

Short Communication

Information and Communication Technologies Use in Dairy Farms in Zimbabwe: A Case Study of Dairy Farms in Mutasa District in Manicaland Province

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Abstract: This study investigated the adoption, benefits, and challenges of Information and Communication Technologies (ICTs) in dairy farms in the Mutasa District of Manicaland Province, Zimbabwe, utilizing a purposive sample of thirty small-scale and medium- to large-scale farmers. The overall ICT utilization was found to be low, with farmers primarily relying on the mobile phone as the most pervasive tool across all scales. The principal benefit cited was improved financial services, for instance mobile money transfers for milk payments. Despite the potential for improved productivity, the adoption of advanced dairy ICTs and computers was negligible. Statistical analysis revealed no significant difference in overall ICT usage between the two farming scales. The main constraints to adoption were identified as the high costs of ICTs and a pervasive lack of skills, compounded by infrastructural deficits such as the unavailability of electricity. The study recommends a dedicated focus on providing adequate financing and implementing targeted skills development through community information centers and extension services to promote the uptake of advanced agricultural ICTs.

Keywords: Dairy farming; Information and communication technologies (ICT); Technology adoption; Agricultural extension

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1. Introduction

The Zimbabwean dairy industry is an important component of the country's agricultural sector, providing nutrition, household income, and employment. Production systems vary widely, ranging from extensive low-cost operations to intensive zero-grazing systems. Annually Zimbabwe requires at least 130 million litres of milk, yet the local dairy industry currently supplies only about 80 million litres with the remaining balance being imported [1]. The primary challenges facing the local dairy sector include poor management, a decreased national dairy herd, weak extension services, and a low uptake of information and communication technologies (ICTs) [2]. The potential of ICTs to transform various business sectors, particularly agriculture, has gained increasing attention in Zimbabwe [3]. Despite this potential, a key challenge in Zimbabwe's dairy sector is the low adoption and utilization of ICTs [4]. Furthermore, there is a scarcity of published studies that appraise the use of ICTs within the Zimbabwean dairy value chain. In the absence of a clear understanding of the types of ICTs adopted and utilized by dairy farmers, it is difficult to identify the specific tools and challenges that hinder their adoption.

The objectives of this study were to identify ICT tools owned and used by dairy farmers, determine benefits and challenges associated with ICT adoption and utilization and assess if there is a differential use of ICTs between different scales of dairy farming in Zimbabwe.

2. Materials and Methods

2.1. Study Area

This study was administered in the Mutasa District of Manicaland Province, Zimbabwe, which falls within Natural Region 2A, characterized by reliable annual rainfall ranging from 750 to 1,000 mm/year [5]. The district was purposively selected due to increasing attempts to promote small-scale commercial dairy production [6], and it includes both large-scale commercial dairy operations utilizing specialized exotic breeds such as Holstein, Red Dane and Jersey. While smallholder farmers maintaining indigenous breeds (Nguni, Tuli, Mashona) with typically low milk yields of 2–5 L/cow/day.

2.2. Study Design and Sampling Methods

A three-stage, non-probability purposive sampling procedure was employed, beginning with the selection of the Mutasa District, followed by the purposive selection of Wards 24 chosen for its Milk Collection Centre location, 17, and 11 selected for ease of accessibility and farmer availability. A total sample size of thirty dairy farmers was purposively selected to ensure a representative sample and 15 were small-scale farmers defined as those with small herd sizes using indigenous breeds and supplying informal markets or the MCC and 15 medium- to large-scale farmers characterized by the use of exotic breeds, larger herd sizes, and specialized formal market access. Data were collected after obtaining informed consent using a structured questionnaire [7] that assessed dairy production, marketing parameters, and the usage of five key Information and Communication Technology (ICT) tools that included mobile phones, television, computers, laptops, and radio [8].

2.3. Statistical Analysis

All data were cleaned, coded, and analyzed using the Statistical Package for Social Sciences (IBM Corp., SPSS Statistics, Version 24.0, 2016). Descriptive statistics were utilized to summarize information regarding adopted ICTs, their benefits, and associated challenges, while an inferential T-test for independent samples was applied to test for significant differences in ICT usage between the two scales of dairying, with statistical significance established at $p < 0.05$.

3. Results and Discussion

3.1. Farmer Demographics and ICT Ownership

The demographic profile of the 30 dairy farmer respondents is presented in Table 1. Most of the participants (40.0%) were in the 41–50-year age bracket indicating the sample consists of middle-aged farmers. The farmer's age has an impact on the utilization of dairy farming innovations and technologies. Young farmers are more inclined to use ICTs in their dairy ventures than older farmers. Kabir [8] observed that young people are making use of ICT services for getting useful information in farming.

Table 1. Distribution of dairy farmer respondents by age (N = 30).

Age Category (Years)	Frequency	Percentage (%)
20-30	4	13.3
31-40	7	23.3
41-50	12	40.0
51-60	5	16.7
Over 60	2	6.7

3.2. Ownership Patterns and Technology Gap

The most pervasive and utilized ICT is the mobile phone, with ownership rates of 30.0% and 40.0% for small-scale and medium- to large-scale farmers, respectively (Table

2). This high rate reflects strong national mobile penetration and is consistent with findings by Musungwini [9] and Masuka et al. [10]. For small-scale farmers, traditional media also maintains relevance, with Radio (13.33%) and Television (6.67%) being more commonly owned. As Bore et al. [11] suggested, common and accessible tools are the most utilized among smallholders.

Conversely, a significant technology gap exists in the adoption of advanced tools. Ownership of both Laptop and Desktop computers is negligible, reported at 0.00% for small-scale farmers and only 3.30% for medium- to large-scale farmers. Furthermore, no farmer utilizes specialized modern dairy technologies such as automated cow sensors or drones. This lack of advanced tool adoption indicates that while connectivity is high, the integration of data-driven or precision farming techniques remains minimal.

Table 2. ICT tools owned by farmers (N = 30).

ICT Type	Small-Scale Farmers (Ownership %)	Medium- to Large-Scale Farmers (Ownership %)
Laptop	0.0	3.3
Mobile phone	30.0	40.0
Desktop computer	0.0	3.3
Radio	13.3	0.0
Television	6.7	3.3

Percentages represent the proportion of farmers within each scale category who reported using each ICT type.

3.3. ICT Use Benefits among Small-Scale and large-Scale Dairy Farmers

The primary benefit of ICTs, particularly mobile phones, across both farmer groups, is improving financial services (Table 3). This is the highest reported benefit for both small-scale farmers (33.3%) and medium- to large-scale farmers (26.7%). The study noted that farmers use phones for receiving milk payments and making payments for inputs, with mobile banking cutting down costs and stimulating transactions. Musungwini [9] also observed that mobile money transfer services are a main use of mobile phones among smallholder farming communities.

Table 3. Perceived ICT use benefits among dairy farmers (N = 30).

ICT Benefits	Small-Scale Farmers (%)	Medium- to Large-Scale Farmers (%)
Improved financial services	33.3	26.7
Information availability	10.0	13.3
Market access	0.0	3.3
No perceived benefit	10.0	3.3

Percentages represent the proportion of farmers within each scale category reporting various benefits.

Information availability is the second most reported benefit, with medium- to large-scale farmers (13.3%) reporting it slightly more often than small-scale farmers (10.0%). This can be attributed to the convenience of audiovisual tools like mobile phones and televisions facilitating communication and understanding of information sources [12]. Farmers demonstrate a drive to gather details on livestock breeding, health, welfare, and management skills via ICT tools, which also reduces the need or costs for extension provider field visits. Market access as a benefit is negligible for small-scale farmers but is reported by a small fraction of medium- to large-scale farmers (3.3%). A significant fraction of small-scale farmers (10.0%) reported no benefits from using ICTs, a rate three times higher than that of medium- to large-scale farmers (3.3%). Overall, the data underscores the utility

of ICTs as tools for financial transactions and basic information exchange, largely confirming the role of the mobile phone as an essential information disseminator therefore it's important to support maximum benefits from ICT tools in dairying.

3.4. ICT Adoption Challenges in Dairy

The high cost of adoption of ICTs is the most common adoption challenge highlighted consisting of 26.7% for each of the two farmer groups (Table 4). Lack of skills in ICT usage is also a huge challenge especially among small-scale dairy farmers.

Table 4. ICT adoption challenges (N = 30).

ICT Adoption Challenges	Small-Scale Farmers (%)	Medium- to Large-Scale Farmers (%)
Lack skills	16.7	6.7
High expenditure	26.7	26.7
Technology is changing too fast	0.0	10.0
Lack of government support	6.7	6.7

Percentages indicate the proportion of farmers within each scale category who reported ICT adoption challenges.

The single most significant hurdle for both farmer groups is the high expenditure of buying ICTs, with an identical 26.67% of both small-scale and medium- to large-scale farmers citing this as a challenge. This finding aligns with the financial constraints identified in existing literature, specifically the agreement with Gavai et al. [4] that high costs negatively affect ICT investments in commercial agriculture. This financial barrier forms a foundational constraint to adoption, as the initial investment deters farmers from upgrading or purchasing advanced tools.

Complementing the financial challenge is the issue of lack of skills in ICT usage. This is a particularly acute problem for small-scale farmers (16.67% reporting), which is more than double the rate reported by medium- to large-scale farmers (6.67%). The findings noted that a lack of skills is a huge challenge, especially among small-scale dairy farmers, preventing them from fully obtaining the benefits of ICTs [11]. This deficiency in human capital points to a need for targeted educational and extension services to improve technological literacy.

Beyond immediate costs and skills, the data revealed challenges related to infrastructure and institutional support. Technology change and obsolescence, which is the challenge of technology changing too fast, is only reported by medium- to large-scale farmers (10.00%), and not by small-scale farmers. This suggests that while large farmers are more likely to attempt to acquire newer technologies, they are also more burdened by the cycle of obsolescence and the need for continuous investment.

The reported lack of government support is consistent across both small-scale and medium- to large-scale farmers, with 6.67% of each group citing this as a barrier. This highlights a need for better policy or financial assistance programs to promote ICT uptake. Although not quantified in the study, unavailability of electricity is a factor that reduces ICT adoption in the dairy. Matekenya [13] observed that electricity availability is crucial as it drives innovation and investment in dairy. This infrastructural deficit acts as a basic technological constraint that limits the use of all electronic devices. In summary, the financial, infrastructural, technical, and institutional challenges confirm the argument by Williams and Agbo [14] that ICT use in farming is limited by a diverse array of constraints, with high costs and lack of skills being the most critical reported barriers to widespread adoption.

3.5. ICT Use in Different Dairying Scales

ICT utilization shows no statistically significant difference between small-scale and medium- to large-scale dairy farmers in the study area (Table 5). This is primarily because the mobile phone stands out as the most widely adopted and utilized ICT tool across both

farmer groups. This finding aligns with observations by Batani et al. [15] and Masuka et al. [10], who also noted high mobile usage across different farmer scales in Zimbabwe. However, a pronounced gap exists in the adoption of advanced technologies. Modern dairy ICTs, such as automated cow sensors or drones, are utilized at a very low rate, being minimally used by medium- to large-scale farmers and completely absent among small-scale operations.

Table 5. The statistical comparison of ICT usage between the small-scale and medium- to large-scale dairy farmers.

ICT Usage Comparison	t-Test Statistics (<i>p</i> Value)	Interpretation
Overall ICT Usage	0.643	There is no statistically significant difference in overall ICT uses between small-scale and medium- to large-scale farmers.
Mobile Phone Usage	0.578	The high and widespread use of mobile phones is a common factor that masks potential differences in other technologies.
Advanced ICT Use	0.941	The near-zero adoption rate of advanced ICTs by both groups suggests a shared constraint rather than a scale-dependent difference.

Percentages represent the proportion of farmers within each scale category reporting different types of ICT usage.

The statistical findings presented in Table 5 demonstrate a critical point that there is no statistically significant difference in ICT usage between small-scale and medium- to large-scale dairy farmers. This homogeneity across farm sizes suggests that the primary constraints to ICT adoption are systemic and shared, rather than dependent on the scale of operation. The near-identical, low adoption rates for overall ICT usage ($p=0.643$) and especially advanced ICT use ($p=0.941$) indicate a widespread technology gap that affects the entire dairy sector, regardless of farm size. The lack of scale-dependent variation points to common limitations such as high initial costs, lack of technical knowledge, poor infrastructure, or the perceived complexity and risk of new technologies. This finding challenges the common assumption that larger enterprises naturally lead in technology adoption, revealing instead a shared barrier across the agricultural continuum.

The high and widespread use of mobile phones ($p=0.578$) among both groups is a key finding. While it masks differences in the use of other technologies, it also establishes a crucial foundation for future ICT integration. Dairy farmers are already receptive to and proficient with mobile technology, which should be leveraged to deliver extension services, market information, and data capture tools, effectively making the mobile phone the primary platform for other dairy ICTs.

To foster the adoption of dairy ICTs and bridge the existing technology gap, several strategies are critical. Increasing awareness and education on ICT usage and adoption is essential. Public and private extension agents are needed to create awareness on the available ICT tools and their potential benefits among farming communities [12]. Government and financial support services are of critical importance. The government, in partnership with the private sector, should develop and subsidize ICT-based services to increase the accessibility of extension and information services to smallholder dairy agripreneurs [12], ensuring farmers can invest in technologies that are available and affordable. Dairy farmers can organize themselves into farmer groups to collectively invest in ICTs. This collaborative approach can significantly reduce the individual expenditure of adopting ICTs,

making tools more financially accessible. Furthermore, these groups can serve as platforms for peer-to-peer education and skills transfer on ICT usage.

3.6. Study Limitations

The findings of this case study are inherently constrained by its methodological design, which employed a small, non-probability purposive sample of only thirty farmers. This small sample, selected from the Mutasa District based on convenience and availability, significantly limits the generalizability and external validity of the conclusions to the broader Zimbabwean dairy industry. Moreover, the study's scope was narrow, focusing solely on the adoption and usage of five basic ICT tools mobile phones, radio, TV, computers, and laptops, thereby failing to assess the integration status of modern, advanced agricultural ICTs or specialized digital platforms relevant to contemporary farming practices.

4. Conclusions

This study confirms that the utilization of Information and Communication Technologies (ICTs) in dairy farming in the Mutasa District of Zimbabwe is generally low, with a critical finding being the reliance on the mobile phone as the most pervasive and utilized ICT across all scales. The primary benefit derived from these tools by both small-scale and medium- to large-scale farmers is improving financial services. Despite the potential for ICTs to enhance productivity, the adoption of advanced tools like computers and specialized modern dairy technologies is negligible. The widespread ICT adoption is severely constrained by high expenditure/costs of ICTs and the lack of skills in their usage, especially among small-scale farmers. Infrastructural challenges, such as the unavailability of electricity, also contribute significantly to low adoption.

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