respondents.

Gender	Frequency	Percentage
Male	24	82.8%
Female	5	17.2%
Total	29	100%

The sample was predominantly male (82.8%), reflecting gender disparities in land ownership and dairy production in the study area. This finding is consistent with patterns observed across Zimbabwean smallholder agricultural systems, where men typically hold land rights and make production decisions. However, the participation of women (17.2%) suggests some gender inclusivity in dairy production, though limited.

Table 2. Age Distribution of Respondents.

Age Group	Frequency	Percentage
25-34 years	3	10.3%
35-43 years	3	10.3%
44-52 years	9	31.0%
52-60 years	4	13.8%
60-65 years	7	24.1%
65+ years	3	10.3%
Total	29	100%

Most respondents (79.4%) were aged 44 years or older, indicating an aging farming population. This demographic pattern has significant implications for dairy production, as older farmers may have limited energy for labor-intensive dairy activities and may be less receptive to new technologies and practices. The aging farmer population also raises concerns about the sustainability of dairy production as younger generations may be less interested in farming.

Table 3. Educational Attainment of Respondents.

Education Level	Frequency	Percentage
No formal education	3	10.3%
Primary education	13	44.8%

Education Level	Frequency	Percentage
Junior Certificate	3	10.3%
O-Level	7	24.1%
A-Level	3	10.3%
Total	29	100%

Educational attainment was generally low, with over half of respondents (55.2%) not having progressed beyond primary education. Limited education constrains farmers' capacity to access and understand technical information, adopt improved practices, and engage effectively with extension services. This finding aligns with Garwi'S observation that management skills, partly determined by education, are a key factor in dairy productivity [2].

4.3. Herd Characteristics and Milk Production

Table 4. Number of Dairy Cows Owned.

Number of Cows	Frequency	Percentage
1	3	10.3%
2	8	27.6%
3	7	24.1%
4	3	10.3%
5+	8	27.6%
Total	29	100.0%

Most farmers maintained small herds, with 72.4% owning between 1 and 4 cows. Herd sizes were significantly smaller than the 5-10 cows typically recommended for viable small-scale dairy operations. Small herd sizes limit total milk production and economic returns, perpetuating poverty cycles. The limited adoption of strategies such as artificial insemination for breed improvement further constrains production potential.

Table 5. Number of Cows Milked.

Number of Cows	Frequency	Percentage
1	9	31.0%
2	8	27.6%
3	7	24.1%
4	3	10.3%
5+	2	6.9%
Total	29	100%

The number of cows actually being milked was lower than total herd sizes, with most farmers (31%) milking only one cow. This discrepancy suggests that many farmers maintain non-productive cows or are not fully utilizing their herd potential. This finding is consistent with patterns observed across Zimbabwean smallholder dairy systems, where low reproductive efficiency and high mortality rates affect herd productivity [3].

Table 6. Daily Milk Production per Farmer.

Litres per Day	Frequency	Percentage
2	1	3.4%
3	1	3.4%
5	7	24.1%
10	12	41.4%
20	6	20.7%
20+	2	6.9%
Total	29	100%

Milk production was remarkably low, with most farmers (41.4%) producing only 10 litres daily. Based on this daily production data and assuming a 305-day lactation period, the estimated 305-day milk yield per cow would be approximately 3,050 kg. This is substantially lower than the 8,000-12,000 kg achieved by Holstein-Friesian cows in commercial systems and the 5,000-8,000 kg typical for Jersey and Ayrshire breeds under optimal management [5]. However, this estimate likely overstates actual annual production given the seasonal decline in feed quality during the dry season and the absence of consistent lactation persistency records. The low production levels indicate serious constraints in breed quality, nutrition, management, and health that require systematic intervention.

Table 7. Monthly Income from Dairy Farming.

Monthly Income	Frequency	Percentage
$20	2	6.9%
$30	2	6.9%
$40	5	17.2%

Monthly Income	Frequency	Percentage
$100	5	17.2%
$100+	15	51.7%
Total	29	100%

Income levels were generally low, with 48.3% of farmers earning $100 or less monthly. The reported income represents primarily revenue from milk sales to the Rusitu Dairy Project collection centres. During interviews, farmers indicated that this income was derived almost exclusively from milk deliveries, with limited additional income from the sale of animals (primarily cull cows or surplus heifers) or other dairy-related activities. Notably, reported income is gross revenue rather than net farm income, as farmers did not systematically track production costs. However, qualitative interviews revealed that major production costs included concentrate feeds (when purchased), veterinary medicines, and maintenance of dairy infrastructure. Farmers frequently noted that the high cost of these inputs relative to milk income severely constrained their ability to invest in herd improvements.

To better understand the economic viability of these operations, approximate net farm income would require detailed cost accounting not available in this study. However, based on farmers' reports, gross margins appear extremely narrow, with many farmers operating at or near break-even during periods of high input costs. This limited profitability perpetuates the cycle of low investment and low production observed in the study.

4.4. Factors Influencing Low Milk Production

The study identified multiple interrelated factors contributing to low milk production at Rusitu Small Scale Dairy Project.

4.4.1. Inadequate Herd Size and Breed Quality

Small herd sizes and reliance on low-producing breeds significantly constrain production. Most farmers maintained only 1-4 cows, with limited adoption of improved dairy breeds such as Friesian, Jersey, or Ayrshire. Crossbreeds and indigenous types predominated, with lower genetic potential for milk production. This finding is consistent with observations in other developing country contexts where breed improvement remains a key constraint [8].

4.4.2. Limited Management Capacity

Poor management practices were evident across the study area. Farmers lacked essential skills in feeding, health management, breeding, and record keeping. The limited educational attainment of most farmers contributed to this challenge, as did insufficient extension support. These findings align with Garwi's observations that management deficiencies are a major constraint on smallholder dairy productivity in Zimbabwe [2].

4.4.3. Inadequate Feeding Systems

Feeding practices were generally inadequate, with primary limitations related to insufficient feed quantity and quality, particularly during the dry season (May-October), inadequate dietary protein and energy in available forages, seasonal variation in feed quality, and limited access to commercial concentrate feeds. Most farmers employed zero-grazing or limited grazing systems, with feed consisting primarily of natural grasses and crop residues. Commercial concentrates were used by only 17% of respondents due to cost and supply constraints. The absence of total mixed ration (TMR) feeding resulted in imbalanced nutrient intake and reduced milk production, particularly during dry periods when forage quality declined substantially.

4.4.4. Capital Constraints

Financial limitations restricted farmers' ability to invest in improved breeds, infrastructure, medicines, and other essential inputs. Limited access to credit, due to lack of collateral and inappropriate loan products, perpetuated these constraints. This finding is consistent with broader observations on financial barriers to smallholder agricultural development [10].

4.4.5. Demographic and Social Factors

The aging farmer population and limited youth involvement in dairy farming raise concerns about the sustainability of production. Older farmers have limited physical capacity for dairy work and may be less willing or able to adopt improved practices. The limited education of most farmers further constrains their ability to benefit from extension services and technical information.

4.5. Strategies for Enhancing Milk Production

Based on the findings, several strategies were identified for enhancing milk production at Rusitu Small Scale Dairy Project.

4.5.1. Genetic Improvement

Breed improvement through artificial insemination and strategic breeding programs offers significant potential for enhancing production. Introducing high-producing dairy breeds such as Friesian, Jersey, and Ayrshire could dramatically increase milk yields. However, such interventions must consider local adaptation, disease resistance, and management capacity [14].

4.5.2. Management Capacity Building

Investing in farmer education and extension services is essential for improving dairy management. Training programs

should focus on feeding practices, health management, breeding, record keeping, and business management. Participatory approaches that build on farmer knowledge and experience are likely to be most effective [1].

4.5.3. Improved Feeding Systems

Developing improved feeding systems, including fodder production, silage making, and strategic supplementation, is critical for year-round milk production. Farmers should be supported to cultivate high-quality fodder crops and establish water systems at their plots to reduce energy expenditure by cattle.

4.5.4. Financial and Institutional Support

Improved access to financial services, including targeted credit products for dairy development, is essential. Financial institutions should develop products that accommodate the specific needs and constraints of smallholder dairy farmers. Institutional support, including effective extension services and input supply systems, is also crucial.

4.5.5. Youth Engagement and Succession Planning

Addressing the aging farmer population requires strategies to engage youth in dairy farming. Succession planning, youth-focused extension services, and demonstration of dairy farming's economic potential could attract younger farmers to the sector.

4.5.6. Limitations of the Study

Several limitations affected this research. Financial constraints limited the researcher's mobility and comprehensive data collection across the study area. Time limitations, arising from the researcher's full-time teaching responsibilities, restricted the duration of fieldwork to weekends and vacation periods. Additionally, some respondents exhibited reluctance to provide financial information, potentially affecting the accuracy of income-related data. Furthermore, milk composition data (milk fat, protein, and somatic cell counts) were not available due to the absence of on-farm testing infrastructure, limiting the study's ability to assess milk quality and its contribution to farmer income through quality-based pricing mechanisms. Despite these limitations, the researcher employed multiple data collection methods to triangulate findings and enhance the validity of conclusions.

5. Conclusions and Recommendations

5.1. Conclusions

This study assessed milk production at Rusitu Small Scale Dairy Project in Ward 9 of Chipinge District, Zimbabwe. The research revealed persistently low milk production, with average daily yields ranging from 2 to 20+ litres per farmer. The findings confirmed that Rusitu Dairy Project experiences low productivity, consistent with the downward trend documented in milk collection records since 2010.

Multiple factors contribute to this low production, including inadequate herd sizes, poor breed selection, limited management capacity, inadequate feeding systems, capital constraints, and demographic challenges. The aging farmer population and limited educational attainment among farmers compound these technical constraints, limiting the adoption of improved practices.

The low milk production translates directly to limited income for farmers, with most earning less than $100 monthly. This income level is insufficient to meet household needs, perpetuating poverty and limiting investment in dairy improvements. The study thus reveals a vicious cycle of low production, limited income, and inadequate investment that characterizes smallholder dairy development in Rusitu.

5.2. Recommendations

Based on the findings, the following recommendations are proposed for enhancing milk production at Rusitu Small Scale Dairy Project:

1) Breed Improvement Program: Implement a comprehensive breed improvement program using artificial insemination with high-producing dairy breeds. This program should be supported by training in heat detection, breeding management, and calf rearing.
2) Farmer Education and Extension: Develop and implement participatory training programs covering dairy management, business skills, and record keeping. Extension services should be strengthened and made more accessible to farmers.
3) Feeding System Improvement: Promote the cultivation of high-quality fodder crops and preparation of silage for dry season feeding. Support the development of water systems at plot level to reduce energy expenditure by cattle.
4) Financial Services: Develop and promote financial products tailored to smallholder dairy needs, including credit for herd improvement, infrastructure investment, and working capital.
5) Youth Engagement: Implement programs to attract youth to dairy farming, including succession planning, youth-focused extension, and demonstration of viable dairy enterprise models.
6) Policy Support: Advocate for policy frameworks that recognize and support smallholder dairy development, including appropriate pricing policies, market infrastructure, and institutional arrangements.
7) Further Research: Conduct comprehensive research covering all 345 plots in the Rusitu Dairy Project to provide more complete evidence on production constraints and opportunities. Research should also examine the effec-

tiveness of intervention programs and identify best practices for upscaling. Specifically, future research should investigate milk composition and quality parameters, as these data were not available in the present study but are critical for understanding the full productivity and economic potential of smallholder dairy systems.

5.3. Contribution to Knowledge

This research contributes to the limited body of empirical evidence on smallholder dairy development in Zimbabwe's resettlement areas. By identifying specific constraints and opportunities in the Rusitu context, the study provides practical insights for policy-makers, development practitioners, and extension services. The findings also contribute to broader understanding of the challenges facing smallholder dairy farming in sub-Saharan Africa and the strategies needed for sustainable development.

Abbreviations

ARDA	Agricultural Rural and Development Authority
FAO	Food and Agriculture Organization
TMR	Total Mixed Ration
THI	Temperature-Humidity Index
ZJC	Zimbabwe Junior Certificate

Author Contributions

Victor Thondhlana Mhlanga: Conceptualization, Data curation, Formal Analysis, Investigation, Visualization, Writing – original draft

Maxwell Mhlanga: Methodology, Resources, Validation, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Food and Agriculture Organization (FAO). World Dairy Situation and Outlook. Rome, Italy: FAO; 2019.

[2] Garwi J. “A Fractious Lot”: Farmer and Arda Relations in the Rusitu Dairy Farming Contract Scheme in Zimbabwe, from c. 1985 to 1997. Southern Journal for Contemporary History. 2023; 48(1): 31-57. https://doi.org/10.38140/sjch.v48i1.6979

[3] Hanyani-Mlambo B, Mudhara M, Tatsvarei S. Innovation Domains for Driving Transformation and Rural Development: The Case of Smallholder Dairying in Zimbabwe. Cutting-Edge Research in Agricultural Sciences. 2021; 7: 31-46. https://doi.org/10.9734/bpi/cras/v7/6769D

[4] Anulisa C, Duba D, Stoian D, Mutune JM, Gahamanyi AP. Practical Guide for Proper Milk Cooling and Storage-Rwanda. Bogor, Indonesia; Nairobi, Kenya: CIFOR-ICRAF, TREPA Project; 2025. Available from: https://www.researchgate.net/publication/408534925_Practical_Guide_for_Proper_Milk_Cooling_and_Storage_-_Rwanda

[5] Chen Y, Steeneveld W, Nielen M, Hostens M. Prediction of Persistency for Day 305 of Lactation at the Moment of the Insemination Decision. Frontiers in Veterinary Science. 2023; 10: 1264048. https://doi.org/10.3389/fvets.2023.1264048

[6] Exploring Africa. Zimbabwe: Physical Geography and Agricultural Potential. East Lansing, MI: Michigan State University; 2014. Available from: http://exploringafrica.matrix.msu.edu/teachers/curriculum/m30/activity.php

[7] Habimana V, Ekine-Dzivenu CC, Nguluma AS, Nziku ZC, Morota G, Chenyambuga SW, Mrode R. Genes and Models for Estimating Genetic Parameters for Heat Tolerance in Dairy Cattle. Frontiers in Genetics. 2023; 14: 1127175. https://doi.org/10.3389/fgene.2023.1127175

[8] Eurostat. Agricultural Statistics: Dairy Farming in the European Union. Luxembourg: European Commission; 2021.

[9] Food and Agriculture Organization (FAO). Status of Dairy Development in Kenya. Rome, Italy: FAO; 2010.

[10] Wongtangtintharn S, Chakkhambang S, Pootthachaya P, Cherdthong A, Wanapat M. Challenges and Constraints to the Sustainability of Poultry Farming in Thailand. Animal Bioscience. 2025; 38(4): 845-862. https://doi.org/10.5713/ab.24.0685

[11] Cole J, Adetona MA, Basiru A, Jimoh WA, Abdulsalami S, Ade-Yusuf RO, Babalola KA, Adetunji VO, Ahmed AO, Adeyemo IA, Olajide AM, Aremu A, Odetokun IA, Eltholth M. Climate Change, Land Use, and the Decline in Traditional Fulani Cattle Practices: Drivers of Antimicrobial Resistance in Kwara, Nigeria. Challenges. 2024; 15(4): 41. https://doi.org/10.3390/challe15040041

[12] New Zimbabwe. Zimbabwe Dairy Industry Records 15 Percent Growth. Harare, Zimbabwe: New Zimbabwe; 2024. Available from: https://www.newzimbabwe.com/zimbabwe-dairy-industry-records-15-percent-growth/

[13] United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service. Dairy 2022: Dairy Cattle Management Practices in the United States. Washington, DC: USDA; 2022.

[14] Greenhalgh T. Case Studies: A Guide for Researchers, Educators, and Implementers. BMJ Medicine. 2025; 4(1): e001623. https://doi.org/10.1136/bmjmed-2025-001623