The Use of Information Technology by Beef Production Farmers in Lobatse, Botswana

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Declaration

This work has not been previously submitted in entirety or in part for any degree. It is my work. Each significant contribution to and quotation in this dissertation, or the work of others, has been attributed and cited. I authorise the University of Cape Town to use it for research, either as a whole or as any portion of the work.

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Date: 2nd April, 2024

Dedication

This dissertation is dedicated to my daughter, Natasha Thuto Letshabo, and my son, Temo Liam Letshabo, who have been unfailingly supportive and understandable while I conducted my studies.

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Abstract

This study examines the use of information technology by beef production farmers in Lobatse, Botswana. This study aimed to explore the role of library-based IT services in enabling access to information on best practices for beef production, market prices and trends, disease management, and other relevant topics. It also examined the training and support provided to farmers using library-based IT services, including digital tools for record-keeping, analysis, and decision making, as well as their familiarity with digital platforms and resources. Moreover, this study examined opportunities for collaboration and networking among farmers, researchers, and extension workers using library-based IT services.

The study adopted a pragmatic paradigm, whose worldview focuses on what works rather than what might be considered valid or accurate. This study is based on the belief that technology is available, but an investigative approach establishes what beef production farmers consider usable, and the basis upon which that usability is based. Coupled with this paradigm, this study considers the Technology Acceptance Model (TAM) as an appropriate theoretical framework. This study adopted a multi-method technique that employed both qualitative and quantitative data collection methods, in which data collection was performed concurrently. The qualitative approach was used to collect data from the BUAN Library Client Services Unit staff, whereas the quantitative approach was used to collect data from traditional and commercial beef production farmers in Lobatse, southeastern Botswana.

Data were collected using questionnaires and structured interviews. Questionnaires were administered to beef production farmers in Lobatse, and interviews were conducted with BUAN Library Client Services Unit staff. Quantitative data were analysed using descriptive statistics and presented in tables, graphs, and charts using the Statistical Package for the Social Sciences (SPSS), while qualitative data were analysed using Microsoft Excel.

The findings emanating from both the qualitative and quantitative data collected demonstrated that, although farmers use information technology to support beef production, it is minimal owing to the lack of interest, relevant expertise in information technology services, and perceived usefulness of the technologies. However, some farmers showed a willingness to use more

advanced information technology tools if given support and training from agricultural institutions in Botswana.

This study provides insights into the challenges and opportunities of library-based IT services in the agricultural sector in Botswana and other developing countries. This study highlights the significance of library-based IT services in providing access to information and promoting digital literacy and skill development among beef production farmers, thereby enhancing their overall productivity and contributing to the agricultural sector development. Recommendations from the study suggest an engagement between stakeholders and local communities as an avenue for deep learning inclined towards sustainable social change and for the library to focus on teaching and demonstrating available IT tools by promoting their usability to farmers regularly.

Table of Contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

BAITS	Botswana Animal Information and Traceability System
BIDPA	Botswana Institute for Development Policy Analysis
BMC	Botswana Meat Commission
BNLS	Botswana National Library Services
BUAN	Botswana University of Agriculture &Natural Resources
BVI	Botswana Vaccine Institute
COVID-19	Coronavirus disease
EU	European Union
EOS	Ease of Use
FAO	Food and Agriculture Organization
FAQs	Frequently Asked Questions
GDP	Gross Domestic Product
GPS	Global Positioning System
IT	Information Technology
MITI	Meat Industry Training Institute
MOA	Ministry of Agriculture and Sustainable Development
MOA DFS	Ministry of Agricultural Development and Food Security
NamLITS	Namibian Livestock Identification and Traceability System
NARDI	National Agricultural Research Development Institution
RFID	Radio Frequency Identification
SADC	Southern African Development Community
SPSS	Statistical Package for Social Sciences

TAM	Technology Acceptance Model
TRA	Theory of Reasoned Action
PLF	Precision Livestock Farming

Definition of Terms

The following terms are relevant to this study:

Information Technology: Information technology (IT) is a collection of technologies and their related disciplines. IT encompasses basic computer-based information systems, including computer software and hardware, that process data into useful information that can be communicated electronically. IT is used to manage computers, networks, and technical areas of companies, such as programming, support, and administration, and has become an integral part of businesses to facilitate their growth (Mish, 2004).

Technology adoption: Technology adoption involves deliberate acquisition and use of technology to satisfy needs. For technology to be utilised, it needs to be accepted mentally and then adopted (Christensen, 2006). It is also defined as the decision to adopt an innovation/technology, idea, or practice thought to be new to an individual, making full use of it, usually by exhausting all stages of adoption (Rogers, 2003:12).

Farmhold: A farmhold is a piece of land reserved for agricultural activities, such as rearing animals and cultivating crops. A piece of land can be owned, leased, or rented (Merriam-Webster, 2022).

CHAPTER 1

INTRODUCTION

1.1 Introduction to the study

Information technology has revolutionised how libraries operate worldwide, including in the beef production industry. The use of technology in libraries has enabled farmers to quickly and efficiently access and share information, resulting in increased productivity and profitability. This is particularly important in developed and developing countries, including Africa and Botswana, where the beef industry is a vital source of income for many farmers.

In developed countries, libraries traditionally use information technology to manage their collections and provide access to resources through online catalogues and databases. This technology can provide farmers with updated information regarding animal health, nutrition, and breeding in the beef production industry. Online resources can also provide access to industry reports and market data, helping farmers to make informed decisions regarding their operations.

Such access to digital technologies has seen farmers enjoy increases in farm-gate prices resulting from improvements in bargaining powers with intermediaries, as increasing participation by farmers in remote areas is well-coordinated and allows farmers to link farmers to markets and critical stages of the value chain, conforming to the claim that was centred around the introduction of the Internet in the 1990s – that it would improve price transparency and make markets more efficient. A study on farmers in Bangladesh, China, India, and Vietnam found that 80% of farmers in these countries owned IT technologies that they used to connect with agents and traders to estimate market demand and selling prices. The study further revealed that more than 50% of these farmers had the opportunity to work directly with larger intermediaries and could expand their networks and establish direct contact with other buyers (Deichmann, Goyal, & Mishra, 2016:24–25).

In developing countries, information technology in libraries has been instrumental in bridging the digital divide and increasing access to information for farmers who may not have access to traditional libraries despite cases where agricultural product markets in many developing countries

are poorly integrated. Mobile technologies, such as smartphones and tablets, have been particularly useful in this regard, allowing farmers to access information on the go and have also facilitated the adoption of improved inputs by providing extension advice and weather forecasts at a lower cost and encouraging agricultural investment decisions. In addition, online forums and social media platforms have enabled farmers to connect and share information and experiences (Deichmann, Goyal & Mishra, 2016:27).

In the beef industry, radio-frequency identification (RFID) chips are commonly used to trace animal movements, enabling the monitoring of animals from birth to the supermarket shelf. An excellent example of this technology is the Namibian Livestock Identification and Traceability System (NamLITS), implemented in 2005 with a focus on nurturing livestock production for export markets in a country where more than 85% of agricultural land is used to raise livestock, and beef production constitutes 87% of agricultural revenue. The objective of NamLITS is to implement a traceability system to help control, manage, and eradicate bovine diseases such as foot-and-mouth disease.

The use of RFIDs to replace traditional paper-based recording has increased the accuracy of data and the speed with which they are disseminated and has also contributed to a more vigorous market that saw the Namibian livestock market increase by approximately $83 million in 2010 (Deichmann, Goyal & Mishra, 2016:27).

Beyond RFIDs, information and communication costs also play a significant role in agricultural production in developing countries, where the need for updated information and the ability to exchange knowledge allows farmers to cope with and benefit from these changes. In this context, mobile phone and Internet connectivity have the potential to contribute to productivity improvements in the rural sector. However, there has been slow but steady growth in how digital innovations help improve the lives of rural people.

In its simplest form, technology can help improve agriculture in developing countries in three ways: improved access to market information, which in turn results in the inclusion of rural and often marginalised producers; raised on-farm productivity; enhanced information (on agricultural practices, new tools, or new seeds) delivered through extension services, resulting in more efficient

production; and benefit from major innovations, including logistics platforms that may better link buyers and sellers along the agricultural production chain. Studies have shown that short messaging service (SMS) or “texting” is the most used technology in these projects because even poor farmers now tend to have access to phones, even though about a quarter of projects now employ Internet tools. The use of such digital technologies has drastically reduced the search costs incurred by farmers and traders, thereby overcoming the constraints of limited infrastructure.

In Africa, the beef industry is a crucial source of income and food security in many countries including Botswana. Information technology in libraries can play a significant role in supporting this industry by providing farmers access to information on best practices, market trends, and industry standards. Online resources provided by the library can also help farmers to remain informed about changes in regulations and policies that may affect their operations.

Digital tools generate immediate private benefits as people can easily communicate with friends and family and access new forms of leisure and sources of information. These benefits explain the rapid adoption of mobile phones even among those with few means. A larger question is whether new technologies also significantly promote economic development, but solid empirical evidence based on careful identification of impacts is much harder to obtain. However, there are several compelling examples across sectors of the economy where technology has improved economic prospects, helped support livelihoods and facilitated service delivery for small-scale African farmers, showing significant time and cost saving in using information and communication technology (ICT) for extension service. Modern large-scale agriculture is becoming unthinkable without precision agriculture tools such as Global Positioning System (GPS), satellite, and drone monitoring, and increasingly detailed and instantly available weather and climate technologies (Deichmann, Goyal, & Mishra, 2016:21).

In Botswana, the beef industry is a vital contributor to the country's economy, accounting for a significant portion of its Gross Domestic Product (GDP). Libraries can help farmers remain competitive in the global market by providing access to the latest research and technology. In addition, online resources can help farmers navigate the challenges of climate change such as drought and water scarcity, which can significantly impact the beef industry.

Overall, information technology in libraries has transformed how farmers access and share information, thereby increasing productivity and profitability in the beef production industry. This is true for both developed and developing countries, including Africa in general and Botswana. As technology evolves, libraries are playing an increasingly important role in supporting the beef industry and other agricultural sectors worldwide.

Chen and Lu (2020:3) posit that there is still a gap in the provision of agricultural information and that farmers are characterised according to their information needs and the various channels to be used to reach them. He cited social and family factors that affect the influence of farmers' information needs and preferences on access to information, which needs to be studied to provide relevant information.

Access to reliable and timely information is crucial for farmers to make informed decisions to improve agricultural practices and productivity. According to Pandey and Pandey (2019:3), agricultural libraries play a vital role in educating communities, sharing research outcomes, and promoting extension services to farmers. Teaching agriculture, disseminating agricultural information, and providing current awareness services in various forms suitable for farmers, even in remote areas, can help improve the quality of education and increase the use of agricultural resources found in the library. They may do so by organising awareness programs, exhibitions, and displays of the latest sources of agricultural information.

In the context of beef production farming in Lobatse, Botswana, information on best practices, market prices and trends, disease management, and other relevant topics is essential for farmers to optimise their production and sustain their livelihoods. However, access to such information is often limited, particularly in developing countries such as Botswana, where the information and communication technology (ICT) infrastructure is relatively low. Other problems cited were low adoption of technology, lack of implementation, and funds to purchase technological innovations for poor farmers who could not afford them (Acquah, 2003: 80–81).

In contemporary agricultural practice, access to relevant information is pivotal for enhancing productivity and sustainability. Information technology services, particularly those provided by institutional libraries, serve as invaluable repositories of knowledge essential for agricultural stakeholders. The BUAN Library, situated in Lobatse, Botswana, offers a spectrum of IT services

that are potentially beneficial to local beef production farmers. Nevertheless, the extent to which these farmers utilise such services remains underexplored. This study aimed to investigate the utilisation patterns of IT services provided by the BUAN Library among beef production farmers in Lobatse.

This study examined the use of information technology by beef production farmers in Lobatse, Botswana. It also investigates the training and support provided to farmers by librarians using library-based IT services, including digital tools for record-keeping, analysis, and decision-making, as well as their familiarity with digital platforms and resources.

Furthermore, this study examined opportunities for collaboration and networking among farmers, researchers, and extension workers using library-based IT services. This study provides insights into the challenges and opportunities of library-based IT services in the agricultural sector in Botswana and other developing countries. By highlighting the significance of library-based IT services in providing access to information and promoting digital literacy and skill development among beef production farmers, this study aims to contribute to the development of the agricultural sector in Lobatse, Botswana, and other regions.

1.2 Background to the study

Lobatse is in the southeastern part of Botswana, 70 km from the capital city of Botswana, and is in a 40-kilometre square of land surrounded by farm holds and a series of low-lying hills (Botswana Ministry of Local Government, 2003:2). The township was established by colonialists during the construction of the Mafikeng-Bulawayo railway line. It is alongside the A1 Highway and a rail route that links it to the neighbouring countries of Namibia, South Africa, and Zimbabwe, with this route commonly used for the transportation of goods between these countries and within Botswana (Botswana Ministry of Local Government, 2003:3). Lobatse is dominated by agro-based industries, which dominate the country's manufacturing sector. The beef sector employs fifths of the total labour force of the town. Lobatse also houses other government administrative offices, such as the High Court, Botswana Geoscience Institute, and other significant departments (Botswana Ministry of Local Government 2003:9).

According to the 2011 Botswana Population and Housing Census, the Lobatse population is 29 007, 14, 145 males and 14, 862 females (Statistics Botswana, 2015:3). Lobatse falls under the south-eastern district of Botswana. The following is a table with statistics extracted from Statistics Botswana (2015:37), which shows the statistics of both traditional and commercial cattle holdings in the southeast and their population by district in comparison to the four other famous beef production districts of Botswana.

Table 1: Cattle holdings by district

District	Cattle Holdings		Total Holdings	Relative Frequency
	Traditional	Commercial		
South-East	395	12	407	3.7
Ngwaketse	3028	151	3179	29.0
Barolong	2791	20	2811	26
Kweneng-East	3332	74	3406	31
Gantsi	1002	146	1148	10.4
Total	**10548**	**403**	**10951**	**100**

Source: (Statistics Botswana, 2015: 37)

Lobatse houses the Botswana Meat Commission (BMC), established in 1966 when Botswana gained independence from Britain. It is a public-owned organisation under the Ministry of Agriculture and Food Safety. The BMC is responsible for the coordination of beef production activities in Botswana through the sourcing of cattle from beef production farmers around Botswana, processing and exporting beef and its products to domestic and European Union (EU) markets, and is the major buyer of beef in Botswana (Botswana Ministry of Local Government, 2003:23). In addition, under the MOA in Lobatse, the Department of Animal Health and Production, a body mandated to reduce the country's dependence on livestock imports by making the subsector competitive. This department transfers technological skills to farmers in animal science, thereby creating job opportunities and lucrative livestock production. It also advises farmers on techniques for improving livestock production, such as breeding, nutrition, and housing, and assists farmers in upgrading their technological applications and farm management

skills. Additionally, the Department of Animal Health and Production assists subsistence farmers in transforming their operations to commercial levels. Through these departments, the Ministry of Agricultural Development and Food Security introduced a system called the Botswana Animal Information and Traceability System (BAITS), an ear-tagging system intended to record and store information about cattle. According to Boy (2013:7), the system has proven problematic because of inconsistencies in record-keeping. Some farmers have also reported difficulties in implementing the system because of internet connectivity, as the system is web-based.

Based in Lobatse is The Meat Industry Training Institute (MITI) formerly the Meat Inspection Training Centre (MITC). It is the only institution in the Southern Hemisphere that offers training in meat inspection and technology at the certificate level (Aganga, 2015). It was established in 1984 by the FAO, Rome, and Botswana governments to provide meat inspection training courses to livestock technicians in Botswana and other developing countries (Aganga, 2015). In 1991, MITI was handed over to the Botswana government under the Department of Veterinary Services and renamed the Meat Inspection Training Centre (MITC) by FAO (Aganga, 2015). In April 2012, the institute moved once again from the Veterinary Services Department to the Botswana College of Agriculture (BCA) (now Botswana University of Agriculture and Natural Resources) and adopted the name of the Meat Industry Training Institute (Botswana University of Agriculture and Natural Resources, 2022). The move was intended to improve the academic profile of the university (Botswana University of Agriculture and Natural Resources, 2022).

BUAN University is a public university operating under the Ministry of Agricultural Development and Food Technology. It is responsible for generating sustainable agricultural technologies through research, dissemination, and advisory services to farmers and other stakeholders to improve agricultural productivity.

MITI, a business centre under BUAN, has graduated with over 1 900 students from over 45 African countries and the European Union in the Certificate of Meat Inspection (Botswana University of Agriculture and Natural Resources, 2022) since its inception. The department envisions becoming a centre of excellence in meat industry training in Africa through the provision of research and training. It offers an intensive Certificate in Meat Inspection programme and has since submitted

other diploma-level programmes to the Botswana Qualitative Authority, awaiting accreditation. Among other departments forming part of the centre is the MITI Library (Refer to Section 1.2.3).

1.2.1. The Botswana University of Agriculture and Natural Resources (BUAN)

BUAN is a public university established by the Botswana government at Botswana College of Agriculture. It became a university in 2016 through the Act of Parliament 12 of 2015, under the Ministry of Agricultural Development and Food Security (Botswana University of Agriculture and Natural Resources, 2022). The decision was to befit and align with the university's strategic vision of 2009-2016, that of becoming an agricultural university.

The university is responsible for providing education and training in agricultural science and related subjects. BUAN has also been mandated to generate sustainable technologies through research and to provide farmers and other stakeholders with advisory services to improve agricultural productivity (Government of Botswana 2022).

The university enrols an average of 500 students annually (Botswana University of Agriculture and Natural Resources 2022), with a current student population of 1148. Currently, 407 staff members comprise the academic and support portfolios. Overall, the university comprises six faculty members (Botswana University of Agriculture and Natural Resources, 2022). The six faculty members of BUAN and the departments of each faculty member are listed in Table 2.

Table 2: BUAN Faculties and Departments

Faculties	Departments
Faculty of Agriculture	1. Agricultural and Biosystems Engineering (ABE) 2. Crop and Soil Sciences (CSS) 3. Food Science and Technology
Faculty of Sciences	1. Biological Sciences (BS) 2. Biometry and Mathematics (BM) 3. Physical and Chemical Sciences (PCS)
Faculty of Natural Resources	1. Land and Atmospheric Resources (LAR) 2. Range and Forest Resources (RFR) 3. Wildlife and Aquatic Resources (WAR)
Faculty of Animal and Veterinary Services	1. Animal Science and Production 2. Meat Industry Training Institute (MITI) 3. Veterinary Science

Faculty of Agri-Business, Education, and Extension	1. Agricultural Extension and Development 2. Applied Economics 3. Agricultural Education
Faculty of Graduate Studies and Research	1. Mathematics and Research 2. Graduate Studies

Source: Botswana University of Agriculture and Natural Resources (2022)

1.2.2 The Botswana University of Agriculture and Natural Resources (BUAN) libraries

BUAN libraries help spread the use and understanding of IT services and serve as primary contacts for stakeholders and customers, a strong appreciation for whom is reflected in the library's values (Botswana University of Agriculture and Natural Resources, 2022). The library envisions a world-class information provider. The libraries are comprised of four units: management, technical services, systems services, and client services. The libraries are spread over two wings of the Gaborone Campus (where the main BUAN campus is based) and MITI Business Centre in Lobatse. The BUAN Library Sebele campus was established in 1967, when the university was first established as a college of agriculture, whereas the MITI Business Centre in Lobatse was established in 1984 (Botswana University of Agriculture and Natural Resources, 2022).

The library envisions itself as a world-class service provider that contributes to universities'scholarship activities. Libraries serve university faculties with resources suitable for their needs by providing them with information resources, conducive study environments, and information literacy programmes. The MITI business centre library is managed by the client services unit at the main campus and is manned by one assistant librarian and one library officer seconded to the centre. Table 3 lists BUAN library units and their respective responsibilities. It also presents the library staff from various units and their positions in the units.

Table 3: Library units, staffing, and responsibilities

Unit	Responsibilities	Library Professionals Staff Complement
Management	– Overall, the Library department directorship	1 Director Library Services

	– Strategic planning, organisation, and general overseer of library management	
Client Services	– Promotion and provision of visibility, accessibility & use of library resources and spaces – Circulation activities management – Marketing and promotion of library services – Farming community outreach programmes – User needs assessments – Information literacy programme	1 Librarian/Manager 4 Assistant Librarians (1 seconded to MITI Library) 2 Library Officers (1 seconded to MITI Library)
Technical Services	– To plan, direct, and manage functional areas of Special Collections, Periodicals, Acquisitions, and Cataloguing – To ensure the existence of clear policies and procedures in the functional areas above – Library budget management – Library staff training and development	1 Librarian/Manager 2 Assistant Librarians 5 Library Officers
Systems Services	– Ensure smooth running of library IT and ICT infrastructures – IT and ICT support and training of library staff and patrons – Development of library systems	-1 Librarian/Manager -1 Assistant Librarian -1 Library Officer
TOTAL		19

1.2.3 Botswana University of Agriculture and Natural Resources (BUAN) Library in Lobatse

The BUAN Library resides within BUAN University and has been mandated to promote higher education and training in agriculture and natural resources through innovative teaching and research (Botswana University of Agriculture and Natural Resources, 2022). This places the BUAN Library under immense pressure to be creative and innovative in promoting high-level use of IT among its learners, staff, and external customers. To achieve this, the BUAN Library is

tasked with establishing an environment conducive to studying and learning, and promoting lifelong learning among its customers.

It is also within the mandate of the BUAN Library to contribute to the advancement of the university's scholarship activities, as it plays a critical role in the achievement of Botswana's Vision 2036 in aspects related to agriculture and in the achievement of the vision mentioned above (Government of Botswana 2016). To this end, the library is committed to maintaining continuous engagement with customers through continuous consultation, feedback, and improvement of service delivery. This is likely to help the library fulfil its critical role in promoting research and innovation to develop relevant technologies and promote their adoption in whatever context they may be required.

Therefore, this study seeks to establish the significant role played by the BUAN Library in the use of IT by beef production farmers to help curb the expenses incurred in accessing and using IT tools. This research is in line with the observations of (Opara (2010:3), who sought to analyse the biographical factors that influence information technology adoption in their attempts to improve and advance beef production. The study also seeks to analyse socio-economic factors, including education, income, and age, as suggested by Krone and Dannenberg (2018:66).

The development and adoption of libraries in Botswana dates back to the colonial government era, when they were aimed at supplying and encouraging recreational reading, a role assigned to the Botswana National Library Service (BNLS)(Brothers, 1991:72). The first private library was established in Lobatse in 1956, followed by the establishment of public libraries in Kanye and Mochudi villages in the early 1960s (Brothers, 1991:72-73). In 1963, a prominent library was built on the grounds of the community centre in Serowe by American university students serving as part of Operation Crossroads. Lobatse, the capital of the then-Bechuanaland Protectorate, can therefore be considered the birthplace of librarianship in Botswana (Brothers, 1991:75).

The scope of library services has since expanded to include the educational and developmental requirements of the country, despite the many challenges emanating from the inclusion of IT in this area and the changing needs of customers across various types of libraries (Brothers, 1991:70). In addition, special libraries continued to be erected in various places, including the Teacher

Training Colleges in Serowe and Kanye villages in the Government Geological Surveys and Department of Education, respectively (Brothers, 1991:71).

To the many sectors and individual participants who lack access to or knowledge of how to use IT, the library has served as a central point of interaction and as a critical role player in how they adopt IT. Farmers engaged in beef production and moving to more IT-centric operations have been critical beneficiaries in this context (Krone & Dannenberg, 2018:65–81).

The library faces the challenge of demonstrating its importance to national socioeconomic development and successfully sustaining its social status. This gives rise to the need to investigate its role in helping beef production farmers, particularly by adopting and using IT to enhance beef production (McHombu & Beukes-Amiss, 2015:120). Libraries should not lose their focus on the services and tasks they have been providing (and should continue to provide), which includes scholarly information, collection development, classification and indexing services, and user services. However, technological changes have also brought about a shift in the execution of these roles from the librarian's perspective, and such changes may continue as long as the technology calls for them.

These changes may require the library to adopt new strategies and become a central place where farmers are assured of the expertise, skills, availability of information, and packaging of technologies and services appropriate to their desired execution and context. The librarian can act as an information mediator (organiser of information from different sources and quality assurance of the same), information expert (providing dependable information to help beef production farmers obtain better results), and information manager (packaging and documentation to ensure availability when recalled). This study sought to establish how beef production farmers use documented information to improve their livestock production, both in the context of Botswana and in the manner that the SADC region can adopt.

The use of IT has proliferated over the years in Botswana, with such use mainly consisting of accessing the internet to address various needs, including those of the agricultural sector. According to Statistics Botswana (2020:4), Internet connections (mobile or fixed) grew from 2 106 985 to 2 144 247 between quarters 2 and 3 of 2020, most of which were mobile Internet subscriptions. While no information is documented on how beef production farmers, in particular,

use IT to achieve their business goals, it seems likely that these figures reflect the increased use of the internet to enhance business transactions or production output. This indicates that mobile telephone usage is widespread.

1.3 Statement of the research problem

The use of information technology in libraries by beef production farmers in Africa and other developing countries has been the focus of several studies in recent years (Thornton, 2010; Kiambi, 2018; Vidanapthirana, 2019; Mdoda & Mdiya, 2022). These studies highlight the potential benefits of information technology in enhancing the productivity and profitability of beef production farms, including access to relevant information on market prices, best practices, and disease management.

However, there is still a significant research gap in understanding the barriers and challenges that prevent beef production farmers in Africa and other developing countries from fully utilising information technology at the library (Khapayi & Celliers, 2016; Abu Hatab, Cavinato & Lagerkvist, 2019; Zerssa et al., 2021). For instance, factors such as lack of access to reliable electricity (Paris et al., 2022), poor Internet connectivity (Janc, Czapiewski & Wójcik, 2019), and low levels of digital literacy among farmers (Smidt & Jokonya, 2022) may limit the uptake of information technology at the library.

Additionally, there is a need to explore the specific information needs and preferences of beef production farmers in Africa to inform the library's design and delivery of information technology services. This could involve conducting surveys, focus groups, or interviews to gain insights into the information-seeking behaviour of farmers and their preferred modes of accessing information.

In Botswana, where the study is being conducted, three-quarters of the landmass is under livestock, the most important agricultural resource, accounting for 80% of the agricultural value added. Annually, approximately 350 000 head of cattle heads are reared, and they contribute significantly to the country's economy by offering approximately 50% of their output to BMC for processing (Botswana Agricultural Census Report 2015; Statistics Botswana, 2015:21-25).

Despite the importance of the beef industry in Botswana to the country's economy, it has stagnated over time and is facing challenges that threaten its sustainability. Consequently, its overall contribution to the economy has decreased (Syed, Canales Gomez & Mataruka, 2022). First, structural changes in the 1990s resulted in a decline in the beef export market of the BMC, followed by a decline in cattle population since 2004 (Stevens & Kennan, 2005). The commercial subsector continues to contract, resulting in lower slaughter cattle sales and beef exports, paving the way for much-needed intervention(Seleka & Kebakile, 2016:76). The BMC has consistently failed to meet European Union requirements since 2008, which Boy (2013:7–9) attributes to possible low numbers of cattle produced, poor rainfall, and lack of technology utilisation. The Botswana beef industry has declined over the years, affecting its contribution to the economy and reducing beef cattle export (Keyser et al., 2013:8-10). While many factors contributed to these decreases, Aina (2006:5) attributed the decline to farmers receiving insufficient information.

Accordingly Seleka and Kebakile (2016:76-77), efforts to promote livestock and beef production should be maintained. He claims that the lack of diversity in the agriculture sector among small-scale farmers can be attributed to low productivity and technology transfer to farmers, while Adeniyi and Ojo (2015:10-11) claim that "communities, where academic libraries are established, are meant to be positively impacted by the influence of libraries." Although they appear to have been catering primarily to their academic communities alone, their presence has not been noticeable in towns or local communities in which universities are located. According to Jain and Mutula (2001:235), the issue of IT diffusion in Botswana, particularly in cattle production, has not been extensively studied, and the available literature is confined to descriptions of the situation concerning the lack of information policy, infrastructure, and relevant skills for the use of IT.

Among the various players in the agricultural industry, it is critical to investigate the library's role in providing information to farmers on beef production, with a particular focus on the BUAN Library in Lobatse. The assumption is that by failing to reach out to its community, the BUAN Library does not contribute to the development of beef production. Given these challenges, beef production farmers' use of information technology by beef production farmers in Lobatse, Botswana, is unknown. This challenges the productivity and profitability of beef production farms, and hinders the growth and development of the region's agricultural sector.

1.4 Aims and objectives of the study

The main aim of this study is to investigate the use of information technology by beef production farmers in Lobatse, Botswana.

1.5 Specific Objectives

The specific objectives of this study were as follows:

1.4.1 To assess the level of access to information technology resources (e.g. computers, internet, and databases) for beef production farmers.

1.4.2 To determine the extent to which beef production farmers in Lobatse, Botswana utilise information technology resources and identify factors that facilitate or hinder the use of information technology by beef production farmers in Lobatse, Botswana.

1.4.3 To explore the information needs and preferences of beef production farmers in Lobatse and Botswana and their perceptions of the usefulness and relevance of information technology

1.4.4 To provide recommendations for improving the use of information technology by beef production farmers in Lobatse, Botswana to enhance the productivity and profitability of beef production farms and promote the growth and development of the agricultural sector in the region.

1.6 Significance of the study

This study allows researchers to define its importance and how it may benefit and contribute to an audience. Studies are different, and therefore, should conform to the standards set for them (Kothari, 2004:5–7). This study on the use of information technology by beef production farmers in Lobatse, Botswana, has significant implications for beef production and agricultural sectors in the region. This study could help to identify gaps and barriers in accessing relevant and timely information on best practices, market prices, and disease management. Doing so could inform the development of targeted interventions and resources that address the needs and preferences of beef production farmers in Lobatse, Botswana and enhance their productivity and profitability. This study could help improve the digital literacy skills of beef production farmers in Lobatse,

Botswana by identifying areas where further training or support is needed. This could enhance the capacity of beef production farmers to use information technology and other digital platforms, thus facilitating their access to relevant information and improving their decision-making. This study contributes to the growth and development of the agricultural sector in the region by identifying ways to enhance the use of information technology by beef production farmers in Lobatse, Botswana. This could increase the competitiveness and profitability of beef production farms, and lead to overall economic growth and development in the region. This study could provide evidence-based recommendations for policymakers and stakeholders on the better allocation of resources and investments in information technology infrastructure, services, and other similar facilities. This information could inform decisions to improve the provision of information and services to beef production farmers in Lobatse, Botswana, and other regions. Overall, this study on the use of information technology by beef production farmers in Lobatse, Botswana, has significant implications for the beef production industry, agricultural sector, and overall economic development of the region.

1.7 Limitations and delimitations of the study

Limitations include the design or research method characteristics that influence the understanding of the research findings and should be communicated in a research paper (Kumar, 2018:273). Beef production in Botswana is a large industry spanning several districts. Owing to time and financial constraints, the study's sample size was limited to Lobatse. The findings of this study may not represent a broader population of beef production farmers in Botswana and other countries in similar contexts. This study relied on self-reported data, which may have been biased or subject to recall errors. The study's findings are limited by technological infrastructure, such as internet speed, availability of databases and software, and hardware limitations.

Delimitations address the boundaries of a piece of research, as well as how that research may be narrowed in scope so that it is better managed and made relevant to what the researcher is aspiring to prove (Kornuta & Germaine, 2019:31). This study focuses on beef production farmers in Lobatse, Botswana, thus limiting its generalisability to other regions within the country or other countries in different contexts. This study focused on a particular timeframe, limiting its ability to capture changes and trends over time. This study focused on a specific methodology, such as

surveys and interviews, thereby limiting its ability to capture multiple perspectives and diverse data sources. Language barriers limited the study because most farmers were proficient in Setswana, and English language use could have affected the accuracy and quality of the data collected. The selection of data collection tools was thorough so that the data collected would mirror the trend in the whole country.

1.8 Structure of dissertation

This dissertation is divided into five chapters. Chapter one presents the introduction, statement of the research problem, aims and objectives of the study, significance of the study, limitations, and delimitations, followed by a summary.

Chapter two presents the theoretical framework and literature review related to this research. This study discusses the theoretical framework of this study, which is the technology acceptance model. This chapter also reviews the literature on the themes derived from the research objectives.

Chapter three presents the research design and methodology. It presents the research paradigm adopted for the study: the pragmatic paradigm, research approach, and research methods. In addition, data collection discusses the reliability and validity of the study, data analysis, and ethical considerations and concludes with a chapter summary.

Chapter Four presents the findings of the study derived from both quantitative and qualitative data under the following themes: assessing the level of access to information technology resources for beef production farmers; utilisation of information technology resources by beef production farmers in Lobatse; factors facilitating or hindering the use of information technology by beef production farmers in Lobatse, Botswana; exploring information needs and preferences of beef production farmers in Lobatse and Botswana; perceptions of the usefulness and relevance of information technology among beef production farmers; recommendations for improving the use of information technology by beef production farmers in Lobatse, Botswana; and enhancing productivity and profitability of beef production farms through information technology.

Chapter Five presents the interpretation, recommendations, and conclusions based on the findings of the study. References and appendices follow the conclusion.

1.9 Summary of the Chapter

The introduction chapter serves as the foundation for the study of the use of information technology by beef production farmers in Lobatse, Botswana. This chapter begins by introducing the research topic and providing background information on Lobatse Town and the history of cattle production in Botswana. This chapter also provides an overview of BUAN, an agricultural and natural resource university, and the contribution of its libraries to the agricultural activities in Lobatse. This establishes the context for understanding the potential role of information technology services in supporting the information needs of beef production farmers in Lobatse. The research problem statement is also presented in the introduction, highlighting the challenges of limited access to reliable and timely information for beef production farmers in developing countries, such as Botswana. The aims and objectives of the study are then outlined, which are to examine the use of information technology by beef production farmers in Lobatse, Botswana, and to explore the role of library-based IT services in enabling access to information, training, and support for using IT services and opportunities for collaboration and networking. This chapter also discusses the significance of the study, which provides insights into the potential of IT services to promote digital literacy and enhance the productivity of beef production farmers in Lobatse and Botswana. Additionally, this chapter highlights the study's limitations and delimitations, including its scope and potential biases or limitations in data collection and analysis. The introduction chapter provides a comprehensive overview of the study and sets the stage for understanding the theoretical framework and literature review presented in chapter two.

CHAPTER 2

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Introduction

This chapter presents the theoretical framework used to guide the research process and the model. It then presents a review of the literature from various scholarly sources under the following themes relevant to this study: Studying and reviewing the existing literature is essential to better understand the research topic. A literature review allows researchers to address these gaps and provide recommendations for future research. According to Kumar (2018:374), literature review is an integral part of the research process and makes a valuable contribution to almost every operational step. The literature review enhances and consolidates knowledge based on the subject area and helps contextualise the existing body of knowledge. A literature review is often understood to extract ideas from other people's works by summarising and studying them. Furthermore, new theories and ideas can be developed based on evidence and new research suggestions (Bolderston, 2008:86). Various studies have assessed the adoption and use of technology across business areas, including agriculture. However, not necessarily from the library's viewpoint, there is room for further research, as new technologies are being developed daily to address the needs of an economy driven by knowledge within the library.

Technology adoption is multifaceted and can be influenced by various factors, such as the ease of use of the technology to be adopted, and social and economic factors (Morris & Archer, 2007). Gagoitsiwe and Keba (2020:258) state that "technology adoption is a complex, inherently social, and developmental process; therefore, psychological factors must be adopted."

2.2 Theoretical framework

A theoretical framework is defined as a structure that can hold or support the theory behind a research study, making it possible to support future studies while also identifying areas that have not been previously defined. It defines key concepts in research and proposes relationships between them while discussing relevant theories based on a literature review (Ngulube, Mathipa & Gumbo, 2015: 44). A theoretical framework served as the foundation for this study. This provides a roadmap for future research. It is a crucial component of research, as it helps organise

and clarify research questions, hypotheses, and methods. Theoretical frameworks are often used in quantitative research to provide a structure for developing a research design, data collection, and analysis. The theoretical framework comprises of key concepts and their relationships. It provides a set of assumptions, concepts, and propositions that help to explain the phenomena under study. The framework also helps identify gaps in knowledge and areas for future research. Theoretical frameworks can be based on a single theory or on multiple theories.

A theoretical framework is typically used when a study is based on single theory. In contrast, when a study is based on multiple theories, a conceptual framework is used to integrate and organise these theories. The choice of theoretical framework depends on the research questions, hypotheses, and specific context of the study. Theories on IT adoption and use are often drawn from social science disciplines such as psychology, sociology, and communication studies. These theories provide a lens through which to view the behaviour of individuals and organisations concerning the adoption and use of technology.

In summary, the theoretical framework supports this study's theory. It defines key concepts, proposes relationships between them, and discusses relevant theories based on a literature review. It is crucial to guide the research design, data collection, and analysis. The theories used in the study of IT adoption and use provide a valuable framework for understanding the factors that influence acceptance and use of technology. Studies on the adoption and use of IT have used various theories to explore the use and acceptance of technology because technology is of no value unless it is accepted and used (Oye, Iahad & Rabin, 2011:22–24).

2.2.1 The Technology Acceptance Model

This study is supported by the Technology Acceptance Model (TAM) theory. This theory originates from the theory of reasoned action (TRA), (Muk & Chung, 2015:2-3). This is a widely used theoretical framework in the study of acceptance and use of technology. The TAM posits that perceived usefulness (PU) and perceived ease of use (PEOU) are critical determinants of users' attitudes towards using technology, affecting their intention to use the technology. PU refers to the extent to which a user perceives the technology as helpful in achieving their goals, whereas PEOU refers to the extent to which a user perceives the technology as easy to use. TAM has been used in various contexts, including education and business. Its applicability across different contexts is

because of its ability to capture the key factors influencing technology adoption and use, including users' beliefs, attitudes, and perceptions.

In the context of this dissertation, the use of TAM as a theoretical framework suggests that this study focuses on understanding the factors that influence acceptance and use of technology by beef production farmers. This study sought to examine the perceived usefulness and ease of use of technology in beef production farming, and how these factors influence farmers' attitudes and intentions to use technology. Overall, using the TAM as a theoretical framework highlights the importance of understanding user perceptions and attitudes towards technology to promote its adoption and use in various contexts.

TAM defines a user's motivation: first, by how they perceive usefulness; second, by how they perceive ease of use; and finally, by their attitude towards using a technology (Taherdoost, 2018:962). It also considers the psychological factors affecting technology acceptance, as mentioned by Gagoitsiwe and Keba (2020:258-260). Further studies in this model include other factors such as social influence, attitude, and perceived economic well-being (Verma & Sinha, 2018:212-213). Subsections 2.2.1.1 to 2.2.1.3 discusses the constructs of the Technology Acceptance Model and how the current study intends to adopt them.

2.2.1.1 Perceived Usefulness (PU)

Perceived usefulness (PU) is the extent to which a person believes that using a particular system enhances performance (Verma & Sinha, 2018:213). Perceived Usefulness (PU) is a critical factor influencing beef production farmers' use of information technology (IT) in Lobatse, Botswana. PU refers to the degree to which a person believes that using a particular technology enhances job performance or productivity. In this study, PU is related to the perceived usefulness of IT services in enabling access to information on best practices, market prices and trends, disease management, and other relevant information. If beef production farmers perceive that IT services help to facilitate their work, they are more likely to adopt and use them. Factors such as ease of use, perceived benefits, compatibility with existing work practices, and the availability of support and training can influence PU. If beef production farmers find IT services easy to use, compatible with their work practices, and perceive that they may benefit from using them, they may be more likely to incorporate them into their daily work routine. According to Davis (2022:323), "the Technology

Acceptance Model predicts the use and acceptance of information systems and technology by individual users". TAM has been widely researched and tested in various investigations and IT model acceptance frameworks. Therefore, it is regarded as a test for IT's usefulness and ease of use in many environments in relation to user behavior towards IT use (Davis,2022:319) Davis 2022:319-320) defines perceived usefulness as "the potential user's subjective probability that using a specific application system enhances their live performance."

A study by Adrian, Norwood, and Mark (2005:266-267) revealed that PU is directly influenced by perceived ease of use; farmers indicated that if the technology was sound, they were prepared to use it. Upon this realisation, the same study proposed a framework within which PU is considered to have a positive outcome on Perceived ease of use and is seen to have a positive outcome on the PU of ICTs. The main objective of the study was to identify barriers to ICT implementation in agricultural extensions in the region of Greater Surakarta, Indonesia. The study's general conclusion emphasised that acceptance of the use of technology is determined by the perceived positive outcome emerging from possible interactions with those already using the technology and positive outcomes emerging from experts' advice in the call for the adoption of any given technology.

The same study concluded that PU affected the intention to adopt precision agriculture technologies. In addition, adoption was also influenced by the perceived net profit derived from the adoption and utilisation of such technologies. In the study, PU is linked to the perceived benefit or profit from technology use in agriculture. According to the study, farmers who participated believed that if they adopted precision agriculture technologies, they could work on a large portion of their farms with minimal workforce, but increased harvest at the end of the day.

Another study titled Acceptance of Artificial Intelligence in German Agriculture: An Application of Technology Acceptance Model and the Theory of Planned Behaviour Mohr and Kühl 2021:1822-1824) indicated that PU affected technology acceptance and adoption, sharing the same sentiments with the first study. Additionally, the study revealed that acceptance makes it easy for farmers to explore innovative ways to improve agriculture through artificial intelligence. However, there are few application-ready systems, which are potential areas for the exploration and

promotion of technological use among farmers. Another area for consideration in future studies is correcting methodological errors such as operationalisation failures or comprehensibility errors.

The general conclusion (informed by questionnaires administered to farmers) derived from these studies was that PU is the best tool for accomplishing tasks easily and quickly, thereby improving productivity.

Understanding the link between PU and IT services is critical to understanding the factors that influence the adoption and effective use of IT services by beef production farmers in Lobatse and Botswana. This study explores farmers' perceptions of the usefulness of IT services and identifies factors that may affect their perceptions of usefulness. This understanding can inform strategies to improve the design and delivery of IT services, and enhance farmers' perceptions of their usefulness.

2.2.1.2 **Perceived ease of use**

Perceived ease of use can be considered the most critical construct of the TAM and a predominant determinant of intention to adopt (Verma & Sinha, 2018:213), establishing how farmers assume that adopting a given technology makes their engagement effortless yet with satisfactory results. Perceived ease of use (PEOU) is another critical factor influencing the use of information technology (IT) by beef farmers in Lobatse, Botswana. PEOU refers to the degree to which a person believes that using a particular technology is effortless. In the context of this study, PEOU relates to the ease with which beef production farmers can access and use IT services. If beef production farmers perceive that IT services are easy to use and free of effort, they are more likely to adopt and use them. Various factors, such as user interface design, ease of navigation, and the availability of clear instructions and guidance can influence PEOU. If beef production farmers find that IT services are easy to navigate and use, they are more likely to use them and incorporate them into their daily work routines.

In their study on “Barriers to acceptance of information and communication technology in agricultural extension in Indonesia” by Purnomo and Kusnandar (2019:513-515), it was reported that perceived ease of use directly influences perceived intention to use and identified barriers in the form of lack of availability (computers and expensive internet connection as well as lack of

human resources to guide extension of ICTs) as one of the key deciding factors for perceived ease of use.

Similarly, Adrian, Norwood, and Mark (2005:260) indicated that perceived ease of use affected the perceived usefulness of technologies and the intention to adopt technologies based on precision agriculture discussed in the study. The same view is shared by Purnomo and Kusnandar (2019:514–515) who state that intentions are usually tied to technical and human resources availability and emphasise that perceived usefulness is also attributed to individual attitudes of confidence towards learning and using agriculture technologies.

Therefore, understanding the link between PEOU and IT services is critical to understanding the factors influencing the adoption and effective use of IT services by beef production farmers in Lobatse and Botswana. This study explored farmers' perceptions regarding the ease of use of IT services and identified factors that may affect their perceptions of ease of use. This understanding can inform strategies to improve the design and delivery of IT services and enhance farmers' perceptions of their ease of use. In the current study, the researcher sought to determine the perceived ease of use by asking farmers questions to determine whether they perceived that the technologies would be easy to use, understand, or interact with.

2.2.1.3 **Attitude towards the use of a technology**

Social, cultural, and political factors influence perceived usefulness and ease of use through language and skills, and influence conditions to facilitate a system (Davis 2022:320). TAM also assumes that when individuals recognise that technology makes their tasks easier to perform, the probability that they may use it and accept it as valuable increases (Ajibade, 2018:3-4).

A study to establish producers' perceptions and attitudes towards precision agriculture technologies established that a producer with confidence and the ability to learn and use technology would find the technology more accessible than someone who is not as confident. This confidence ultimately influences the perception of usefulness derived from how well someone is confident in using it, as emphasised by Compeau and Higgins (1995), Igbaria and Iivari (1995), and Venkatesh (2000), who believe that a perception equally influences intentions to adopt IT. It

is clear from this study that farmers' attitudes towards precision agriculture technologies showed a greater propensity to adopt precision agriculture technologies.

TAM is considered appropriate for this study as it explores the influences on technology adoption by farmers through word-of-mouth or their possible interaction with staff at the BUAN Library. The theory forms a practical framework that should make it easier to investigate the role of staff in promoting technology adoption through informal and formal collaboration with farmers, propelled by the demonstrated value of adopting and using any given technology, regardless of the educational level of the farmer.

This study sought to determine the role of library-based IT services in enabling access to information for farmers dealing with beef production.

2.3 Role of library-based IT services in enabling access to information for farmers dealing with beef production

The role of library-based IT services in enabling farmers to access information is becoming increasingly essential in the complex agricultural industry. Beef production farmers need information to assist them in making informed decisions, and library-based IT services can help fulfil this need. Library-based IT services enable farmers to access information about beef production on best practices in beef production, market prices and trends, disease management, and other relevant topics (Smith, Gotoh & Greenwood, 2018). Digital platforms and social media also facilitate information sharing among farmers and other stakeholders in the agricultural sector (Borrero & Mariscal, 2022). Library-based IT services promote digital literacy and skill development through training and support in digital tools for record-keeping, analysis, and decision making (Birner, Daum & Pray, 2021). Library-based IT services also encourage collaboration and networking among farmers, researchers, and extension workers (Fabregas et al., 2023). However, challenges such as limited access to IT infrastructure and resources, limited IT skills and knowledge among farmers, financial constraints, and concerns about digital security and privacy, may hinder the effective use of library-based IT services to enable access to information by beef production farmers.

2.3.1 Information access and dissemination

Library-based IT services are essential to provide beef farmers with access to information. These services include IT resources and infrastructure in the library, access to information on best practices for beef production, market prices and trends, and disease management. The dissemination of this information through digital platforms, including social media and other online resources, facilitates information-sharing among farmers and other stakeholders in the agricultural sector. By providing access to reliable and timely information, library-based IT services enable farmers to make informed decisions that can improve their beef production practices and enhance overall productivity.

In light of trends in other institutions, libraries have also adopted the use of social media technologies to access and disseminate information by offering marketing services, library awareness, reference services, collaboration, document delivery, information literacy, and research services, and the use of these technologies has allowed libraries to remain significant (O' Dell, 2010:246–248).

2.3.2 Digital literacy and skills development

Library-based IT services provide access to information and promote the development of digital literacy and skills among the farmers involved in beef production. These include training and support for library-based IT services, developing familiarity with digital platforms and resources, using digital tools for record keeping and analysis, and developing skills in using IT for decision-making. Understanding digital security and privacy is crucial to protect farmers' sensitive information and prevent potential cyber threats. By promoting digital literacy and skill development, library-based IT services equip farmers with tools and knowledge to effectively use digital resources for beef production practices.

Agricultural libraries should be able to support the community of users by creating a digital environment with tools and techniques that promote the sharing of resources between them, regardless of their location, as well as offering training in the use of tools and techniques (Pandey & Pandey, 2019).

2.3.3 Collaboration and networking

Library-based IT services promote collaboration and networking among farmers, researchers, and extension workers. Through library-based IT services, beef production farmers can collaborate and network with each other and other stakeholders in the agricultural sector. This facilitates knowledge exchange and learning and provides opportunities to share experiences, best practices, and innovative ideas. Collaboration between researchers and extension workers can facilitate the translation of the research findings into practical applications for beef production farmers. IT for virtual communication and collaboration further enhances these opportunities, allowing for real-time collaboration and communication regardless of geographical distance. Ultimately, collaboration and networking through library-based IT services could improve beef production practices and contribute to the overall development of the agricultural sector.

2.4 Information Technology (IT) adoption in support of agricultural production in the developing world and advanced economies

Many factors influence the adoption of technology in agriculture, and these vary from farm to farm, and even country to country, as such requirements increase daily, driven by global events, making them even more complex. From the perspective of developing countries, some of the factors that influence the adoption of technology are technological, economic, and institutional (Kariuki, Njoka, & Mbugua, 2015:210-211), whereas for developed countries such as the USA, adoption appears to be driven by the level of education and the size of the farm where such technologies are to be deployed. However, the adoption of the same has been low. This viewpoint is further supported by Kariuki et al. (2019:210), who stated that farmers with large farms are more likely to adopt technology to deploy in their different activities, where a portion of the farm is devoted to technology trials. Taking the example of a developing country such as Ethiopia, adoption is hindered by a lack of resources such as credit, land, and ineffective markets (Cafer & Rikoon, 2018:690).

In Tanzania, the agricultural beef sector accounts for approximately 27% of GDP and 67% of the population's employment sector. However, the sector does not bring in significant wealth creation and poverty eradication, mainly because of low technology adoption, lack of funding, and reluctance of farmers to use technologies because of the risks they believe they entail.

In the United States, IT in beef cattle production has been a critical contributor to safe, affordable, and wholesome production, leading to a wholesome and affordable supply of beef that has increased market profits. The technologies adopted by farmers include implants, antibiotics and vaccines. These technologies contribute to high investment returns (Hersom, Thrift & Yelich, 2011).

2.4.1 Economic or financial factors affecting Information Technology (IT) Adoption for agricultural production

From the perspective of developed countries, technology adoption has been slow, growing from 3.6% in 1984 to 11.7% in 1987. This could be attributed to the slow adoption rate caused by rapid IT changes, which may discourage farmers from investing. Coupled with these are the financial stress and farm information systems that do not necessarily meet farmers' needs. Recently, computer hardware and software costs have decreased, providing opportunities to increase their use in agricultural production. Bridging the Technology gap for farmers to encourage technology adoption among farmers, it is crucial to have collaboration between public and private sectors. This partnership should focus on developing user-friendly software, training programs, and information services tailored to farmers' needs. Recognising this need, is essential to evaluate the factors influencing technology adoption within this demographic.

Lekopanye and Meenakshi (2017:17-18) and Ntokwane and Dibeela (2016:2) agree that livestock production plays a critical role in the economic value of Botswana. Moreover, no IT policy has yet been formulated for Botswana. However, according to the Botswana Vision 2036 plan, the country has embarked on an IT diffusion or transfer strategy to make information a part and parcel of everyday activities that would improve its economic, social, and political situation. In this study, IT diffusion improved beef production, which is the information gap this study intended to investigate.

2.4.2 Institutional factors affecting Information Technology (IT) Adoption for agricultural production

The need for developing countries to adopt technologies for agricultural production cannot be ignored, primarily because most developing countries still rely on rainfall, which often leads to

food insecurity because rainfall alone has not been consistent over the years. For example, in Ethiopia, 85% of the population, like most African countries, relies on agriculture for their livelihood, calling for innovation and technology for sustained agricultural production and industrialisation (Cafer & Rikoon, 2018:688).

In developing countries, it is evident that farmers within the same social group tend to adopt agricultural technologies by learning from each other, as such groups enhance information exchange and technology adoption (Mwangi & Kariuki, 2015:212). There are training institutions in Ethiopia that promote agricultural production by conducting research and interventions for the communities they are in, and the Ministry of Agriculture is active in extension service participation (Cafer & Rikoon, 2018:690). A similar intervention or approach is also seen in Nigeria, where institutions and their libraries generate information or knowledge for agricultural extension workers, researchers, students, farmers, and policymakers in government (Aguolu, 2000: 115),

Notably, the cost of suitable technologies is high in developing countries. Therefore, measures should be implemented to suggest subsidies on prices and increased access to credit to promote technology adoption, thus calling for policymakers to improve credit systems for farmers and tiny farm owners (Mwangi & Kariuki, 2015:210).

At the core of technology adoption, information providers must be trained to offer suitable information to farmers and librarians must be continually trained in agricultural technologies to keep up with changes. Agricultural universities need to be funded so that they are not limited to sourcing the technologies necessary to assist farmers (Aguolu, 2000:115–116). Factors that hinder the adoption of technology, such as reduced government grants for technology adoption and the inability to package IT to suit farmers' and librarians' resistance to the application of IT in disseminating agricultural information, should be addressed for maximum adoption and an increase in intended outputs (Aguolu, 2000:115–119). It is paramount that librarians be trained to use, convert, and disseminate effective information to farmers for improved production, and focus should be placed on developing agricultural libraries to cater to students and farmers (Aguolu, 2000:115).

Locally, livestock production is considered a matter of national pride, the impact of which has been felt in European countries, where Botswana has proudly engaged in business transactions that have contributed to its GDP over the years (Pinielo, 2018).

Botswana's Vision 2036 pillar relative to agriculture is to develop a disease-free agricultural sector that optimises the use of land and other resources, uses technologies and modern farming methods to improve productivity, and encourages the expansion of private sector-led value chains in the sector, including production, processing, marketing, and distribution activities (Food and Agricultural Organisation, 2016; Government of Botswana, 2016). Lekopanye and Meenakshi (2017:17) revealed that IT technology improves livestock production, although they proposed that information systems must be more mobile-driven than computer-based systems.

IT has brought about encouraging changes with respect to how things are done, and many countries have endeavoured to acquire the latest technologies in various fields, such as artificial insemination and information communication, to improve farming. The Botswana government aspired to enhance food production in the agricultural sector by improving livestock breeding and management through technological support (Gagoitsiwe & Keba, 2020:258). Nonetheless, more research is needed because, according to the statistics reported earlier in this study, the decline in livestock production remains rampant.

2.4.3 Farm size as a factor affecting Information Technology (IT) adoption for agricultural production

Various studies have suggested socioeconomic traits such as farm type and size as possible factors influencing technology adoption. Similarly, farm size substantially affects technology adoption, with larger farms being more likely to adopt technology than smaller ones (Feder, Just & Zilberman, 1985:271). Results from a report that involved both traditional and commercial practices were that farm size was vital as it increased space where farmers could feed calves beyond weaning and thus increase production, and that together with capital and diversity in farm operations, farmers with larger farms were likely to adopt technologies; however, it is worth noting that precision farming is capital- and time-intensive, which may make it difficult for farmers with smaller farms to adopt IT (D'Souza, Cyphers & Phipps, 1993:163). Similarly, in their study titled "Producers' perceptions and attitudes towards precision agriculture technologies," it was reported

that agriculture technologies are costly and therefore unlikely to be adopted by farmers with small farm holdings compared to those with larger farms. According to the study, the level of education of farmers also played a role in their intention to adopt technologies, citing educated farmers who were likely to adopt technologies, as their perception of usefulness influenced the benefits tied to their adoption and use (Adrian, Norwood & 2005:261).

2.4.4 Education levels and Information Technology (IT) adoption for agricultural production

Various factors influence acceptance of technology. In most developed countries, where farmers are older, they are more likely to adopt technology because they have gained experience, making it very important to provide information about technologies useful for beef production, and such information should be reliable and consistent (Kariuki, Njoka & Mbugua, 2015:210). However, this is not the case in developing countries where technology adoption is attributed to irrelevant education. It is very important for developing countries to understand the factors that hamper technology adoption so that they plan and execute programs that promote technology adoption for general food production, including beef production (Kariuki, Njoka, & Mbugua, 2015:212).

2.4.5 Age and Information Technology (IT) adoption for agricultural production

There has been a long debate on the effect of farmer age on productivity in agricultural production processes via various channels, such as physical capital investment decisions and attitudes towards agricultural technology innovations. It has been argued that the aging of farmers causes a significant decline in productivity because, as farmers age, they become more conservative, lose physical capacity, and hesitate to adopt new technologies (Corner-Thomas et al., 2015). Rogers (2003) argued that some of these factors, especially operator age, are not usually determinants of innovation but that age influences the adoption of technologies. He further states that age is assumed to be negatively related to the adoption of technology and that younger farmers are more likely to use computers than older farmers, who may not be able to learn the skills necessary to enable them to adopt and use IT and other technologies for their potential returns. Studies have shown that younger farmers contribute significantly to economic performance and sustainability (Brennan et al., 2015; Brennan et al., 2016).

2.5 The importance of Information Technology in beef production

Information Technology (IT) can play an essential role in empowering farmers to improve their livelihoods. Important information regarding climatic conditions, droughts, floods, pests, and disease outbreaks can easily be predicted using IT. IT can significantly transform and improve beef production through information processing, exchanges, and management. IT also offers a solid opportunity to facilitate information flow, and the evolution of the IT era has provided opportunities for livestock farmers to use IT to improve their beef production practices (Kumar et al., 2017:9–11). FAO foresees a growth in the world population from the current 7 billion to 9.5 billion, and with this growth, beef consumption also grew by 18%. He further states that, because of this growth, the livestock industry is pressured to invest in IT to intensify productivity (Strydom, 2016:22–30).

Rolled out in Botswana in 2015, the Botswana Animal Information and Traceability System (BAITS) provided a centralised platform for farmers to assist them to manage their livestock information and track animal movement throughout the country (Ntokwane and Dibeela, 2016:6).

Generally, these technologies improve beef production efficiency. They provide weather forecasts; ease farm input, purchase, and pricing information; and expand the reach of extension services. Technology allows farmers to use mobile and internet banking and encourages timely payments for farm supplies (Hou, Huo, & Yin, 2018:389). Governments need to recognise the importance of IT in agriculture in general for rural development and to develop initiatives to improve IT use. Initiatives to improve IT use and adoption include, but are not limited to, increasing web-based storage of agricultural information, improving connections in rural communities, tailoring agricultural information services to recipients of information, and collaborations within relevant institutions (Pardamean et al., 2018).

2.5.1 Information Technology (IT) role in weather and climatic management in beef production

Weather and climatic conditions have had an impact on decreased fodder production from dry land and irrigated pastures, resulting in higher feed costs, decreased grain production, higher feed costs, decreased animal weight gain, decreased reproduction rate, lower feed conversion efficiencies, and

increased prevalence of vector-borne diseases and internal parasite infestation (Rust & Shafi, 2013:260). To determine their relationship, IT technologies have been instrumental in monitoring weather conditions using sensors that can capture factors, such as temperature and humidity (Rust & Shafi, 2019). Little is known about how Lobatse beef production farmers use and adopt sensors and other ICT tools to monitor and manage weather and climatic effects on beef production.

2.5.2 Information Technology (IT) and drought management in beef production

Beef producers can use technology to manage records, conduct DNA testing, monitor livestock, and provide cutting-edge information on animal well-being. IT technologies, such as Sense Hub Beef, analyse behaviour based on activity, rumination, eating, and other key cow stats, bringing a modern data-driven management approach to the beef cattle industry (Bedord, 2019). Sense HUb beef uses artificial insemination or naturally bred animals, and provides producers with cow reproduction and health management information to help them make better decisions.

2.5.3 Information Technology (IT) and pest management in beef production

Pests and disease attacks contribute to low production in agriculture; however, with the prediction of diseases caused by pests, farmers may be warned well in time and take necessary steps to safeguard their animals and control the spread of diseases. IT technologies can enable farmers to calculate, predict, and control pests on time using sensors such as fluorescence imagery and thermal and RGB sensors (Rust & Shafi, 2019:13).

2.5.4 IT and disease outbreaks control in beef production

Tickbone, foot, and mouth diseases have been prevalent in Africa over the years, and the Department of Veterinary Services in Botswana imposed a ban on beef movement and export due to a suspected outbreak of foot and mouth disease, with the possibility of over ten thousand cattle being put up for culling, a move that has affected beef cattle sales and dampened the country's economy (Mguni, 2022). In a review of strategies for overcoming beef production challenges in Tanzania," disease outbreaks were reported to also cause high mortality in beef cattle, with an annual estimated loss of a million animals, resulting in poor beef quality and, ultimately, economic loss (Iddy & Provenza, 2018).

2.6 Challenges faced by beef production farmers in using Information technology (IT)

Over the years, the agricultural sector has drawn controversy regarding the overuse of chemicals and genetic modifications, which have both negative and positive consequences. They believe that agriculture technologies often lead to knowledge marginalisation, which, in turn, leads to job dissatisfaction within the farm working population. However, it is anticipated that the use of IT in agriculture could result in highly skilled and better-performing jobs (Alhassan & Akudugu, 2020:13-14).

2.6.1 Cost of technology

The cost of this technology is relatively high, and it cannot be achieved by most farmers. This perspective is shared by Mogotlhwane, Khosrowshahi, and Underwood (2013:1055), who agree that costs prevent members of the public from using technology. In the Australian beef industry, issues surrounding the cost of technology have resulted in beef producers struggling to afford labor costs due to an increased need for qualified farm workers, calling for widespread adoption of technology for the efficient management of farms (Harrington, 2018:11-12), while Mwangi and Kariuki, (2015:210) believing that the cost of technology may result in resistance to technology adoption.

Other technological challenges include data collection, technological solution costs and various business models." The private sector and public institutions have responded by making a wide range of software, training, information services, and products available to farmers, although technology adoption has continued to lag (Putler & Zilberman, 1988:791-792).

2.6.2 Internet subscriptions

Harrington (2018) also stated that in Australia, significant cattle breeders are found in remote areas where Internet connectivity is accessed through satellites, and the speed is below average. This results in cloud-based technologies commonly utilised by most IT products (Harrington, 2018:25–26).

2.6.3 Network coverage

Farmers can use mobile phones to connect to markets, fill in information gaps, and make informed decisions. Most farmers currently focus on a few markets, resulting in market "floods", low prices, and deterioration of fresh produce, while some potential markets go untapped (Masuka et al., 2016:121).

However, network coverage remains a challenge. Mobile network coverage is relatively sparse and the connection speed is relatively slow, making it difficult to execute business transactions (Statistics Botswana, 2020: 39).

Masuka et al. (2016:121) examined mobile phone ownership, farming use, and the potential for transforming production and marketing in their 2015 survey of farmers in Zimbabwe's Svosve–Wenimbi District. Farmers use mobile phones to access advisory services, and high literacy and mobile phone ownership have been reported. Mobile phones are used to access market information regarding inputs and products, advisory services, weather data, transactional mobile money transfers, and insurance. Farmers use their mobile phones to make better decisions, while saving time and money. Given Botswana's network coverage, it is unknown whether beef production farmers use mobile phone coverage to improve their production, marketing, food security, and livelihoods. This study investigates this aspect as a part of this research.

2.6.4 Basic education and absorption of advanced technologies

Most farmers in Botswana have obtained, at best, primary education, and such farmers cannot easily absorb information packaged and transmitted to them, especially as this is usually presented in English. Most farmers also lack financial resources to acquire IT tools suitable for their farms (Mogotlhwane, Khosrowshahi & Underwood, 2013: 1055). Education is vital to enhance analytical and problem-solving skills. It is capable of changing attitudes and instilling knowledge in farmers. In Australia, northwest of Queensland, extension workers whose role is to support beef production farmers are given a car to travel to remote farms to equip them with knowledge, thereby enhancing their adoption of technologies and decision making (Harrington, 2018).

2.7 Contribution of libraries in supporting beef production farmers' access to Information Technology (IT) to support livestock production

Academic libraries, because of their versatility and position as trusted knowledge bases, should not only be seen as providing information services to their immediate clients, but also to the university communities they reside in. They can achieve this in many ways, such as by collaborating with public libraries working towards community building and by being proactive and innovative in doing things such as organising conferences, book fairs, and IT community programs alongside relevant stakeholders (Itsekor, Asaolu & Osinulu, 2015: 91). According to Aina(, 2006:3), community development is not just about working with the community in reaching their goals, but also about how the library works with the community and helps them understand how the library can aid them in reaching their goals. He describes libraries as agents of change that can easily connect communities with reliable sources to maximise their mandates.

Bringing the community together is also part of community development and represents a critical task for librarians. They must provide sound knowledge of the resources and be able to package the information accordingly. Therefore, it is necessary to possess the skills and expertise to expedite this process (Itsekor, Asaolu & Osinulu, 2015:83).

Odularu (2020:157–173) also agrees with Itsekor et al. (2015) in describing librarians as experts responsible for information dissemination and mandated providing communities within which they fall with digital information on areas, such as climate change, to support farmers. He also says that librarians must have the skills to effectively manage library products and resources, including overseeing websites, online data, marketing, and information systems, to effectively deliver library products and services. This is also in line with Chisita (2011), who reported that university libraries predominantly give access to educated communities within their enrolment and exclude communities within which they believe is going against the African renaissance of securing education and culture as a way of living. University libraries should be viewed as drivers of knowledge sharing and skill transfer. Libraries should repackage information using modern technology, such as integrating texts, graphics, and podcasts, to record or impart knowledge to rural communities (Chisita, 2011).

2.7.1 Role of libraries in organising conferences

Like public libraries, university libraries should engage communities through workshops and promote publishing in various forms for the back-and-forth sharing of experiences. Libraries of various types have been left behind in the adoption of service delivery technologies. They are evolving their role beyond being centres for academic purposes to centres that embrace any development agenda of the community they serve.

Libraries, in this view, have become community spaces for meeting and organising events of community interest, and their role in organising conferences has not been overlooked (Gayton, 2008). Libraries are essential to provide software (web) or hardware (video) for conferencing. They provide spaces and the environment (including equipment and connectivity) to facilitate conferencing needs expressed by library users in web conferencing (Isaac & Omame, 2020). Libraries continue to create spaces, defined as collaborative learning environments in which clients can gather to share materials and learn new skills. Libraries are becoming centres that incorporate support services (including conferencing) traditionally operated outside the library to support their role in conference organisations (Turner, Welch, & Reynolds, 2013). Little is known about the impact of book fairs on the lives of farmers who produce Botswana beef. This research can help to close this information gap.

2.7.2 Role of libraries in book fairs

Book fairs generate excitement among library customers and help libraries reach prominent communities. The participation of librarians at book fairs should not be underestimated because it provides opportunities for librarians to foster collaborative and diverse collections while also providing a mechanism for area studies specialists to grow professionally (Atwill & Hickey, 2003) and participation that helps improve efficiency, organisation, and harmony in collection development (Nongo, Sambe, & Adadu, 2021). However, little is known about the role of book fairs in beef production in Botswana. Have Botswana beef producers benefited from numerous book fairs held by librarians and information professionals? This study fills this gap in literature.

2.7.3 Role of libraries in Information Technology (IT) community programmes alongside relevant stakeholder

To remain relevant in this technological era, libraries should develop IT programmes through partnerships with stakeholders. These partnerships should include training library personnel entrusted with the mandate to make technology and services available to users (Krolak 2005, 2006). It is also interesting for libraries to use information technology and retain community reference points (Allen & Retzlaff, 1998).

Embracing libraries as community spaces, even with the emergence of information technology, has resulted in the concept of marketing spaces, in which technology is used to develop appropriate solutions specific to the communities within which they serve. Libraries should engage in digital literacy programs to facilitate and promote access to online information sources and services, and engage in transferable skills through continuous training (Martzoukou & Elliott, 2016). Librarians should also prioritise building more cooperation with communities to meet their fundamental needs (Caspe & Lopez, 2018).

2.8 Summary of the chapter

This chapter presents the theoretical framework used to guide the research process, research model, and literature review, based on themes from various scholarly articles. Research has been undertaken on farmers' adoption of IT using libraries to improve beef production, but little research has been undertaken in Botswana. This is a productive area for further research, and the information gathered would interest farmers and policymakers in Botswana. The most obvious departure from the literature review is that technology, if widely utilised, can enhance beef livestock production.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This section describes the methodology used in this study. All procedures were used to obtain answers to the research questions, including the research paradigm, population and sample size, data collection, and the tools used to collect the data. The reliability and validity of the study were presented, including pretesting of the data collection instruments. Data analysis was conducted, followed by ethical considerations, including approval from relevant institutions, informed consent, and confidentiality and anonymity clauses to ensure that integrity and honesty were maintained in the research. The chapter concludes with a summary.

The main objective of this study was to investigate the use of information technology by beef production farmers in Lobatse, Botswana. The critical questions to address this main objective are as follows.

1. To assess the level of access to information technology resources (e.g. computers, internet, and databases) for beef production farmers.
2. To determine the extent to which beef production farmers in Lobatse and Botswana utilise information technology resources:
3. To identify the factors that facilitate or hinder the use of information technology by beef production farmers in Lobatse and Botswana
4. To explore the information needs and preferences of beef production farmers in Lobatse and Botswana and their perceptions of the usefulness and relevance of information technology
5. To provide recommendations for improving the use of information technology by beef production farmers in Lobatse, Botswana to enhance the productivity and profitability of beef production farms and promote the growth and development of the agricultural sector in the region.

3.2 Research paradigm

A paradigm is a theoretical framework comprising fundamental beliefs that guide research conducted by a scientific community and influence how knowledge is studied and understood within a discipline. The choice of paradigm is usually influenced by the nature of reality and the knowledge to be studied by a researcher(Verma & Sinha, 2018:47).

The pragmatic paradigm is a research paradigm that emphasises the practical application of knowledge and focuses on real-world problem-solving. This paradigm views knowledge as being constructed through practical experience and action rather than being discovered through objective observation. In this paradigm, research is seen as a collaborative and iterative process between researchers and participants, emphasising practical solutions and applying research findings to real-world situations. The pragmatic paradigm is often used in fields such as education, social work, and business, in which the practical application of knowledge is a primary concern.

The paradigm lies in beliefs based on consequences, and humans shape their actions based on their experience. Pragmatists believe that reality changes at multiple turns of events and is therefore open to enquiry; because it forms a researcher's worldview, it can influence how they conduct research (Kaushik & Walsh, 2019:5–6).

This study was conducted using a pragmatic paradigm. This worldview focuses on what works rather than what might be considered valid or accurate, and helps guide research in which qualitative and quantitative data are collected. The paradigm lends itself to various research methods, and the study adopted a multimethod approach. This study is based on the belief that technology is available, but an investigative approach establishes what beef production farmers consider usable, and the basis upon which that usability is built. Coupled with this paradigm, the study considered the Technology Acceptance Model (TAM) as an appropriate theoretical framework.

3.3 Research approach

The multimethod research technique involves a combination of data capture from two or more data collection tools (Seawright, 2016:4).

A multimethod research technique involves the use of multiple methods and data sources to investigate a research question or problem. This research approach combines quantitative and qualitative methods to understand a phenomenon comprehensively. The multimethod research technique typically involves collecting data through various methods such as surveys, interviews, focus groups, observations, and document analysis. The data collected from these methods are then analysed and integrated to provide a more complete and nuanced understanding of the research problem. This approach can be instrumental in complex research problems, where no single method is sufficient to capture the entirety of the phenomenon being studied. Multimethod research can also provide greater validity and reliability by triangulating multiple data sources and reducing biases associated with a single method. However, this can also be time- and resource-intensive.

This study adopted a multimethod approach using qualitative and quantitative data collection methods. This study adopted a quantitative approach using questionnaires issued to beef production farmers to gather their opinions and perspectives on the use and adoption of IT, the use of the BUAN library to support them, and the challenges experienced in adopting these technologies. A qualitative approach was adopted using interviews administered to the library client service unit staff. Interviews were selected for this group because, compared to farmers, who are a larger group, the staff make up a smaller group and are therefore easier to interview (Kumar, 2018:182). The interviews sought to determine the extent to which Lobatse farmers used IT to support livestock production and to determine the contribution to the adoption of technology to improve livestock farming for Lobatse beef production farmers.

3.3.1 Questionnaires

A questionnaire is a commonly used research tool that consists of a set of questions to gather data from the respondents. The questions were designed to be simple so that they could be easily understood by the target population, considering their educational level. In cases where the respondents could not complete the questionnaire, the researcher read the questions and marked the necessary selections on the questionnaire on behalf of the respondents.

In this study, a questionnaire was used to collect data on the use of information technology by beef production farmers in Lobatse, Botswana. The questions were selected based on the technology

acceptance model, which aims to explain how and why individuals adopt or reject technology. To encourage honest and accurate responses, questionnaires were completed anonymously. This means that the respondents were not required to provide their names or personal identification information. This helped minimise any potential bias or influence that may have arisen if the respondents felt they were being identified. Overall, the questionnaire was a valuable tool for collecting data on the use of information technology by beef production farmers in Lobatse, Botswana.

3.3.1.1 Research instrument

A research instrument or tool is a method that is used to collect data from respondents for a particular study. The choice of research instrument depends on the research question and objectives, and the type of data required. The research instruments included surveys, questionnaires, interviews, focus groups, observations and experiments. Each instrument has advantages and limitations, and should be chosen based on the research aims and characteristics of the study population. Questionnaires were selected as the research instrument to collect data from beef production farmers in Lobatse, Botswana. This was done for several reasons, including convenience and cost-effectiveness, as stated by Kumar (2018:381).

The questionnaires used in this study were predetermined and were designed to align with the study objectives. The questions were straightforward, easy to understand, and offered respondents alternative answers. Additionally, multiple-choice questions were included to provide the participants with answer options.

The questionnaires were hand-delivered to the farmers and later retrieved to ensure anonymity. Using questionnaires as a research instrument allowed for the collection of quantitative data that could be easily analysed and compared to previous studies. Overall, the questionnaires used in this study were appropriate and effective in gathering data from the targeted population.

3.3.2 Interviews

Interviews are used in qualitative research because they offer opportunities to collect contextualised and individualised data from respondents (Frey, 2018). Interviews are a standard

method for collecting qualitative data, because they allow researchers to gather in-depth and nuanced information about a particular topic or population. By asking open-ended questions and engaging in dialogue with the interviewee, researchers can gain insight into the interviewee's perspectives, experiences, and attitudes. They collect data by gathering the information or opinions of a population by asking a series of questions in which dialogue exists between the interviewer and interviewee (Jupp, 2006).

In this study, the researchers interviewed BUAN Library Client Services staff using video conferencing. This approach allows researchers to collect data remotely, without requiring physical travel or in-person meetings. Scheduling the interviews allowed the researcher to ensure that the necessary staff members were available, and that the interviews could be conducted efficiently. The use of video-conferencing technology has also enabled researchers to capture nonverbal cues and visual information that might have been missed in purely audio-based interviews. Overall, the interviews in this study provided an opportunity to gather rich and detailed information about the use of information technology by beef production farmers in Lobatse, Botswana.

3.3.2.1 Research instrument

Interviews were conducted to collect data from BUAN library staff. The interviews were designed with open-ended questions to allow participants to provide qualitative information to inform them about the research. Semi-structured interviews were also conducted. Semi-structured interviews involve asking similar questions across participants, but not necessarily in the same order; the researcher asked individualised follow-up questions, not in the same order, giving respondents the liberty to provide open-ended responses (Frey, 2018). Consent forms were issued to be filled in and signed, and respondents provided consent before gathering data (Appendix B).

3.4 Population and sample size

Population refers to target groups of people, object events, or group members with similar characteristics on which research can be conducted (Kumar, 2018:378). This can include people, animals, organisations, or other entities with specific characteristics or traits. The population can be defined in various ways, such as age, gender, location, profession, behaviour, or any other

relevant criteria chosen by the researcher. This population is significant because it determines the scope and generalisability of research findings. The study population included beef production farmers in the Lobatse region, which lies in the southeast of the country. Three hundred ninety-five traditional beef cattle farms and 12 commercial farms (Statistics Botswana, 2015:37–63). The study population also included librarians from BUAN. Currently, there are 19 members of the library staff.

3.4.1 Sampling

Sampling is a technique in which a smaller group is formed from a larger group of respondents, representing the entire population. The subset or sample was then studied and analysed to determine a larger population. Sampling is a commonly used technique in research because it is often impractical or impossible to study an entire population, owing to logistical or financial constraints. Sampling aims to ensure that the sample is representative of the population, so that the findings can be generalised to a larger population with a reasonable degree of confidence. A smaller group represents a larger group for predicting unknown information regarding the larger group (Kumar, 2018:229–230).

For quantitative data collection, this study adopted a probability sampling technique in which the total population was divided into groups (strata) for samples to be selected from (stratum). A disproportionate allocation scheme was used. This allows researchers to choose varied sampling fractions according to the population size. The researcher opted for this scheme because of the varied differences in the populations of traditional farms compared with commercial farms.

Table 4: Population for beef production farmers at Lobatse

Stratum	Area A: Traditional Farmholds	Area B: Commercial Farmholds
Population size	395	12
Sampling fraction	1/10	½

Final sampling size results	40	6

This study adopted a nonprobability sampling technique and purposive sampling for qualitative data collection. This is also called judgment sampling, because researchers choose participants based on their qualities that are suitable for the study. This technique was used because of the nature of the participants, who possessed particular characteristics of interest to researchers. The BUAN client service unit is responsible for the provision, accessibility, and use of library resources, including farmer outreach programs, and was selected for this study.

Table 5: Sampling frame for BUAN library staff

Population	**Population size**
Client Services Unit staff	6

3.5 Data collection

A multi-method technique is a research approach that combines different methods, techniques, and data sources to provide a comprehensive understanding of the research problem. In this study, qualitative and quantitative data were collected to provide a more complete picture of beef production farmers' use of information technology by beef production farmers in Lobatse, Botswana. Qualitative data were collected through interviews with BUAN Library client service staff, whereas quantitative data were collected through questionnaires distributed to beef production farmers in Lobatse. By combining these two methods, this study captures both subjective and objective information, thus providing a more nuanced understanding of the research problem. The data collected from the farmers were based on their opinions and perspectives concerning the use and adoption of information technology, the use of the BUAN library to support them in using information technology, and the challenges experienced in adopting these technologies. Consent forms were sent to participants, and questionnaires were dropped from each farm holding office or residence, with copies emailed to farmers who had access to email services.

Some questionnaires were emailed, while others were delivered to farmers through various veterinary and extension officers and were sent only to those who consented. Follow-ups were made every second day via telephone/cell phone. Two weeks were allowed to complete and return to the researcher to analyse the results.

Interview meetings were set up with the library staff for concurrent interviews. Data collected from the client service unit library staff on the extent to which Lobatse farmers use IT to support livestock production were used to determine the contribution of adopting technology to improving livestock farming for Lobatse beef production farmers. Interviews were conducted over team conferencing and recordings were performed for respondents who permitted the researcher to do so.

3.5.1 Data collection tools

Table 6 shows the data collection tools, target audience, distribution channels, and researcher expectations from data collection.

Table 6: Data collecting tools

Data collecting tool	Target audience	Distribution	Researcher expectation
Questionnaires	40 Traditional farm hold owners 6 Commercial farm hold owners/managers	Email, courier, and physical distribution to the farm holds veterinary/extension office.	To gather data from farmers on their opinions and perspectives concerning the use and adoption of IT and the use of BUAN Library in supporting them in using IT also challenges encountered in adopting information technologies. The researcher obtained consent by explaining the research and assessing

			participant comprehension using a consent document, and a written consent form, as a guide for explaining the study. The researcher sent the consent form and questionnaire together to the farm hold owners.
Interviews	6 Library Client Services Unit staff at BUAN	Client Services Unit library manager and library officers	To gather data from staff about the extent to which Lobatse farmers use IT to support livestock production and to determine the contribution to adopting technology to improve livestock farming for Lobatse beef production farmers. The researcher distributed interview consent forms for approval before engaging the interviewees.

3.6 Reliability and validity

A research instrument should be able to produce similar results throughout data collection; therefore, reliability specifies the accuracy of the research instrument. This instrument should be consistent (Kumar, 2017:380). Validity is associated with an instrument's ability to measure what it is designed to measure (Kumar, 2017:386).

3.6.1 Pretesting of data collection instruments

To achieve reliability and validity, the researcher pilot tested the instruments before disseminating them to ensure that the questions were straightforward and to eliminate any uncertainty that may have arisen. Twenty questionnaires and three interview questions were distributed to colleagues at the MITI to verify their feasibility and compliance with the study's objectives.

3.7 Analysis of data

Data analysis is the key to unlocking insights from the data collected. It is important to analyse the data once they have been collected so that they can be understood. Data analysis is greatly influenced by the research design, sample, and other decisions taken earlier in the study, including the choice of data coding (Bergman, 2008:587–588). The quantitative aspect of the research involving administering questionnaires to beef production farmers was analysed using the Statistical Package for Social Sciences (SPSS). In contrast, the qualitative aspect of the research involving the administration of interviews with BUAN library clients' service unit staff was analysed using Microsoft Excel.

3.8 Ethical considerations

The researcher took appropriate steps to uphold the privacy and confidentiality of participants. Ethics are moral principles guiding the conduct of research, such as consent, approval, confidentiality, and anonymity.

3.8.1 Institutional approval

Institutional approval is granted (or withheld) by research governance or a similar body that ensures that research meets the ethical standards set out by the particular body (Kumar, 2014:282-283). Institutional approval is crucial in any research study as it ensures that the research is conducted ethically, upholding the welfare of the participants and the integrity of the research process. This study was approved by the institutional review board and ethics committee. This board reviewed the research proposal and assessed the potential risks and benefits to the participants. They also ensured that the research complied with legal and ethical guidelines and standards, including informed consent, confidentiality, privacy, and protection of vulnerable populations. The researcher carried out all necessary ethics clearance requirements, both with the University of Cape Town (Appendix C), where the researcher was a student, and with the Botswana University of Agriculture and Natural Resources, where data were collected for the qualitative part of the data collection (Appendix D), and the Ministry of Agriculture, Department of Agricultural Research, where data were collected for the quantitative part of the data collection (Appendix E).

3.8.2 Informed consent

Informed consent is the essence of the principle that participants involved in the research should be allowed to consent to participate by agreeing or refusing to participate. Informed consent is a crucial ethical principle that requires researchers to inform participants of the nature of the study, expected outcomes, potential risks or benefits, and their rights before asking them to participate. Informed consent ensured that the participants were fully aware of the study's purpose and procedures and were free to decide whether to participate. The participants were required to be able to make informed decisions without being coerced, deceived, or unduly influenced. The researcher was responsible for obtaining informed consent from participants before data collection. Informed consent can be obtained through written, verbal, or implied consent, depending on the nature of the study and the participants involved. They must have full knowledge of the research, what is expected of them, and why they must participate (Kumar, 2018:285). Participants were informed of their contribution to the study and their unrestricted consent was requested through a signed consent form for participation. They were informed of the voluntary nature of their participation and were free to withdraw from the study at any time (Appendices F and G).

3.8.3 Confidentiality and anonymity

In research, confidentiality refers to protecting participants' personal information from being disclosed to others without their consent, whereas anonymity means that participants' identities are unknown to the researcher. To ensure confidentiality and anonymity, researchers can assign code numbers to participants instead of using their names, storing data securely, and only reporting aggregated data in research findings. Researchers must uphold confidentiality and anonymity to protect the participants' privacy and encourage honest and open responses. To maintain confidentiality and anonymity, researchers must guarantee that participants are not identified by the information they provide, and must keep their information anonymous (Kumar, 2018:286). Data collected from the participants were kept confidential by anonymising the questionnaire respondents and ensuring that the collected information would be treated with utmost confidentiality during the reporting process.

3.9 Summary of the chapter

The chapter on the research design and methodology in a research project provides readers with an understanding of how the research was conducted, including the research paradigm, design, data collection, and analytical methods. This chapter outlines the steps taken to ensure that the study is rigorous and that the results are credible, providing readers with a clear understanding of the research process. A pragmatic paradigm was adopted in this study, meaning that the research design focused on the practical implications of the research. This study aimed to explore the use of information technology by beef production farmers in Lobatse, Botswana, and provide recommendations for improving the use of information technology to enhance the productivity and profitability of beef production farms in the region.

A multimethod research design involving quantitative and qualitative data collection was adopted to achieve the research objectives. Data were collected through questionnaires, interviews, and observations. The questionnaires were designed to collect quantitative data, whereas the interviews were designed to collect qualitative data. Observations were used to collect data on the physical environment and how farmers used it. The data collection steps are outlined in the Methodology section. The questionnaires were distributed to farmers and the responses were collected anonymously. Interviews were conducted with the BUAN Library Client service staff through video conferencing, and time slots were scheduled for the respondents. Observations were made on the physical environment of the BUAN Library and how the farmers used it. The reliability and validity of the data collection instruments were ensured by following the established protocols. For example, the questionnaire was pretested to ensure that the questions were clear and understandable. The interviews were recorded and transcribed and the transcripts were checked for accuracy. Ethical considerations were also taken into consideration in this study. Institutional approval was obtained before the commencement of the study. Consent notes were obtained from all participants, and they were assured that their responses would be kept confidential and anonymous.

CHAPTER 4

PRESENTATION OF QUANTITATIVE AND QUALITATIVE RESEARCH FINDINGS

4.1 Introduction

This study sought to ascertain the use of information technology by beef production farmers in Lobatse-Botswana using a multi-method approach of quantitative and qualitative data collection. Data were concurrently collected. A qualitative approach was used to collect data from the BUAN Library Client Services Unit staff, while a quantitative approach was used to collect data from beef production farmers in and around farms within the Lobatse district, using a pragmatic paradigm coupled with the Technology Acceptance Model theoretical framework of the TAM.

This chapter presents the findings of this study derived from both quantitative and qualitative data. The chapter begins with an analysis of demographic data to give the reader an overview of the sample composition from which the data were collected.

For the purpose of reporting, the findings from the research objectives are summarised in headings and subheadings as follows:

1. Assessing the level of access to information technology resources for beef production farmers
2. Utilisation of information technology resources by beef production farmers in lobatse and
3. Factors facilitating or hindering the use of information technology by beef production farmers in lobatse, botswana
4. Exploring information needs and preferences of beef production farmers in lobatse and botswana
5. Perceptions of the usefulness and relevance of information technology among beef production farmers
6. Recommendations for improving the use of information technology by beef production farmers in lobatse, botswana
7. Enhancing productivity and profitability of beef production farms through information technology

8. Promoting growth and development of the agricultural sector in the region through information technology

The second part of the responses to the research objectives covers the analysis of qualitative interviews conducted with the Client Service Unit Library staff at the BUAN library. Qualitative data were collected from the six (6) library staff members. The library staff interviewed included one librarian with a master's qualification, three assistant librarians (three of whom held a master's qualification), one with a bachelor's degree, and one library officer with a bachelor's qualification. Half of these respondents had worked at the BUAN library for more than ten years, while others had worked for nine, four, and 1.5 years respectively. The interview findings were arranged into themes emanating from the research objective.

4.2 Demographic data

Demographic data were analysed by computing the frequencies and percentages. They included the type of farm hold, level of education, and the number of livestock kept on the farm hold. The demographic data collected and analysed were also used to determine the influence of farm-hold demographics on IT usage, in addition to the influence of perceived ease of use and the usefulness of IT tools in beef production. The demographic data are presented in Table 7.

Table 7: Demographic data for the farmers

Variable	Categories	Frequencies	Percentages (%)
Type of farm-hold	Commercial farm hold	6	14.9
	Traditional farm hold	40	85.1
Level of education	No formal education	1	2.1
	Primary	10	21.3
	Secondary (high school)	16	34.0
	Tertiary (College or University)	20	42.6
Number of livestock	Less than 50	23	48.9
	51-100	14	29.8
	101-150	6	12.8
	151-200	0	0.0
	More than 200	4	8.5

The study aimed to include both commercial and traditional farms. Traditional farms comprised 85.1% (40 farm holds) of the sample, while only 14.9% (six farm holds) were commercial.

In terms of education, farmers were well-educated. Over 42.6% (20 farmers) had achieved tertiary education, whereas 34% (16 farmers) had completed high school. Other farmers had a primary school education at 21.3% (10 farmers) and no formal education at 2.1% (one farmer).

Herd size varied amongst the farms. Nearly half (48.9%, 23 farms) had herds of less than 50 cattle. A significant proportion (29.8%, 14 farms) had herds between 51 and 100 cattle. The remaining farms were more evenly divided, with 12.8% (six farms) having 101-150 cattle and 8.5% (four farms) having herds exceeding 200 cattle.

4.3 Assessing the Level of Access to Information Technology Resources for Beef Production Farmers

The level of access to information technology resources was first assessed by the BUAN library's resources and services in the area of information technology, as well as an assessment of the available IT resources, their reliability, and accessibility to the beef production farmers through data analysis from quantitative data received from questionnaires that were given to the Lobatse beef production farmers. A discussion of the challenges beef production farmers reported faced in their quest to access the IT resources of the BUAN Library

Table 7: Information resources and services offered by BUAN Library

IT Resource	Description
Internet access	The library has a high-speed internet connection including a WIFI connection for access outside the Library building
Computers	The MITI Library is a 100-seater Library equipped with 32 computers and workstations for use

Online databases	The library subscribes to several databases in the area of Agriculture with a special collection in the meat industry for the MITI Library
Online remote access	All online resources of the library are accessible remotely to users
Technical client support and training	Users are trained and supported from time to time
Access to Online Applications	Online applications are accessible within and outside the library

Although the BUAN library is equipped with the resources and services listed in Table 7, the staff acknowledged having limited knowledge of the new technology that farmers could use to improve beef production. One respondent stated, "*Farmers do not know much about the technology tools for improving beef production."*

Unavoidably, such technologies were not mentioned by any respondents. New technologies include augmented reality (RFID tags), robotics (automated milking), drones, sensors, geographic information systems (GIS), weather information systems (WIS), and statistical modelling.

When posed with the question " To better use the information technologies available" 17 (36.9%) farmersresponded by preferring to own their equipment, 3 (6.5%) preferred to hire the technology from another farmer or service provider, while 19 (41.3%) preferred to engage experts to use the technology on their behalf and only 4 (8.6%) chose to use the BUAN Library while 3 (6.5 preferred "other" as their choice of access to IT technologies.

The library staff indicated that they sometimes interacted with farmers virtually, but they often reached out and interacted with farmers on site. This indicates that farmers use information technology, although to a small extent. Another piece of evidence for the use of IT by farmers is that they findings show that farmers find it much easier to email and use mobile phones and social media but no other complicated IT applications. One respondent stated, *"We have open Wi-Fi, laptops, and iPads for use by farmers to access their social media, chat service, Frequently Asked Questions (FAQs), and Microsoft Teams meeting."* This shows that farmers use available technologies to a small extent.

Finally, a discussion of the challenges beef production farmers faced in their quest to access information from the BUAN Library is as follows:

4.3.1 Lack of interest in the use of technology

One of the main challenges is a lack of interest in the use of technology. One respondent stated that: *"Adoption is slow. The older generation does not seem as interested as the younger ones, which I want to believe is because of their level of education and general technophobia on the older generation."* Another respondent stated,' *Most older farmers are not interested in learning. Most of the farmers are just generally scared of the use of technology and prefer hardcopy newspapers."*

4.3.2 Fear of technology by farmers in the use of technology

The fear of technology by older farmers as a challenge was indicated by respondents. This is because most of them are semi-illiterate and lack significant exposure to technological advancements. One respondent stated, 'Fear, technophobia, and the perception that IT is for the younger generation. '

4.3.3 Lack of acceptance of the benefits of Information Technology (IT)

The interviews revealed that most farmers lacked knowledge of the importance of technology, which limited their acceptance. One respondent stated,' *When farmers visit the library, they use computers and the Internet to access social media and check their emails. Nothing else. They do not use IT to improve beef production because they don't know how to do that."* Many other

respondents indicated that farmers use the Internet only for social media and sending and receiving email.

Many farmers do not have smartphones and are often unable to visit libraries. One respondent stated,' Many farmers have technophobia. Most are traditional farmers staying outside towns without electricity, and this limited exposure to technology causes many farmers from deep rural areas to fear using technology. Another study mentioned that farmers find the library out of their way, as most of their farms are in rural Lobatse areas.

4.4 Utilisation of Information Technology Resources by Beef Production Farmers in Lobatse and Botswana

This section presents and interprets quantitative data regarding the extent to which farmers use technology to support beef production and determines factors that facilitate or hinder the use of IT. The section proceeds by analysing the influence of farmers' demographic characteristics on the usage of IT by farmers. The use of IT by commercial and traditional farmers is also compared. The influence of farmers' education level and farm size (number of livestock) on IT usage is also investigated in this section.

4.5 Extent of Information Technology (IT) usage in beef production farm holds

Descriptive statistics were used to determine the extent to which the beef farmers used IT tools to support beef production in Lobatse. The usage of IT was measured by ten (10) items whose responses were summed to obtain the composite score for the usage of IT tools in farm holds. To measure the extent to which farmers used IT on their farms, they were asked whether they used electronic mail, the internet, online databases, telephone applications, computer applications, and social media. They were also asked whether they had used cell phones and computers to record farm records.

Analysis of the data showed that the most frequently used technology was telephone applications (87.2%), followed by social media (61.7%) (Figure 1). More than 50% of the farmers used only these two technologies to support their farm activities. A small proportion of farmers used the remaining technologies investigated, including smartphone farm records (46.8%), computer

applications (29.8%), computer farm records (21.3%), the internet (14.9%), electronic mail (12.8%), and online databases (10.6%) (Figure 1). Generally, farmers use IT on their farms but to a small extent.

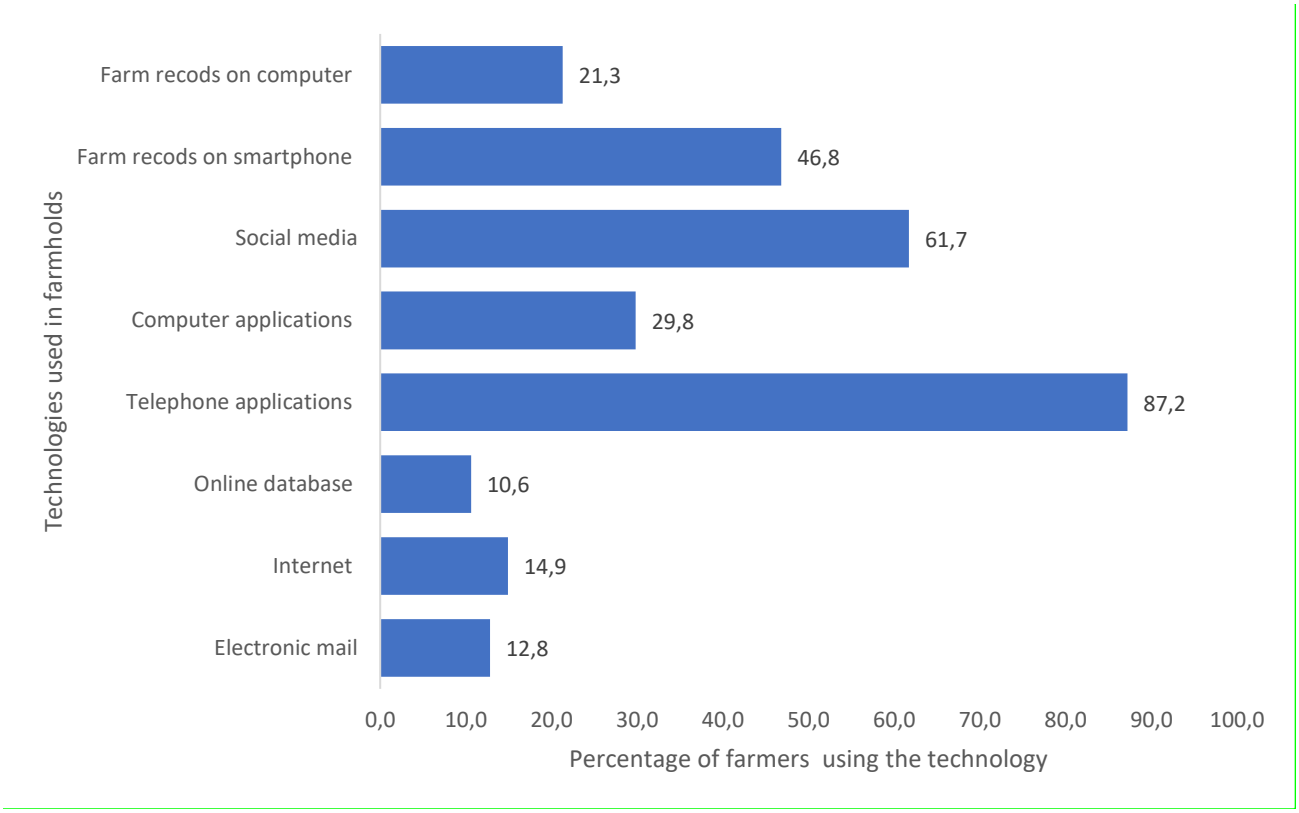

Figure 1: Usage of technologies by beef production farmers

4.5.1 Impact of demographic characteristics of the farmers

The demographic characteristics investigated included the type of farm hold (commercial vs. traditional), the level of education of the farmer, and the size of the farm hold, which is indicated by the number of livestock. The influence of each demographic characteristic was analysed individually after selecting the most appropriate tool. Subsections 4.3.2.1 to 4.3.2.3 present the data analysis using inferential statistics.

4.5.1.1 Type of farm hold

The influence of farm holdings on IT usage was analysed using an independent sample t-test. This study aimed to determine whether IT use differs significantly between commercial and traditional

farmers. The mean IT use was higher for commercial farmers (5.43), and much lower for traditional farmers (3.53). Levene's test for equality of variances (Table 8) shows that IT is not significantly different between commercial and traditional farmers (p=0.103). The t-test statistics indicate that the usage of IT is significantly higher among commercial farmers than among traditional farmers (p=0.006). This implies that commercial farmers use IT on farms more than traditional farmers (Table 8).

Table 8: Independent samples t-test for Information Technology (IT) usage between commercial and traditional farmers

		Levine's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	Sig. (2-tailed)
Usage of IT in farm-holds	Equal variances assumed	2.773	0.103	2.898	0.006
	Equal variances are not assumed.			2.180	0.066

4.5.1.2 Education level

The influence of the level of education and the number of livestock on the usage of IT in farm holds was investigated using Spearman's correlation analysis. Spearman's correlation was selected as appropriate because education level and the number of livestock were both categorical variables. There were four main educational levels: no formal education, primary school, high school, and tertiary education. The Spearman correlation analysis (Table 9) indicates that educational level has a statistically significant correlation with the use of IT on farm holds (r= 0.412, p=0.004). This was because the p-value was less than 0.005, which was the critical p-value at the 95% confidence interval. This implies that the positive correlation between educational level and IT use on farms may not have appeared by chance. It can be deduced that farmers with higher educational levels are more likely to use IT tools to support beef production.

4.5.1.3 Number of livestock

Spearman correlation analysis (Table 9) showed that the number of livestock in farms had no statistically significant correlation with the use of IT (r= 0.259, p=0.078). This is because the p-value was more significant than 0.005, which is the critical p-value at the 95% confidence interval. This implies that a positive correlation between the number of livestock and the use of IT in farm holds could have occurred by chance. Therefore, it can be deduced that the number of livestock does not influence the use of IT on farms.

4.5.1.4 Impact of perceived usefulness

Spearman's correlation analysis (Table 9) showed that the perceived usefulness of technology had a statistically significant correlation with the use of IT on farms (r= 0.428, p=0.003). This was because the p-value was less than 0.005, which was the critical p-value at the 95% confidence interval. This implies that the positive correlation between the perceived usefulness of technology and IT use on farms may not have appeared by chance. It can be deduced that farmers who perceive certain technologies as being useful are more likely to use the same IT tools to support beef production.

4.5.1.5 Impact of perceived ease of use

The findings from the Spearman correlation analysis (Table 9) show that the perceived ease of technology in farm holds no statistically significant correlation with the use of IT in farm holds (r= 0.254, p=0.085). This is because the p-value was more significant than 0.005, which is the critical p-value at the 95% confidence interval. This implies that the positive correlation between the perceived ease of use of IT in farm holds could have appeared by chance. Therefore, it can be deduced that the perceived ease of use of technology does not influence the use of IT in farms.

4.5.1.6 Impact of attitude towards the use of technology

The findings from the Spearman correlation analysis (Table 9) also showed that attitudes towards the use of technology on farms had no statistically significant correlation with the use of IT on farms (r= 0.104, p=0.499). This was because the p-value was greater than 0.005, which was the

critical p-value at the 95% confidence interval. This finding implies that the positive correlation between attitudes towards IT and the use of IT in farm holds could have appeared by chance. Therefore, it can be deduced that attitudes towards IT do not influence the use of IT on farms.

Table 9: Spearman's rho correlation with the use of Information Technology (IT) in farm-holds

Variables	**Spearman's Rho correlation with the use of IT in farm-holds**	
	Correlation coefficient	p-value
Education level	0.412	0.004
Number of livestock	0.259	0.078
Perceived usefulness	0.428	0.003
Perceived ease of use	0.254	0.085
Attitude towards the use of technology	0.104	0.499

4.6 The extent of using Information Technology (IT) tools by farmers

According to this sub-theme, farmers use information technology to a small extent. Many farmers only use social media and telephones. Respondents were asked to state the extent to which Lobatse beef production farmers used information technology to improve beef production. One respondent stated,' *Not much. I would scale it to 3, 1 being the lowest."*

Another respondent explained that farmers did not use information technology in the library. Another respondent stated, *'Farmers here in Lobatse do not fully utilise the information technology services at the library, especially traditional farmers'*. Another respondent stated, "*Adoption is slow'. The older generation do not seem as interested as the younger ones, which I want to believe is because of their level of education and general technophobia on the older generation."*

According to the respondents, traditional beef production farmers are less interested in technology because of their low levels of education.

4.6.1 Technophobia

A low level of education coupled with limited exposure to technology causes farmers to have a phobia of the technologies that they are supposed to use to improve beef production. Another respondent stated,' *Most older farmers are not interested in learning. Most farmers are generally scared of the use of technology and prefer hardcopy newspapers".* This generally shows that farmers' age influences their adoption of technologies, with older farmers resisting the adoption of new technologies.

4.6.2 Social distancing and travel restrictions

The use of IT by farmers has worsened during the coronavirus disease (Covid-19) pandemic. Farmers could no longer attend community outreach programs because of the extreme social distancing and travel restrictions imposed by many countries to curb the spread of Covid-19. This is because community outreach programs, where farmers gained IT literacy when teaching new technologies, stopped during the Covid-19 pandemic. One respondent stated, "We used to hold outreach programmes like agriculture shows but since Covid-19 hit *three years ago, it has not been possible."* Even after the pandemic, community outreach programmes have not resumed. This is one reason why few farmers use Lobatse Library Services. Concerning the community outreach program, another respondent stated, "*We used to reach out to farmers regularly, but nowadays, we rarely reach out to them."* This shows that most farmers no longer receive training on technologies that can be used to improve beef production.

Information technology tools that farmers can adopt to improve beef production include augmented reality (RFID tags), robotics (for automated milking), drones, sensors, geographic information systems (GIS), weather information systems (WIS), and statistical modelling. Farmers were asked to indicate whether they would adopt such technologies if they were given an opportunity. The responses from the farmers (Figure 2) showed that 68.1% of them farmers wished to use augmented reality (RFID tags), 51.1% wished to use robotics (for automated milking), 72.3% used drones, 78.7% used sensors, 74.5% used geographic information systems (GIS), 83.0% wished to use weather information systems (WIS), and 76.6% used statistical modelling. Generally, farmers are willing to adopt information technologies to improve beef production,

because more than 50% of the farmers indicated that they would use each of the selected technologies.

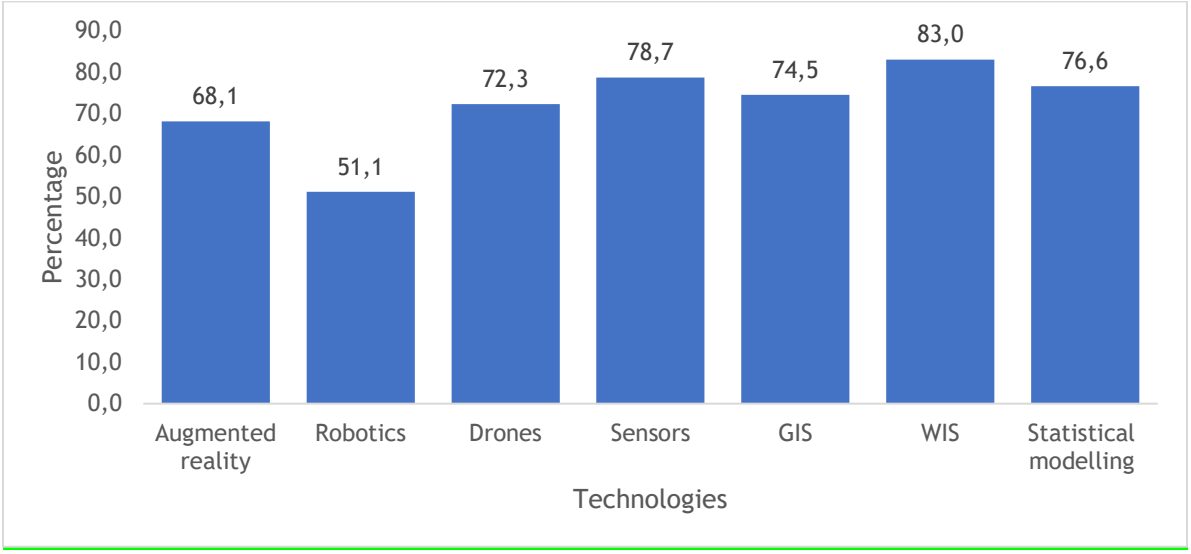

Figure 2: Information Technology (IT) tools farmers would adopt

4.7 Factors facilitating or hindering the Use of Information Technology by Beef Production Farmers in Lobatse, Botswana

The BUAN Library has an array of IT resources that facilitate the use of IT by beef production farmers in Lobatse. The library boasts a selection of resources from Internet access, computers, and agriculture databases, and provides technical support and training on the resources to clients, including beef production farmers. The library also provided various comfortable spaces for clientele use.

However, the interviews showed that beef production farmers mainly used telephones, social media, and emails. However, beef production farmers have not embraced information technology tools, such as drones and robotic technologies. They mostly use computers and the Internet; however, in most cases, they access social media, emails, and research. The interviewer asked the interviewees about the information technology tools and services most preferred by the farmers, which facilitated their use.

One interviewee stated that: *"Farmers mainly use the Internet, computers, and Wi-Fi to access social media and do research"*. Another respondent stated, "*Farmers who come to the library*

mainly use laptops, iPads, the Internet, and Wi-Fi. This implies that farmers only use a limited number of IT tools available in the library. Farmers mainly use the gadgets they have and go to the library to access the internet.

Some factors that hinder the use of IT include a lack of essential skills, which makes it difficult for beef production farmers to access the available resources and appreciate the benefits of using IT.

One interviewee stated that "*most beef production farmers do not use IT because they perceive it to be difficult and expensive",* and echoed that they encourage beef production farmers to attend training sessions on the use of IT resources and services available at the library.

4.8 Exploring Information Needs and Preferences of Beef Production Farmers in Lobatse and Botswana

The BUAN Library can explore beef production farmers' needs and preferences through the use of customer surveys, where data can be collected on their specific IT and information needs and how they prefer information to be disseminated to them. Farmers' information-seeking behaviours can also be studied to determine how they utilise IT resources and services, and the challenges they encounter while using them. Librarians could attend to beef production farmers in focus groups where they could gather information about the beef production farmers' trends and patterns of IT use and encourage the learning and sharing of information within themselves.

The BUAN Librarians interviewed cited that there was a need to explore the information needs and preferences of beef production farmers, but cited that due to financial constraints and the Covid-19 pandemic, outreach programs that could otherwise benefit beef production farmers were halted, as most of them are not regular to the library.

4.9 Perceptions of the Usefulness and Relevance of Information Technology among Beef Production Farmers

The results from the interviews conducted with the BUAN Client services staff suggest that IT is a useful tool and, if harnessed, a valuable resource that could aid Lobatse beef production farmers in their activities; however, not all beef production farmers use it exhaustively. Five (5) out of the six (6) interviewees affirmed that beef production farmers in Lobatse use IT unsatisfactorily. They

stated that beef production farmers used IT to access the Internet, computers for social media platforms, library guides, and library questions and answers.

4.10 Recommendations for Improving the Use of Information Technology by Beef Production Farmers in Lobatse, Botswana

The findings from the quantitative data show that a lack of support from local agricultural agencies and institutions is the main challenge hindering farmers from adopting information technology. A lack of support was reported by 76.6% of the farmers. Another major challenge was the lack of relevant knowledge and skills, which was selected by 68.1% of the farmers as a significant challenge. The remaining challenges were selected as the major challenges in significantly smaller proportions. These minor challenges included fear of technology, which 29.8% of the farmers selected as a significant challenge, and lack of interest in technology, which only 10.6% selected.

Interventions to assist beef production farmers include training farmers when they arrive at libraries. One of the respondents stated,' Many farmers come to the library, and we assist them and train them on how to use the Internet and IT gadgets. *We have open Wi-Fi, laptops, and iPads for use by farmers, which farmers use for social media, chat service, FAQs, and Microsoft teams' meetings."* Free-open Wi-Fi attracts farmers to the library, where they are exposed to IT and learn more about the technologies that can be used to improve beef production.

4.10.1 Marketing of Information Technology (IT) through government information systems

There is also marketing of information technology and promotion for markets, vaccine information, and government systems such as BAITS systems. One respondent stated, "*We reach out to farmers and show them the importance of technology in improving beef production during outreach programmes through agricultural shows."* Another respondent stated that: *"we conduct community outreach programs to create awareness as per the mandate of the BUAN library,* which implies that the BUAN Library Client Services unit is sensitising farmers to use the library, access information, and adopt new technologies in beef production.

4.10.2 Community group training and participatory training

BUAN library staff have been conducting community group training, mobile applications, and training participation are also among the interventions used. One respondent stated, "*We have been*

training farmers on the introduction of information technology resources and services." Another respondent stated, *"We provide farmers information through training, email, and virtual services."*

4.10.3 Use of social media

The BUAN Library also uses information technology, such as social media, to disseminate important information on disease outbreaks and sensitisation about beef production and beef markets to encourage farmers to develop an interest in information technology. This encourages farmers to appreciate the use of IT in their lives and prepares them to accept technologies that can be introduced in the future. One respondent stated,' We use social media, chat services, FAQs, and Microsoft team meetings to communicate and interact with farmers. *We started this online interaction during the Covid-19 pandemic when we could not conduct outreach programmes to interact directly with farmers, although the feedback was low."*

4.11 Enhancing Productivity and Profitability of Beef Production Farms through Information Technology

Information technology enhances productivity, leading to increased productivity. Precision livestock farming (PLF), such as sensors, can be used to assist beef production farmers in identifying problems earlier, leading to improved animal welfare, monitoring the behaviour of animals, detecting animal diseases, automating the feeding of animals, and animal tracking and identification.

All Client Services Library unit staff interviewed when posed with the question "*Which information technology tools and services would you recommend to Lobatse beef production farmers, and why?"* responded by " *"all tools"* to cater for all the beef production farmers different information needs.

4.12Promoting Growth and Development of the Agricultural Sector in the Region through Information Technology

The government makes efforts through various institutions, including BUAN, to invest in IT infrastructure to promote beef production by improving Internet connections and access to IT

resources and services. The results suggest that beef production farmers require more support from local agricultural agencies and institutions, with 76.6% of beef production farmers citing a lack of government support.

4.13 Summary of the Chapter

This chapter presents the research findings of the quantitative data collection method using a questionnaire that generates themes based on the research objectives. Quantitative data were collected from traditional and commercial beef production farmers in the Lobatse region. This chapter also presents the findings derived from the qualitative data analysis. Qualitative data were collected through team conference interviews with the library staff at the BUAN library. The qualitative data supplement the quantitative data presented in section 4. The next chapter discusses the results of the study and presents its conclusions and recommendations.

CHAPTER 5

INTERPRETATION, RECOMMENDATIONS, AND CONCLUSION

5.1 Introduction

This chapter presents an interpretation of the study's findings, which are presented in chapter four. and recommendations and conclusions derived by the researcher based on the findings of this study.

5.2 Interpretation and Discussion of Results

The findings are discussed in relation to themes emanating from the research questions, while acknowledging the limitations of the study and considering the implications of the findings. These findings recognise IT as a valuable resource for beef production, and, if harnessed, it can improve beef production.

The findings also recognise the invaluable contribution the library offers to beef production farmers in harnessing it, as it offers an array of resources such as Internet connection, computers, online databases, computer programs, and applications for technical support.

The study was limited to Lobatse; therefore, it did not represent the broader population of Botswana and relied on self-reported data. It was also limited by the available technological infrastructure, such as Internet speed, availability of databases and software, and hardware limitations. This section interprets and discusses the study's results regarding the themes emanating from the research questions.

5.2.1 Use of Information Technology (IT) to support beef production

Qualitative and quantitative data show that farmers used information technology to a small extent. Many farmers use social media and telecommunication tools such as mobile telephones. Most farmers in Lobatse are traditional farmers who lack interest in and expertise in information technology services. The researcher could not determine whether social media and telephone services helped improve beef production or whether farmers were using social media for their

social lives instead of obtaining agricultural information. Farmers may also use telephone services to communicate, and may not necessarily add value to the beef production process.

Thakur and Chander (2018) revealed that although social media platforms are cost-effective, they require minimal ICT skills to use and operate. This was shared by Pal and Kameswari (2022), who established that the majority of farmers have moderate knowledge of social media. Although difficult to establish, it is evident that farmers use telephone services to interact with agricultural extension officers. However, the literature recommends that engaging farmers through social media tools provided by agricultural institutions can improve the quality of agricultural information in terms of timeliness and accuracy. However, they are heavily affected by factors such as slow rural internet connectivity, information deciphering, and utilisation. When technology is adopted, administrators should explain the purposive nature of the groups and remove irrelevant posts. Using such social platforms can improve information-sharing and usage, ultimately contributing to increased income sources among those who adopt and use social platforms.

In addition to the minimum skills required by beef production farmers, the literature also establishes that hosting web portals, e-learning applications, and application development comes at a higher cost (Thakur & Chander, 2018), which is almost impossible for most developing countries. However, where this exists, farmers and agricultural extension workers should be encouraged to adopt IT and encourage users to create and disseminate information by publicising and making applications relevant for generating localised content in farm extension activities (Thakur & Chander, 2018).

The lack of interest in technologies by beef production farmers could be because they lack sufficient sensitisation to make them see the usefulness of IT in boosting beef production. Their educational level also limits their ability to appreciate the usefulness of the technology in beef production. This is because more educated farmers quickly adopt new technologies, unlike less educated farmers. To generate interest in information technology, Salim et al. (2014) recommend an appropriate emphasis on relationships and trust-building as a catalyst for faster adoption of information technology at the production level.

According to the collected data, farmers can easily understand how technology works and how it is essential to carry out commercial activities on the farm. This view is supported by a statistical

analysis of the factors influencing farmers' IT use. The statistics revealed a positive correlation among educational level, IT usage, perceived usefulness, and IT usage. Once a farmer knows that a particular technology is valuable, they are willing to learn or hire an expert to use it regardless of its perceived ease of use. This is in line with Plannin's (2014) argument that the perceived usefulness of technology is the primary factor influencing the acceptance of new technologies.

Although farm size did not significantly influence IT usage in farms, the literature shows that larger farms tend to adopt IT more than smaller ones. In the USA, Kariuki et al. (2019) reported that farm size is among the many factors that influence the adoption of technology in agriculture. These factors vary from farm to farm and even country to country, as such requirements increase daily, driven by global events, making them even more complex. From the perspective of developing countries, these factors are technological, economic, and institutional in nature. In contrast, in countries such as the USA mentioned above, adoption appears to be driven by the level of education and the farm size where such technology is to be deployed, although, in some instances, adoption of the same has been low. According to Mwangi and Kariuki (2015), farmers with large farms are more likely to adopt the technology they deploy in different activities, and a portion of the farms are devoted to technology trials.

The results also show that most farmers often use telephone services and social media, but seldom use other IT services such as emails, computer applications, and other applications requiring smartphones. The results show that only 46.8% (less than half of the sampled population) used smartphones for farm records. This implies that farmers have limited smartphone access and are unaware of cell phone applications that they can use for farm records. A small number of farmers (29.8%) used computer applications. A much smaller percentage (21.3%) of farmers used computers for farm records. A handful of farmers (14.9%) used the internet on their computers. Fewer farmers used e-mails (12.8%) or online databases (10.6%). As more farmers use telephones and cellphones, very few use smartphones or computers. However, they are the most convenient and valuable gadgets in IT. The limited use of computers and computer applications can be attributed to many farmers having no access to adequate use of computers and the Internet and some even living in areas without access to electricity. The library staff forwarded these facts during interviews.

Limited computer literacy and general exposure to technology eventually lead to a fear of technology. Fear of technology among farmers, especially older farmers, is also reported as one of the challenges limiting the adoption of IT in farm holds. Some farmers fail to take advantage of IT owing to their countries' political, social, economic, and organisational stances. This has been observed in most developing countries (Neethirajan & Kemp, 2021).

5.2.2 Tools that farmers may use to improve beef production

The interview findings showed that beef production farmers used telephones, social media, and emails. Beef production farmers also use computers and the Internet; however, in most cases, they access social media, emails, and research. On the other hand, beef production farmers are willing to accept new technologies and use associated tools to improve their farm holdings and beef production. These technologies were analysed using quantitative data. Beef production farmers indicated that they were willing to use technologies such as augmented reality (RFID tags), robotics (for automated milking), drones, sensors, geographic information systems (GIS), weather information systems (WIS), and statistical modelling. Generally, farmers are willing to adopt information technologies to improve beef production, because more than 50% of them indicated that they would use each of the selected technologies.

Literature indicates a variety of digital livestock farming technologies and systems that beef production farmers can use to improve their production. The first is advanced digitisation technologies that can help modern farms optimise economic contributions per animal, reduce the drudgery of repetitive farming tasks, and overcome less effective isolated solutions, thus providing an individualistic approach to beef production. Another technology worth considering is biometric sensors, which could help contribute to real-time, consistent, objective, and regular welfare monitoring of livestock and reduce medication intake.

PLF technologies, such as biometric sensors, promote consistency in farms by providing predictive information to beef production farmers, allowing them to take precautions against disasters before they occur. This helps farmers make realistic choices that prevent them from overusing their monetary and human resources. On the other hand, blockchain technologies engage consumers by tracking farm activities with less time consumed by beef production farmers and the time spent doing other farm activities (Neethirajan & Kemp, 2021).

5.2.3 Challenges

The major challenge affecting IT adoption is that the rate is slow due to a lack of interest in beef production farmers. As previously argued, this lack of interest is because beef production farmers do not consider the usefulness of the introduced technology. This indicates that technologies may be introduced to beef production farmers by using incorrect approaches. This finding implies that farmers failed to appreciate the usefulness of technologies that would otherwise increase their interest in using them.

The lack of IT adoption in beef production can also be attributed to poor diffusion of knowledge to intended users, policy advocacy, poor entrepreneurial skills, and poor interaction with relevant agricultural stakeholders (Neethirajan & Kemp, 2021).

The second challenge indicated by the respondents was fear of technology among older farmers. The effect of age on technology adoption is supported by findings from Tanzania, where farmers' ages were found to influence technology adoption. Older farmers are more likely to adopt technology because they have gained experience, making it essential to provide information about the technology to be adopted. Such information should be reliable and consistent(Mwangi & Kariuki, 2015). Although the effect of age was not investigated in this study, the fact that many farmers are old could be one of the causes of the slow adoption of IT in farmholds. As reported earlier in this study, age and low literacy levels can be attested to farmers' fear of technology. Most farmers are semi-illiterate and lack significant exposure to technological advancement. However, this may be because the farmers' perceptions of the usefulness of these technologies are shallow. From statistical analysis, the perceived usefulness of the technology surpasses its perceived ease of use and attitude.

The third challenge revealed by the interviews was the acceptance and education of the IT benefits. However, this challenge of acceptance may be associated with a lack of interest and low level of education. The two main challenges were the lack of interest in technology tools and the fear of technology by older farmers, which were echoed by both farmers (quantitative data) and library staff (qualitative data). Therefore, these findings are credible. For technology to be adopted, it must be understood and the benefits and value of the technologies must be clearly defined. Information

can be relayed in various ways, such as through social networks and social events where farmers can interact, share, and discuss social issues (Harrington, 2018).

Another challenge is that IT has the potential to distinguish between non-techno-savvy and techno-savvy farming workers, thereby creating inequality. A disadvantage is also placed on remote farmers compared to farms within towns because of governments' uneven distribution of resources, such as internet connectivity and electricity(Neethirajan & Kemp, 2021).

5.2.4 The role of libraries to provide access to information through ICTs

Libraries play a crucial role in providing access to information through Information and Communication Technologies (ICTs) in the current digital era. This is especially true for beef production farmers in Lobatse who require timely and relevant information to enhance their productivity and remain competitive in the market. A comprehensive approach was adopted when surveying specific activities carried out by librarians at the BUAN library to provide information to beef production farmers.

The librarians in the BUAN library are engaged in various initiatives for disseminating information to beef production farmers. Workshops, seminars, publications, and online resources are among the methods that libraries use. The contents of these sources are tailored to meet specific needs, covering topics ranging from market trends and production techniques to animal health and regulatory requirements. By organising regular workshops and seminars, librarians ensure that beef production farmers have opportunities to learn and stay updated about the latest developments in their fields.

Furthermore, librarians actively reach beef production farmers through outreach programs, and participate in agricultural fairs in and around Lobatse. These events provide platforms for direct interactions between librarians and beef farmers. By booking stalls at fairs, librarians can engage in face-to-face discussions to address queries and concerns of beef production farmers. Additionally, the BUAN Library website features a dedicated question-and-answer platform where they can seek remote assistance from librarians. This virtual interaction facilitates continuous support and information-sharing between beef production farmers and librarians.

On average, librarians interacted with beef production farmers once a month, with a majority (67%) indicating monthly interactions, and the remaining librarians (33%) had weekly interactions. These regular interactions strengthen the librarian-farmer relationship and enable a better understanding of beef production farmers' information requirements.

BUAN library employs a range of ICT services to enhance accessibility to information. Internet access through open Wi-Fi, library guides, chat services, and social media platforms is one such service. However, despite the availability of these services, most beef production farmers in Lobatse preferred traditional means of communication over the library's ICT offerings such as social media and telephones. This preference could be attributed to beef production farmers' limited familiarity with and interest in information technology.

The lack of interest in ICT services among beef production farmers can also be attributed to a lack of sensitisation regarding the benefits and utility of technology for boosting production. Traditional beef production farmers often prioritise conventional methods and may not fully grasp the potential advantages offered by information technology. Additionally, the educational level of beef production farmers plays a role in limiting their ability to appreciate the usefulness of technology in beef production. A lack of exposure and understanding may hinder their willingness to adopt new technological tools.

In conclusion, the role of libraries, exemplified by the BUAN library, in providing access to information through ICTs is instrumental in supporting beef production farmers, specifically those involved in Lobatse. The librarians' efforts to organise workshops, seminars, publications, and online resources, as well as their active engagement through outreach programs and participation in agricultural fairs, contribute significantly to empowering beef production farmers with relevant and timely information. However, addressing the lack of interest in ICT services among beef production farmers requires sensitisation campaigns and educational initiatives to highlight the benefits and potential of technology in beef production. By bridging the digital divide and encouraging technology adoption, libraries can enhance the productivity and overall success of beef production farmers in Lobatse.

5.2.5 Information Technology (IT) tools and services used by farmers

The BUAN Library offers a range of information technology tools and services that can benefit beef production farmers in Lobatse. These tools include access to online databases, e-books, and journals, as well as computer workstations and internet connectivity. The technology recommended by beef production farmers depends on their unique requirements and objectives.

Access to online databases, e-books, and journals can provide beef production farmers with valuable resources to inform them about the latest research and industry trends. By accessing these digital resources, farmers can gain insight into best practices, emerging technologies, and market dynamics. This knowledge can assist in making informed decisions and implementing strategies to enhance beef production.

The BUAN Library also provides various services to support beef production farmers using information technology. These services include Lib Answers, Lib Guides, Chat Services, and library websites. Lib Answers is a platform on which beef production farmers can submit queries and receive expert responses from librarians, providing them with personalised assistance remotely. Lib Guides offer curated guides and resources tailored to specific topics or subjects, offering beef production farmers a comprehensive collection of information relevant to their needs.

In addition, the library offers computer workstations, laptops, tablets (such as iPads), and internet connectivity, enabling beef production farmers to access these technological tools within the library premises. This provides a convenient and conducive environment for beef production farmers to conduct research, access online resources, and engage in communication related to beef production.

To further facilitate the adoption of information technology by beef production farmers, the BUAN Library has implemented specific interventions such as training sessions, workshops, and technical assistance programs. These initiatives aim to familiarise beef production farmers with available technological tools and train them in their effective usage. Beef production farmers can participate in these sessions either by visiting the library or through outreach programs conducted by librarians. The library engages beef production farmers through social media platforms, marketing services, and training programs to create awareness and encourage active involvement.

Overall, the BUAN Library strives to provide beef production farmers with a wide range of information technology tools and services to support their production activities. By offering access to online resources, computer workstations, and training programs, the library aims to empower farmers with the necessary knowledge and skills to effectively leverage information technology. Through these efforts, the library aims to bridge the digital divide and ensure that beef production farmers in Lobatse can fully utilise the potential of information technology in their pursuit of improved productivity and profitability.

5.2.6 Librarian roles in improving farmers' access to library information resources and services

According to librarians at the BUAN Library, information technology resources play a vital role in improving beef production farmers' access to library information resources and services. By providing online access to databases, e-books, and journals, technology facilitates the availability of a vast amount of information highly relevant to beef production farmers' needs. Digital access empowers beef production farmers by offering valuable insights into market trends, vaccination protocols, and other essential information crucial to farming operations.

One of the key applications of information technology in this context is marketing and promotion. Librarians employ technology such as updates on markets and vaccination procedures to effectively disseminate information to farming communities. Through targeted online marketing campaigns and social media platforms, libraries can successfully reach beef production farmers, ensuring that they receive critical information that directly affects their farming practices. This proactive approach helps farmers to remain informed and make informed decisions regarding their agricultural activities.

Additionally, technology enables virtual workshops and training sessions, which can significantly extend the scope of educational initiatives. Geographical barriers often prevent beef production farmers from attending in-person workshops and training programmes. However, through virtual platforms, beef production farmers can participate remotely in these activities to overcome geographical constraints. By offering virtual workshops and training sessions, libraries ensure that beef production farmers have access to valuable knowledge and skills regardless of their location.

This inclusive approach broadens the dissemination of information and benefits large communities.

Community outreach programs were conducted to create awareness and establish the BUAN Library as a valuable resource. Through these programs, librarians directly engage with beef production farmers, introducing them to the library's resources and services and the benefits of utilising information technology. By collaborating with local agricultural organisations and participating in community events, libraries can build trust and establish a strong presence within the farming community. This fosters a sense of partnership and encourages the greater utilisation of information technology resources among beef production farmers.

As beef production farmers are often located in remote areas, it is essential to promote virtual and remote access. Libraries emphasise the convenience and accessibility of online resources, highlighting how farmers can easily access and utilise these resources from their farms. By promoting virtual and remote access, libraries ensure that beef production farmers understand the practicality and advantages of leveraging information technology in their farming practices. This approach encourages beef production farmers to embrace information technology as a valuable tool to enhance their agricultural activities.

Libraries play a pivotal role in training beef production farmers in the utilisation of available resources and their benefits in farming activities. Through workshops and personalised guidance, librarians educate beef production farmers on how to navigate online databases, effectively utilise e-books and journals, and make the most of the various tools and services provided by libraries. By equipping beef production farmers with the necessary knowledge and skills, libraries empowered them to independently access and leverage information technology resources to enhance their farming operations.

In conclusion, BUAL Library staff suggested that IT resources such as online databases, e-books, and journals serve as invaluable tools for improving beef production farmers' access to library information resources and services. By promoting virtual workshops, conducting community outreach programs, advocating virtual and remote access, and providing comprehensive training, libraries ensure that beef production farmers are well informed and equipped to effectively leverage these resources. Embracing information technology enables beef production farmers to

enhance productivity, make informed decisions, and remain updated about the latest advancements in their fields, thereby contributing to the overall growth and success of their farming endeavours.

5.2.7 Librarians' mode of communication with Lobatse beef production farmers offsite

When it comes to communicating with Lobatse beef production farmers outside the library, librarians employ a variety of methods, depending on the circumstances. These methods include face-to-face interactions, phone calls, emails, and social media platforms.

Email, mobile phones, and social media have emerged as popular communication channels among librarians at BUAN Library. These platforms provide convenient and efficient means of reaching out to beef production farmers and engaging in discussions related to their beef production farming activities. Emails allow for detailed and formal communication, ensuring that important information is accurately conveyed. Mobile phones offer a more immediate and personal mode of communication, enabling librarians to have direct conversations with beef production farmers and to promptly address their queries. Social media platforms are effective tools for interacting with farmers, sharing updates, and disseminating information informally and engagingly.

In addition to email and social media, other digital communication tools have been utilised. These tools include chat services, frequently asked question (FAQs) sections, and virtual meetings through platforms such as Microsoft Teams. Chat services provide beef production farmers with the opportunity to engage in real-time conversations with librarians seeking immediate assistance or clarification. The FAQ sections address commonly asked questions, offering beef production farmers quick access to information, without direct communication. Virtual meetings through platforms such as Teams enable librarians to conduct interactive sessions with farmers, fostering collaboration and knowledge-sharing.

The use of social media and email remains prevalent among librarians when communicating with lobatse beef production farmers outside the library. Social media platforms serve as valuable channels for sharing updates, events, and important information that beef production farmers can access easily. Email continues to be a reliable means of communication, allowing detailed discussions and formal exchanges.

Overall, the mode of communication with Lobatse beef production farmers outside the library incorporated a mix of face-to-face interactions, phone calls, emails, and social media platforms. Librarians at the BUAN Library recognise the importance of utilising various communication channels to effectively engage with beef production farmers and address their needs. By leveraging these diverse methods, librarians ensure that farmers receive timely information and support, foster meaningful connections, and promote the adoption of information technology in their farming practices.

5.2.8 Librarians' experience using Information Technology (IT) with Lobatse beef production farmers at the library

The experience of Lobatse beef production farmers using technology at the BUAN Library can vary greatly, depending on their comfort level and familiarity with technology. While some beef production farmers may be technologically savvy and comfortable using technology resources at the library, others may require more assistance and support because of their limited exposure to and comfort with technology.

It has been observed that the adoption of technology among Lobatse beef production farmers, particularly in the older generation, is slow. This can be attributed to factors such as level of education and general technophobia prevalent among the older population. Farmers from the older generation may find it challenging to embrace technology, and may require more guidance and assistance to navigate and utilise the resources available at the library.

There is notable technophobia among Lobatse beef production farmers, particularly in the older farming communities. They may face difficulties in grasping technological concepts and may feel overwhelmed or intimidated by the use of technology. This hesitation and fear can hinder their willingness to explore and adopt farming technology.

Furthermore, some beef production farmers tend to perceive information technology as something primarily for the younger generation, leading to resistance or disinterest in learning and utilising technological resources. The preference for hardcopy newspapers over digital resources exemplifies certain beef production farmers’ reluctance to use technology.

However, it is important to note that these experiences are not universal among Lobatse beef production farmers. Some of these farmers, especially the younger generation, may be more open and eager to embrace technology, quickly adapting to its use in the BUAN Library. Their familiarity with and comfort with technology allows them to leverage the available resources more effectively.

Recognising these varying experiences, librarians at the BUAN Library strive to provide support and assistance tailored to the individual needs of beef production farmers. They understand the challenges faced by the older generation and technophobic individuals and work to address their concerns and facilitate their understanding and adoption of technology. Through patient guidance, training sessions, and personalised assistance, librarians aim to bridge the technological gap and ensure that all farmers can benefit from the technological resources available at the library regardless of their comfort level.

In conclusion, the experience of Lobatse beef production farmers using technology can be influenced by their comfort level and familiarity with the technology. While some farmers may readily embrace and utilise technological resources, others may face challenges due to limited exposure and technophobia, particularly among the older generations. However, librarians at BUAN Library are committed to providing necessary support and assistance to ensure that they can effectively access and utilise technology for their farming activities.

5.2.9 Factors that could influence the use of technology by Lobatse beef production farmers

Several factors influence the use of technology by Lobatse beef production farmers. These include access to technological resources, training and support, language barriers, and financial constraints. One crucial factor is the acceptance and education of the benefits of information technology. Beef production farmers must understand the advantages of technology in their farming activities such as access to valuable information, improved efficiency, and enhanced productivity. Librarians at the BUAN Library actively introduce information technology resources and services, providing beef production farmers with the tools they need to effectively utilise technology in their agricultural practices. They emphasised the importance of training to equip beef production farmers with the necessary skills to navigate and leverage these resources.

Training in basic IT skills plays a vital role in enabling farmers to use this technology. The BUAN Library organises training sessions tailored specifically to the needs of beef production farmers, ensuring that they acquire the fundamental skills required to access and utilise technological resources. Additionally, outreach programs are conducted to engage farmers actively and provide them with training opportunities. These initiatives aim to bridge the knowledge gap and empower beef production farmers to embrace the technology confidently.

Language barriers pose a challenge for beef production farmers to effectively utilise technology resources. The BUAN Library recognises this and makes efforts to address language barriers by assisting farmers in their local languages, thus enabling them to access information and communicate more comfortably. By breaking down language barriers, librarians facilitate smoother and more inclusive adoption of technology.

Financial constraints can also affect beef farmers' use of technology. Acquiring and maintaining technological resources can incur costs that may be challenging for beef production farmers. The BUAN Library understands these financial limitations and works to mitigate them by exploring avenues for subsidised or affordable access to technology. By seeking partnerships and funding opportunities, librarians aim to alleviate financial barriers and ensure that technology is accessible to all beef production farmers regardless of their financial situation.

Furthermore, the BUAN Library has taken proactive measures to reach beef production farmers by participating in agricultural shows and similar activities. These platforms provide an opportunity to engage directly with beef production farmers, share information about the library's resources and services, and address queries and concerns. By actively connecting with beef production farmers and disseminating relevant information, librarians can strengthen the links between technology and farming communities.

In conclusion, the factors influencing the use of technology by Lobatse beef production farmers at the BUAN Library included access to technological resources, training and support, language barriers, and financial constraints. The library actively addresses these factors by providing training, engaging in outreach programs, offering resources in local languages, and exploring avenues for affordable technological access. Considering these factors and tailoring efforts to meet the needs of farmers, librarians strive to promote the effective use of technology among beef

production farmers, ultimately enhancing their farming practices and overall agricultural productivity.

5.2.10 Librarian's role in promoting information technology use by Lobatse beef production

Librarians play a crucial role in promoting IT use of information technology among lobatse beef production farmers. Their responsibilities include providing access to technological resources and training, supporting and promoting available resources and services, and advocating for farmers' needs and interests. Librarians also collaborate with other stakeholders to develop and implement programmes and initiatives that support the use of technology in beef production.

To promote the use of technology, librarians actively teach and demonstrate various available information technology tools and services. They provide librarians with a role in promoting technology use among beef production farmers with access to technological resources such as computers, Internet connectivity, and relevant software. Through hands-on demonstrations and personalised guidance, librarians empower farmers to make up for most available technology resources.

Furthermore, librarians disseminate relevant beef production information through various channels including library websites and social media platforms. This proactive approach ensures that farmers are well-informed about the resources and services that can support their farming endeavours.

Collaboration is key to librarians' role in promoting technology use among beef production farmers. Librarians actively engage with industry associations and government agencies to develop programmes and initiatives that address the specific technological needs of the beef production sector. This collaboration helps to create a supportive ecosystem that facilitates the integration of technology into farmers' practices.

Additionally, librarians advocate for the needs and interests of farmers, acting as their voices and ensuring that their perspectives are considered in technology-related decision-making processes. They provided feedback and recommendations based on a thorough SWOT analysis, identifying the strengths, weaknesses, opportunities, and threats of the use of technology in beef production.

By advocating for farmers' interests, librarians contribute to the development of policies and strategies that promote effective and sustainable use of technology in the industry.

In summary, librarians play a vital role in promoting the use of information technology by Lobatse beef production farmers. By providing access to technological resources and training, offering technical support and training, promoting available resources and services, and collaborating with stakeholders, librarians can actively foster technology adoption and integration in beef production. By fulfilling their responsibilities, librarians contribute to the advancement of the agricultural sector and the overall growth and success of farmers, including beef production farmers.

5.2.11 Recommendations for farmers regarding adopting IT

Librarians at the BUAN Library strongly recommend that beef production farmers take advantage of the available information technology resources and training. By doing so, farmers can remain informed and up-to-date about industry trends and best practices, ultimately enhancing their agricultural practices and productivity.

One recommendation is for ‘farmers to participate in community group training sessions and to utilise mobile applications relevant to their farming activities. They are encouraged to exercise patience and start with phases, as technology takes time for most people to adopt. These sessions provide valuable insights and hands-on training on how to effectively utilise information technology tools and services. In addition, mobile applications can serve as convenient and accessible resources for farmers to access on-the-go information.

The BUAN Library provides open Wi-Fi access, laptops, and iPads for users. Beef production farmers are encouraged to utilise library resources to their advantage by accessing online databases, e-books, journals, and other digital resources available through the library to later apply to their agricultural activities.

Farmers who require additional assistance and support are encouraged to seek help from library staff. Our knowledgeable librarians are readily available to provide guidance, answer queries, and offer personalised assistance. Furthermore, participating in information literacy sessions can equip farmers with the necessary skills to effectively navigate and utilise available resources and services

at the library. They are encouraged to work in groups, learn from one another, be patient, and start with phases because technology requires time to adapt to other people.

Finally, librarians recommended that beef production farmers become members of the library and actively participate in training sessions specifically relevant to their areas of interest and needs.

In conclusion, the recommendation of beef production farmers regarding the use of IT is to use the resources and training provided. By actively engaging with available technology tools, seeking assistance from library staff, and participating in training sessions, farmers can harness the power of information technology to improve their farming practices, enhance productivity, and stay updated with the latest industry knowledge.

5.2.11.1 The role of libraries and librarians in beef production

Libraries are critical for providing information and promoting education in various communities, including farmers. Regarding beef production, librarians can provide valuable resources and support for Lobatse beef production farmers. To provide information to beef production farmers, librarians can curate the collection of relevant resources and disseminate information through various channels. This can include in-person interactions at the library, virtual interactions through digital platforms, and community outreach programs such as panel discussions and video and/or audio screenings, where information specialists can share knowledge and experiences with the community. Librarians can also use instant messaging and take advantage of free social networking sites, such as Facebook and MySpace, to share and transmit information.

Additionally, they can provide information literacy and digital literacy sessions targeting beef production farmers in their areas of expertise, such as beef production, cattle health, cattle breeding, genetics, best farming practices, and marketing and financing of beef products, and can assist farmers in navigating and utilising information technology tools and services provided by the library.

Librarians can also use information technology to bridge the digital divide by assisting farmers in improving their access to library information resources and services. This could involve offering

tutorials or webinars, creating user-friendly online interfaces to access resources, or providing remote assistance through digital platforms.

BUAN Librarians can communicate with Lobatse beef production farmers outside the library through various modes of communication such as email, phone calls, and messaging apps. They can track and measure the impact of information technology adoption by farmers by administering surveys with questionnaires about the types of technologies farmers adopt, their perceived usefulness, and the benefits and challenges they encounter while using these technologies. The survey results were analysed to measure their efficiency.

Librarians can also track the usage of technologies, such as databases and other online resources, which can provide statistics on farmers' levels of engagement and use of resources. Beef production farmers should also be encouraged to provide feedback on how IT adoption influences farming practices. This can be achieved by generating e-mail, e-forms, and interviews.

It is important to note that beef production farmers' attitudes towards the use of information technology may vary depending on factors such as access to technology, familiarity with technology, and cultural or socioeconomic factors. To promote positive attitudes towards the use of technology, librarians can provide tailored services and support that considers the specific needs and challenges faced by beef production farmers. However, most African librarians require better technical expertise to make most of the IT available to enhance their information services and attract all users (Mchombu & Beukes-Amiss, 2015:122).

5.2.11.2 The use of libraries by beef production farmers in Lobatse

Libraries are critical for providing information and resources to beef farmers worldwide. They offer a wealth of information about animal husbandry, pasture management, and meat processing. The information provided by libraries can help farmers improve their production methods, increase yields, and enhance the quality of meat products. They disseminate information and offer access to various subject areas depending on their clientele, and there has been a growing trend to adopt the electronic resources that libraries are now aspiring to achieve (Mugwisi, 2014:52–53).

In many countries, librarians actively engage with beef-producing farmers to provide relevant information and resources. They may interact with farmers on site in the library through community outreach programs or virtual channels. The methods of communication may vary depending on available resources and farmers' preferences.

Technology has become an essential tool for libraries and beef production. Information technology tools and services have made accessing and sharing information more accessible. IT is constantly evolving and the people responsible for its growth must remain informed. Fortunately, the internet and various agricultural databases provide a wealth of information that can be used by agricultural librarians, researchers, and extension officers. Availing this information and making it available to farmers in a way that is easy to understand leads to faster agricultural development (Lamptey et al., 2016:901). It would also be highly beneficial if librarians and other stakeholders joined forces to integrate the use of technology into every aspect of agricultural development.

Despite the benefits of this technology, there are challenges to its adoption by beef production farmers. Factors such as the availability of resources, level of digital literacy, and cultural attitudes towards technology influenced the extent to which farmers used information technology at Lobatse.

A study by Lamptey, Sambo, and Hassan (2016:906) shared the same citing that the dissemination of information is confronted with a significant challenge–the technological barrier where many farmers are not proficient in technology, significantly limiting its application in farming.

Therefore, there is a need for librarians to repackage information to suit African farmers who are mostly illiterate to ensure that the information is in a format that a farmer can comprehend, as echoed by Aina (2006:3) in his paper titled *"Information Provision to Farmers in Africa: The Library Extension Service Linkage."*

Libraries can play a vital role in addressing these challenges by providing relevant resources and training programs to help farmers navigate the technology.

In conclusion, libraries and librarians are essential partners of beef production farmers worldwide. They offer a wealth of information and resources, and their engagement can help farmers improve

their production methods and enhance the quality of meat products. As technology continues to play an increasingly important role in agriculture, libraries can help farmers harness their benefits and overcome challenges associated with its adoption.

5.2.11.3 Interventions

Interventions to assist farmers in adopting information technologies include training farmers when they come to the library and providing information on IT tools that they may use to boost beef production. These tools are available in databases and integrated library-management systems.

Information technology marketing and promotion for markets, vaccine information, community group training, mobile applications, and training participation were among the interventions used. These interventions are conducted through community outreach programs and agricultural shows, and incorporated within day-to-day library visits.

Information technology, such as social media, to disseminate important information, such as disease outbreaks and sensitisation about beef production and beef markets, is used to attract farmers in information technology. Hopefully, this associates the technology used with the usefulness of delivered information. Beef production farmers are likely to become interested in learning more about IT. For example, a farmer may not be interested in zoom video communications. However, if there are conferences on zoom video communication educating farmers on lucrative beef markets, the farmer is likely to develop an interest in learning how to use zoom video communication to access conferences.

5.3 Conclusions based on the study objectives

The conclusions that the researcher arrived at based on the study results are discussed below, along with the research objectives.

5.3.1 Objective 1: To assess the level of access to information technology resources (e.g. computers, internet, and databases) for beef production farmers.

Based on the findings of this study, farmers use IT to support beef production to a minimal extent. This was confirmed by the farmers and Client Services Library staff. The extent to which farmers

use IT on their farms is positively associated with their education level and perceived usefulness of IT tools. This implies that the more educated the farmer is, the more likely they are to use IT to improve beef production. Additionally, the more aware farmers are about the usefulness of a given technology, the more likely they are to use that technology.

5.3.2 Objective 2: To determine the extent to which beef production farmers in Lobatse, Botswana utilise information technology resources and identify factors that facilitate or hinder the use of information technology by beef production farmers in Lobatse, Botswana.

From the study findings, it can be concluded that beef production farmers use IT to a small extent by using computers and phones for social media and communication. Factors that hinder the use of IT by beef production farmers in Lobatse include lack of support from relevant agricultural institutions in Botswana, lack of relevant knowledge and skills, fear of technology, and lack of interest in technology and infrastructure to use technologies such as electricity and Internet connection.

Traditional beef production farmers are less interested in IT than commercial beef production farmers. However, all beef production farmers are willing to use more advanced information technology tools that can be adopted to improve beef production, such as augmented reality (RFID tags), robotics (for automated milking), drones, sensors, geographic information systems (GIS), weather information systems (WIS), and statistical modelling.

The BUAN Library has an array of IT resources that facilitate the use of IT from Internet access, computers, and agriculture databases and provides technical support and training. However, there is a need to exhaustively market the library to beef production farmers and offer more training and extension services to reach the farming community.

5.3.3 Objective 3: To explore the information needs and preferences of beef production farmers in Lobatse and Botswana and their perceptions of the usefulness and relevance of information technology

Based on the findings of this study, it is evident that beef production farmers require IT resources and services based on animal welfare, markets, government processes, and regulations with up-to-date information. Beef production farmers in Lobatse perceive IT as useful and relevant to their operations and believe that IT can promote beef production. However, they still prefer traditional methods of beef production farming, especially traditional beef farmers who lack IT skills. The findings report that given exhaustive training and specialised information on beef production as well as localised content, beef production farmers are willing to use the BUAN Library.

5.3.4 To provide recommendations for improving the use of information technology by beef production farmers in Lobatse, Botswana to enhance the productivity and profitability of beef production farms and promote the growth and development of the agricultural sector in the region

The findings show that the BUAN Library is making efforts to assist beef production farmers in utilising IT at the library. On offer are library spaces and infrastructure. The Library also offers Internet connection, computers, iPads, printing, and photocopying services, as well as online databases, library questions and answers, library guides and social media pages, and the library website where information is shared. The Library offered technical support, training, and extension work, although contact sessions were halted due to the covid-19 pandemic. The BUAN Library made efforts to reach beef production farmers virtually regrettable, and only a few beef production farmers were reached.

5.4 Recommendations

It is hoped that stakeholders may view the practice of engagement between universities and local communities as a formality and an underutilised avenue for deep learning inclined towards sustainable social change. Hopefully, this study opens new ideas to promote further research, debate, and action for relevant and tangible development. The researcher suggests the following

recommendations for this study, hoping that if put into positive thought, brings a change towards the use of information technology by beef production farmers in Lobatse, Botswana:

The library should focus on teaching and demonstrating available IT tools by promoting their usability to farmers. This encourages beef production farmers to develop more interest in using information technology. Specialised trainers should be recruited to ensure that the training of farmers is formalised with a specific curriculum and schedule. Farmers should also be awarded certificates when completing training courses. Certificate of completion is an excellent motivation for farmers and encourages them to use the library and attend more training.

According to Chisita (2011), libraries must promote various forms of knowledge to cater to all clientele, both internal and external, educated and non-educated. Libraries must package information and knowledge in order to meet the needs of indigenous communities for sustainable agricultural production. Knowledge centres should be developed to offer knowledge in all forms. Collection development should speak to all library communities and be balanced among all forms of print and electronic resources. Several studies encourage libraries to adopt the latest technologies, such as smartphones, and offer outreach programs to cater to farmers in the comfort of their farms and market days, as well as agricultural fairs (Siraj, 2010; Ramamritham, Bahuman & Bahuman, 2011; Sousa, Nicolay & Home, 2016; Das, 2017). The use of ICTs and mass media devices has also been encouraged.

The Ministry of Agriculture should utilise social media and mobile applications to sensitise and train farmers to use IT in beef production and agriculture in general. This is because most farmers already use social media on their phones, which creates an opportunity to easily reach them.

In countries such as New Zealand, Canada, and the USA, user support networks are encouraged to share information among farmers and social activities. In Ireland, farmers engage in discussion support groups to share market information and initiatives from which Botswana can draw (Harrington 2018).

Further studies should be conducted to cover a more extensive scope to increase the external validity of the findings and ensure that they can be generalised to the entire country. The study was only carried out within and around the Lobatse area of Botswana’s beef production

community, which lies on the southeastern side of the country. The findings of these studies guide policy development, and the availability of research-based evidence directs government policies towards promoting the use of IT by farmers to improve beef production. A similar study was conducted in all other areas of the beef production district of Botswana.

Because IT technologies are highly reliant on connectivity and modern electricity infrastructure with high-speed connections, the government must distribute resources evenly to cater to remote areas (Harrington 2018).

5.5 Summary of the Chapter

This chapter presents the interpretation and discussion of the results, the challenges faced by farmers in the adoption of IT, the interventions in place to assist farmers in adopting IT, the conclusion of the study based on the objectives set out, and recommendations for the research.

5.6 Conclusion

This study aimed to determine the use of information technology by beef production farmers in Lobatse, Botswana, and how it may benefit beef production practices to increase beef production. This was carried out in a pragmatic paradigm using a Technology Acceptance Model. The results of this study indicate that Lobatse beef production farmers used IT to support beef production to a minimal extent. They are inclined to use computers and cell phones, primarily for social media and farm communication. However, farmers are willing to use more advanced information technology tools that may be adopted to improve beef production. It was concluded that the main challenges hindering farmers from adopting information technology are lack of support from relevant agricultural institutions in Botswana, lack of relevant knowledge and skills, fear of technology, and lack of interest in technology and infrastructure to use technologies such as electricity and Internet connection (Muk & Chung, 2015).

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Appendices

Appendix A: Informed Consent & Questionnaire for farm-hold Manager/owner

Investigator:

My name is Lilian Mmapula Letshabo. I am a graduate student pursuing a Master of Philosophy in Digital Curation at the Department of Knowledge and Information Stewardship at the University of Cape Town. My supervisor's name is Dr. Patrick Mapulanga.

Purpose:

I am undertaking a research study in which I would like to invite you to participate as part of its population. This study is designed to investigate the use of Information Technology (IT) at the by beef production farmers in Lobatse and to collect data from the BUAN Library Client Services Unit. The interview will be held over the teams' video conferencing and scheduled for a time convenient for you, and involvement in the interview is voluntary. Your participation in this study is highly appreciated.

Agreement:

The interview session will be recorded with your permission, and a consent form will be signed by you if you agree to the interview before it commences. Kindly review the consent form carefully before making a decision. The interview session lasted for approximately 30 minutes.

Confidentiality and anonymity:

The collected data will be used for academic purposes only and in no way against the participants. Confidentiality will be maintained throughout. Only the researcher will have access to survey data. The data will not contain any identifying information to protect your privacy. The interview audio transcripts will be anonymised.

Contact information:

For any questions or clarity regarding the consent form and your right as a participant in the study, the following is the researcher's contact information and the supervisor's name and email address (Dr. Patrick Mapulanga, patrick.mapulanga@uct.ac.za). Note that a copy of this consent form is provided for your records.

Researcher	Lilian Mmapula Letshabo Email: ltslil001@myuct.ac.za Tel: +267 5330671/ +267 71922066

Participant informed consent

I read and understood the information provided for the study and obtained consent to participate. I have been given the opportunity to ask questions and they have all been answered satisfactorily. I **agree/ do not agree** to participate in the research study (circle appropriate).

Signature of research participant…… Date: ……..

Signature of researcher …… Date:……..

Questionnaire for farm hold manager/owner

Serial Number_____

Introduction

My name is Lilian Mmapula Letshabo. I am a Department of Knowledge and Information Stewardship student at the University of Cape Town, pursuing my Master of Philosophy, specialising in Digital Curation. I am conducting a study in partial fulfilment of the degree mentioned above. I request your participation.

Section A: Demographic information

Please tick the appropriate answer

Type of farm-hold

☐ Commercial farmer

☐ Traditional farmer

1. What is your highest level of **educational qualification**?

☐ Primary

☐ Secondary (High School)

☐ Tertiary (College or University)

☐ Other (s) specify_____

2. What is the **number** of beef livestock kept in the farmhold?

☐ Less than 50

☐ 51-100

☐ 101-150

☐ 151-200

☐ More than 200

3. Are you a regular **seller** of beef livestock with the Botswana Meat Commission in Lobatse?

☐ Yes

☐ No

Section B: BUAN Library Membership

4. Do you ever **use the library** in your community to access information technology (IT) tools and services?

☐ Yes

☐ No

5. Are you a **member of any library** within your community?

☐ Yes

☐ No

Section C: IT use at your farm hold

1. Which of the following **technologies do you use** in your farm hold?

☐ Electronic mail

☐ Internet

☐ Online databases

☐ Telephone applications

☐ Computer applications or programs (like MS Excel)

☐ Social media

☐ Other(s) specify_____
_____
_____

2. How do you **record important information** about farm activities?

☐ I do not record anything

☐ On paper

☐ On my smartphone

☐ On my computer

☐ Other(s) specify _____
_____
_____

3. Which of the following **factors affect your usage of technology**?

☐ No perceived economic benefits

☐ Cost of technology

☐ Lack of training

☐ I do not have enough time for technology
☐ I am not interested

☐ Other(s) (Please specify) _____
_____
_____

4. What do you think would be the **perceived consequences of not using technology**?

☐ No consequences

☐ Loss of competitiveness

☐ Loss of business

☐ Loss of connection to potential helpers

☐ Other(s) specify_____
_____

5. Would you **encourage other beef production farmers** to use technology once you have seen its benefits?

☐ Yes

☐ No

6. Which of these **technologies would you adopt** to help improve beef production on your farm? (Tick all that apply)

☐ Augmented reality (real-time use of information like live maps that identify real-time the location of individual cattle using RFID tags)

☐ Robotics (a type of robot that replaces a manual milking of a herd of cows with an automatic
milking system)

☐ Drones (airborne (flying) remote-controlled instruments that can collect data, such as aerial photographs)

☐ Sensors (a device that measures or detects changes in the farm condition and requires action on the part of the farmer, i.e. temperature, disease outbreak)

☐ Geographic Information Systems (GIS) (Information maps of disease incidence, prevalence,
mortality, morbidity on-farm, region, or national levels)

☐ Weather Information systems (information systems that provide a variety of weather information
for farming purposes)

☐ Statistical modelling (computer programs that predict feed costs, livestock fertility, and market
prices)

☐ Other(s) specify_____
_____
_____

7. Do you think that the government should **finance more agricultural technologies** to ensure that more farmers take advantage of their existence?

☐ Yes

☐ No

8. To better use the information **technologies available, I prefer**

☐ To own the IT equipment

☐ To hire the technology from another farmer or service provider

☐ To engage experts to use the technology on my behalf

☐ Others (please specify)_____
_____
_____

9. My **major challenge** in using information technology is:

☐ Lack of relevant knowledge and skills

☐ Lack of interest

☐ Fear of technology

☐ No support from local agricultural agencies and institutions

☐ Others (please specify)_____
_____
_____

10. The BUAN Library could help me to be more comfortable using technology by:

☐ Teaching me to use IT services effectively

☐ Providing IT training in a local language

☐ Demonstrating the capabilities of information technology at my farm,

☐ Others (please specify)_____
_____
_____

Section D: Seeks to gather your views about using IT at the BUAN Library for beef production using the Technology Acceptance Model.

Perceived usefulness: Please select the most appropriate response for each item. Tick (✓) into the spaces provided.

16. I believe i need help with information tools or assistance with using the following tools and interpreting data from them :

Sensors and devices	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
(a) Pasture growing measurement					
(b) Roughage intake					
(c) Animal tracking systems					
(d) Rumination sensors					

(e) Activity sensors					
(f) Electronic ear tags					
(g) Electronic weighing system					
(h) Camera monitoring					
(i) Concentrate feed intake					
(j) Transponder collar					
(k) Others (please specify)					

17. I believe using information technology tools and services would help me in selecting appropriate technologies for the following:

Electronic controls	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
(a) Automatic feeding system					
(b) Selection gates					
(c) Automatic calf feeder					
(d) Concentrate feeding station					
(e) Others (please specify)					

18. I believe using information technology tools and services will help me better manage the following:

Electronic data processing	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
(a) Pasture management					
(b) Disease detection					
(c) Feed ration planning					
(d) Oestrous detection					
(e) Data transfer into herd management systems					
(f) Others (please specify)					

Perceived ease of use: Please select the most appropriate response for each item. Tick (✓) in the spaces provided.19 For each statement below, please indicate the extent to which you agree or disagree that the IT factors listed are essential to your decision to use IT recording for farm management purposes:

Attributes	Disagree Strongly	Disagree	Neither agree nor disagree	Agree	Agree Strongly
(a) For me to decide to use IT in beef production processes, the ease of use of IT is essential to my decision to use it.					
(b) (a) For me to decide to use IT in beef production processes, the time					

required to use IT is important for me to decide to use it					
(c) For me to decide to use IT in beef production processes, IT must be **convenient to use**.					
(d) The use of IT in monitoring cow health is essential.					
(e) The use of IT in flock productivity is essential for beef production.					
(f) The cost of IT equipment is essential for my decision to use it for beef production.					
(g) Adopting IT by other beef production farmers is important for me and the beef production industry.					
(h) External support with IT is vital to my decision to use it for beef production.					
(i) IT that allows me to get more out of the veterinary consultation is vital to my decision to use it for beef production.					
(j) IT that makes it easier to receive information from the abattoir is vital to my decision to use it for beef production.					
(k) IT that helps with animal traceability is vital to my decision to use it for beef production.					

(l) IT that helps with genetic selection, genealogy, and crossbreeding is essential to my decision to use it for beef production.					
(m) Fears about technology failure and reliability issues are essential to my decision to use it for beef production.					
(n) Finding an appropriate beef management software package that meets my requirements is vital to my decision to use it.					
(l) Others (please specify					

Attitude towards using technology: Please select the most appropriate response for each item. Tick (✓) into the spaces provided**.**

20. For each statement below about IT in relation to farmers and the beef production industry, please indicate the extent to which you agree or disagree:

Attributes	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
(a) It adds to the complexity of information demands placed on beef production farmers.					
(b) Increased IT adoption and use in beef production are beneficial for the industry.					
(c) The government and the market have too much					

pressure on farmers to adopt modern technologies.					
(d) Current IT is not 'future proof' for the beef production industry; hence it is better to wait longer before investing.					
(e) Farmers need more support in developing the skills to use IT technologies effectively.					
(f) I am optimistic about using IT to enhance my farming beef production methods.					
(g) I believe using IT will provide a conducive learning environment in my workplace.					
(h) Others (please specify					

End of Questionnaire

Thank you very much for your participation

Appendix B: Informed consent & Interview schedule for BUAN Library staff

Investigator:

My name is Lilian Mmapula Letshabo. I am a graduate student pursuing a Master of Philosophy in Digital Curation at the Department of Knowledge and Information Stewardship at the University of Cape Town. My supervisor's name is Dr. Patrick Mapulanga.

Purpose:

I am undertaking a research study in which I would like to invite you to participate as part of its population. This study is designed to investigate the use of Information Technology (IT) at the BUAN Library by beef production farmers in Lobatse and to collect data from the BUAN Library Client Services Unit. The interview will be held over the teams' video conferencing and scheduled for a time convenient for you, and involvement in the interview is voluntary. Your participation in this study is highly appreciated.

Agreement:

The interview session will be recorded with your permission, and a consent form will be signed by you if you agree to the interview before it commences. Kindly review the consent form carefully before making a decision. The interview session lasted for approximately 30 minutes.

Confidentiality and anonymity:

The collected data will be used for academic purposes only and in no way against the participants. Confidentiality will be maintained throughout. Only the researcher will have access to survey data. The data will not contain any identifying information to protect your privacy. The interview audio transcripts will be anonymised.

Contact information:

For any questions or clarity regarding the consent form and your right as a participant in the study, the following is the researcher's contact information and the supervisor's name and email address (Dr. Patrick Mapulanga, patrick.mapulanga@uct.ac.za). Note that a copy of this consent form is provided for your records.

Researcher

Lilian Mmapula Letshabo

Email: ltslil001@myuct.ac.za

Tel: +267 5330671/ +267 71922066

Participant informed consent

I read and understood the information provided for the study and obtained consent to participate. I have been given the opportunity to ask questions and they have all been answered satisfactorily. I **agree/ do not agree** to participate in the research study (circle appropriate).

Signature of research participant…… Date: ……..

Signature of researcher …… Date:……..

Use of information technology of the BUAN Library by beef production farmers

in Lobatse, Botswana

Interview questions for Library Staff at BUAN Library

Introduction:

My name is Lilian Mmapula Letshabo. I am a Department of Knowledge and Information Stewardship student at the University of Cape Town, pursuing my Master of Philosophy, specialising in Digital Curation. I am conducting a study in partial fulfilment of the degree mentioned above. I request your participation.

Biographical Information

1. Please introduce yourself and tell me about your role at the Botswana University of Agriculture and Natural Resources (BUAN) Library.

2. State your highest academic qualification and areas of LIS expertise.

3. How long have you been employed at the BUAN Library?

Section A: Library Client Services

1. What is your position in the BUAN Library Client Services Unit?
2. What functions or roles are performed in this position in the BUAN Library Client Services Unit?

Section B: Perceived Usefulness

3. What do you specifically do about providing information to farmers, particularly the Lobatse beef production farmers?

4. How often do you interact with beef production farmers in your functions at the BUAN Library?
5. How do you interact with the farmers at the BUAN Library? Hint (remote interaction, virtual interaction, on-site).
6. How often do you interact with farmers in the BUAN Library?
7. In what other ways do you interact with beef production farmers outside BUAN Library? Hint (community outreach programs, information literacy sessions, and digital literacy sessions targeting beef production farmers).
8. What information technology tools and services do farmers use in your BUAN Library?
9. Which information technology tools and services provided by the BUAN library would you recommend to Lobatse beef production farmers, and why?
10. Are there any specific interventions that the BUAN Library uses to promote information technology adoption by farmers?
11. In what ways do you feel that the library may use information technology resources to assist farmers in improving their access to library information resources and services [for what purpose]?
12. What recommendations do you have for farmers regarding adopting information technology at BUAN Library?

Section C: Perceived Ease of Use

13. What mode of communication do you use with lobatse beef production farmers outside the library offsite?
14. What is your experience using technology by Lobatse beef production farmers at the library?
15. In your view, what factors could influence the use of technology by Lobatse beef production farmers at the BUAN Library?
16. To what extent do you feel that Lobatse beef production farmers use information technology to improve beef production?
17. Are any services tailored explicitly for Lobatse beef production farmers at the BUAN Library? What are the factors involved?
18. What is the role of librarians in promoting information technology use by Lobatse beef production in the BUAN Library?

Section D: Attitude towards the use of a technology

19. Do Lobatse beef production farmers use information technology services at the BUAN Library? (If Yes, proceed to Questions 20, 21, and 22. If No, please proceed to Questions 21 and 22).
20. Among the information technology tools and services, which farmers most prefer?
21. Does the Library measure the impact of the information technology adopted by farmers?

22. What would you say are the perceptions held by beef production farmers about adopting the use of information technology in the library?

End of Interview Thank you very much for your participation.

Appendix C: Ethics Clearance Letter from the University of Cape Town

Department of Knowledge & Information Stewardship
University of Cape Town
Upper Campus

Private Bag X1, RONDEBOSCH, 7701 South Africa
Level 5, Hlanganani, The Chancellor Oppenheimer Library
Tel: +27 (0) 21 650 4546 Fax: +27 (0) 21 650 2529
E-mail: dkis@uct.ac.za
Internet: www.dkis.uct.ac.za

Ref No.: UCTDKIS2022-03-03

22 April 2022

Ms Lilian Letshabo
Department of Knowledge and Information Stewardship
Chancellor Oppenheimer Library
University of Cape Town

Ethics approval for Master's research

Dear Ms Letshabo

I am pleased to inform you that ethics clearance has been granted by the Ethics Review Committee of the Department of Knowledge and Information Stewardship, Faculty of Humanities, for you to proceed with collecting data for your Master's study on '**The use of information technology of the BUAN Library by beef production farmers in Lobatse, Botswana**'.

As a next step, please ensure that you obtain approval from the relevant ethics committees to collect data at your data collection sites, as necessary.

We wish you well with your data collection and the completion of your research.

Yours faithfully,

Mr Richard Higgs
Chair: Department (DKIS) Research Ethics Committee

Appendix D: Authorisation Letter from BUAN

BUAN
BOTSWANA UNIVERSITY OF AGRICULTURE AND NATURAL RESOURCES
Inspiring Sustainable Growth

Private Bag 0027, Gaborone, Botswana
Content Farm, Sebele, Gaborone, Botswana
+267 3850100

Our Ref: BUAN/6/1/1 4th May 2022

Lilian Mmapula Letshabo
Department of Knowledge and Information Stewardship,
Humanities Faculty
University of Cape Town

Issuance of Research Permit: Lilian Mmapula Letshabo

Reference is made to your application for issuance of research permit, to conduct survey at the Department of Library Services: Client Services Unit, Botswana University of Agriculture and Natural Resources (BUAN). This is in fulfilment of your studies for MPhil in Digital Curation with the University of Cape Town.

BUAN is very pleased to inform you that permission has been granted in respect of your research request on conducting survey on **"The use of information technology of the BUAN Library by beef production farmers in Lobatse, Botswana"**. You are therefore advised to abide by research ethics, present this letter to all your key stakeholders, upon arrival and during your research tenure. You are also requested to share your research thesis with BUAN, once completed.

Thank you.

BOTSWANA UNIVERSITY OF AGRICULTURE & NATURAL RESOURCES
04 MAY 2022
DEAN
RESEARCH AND GRADUATE STUDIES

Yours sincerely,

Samodimo Ngwako
Dean, Research and Graduate Studies
Email: sngwako@buan.ac.bw; Tel: +267 3650100/117

Appendix E: Authorisation Letter from Ministry of Agriculture

TELEPHONE: +267 3668100
FAX: +267 3928965
TELEGRAMS: RESAGRIC
REFERENCE: AR 7/6 I (98)
EMAIL: dar@gov.bw
WEBSITE: www.dar.gov.bw

DEPARTMENT OF AGRICULTURAL RESEARCH
PRIVATE BAG 0033
GABORONE

MINISTRY OF AGRICULTURE
ALL CORRESPONDENCE TO BE ADDRESSED TO: THE DIRECTOR OF AGRICULTURAL RESEARCH

5 May 2022

Department of Knowledge and Information Stewardship
Humanities Faculty
University of Cape Town
Private Bag X1
Rondebosch, 7701
RSA

ATT: Ms Lilian M. Letshabo

Dear Ms Letshabo,

RE: REQUEST FOR PERMISSION TO UNDERTAKE RESEARCH

Reference is made to your letter dated 16 February 2022 on the above subject.

Your request for permission to undertake research survey on farmers around the Lobatse area is acceded to. You are expected to exercise the outmost consideration to the research ethics with regard to use of personal information collected from farmers in your study. We also hope your study findings will be shared with the same community to enable them in advising for policies that will better serve their needs and the needs of the nation.

Thank you.

Yours sincerely,

Lekgari A. Lekgari, PhD
For/ACTING DIRECTOR OF AGRICULTURAL RESEARCH