

ROLE OF INDIGENOUS KNOWLEDGE SYSTEMS ON CATTLE PRODUCTION IN WATER-STRESSED RESOURCE-LIMITED HOUSEHOLDS IN MUSINA MUNICIPALITY, LIMPOPO PROVINCE

by

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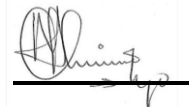
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JUNE 2023

DECLARATION

I, Nephawe Ndivhoniswani, hereby, declare that this dissertation for Masters in Rural Development (AGMARD) submitted to the Institute for Rural Development at the University of Venda has not been submitted previously for any degree at this or another university. It is original in design and in execution, and all references material contained therein has been duly acknowledged.

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ABSTRACT

The world today is being challenged to consider utilising Indigenous Knowledge Systems (IKS) for livelihoods, animal production and the environment care. The application of IKS in cattle production and water conservation thereto is of great importance in this modern time. Since even at this stage, IKS remains one most important method that cattle farmers can use because it is cheaper and easy to apply. The study was designed to determine the role of IKS on cattle production under water-scarce conditions; the importance of IKS in cattle selection and assess the importance of applying IKS on cattle production in rural development. A qualitative design was employed and the respondents were selected using purposive sampling procedure. Data were collected using open-ended type of questionnaire and face-to-face interviews. Qualitative data were analysed using the Atlas ti version 8 software. Cattle were selected using purposive sampling method. Data on IKS, cow production and water security was gathered using a semi-structured questionnaire and participant observations. Challenges to cattle production under water-scarce conditions included increased prevalence of diseases and parasites, dehydration, lack of resources to sustain cattle, unavailability of fodder, and limited access to water. Farmers use IKS to deal with gastro-intestinal parasites, treatment of wounds, maintenance of health, parasites detection, prevention of dystocia and loss of body weight. In selecting cattle, farmers preferred large-framed bulls and cows with short horns and brown coat colour. IKS remain vital in advancing cattle farming in most of the rural households. It is highly recommended that farmers should document the IKS for future reference and also to teach up and coming farmers about the IKS in order for them to continue the legacy. Also, water conservation to IKS should be promoted amongst the farmers to sustain water that cattle can use.

Keywords: Cattle selection, Indigenous Knowledge, rural development, water security

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DEDICATION

I dedicate my work to the highest God. Matthew 19:26 says 'With man this is impossible, but with God all things are possible'.

I dedicate my work to my mother N.I Lalumbe

I dedicate my work to my people Adivhaho Nephawe & Olugaho Nephawe

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ABBREVIATIONS

COVID 19 – Corona Virus 2019

DALRRD – Department of Agriculture, Land Reform and Rural Development

FAO – Food and Agriculture Organization of the United Nations

GDP – Gross Domestic Product

IAEA – International Atomic Energy Agency

IK – Indigenous Knowledge

IKs – Indigenous Knowledge's

IKS – Indigenous Knowledge System

IKSs – Indigenous Knowledge Systems

POPI – Protection of Personal Information

PRA – Participatory Rapid Appraisal

SA – South Africa

SAIL – Sustainable Agriculture Information Initiative

SDGs – Sustainable Development Goals

SSA – sub-Saharan Africa

UN – United Nations

CHAPTER 1: INTRODUCTION

1.1 Background

Indigenous Knowledge Systems (IKS) have been a reliable source of knowledge used by households to achieve their socio-economic goals (Priyadarshi & Abhilash, 2019). Indigenous communities have developed critical skills and knowledge as they effectively secured water for irrigation, livestock production, domestic consumption and as they moved from one area to another in pursuit of water to sustain their lives. Indigenous communities survived centuries before imported technologies for water security came into being. For world development and sustainability, water plays an important role in every sphere. Most countries are creating mechanisms that can help to secure water (Wahyudi & Angelika, 2014). This is in line with the Sustainable Development Goal (SDG) Number 6 which aims to achieve universal and equitable access to safe and affordable drinking water by 2030 (United Nations, 2015a). Also, this is important in promoting the role of IKS on water conservation for livestock, during drought and dry conditions.

The IKS is used to conserve water for livestock through participatory based natural resources management. In addition, farmers use their IKS to come up with effective bylaws to manage challenges during drought condition. Moreover, the level of water scarcity can be reduced with proper grazing management. Cattle production needs large amount of water for various purposes such as consumption and fiddery. The use of IKS for conserving water for livestock can be effective in improving water scarcity in households and communities (FAO, 2018). Correspondingly, meat, milk, wool, bones and hides can be used to generate household income using trade. Therefore, water conservation remains an important factor in advancing the needs of the farmers.

Each community has unique experiences in indigenous water conservation that plays a vital role in the day-to-day lives of its local people (David & Ploeger, 2014). Indigenous knowledge connects people to their traditional ways of doing things (David & Ploeger, 2014). The need to mainstream indigenous knowledge (IK) and traditional practices into sustainable development has been well acknowledged, including the 1989 Indigenous and Tribal People Convention, the 2007 United Nations Declaration on The Rights of Indigenous People and the 2015 Paris Agreement on Climate Change (Merino & Gustafsson, 2021). In Africa, these knowledge systems are transmitted and renewed by each succeeding generation. Indigenous knowledge is a social capital for resource-limited households and is relied upon for food production and survival. Hailu (2017) reported that more than 60% households in Africa rely on indigenous knowledge. For example, Tanzania, Uganda, Zambia, Zimbabwe and South Africa still rely on

indigenous knowledge for livestock farming (Hailu, 2017). Nevertheless, there is a need to understand the concepts of indigenous knowledge.

Indigenous knowledge (IK) is a wisdom that develops within a particular culture and specific geographical area and has been orally transmitted from one generation to another through art, songs, stories and laws (Rusiro *et al.*, 2013). The knowledge originates from indigenous communities and is maintained by local people, usually in the rural areas, through their extended interaction with their environment (Boven & Morohashi, 2002). The use of IK is especially relevant to resource-limited communities that have high illiteracy levels and are unable to access information (Muyambo *et al.*, 2017). Agricultural decisions made, based on IKS, help farmers to prepare and cope with catastrophes, climate change and water insecurity included (Warren, 1991). The establishment of a Democratic Government in South Africa in 1994 ushered in a new era where indigenous farming would no longer be alienated by the majority (Magoro, 2004). This becomes crucial in promoting water security.

Water security is a concern for many national governments and policy-making bodies the world over. Currently, more than one billion people lack access to safe drinking water, while 2.4 billion people lack access to water for improved sanitation (Thopil & Pouris, 2016). Water shortages have, therefore, led to increased attention to rethinking IK that has been used to sustain communities (Thopil & Pouris, 2016). There is a need to unpack and unbundle affected communities' perceptions on the use and adoption of IKS pertaining to water security and livestock management.

Based on population and economic growth projections, water demand in South Africa is estimated to be 17.7 billion m³ by 2030 (Garutsa, 2019). This means that South Africa could have a 17% gap between supply and demand by 2030 (Garutsa, 2019). Indigenous knowledge systems (IKSs) are potentially transformative if they are effectively integrated into water conservation and management systems, not only as a matter of redress but also to enrich the current water systems (Mlobela & Sinha, 2018). IK provides a sound platform for the conservation and management of water in rural areas (Mahlangu & Garutsa, 2014). The IKS has the potential to play a vital role on water conservation and livestock management in the Limpopo province (Thopil & Pouris, 2016), where water shortages persist. In Musina, for example, ambient temperatures are usually high and rainfall is intermittent and most communities rely on borehole water for sustenance. The boreholes are expensive to construct. For communities where boreholes have been erected, they are poorly maintained and even vandalised. Investigating role of IKS on cattle production in water-stressed resource-limited communities is necessary to develop strategies for sustainable cattle production and hence rural development.

1.2 Statement of the problem

Water security for human consumption and livestock watering is a huge concern in developing countries particularly in South Africa (Mahlangu & Garutsa, 2014). Incorporation of IKS to provide solutions to water shortages and insecurity is limited yet there is evidence for its application before the introduction of Western technologies. There are misgivings on the extent to which IKS can play a role in water conservation to improve cattle productivity in resource-limited communities. It is becoming increasingly important to assess the involvement and improvement of IKS in cattle production, which is seriously threatened by water insecurity. Water is essential for drinking and growth of forages (Gül & Deveci, 2022). The availability of water for human consumption and cattle is getting scarce, calling for the need to sustain and develop IKS methods of improving cattle productivity (Edgar & Lee, 2022). Investigating the role of IKS on cattle production in water stressed resource-limited households, therefore, becomes important. The role of IKS need to be increased through government involvement and support, and developing appropriate strategies to disseminate the knowledge to ensure that it is used appropriately and effectively. The knowledge holders need to be identified and involved in the design and implementation of any strategies to be developed. Similarly, Domboni village in the Musina municipality of the Limpopo province requires much attention on the implementation of IKS, since the village is mostly affected by drought and dry conditions. However, the environmental factors such as drought and dry conditions need the involvement of knowledge holders to bring solution to their problem.

1.3 Justification

In most water-stressed resource-limited communities, IKS and cattle production are overlooked. IKS is cheaper and easily accessible by all farmers compared to the expensive modern methods. It can be transmitted from generation to generation making it easier for new farmers to adopt to without any further expenses compared to other methods that require a lot of trainings, workshops and involve a lot of money. In this study, the beneficiaries are the Domboni farmers who enjoy to apply the IKS methods to their farming systems.

Most resource-limited households strongly rely on IKS in the management and production of their cattle. These households also apply conventional cattle management technologies for parasite control, vaccination against diseases, to complement IKS. There is need to advocate and promote the utilisation of IKS on water security and cattle management. The utilisation of IKS is sustainable and does not rely on employing modern mechanisms. The IK is locally accessible, available and is user-friendly as no academic skills are required. Additionally, it does not require much time and money. Exploring the interface between IKS and cattle production in water-stressed environments is expected to add a voice in the academic discourse of the IKS. Also, most resource-limited households are voiceless. Lack of

participation in the decision-making embedded the communities to the voiceless and their views are hardly considered in development of policies that govern the utilisation and sustenance of livestock as well as other natural resources that are integral to their livelihoods and wellbeing. The research gap that the current research seeks to fill was based on the idea that the IKS knowledge is still present, but most of the knowledgeable individuals hardly share the knowledge with their contemporaries. Therefore, this is a threat the knowledge may disappear, if it is not captured and disseminated. Conventional knowledge is preferred by the young generation and is disseminated widely, further threatening the existence and adoption of indigenous knowledge.

1.4 Objectives

The broad objective of the study was to explore the role of IKS on cattle production in water-stressed resource-limited households. The specific objectives were to:

1. Determine the role of IKS on cattle production under water-scarce conditions; and
2. Assess the effects of indigenous cattle selection strategies on rural development.

1.5 Research questions

The main research questions were:

1. What is the role of IKS on cattle production under water-scarce conditions?
2. What are the effects of indigenous cattle selection strategies on rural development?

1.6 Operational definitions of key terms and concepts

Indigenous knowledge system - ways of (relational) knowing and living that evolved among groups that were initially indigenous to a particular geographical location.

Water security –the adaptive capacity to safeguard the sustainable availability of, access to, and safe use of an adequate, reliable and resilient quantity and quality of water for health, livelihoods, ecosystems and productive economies.

Water conservation - a system or process by which efficient water usage is practiced to reduce loss of water or misuse of water (SAII, 2011).

Cattle management - the activities carried out by cattle producers to raise cattle from day-old to the point of marketing or disposing the cattle.

Cattle production –the quantity and quality of production characterising single cattle during a specific period (day, month, lactation period, year, and lifetime). Production depends on features of a given animals based on species, breed, and age.

Cattle selection - a process in which a certain individual in a population is preferred over the others for producing the next generation. The selected cattle should meet the requirements of the breeding objective and will, in a breeding enterprise, pass particular characteristics to future generations.

1.7 Outline of the dissertation

This dissertation consists of six chapters. Chapter 1 outlines a background of the study, problem statement, justification of the study, the objectives, research questions, hypothesis, and operational definitions of key terms in what the study eventually seeks to achieve. The literature review based on the two research objectives is presented in Chapter 2. Chapter 3 provides the methodology that focuses on qualitative and quantitative approaches. Chapter 3 presents a detailed discussion of the study site, population, techniques that were used to obtain and analyse data and research ethical considerations for the study. Chapter 4 deals with the relationship between IKS challenges in cattle production under water-scarce conditions. The role of indigenous methods of cattle selection on rural development are described in Chapter 5. Chapter 6 gives the general discussion, recommendations, and conclusion.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

There is little information on the utilisation of IKS on cattle selection. Moreover, the role of cattle selection and productivity on the development of water-stressed resource-limited communities has not received the attention that it deserves. The chapter reviews literature on the relationships between IK, water scarce conditions and cattle productivity for water sustenance among resource-limited households.

2.2 Importance of cattle production

Globally, livestock farming is important. Livestock is a source of livelihood for resource-limited households (Lumu *et al.*, 2013). This is driven by the rapid increase in the demand for livestock products (Thornton, 2010). Livestock is important for the provision of food for the region and source of income for the resource-limited households (Pérez-Escamilla *et al.*, 2020). Cattle farming is an important part of national development plan. The importance of cattle farming includes increasing the quality of human resources, income and welfare of farmers, preserving the environment and increasing the country's foreign exchange, to sustain poverty reduction (Pica-Ciamarra *et al.*, 2011). Cattle farming is important for the production of commodities such as meat and milk. Also, it is important in meeting the needs of animal proteins to improve the quality of human resources (Tenrisanna & Kasim, 2021). Cattle contribute to household livelihoods in terms of cash income or savings. Moreover, livestock provide manure, draft power and transport services, source of wealth or social status (Pica-Ciamarra *et al.*, 2011).

Cattle play an integral role in the African economy and society with about 150 cattle breeds and over 312 million cattle present (Kim *et al.*, 2017). Sub-Saharan Africa (SSA) has one of Africa's largest cattle populations estimated to be over 155 million (Mwai *et al.* 2015). In Zimbabwe, livestock contribute 25% to agricultural Gross Domestic Product (GDP) and cattle contribute almost half of the 25% (Mutibvu *et al.*, 2012). In addition to meat and milk, communal farmers depend on cattle for draught power, manure, cash and socio-cultural uses (Mapiye *et al.*, 2009). Maasai traditions of Kenya view the cattle that they rear as a gift from God (Galaty, 1982). that Zimbabwe's cattle population is estimated 5 million, 91% of which is found in semi-arid and semi-humid communal rangelands (Gororo *et al.*, 2017; Nyamushamba *et al.*, 2017). Cattle productivity under communal rangelands in SSA is constrained by a myriad of challenges including lack of effective veterinary support, feed and water shortages, drought, parasites and diseases, poor access to extension services, lack of markets, small herd sizes and very low off take (Mapiye *et al.*, 2009, 2018; Khapayi & Celliers, 2016). Some rural communities use or apply indigenous knowledge on animal medicine. These environmental challenges are similar in both semi-arid and sub-humid regions depending on type on location (Dzavo *et al.*, 2018).

The most noticeable differences are availability of wetland patches, riverbanks and perennial rivers that can help sustain cattle during drought periods in sub-humid areas (De Haan *et al.*, 2016). Roland *et al.* (2016) indicated that drought stress on calves negatively affects the animal welfare condition and besides causing direct losses due to mortality and indirect costs caused by reduction in bodyweight gain. In this way, heat stress interferes with the growth and development of calves and also affects their production.

In developing countries, cattle production is below its potential due to inadequate feeding systems, low reproduction efficiency, high prevalence of diseases and parasites and the lack of effective veterinary support. Correspondingly, this is exacerbated by water insecurity. Cattle management has been met with limited or lack of grazing land (Doumbia *et al.*, 2012), lack of access to medications (Usha *et al.*, 2016), seasonal changes in feed quality (Ritter *et al.*, 2012), high prevalence of diseases and parasites (Nabukenya *et al.*, 2014; Raot *et al.*, 2016). There is a limited number of people with IK on animal medicines. Most resource-limited cattle farmers depend on natural pastures and forages usually found in communal grazing areas (Matlabyane *et al.*, 2010). Due to lack of standardised feeding management practices, the natural pastures become overgrazed. Likewise, they cannot provide adequate nutrients for expected level of cattle productivity (Mogale, 2017). Additionally, poor productivity occurs during the dry season when there is low quantity and quality of available forages that cannot meet nutrient requirements of grazing cattle. In this regard, Limpopo Province is no exception (Matlabyane *et al.*, 2010).

In Limpopo, agriculture plays an important role in its economic development. Agriculture is an important employer in the province accounting for 18% of formal employment and 25% of informal employment (Department of Agriculture and Rural Development, 2017). However, it is the most important role player in the provinces.

2.3 Use of indigenous knowledge in cattle production

In Africa, IKS remains one most undermined resource that is owned by rural people since they have been the last to be mobilised for sustainable development (Maunganidze, 2016). The use of IK as a means of raising production level and living standards is disappointing at best (Brings & Moyo, 2012).

2.3.1. Use of indigenous knowledge in cattle health

Rishi and Krishi regions in India have a rich heritage of traditional health control and several treatment systems that have been used for animals since time immemorial (Devaki & Mathialagan, 2015). These practices considered to be the holistic approach for cattle management methodologies adopted by non-literate cultures (Devaki & Mathialagan, 2015). In most societies, there are experienced and knowledgeable specialists who use IK. The IK is transmitted verbally from one generation to the next. (Devaki & Mathialagan, 2015). Cattle farming is the major occupation of most parts of South Asia. However, due to lack of resources and limited access to conventional medicine, most of the cattle farmers use traditional plants to treat their animals (Suroowan *et al.*, 2017). In the developing world, IK is an important sector for livestock production.

2.3.2 Indigenous knowledge on cattle breeding

Cattle breeding plays an important role in increasing the production efficiency of cattle (Seidel *et al.*, 2020). IK for cattle breeding is the most important aspect in the region (Garner *et al.*, 2016; Mapiye *et al.*, 2019). Indigenous cattle breeds are currently underutilised in the commercial sector largely due to their slow growth rate and low carcass yield (Feliuss *et al.*, 2011; Raffrenato, *et al.*, 2017). However, indigenous breeds can survive harsh climatic conditions such as water scarcity, drought and dry conditions (Mapiye *et al.*, 2019).

Adaptive traits should be considered to ensure equitable and sustainable sharing of benefits derived from the cattle, and when developing strategies to respond to climate change as well as future policy and regulatory measures (Mapiye *et al.*, 2019). Sustainable use of indigenous breeds adapted to the harsh local environmental (i.e. feed and water scarcity and extreme temperatures) and socioeconomic conditions are unlikely to be optimal without addressing non-genetic factors (Rege *et al.*, 2011). Knowledge of population structure and genetic diversity among indigenous cattle breeds is, nonetheless, important for genetic improvement as well as their subsequent conservation and sustainable use (Nyamushamba *et al.*, 2017; Van Marle-Köster & Visser, 2018).

Indigenous cattle breeds are used for multiple purposes, particularly for milk, meat and draught power provision including manure production (Tucho *et al.*, 2021). Dzavo *et al.* (2019) indicated that, in Zimbabwe, Mashona cattle were the most preferred breed in both semi-arid and sub-humid regions. The preference for the Mashona breed was due to their adaptation to harsh environmental conditions such as water scarcity and extreme temperatures. Similar sentiments were echoed by Matope *et al.* (2020).

Indigenous breeds are compatible with the local environment and, thus, are usually healthy under the harsh environments (Dzavo *et al.*, 2019). The quest for fast-growing large-framed breeds coupled with uncontrolled mating has, however, resulted in a population of largely non-descript breeds with varying morphological characteristics and production performances under harsh environmental conditions (Nyamushamba *et al.*, 2017). Admiration of large-framed breeds could be because of the mistaken perception that the breeds are more productive than small-framed breeds (Zindove *et al.*, 2014). This perception is based on performances in environments that are conducive to the large-framed breeds (Scholtz & Theunissen, 2010; Nyamushamba *et al.*, 2017). Farmers should be encouraged to stick to local cattle breeds that have a higher capacity to consume and digest fibrous diets (Zindove *et al.*, 2014; Mkize & Zishiri, 2021).

2.3.3 Indigenous knowledge methods in water conservation

The misinterpretation of oral histories and IKS by both government and science is a recognised threat that may impede the elders' willingness to transmit their experiences and cultural knowledge (Latchmore *et al.*, 2018). A number of Indigenous knowledges (IKs) are potential transformative tools if they are effectively integrated in water conservation and management systems not only as a matter of redress but also to enrich the current water systems. Local knowledge systems provide a sound system for the conservation and management of water in rural areas.

Nonetheless, many indigenous people, often taking the form of stories and traditional teachings, speak of the great significance of the spiritual connection between land, water and animals and support indigenous way of knowing (McGregor, 2012). In this regard, indigenous people play a fundamental role in water resource protection and are considered the primary holders of knowledge in indigenous communities (Anderson *et al.*, 2013). Additionally, the collection and consumption of water from natural resources such as local springs and aquifers is a common practice among indigenous people that dates back to the pre-colonial contact era (Daley *et al.*, 2015).

2.4 Cattle production and the availability of water

The main climate changes perceived by pastoralists include more erratic and reduced amounts of rainfall, rise in temperature and prolonged and frequent periods of drought (Kimaro, 2018). Pastoralists mainly view population pressure and tree cutting as the major causes of climate change. The severe recurrent drought periods result in shortage of forage and water, leading to cattle starvation and malnutrition. Pastoralists reported massive cattle deaths and outbreaks of diseases such as contagious bovine pleuropneumonia and tick-borne diseases. Further, reduction in milk production and poor livestock market prices were also reported as negative impacts on cattle production (Kimaro, 2018).

Rainfall variability is of great importance (Leweri, *et al*, 2021). Cattle production activities are heavily dependent on rainfall. The impact of rainfall on cattle production has often been expressed as a drastic decline in cattle population in the years following drought incidents (Kariuki *et al.*, 2018; Kimaro *et al.*, 2018). However, recurrent drought periods have caused massive losses of cattle. Droughts have led to severe feed shortages and water scarcity, that lead to serious socio-economic challenges (Alves, 2020; Leweri *et al.*, 2021).

Water and feed intake are the basics for the survival and production of cattle. Climate change is, therefore, likely to affect the production and reproductive performance of cattle through its indirect effects on the quantity and quality of pastures, availability of water, and posing thermal stresses on animals (Thornton *et al.*, 2009). Cattle farming is an integral component of South Africa's agricultural industry contributing more than 27 % of total agricultural output (DAFF, 2017). It is, therefore, crucial to select cattle that are resilient to climate change effects.

2.5 The role of selection and impact on rural development

Selection criteria for Ankole cattle to a large extent are similar to criteria used by other pastoral cattle keepers in the East African region. For example, large body-sized bulls are preferred by the Karamojong (Loquang, 2003), Kenyan Maasai (Kavana *et al.*, 2005), Tanzanian Maasai (Yiapin, 2003), Ethiopian Boran (Halake, 2003) and the Beni-Amer of Eritrea (FAO, 2003). Bulls, whose close female relatives (grand dams, dams and female siblings) produce much milk, have higher survival rates, are drought tolerant and grow faster and are also preferred by Tanzanian Masaai (Yiapin, 2003), Karamojong (Loquang, 2003) and Ethiopian Boran (Halake, 2003). Ankole cattle are superior to the East African Zebu in body size and weight. Kungonza *et al.* (2012) indicates that superiority is mainly as a result of the cattle being raised in locations that have better forage biomass yield and a relatively more conducive climate. However, Ankole cattle are inferior in milk yield when compared to East African cattle. Sustainable breeding program of cattle in the coming climate change scenario need to consider selection of breeds that are heat tolerant, feed efficient, disease and parasite resistant and that will survive and produce at optimum satisfying preference of the society (Mummed, 2019).

Kungonza *et al.* (2012) also indicated that during selection of both bulls and cows, emphasis should be put on production traits. Aesthetic and adaptation traits should, nevertheless, be incorporated. A breeding programme should eventually be developed, clearly considering the traits of interest of cattle owners. A selection index which considers the value of the different traits should be a key tool in implementing such a programme. Indigenous methods used in cattle selection need to be understood to ensure sustainable production of cattle.

2.6 Summary of literature review

The use of IKS remains critical as most of the cattle farmers are shifting to Western ways of farming which are technological dependent. Appropriate selection of cattle improves productivity. This is where IK on cattle breeding comes in, especially where droughts are frequent and negative impact during dry seasons. IKS methods application in water conservation has seen cattle farming surviving challenges such as poor water conditions, seasonal water availability and long distance to water sources. Producers of meat and milk have to consider IKS processes to increase productivity during droughts. The availability of water can increase cattle production. As a result, IKS becomes a center point to consider when doing cattle farming in the remote areas. Lack of IKS exposure to emerging cattle farmers can make the knowledge to disappear. The chapter that follows presents the methodology adopted for the study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

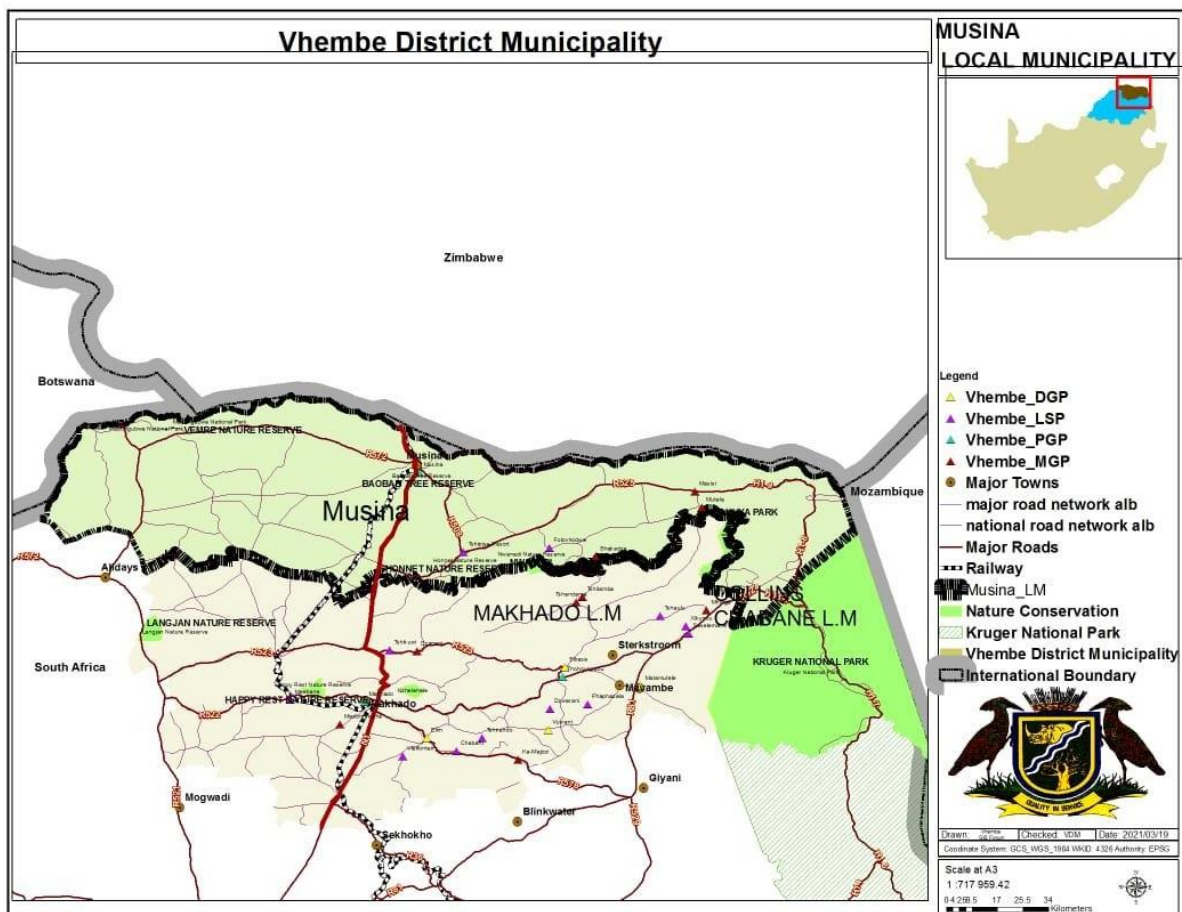
For the study to be carried out, it is important to focus this chapter well on research methods. This includes description of the study site, research design, population and sampling procedures, data collection, data analysis and ethical consideration.

3.2 Description of the study site

Domboni village found on the eastern part of the Musina town. It lies 65 km to the north part of Thohoyandou in the Limpopo Province, of South Africa. The neighboring villages are Tshiungani, Mabvete and Malalale. Domboni has one perennial river fountain and a lot of grazing land with dense bushes. The village is a remote rural village that is full of IKS activities as far as cattle farming is concerned. Because of this situation, there is high interest from the villagers on sharing such information as they feel very proud of their cultural standing. Domboni village has established a good relationship between the households and the Department of Agriculture and Rural Development. During community entry, the community also show great interest and willingness to participate in the study. Figure 3.1 shows the location of Domboni village. Most of the farmers indicated that they apply IKS in their cattle production e.g., they apply 'Malongekanye' medicine in order for the cattle to become more productive.

3.3 Research design

The study followed qualitative research design because there was a need to obtain an in-depth understanding of the relationships between IK and cattle productivity for water sustenance among resource-limited households. A research design is a general plan that describes how the research can be conducted (McMillan & Schumacher, 2006). The study collected and analysed qualitative data. The study was conducted by designing and administering data collection tool. The researcher collected data from key informants using interviews and case studies in exploration of phenomenon within the Domboni village. The strategy helped in collecting detailed data on indigenous practices that cattle owners use. This allowed incorporation of relevant information from qualitative study.



Source : Vhembe data base (2021) AfriGSI (Pty) Ltd. Google

Figure 3.1: Location of Domboni village

3.3.1 A qualitative approach

Participatory rapid appraisal (PRA) tools and methods such as key informant interviews, semi-structured interviews and observations were used in qualitative data collection. In the study, qualitative approach produced rich, detailed and valid process data based on the respondents, rather than researchers' perspectives and interpretation. Semi-structured interview encouraged two-way communication and provided an opportunity where interviewers learnt answers to questions and reason behind the answers. The participant observation method provided high accuracy since the observer directly interacts with the observed participants. These tools are discussed in the following sections.

Key informant interviews aimed at obtaining a general idea regarding the extent to which IK practices are applied in the study village and identifying cattle owners who could be used as case key informants. The selection was conducted using the criteria from Zeeuw & Wilbers (2004), who state that key informant interviews are conducted with specially selected individuals who have a lengthy experience of a village, or knowledge of and involvement in a subject matter. The selection of the household owner was based on the extent of the knowledge concerning IK and cattle farming. The selection of farmers was focused on the extent of farmers' involvement in cattle farming. For example, residents with cattle were selected to be interviewed. Purposive sampling was adopted for selecting cattle owners for key informant interviews.

3.4 Sampling procedures

In the study, cattle farmers, local traditional leaders and extension officers from the Department of Agriculture, Land Reform and Rural Development (DALRRD), both male and female respondents, were included in the study. Population refers to the total number or universality of subjects or subject in question (Flick, 2015). The study population targeted all 22 households who are cattle farmers, local traditional leaders and extension officers at the Domboni village. Out of the 22 cattle farmers, 14 were selected based their availability to provide information required by this study Those who were not interviewed werenot present during the visitation. Purposive sampling method was used to determine samplingsufficiency for qualitative method. Selection of households from each site was done purposively with the assistance of local cattle farmers associations, local traditional leaders and the extension officers from the DALRRD in Musina Local municipality.

Also, the willingness of the potential participants was considered, meaning that only participants who were willing to take part in the study were selected. The semi-structured interview guide was conducted with all available cattle farmers in the area of the study. Households were interviewed on relationships between IK and cattle productivity for water

sustenance among resource-limited households and water security for both households and cattle use. During the interview, cattle farmers were encouraged to adhere to the COVID 19 regulations (social distancing – a meter and half between each other, compulsory wearing face masks that cover mouth and nose and regular hands sanitising).

3.4 Data collection methods

Data was collected by means of semi-structured interview with open-ended questions to allow for in-depth probing of the participants. An interview was undertaken on both male and female cattle farmers. The data collection tool was administered using person-to-person interviews data collection format. Also, observation on the role of IKS on cattle production under water stressed conditions was done. Furthermore, notes were taken to help determine what the survey and observed events might mean. This helped to answer the research questions during subsequent data analysis. Key informants' interviews were administered. This was administered randomly to more than 10% of the households in the study area. Two trained research assistants assisted during data collection (De vos *et al.*, 2011).

3.5 Data analyses

Atlas ti 8 software was used to analyse the qualitative data. This helped in unpacking different themes that were coming out of the interviews. The program provides tools that let the user locate, code, and annotate findings in primary data material, to weigh and evaluate their importance, and to visualise the often-complex relationships between them. An independent coding was used during data analysis. These codes were mainly created using the themes that are related to the study objectives. More codes were created in an inductive manner from the quotations. Codes were further classified into code families using code manager. This was done in order to categorise codes according to objectives. Codes-primary document table and network diagram tools were used to analyse data. After computing data, the researcher wrote the narrative description of the diagrams that the software would have generated. Data analysis is a way of familiarising, interpreting and deducting a meaning from data collected. Data analysis means doing reduction, presentation and interpretation (De vos *et al.*, 2011). Thus, this study was mainly qualitative in nature.

3.6 Measures taken to ensure validity and reliability of the study

The four criteria for developing trustworthiness proposed by Lincoln and Guba's approach in Polit and Beck (2008) were followed to assure data trustworthiness. Credibility, conformability, transferability, and authenticity were the four pillars of the framework.

3.5.1 Credibility

The researcher ensured credibility in this study by engaging cattle farmers or IK users for longer periods of time during interviews, allowing them to express their opinions in their language, allowing for a more in-depth understanding of the relationships between IKS and cattle productivity. Prolonged engagement, persistent observations, triangulation, contextual validation, peer debriefing and negative case analyses were conducted to increase credibility of the research. The overarching goal of any qualitative research is credibility. It refers to trust in the accuracy of data and its interpretations. As a result, qualitative researchers should aim to develop confidence in the findings' accuracy for the specific respondents and setting of the study (Polite & Beck, 2008).

3.5.2 Dependability

To ensure dependability, a full explanation of the research design were provided in this study. The methodology was detailed in the description of data collection, analysis and interpretation. This was to ensure the study could be auditable to describe the situation, and for another researcher to follow. Polit and Berk (2008) describe dependability as the stability or reliability of data over time and over conditions. To them, it is the stability or reliability of data through time and under various settings.

3.5.3 Conformability

The conformability of the study was ensured by the utilisation of subject matter experts in data analysis, transcripts, and audiotapes. In this study, confirmability was achieved when findings of a study reflect from the respondents of the study and make sure the data speaks for itself and is not based on biases and assumptions. An impartial coder during data analysis could double-check the interviews with the respondents. Conformability refers to the classic test of objectivity to see if a study's conclusions can be corroborated by another. It refers to objectivity and the possibility of agreement on the data's accuracy, significance, or meaning between two or more independent people. This criterion ensures that the data accurately reflects the information provided by the respondents rather than the researcher's imagination (De vos, 2005; Polit & Beck, 2008).

3.5.4 Transferability

The data gained from the sample, in this study, can be transferred to another setting. The generalisability of the data or the extent to which the findings may be transferred or applied in another situation is referred to as transferability. In this study, the researcher utilised a thick description, which involves providing adequate details on the Domboni village, respondents (cattle farmers) and methods used during data collection.

3.8 Ethical considerations

Rights, anonymity, and confidentiality of the respondents were respected in this study. Permission to conduct the research was sought from the University of Venda Research Ethics Committee (see Appendix 1). The consent declaration in Appendix 2. The letter of permission for the Department of Agriculture in Appendix 3, letter of permission for the municipality in Appendix 4. Ethical clearance certificate in given as Appendix 5 and the research project approval in Appendix 6). Consent form for confidentiality and privacy for community participation has been made available. The participants were informed that the results will only be used for academic purposes. In this research, permission to use information concerning indigenous knowledge, cattle productivity, and water related information from different sources were sought. Informed consent and voluntary participation was sought before conducting the study from potential research participants. Avoidance of harm to the participants were also adhered to by ensuring the privacy and confidentiality of the participants' views and perceptions. To preserve, anonymity all findings were presented without ascribing names or identifiable personal description. Codes were used instead.

Participants were not coerced into taking part in this research by signing informed written consent and if they felt not interested during data collection, they could withdraw anytime they wish to do so. The potential participants were assured that those who would have withdrawn will not be recorded or prejudiced. Most importantly, a detailed explanation of the research purpose, processes and rights of respondents were provided in the local language to ensure clear understanding by the respondents. Based on the protection of respondents amid of Covid-19 pandemic, precautionary measures were in place and both parties were vigilant in adhering to the recommended precautions. Masks were given to respondents; social distancing was practiced and sanitizers were used throughout. The researcher applied Protection of Personal Information (POPI) Act and regulations to protect personal information and to take responsibility to protect personal information of the participants, so that it may not be used unnecessarily.

CHAPTER 4: THE ROLE OF IKS ON CATTLE PRODUCTION UNDER WATER-SCARCE CONDITIONS

Abstract

It is crucial to understand the role of IKS on cattle production under water-scarce conditions for rural cattle farmers. The main objective of this study is to research the role of IKS on cattle production under water stressed conditions. Furthermore, it is crucial to understand that IKS plays a major role in those cattle farmers who practice it for so long that even in this modern life that method remains important to them as they still practice it in their farming system. The challenge that comes with this is that most cattle farmers are using IKS methods to sustain their farming under extreme weather conditions that are associated with no water or limited access to water. Therefore, the farmers have to come up with different ways to try and sustain their livestock. Hence, the reason for applying the IKS methods as one important strategy for keeping their livestock alive during harsh conditions. In the current study, a qualitative research design was adopted. The study used purposive sampling to determine sampling sufficiency for the qualitative method. The selection of households from each site was done with the assistance of local cattle farmers' associations, local traditional leaders, and the extension officers from the DALRRD in Musina Local municipality. Data was collected using semi-structured interview questionnaires with open-ended questions to allow for in-depth probing of the respondents. To analyse qualitative data properly network diagram techniques and code primary document tables of the Atlas ti 8 software were applied. Therefore, the qualitative results reviewed IKS methods, cattle productivity, and challenges to cattle production under water-scarce conditions. The outcomes of this study indicate that the IKS methods are being utilised mainly by the elderly cattle farmers both male and female. The study outlines challenges to cattle production as follows; increased prevalence and burden of diseases and parasites, dehydration, lack of resources to sustain cattle, unavailability of fodder, and limited access to water. For farmers to curb the challenges that they experience they apply IK in cattle production, for example, cattle farmers use IKS to deal with infertility; maintain their health, parasite detection, treat wounds and maintain body weight. It is highly recommended that farmers should document the IKS for future reference and that water conservation to IKS should also be promoted amongst the farmer in order to sustain water that cattle can use.

Keywords: cattle farmers, cattle production, indigenous knowledge, water scarcity

4.1 Introduction

Indigenous knowledge system plays a major role in cattle productivity under water-stressed conditions (Siambombe *et al.*, 2018). On the other hand, IK provides a means of dealing with challenging situations such as drought (Muyambo *et al.*, 2017). Generally, livestock farming is strongly associated with poor and rural communities because of the importance of livestock in society (Bulcha *et al.*, 2022). However, production of cattle is hampered by water scarcity. As such, farmers resort to use of IKS to meliorate the challenges they face in cattle production. Resource-limited cattlemen prefer IKS as they find it to be effective (Getyengana, 2021). It is not clear though whether there is a relationship between IKS and cattle production under water-stressed conditions. Therefore, there is a need to explore the challenges related to the application of IKS on cattle production in water-stressed conditions. The objective of the current study was, thus, to explore the role of IKS on cattle production under water-scarce conditions.

Drought and dry condition do affect cattle production in an extreme way. In this remote area, drought and dry conditions which affect cattle production in different ways, when there is lack of water cattle are attacked by different types of diseases. Cattle can be easily attacked by parasites and their lives are threatened. The availability of water in cattle production is of great importance, in that farmers spend more to keep their cattle survive when there is water challenges. During drought and dry conditions farmers devise the means of getting more water through boreholes and so by keeping their cattle on mountains where the conditions are cool so that they may not die because of hunger.

4.2 Methodology

The qualitative research design that was used is described in chapter 3. Data was collected from the elderly cattle farmers, because they have more knowledge and information about IKS. The selection of cattle farmers for the study was undertaken with the assistance of extension officers from DALRRD, young cattle farmers, and other community leaders. Two trained research assistants conducted semi-structured interviews. Detailed information on how the tool was administered is explained in Chapter 3. The collected data were verified by a group of cattle farmers during a meeting.

4.3 Results and interpretation

4.3.1 Biographical information of respondents

Table 4.1 shows that both male and female participated in the study. The study findings show that out of 14 participants, 8 (57%) were males and 6 (43%) were females. Male cattle farmers and female cattle farmers in Domboni village indicated that they are engaged in farming to make a living. In most cases, youth become farmers after inheriting the cattle from their parents. People of all ages including the youth group in Domboni village participated in using IKS, while all people from all categories are involved in farming cattle and sharing IK. Cattle farming is considered as a source of income.

4.3.2 Importance of cattle farming

Reasons for Domboni villagers to keep cattle are that some are farming the cattle for milk that they consume or sell, others farm for meat that they use for domestic purposes others keep them to perform traditional rituals and ceremonies while the others sell the meat for financial gain... For example, a certain farmer indicated that he is farming and keeping cattle to prove the power of richness within the community.

“For me, cattle farming is the greatest source of income as I can sell cattle, milk and meat to sustain my family”.

“The reason why I farm cattle is that I want to sell the cattle and make money that I can look after my family with”.

“I farm cattle for the only one reason because cattle do produce milk, so we get milk from these cattle that we enjoy here at home and sell to the local communities so that we have food on the table, and we still make money by selling the milk to others which are the benefits of the business”.

“I farm cattle because my ancestors have been farming cattle and I think it is proper for me to keep the legacy of farming cattle and these cattle help when we do cultural and traditional functions where there is a community banquet, community gathering or celebration, then we slaughter the cattle in line with that celebration”.

“I farm cattle because when you have got cattle you can slaughter the cattle for meat to feed the children or sell the meat, use the money maybe to take kids to school or to buy other things that are needed at home”.” I farm cattle only to show the power of richness within my community”.

Table 4.1: Biographical information of the sampled participants

PARTICIPANT	CATEGORY	GENDER
A	Cattle farmer	Male
B	Cattle farmer	Female
C	Cattle farmer	Female
D	Cattle farmer	Male
E	Cattle farmers	Male
F	Cattle farmer	Male
G	Cattle farmer	Female
H	Chief	Female
I	Chief	Female
J	Cattle farmers	Male
K	Cattle farmer	Male
L	Cattle farmer	Female
M	Cattle farmers	Male
N	Cattle farmer	Male

Ouédraogo *et al.* (2020) research findings revealed that farmers are keeping cattle based on the following reasons, cash income, which is the primary purpose for keeping cattle, followed by social reasons, saving, and good wealth status. In addition, milk for home consumption is frequently reported by transhumant farmers while respondents from the other two systems do not mention milk. Keeping cattle for milk, saving, wealth status and other reasons are significantly different among the production systems. Kugonza *et al.* (2012) alluded that the purposes for which cows and bulls Ankole cattle were being kept and the relative ranks of these roles are as follows; male cattle were kept mainly for income generation through animal sales, and also for their beauty and slaughter for consumption at home, in the case of calves, or during traditional ceremonies, in the case of mature bulls. Conversely, female cattle were mainly kept for milk production. Ankole cattle were also being kept because these cattle are part of the Bahima heritage. They also have aesthetic value or beauty and contribute to wealth saving, production of manure, and production of butter from milk.

To most of the cattle farmers within the village farming cattle is a habit and is also generational. For example, there are farmers who keep the legacy or the tradition of farming going on while most farmers are farming for feeding their families while on the other hand they are able to sell and make living out of what they have produced. It is, therefore, important for them to gain the IKS to sustain their farming.

4.3.3 Challenges to cattle production

The study reveals that because of dry conditions and constant drought cattle survive under extreme conditions. They are vulnerable to pests and parasites, they are easily vulnerable to diseases and they are dehydrated which results in low production and loss. As highlighted in Figure 4.1 that has been illustrated in the subsequent diagram, there are various challenges to cattle production. The major challenges faced are increased prevalence and burden of diseases and parasites, dehydration, lack of resources, unavailability of fodder and limited access to water.

4.3.3.1 Increased prevalence and burden of diseases and parasites

Cattle farmers at Domboni village indicated that during water scarcity, they experience a lot of challenges, one of them being the high prevalence of diseases and parasites. Parasites and diseases spread when there is no rain and they threaten the cattle or livestock, which plays a negative role in farming. Dzavo (2019) alluded that diseases and parasites, which can be exacerbated by drought, are the major cause of cattle losses in semi-arid environments. Sungirai *et al.* (2016) reported that diseases and parasites are the major cause of cattle losses. Correspondingly, Mlambo and Mapiye (2015) showed that diseases and parasites were ranked highly as a cause of cattle losses in semi-arid environments. These semi-arid

environments are characterised by low pasture quality and quantity.

When there is no sufficient water, cattle are infected with various diseases due to poor weather conditions that make diseases prone in the region during drought periods. Climate change may also impact infectious livestock diseases by changing their spatial distributions, affecting annual and seasonal cycles, altering disease incidents, and severity, and modifying the susceptible ability of cattle to illness (White *et al.*, 2003; Patterson and Guerin, 2013; McIntyre *et al.*, 2017; Bagath *et al.*, 2019; Filipe *et al.*, 2020).

4.3.3.2 Dehydration

Lack of water and dry conditions contribute to cattle dehydration, more especially in milk cattle. For this reason, when they are dehydrated, they cannot produce the quantity of milk expected. Thus, their lives are also threatened, because when they get dehydrated, they are at chance of contracting other diseases related to that and they are at the risk of dying. However, Nkondze *et al.* (2013) reported that dehydration is poorly ranked among the causes of livestock losses in semi-arid and sub-humid environments, which is unexpected since water scarcity is ranked among the main challenges in cattle production. Dehydration in cattle is not easily recognisable, but it is life-threatening. Heat stress also affects cattle production by altering fertility and susceptibility to disease. In mammals and poultry, fertility impacts are caused by reduced ovarian function, reduced sperm motility, and inhibition of embryonic development (St-Pierre *et al.*, 2003; Polsky & von Keyserlingk, 2017; Nawab *et al.*, 2018).

4.3.3.3 Lack of resources to sustain cattle

Farmers indicated that they have got limited grazing space because they do not have camps. Further, they urged the department of agriculture to create camps. These can improve control of inbreeding and infection of diseases as well because when cattle are in camps it is easier to administer medication and to notice if there are any other problems. Dzavo *et al.* (2019) supported that cows have the highest mortalities during drought periods, most likely because of their high nutritional requirements relative to other classes of cattle. Therefore, meeting these requirements during the droughts period will play a significant role in mitigating some challenges.

4.3.3.4 Unavailability of fodder

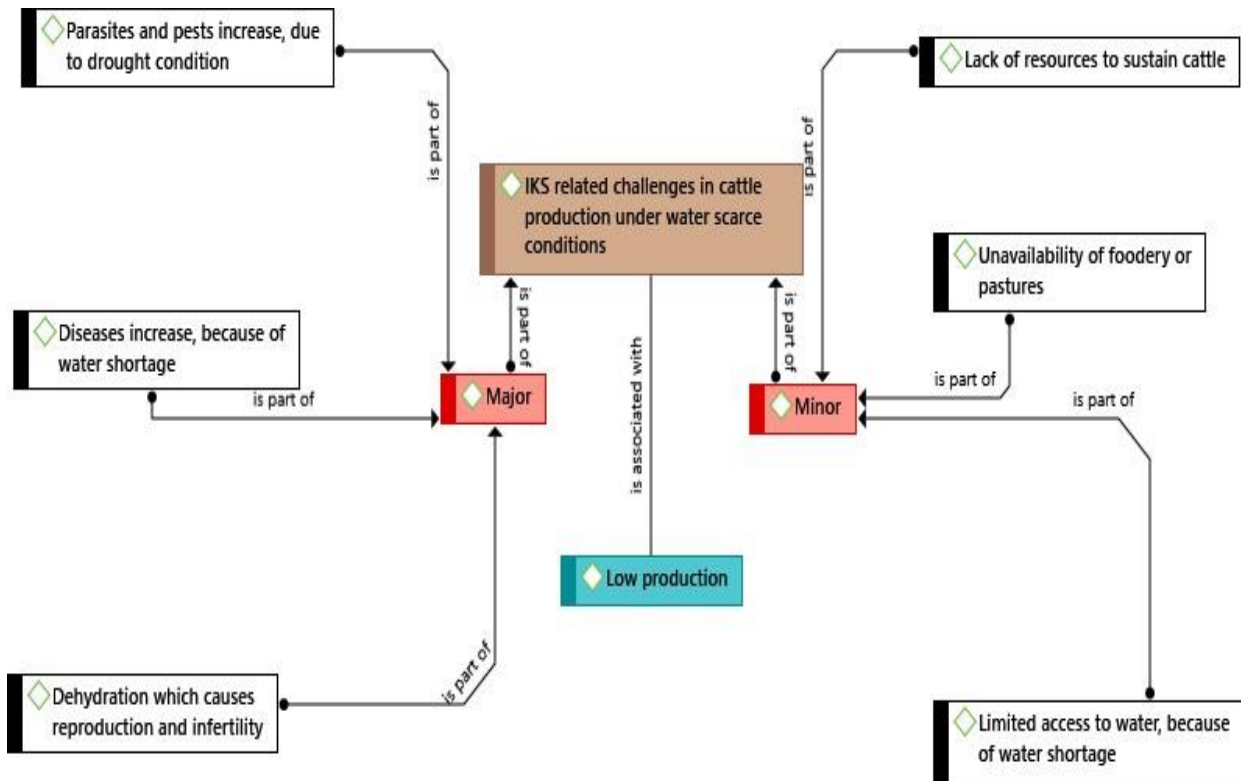
During drought and dry conditions, fodder becomes scarce. Farmers are struggling to afford money required for transport to acquire fodder and pastures. In addition, fodder and pasture last for a short period even if cattle farmers try to get them depending on how long the dry conditions will remain. Dzavo *et al.* (2019) indicated that low pasture quality and quantity lead to malnutrition and a reduction in the immune status of malnourished cattle. Thus, high incidences of diseases are increased, and starvation continues at a high rate. The same reason might explain why the severity of the impact of feed shortage on cattle production was ranked lower in semi-arid environments than sub-humid environments and why emaciation was ranked higher in sub-humid environments as an effect of drought on cattle.

4.3.3.5 Limited access to water

Farmers indicated that they do not have enough water sources. The Nwanedi River is the only perennial river in the area. Farmers depend on the perennial river and sacred wells during droughts. Dzavo *et al.* (2019) highlighted that water shortage has the most severe impact on cattle production during drought, dry conditions, and harsh temperatures. Water intake helps to keep cattle's body temperature within normal limits (Golher *et al.*, 2014). Harsh temperatures, coupled with water scarcity result in heat stress on cattle and can reduce feed intake resulting in mortalities. Water intake in cattle is essential for production, reproduction, adaptive potential, and feed intake (Rojas-Downing *et al.*, 2017).

4.4. The role of IKS on cattle production and its effectiveness under water scarce conditions

Generally, the Domboni cattle farmers practice IKS in their dairy farming. They indicated that they have been applying IKS methods for decades and as such, they believed that it is working for them. For example, when the cattle are attacked by diseases and illnesses, they use IKS methods which help to protect cattle from diseases. They believe in indigenous ways or methods of treating diseases and parasites. Mahlangu & Garutsa (2014) indicated that the use of indigenous knowledge systems seems to be potential as transformative tools. Moreover, they believed that if they are effectively integrated into water conservation and management systems, not only as a matter of redress but also to enrich the current water systems. IKS provide a sound platform for water conservation and management of water in rural areas.



Source : Author's own design

Figure 4.1: IKS related challenges in cattle production under water scarce conditions.
Reconstruct the figure.

4.5 IKS methods for cattle productivity under water scarce conditions

Cattle farmers at the Domboni village, use *Aloe marlothii* (Tshikhopha), *Muvhuya*, and *Xnthocercis zambesiaca* (Mutshato) trees to treat internal worms in cattle as these trees are believed to be helpful in dealing with internal parasites. Also, they indicated that when the cattle give birth unconditionally, they use *Tabernae montana elegans* (Muhatu), *Trigria rupestris sond* (Mutondovhe), and *Malongekanye* trees. Domboni cattle farmers indicated that to maintain the health of the cattle they use the *Cassia petersiana* (Munembenembe) and Olive tree / *Tarchonanthus trilobusvarand galpinii* (Mutwari) trees. Furthermore, they indicated that for parasite detection, they use *Combretum hereroense* (Musingidzi) and *Andostachys Jonson* (Musimbiri) trees. To heal wounds, cattle farmers indicated that they use the *Cissus quadrangularis* (Malongekanye) and *Muvhengakanye* tree and when the cattle are losing weight, they use the *Andostachys Jonson* (Musimbiri) tree. Ezeanya-Esiobu *et al.* (2021) also reported on local plant species used in water-stressed environments. However, unanimously agreed that indigenous treatments or methods are still effective for treating cattle diseases. The findings are of the view that some indigenous methods are effective for ailments that defy modern veterinary treatment.

Cattle farmers in Domboni use IKS cattle selection methods, and they believe it's working for them. They use crossbred bulls, citing the reason that they are strong to survive harsh dry conditions and drought conditions. They also used Nguni cows for meat and milk production. Both the crossbred bull and the Nguni cow are traditionally believed that they can survive drought conditions. Cattle farmers indicated the significance of applying the IKS due to its effectiveness, that also gives a clear comparison in relation to a modern way of things. The subsequent Table 4.2 shows the findings of IKS methods for cattle production under water-scarce conditions. The table illustrates the health condition of the cattle, the scientific names of the plants and the indigenous knowledge terms of the plants used.

4.6 Other strategies used to support IKS in cattle production

The study reveals that during drought when cattle farmers are faced with shortage or limited resources to sustain their cattle, they involve the Department of Agriculture for assistance in conserving trees or plants and conserving water. Cattle farmers prefer herding cattle to the mountain to address the challenge of unavailability fodder or pasture and use private boreholes to help reduce limited access to water. This is supported by Maru & Haile (2022) who recommended that government and local people should work hand in hand to protect indigenous trees. Bahta & Muyeki (2022) study findings reveal that borehole is one of the alternative primary sources of water for livestock production. Table 4.3, illustrated below, shows

the findings of IKS other strategies used to support IKS for cattle productivity under water stressed conditions.

4.7 Breed preferences and cattle breeding practices

Farmers in Domboni village prefer Nguni cattle because they can survive drought and harsh weather conditions. They prefer Nguni type of cow for milk and meat. The Nguni cow is thought to be strong and can survive drought conditions and dry weather conditions. This is because cattle farmers believed that Nguni cattle have low nutrient requirements for maintenance, and they are strong (excelling walking ability). Besides they can walk long distances in search of grazing and water. They are strong in producing milk, as well, during these periods. They also prefer crossbreds with short horns, because they can stand drought, dry conditions and survive harsh conditions. One of the cattle farmers reiterated that:

“I prefer a crossbred bull because it can survive conditions and it is strong when there is a shortage of food and water, I can feed it from home using fodder and it won’t give me any problem”.

The other cattle farmer said,

“I prefer Nguni cows for milk production and meat since Nguni cows proved to be strong and can survive harsh dry conditions and during drought, they are the best to rely on”.

Nguni cattle possess desirable phenotypic and adaptive characteristics which are tolerance to heat, drought, diseases, and parasites (Mapholi *et al.*, 2017; Mapiye *et al.*, 2019). They have the ability to reproduce under low input systems (Scholtz & Theunissen, 2010; Marufu *et al.*, 2011). Nguni cattle have excellent grazing ability and good milk and beef quality. These characteristics require an understanding of the genes involved, that may be important in sustaining the production of Nguni and other local breeds in changing environments in view of climate change. Zwane *et al.* (2021) indicated that Nguni cattle have genes that are associated with body size, feed intake, meat quality, heat tolerance, and disease resistance.

Table 4.2: Indigenous methods used for cattle production

Condition	Scientific names	Indigenous Knowledge terms
Gastro-intestinal nematodes	<i>Aloe marlothii</i> , <i>Xnthocercis zambesiaca</i>	Tshikhopha Muvhuya and Mutshato tree
Infertility	<i>Tabernae montana elegans</i> and <i>Trigia rupestris sond</i>	Muhatu, Mutondovhe and Malongekanye tree
Maintain health	<i>Cassia petersiana</i> and <i>Tarchonanthus trilobus var.galpinii</i> (Olive tree)	Munembenembe and Mutwari
Parasite detection	<i>Combretum hereroense</i> and <i>Andostachys Jonson tree</i>	Musingidzi and Musimbiri tree
Treating wounds	<i>Cissus quadrangularies</i>	Malongekanye tree and Muvhengakanye tree
Losing body weight	<i>Combretum hereroense</i> and <i>Andostachys Jonson tree</i>	Musingidzi and Musimbiri tree

Table 4.3: Other strategies used to support IKS in cattle production

Condition	Strategies
Lack of resources to sustain cattle	Involving department of agriculture for assistance, conserving trees or plants and conserving water
Unavailability fodder or pastures	Grazing in the mountain
Limited access to water, because of water Shortage	Private borehole

Most of the cattle farmers in the Domboni village farmed throughout the year. The area is prone to droughts and dry seasons. Farmers who are farming for meat and selling cattle prefer to farm with the Nguni breed because they survive throughout all weather and climate conditions. Generally, Domboni village is a water-scarce area which can discourage many farmers not to farm cattle, because of risks involved. However, IKS has been used from generation to generation to sustain cattle farming during these conditions.

4.8 Role of IKS on cattle production

The application of IKS is one of the utmost important methods that can sustain cattle as it has been seen to be working for those farmers with its understanding. Also, they indicated that they totally depend on IKS methods in dealing with cattle diseases, addressing water shortages, and addressing expenses that come with medication and other things such as fodder and pest control. They see applying IKS methods as a cheap and sustainable way with limited inconveniences compared to the modern way of farming. The Domboni cattle farmers' belief in IKS methods remains high based on the fact that for decades, IKS methods had been working for them and they have not yet established a better way of farming that can replace the IKS.

Ezeanya-Esiobu *et al.* (2021) supported the findings that cattle ailments are treated better with indigenous methods or indigenous medicine than with modern medicine and can be treated best with a combination of traditional and modern procedures. Also, they are of the view that including IK in the curriculum can allow useful animal health as far as the IK to spread all over. Kugedera *et al.* (2021) indicated that IKS plays an important role in achieving sustainable agriculture starting from land management through traditional leaders. The use of the IKS was reported to be a major aspect of culture that many people use to improve agricultural production and food security. IKS has the potential to promote sustainable agricultural practices (Kugedera *et al.*, 2021).

Some farmers at Domboni village do not understand how IKS methods can be used or applied in their farming, because those people who possess the knowledge are getting older and some of them die without passing it on to those remaining in order for them to use it effectively. There is normally a general mixed feeling amongst young cattle farmers who are lacking proper or full knowledge of how IKS can be used as they are not trained and workshopped on how to use these methods in their daily farming. Young farmers at Domboni are caught between the challenges such as expensive veterinarians, animal medication, and limited IKS knowledge that they must apply to their cattle when they face challenges such as diseases and dry conditions. This was supported by Rojas-Downing *et al.* (2017) who stated that cattle

production is being adversely affected by the frequent droughts which result in scarcity of natural resources, poor quantity, and quality of forages, high prevalence of cattle diseases, parasites, and heat stress. Kugedera *et al.* (2021) alluded that IKS used in weather forecasting by spirit mediums have been proved to be reliable in predicting weather patterns. Such knowledge is used by farmers to take measures including water conservation, harvesting, and selection of crops that are tolerant to drought (Kugedera *et al.*, 2021).

4.9 Link between IKS, cattle production and water scarcity

It was established in Domboni village that cattle farmers based their farming on IKS methods for many years and they also believed that such IKS information and methods are transmittable from generation to generation, based on this belief, cattle farmers at Domboni village rely on IKS methods for cattle productivity, for example, their cattle selection is based on the reproductivity where they believe that they must farm cattle which are able to survive harsh conditions such as dry weather and drought conditions. Due to that fact, we can simply see that the reason why there are still cattle farmers at Domboni village today, is because they have survived through many years relying on these IKS methods.

The Domboni village is one village with only one perennial river, that is the Nwanedi river, and they also have one well which for decades their cattle have been using for water drinking. They had their own methods of conserving water during drought for their cattle so that they remain productive, and their cattle survived hence the selection of crossbred bull and Nguni cow. Emery (1996) indicated that the relationship between IKS and water security is embodied in the traditional knowledge and skills in managing and protecting water sources. Mahlangu & Garutsa (2014) alluded that the use of IKS in the application of water security processes has diminished over the years. Indigenous management and water techniques have the potential of improving water security in rural households. The elderly plays a key role in water security since they are the custodians of IK.

4.10 Conclusions

It is vital to note that IKS plays an important role in cattle productivity and water conservation. IKS methods have been used to sustain cattle productivity in many cases in Domboni village, while the very same methods have been applied to conserve water for the cattle. IKS methods are used in cattle selection in the village as well since the area is characterised by droughts.

CHAPTER 5: EFFECTS OF INDIEGENOUS CATTLE SELECTION STRATEGIES ON RURAL DEVELOPMENT

Abstract

The importance of cattle selection is of a great concern to most of the farmers in remote villages as they believe that it plays a major role in their farming system. The main objective of this study is to investigate role of IKS on cattle production (cattle selection and rural development). The challenge that comes with this is whether cattle selection plays a positive or a negative role in their daily farming. Therefore, it is crucial to explore if cattle farming has got an effect on people in these areas. In this study, a qualitative research design was utilised. This study used purposive sampling to determine sampling sufficiency for the qualitative method. The selection of households from each site was done purposively with the assistance of traditional leaders, community leaders, and other young cattle farmers. In this section, data was collected by means of observation and semi-structured interview guides to allow for in-depth probing of the respondents. Qualitative data were properly analysed using Atlas ti 8 software where network diagram techniques and code primary document tables were applied. Therefore, the qualitative results reviewed selection strategies used by cattle farmers under water-stressed conditions. The outcomes of this study indicated that both male and female, young and old cattle farmers are practicing cattle selection in their farming system. Due to the experience that cattle farmers have during water-stressed conditions where there is lack of water they prefer different ways of selecting their cattle in order to survive such conditions, for example, the study revealed that cattle farmers at the Domboni village prefer a cow with small body size, heat tolerance, mothering ability, cattle with small horns, red and white color because they can survive drought conditions more especially when there is no enough water. The main purpose of the way they select their cattle is that they are able to sustain their families, trade, and also compete in the local economy. Farmers do apply IKS when they select their cattle for farming for the following reasons, some cattle farmers do far cattle for reselling, meat production, and others for milk production

Keywords: Cattle selection, indigenous knowledge, rural development, water stressed conditions

5.1 Introduction

Cattle farming is strongly associated with rural communities because of the importance of cattle and other livestock in society. Because of the environmental conditions of where they are staying therefore farmers have to consider IKS methods of selecting their cattle. Cattle have been indigenous selected based on the needs, agroclimatic condition of the region, importance, adaptation, availability in that area, as well as their ability to improve by selection (Bulcha *et al.*, 2022). One of the expertise that cattle farmers use to sustain their farming is based on how they sustain their cattle for various reasons such as how long can their cattle survive water-stressed conditions, drought and also how long can they survive under water-stressed conditions as far as different cattle diseases and illnesses are concerned.

The main challenge faced by cattle farmers when selecting their cattle is that they want to protect or sustain as much as livestock as they could during the drought conditions and they try to find out a conducive environment where they can continue farming regardless of the challenges. The study itself intends to reveal that indigenous cattle selection plays a positive role in cattle farming under water scarce conditions. Cattle farmers can sustain their farming and improve the lives of the local people whom they are farming for. This section aimed to investigate cattle selection and its influence on rural development.

5.2 Methodology

The qualitative research design that was used is described in chapter three. Data were collected from both young and old farmers. The selection of cattle farmers was undertaken with the assistance of traditional leaders, community leaders, and other young cattle farmers. Semi-structured interviews were conducted with the assistance of two trained research assistants and other young cattle farmers. Explanations of how the interview guide was administered is described in Chapter 3. The collected data were verified by the traditional leader and other community members during a meeting. Methods that were used during data collection are described in Chapter 3.

5.3 Results and Discussion

5.3.1 Biographical information

The biographical information of the respondents was described in Chapter 4.

5.3.2 Farmers selection preference

This study reveals that heifer stage is the most appropriate in cattle selection, because heifers resist harsh weather condition and they can tolerate different environments. Therefore, heifer can be grown to the stage in which they are ready to produce quality meat, milk and calves.

5.3.3 Importance of heifers

Heifers are critical in determining sustainability of cattle herds. This is where a cattle is still a calf. It is at its beginning, and this is the most important stage because a cattle value is determined in this stage, for example, if a farmer is farming the cattle for meat production, he or she will make sure that s/he is getting a profit, at this stage the profit is very high because the heifer has no defect not yet visit with any diseases and illness. An important stage of the calf is the heifer stage because at that stage the animal has not yet given birth and can be used to produce milk, meat, or resell at the highest cost rather than getting a cow or a bull which respectively has already given birth or castrated. Cattle farmers indicated that their intention is to produce more cattle for reselling, and more for meat production so that they can increase their profit where they can sustain their families and where they can be able to sustain their selling businesses. It is also important to note that if farmers sell cattle means that they can be making a lot of money, because the value of a cattle is higher than the milk and the meat. If farmers sell meat means that their meat production can grow, if farmers sell milk means that their businesses can grow as well.

5.3.3.1 Milk production

During this stage a farmer can determine how long it takes for the heifer to be in the stage to produce milk. By looking at this stage a farmer can predict how much the heifer or amount of milk the cattle can produce. The farmer can determine the period within which the milk can be produced. When farmers do select their cattle for milk production, they check for udder size and shape.

5.3.3.2 Meat production

A heifer is at the best stage for meat production because at this stage a farmer is able to measure the weight of the heifer against the market value. The reason why a heifer is important is that a farmer can determine the value of profit that he is going to have from that calf compared to a cow that is milked, or which has calves before. We must be checking also

the longevity of the animal, at a heifer stage, there are fewer risks involved than when a cow is full-grown, chances of diseases are minimal and for a farmer to be successful a farmer must choose to keep a heifer and sell a fully grown cow, knowing that there still has more lifespan for the heifer. A farmer stands surety or can rest assured when having a heifer compared to challenges such as drought, challenges such as water scarcity or unavailability of water, and other aspects such as diseases and illnesses. It will be cheaper for a farmer to maintain a heifer than to maintain a fully grown cow and the farmer opts to do so knowing that the benefits are that such a heifer can produce quality meat that makes that farmer to get enough profit. When farmers do select their cattle for meat production, they check body size of cattle.

5.3.3.3 Reselling

It is also important to consider that farmers achieve their goal of making a profit by selling cattle at this stage because they have full value. At this stage, heifers are fully profitable compared to other cows and bulls at a different stage. Again, farmers enjoy the benefits of selling or reselling calves because they have no different shortcomings that a buyer can complain about. It is in this stage where the selling of the cattle benefits the owner of the cattle a lot. Farmers believe that keeping the cattle or a cow for a long time in the stable or in the kraal is disadvantageous, because of many reasons such as facts that they consider when farming such facts are like the effect of drought, lack of water, and unfair weather conditions, diseases and parasites infestations and infections. These only differ with applying IKS that are well applied in this beginning stage, where a calf is determined to be productive. Also, it is determined to be profitable, and to be beneficial to the farmer, considering that the calf can produce good fresh profitable meat., If the calf is for milk production the calf, then is about to produce milk for the farmer to sell for profit or for consumption. The farmer can also resell the calf at a higher price because the buyer can benefit from longevity with the calf while the calf has no defect or threat for a buyer who wants to make business either to get milk, meat or reselling.

5.3.3.4 Cattle breeding

Before a cow gives birth, it should be fed on fodders in order for them to reproduce a bulk amount of milk. They also indicated that milk that is produced for the first time by a cow is mixed with a certain tree so that the cattle can produce more milk per day. Domboni farmers prefer 'milk cow' for milk production where they sell milk to fellow villagers and also for their own consumption within their families while they aim to expand their milk provision to the local businesses. Ouédraogo *et al.* (2020), alluded that milk yield is considered as daily production. A high preference for cows for milk was documented for smallholder farmers who keep cattle

primarily for milk production to feed their family and to earn additional income (Kassie *et al.*, 2009; Desta *et al.*, 2011). In addition, cows with high milk production have better-fed calves that will have better pre-and post-weaning survival rates, grow better, and, probably, attain better adult size. Besides, they reach puberty earlier and thus also mate sooner (Zewdu *et al.*, 2006).

5.3.4. Traits of economic importance in heifers

5.3.4.1 Small body size

Cattle farmers prefer small body size cattle for different reasons, the main reason is that small body size cows can survive drought conditions. Small body size cows are able to live under different weather conditions, under extreme weather conditions and they can also survive different illnesses and diseases. Gudeto *et al.* (2021), support the finding that cows of large size have lower resistance to surviving in prolonged drought seasons than cows of small body size. Cows were also selected based on their physical appearance in many places.

5.3.4.2 Heat tolerance

Domboni village is one area that has got high temperatures during summer. Farmers on this side of the province prefer heat tolerant cows because temperatures are always high. Heat tolerant cows are able to survive even when there are water shortages and during drought conditions. Heat tolerant cows are preferred because farmers do not lose a lot during drought periods as they can live through or they can manage to survive (Wolfenson & Roth, 2018; Aggarwal & Upadhyay, 2012). Heat stress has been of a great concern for animal growth, development, and, in particular, the decline of reproductive efficiency in animals. Ferreira *et al.* (2016), alluded that heat stress causes great economic loss to the livestock industry worldwide, particularly the dairy industry. Increasing evidence suggests that heat stress not only affects the physiology, feed intake, and milk production but also the reproduction efficiency of dairy cattle (Upadhyay *et al.*, 2017). Also, indigenous cattle have better heat tolerance and adapt to low-quality food and the limited quantity of feeds compared to exotic ones (Hirwa *et al.*, 2017a).

5.3.4.3 Mothering ability

Farmers prefer cows that are fertile and that can produce offspring, and cows that can give birth even under harsh conditions. Zewdu *et al.* (2018) concurs with the idea that cows are selected primarily based on reproductive fitness and milk yield. This is because the cows with good milk yield can nurse strong calves and also some extra milk can be made available to the family members (Gudeto *et al.*, 2021). The authors indicated that farmers prefer cows with

short calving intervals to cows with long calving intervals to increase their herd numbers, while female farmers prefer cows with long calving intervals to get more milk from their cows as a result of the extended lactation period.

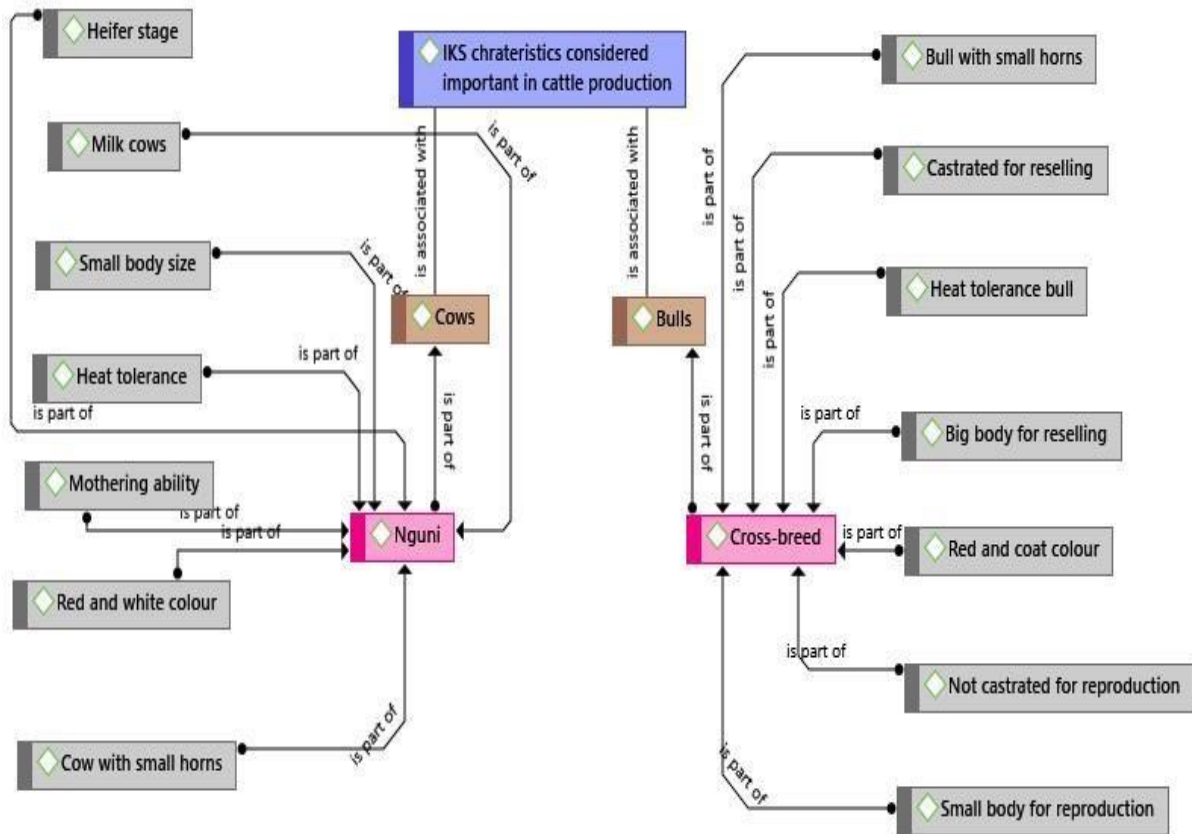
5.3.4.4 Coat colour

Most of the farmers believed that red coloured cows are survivors of heat and harsh conditions. It is believed that red coloured cows are good in meat production and are also good in milk production. The red and white cows are believed to be used for ritual purposes where they are associated with free spirit with good luck. Also, they are associated with peace and prosperity. Kugonza *et al.* (2012), indicated that all households studied to carry out a selection of potential breeding animals within their herds. Big body size and dark red coat colour at birth, were given more weight. They were the main criteria for selecting both Ankole bulls and cows (Kugonza *et al.*, 2012).

5.3.4.5 Cows with small horns

Cows with small horns are thought to be able to survive harsh conditions because they do not have heavy horns, they can survive dry conditions compared to large horned cows. They are independent while grazing and they can travel long distances without getting tired and from the better grazing land.

Cattle farming is one most important activity amongst most rural villages, where it is regarded as keeping wealth and is done mostly for survival. In this way, history tells us that cattle farming has been done so long as people move from one village to another, and IKS was applied when doing so. It is believed that farming cattle can be achieved for three main reasons or purposes. It is in this sphere where we need to explore more about cattle farming from different stages.



Source : Author's own design

Figure 5.1: IKS characteristics considered important in cattle production

5.3.5. The role of IKS on cattle selection under water scarce conditions

In cattle selection, the Domoni cattle farmers indicated that they are aware of the timely weather conditions that they live in. The weather conditions and the constant drought conditions influence cattle farmers in Domboni village to rely on certain cattle selection methods. These methods are tried, tested, and proven to be the best for cattle farmers in the village based on the yielding results that they have on their farmers themselves. Farmers prefer short horn cattle because they believe that they can survive drought conditions more especially when there is no water. These cattle are believed to be able to survive through hardships.

Farmers prefer small-bodied cattle which they think when there is dry condition or drought, these cattle can live long compared to big- cattle. They believe in red, white, and coat colours, because those colors are believed to be strong and endure harsh conditions as well. This was also supported by Ouédraogo *et al.* (2020) who indicated that in the South West of Burkina Faso, the traits preferences for cattle reflect the multiple purposes of production objectives. Selection criteria related to productive traits such as adult size, growth performance, fertility, and milk yield are of high importance for farmers when selecting breeding cattle with some variability across production systems. Gudeto *et al.* (2021) indicated that cattle keepers practice the selection of parent stock for the next generation based on a few selection criteria. Other traits that are considered are docility, libido, and calf survivability. Besides, the study indicated that the cows are selected based on their reproduction ability and milk yield.

5.3.6 The effectiveness of cattle selection on rural development

Selection of cattle through IKS is a vehicle to develop the village at large and therefore cattle farmers do play a role in community development. For example, cattle products such as milk, meat hide, and bones are sold or used within the communities for different ceremony functions. The community relies on cattle farmers during celebrations, ceremonies, and other community activities that need mass attendance where they will be food catering. Some cattle farmers do farm cattle to resell, which is regarded as profitable to themselves whilst they can improve their lives and those of their children, improving the village and the community at large.

The other fact that should be considered is that cattle farmers do employ headmen or head boys to look after their cattle which is job creation. Economically, cattle farming is regarded as an informal way of economic empowerment. Therefore, it is important to consider that if there is no cattle farming within the village it can be difficult for the village to improve or to develop in a way that people can live a normal life. The interface between IKS and water security is

embodied in traditional knowledge and skills in managing and protecting water sources (Emery, 1996). The water knowledge rural societies possess can enable them to develop their capacities to achieve sustainable and equitable development (Mahlangu & Garutsa, 2014). The utilization of IKS in the water security processes is based on the fact that indigenous people have managed the ecological and hydrological environments without damaging them (Emery, 1996).

5.3.7 Improving the relationship between IKS and cattle production

5.3.7.1 Awareness and workshops

Ways to enhance rural development and livelihoods should be explored. The workshops should involve agricultural department officials in practicing and understanding IKS methods. Extension officers can help farmers to understand or to improve the relationship or to apply IKS methods properly. There must be awareness campaign, training, and workshops on cattle farmers, villagers, and also extension officers. Cattle farmers and community members must be workshopped, trained and awareness should be carried out so that people should not be ashamed to practice IKS methods, they must openly practice these methods so that they can complement the modern way of farming systems which are alone can make farming easier. If IK is applied to an education that farmers have concerning IKS, then it could be as effective as a modern way of doing things.

5.3.7.2 Pastoral camps

Camps must be created where their cattle can mate or can have the opportunity to breed without sharing knowledge and experience on cattle selection with other farmers. Proper cattle identification can improve cattle selection by creating individual camps for cattle farmers. Pastoral camps must be created. There must be more water sources created such as dams. It was suggested that the DALRRD can be engaged in acquiring land for camps where cattle can properly breed and be taken care off. These can help to move cattle from one area to the another for pastures.

5.3.7.3 Grouping cattle

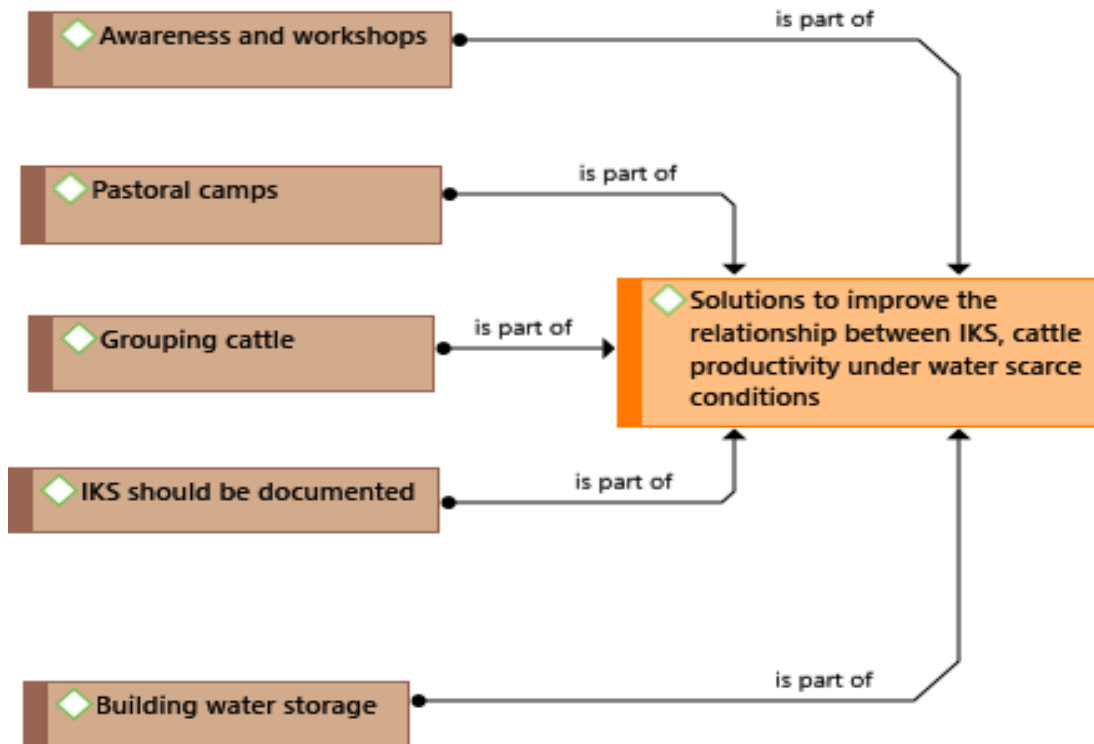
Cattle should be grouped according to their category e.g., milk cows, meat cows, and those for reselling also must be grouped according to the way they are going to be sold. IKS should be taught to the villagers maybe at the secondary, or primary level so that this information must not be lost on the community. Monthly traditional meetings can be utilised to pass information about IKS.

5.3.7.4 Documentation of IKS

The IKS methods of reproduction and productivity like increasing milk or giving birth twice a year or giving birth to more than one calf at a time should be scientifically proven so that they can be officiated or documented for reference to the upcoming farmers to use the knowledge. IKS methods should be documented so that farmers can refer to them should they know something or apply something from it. Involve local writers, local village people with indigenous knowledge and experiences to document the information as a way to store it for future reference.

5.3.7.5 Building water storage

Since the Domboni village has no water storage system it is important to consider ways to make water available for cattle. In doing that, communities can be involved in conserving water. Communities must be engaged in sustaining water since they depend on boreholes and one river. Water storage can be erected to divert water from the Nwanedi river for cattle consumption and villagers can be encouraged to take care of the river (avoiding throwing chemicals or dumping dirty in the river).



Source : Author's own design

Figure 5.2: Solutions to improve the role of IKS on cattle production under water scarce conditions

5.4 Conclusions

It is crucial for the farmers to have sustainable breeding programmes for them to sustain their farming. In doing so, farmers should apply IKS which are helpful in continuing farming under water-stressed conditions. Pastoral camps should be created where the livestock or cattle can have the opportunity to breed. Cattle should be grouped according to their breeding category. The IKS should be documented and to support IKS water storage facilities can be constructed to divert water from the Nwanedi river.

CHAPTER 6: GENERAL DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

In this section, summary and additional information of the study findings are provided which include the following, namely, The importance of IKS in Domboni village, Justification of the relationship between IKS and cattle productivity under water scarce conditions, IKS and cattle production challenge under water scarce conditions, The role of IKS and cattle productivity and its effectiveness under water scarce conditions, Link among IKS, cattle productivity and water scarcity, Cattle selection, effectiveness on rural development and Solutions to help improve the relationship between IKS and cattle productivity under water scarce conditions. However, there are some of the IKS methods that are similar, but they serve different situations. It is in this chapter where recommendations for policymakers, recommendations for the agricultural sector, recommendations for cattle farming communities and future research are included. The implications of the research findings are briefly discussed in the conclusion of the study.

6.2 Summary of the findings

IKS is deemed as an important aspect of community development in the view of culturalism and tribalism. Today world of technology has embarked on a process of adopting IKS as one feature that can help improve the standard of living of the people if it is applied correctly. In this regard, IKS methods become very important in the sense that if a feature is passed on from one group to the other or from one community to the other without considering the role of IKS within that community or tribe, one can be misled as to how these people survived the decades without IKS. It is, therefore, important to note that IKS has been playing an important role and, as such, it remains important to be explored and to be used in order to improve the lives of the villagers. The study has established that cattle farmers at Domboni village use IKS methods in their farming and it has been done likewise for so many years and this knowledge has been passed on from one generation to the other. In this view, IKS methods have been seen as a way to increase cattle production in the sense of reproduction. Secondly, they can be used for making a profit or for profitability as it is cheap and affordable and these IKS methods can also be used as a development mechanism within the local communities. Cattle production is the focus of cattle farmers. It is the core of why the Domboni village cattle farmers farm cattle. There are three major reasons why the cattle farmers farm cattle at Domboni and these are: mainly for milk production, meat production and reselling. They focus on these three aspects not only for survival but to advance their families, communities, and the district at large. The exchange of IKS knowledge and its use to enhance cattle farming make things run smoothly in the village. Cattle farming in the village is also a major domestic producer of means

to develop the area. It is, therefore, important to note that cattle farming using the IKS method has been endorsed because Domboni community is one of the water-scarce villages within the Vhembe district. Lack of water and unavailability of water has seen IKS methods being applied for a long time, and it is believed and established that these methods are viable and have been working for the cattle farmers in the area.

The findings reveal that IKS play an important role for farmers to treat different types of diseases that affects their livestock and to protect their livestock during harsh and dry conditions, while they sustain their livestock for their own benefit by applying IKS methods to conserve water and also medication which is affordable locally accessible. Most of the farmers use IKS in cattle selection regardless of the existence of the conventional methods. IKS selects cows select cows that are strong and survive harsh conditions dry conditions and drought conditions. The farmers value their livestock.

6.3 Use of IKS in addressing challenges to cattle production

Cattle farmers are faced with various challenges. Those challenges varied in the form of how farmers reacted to them. In Domboni cattle farmers are faced with major challenges like any other village, the major challenge in Domboni has been water scarcity. To make the matter worse there are no other means of living in Domboni except cattle farming or livestock farming. It is proven that as for the livestock in Domboni, most of the stock farmers focus on cattle farming as it can sustain their families, businesses and put them in the line of economic development. Cattle farming in Domboni has been faced with challenges related to water, that can be the first issue to focus on. The question is how do cattle farmers get water for their livestock? For many years local farmers have been deriving water from a perennial river called Nwanedi and from fountains. However, as time pass by, villagers were helped to get borehole water and those cattle also get water from the truphs that is created around the borehole. The other challenges that have been faced by the cattle farmers in the village have been drought conditions. Villagers are faced with severe drought conditions which in most cases are continuous for more than two to three years leaving the village with less to hope for. Cattle farmers under these conditions strive to keep their cattle and feed them under harsh conditions which makes things to be very difficult as the expenses kept on increasing. Farming cattle during drought conditions needs expertise. Hence, the essentiality of the IKS methods for cattle selection and for reproduction Challenges such as reproduction during drought and dry conditions require cattle farmers to have knowledge on IK and also a modern way of farming. Farmers need to be appointed on how to deal with these conditions hence they can be a great loss during drought and dry conditions, leaving farmers with no option but to stop farming cattle

if they did not do things right. The other challenge is diseases and illnesses that affect cattle during harsh conditions even during rainy seasons. At this stage, cattle can be affected by many diseases where farmers can lose their production or be forced to sell their cattle at cheaper prices avoiding fatalities. Indeed, fatalities occur when cattle farmers fail to access medication or treatment of the diseases and illnesses that affect their cattle. It is in this view that cattle farmers are mostly discouraged to continue farming in the realisation of such challenges because, in most cases, they end up not finding a proper solution thereby leaving them with little option of selling what they are left with in order to try other options that can sustain them and their families.

6.4 The role of IKS and cattle production and its effectiveness under water-scarce conditions

The role of IKS in most countries has been defined as significant. There is no difference in Domboni village IKS has played an important role. This is because this study has established that IKS methods have been used for decades by people, passing on from one generation to the other based on their belief in the effectiveness of the IKS methods in their cattle farming endeavor. Again, it is also proven in this study that the effectiveness of the IKS has been great and successful because most of the farmers who were interviewed indicated that they use IK methods to treat cattle for various diseases and challenges that they encounter during farming. Also, they indicated that they use these methods for cattle selection, and they use IKS methods also to preserve and protect their livestock. It can be concluded that the effectiveness of the IKS in the village has been enormous, most importantly through the water scarcity period. There are times when the village would not receive any rain hence farmers get to rely on water from the river and well to feed their cattle and they have survived. In interviewing cattle farmers most of them indicated that they have been applying IKS methods since they started farming because they were told by their grandparents and great-great grandparents about how to use IKS methods in conserving and preserving water for their livestock. They use to do rituals and ancestral worship to sustain water and bringing rain. It is in this situation or condition that IKS methods proved vital. To date, there seems to be no other method that farmers can rely on except IKS because they regard it as cheap and affordable.

6.5 Link between IKS, cattle production and water scarcity

There is a link between IKS cattle productivity and water scarcity. The study identified that Domboni area is a water scarcity village where farmers still do farming regardless of this challenge. In order to find a solution for water scarcity in the village former farmers and current farmers relied on and used IKS. Cattle productivity could easily be achieved through IKS being applied to address water scarcity and increase productivity and reproduction of the cattle so

that the business that farmers embark on producing milk, meat, and reselling the cattle could grow smoothly. Should the farmers not try and apply the IKS methods to address water scarcity, cattle productivity would be at risk of falling to increase since they did not rely on any method that can address challenges are faced by cattle farmers. It is important to note that the link between the IKS, and cattle production could not be divided because IKS method and cattle production depends on each other to stand by itself. It is important to note that if the relationship between IKS method and cattle production are not taken serious, water scarcity could remain a problem, IKS method would not be understood and viewed as a solution and cattle production could be low. By linking these three features, one would understand that they complement each other in the sense that in order to have a high productivity rate IKS methods have been used to address water scarcity challenges faced by cattle farmers.

6.6 The effectiveness of cattle selection on rural development

In selecting cattle, farmers focus on certain reasons that they think contribute to the success of their farming. The reason they do so is because cattle farmers believe that if they follow the proper way of selecting cattle when farming, then their choice can sustain their business or the interest of those choices. For example, cattle farmers would farm cattle with short horns, small body because they believe that this feature can make their cattle to survive through harsh weather conditions and drought. In selecting cattle, farmers can also check the size, colour of the cow, for example, they are interested in cows or bulls with red and white coat colour. This mentioned feature characterised the choice of a farmer towards the cattle they want to farm with because they know that they are situated in the villages that are prone to drought and harsh weather conditions such as dry land and extremely hot conditions.

6.7 The Role of IKS on Cattle Selection under water scarce condition

The importance of IKS and cattle selection enhances rural development. One can assure that most rural villages have no activities that can increase employment or engage people in developing themselves, so the IKS method and cattle selection play an important role for the village to realize whole of sustainability, positive development, and empowerment and also to see through cattle farmers coming rip farmers who can be competed at a district or provincial level. In this view, the village as a whole is a major beneficiary of IKS and cattle productivity in the sense that they come to empower not only the cattle farmer but the entire village and beyond. Thus, farmers in Domboni village are seen as a vehicle for development and success and remain the focus in the center of development, so rural development cannot do away with IKS methods used to develop such a village. They are aware that their ancestors practiced this knowledge during the days gone by to survive. Hence, the survival of today's farmers.

6.8 Conclusions

It can be concluded that there is a strong relationship among IKS, cattle productivity and water conservation in Domboni village. Farmers in this area still view IKS methods as a way of farming and are still practicing those methods in their daily farming. The combination of IKS methods and modern ways of dealing with farming can enhance farming in the village and put farmers in an advance stage as far as production is concerned. The relationship between IKS and water in the village can be improved drastically if IKS methods are followed and if all farmers are acquainted with the way that IKS is intended to be achieved. Therefore, IKS should be passed over from one generation to another and well documented.

6.9. Recommendations

The Department of Agriculture should organise summits, conferences and perhaps virtual conferences where they will discuss the impact of IKS on farming, and the importance of IKS. The researcher is recommending that it should be make known to all learners that IK is important. Moreover, the researcher recommends that that water conservation methods should be practiced to sustain development within the villages. Indigenous trees or indigenous plants must also be preserved because they form part of IKS methods to protect and maintain cattle productivity. It is recommended that The Department of Agriculture must make land available for the camps. Cattle farmers must be workshopped, trained and more awareness should be raised for cattle farmers about the importance of IKS and how it should be applied, passed on and preserved.

6.9.1. Future research

In future, a topic of this calibre should be researched. The IKS method must further exploration on the challenges to the application of IK. Livestock production under water stressed conditions should be undertaken into consideration at the Vhembe District in Limpopo Province, South Africa.

6.10. Information dissemination

Feedback was given in the form of presentation in which the researcher shared findings at a community meeting or workshop. The results was shared with the participants, as well as the traditional Council and Musina Municipality stakeholders. During the workshop, all COVID 19 regulations were followed.

6.11. Limitations of the study

The impact of Covid19 played a negative role on making the study to be completed on time. Inadequate funding. Institutions were not funded during Covid 19 as most institutions they were on lockdown making funds to be focused on other projects for human survival than research projects.

People were not allowed to make personal contact. Therefore, communication was threatened. There was inadequate time as the availability of people during data collection became scarce.

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Appendix 1: Data Collection and Ethical Clearance Tools

TIME ALLOCATION (MINS)	TASK: RELATIONSHIPS BETWEEN INDIGENOUS KNOWLEDGE AND CATTLE PRODUCTIVITY FOR WATER SUSTENANCE AMONG RESOURCE-LIMITED HOUSEHOLDS
	ETHICAL CLEARANCE
	The aim of the study is to investigate relationships between indigenous Knowledge and cattle productivity for water sustenance among resource limited households. This questionnaire seeks to assist the researcher to get necessary data that will provide answers on relationship between indigenous knowledge and cattle productivity at Domboni village. Therefore, you have been selected in this study as a cattle farmer who could provide the needed data. The information you give will be treated confidentially and used for academic purpose only. Your identity and personal information will not be divulged to any other person in anyway.
	RESPONDENT INFORMATION
	Name : Age : Gender : Occupation : Experience of IK
	1. CHALLENGES ASSOCIATED WITH SURVIVAL ABILITY OF CATTLE DURING DROUGHT
	1.1 Challenges ----- -----

	2. CATTLE SELECTION CRITERIA FOR BREEDING
	<p>2.1 Breeds prefer for survival during droughts?</p> <p>-----</p> <p>-----</p> <p>-----</p>
	<p>2.2 Why do you keep cattle?... milk, meat, reselling etc.</p> <p>-----</p> <p>-----</p> <p>-----</p>
	<p>2.3 When buying cattle which gender or class do you prefer? Male or Female?</p> <p>-----</p> <p>-----</p> <p>-----</p>
	<p>2.4 Which characteristics (traits) are important to you?</p> <p>-----</p> <p>-----</p> <p>-----</p>
	3. Cows
	<p>3.7 When buying cows, which questions do you ask the seller? Or which characteristics do you consider?</p> <p>-----</p> <p>-----</p> <p>-----</p>

	<p>3.8 What age/stage do you buy your cows? E.g., Calf, heifer, breeding cow</p> <p>-----</p> <p>-----</p> <p>-----</p>
	<p>4. Bull</p>
	<p>4.1 What characteristics do you consider important in a bull?</p> <p>-----</p> <p>-----</p> <p>-----</p>
	<p>4.2 When buying bulls, which questions do you ask?</p> <p>-----</p> <p>-----</p> <p>-----</p>
	<p>4.3 When buying bull, at what stage / age do you buy them?</p> <p>-----</p> <p>-----</p> <p>-----</p>
	<p>4.4 Do you practice castration? Why?</p> <p>-----</p> <p>-----</p> <p>-----</p>

	<p>5. Characteristics for survival during droughts</p>
	<p>5.1 Which characteristics do you consider for survival during droughts?</p> <p>-----</p> <p>-----</p> <p>-----</p>
	<p>5.2 How does each trait of cattle above assist your animals to survive during drought?</p> <p>-----</p> <p>-----</p> <p>-----</p>
	<p>5.3 What is the importance of selection to droughts and rural development?</p> <p>-----</p> <p>-----</p> <p>-----</p>
	<p>5.4 How does government influence your selection criteria?</p> <p>-----</p> <p>-----</p> <p>-----</p> <p>-----</p>
	<p>5.5 Do you think selecting your animals is important?</p> <p>-----</p> <p>-----</p> <p>-----</p> <p>-----</p>
	<p>5.6 What can be done to improve selection in your area?</p> <p>-----</p> <p>-----</p> <p>-----</p>

Appendix 2: Consent declaration

My name is Ndivhoniswani Nephawe (Student no. 15018445), Masters student at the University of Venda. I am conducting a research on water relationships between indigenous knowledge and cattle productivity at Domboni village at Musina Municipality. You have been selected as an important respondent to provide information regarding this study. This information will be treated strictly confidential and used for academic purpose only.

I.....age.....

Cell no-----I give permission to the researcher to interview me concerning relationships between indigenous knowledge and cattle productivity. I give my full approval to participate or provide information in this study

Place

Signature

Date

Appendix 3 : Letter of permission (Department of Agriculture)

Agriculture and Rural Development
The Head of Department
Private Bag x 611
Musina
0900

Dear Sir / Madam,

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

This letter serve as an application to conduct research about relationships between indigenous knowledge systems and cattle productivity for water sustenance among resource-limited households. I am undertaking to study about relationship indigenous System for a Masters degree in Rural Development at the University of Venda. The stuy will be conducted at Domboni villagein the Vhembe district of the Limpopo province. The study will be conducted under the supervision of Prof M. Manjoro, Prof M. Chimonyo and Prof J. Zuwarimwe.

The purpose of the study is to investigate the influence of indigenous knowledge system on water security and livestock productivity management. To achive this study cattle farmers will serve as respondents during data collection.

Based on the above information, I kindly request permission to do or to conduct research

Appendix 4 : Letter of permission (Municipality)

Musina Municipality
The Manager
Private Bag x 611
Musina
0900

Dear Sir / Madam,

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

This letter serve as an application to conduct research about relationships between indigenous knowledge systems and cattle productivity for water sustenance among resource-limited households. I am undertaking to study about relationship indigenous System for a Masters degree in Rural Development at the University of Venda. This letter serves as an application to conduct research at Domboni village in Vhembe district of the Limpopo province. The research is all about the relationships between indigenous knowledge systems and cattle productivity for water sustenance among resource-limited household. The study will be conducted under the supervision of Prof M. Manjoro, Prof M. Chimonyo and Prof J. Zuwarimwe.

The study's goal is to find out how indigenous knowledge systems affect water security and livestock productivity management. During the data collection phase of this project, cattle farmers will function as respondents.

I respectfully request permission to do or conduct research based on the aforementioned information.

Yuurs Faithfully,



Ndivhoniswani Nephawe

Appendix 5: Ethical Clearance certificate

ETHICS APPROVAL CERTIFICATE

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Mr N Nephawe

STUDENT NO:
15018445

PROJECT TITLE: Relationship between indigenous knowledge systems and cattle productivity for sustenance among resource-limited households.

ETHICAL CLEARANCE NO: FSEA/21/IRD/24/2106

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Dr M Manjoro	University of Venda (Institute for Rural Development)	Supervisor
Prof M Chimonyo	University of KwaZulu-Natal	Co - Supervisor
Dr J Zuwarimwe	University of Venda (Institute for Rural Development)	Co - Supervisor
Mr N Nephawe	University of Venda	Investigator – Student

Type: **Masters Research**

Risk: **Minimal risk to humans, animals or environment (Category 2)**

Approval Period: **June 2022 – June 2024**

The Research Ethics Social Sciences Committee (RESSC) hereby approves your project as indicated above.

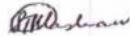
General Conditions

- While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following.
- The project leader (principal investigator) must report to the principal on progress in the REC:
 - Annually (or as otherwise requested) on the progress of the project, and upon completion of the project
 - Within 48hrs in case of any adverse event (or any matter that contravenes sound ethical principles) during the course of the project.
 - Annually a number of projects may be randomly selected for an external audit.
 - The approval applies strictly to the protocol as stipulated in the application form. Would any changes to the protocol be deemed necessary during the course of the project, the project leader must apply for approval of those changes at the REC. Would there be deviation from the project protocol without the necessary approval of such changes, the ethics approval is immediately and automatically forfeited.
 - The date of approval indicates the first date that the project may be started. Would the project have to continue after the expiry date; a new application must be made to the REC and new approval received before or on the expiry date.
 - In the interest of ethical responsibility, the REC retains the right to:
 - Request access to any information or data at any time during the course or after completion of the project,
 - To ask further questions; Seek additional information; Require further modification or monitor the conduct of your research or the informed consent process.
 - Withdraw or postpone approval if:
 - Any unethical principles or practices of the project are revealed or suspected.
 - It becomes apparent that any relevant information was withheld from the REC or that information has been false or misrepresented.
 - The required annual report and reporting of adverse events was not done timely and accurately.
 - New institutional rules, national legislation or international conventions deem it necessary

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE
Date Considered: **May 2022**

Name of the RESSC Chairperson of the Committee: **Prof TS Mashau**

Signature




Appendix 6: Research Project approval (UHDC)

UNIVERSITY OF VENDA

OFFICE OF THE DVC: RESEARCH AND POSTGRADUATE STUDIES

TO : MR/MS N. NEPHAWE
FACULTY OF SCIENCES, ENGINEERING AND AGRICULTURE

FROM: PROF. N.N FEZA
DVC: RESEARCH AND POSTGRADUATE STUDIES

DATE : 29 AUGUST 2022

DECISIONS TAKEN BY UHDC OF 29TH AUGUST 2022

Application for approval of Masters Proposal Report in the Faculty of Sciences, Engineering and Agriculture: N. Nephawe (15018445)

Topic: "Relationships between indigenous knowledge systems and cattle productivity for water sustenance among resource-limited households."

Supervisor	UNIVEN	Dr. M. Manjoro
Co-supervisors	UNIVEN	Prof. M. Chimonyo
	UNIVEN	Dr J. Zuwarimwe

UHDC approved Masters proposal



PROF. N.N. FEZA
DVC: RESEARCH AND POSTGRADUATE STUDIES