An Exploration of African Indigenous Knowledge Methods of Water Conservation and Management in the Limpopo Province of South Africa

by

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CANDIDATE'S DECLARATION

I, Budeli Andani Edgar, hereby declare that this full dissertation for a Master of Arts in African Studies degree at the University of Venda hereby submitted by me, has not been submitted previously for a degree at this or any other university and that it is my work in design and execution, and that all reference material contained therein has been duly acknowledged.

Signed (Student): ..... Date: .....

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GLOSSARY OF TERMS

Tsivenda words in this dissertation	Approximate English meaning
Biseloni la khali	A place where newly made pots are burnt
Dzomo la mupo	An organisation based in the Limpopo province, in the Vhembe district that works to recuperate cultural diversity in South Africa.
Isha	Lake
Khoro	A social network where people meet and talk about meaningful issues, share thoughts, visions and create awareness about issues concerning them and their communities
Khubvumedzi	September
Luvuvhu River	River situated in the Limpopo province of South Africa
Mahundawane	An indigenous game that is played by children, reflecting on the real-life situations, where children imitate the daily activities of households in their communities
Makhadzi	Paternal aunt
Makukwe	Debris
Maroroma	Wetlands
Mativha	A point in a river where water gathers and may seem no to be flowing, making a shape of a dam

Midulu	Fern tree
Mudaphondo	A heavy rain that starts around September and ends in February
Muedzi	Valley
Mueneene	Forest fever tree
Mulambo	River
Munadzi	Quinine tree
Munambala	Wild bramble tree
Munengeledzi	Flute willow
Munzere	Coat gold leaf tree
Mutale River	A tributary of the Luvuvhu River that flows through Lake Fundudzi to the south.
Mutshundudi River	A river in Limpopo province which is the right-hand tributary to Luvuvhu River
Mutu	Waterberry tree
Mvula	Rain
Mvuvhelo	Small rounded pot used to carry water
Nkho	Big round pot used to store water
Nwali	God
Nyahalwe River	Interment stream with its sources from Tshandama village in the Limpopo province of South Africa
Nzhelele River	A major watercourse in the Limpopo province of South Africa that flows through the Soutpansberg
Phadi	Scabies

Phuri	Pumpkin
Thathe-Tshidzivhe	Ceremony conducted after harvest to give
Thevhula	thanks and send requests to ancestors
Tseula	Rain that is commonly known as plant-growing rain. This rain comes after the winter season when land is dry.
Tshikona	Male traditional dance
Tshinane River	River that originates in the Thathe-Vondo and flows to the Mutshundudi River
Tshirovha River	A stream in the Limpopo province that flows through the Tshatshingo potholes
Tshisima	Spring
Tshitamboni	A place in the river where people bath
Tsinyamatanga	Rain that is known to come around the autumn
U phasa	Libations
Vhakoma	’Chief’s right-hand man
Vhalemba	A sub-group of Vhavenda people who claim to be of the Jewish lineage and have their own identity
Vhavenda	Southern Bantu people in the Limpopo province in the Vhembe district who speak the Tshivenda language
Zwifho	Sacred sites

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ABSTRACT

The aim of this study was to explore African indigenous knowledge methods of water conservation and management in the Limpopo province of South Africa. Indigenous people in their different environmental settings managed to use their water sustainably. Throughout time, they developed methods of conserving and managing water to ensure that there is water availability. Water conservation and management methods have sustained indigenous societies for years and continue to do so even though they are challenged by western worldviews. The objectives of the study were as follows: to appraise the African indigenous knowledge teachings and stories of water conservation and management, to examine the efficacy of African indigenous knowledge methods of water conservation and management, to determine factors leading to the disappearance of the African indigenous knowledge of water conservation and management, and to explore possible palliatives to ensure that indigenous methods of water conservation and management operate on an equal footing with the Eurocentric methods. This study was grounded in the socio-cultural and Afrocentric theory. In this study, an exploratory qualitative research design was adopted. Data was collected using one-on-one semi-structured interviews, focus group discussions and non-participant observation. The target participants were sampled using non-probability sampling and purposive sampling. The study discovered that African indigenous knowledge still has an intrinsic role in water conservation and management. The study establishes that cultural beliefs, taboos and understanding of the surrounding natural environment have been influential in promoting African indigenous knowledge methods of water conservation.

Key words: African indigenous knowledge, African indigenous people, Tshidzivhe, water challenge water conservation, water management

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CHAPTER ONE
ORIENTATION OF THE STUDY

1.1 INTRODUCTION

In antiquity, indigenous communities played a leading role in producing knowledge and well-grounded strategies that enabled intelligent water conservation and management. The entire environment is not their rival but rather the primary source of livelihoods, hence the need to conserve the water bodies and related aspects. This indigenous knowledge of water conservation and management has been developed over a period through active interactions and interdependence with the natural environment. As such, it has been passed from generation to generation. Lately, the formalisation and mainstreaming of indigenous water conservation methods and management methods have been advocated for. Thus, this chapter of the study outlines the problem statement, the significance of the study, the aim of the study, objectives of the study, research questions that guided the study, the definition of key terms and preliminary chapter division.

1.2 BACKGROUND

African indigenous knowledge has contributed to the conservation and management of natural resources for decades (Khan, Khumbongmayum & Tripathi, 2008). Currently, the world is looking for ways to protect the natural environment from harm and depletion (Obiora & Emeka 2015). The United Nations International Disaster Reduction (2009) desires the battling of dreadful conditions on the natural environment to limit the pressures placed on earth to support people's social and environmental needs. According to Kanene (2015), the degradation of the natural environment can damage the whole world if not attended to. In recognition of the efforts made to battle against challenges facing the natural environment, there is a serious need for a multidimensional and interdisciplinary method that includes the use of cultural paradigm, herein referred to as African indigenous knowledge (Obiora & Emeka 2015).

African indigenous knowledge is known as the knowledge, skills and technologies emerging around conditions of the African societies in each environmental setting (Wasongo, Kambewa & Bekalo, 2011). It is a developed societal knowledge

throughout time and continues today (Obiora & Emeka, 2015). Like other knowledge systems, African indigenous knowledge is fixed to society, institutions, associations and rituals (Ngara, 2013). One of the recognised characteristics that make up African indigenous knowledge is that this knowledge was transmitted orally from one generation to the next. It is usually excluded from the processes of development (Kaoma, 2010). African indigenous knowledge is the foundation for local-level decision-making in many local African societies, and it is valuable to the culture or society it belongs to (Zuckermann, 2015).

According to Ngara (2013), African indigenous knowledge encompasses a way of understanding and classifying natural resources and a system that governs the use of these resources. He further argues that traditional practices, beliefs and mores of culture are important in how Africans approach the governance of natural resources, which includes conservation and management of these resources. Indigenous people who have a history of living and using resources possess a rich knowledge of the behaviour of the ecological systems (Kala, 2012).

Before western knowledge was introduced in Africa, African indigenous people had their form of knowledge and methods of doing things e that reflected their environmental setting, culture, and experience of the people involved (Lssozi, 2012). These forms of knowledge still exist to date, and the latter knowledge is local and can vary from one location to another. This means that it is indigenous to groups or people who own them (Obiora & Emeka, 2015).

David (1997) states that indigenous people are the people who have a common traditional background which is different from the common groups of people, which subjects them to be disadvantaged by the mediators of development where they live“. They are also understood as the original citizens of a place, in contrast to groups that joined or colonised their environment (Mathewson, 2004). The knowledge of indigenous people is believed to cover all aspects of human life.

The culture and system of knowledge of indigenous people have been misinterpreted or even discharged by the development officials in the past (Fara & Tremolada, 2014).

This claim was presented in a final statement on the World Commission on Environment and Development (WCED): Our Common Future

> Some traditional lifestyles are threatened with virtual extinction by insensitive development over which the indigenous people have no participation. Their traditional rights should be recognized, and they should be given a more decisive voice in formulating policies about resource development in their areas (Brundtland Commission, 1987).

It can be deduced from the above quote that indigenous practices are not promoted, and the rights of indigenous peoples are ignored. On that note, indigenous people should be allowed to play a key role in developing development strategies and the development of natural resources in their areas (Fara & Tremolada, 2014).

Indigenous people have maintained their cultural identity through their knowledge about their local environments (Ngara, 2013). This knowledge gained the attention of the western community as an important basis for social and environmental knowledge. There is more information regarding the usefulness of methods used by the indigenous societies to ensure that there is sustainable utilisation of resources (Obiora & Emeka, 2015). Such information suggests that the use of indigenous knowledge is a serious matter that needs special attention.

Different resources are provided by nature (Mercer, Kelman, Taranis & Suchet-Pearson, 2010). Water is a focal point of this study. African indigenous knowledge has also been employed in conserving and managing water (Kaoma, 2010). All over the African continent, indigenous people in their communities practised the conservation and management of water for sustainable use to meet basic human needs and basic human sustain their livestock (Kaoma, 2010).

South Africa is known as one of the water-scarce countries in Africa, despite the natural water sources available (Blignaut & Van Heerden, 2009). According to Lssozi (2012), African people possess a rich indigenous knowledge of water conservation

and management that one can understand through paying attention to their beliefs, taboos, myths, proverbs, stories and observing rituals. African indigenous people recognise the ties existing between water and their physical and spiritual well-being (Chuvieco, 2012). Several indigenous knowledge methods have been employed in different parts of the world depending on the situations in those environments to conserve and manage water. The principal influence for water conservation and management is the challenge of water scarcity (Knutsson, 2014).

The above information has been supported by scholars who promote the rebuilding of the love and reverence of the natural resources that indigenous communities in the world scholars who promote the rebuilding of the love and reverence of the natural resources indigenous communities have retained for years, including water. Wolgram (2006) supports this view by saying that indigenous people have lived in peace and harmony with natural resources. Thus their continued sustainability of these resources must be appreciated.

Like other natural resources, water affects the economy and the natural environment if not managed well (United Nations Environmental Programme, 2012). This is because water does not exist independently, but it is a part of a large, complex ecosystem that consists of land, plants, aquatic and other forms of life (Dieter et al., 2018). Poor management and unregulated water usage do not only impact negatively on humans but on the ecosystem as well (Grafton & Hussey, 2011). Proper management and sustainable use of the available water resources are currently obligatory (Attari, 2014). It has been considered that indigenous people and their knowledge play an intrinsic role in managing water resources (Chuvieco, 2012). Indigenous knowledge has been reported to be a barrier to development and inefficient for water conservation. However, indigenous knowledge is currently valued and given attention as a basic source for such activities (Agrawall, 2002).

Indigenous knowledge is the ultimate part of humans' heritage and cultural diversity; therefore, the relationship between indigenous people and water resources is rooted in cultural and spiritual values. The understanding of water resources by indigenous people is beyond its significance for human survival and as an important part of the

spirituality of people attached to the myths and rituals (Wasongo et al., 2011). Water is an important part of the dreamtime narrative and cosmological stories to give a comprehension of the water resource management and conservation rooted in the practices and principles that maintain the balance between the instant needs of people, the environment and other living things, as well as the sustaining the needs of the future generations (Mercer et al., 2010). Water is essential in the sustainability of livelihoods. The availability of water signifies the ’scommunity’s food security. One of the most vital pro-ecological activities to be developed and fashioned for sustainability is the consideration of African indigenous knowledge methods of water conservation management.

1.3 PROBLEM STATEMENT

The scarcity of water in South Africa has become a serious challenge as most reservoirs that were thought to be sufficient are running low and dry (Yunana, Shittu, Ayuba, Bassah & Joshua, 2017). In addition, this lack of potable water, coupled with drought and other related matters, negatively impacts human health and the lives of the plants and animals. This is exacerbated by the fact that only one form of knowledge, western scientific knowledge (WSK), is being used to conserve and manage water (Musingafi, 2011). In that way, the dominance of WSK in water conservation and water management has threatened the acceptance and recognition of Indigenous Knowledge Systems (IKS) in water conservation and water management. Consequently, some modern methods used to conserve and manage water seem unsuccessful, mostly in rural areas (Ross, Delaney, Beard, Fuller, Mohr & Mitchell, 2014). Key to this failure is the allegation that there is too much interference in the indigenous scene, undermining deeply entrenched traditional institutions that had been active players in conserving and managing water. Currently, little knowledge exists about the African indigenous knowledge methods of water conservation and management, which has been hailed for water security and sustainability. As a result, most development agents side-line African indigenous knowledge in their processes to conserve and manage water in the rural communities and urban areas (Cleaver, 2012). These developmental agents and other officials prefer western scientific methods of water conservation and management, which African scholars opine are unsuccessful in some indigenous rural communities (Yaw, 2011). They are

unsuccessful because they do not match the community norms and mores and are expensive, making them unusable as most indigenous community members cannot afford them. In line with the latter, Kasongo (2010) claims that indigenous knowledge is excluded in the development processes while accommodating WSK. These stringent bottom-up governmental management strategies are falling short in enhancing sustainable conservation and management of water.

1.4 SIGNIFICANCE OF THE STUDY

This study of African indigenous water conservation and management is indispensable:

1.4.1 Influence the adoption of indigenous knowledge

The results of this study are expected to influence the need for the indigenous communities to adopt their indigenous knowledge to conserve and manage water in communities. Furthermore, this study is more likely to provide awareness of the significance of the African indigenous knowledge methods of water conservation and management that will implant the need for the rural communities and development agencies to use indigenous knowledge methods to conserve and manage water, while, on the other, hand legitimising and popularising it.

1.4.2 Pave way for the preservation of indigenous knowledge

The outcomes of this study are highly likely to provide a chance to document some of the indigenous knowledge used to conserve and manage water. The availability of this information in the body of knowledge will provoke more debates and research on indigenous water conservation methods and management methods. Traditional leaders and traditional practitioners are the custodians of indigenous knowledge and will retain their lost pride in being knowledge holders.

1.4.3 Influence Integration of different knowledge frontiers

Lastly, the results of this study are also expected to influence that African indigenous knowledge methods of water conservation operate at an equal footing with Eurocentric methods of water conservation and management.

1.5 AIM OF THE STUDY

The study aimed to explore the African indigenous knowledge methods of water conservation and management in the Limpopo province of South Africa.

1.5.1 Objectives of the study

To achieve the above purpose, the following objectives were examined.

1. To appraise the African indigenous knowledge teachings and stories of water conservation and management.
2. To examine the efficacy of African indigenous knowledge methods of water conservation and management.
3. To determine the factors leading to the disappearance of the African indigenous knowledge of water conservation and management.
4. To explore possible palliatives to ensure that indigenous water conservation methods and management methods operate on equal footing with the Eurocentric methods.

1.5.2 Research questions

To achieve the above objectives, the following questions were asked.

1. What are the African indigenous knowledge teachings and stories of water conservation and management?
2. Are the African indigenous knowledge methods of water conservation and management effective?
3. What are the factors leading to the disappearance of indigenous knowledge of water conservation and management?
4. What are the possible palliatives to ensure that indigenous water conservation methods and management methods operate at an equal footing with the Eurocentric methods?

1.6 DEFINITION OF KEY TERMS

This part of the write-up presents the definition of key terms or words used because they give direction to the research study. The key terms are as follows.

1.6.1 Indigenous people

Indigenous people are the cultural groups that are different from those that inhabited or colonised the environment (Fondahl, Filippova & Mack, 2015). Cultural, economic, political and social characteristics of indigenous people are attributes to their distinctiveness from the dominant societies they live in (Kaoma, 2010). The groups are described as indigenous when they uplift their traditions and other important parts of the early culture connected to a given area (Mathews, 2004). They have a special relationship with their ancestral land for their survival. Indigenous people from different parts of the world have a common problem associated with . T protecting their rights and striving to maintain their identities, way of life, rights to traditional land, and natural resources to be recognized (Fara & Tremolada, 2014). In this study, the indigenous people are the people who live in the selected study area (*Tshidzivhe*).

1.6.2 Indigenous knowledge

Indigenous knowledge is the local knowledge unique to a given culture or society (Zuckermann, 2015). It is also referred to as a system of knowledge rooted in the tradition of the cultures, a system of knowledge rooted in indigenous or local communities (Wasongo et al., 2011). Indigenous knowledge is an organised body of knowledge acquired by local people through the build-up of informal experiences and an intensive understanding of their environment in a given society (Kala, 2012). Indigenous knowledge is transferred orally from one generation to another. In this study, indigenous knowledge is referred to the information and methods that the community members in the Tshidzivhe area possess and used for generations to conserve and manage water.

1.6.3 Western knowledge

Western knowledge depends on the laws that have been established by applying scientific methods to the phenomena (Ngulube 2016). Western knowledge is referred to as western science. Western knowledge commences with an observation followed by a hypothesis and is subjected to a test (Baldwin et al., 2018). In this study, western knowledge refers to the Eurocentric scientific knowledge that operates differently from the African indigenous knowledge.

1.6.4 Natural resources

Natural resources are the raw materials supplied by the Earth and its processes. They include things in the physical environment used for housing, clothing, heating, cooling, and transportation, and to meet other human needs (Nellemann & Corcoran, 2010). In this study, natural resources referred to include water, plants, animals and soil.

1.6.5 Water conservation

Water conservation is the management and protection of water for current and future use (Kumar, 2014). Water conservation practice is associated with avoiding damages to the quality of water and improving the management of water practice that reduces or improves the use of water, which is helpful (Dziegielewski & Kiefer, 2010).

1.6.6 Water management

Water management is planning, developing, distributing and optimum use of water resources (Grafton & Hussey, 2011). In water management, the purpose is to find a balance between the distribution of water for various purposes and the facilitation of how water can be accessed (Walmsly & Pearce, 2010).

1.7 PRELIMINARY CHAPTER DIVISION

This research study is comprised of five chapters. The division of this study into chapters was employed to allow the study to have logic, to give direction to the reader to know the type of information to look for in a chapter. The chapters of this study are described below.

1.7.1 Chapter one

This chapter presents the orientation of the study, which consists of the introduction and background of the study. The introduction and background of the study present information on how indigenous people used their knowledge to manage and conserve water. This chapter further outlines the problem statement, the significance of the study, the aim of the study, objectives of the study, research questions that guided the research and definition of key terms.

1.7.2 Chapter two

This chapter presents the theoretical framework and literature review. The study was grounded in the socio-cultural theory and the Afrocentric theory. The literature was reviewed to give insightinto what already exists and the shortcomings of the study. Aspects covered in the literature review include water challenges, water conservation and management, African indigenous people's methods of water conservation and management, and factors leading to the disappearance of African indigenous knowledge and integrated water management.

1.7.3 Chapter three

This chapter presents the approaches employed to conduct the study. This chapter presents the adoption of qualitative research design and an interpretivist research paradigm that allowed a researcher to interact with the participants and probe them to understand how they relate to African indigenous knowledge methods of water conservation and management. The study area, the population of study and non-probability sampling, are outlined and justified. This chapter also presents semi-structured interviews, focus group discussions, and non-participant observations as methods used to collect data that is thematically analysed. Lastly, the ethical considerations observed by the researcher, such as confidentiality, informed consent and University of Venda ethical clearance, are also presented.

1.7.4 Chapter four

In this chapter, the data collected are presented and analysed. Data presented and analysed provided some answers to the research questions of the study. Data were analysed thematically, and the following are the themes that were developed: contemporary issues on water conservation and management, African indigenous water sources, storage and ceremonies, African indigenous uses of water, challenges causing water problems, African indigenous knowledge methods and teachings of water conservation and management, factors leading to the disappearance of African indigenous knowledge of water conservation and management, and possible palliatives to ensure that indigenous methods of water conservation and management operate at an equal footing with the Eurocentric methods.

1.7.5 Chapter five

This is the last chapter of the study that presents the findings, recommendations and conclusion of the study. The findings of the study were informed by the objectives, which were to appraise the African indigenous knowledge teachings and stories of water conservation and management, to examine the efficacy of African indigenous knowledge methods of water conservation and management, to determine the factors leading to the disappearance of the African indigenous knowledge of water conservation and management and to explore possible palliatives to ensure that indigenous methods of water conservation and management operate at an equal footing with the Eurocentric methods.

CHAPTER TWO
THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 INTRODUCTION

The previous chapter provided a brief background and elucidated the study's main aim, and the problem statement and objectives were also outlined. This part of the write-up presents two parts which are a theoretical framework and literature review. The researcher used a theoretical framework to analyse theories, philosophies, and traditions to pinpoint the direction the study took in and ensure that the study's objectives and traditions point to ensure that the study's objectives are met. A literature review was used to study previous and current studies to discuss what is known and not known and the research gap on African indigenous knowledge methods of water conservation and management. The literature review was guided by the objectives of the study while referring to the research questions.

2.2 THEORETICAL FRAMEWORK

A theoretical framework is a group of organised ideas that guide a research study (Simon, 2011)**.** A theoretical framework enables the researcher to explain the reason for the existence of the research problem Theories are used by researchers in their studies to support their research questions. A theoretical framework does not solve the research problem, but it simplifies a way for the researcher to address the research problem (Creswell, 2012). Theories provide explanations, descriptions and understanding of the research study (Simon, 2011). This is discussed in detail below. In this study, the socio-cultural theory and the Afrocentric theory were used.

2.2.1 The socio-cultural theory

The socio-cultural theory is a theory that was developed in 1934 by the Russian psychologist Lev Vygotsky. This theory was developed as a response to behaviourism (Simon Marginson & Dang 2016). The socio-cultural theory suggests how people interact and the culture they are subscribed to shape their mental abilities. According to Lin Fang (2010), the socio-cultural theory emphasises the importance of culture and society in shaping and developing individuals. The sociocultural theory suggests that family, peers and society have an intrinsic role in socio-cultural learning (Eun-Young

Jang & Robert, 2011). This means that people learn at their early ages from their parents and other family members, when they interact with peers, when knowledge is shared and when they interact with other people in society.

The researcher selected this theory because it is aligned with the intellectual adaptation tools provided by society and culture. The tools to develop human intelligence provided by society and culture include taboos, myths and stories that have been used in the African indigenous knowledge methods of water conservation and management. Taboos, myths and stories are important to the indigenous communities because they have been part of their history. These taboos, myths and stories are attached to *zwifho* (sacred places) surrounding the water bodies. *Zwifho* are sacred places owned by royal families to bury those who have died, communicate with ancestors, and perform different rituals. The ancestral spirits are believed to be the caretakers and protectors of water. Water conservation and management have been shaped by the belief in ancestral and water spirits that have likes and dislikes about water conservation and management; mostly, these likes and dislikes are associated with sanitation. Water spirits are hidden forces that secure water sources from misuse and pollution. The use of taboos is a common practice that has been applied to help in the protection of water bodies from pollution. The taboos prohibited several human activities, such as throwing objects into the water. Indigenous communities used these tools to communicate the important aspects of their day-to-day activities.

The researcher studied and understood the societal setting and the culture of the society to understand the water conservation and management methods they use. The researcher used this theory to understand how the society provides the adaptation tools and understand the African indigenous knowledge methods of water conservation and management. During interactions with the participants, knowledge of water conservation and management in society is acquired in four ways. The ways of acquiring knowledge are determined by these categories: public knowledge (such as folklore activities), discretionary knowledge (knowledge gained through clan-based structures), secret knowledge (knowledge that has been inherited) and social knowledge (knowledge acquired through social structures such as age and gender)

2.2.1.1 Critique of the socio-cultural theory

Other scholars have argued that socio-cultural theory limits the process of learning because it presents a reduced role for learners to be active in learning due to their dependence on the adults or teachers in their life (Saifer, 2010). The socio-cultural theory does not seem to consider the child's needs while learning (Chaiklin, 2003). This means that individuals cannot bring about their understanding because the socio-cultural theory restricts them from rising above their social norms (Mathews, 2005). According to Lui and Mathews (2005), Lev Vygotsky's sociocultural theory does not address equality because it considers the same learning outcomes without observing how learners differently participate in the learning process.

2.2.1.2 Relevance of the socio-cultural theory in the study

African indigenous knowledge methods of water conservation and management involve society, culture and history. Thus, the teacher must be active in the learning process to introduce learners to society and share the experiences and history of the culture to ensure learners' cognitive development (Lantolf, 2000). The socio-cultural theory requires the teacher to be at the centre of the learning process to shape and fashion the social environment for cognitive development. The socio-cultural theory was used in this study to demonstrate how knowledge is perceived as a collective rather than individual situated in the African indigenous communities. The socio-cultural theory does not present limitations of learning as it allows learners to engage further with their peers; it allows for interactive learning between peers. This is how knowledge acquired is shared by individuals as they interact in society and work together in some of the activities.

2.2.2 The Afrocentric theory

A group of African American academics in the department of Black Studies in the universities suggested ways of analysing information during the 1960s. Unlike what had been understood as the "white perspective" of most information in the American academy, these ways of analysing information were aimed at studying information from an African perspective. In the late 1970s, Molefi Kete Asante started talking about the importance of the Afrocentric concept (Keita, 2010) because he wanted to set

Africans free from the grip of not understanding knowledge and reality from an African perspective.

The Afrocentric theory is a radical movement of thinking projected as an adjustment to the confusion of blacks and a lack of agency (Keita, 2010). The Afrocentric theory is understood as a theory of social change, which refers to societal progress driven by cultural, economic, religious and political aspects of society (Mugane, 2015). The Afrocentric theory is a concept grounded in the impression that Africans should re-build a sense of agency to achieve stability. The Afrocentric theory recommends that African people must express their knowledge from an African view. It explains that Africa is misunderstood because of perceptions and terms that are not African, and this needs to be studied (Kasongo, 2010). The implication of this theory leads to the question, "What would the Africans do without the Europeans?'" In other words, if Africa did not experience colonialism, what natural responses would arise in the relationships, attitudes towards the environment, kingship form, and favouritism for colours, nature of religion and other aspects of life?" (Mugane, 2015)

This theory was helpful in the research study of an exploration of African indigenous knowledge methods of water conservation and management because it encourages African people to use the African indigenous knowledge they possess. The researcher studied the concepts, politics and cultural aspects related to the African indigenous knowledge methods of water conservation and management from an African perspective. It was discovered during the study that these political and cultural aspects play an essentialrole in the understanding of the African indigenous knowledge methods of water conservation and management, which involve the use of water, distribution and conservation, as well as management by and to the people in the rural areas.

(a) Political aspects of water conservation and management

During the study, it was revealed that traditional governance and customary law govern the facilitation of water access, usage, conservation and management. Water sources in the *Tshidzivhe* village are under the authority of *vhamusanda* (traditional leaders), who are the main decision-makers about the issues of their communities.

They are also the custodians of culture. Although *vhamusanda* do not own water, they ensure good use of water by community members and the well-being of the water bodies. *Vhamusanda* is assisted by the vhakoma (headman) on community issues, including water conservation and management. Community members are also important people for activities associated with water and other things.

(b) Cultural aspects of water conservation and management

Culture plays an intrinsic role in the lives of the vhavenda people in *Tshidzivhe* village. Culture has been an integral part of their day-to-day activities, including water conservation and management. People believe that they have been given the land and everything in it by *Nwali* (God), who loves peace. Their role as people is to maintain peace and live in harmony with the natural environment. If anyone harm the water, they upset *Nwali*. Taboos also make out part of their cultural setting, as mentioned above. Other families use rivers, springs, and other water bodies to communicate with the ancestors. These are the practices believed to be appreciated by *Nwali* and the ancestors; hence the water bodies remain in good shape.

2.2.2.1 Critique of Afrocentric theory

Afrocentric is a theory that has a long history and has been a subject of various discussions. There are several pieces of literature related to this subject, some of which are critiques by other scholars. However, the Afrocentric theory has been argued to hinder cultural change in the contemporary world (Gray, 2001). Afrocentricity is understood as a deterring movement and not qualified to understand the complexities of the modern identities of Africans (Gray, 2001). The Afrocentric theory has been criticised fore being as a reversed Eurocentrism as it argued that it seeks to substitute western knowledge with African knowledge. The Afrocentric theory is also said to present threats to the unity of societies (Gray, 2001).

2.2.2.2 Relevance of Afrocentric theory in the study

The Afrocentric theory was used in this study to strengthen the Africans and make them aware of their history and cultural heritage, which is vital to the foundation of the knowledge they possess. This is because Africans share a rich history and culture that is rooted in their identities. The Afrocentric theory was used as a defensive tool against

the Eurocentric view and threats posed before the Africans; however, it has been used to provide solutions to problems that need to be solved in an African way for Africans. It also serves as the best alternatives for Africans to make sense of the environments they live in. It can be a defensive tool, not against Eurocentric ideologies, but to restore lost African culture and history. In this study, the Afrocentric theory allowed for the visitation of the African indigenous knowledge and practices related to water conservation and management.

2.3 LITERATURE REVIEW

A literature review is a writing of a scholarly account that consists of recent information. It includes applicable findings, theories and methodological contributions to a particularstudy topic (Galvan, 2015). This chapter elucidates different aspects contributing to the study of African indigenous knowledge methods of water conservation and management. The following are the themes addressed below: water challenges, water management, ways of water management, water security and other subjects related to the study.

2.3.1 Water challenges

Life is impossible without water because it is regarded as a crucial resource as a day becomes difficult without this resource in households (World Health Organization, 2017). The expectation of water by people is high, but the supply of water is very low (Visser & Brühl, 2018). Apart from water being a commodity, it is also a chemical molecule that is significant for health and human survival. The human body is compromised when water is not available because the body of a human being does not have any provision for the absence of water (World Health Organization, 2017). As such, this part of the write-up provides an insight on some of the challenges regarding water to show as one of the focal points of this study.

Several countries in Africa are experiencing water challenges (Besada, & Werner, 2015). This fact was stressed during the International Climate and Water Dialogue in 2004, including that there would be increased water stress in the sub-Saharan region. Water scarcity is also the cause of other problems in the societies, such as poor agricultural production, which may lead to poverty or a lack of financial support (Kelly,

Cunningham & Plant, 2019). Many people have been reported to be living without potable water. This water stress has been existing in many countries, and it impacts negatively on health and has led to the death of many (United Nations Economic Commission for Europe, 2018). This challenge is not faced by African countries only but also by the rest of the world, including South Africa.

Africa is a rich continent with several attractive natural water resources, including water resources (Zalewski, Fazi & Wolanski, 2018). However, the water challenge is still a dominant factor in Africa, known for its abundant natural resources (Besada & Werner, 2015). In South Africa, the challenge of water is complex, and the main water challenge faced is water scarcity (Courtney & Hedden, 2018). There seems to be a need to explore water conservation and management from an African indigenous knowledge perspective; therefore, it is important to understand the existing challenge of water for the current study.

The challenges of water faced by South Africa and other African countries are arguably caused by the unsuccessful conservation and management of water bodies such as rivers, lakes, ponds, streams and springs (Yunana et al., 2017). These water challenges do affect the quantity of water and have a negative impact on the quality of water, which, in turn, impacts human and animal health, as indicated above. Human activities and some natural causes are opined to contribute to the high level of stress about water challenges. These are discussed below.

2.3.1.1 Human activities contributing to water challenges

Human beings engage in different activities to satisfy their domestic, industrial and agricultural needs (Desai, 2014). Through these activities, a lot of water is used and consumed, and when the use and consumption of water escalates, it brings about different water challenges. The following discussion elucidates population growth, pollution and deforestation as the main human activities causing water challenges.

(a) Population growth

Population growth is an explosion in people living in an environment (Simon, 2019). It is exacerbated by several aspects, such as a high birth rate and migration that

exceeds emigration (Mberu & Ezeh 2017). Population growth leads to stress in socio-economic issues such as poor health, environmental stress and others related to low supply and high demand of resources for sustainability (Mberu & Ezeh 2017). Few countries in the world have developed strategies to mitigate the growth of the population, which has been causing several challenges. As the country with the largest population globally, China made efforts to mitigate its birth rate to regulate population growth in 1979 (Nedelman, 2018). The commitment by the Chinese government to introduce a birth rate control policy led to considerable birth control from 1979 to 2015, although it was discontinued after that (Nedelman, 2018).

The identification of the use and consumption of natural resources is greatly influenced by the size of the population (Hannes & Sciubba (2019). These implications for natural resources, exacerbated by population growth, have been a stressful subject for the world (Mberu & Ezeh 2017). In studies conducted about the relationships between people and natural resources, it has been unearthed that population growth has led to natural resources challenges related to conservation, management and scarcity (Hannes & Sciubba 2019). This might be that when many people occupy a certain environment, they compete for resources. With the rise in the demand for natural resources influenced by population growth, water is the most demanded natural resource (Hannes & Sciubba 2019).

A population that is growing automatically demands more on the environment, and every individual has a contribution to the amount of the resources used or consumed every day (Statistics South Africa, 2012)**.** It is generally understood that the size of the population does not only have an impact on the amount of natural resources used or consumed but also on the volumes of waste produced. The population may grow as the number of households increases, and most of these households are situated very close to the rivers or even on the riverbank (Goransson, Norman, Larson, Alen & Lars-Rosen, 2015). This means that there is excessive water usage and rivers endure everyday pressure imposed by the inhabitants.

Water is a compelling natural resource, important for the lives of human, plants and animals (Ali et al., 2018). However, according to Chen, Sivakumar and Peart (2016),

water demand is mounting, and pressure on the water resources intensifies as the population grows. There seems to be enough water in the world, but little water is used for human consumption. Population growth leads to water scarcity through the increasing demand for food and the competition for agricultural, domestic and industrial water (Pereira, 2017). According to the United Nations Population Division (2010), the projection of water scarcity in Africa shows that by 2035, a billion people will be living in areas where water is scarce due to the population explosion. The study of African indigenous knowledge methods of water conservation and management seeks to provide water solutions.

(b) Water pollution

Water pollution refers to the corruption of the purity of the water bodies, mostly because of human activities (Kelland, 2017). Examples of common water bodies are aquifers, groundwater lakes, rivers and oceans. Water pollution occurs when there is an introduction of poisonous or waste products in the natural environment (United Nations – Water 2018). When contaminants are introduced to the water bodies, problems relating to public health develop, especially for people living downstream (Kelland, 2017). pollution of water causes many diseases such as cholera, amoebiasis, dysentery and others that people consume every day (Phillips, Osmond, Williams & Jones, 2017). This means that polluted water cannot be used for specific purposes.

The pollution of water is commonly promoted by different activities that people engage in (Doug, 2017). Population growth, domestic activities, industrial and agricultural practices are the leading causes of water pollution (Zhenga & Shi, 2017).
When areas become overcrowded, the chances of water being polluted increase (David et al., 2017) and the world's water resources are threatened by extensive pollution (Drinan & Spellman, 2015). The results of the affected water lead to the availability of water that cannot be consumed or used for the production of food and any other reason.

Water pollution also has an effect not only on living beings but also on the natural environment (United Nations – Water, 2018). In less developed countries, water

pollution has caused thousands of deaths because of the consumption of contaminated water or untreated sewage water (Owa, F.D 2013). The consumption of polluted water leads to the expectation of a reduction in productivity. According to Grema et al. (2013), food production and security become a challenge due to water pollution because polluted water cannot grow plants, and aquatic creatures are destroyed and disappear because of the pressure of toxic materials that pollute water. When plants are affected by toxic substances from polluted water, animals and human being suffer.

(c) Deforestation

Deforestation refers to clearing, cutting, or removing forest or trees from land (Harris, Goldman, Weisse & Barrett, 2018). Deforestation occurs when land is being converted to different land use such as farming, the building of estates and other urban uses. In areas where there is deforestation, most aspects of the natural environment are affected (Julia & Byker, 2017). An argument exists that disadvantaged people are likely to clear forests and trees because they lack alternatives or money to pay for materials they need in their day-to-day activities, such as firewood (Harris et al., 2018). However, this statement can be discharged by the understanding that most disadvantaged people depend on plants for their survival; thus they ensure that their use of plants is sustainable. It can be argued that people who are not living in poverty are also likely to exploit the forests for profit generation. This subject is reviewed to present a relationship between deforestation and water resources shown in the paragraph below.

Water resources and forests are important aspects of the natural environment that performs different functions and provides services to humans (Baofu, 2014). Forests provide land cover that maximises the availability and quality of water, prevents soil erosion from taking place and regulates the flow of water (Hrachowitz, Stockinger, Bogena, Heye & Andreas, 2019). The effects of soil erosion on water include siltation of water storages and watercourses and reduced water quality of creeks and rivers (Baofu, 2014). Toxic chemicals that are in the soil are deposited in the water, thereby contributing to water pollution. This displays that the disruption of the forests has a

negative impact on water. Deforestation poses a threat to the availability of water and its quality (Runyan & 'D'Odorico, 2016).

Deforestation has negative impacts on water and the water cycle. Trees use their roots to absorb water, release it into the atmosphere (Baofu, 2014), and forests are cleared; trees no longer perform this function. The water content in the soil is then reduced by deforestation (Runyan & 'D'Odorico, 2016). The soil becomes dry and reduces the intake of water for the remaining trees to extract. When an area is deforested, it is exposed to the possibility of floods, which can be dangerous to the environment and the lives of humans and animals (Runyan & 'D'Odorico 2016).

2.3.1.2 Natural causes of water challenges

The natural environment experiences changes on a day-to-day basis. These challenges affect the lives of people and their health and the well-being of plants and animals (Whittingham et al., 2014). Climate change is a huge challenge that is by now affecting people and the environment worldwide.

(a) Climate change

Climate change refers to the changes in temperature, wind, snow or rainfall (Thom, Rammer & Seidl, 2017), and it takes place when the systems of the temperature give patterns of whether that is new or not expected (Brugger, Feulner & Stefan, 2017). These climatic changes in new patterns may last for a decade or thousands of years, thus causing environmental problems (Rohli & Vega, 2018).

It has been recognised that one of the several natural systems affected by climate change is the increase in temperature (Rohli & Vega, 2018). According to Plänitz (2019), sub-Saharan countries are the countries that are expected to endure the climate change impacts. This is because they depend much on climate-sensitive sectors of renewable natural resources such as agriculture and water with their low capacity to adapt to environmental changes. Deforestation, run-off decline from water catchments, soil infertility and population growth are other factors that lead to the African countries being vulnerable to climate change (Brugger et al., 2017).

Water resources have been identified as natural renewable resources that are more likely to be affected by climate change with extensive pressure by human activities and the ecosystem (Melese, 2016). One of the most common topics in scientific discussions and meetings and among water managers is the impact that climate change has on water resources (Gosling & Arnel, 2016); it intensifies the situation in areas that are already facing water challenges (Melese, 2016). Several regions in the world are currently experiencing the negative impact of climate change on water resources and the ecosystems of freshwater (Intergovernmental Panel on Climate Change, 2007). The traits and concentration of the impact of climate change can differ from one region to another (Gosling & Arnel, 2016). The common impact experienced in several regions is the shortages of water, which increases during high water demand and puts the lives of people at risk (Melese, 2016). The impact of climate change that can be recognised in Africa; include flooding and drought (Matata & Adan 2018). The various aspects of the impact of climate change are discussed below.

- *Flooding*

Flooding is understood as an excess flow of water (Eychaner, 2015). . On many occasions, flooding occurs as an excess flow of water from the different water bodies such as lakes, oceans, or rivers (Eychaner, 2015). Flooding also occurs when a wet area accumulates rainwater that is more than enough for the soil to contain (Loreti, Veen & Perata, 2016). Often, floods may develop at a slow pace and occur as flash flooding with no sign of rain. Floods are well known to negatively impact the lives of plants, humans and animals, and soil fertility and different water bodies (Chanson, Brown & McIntosh, 2014). When flooding occurs, plants are removed from the soil, thereby causing soil erosion, and human beings who survive are left without food and exposed to diseases such as cholera, bilharzia and other water-related diseases.

In Africa, people have found residences in the floodplains for the tillage of fertile soil for many years (Musyoki, Thifhufhelwi & Murungweni, 2016). These people found land on a flat surface and turned it into settlements. These areas were selected to ensure the people have access to water or rivers and easy access to transport (Douglas, 2018). These settlements were built in the floodplains, and they did not have the

necessary mechanisms to mitigate or control flood damage, which means that a large part of the population is now at risk of being flooded.

According to Asiedu (2020), flooding is one of the predominant disasters in many African countries. As such, many populations are affected by this disaster which often results in deaths of living things (Rapolaki & Reason, 2018). Floods can , occur in humid and dry areas, and flooding usually occurs because of cyclones in tropical near-coastal areas. In January 2015, Malawi, Mozambique,, and Madagascar experienced severe floods (Rapolaki & Reason, 2018), leaving the people without shelter, food, and good health. It is prudent for this study to provide some indigenous knowledge on reducing flood risks through water conservation and management.

- *Drought*

Drought is a natural disaster when an area receives lower than the average precipitation; it results in shortages in the supply of water (atmospheric, surface or groundwater) (Mosley, 2014). Drought has a negative impact on the natural environment and may lead to harm to the local economy. The evaporation of water is caused by prolonged heat and dry conditions. Drought has influenced many people to migrate from one place to another, which causes a humanitarian crisis (Defrance, Delesalle & Gubert, 2020).

The interaction between natural conditions and human activities such as land use and the demand for and use of water lead to the increase in the impact of droughts (Musyimi, Nduru, Huho & Opiyo, 2018). When an area experiences drought, many people are left with little or no access to water. The consequences of drought may include the loss of water and the loss of crops, which can cause starvation (Nath, Nath, Li, Chen & Cui, 2017). The spread of diseases may be exacerbated by the lack of water, leading to a lack of basic hygiene such as bathing, brushing teeth and washing hands.

2.3.2 Water conservation

Water conservation refers to the strategies applied in the processes and activities of protecting and giving care to water to meet current and future generations (Virgilio,

Robin, Linke & Boon 2016). This means that water conservation involves the use of less water or the re-using of used water. Water conservation is also about the efficient use of available water to avoid or reduce wasting or redundant water use (Fatta-Kassinos, Dionysiou & Kümmerer, 2016). Different countries have implemented modern ways of water conservation, as discussed below.

2.3.2.1 Modern ways of water conservation

Some strategies have been used in the conservation of water which are modern and foreign to indigenous communities. One of the water conservation methods or strategies used in modern days is water-efficient technology.

(a) Water-efficient technology

Water-efficient technology refers to the advanced technologies delivering better services with compact water consumption (Beal, Gurung & Stewart, 2016). Water-efficient technology is about using only the water that is required (Gurung, Stewart, Beal & Sharma, 2015). These water-efficient technologies include aerated tapes, flow restrictors, greywater re-use systems and types of toilets (composting toilet, dual-flush toilet and other examples). These technologies were implemented to help the urban households supplied with surface water to reduce their water usage (Gurung et al., 2015). The predominant problem with this type of technology is the fact that they have been designed in most cases to prevent the overuse of water in urban households that are supplied with surface water (Gurung et al., 2015). Water-efficient technologies' potential and viability have not been well examined in the indigenous in rural areas (Ross et al., 2014).

Water-efficient technology operates well in urban areas where there are plenty of resources to support the increasing scale of the economy (Beal et al., 2016). But the lifespan of water efficient technology decreases in the rural areas because of the climatic conditions and social patterns in many rural areas (Ross et al., 2014). This means that how people in rural areas respond to their environment is different from how the people in urban areas respond to their environment and resources. Water-efficient technology used in rural areas requires high maintenance programmes, which are mostly not available because they are of the standard of the urban regions. As

such, indigenous people in rural areas find it difficult to operate or maintain these technologies.

Water-efficient technology in indigenous communities fails because the technology is usually installed without involving the community members. At some point, they might not know how to use and maintain such technologies (Yencken & Porter 2001). One can deduct that when the communities do not know how to use and maintain the equipment, they do not feel the importance to look after it. This is supported by Behailu, Pietilä & Katko (2016), who claim that African indigenous communities come together during their water conservation and management activities water conservation and management activities; therefore, anyone understands it is their responsibility to look after their sources of water.

2.3.3 Water conservation and management

This part of the study looks atwater management and conservation as a focal point of this study. Water conservation refers to the activities and strategies employed to protect water resources to meet users' current and future demand (Moorberg, 2019). On the other hand, water management refers to the plans, development and distribution water service (Muller, 2015). Water management processes consider all the stakeholders demanding water and pursue water distribution accordingly to all the stakeholders (Eggimann et al., 2017). The most important part of sustainable water management is maintaining the equilibrium between allocating water for different uses (Chen, Yang, Yang & Chen, 2015).

Water is a renewable resource, and is it is important to use and manage it in a sustainable way (Butler & Ward et al., 2016). This involves considering the amount of available water and the demand for water (Muller, 2015). Water as a renewable resource should be taken seriously, and water conservation and management should be a non-stop process in which people are actively part of the processes and activities of water management (Kabogo, Anderson, Hyera & Kajanja, 2017).

According to Beshah et al. (2016), it is the responsibility of community members to participate in water conservation and management activities as informed by their

indigenous knowledge systems. Therefore, rural and urban communities are expected to participate in water resource management. However, in Australia, few indications that demonstrate community members' participation in processes of managing water, especially groundwater supplies (Wright 2002). According to Radwan (1998), the monitoring of groundwater is facilitated by the government. In most cases, they identify areas suitable for drilling bores using satellite to acquire relevant information on the level of bore water. The government also has reports and references filed on groundwater sustainability and evaluations for rural areas (Marshal, 2001). However, most of the indigenous societies do not have full access to the information that the government files.

It is important to review the approaches where water supplies knowledge is understood by the providers and shared with the communities (Cole, Bailey, Cullis & Mark, 2018). This allows indigenous people to make decisions about sustainable water supply. As indicated in the discussions above, water plays an important role in the lives of indigenous people and supports them with economic, environmental and social security. I It is important to know and understand the cultural and societal issues that encourage water use and water supplies when addressing water sustainability in indigenous societies (Remmington 2018). This means that water systems must be understood in terms of the cultural settings they operate; the formal and informal power structures that govern social relations and behaviour interact to create a functioning village or community.

The threats that water conservation strategies encounter in the indigenous communities are caused mainly by not considering and appreciating the cultural values of the societies (Chief, Meadow & Whyte, 2016). The discussion below looks at the methods of water conservation and management that African indigenous people have employed.

2.3.4 African indigenous people methods of water conservation and management

Like other communities in the world, many African indigenous communities need water for cleaning, human and animals' consumption, irrigation, medicine and rituals, and

different approaches and methods of using, conserving and managing water have been developed by those communities (Remmington, 2018). Every community member is a custodian of the indigenous knowledge that these communities possess (Du Plessis, 2017), which includes farmers, labourers, landless, pastoralists, and women and men (young and old). The discussion below provides insight into issues related to African indigenous people methods of water conservation and management.

2.3.4.1 Water governance and administration

Governance refers to the processes of interacting and making decisions among actors or members of an organisation or community through norms, power or a language of that group. These groups can be a family, tribe, organisation or territory. On the other hand, administration is the processes or activities of ensuring that an organisation is running well and includes planning, executing, evaluating, and monitoring the activities taking place in an organisation. The discussion below gives information on the governance and administration of water.

Before colonialism in South Africa and other African countries, tribal governments were visible in their areas of authority (Eberbach, Kubera, Okoth & Watanabe, 2017). These tribal governments were rooted in the patriarchal and inscriptive customs in most areas (Pickering & Nyapisi, 2017). Traditional leaders , rule their tribal societies and occupy a central role in the tribes they lead (Adjei, Busia & Bob-Milliar, 2017). They are understood as cultural, judicial and spiritual figures and as custodians of the values of the entire society (Eberbach et al., 2017). This means that they were considered as a factor of linkage between the people and their ancestors. Traditional leaders directed aspects of the day-to-day lives of the people and maintained peace and respect between people and the economic, natural, physical, social and spiritual world (Pickering & Nyapisi, 2017). Therefore, it was the responsibility of the traditional leader to consider the common good of all members of the tribe.

The traditional system of governance and administration operated mostly in rural societies before and during colonialism and apartheid in South Africa (Sithole & Mathonsi, 2017). Conflict mediation and land allocation were the responsibility of the traditional leaders, and so was the management of water or water sources (Buthelezi

& Yeni, 2016). Customary laws and activities of culture facilitated those functions. The service of traditional leaders has an intrinsic role in the societies they serve and manage water and other natural resources (Branson, 2016).

In South Africa, before the colonial and apartheid regime, traditional governance systems in rural areas included forms of administration and governance (Sithole & Mathonsi, 2017). The management of natural resources such as water and other functions was the responsibility of the traditional leaders (Owusu, Asumadu-Sarkodie & Ameyo 2016). Cultural practices and customary laws have informed these functions for years.

Governance and administration changed during apartheid in South Africa. The government of the homeland had the decision-making powers for most water-related matters during the apartheid regime (Koenane, 2017). This was when people were systematically placed in different locations according to their tribes by the apartheid government. Various chiefs were assigned responsibilities by the homeland government (Koenane 2017). Regarding water supply facilities in the rural areas, a chief was the dominant person for the community members and the outsiders to check-in (Gondo, Kolawole & Mbaiwa, 2019). Various duties such as operating and maintaining the supply of water, water management and conservation were assigned to the tribal council members who formed relevant working groups in the villages (Gondo & Kolawole 2019). The reign of the apartheid government, traditional governance system and customary laws was disordered through the enduring dislocation of people and social engineering (Sithole & Mathonsi, 2017). In many cases, traditional leaders were understood to be the agents of the government or state; however, in some parts of traditional leadership institutions, the management system is still purposeful and cherished.

Traditional leaders' role is not visible in the new legal framework governing water resource management (Findlay & Twine 2018). This means that the ways in which traditional leaders can be well recognised in the current democratic system of governance are also not visible. Although chapter 11 of the South African Constitution recognises traditional leaders, their water management authority is augmented by

legislation. The traditional water management system is not documented in the National Water Act; however, the act emphasises the minister's role in working together with the relevant government departments.

During apartheid in South Africa, the dominant communities benefited from the policy and legislation of water because it favoured them (Knüppe & Meissner, 2016). Access to water was associated with ownership of land under the Water Act, 54 of 1956. Intercontinental trends encompassing a transition from supply to demand, reorganising conclusions of management and a participatory approach to water resource management are the main objectives for the post-apartheid water governance (Chikozho, Danga & Saruchera, 2017). The participation of the water users in the management of water and the remodelling of water allocation measures is part of the new legal framework for rectifying the previous differences, as indicated in the South African Bill of Rights. This can be considered as a social and environmental justice improvement instrument.

The importance of water is not limited to its social and economic contribution in an African view; it is also culturally and spiritually significant (Padmanabhan, 2019). Water is regarded as a common pool resource in rural areas in Africa where customary laws and traditional governance facilitate accessibility, usage and management. Concerning intercontinental trends and activities, the approach to water management in South Africa is considered progressive (Chikozho et al., 2017); however, the traditional governance system and customary laws have been ignored in the practice of water management. Mosha, Vedeld, Kajembe, Tarimo and Katani (2016) pinpoint the challenge of disregarding traditional and informal organisations, including t raditional norms, taboos, and restrictions on the development water management institutions in Tanzania led to the drying up of water bodies.

It can be deduced from the above discussion that the traditional system of governance has always been influenced by the culture to which people are subscribed. Culture informs the relationship between traditional leadership, and water governance is influenced by culture. The following part of the study gives brief information about the relationship between culture and water.

2.3.4.2 Relationship between culture and water

Culture is understood as a set of social aspects that defines and describes a certain group (Chigbu, 2015). Culture is defined chiefly through its beliefs, values, systems of communication, and language (Rothman, 2014). It is an important element of the lives of Africans, mainly those in rural societies (Knutsson, 2014). Water has been fundamental in the culture and religion of the African people and continues to be so today. Thus, it is important to explore the relationship between culture and water. Africans possess rich knowledge and skills in the maintenance of the relationship between water and land. There are sets of rules rooted in the utilisation of water based on the teachings and principle of religion (Chuvieco, 2012).

Every human being relies on water, irrespective of the differences in culture, religion, and cultural norms (Knutsson, 2014). Knutsson (2014) adds that many religions such as Christianism, Buddhism and Islam have a strong bond with water as a spiritual element or a means of purity before the creator. Religious teachings and cultural institutions have an impact on systems of managing water. The cultural and religious organisations are likely to guide the ways of attaining a sustainable environment through their beliefs and informal rules and constraints (Chuvieco, 2012). The merits of water confer an extraordinary symbolism and sacred prominence. Consequently, water is the major component in the ritual events and rites of African cultures. There are different examples, by culture, of how water has been considered related to the sacred life processes and not just a drinking product (Knutsson, 2014).

During the United Nations Educational, Scientific and Cultural Organization (UNESCO) meeting held in March 2006, the theme that was adopted or declared was about water and culture (Nyambe & Feilberg, 2009). This theme was explored to highlight the importance of culture and how people understand, use and conserve water. During the meeting, it was discovered that the way water is understood, used, conserved, and treasured is deeply rooted in the people's culture and identity. UNESCO has also reported that the practices of water management constitute knowledge systems and behaviour that are unique and, therefore, these practices should be adapted to specific cultures.

Water is considered one of the most critical aspects of different indigenous people's culture, social life, and economy (Global Water Partnership, 2009). On the National Water Initiative (NWI) in Australia, Jackson and Robinson (2009) wrote that the organisation's goal should consist of recognising the needs and management of water with regard to access to water and the protection of native title through water provision. This is due to the marginalisation of the rights of indigenous people and their governance, as well as the management of water in Australia. This suggests that there must be room to include indigenous people in managing and planning natural resources, particularly water. Culture involves beliefs and taboos; therefore, the following discussion focuses on the cultural beliefs and taboos used in water conservation and management.

(A) Cultural beliefs and taboos used in water conservation and management

This part of the study focuses on how African indigenous knowledge systems have been used in water conservation and management practices through cultural beliefs and taboos. Cultural belief is any belief and understanding of a particular thing that is considered ,fundamental, or unreal and right or wrong by people who belong to a given cultural group. On the other hand, taboos are sanctions of a society that discourage adopting specific characteristics of behaviours (Sayi, 2019). This is because cultural beliefs and taboos are an essential part of African indigenous knowledge systems that influence the activities of indigenous people and have played an intrinsic role in developing and shaping water conservation and management.

Indigenous people have constructed African indigenous knowledge systems through ages of societies existing with the natural environments (Oladapo & Ogundele, 2018). African indigenous knowledge systems are grounded in the norms, taboos, beliefs, and classification of natural resources, empirical observations of the natural resources available in each environmental setting and a governing system of the use of resources (Adom, Kquofi & Eri Asante, 2016)

African indigenous beliefs, cultural values and practices, including taboos, play an intrinsic role in ensuring the management and conservation of natural resources in

successful developing countries (Gondo, Mogomotsi & Mogomotsi, 2018). Natural resources, especially water bodies, are exposed to threats associated with water conservation and management. However, the taboos played a key role in water conservation and management while hindering the abuse of natural resources by local people (Osei-Tutu, 2017). It was noted that looking after natural resources has an inseparable relationship with the culture of the people (Oladapo & Ogundele, 2018). This is more visible in indigenous people's care of land, forests and, most importantly, water, as indicated above.

The use of taboos is a common practice applied to assist in the protection of water bodies from mistreatment due to human activities (Tonorgbevi, 2016). Tonorgbevi (2016) further states that taboos prohibited several human activities, including throwing objects into water bodies. In addition, some taboos depict that lactating mothers and women on their menstrual period were prohibited from visiting the water sources, and people should not be allowed to bath in the streams or rivers (Amonum, Ikyaagba & Maa, 2017). In that way, water conservation and management practices were ensured.

According to Boamah (2015), ancestral reverence in Ghana plays an intrinsic role in conserving natural resources. It is commonly believed that anyone who intrudes upon traditionally certified locations and tempers with environmental wellbeing will be punished. Some places in rural areas are believed to be the abode of the ancestors, especially where natural resources are dominant. The core purpose of the practice is to conserve and manage natural resources.

According to Garutsa (2014), in Ghana, the natural water sources were well managed because of the local traditional customs, including taboos and belief in water spirits. African people believe that each source of water has a spirit. The spirit transmits messages to the traditional leader or a custodian while he or she is sleeping and communicates their likes and dislikes with the custodians of a water source. Therefore, custodians have to report to the community what they received from the spirits and ensure that it is implemented (Garutsa, 2014). The spirits have likes and dislikes mostly, these likes and dislikes are associated with sanitation. They are respecting

this belief in the water practice led to the good management of natural water sources (Knutson, 2014).

It can be deduced from the above discussion that African indigenous knowledge systems through cultural beliefs and taboos are important in the conservation of natural resources, particularly water, as a focal point of this study. It was also depicted in the discussion that cultural beliefs and taboos presented prohibitions or restrictions on certain behaviours. According to Diawuo (2015), the prohibitions or restrictions on using natural resources were introduced by God. Diawuo (2015) argues that the purpose of prohibitions or restrictions associated with cultural beliefs and taboos is to guide the conduct of people in the use of natural resources. As indicated that the spirits would punish people who do not respect or obey the cultural beliefs and taboos, Kideghesho (2008) argues that people observed the prohibitions and restrictions as no one wanted to be punished. The punishments would be the outbreak of diseases, drought, pests, loss of assets or death. Diawuo (2015) indicates that no matter the reasons for the cultural beliefs and taboos on the activities of natural resources conservation, water conservation and management in the communities have been well conserved and managed.

2.3.4.3 Water practices of different African indigenous communities

Several practices and techniques of water conservation and management have been employed in different parts of the world since time immemorial (Tonorgbevi, 2016). These practices and techniques are not the same, depending on the various societies and their environmental settings. In many developing countries, some of these techniques are still in existence but are not improving. The following gives some insight into the practices and techniques employed by African indigenous communities for water conservation and management. The following are discussed below: the *Gadda* governance system, *Marakwet* community in Kenya and natural engineering skills of *Konso* people.

(a) The Gadda governance system

Gadda is a traditional governance system of the *Borana Oromo* people found in Southern Ethiopia and some parts of Northern Kenya (Denver, 2015). The *Gadda*

system of administration and governance has been used in the practices of the communities, including for water conservation and management in *Borana* (Biratu & Kosa, 2020). The *Gadda* general assembly takes place every eight years to evaluate the previously approved rules (Denver, 2015). This *Gadda* general assembly aims to reflect on the challenges the community is faced with to modify existing rules and implement new rules that address those challenges (United Nations Educational, Scientific, and Cultural Organisation, 2016).

One of the most important agendas of the *Gadda* assembly is water (Biratu & Kosa, 2020), and it has an important place on the agenda. According to Biratu and Kosa (2020), water management is considered in the assembly to evaluate the enactment of rules on water management in the community in general and the integration of wells management. *Abba Gadda* (the manager in chief of the Gadda system) is responsible for the well-being of the *Borana* community, although water sources might belong to different communities (Dika, 2016).

A water source is managed by a distinct clan (tribe) in *Borana* and by the father of water, known as *Konfi* (Dika, 2016). However, other clans are not excluded from using water from this source. Every household in *Borana* is entitled to a formal request to the father of water before fetching water from any nearest or preferred water sources (Biratu & Kosa, 2020). Requests are not rejected; it is just a formal procedure unless one has a serious problem with his original source of water rules. According to Dika (2016), all water source users have a responsibility to take part in the maintenance and operation of the well. The maintenance of a source of water, particularly a well, takes place in three categories which are: (a) daily maintenance of removing dung, (b) seasonal maintenance to clean a sediment deposit after flood season, and (c) major well rehabilitation-extension of the depth of the well following the depletion of a groundwater table.

Every member of the *Borana* community is loyal to the *Gadda* system of administration and governance and the customary laws that it encompasses (United Nations Educational, Scientific, and Cultural Organisation, 2016). The customary laws operate on a participatory basis where responsibilities are given to individuals depending on

their capacity. All members are expected to offer labour and cattle during the excavation and maintenance of a well (Roba & Yildiz, 2019).

In cases where a person refuses to participate, they are given a strong warning from the council of the well. The well council consists of six to seven members who have been involved in the extraction of water from a well for years and have experience in all the traditional activities associated with water (Wako, 2020). The role of the well council involves arbitration, mediation, enforcement and water allocation (Biratu & Kosa, 2020). If this person persists in breaking the rules, he or she is banned for good from using wells and other communal water sources in *Borana*.

Sources of water in *Borana* do not have what may be regarded as a formal committee which constitutes a chairperson, treasurer, and so on to manage the water sources. The *Borana* management and administration is unique in its traditional nature. Gadda seems to serve the Borana community in a good way hence the information above shows that community members adhere to the customary laws.

(b) The Marakwet community in Kenya

In Kenya, along the valley of Kerio in the Marakwet district, the challenge of insufficient supply of water was experienced, which affected people, livestock and wildlife (Kiptum & Sang, 2017). Because of the lack of water, conflicts emanated regarding water use and access during seasons of drought. To maintain and ensure equal access to water for all, the Marakwet community used their indigenous knowledge (Cheserek, 2005). The following are some strategies the Marakwet community developed to overcome their water challenge.

Speranza, Kiteme, Wiesmann & Jörin (2016) report that in the Marakwet community, it is the responsibility of every member of the community to look after the water bodies and water catchments. Although the whole community is responsible for water bodies and water catchments, the user rights are assigned to the elder of a clan who controls accessibility and utilisation of water from different sources and points of water. Water points are allocated to different clans for various different uses by the elders in Marakwet. Wells are helpful in the community during the seasons of rain for domestic

use, and ground water is essential for usage by the livestock. During seasons of drought, elders make sure that the whole community knows that livestock will use the dry season points of watering, allowing wells to provide water for domestic use.

According to Mpiri (1995), the aspect of water management used in Marakwet is migration, where particular grass is saved for late grazing and wells used during dry seasons. Livestock survives the everyday journeys between the points of watering and the points of grazing (Cheserek, 2005). Migration is a strategy that has been employed to save water sources that are running low by moving livestock to where water is abundant (Mpiri, 1995).

Farming upstream around water bodies was forbidden in Marakwet (Cheserek, 2005). This was informed by the belief in the rain god who punishes anyone who interferes with water purity. Farming activities were taking place a distance away from the course of water. Through this practice, the siltation of rivers was lessened, and people could access clean water downstream.

According to Saina (1996), the *Marakwet* community occasionally practised water rituals to call upon the god of rain to give them rain. This practice involves the elders of the community participating in prayers and sacrifices. Rain-making rituals have existed in Africa for many years. According to King'asia (2018), water sources such as rivers and springs are considered sacred because of the belief that rain spirits and supernatural beings reside there. Cattles were sacrificed during the dry season and goats or sheep when the onset of rain is delayed. The power of the rain makers was used to communicate to the spirits to appease the community to behave and release rain (Cheserek, 2005).

Cutting down trees was forbidden in *Marakwet,* and people could only use dead wood (Saina, 1996). This is because many indigenous trees were understood to be sacred and were used only when performing rituals. Through this practice, trees grew and matured, hence the preservation of water catchments. To lessen interventions by human activities, livestock and wild animals around rivers and streams, the community encouraged the planting of indigenous trees, which ensured that water courses were

not eroded during heavy rains. Points of collecting water were also fenced with stones or wood. According to Moyo, Chikuni and Chiotha S (2016), forests act as shelter for water sources and explain that it is important to maintain and manage forests to protect water sources.

(c) Natural engineering skill of Konso people in Ethiopia

Beshah et al. (2016) state that, like other African communities, Konso has a traditional , governance system and administration responsible for all the activities in their location. Water management and protection of water sources are some of the top priorities of the Konso community. The activities of water management and protection involve every member of the community. This has been in other African communities where water conservation and management are communal (Behnke et al., 2017).

Conservation of resources is one of the areas of specialisation of the people of Konso. These people have full control over their landscape and forests (Belachew & Mezgebe, 2019). The *Konso* community has built bench terraces to preserve soil and planted multi-function trees that are drought resistant. They say that “a drop of water that falls in Konso belongs to Konso” because of how active they are in the processes of water conservation. They ensure that there is no water runoff flowing out of their catchment (Gara, 2006). Most of the trees that have been planted on a steep slope can absorb large amounts of water. In that way, the people in Konso ensure that water is collected in well-constructed ponds in locations that are appropriate for the maximum harvest (Cheserek, 2005).

The people of *Konso* are also experts in the selection of a site according to the property of soil and its potential to contain water (Gara, 2006). This knowledge has developed through their existence on their land for many years. ,For example, silt trap structuring in modern engineering could learn from *Konso* and make such structuring from local materials. Through many years of practice, *Konso* people realised that high water velocity carries silt that can pose threats to the life of constructed ponds. Therefore, they provided structures and trees that can slow down the water speed before reaching ponds (Gara, 2006).

In terms of water conservation and management, the practice was communal so that each member of the community is expected to participate. According to Beshah et al. (2016), members of the community who did not participate in water conservation and management activities were not prohibited from using water. This is motivated by a belief that “water is a gift from God”. Therefore people cannot be prohibited from accessing it. However, no one in the community would help members who do not participate in the conservation and management of water, such as cleaning the water sources; in most cases, social sanctions would be imposed on them. Therefore, one can conclude that this practice was merely to promote unity in society's activities.

In *Konso*, the most common source of water is springs, particularly potable water. In areas that do not have a spring, traditional ponds are created to accumulate floodwater for use during dry seasons (Beshah et al., 2016). Garra (2014) indicates that households do not have the same access to water sources due to distances. Therefore, members of the community in *Konso* bestow the responsibility of monitoring the well-being of the water source on the households that reside closer to the water source. In this way, water conservation and management were ensured.

The above discussions on the *Gadda* governance system, *Marakwet* community in Kenya by working together as a community. The most important characteristic of indigenous knowledge that it is communalistic. It can be deduced that the African indigenous approaches used in the above three communities and systems present ownership of water sources to all members of their communities. Thus, it was shown in the discussion above that members were actively involved in water conservation and management activities.

(d) Rain Making Practices Among Balobedu People in South Africa

The *Balobedu* people resides in the Limpopo province of South Africa, below the escarpments of Drakensberg close to Duiwelskloof. The *Balobedu* people have been under the rule of a Queen for many years. The rain queen, Modjadji, who died in 2005 was well known for her rain making powers and for this, many referred to her as a rain Queen. According to Joubert (2011), the lives of *Balobedu* people are intertwined with

rain, hence, Queen Modjadji conducted several rain-making rituals, particularly for agricultural practices.

The rain-making practice in Modjadji is overseen by the Queen who possess rain-making powers (Muller, 2008). The art and secrets of rain making is transferred to the successor of the Queen before death. According to Setlhabane (2012), the Queen is regarded as the season changer and the benefactor of their sustainability. Setlhabane (2012), adds that in the *Balobedu* culture the Queen does not operate on her own regarding rain making powers she possesses; however, the process is influenced by a complex of institutions through various aspects of their culture.

During drought seasons or in September before the commencement of rainy season, the queen is approached by her great councillors, believing rain making rituals can help bring rain (Mohale & Phaahla, 2014). One of the rituals performed is known as 'mofuko' which involves requesting young men from various royal families under the rule of Queen Modjadji to go from one house to another in their area, sprinkling rain medicine and playing musical instruments such as horns. This will then be followed by dancing for rain, whereby local chiefs and their headman gather at the Queen's royal kraal to dance for her (Mohale & Phaahla, 2014). According to Mohale & Phaahla, (2014), women are the last group to dance for the queen if the above-mentioned rituals do not galvanize rain.

The rain queen appoints a traditional healer to assist with the rain-making ritual. According to Mohale & Phaahla (2014), if the process does not go accordingly, or people grumble about insufficient rain or when the rain is preceded by thunderstorms, the queen appoints a new traditional healer to bring rain that will only be beneficial to people. Krige and Krige (1980) acknowledge that the queen was never held responsible for tragedies caused by rain. This is because the key purpose of the traditional healer was to complement the Queen in some of the things she could not do.

During drought seasons, the appointed traditional healer for rain-making examines the causes of drought through his or her knucklebones and oracles, and identifies forces

that may temper with the rain-making powers of the Queen (Mohale & Phaahla, 2014). The traditional healer is then expected to use his or her powers and medicines to eliminate obstacles interfering with the rain-making powers of the Queen (Mohale & Phaahla, 2014). Kringe & Kringe (1980) adds that the relationship between the traditional healer and Queen Modjadji was rooted on the acknowledgement that they are all experts in their different arts, inherited from their ancestors.

The rain-making ritual as a water practice is significant amongst the *Balobedu* people, as can be deduced from the above discussion. The *Balobedu* rain-making practice links well with the current study, because it addresses the aspect of water accessibility. Water accessibility informs conservation and management practices or methods which this study explores. The *Balobedu* assume that Queen Modjadji possesses authority to ensure a good season (Mohale & Phaahla, 2014). The water practice amongst the *Balobedu* people demonstrates an intimate relationship between people, natural resources and ancestors. This relationship also implants a sense of water security which is important for health, livelihoods and production within their community.

2.3.5 Factors leading to the disappearance of African indigenous knowledge

African indigenous knowledge has been reported to be under threat of extinction. It is visible in the modern-day, where much of African indigenous knowledge is not commonly employed, even in the areas where there seems to be a need for it. Therefore, it is important to look at aspects contributing to the disappearance of African indigenous knowledge to provide solutions and protect it. This part of the study provides insight into some of the factors contributing to the loss of African indigenous knowledge.

2.3.5.1 Impacts of colonialism and its aftershocks

Colonialism refers to the taking over land by people from another location and enforcing governance on them (United Kingdom Essays, 2018). In other words, this is a practice of conquest that pertains to people's enslavement in their indigenous land. Colonialism comes with activities that destroy the colonised land's norms and values and submits to those enforced on them (Higgs, 2015). Africa experienced colonialism

by Europe. The Europeans' motive for colonising Africa was to attain political, social and economic control to pursue and protect their interests (Higgs, 2015).

The colonial government used policies and governance methods that overpowered African people to control their lands and natural resources. The policies and methods used by the colonial government subjected African indigenous cultures to be inferior, and the African indigenous knowledge systems were disregarded and disregarded with their Western knowledge systems (Adom et al., 2016). These policies were introduced in such a way that African communities submitted and stigmatised their system of knowledge. As a result, African communities were stuck in the schemes of perpetuating their suppression through western education and degenerating economies that are self-sufficient into consumers who are dependent (Shava & Nkopodi, 2020).

In South Africa, during apartheid, the colonial government imposed the dominance of their languages in schools, media, and many different public contexts, thereby causing more harm to the languages of indigenous people (Malindi, 2018). The education system introduced by the apartheid government was against the knowledge of African indigenous people and their education system. The western education system was superior while ignoring the existing diversity of knowledge epistemologies (Shava & Nkopodi, 2020). The imposition of western education as superior led to the redefinition and socialisation of many South Africans out of their own African indigenous knowledge systems to favour the ideologies of the colonisers (Onuora-Oguno, 2019). In due course, African indigenous people abandoned their knowledge and approved the dominance of European knowledge systems.

In the post-colonial era, the dominance of the colonial government is still visible in the economic and political spheres in many African countries, including South Africa (Robinson, 2019). The systems of transferring academic knowledge in Africa reveal the western domination. African Indigenous knowledge is less appreciated by those who are more exposed to western education and less to indigenous knowledge-based education. People who practice indigenous knowledge are often looked down upon and labelled as primitive and outdated (Shava & Nkopodi, 2020). The scars

exacerbated by colonialism and apartheid are still affecting the African indigenous communities and their generations (Adom et al., 2016). The disappearance of African indigenous knowledge reduces the social capital of the younger generations

It can be deduced from the above discussion that the impacts of colonialism and its aftershocks are still active in the lives of South Africans, including indigenous people. This may exacerbate the disappearance of African indigenous knowledge of water conservation and management, as Shava and Nkopodi (2020) indicate that people who practice African indigenous knowledge are looked down upon. Therefore, African indigenous knowledge may be lost because it is not used by those who possess it.

2.3.5.2 The inactive reaction of universities and research institutions

A university is an institution of higher education and training that provides training in vocational subjects and typically possesses the authority to confer degrees (Lowe & Yasuhara, 2013. Other traditional roles of a university include education, service and research (Segre, 2015). In South Africa, during apartheid, the education system was designed to cater for the apartheid government and other European countries (Heleta, 2016). As a result, the African indigenous people received an education that focused on making them inferior and only is labourers of the apartheid government (Adom et al., 2016). However, it seems like the education system has not developed to cater for the indigenous people, even after the era of apartheid (Higgs, 2016). In other words, African indigenous people are still receiving an education that is not in their context and understanding of life.

All systems of production, distribution, and intake of knowledge are strongly rooted in European culture, since colonialism (Shava & Nkopodi, 2020). And the culture of colonialism seems to remain dominant in post-colonial times Africa. Shava and Nkopodi (2020) claim that “western culture is everywhere, dominating the disciplinary and interdisciplinary discourses and departments, paradigms and publications, academic politics and practices”.

According to Mamdani (1990), universities that are recognising and adopting the policies of African indigenous knowledge are few, yet the western academic perspective dominates these policies. Most universities in Africa still perceive African

indigenous knowledge systems as an alternative or other knowledge system (Chilisa, Major & Khudu, 2017). According to Msuya (2007, the enigma is that these universities are in Africa, and conduct their teachings and research in Africa, but much of what they teach and research do not reflect the African context. These arguments firmly expose that research ,methodology and teachings on the African indigenous knowledge system in research and teaching. Therefore, one would conclude that there is a need for intellectuals who might challenge the existing knowledge systems by exploring the sources of knowledge, probing its potentials and understanding its epistemology, how knowledge should be validated and invalidated.

According to Zeleza (2006, the activities of forming new universities and research centres never stopped. However, according to the discussion above, the dominance of western culture in all these establishments seems to remain active. Therefore, African indigenous knowledge may be ignored because of the dominance of western culture and education. Zeleza (2004) also states that many years have passed since African indigenous knowledge systems were introduced to research and research. Yet, academics who pursue research of the African indigenous knowledge systems are motivated by their commitment and incentivised by government political and financial support are few. This can lead to African indigenous knowledge disappearing, as the knowledge may not be researched, adopted and incorporated into academic teaching and learning. This includes African indigenous knowledge methods of water conservation and management.

2.3.5.3 Lack of documentation

There is a lack of documentation or recording of African indigenous knowledge systems and practices (Issa, Owoeye & Awoyemi, 2018) because African indigenous knowledge has been transmitted orally from one generation to another (Pandey, Mittal & Sharma, 2017). In this manner, African indigenous knowledge faces the possibility of disappearing. The challenge of documenting the African indigenous knowledge is also related to access, intellectual property rights and methodology (Saurombe, 2017). This is because access to African indigenous knowledge is not controlled or regulated hence it is exposed to exploitation. ,Therefore, irrespective of the intrinsic role that

African indigenous knowledge plays in natural development, the question of its documentation remains (Haumba & Kaddu, 2018).

As indicated above, Western education has been enforced while discarding African indigenous education and knowledge (Shava & Nkopodi, 2020). Therefore, it can be deduced that another challenge associated with the lack of documentation of African indigenous knowledge is the availability of alternative methods and knowledge sources to solve problems that were previously solved through African indigenous knowledge. Furthermore, African indigenous knowledge has been constructed with the involvement of secrecy embedded in families. Another challenge would be that the western and other foreign values have been enforced on the African indigenous people, making it difficult for them to practice all aspects of their knowledge (Onuora-Oguno, 2019).

Africa has not been successful in documenting its indigenous knowledge in efforts to protect and prevent it from disappearing and becoming pirated (Haumba & Kaddu, 2018). This is because the current generation spends most of their days in formal education and technologies that have been introduced by the foreign, mainly western, systems of knowledge and practices (Shava & Nkopodi, 2020). This led to their disapproval of their own African indigenous knowledge systems. It is important to have African indigenous knowledge, systems and practices recorded and documented in materials that the new generation is familiar with. Furthermore, it is important to document African indigenous knowledge to preserve it, ensure its prosperity, and ensure that it cannot be used to obtain patents by people who do not own it (Moahi, 2005). Moreover, the intellectual property of African indigenous knowledge is being demanded by those who do not own it only because they codified it. This means that there is a need for African indigenous people to employ indigenous knowledge systems in their ways of living while claiming rightful ownership.

Some challenges of documenting African indigenous knowledge, as highlighted by Pandey et al. (2017), are the impact of values of western knowledge in the use and distribution of African indigenous knowledge and the loss of African indigenous knowledge through transfer and documentation well as translations. African

indigenous knowledge is sacred and secretive and has been transmitted through the lineage patterns of families (Mpofu, 2016). This means that African indigenous knowledge is rooted in customary laws that are only available and applicable to a certain indigenous group. As such, access to African indigenous knowledge is limited. Aboyade and Adeyemo (2019) point out that much of the African indigenous knowledge is found in rural areas. As a result, there is limited information on the sources of African indigenous knowledge to those who do not reside in these rural areas. Most sources of African indigenous knowledge are also found in rural areas; these sources of African indigenous knowledge range from clans of clothing makers, herbalists, musicians, rainmakers, storytellers, poets and others who have a specific speciality within the context of African indigenous knowledge systems (Dlamini, 2017).

The challenges of documenting African indigenous knowledge also pose the threat of the possible disappearance of African indigenous knowledge methods of water conservation management due to the sacred nature of the practice. Moahi (2005) asserts that ways in which indigenous knowledge can be documented and protected include establishing the resource concept of African indigenous knowledge, creating databases, databanks and websites of African indigenous knowledge, and conducting African indigenous knowledge research. Pandey et al. (2017) add that African indigenous knowledge faces the challenge of lacking proper , recording methods, and this can be solved by recording methods. This can be solved by collecting and documenting it through a datasheet of survey, pictures, and video recording.

The use of methods of documenting or recording African indigenous knowledge given the above may be beneficial in giving access to different aspects of African indigenous knowledge, including water conservation and management. It can be deduced from the above discussion that without the modern ways of storing information, African indigenous knowledge methods of water conservation and management are at risk of disappearing. On the other hand, Moah (2005) argues that the challenges of documenting African indigenous knowledge are associated with the limited number of indigenous knowledge researchers and poor access to information technology for the people in the rural areas. Therefore, there is a need to encourage African indigenous

knowledge research, particularly water conservation and management, as it is a serious challenge. Consequently, it is the focal point of this study.

2.3.6 Integrated water management

The Global Water Partnership (GWP) has defined Integrated Water Management (IWM) as a process that encourages water development and management, as well as land resources to increase the economic and social wellbeing without exploiting the sustainability of the ecosystems (Friesen, Sinobas, Foglia & Ludwig, 2017). This part of the write-up focuses on the employability of integrated water resource management and integrated knowledge approaches to water management. It also looks at the significance of indigenous knowledge systems and the strong relationship that indigenous communities have with the environment.

The establishment of IWM was recommended at the International Conference on Water and the Environment in Rio de Janeiro in 1992 as a concept that is aimed at promoting and achieving improved management of water resources (Silva, Pereira & Vieira, 2020). The understanding of IWM is hosted within three principles which are given below.

- **"Social equity:** ensuring equal access for all users (particularly marginalised and poorer user groups) to an adequate quantity and quality of water necessary to sustain human well-being.
- **Economic efficiency:** bringing the ,most significant benefit to the greatest number of users possible with the available financial and water resources.
- **Ecological sustainability:** requiring that aquatic ecosystems be acknowledged as users and that adequate allocation is made to sustain their natural functioning." (Mehta, Movik, Bolding, Derman & Manzungu, 2017).

This study looked at water resources management by including African indigenous knowledge methods of water conservation and management, which encompass the above-mentioned principles of integrated water management. This study seeks to achieve integrated water management by recognising that African indigenous knowledge and western science have one thing in common; they have developed

methods and techniques for doing things in their environments. However, there are also significant differences between these two knowledge systems, which are that African indigenous knowledge is more spiritual while western science is materialistic; and African indigenous knowledge is holistic while western science is particularistic (Chapman, 2007; Mazzocchi, 2006; Berkes & Berkes, 2009).

According to Friesen et al. (2017), integrated water resource management advocates for improving the relationship between humans and the systems of the environment. In many different countries in the world, water management is a serious challenge for sustainable development. ,Therefore, integrated water resource management is a strategy that has been identified to attain the appropriate management of the water resources in the world and sustainable development (Carrera, Warren, Van Beek, Jonoski & Giardino, 2017).

According to Ajayi and Mafongoya (2017), in Africa, western knowledge and technologies have not been entirely successful in managing the systems of the environment to ensure the sustainability of the ecosystem, especially in the rural areas where there are indigenous people who are more subscribed to their knowledge systems. There is special attention to and recognition of African indigenous knowledge systems for their ability to provide solutions to complex environmental issues because it is holistic (Osemudiame, 2017).

Water is understood to be a component that brings together the culture of people and the environment; hence, the role of African indigenous knowledge and western knowledge in water management must be recognised (Beshah et al., 2016). Western knowledge has been more instrumental in developed countries than indigenous knowledge (Ajayi & Mafongoya, 2017). Nonetheless, to fathom the relationship between people and the environment, other knowledge systems such as African indigenous knowledge must be recognised and treasured (Mazzocchi, 2006). The acknowledgement of the strength of African indigenous knowledge and western science has a positive impact on applying them to complement one another in water management (Huntington et al., 2004).

Scholars and policy makers consider the integration of African indigenous knowledge and western science to be an excellent approach to water resources management (Gondo & Kolawole, 2019). African Indigenous knowledge is holistic, and it can capture a few indicators such as the behaviour of animals. Most of these indicators can be understood using African indigenous knowledge and are not usually studied by western science. This shows that much of the African indigenous knowledge still can contribute to water management in modern society. In the same way, it is essential to understand the knowledge of western science in water resource management (Kirk, 2012). This is vital because western science may provide the designs to analyse and evaluate and provide the correct information or results of the investigated matter. Therefore, the integration of African indigenous knowledge and western science will provide room for improvement in the management of water resources and solutions to water problems that cannot be addressed using a particular knowledge system (Rawiri & Fitzgerald, 2012).

The integration of African indigenous knowledge and western science for water management seems to be the centre of interest for many. It should be considered that there should be intercultural dialogues, particularly in areas where there is a diversity of cultures, to raise awareness and promote the practice of integrated water resources management. It can also be deduced from the information above that acknowledging that cultural values are deeply rooted in water management supports the notion of using both African indigenous knowledge and western science to approach water management. Although there is a great need to integrate African indigenous knowledge in water resources management, there are no clear indications of whether all values of a culture or just aspects of it must be used in collaboration with Western science practices.

To answer the above, there must be a strong representation of African indigenous people and incorporation of the customary, social and spiritual strategies and objectives in water management plans (Gumbo & Van der Zaag, 2001. This will allow a better understanding of African indigenous knowledge of water conservation and management towards achieving integrated water resource management. This is because Gumbo and Van der Zaag (2001) assert that some challenges of allowing the

involvement of African indigenous people in water management include ,inadequate understanding of the philosophies of the environment, indigenous cosmology and the institutions of managing resources in the indigenous societies by the development agents. Therefore, the discussion below looks at the Zambian approach to integrated water management.

2.3.6.1 Zambia's efforts towards integrated water management

The government of Zambia realised the importance of water to sustain all aspects of life and improve the socio-economic status of the citizens. In their efforts to drive change and development, the Zambian government, through development agents and policy makers, sanctioned the 2030 vision (Musambo, 2017). The Zambian 2030 vision was inspired by the need to redress challenges the country faces regarding achieving sustainable water management. Water resources encounter in Zambia include droughts, flooding and water logging, and it was then that it was realised that something must be done regarding water management in Zambia (Vision Africa Regional Network, 2015).

To redress some of the water challenges in Zambia, the National Water Policy (NWP) of 2010 talks about an integrated approach to water management, with particular attention on planning, development, utilisation and management of water. The Zambia 2030 water vision is more about harnessing sustainable use of water to improve the economy's effectiveness and eradicate poverty (Mabeta, Mweemba & Mwitwa, 2018). The policy provides platforms in which different stakeholders such as traditional leaders, participate in research institutions, line ministries, and the National Assembly. This is how integrated water resources management (IWRM) was established to fight against the water challenges that Zambia is facing.

According to Makondo and Thomas (2018), integrated water resources management is a process that encourages the development and management of natural resources, particularly water, to improve cultural identity, economic and social well-being without causing harm to the natural environment. Therefore, aspects that are affected by integrated water resources must be considered. There is also a need to consider the physical and natural systems associated with water, such as land and land use

activities because their impact on ground and surface water resources is direct. Suppose the land is used in a sustainable wasustainably. In that case, the sustainability of water management processes will be a success and surface, and ground water resources depletion and pollution will be avoided. ,Therefore, it is important that this study should provide an approach that should be adopted to meet water challenges in places with such conditions.

2.7 CHAPTER CONCLUSION

The socio-cultural theory was used in this study because it is entred on the intellectual adaptation tools offered by society and culture. The cultural beliefs, taboos, myths and stories are essential tools to the African indigenous communities because they have been part of their history. African indigenous communities used these tools to communicate the important aspects of their day-to-day activities, including water conservation and management. Afrocentric theory encourages African people to make use of the African indigenous knowledge they possess. The study of African indigenous knowledge methods of water conservation and management was also rooted in this theory, with African indigenous knowledge as a priority.

It can be deduced from the information above that water is a serious challenge affecting several countries in Africa. Various activities cause the challenges relating to water that human beings involve themselves in and some natural causes. Other challenges are associated with the management of water, which is unapparent in the African indigenous communities. African indigenous knowledge has a significant role to play in the conservation and management of water. The administration and governance of water, socio-cultural and spiritual issues related to water have sustained the lives of the water bodies in rural indigenous communities. However, African indigenous knowledge faces the threat of extinction because of the various factors that have been elucidated above. It is important to conserve and manage water. While advocating for African indigenous knowledge methods of water conservation and management, it is also important to consider integrated water management, which should advocate for incorporating the African indigenous knowledge and Western knowledge and its technologies in conserving and managing water.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 INTRODUCTION

The previous chapter outlined the theoretical framework and literature review adopted in the study. This chapter provides the research methodology used in this study. Descriptions of research design, study area, population and sample are also given in this chapter. In addition, the discussion of qualitative research methods of data collection in African indigenous knowledge is provided. The researcher also explains the ethical considerations and measures to ensure the trustworthiness of the study.

3.2 RESEARCH METHODOLOGY

Methodology is a process, plan and measures that the researcher uses to approach a problem and find answers (Soeters, Shields & Rietjens, 2014). Methodology is also understood as a research approach that summarises how research is conducted (Creswell, 2012). Methodological procedures are influenced by traditions, expectations and objectives (Soeters, Shields & Rietjens, 2014).

3.3 RESEARCH DESIGN

Research design is a detailed strategy of how a research study is directed (Creswell, 2012). Furthermore, a research design describes the way, time and place in which data will be gathered and examined. I A research design aims to provide a summary for the researcher to solve research problems or challenge the research theory (Muaz, 2013**).** A smooth process of the procedures of research that help in the development of professional research is enabled by the research design. A research design employed in this study was the qualitative research design, and its appropriateness is outlined in the discussions below.

3.3.1 Qualitative research design

Qualitative research is research in which data are not in the form of numbers (Pernecky, 2016). In other words, this is a type of study that puts the researcher in the natural environment. The qualitative research design is widely used in the social sciences to conduct their studies on cultural and socially oriented phenomena (Fusch, Fusch & Ness, 2017). For example, a qualitative research design was considered

suitable to explore African indigenous knowledge methods of water conservation and management because the researcher was interested in understanding the meanings people have established, that is, how they perceive their realm and knowledge and practices in that realm regarding water conservation and management (Hammersley, 2013).

The main aim of using the qualitative research design was to explore African indigenous knowledge methods of water conservation and management, as explained above. The qualitative research design was relevant to this study because it is rooted in a philosophical state about the interpretations of the social world; how it is understood, experienced and produced concerning African indigenous knowledge methods of water conservation.

The researcher conducted this study in a natural setting, making efforts to make logic of, or to understand, African indigenous knowledge methods of water conservation and management regarding participants' senses (Denzin & Lincoln, 2011). Moreover, the researcher selected a qualitative research design because it provided an opportunity for direct contact with participants in the study area, which assisted the researcher in gathering relevant information based on individual experiences about African indigenous knowledge methods of water conservation and management. In addition, qualitative research design assisted the researcher by providing information that contributed to understanding reports from participants because the data was gathered through questions and answers. The qualitative design in this study was exploratory.

3.3.1.1 Exploratory qualitative research design

Exploratory qualitative research design is a research design directed at a problem that has not been studied in more detail (Stephen & Kasim, 2015). The study sought to explore African indigenous knowledge methods of water conservation and management; thus the exploratory research design allowed the researcher to ask different types of questions (what, why, how). In this way, the researcher could unearth the relationship between African indigenous people, their skills, knowledge and methods of water conservation and management. Furthermore, the exploratory

research design assisted the researcher to explore in detail the problem concerning water conservation and management. In addition, the researcher managed to gain new ideas and develop solutions regarding water conservation and management because the study was conducted in the natural environmental setting.

3.3.2 Research Paradigm

Paradigm is a concept that originated from the Greek word *paradeigma,* which means 'pattern' (Ralph, 2018). Thomas Kuhn first used this concept in 1962. This concept was used as an approach that scientists share as it provided them with a model to examine problems and find solutions (Stephen & Kasim, 2015).

The purpose of a research paradigm is to help the researcher develop a suitable and effective methodology (Ralph, 2018). The research paradigm used in this study reflected the beliefs about the world in which participants of the study live (Stephen & Kasim, 2015). In this study, a research paradigm described the participants' worldview. According to Herrin (2019), a worldview is a construction of an individual's belief about the question of reality. A worldview in this study refers to what is known and how it is known by participants in association with African indigenous knowledge methods of water conservation. The interpretivist paradigm was employed in this study.

3.3.2.1 Interpretivist Paradigm

Most qualitative research in social sciences uses the interpretivist approach to understand things (Thanh & Thanh, 2015). Interpretivists believe that human behaviour is multi-layered and cannot be determined by pre-defined probabilistic models (Gergen, 2015). It depends on the situations and is determined by environmental factors other than genes. Human behaviour is quite unlike a scientific variable that is easy to control (Scotland, 2012). Human behaviours are affected by several factors and are primarily subjective (Parahoo, 2014). Therefore, interpretivists believe in studying human behaviour in daily life rather than in the controlled environment (Ralph, 2018).

The interpretivist paradigm enables researchers to understand the world through the experiences and opinions of the participants in a study (Ralph, 2018). The participants' experiences and opinions are instrumental for the researchers who use the interpretivist paradigm (Gergen, 2015). The interpretivist paradigm has received considerable attention due to its ability to accommodate various perspectives and varieties of truths (Yanow & Schwartz-Shea, 2014). Interpretivists seek to investigate the core belief of the realities constructed in a social setting (Patton, 2015).

The interpretivist paradigm enabled the researcher to understand the solid relationship between human beings with their natural environment and the role people in forming the fabric of the society they are part of. This research paradigm provided a researcher with an opportunity to interact with the participants and probe to understand how they relate to African indigenous knowledge methods of water conservation and management. In this regard, participants shared their cultural beliefs, values and social norms that form part of how they perceive their surrounding environment. These cultural beliefs, values and social norms contain the African indigenous knowledge methods of water conservation. The usage of the interpretivist paradigm is clear and evident in the data presented.

3.4 STUDY AREA

This study was conducted in the *Tshidzivhe* village, Vhembe district of Limpopo province, South Africa.

3.4.1 Limpopo province

Limpopo is the northernmost province of South Africa. This province was named after the Limpopo River. The capital city of Limpopo is Polokwane, which was previously known as Pietersburg. The economy of the province is mainly sustained by farming, mining and tourism. The province is home to the Mapungubwe world heritage site and the Kruger National Park.

The Limpopo province is a gateway to the Gauteng, Mpumalanga and Northwest provinces while serving as a gate to the sub-Saharan region of Africa. The province shares borders with Botswana, Lesotho, Mozambique, Swaziland and Zimbabwe to

and from South Africa. The languages spoken in Limpopo are predominantly Sepedi, Xitsonga and Tshivenda. The province is divided into four district municipalities: Capricorn, Mopani, Sekhukhune, Vhembe and Waterberg district municipalities. The researcher selected the Vhembe district for this study. Below is a map of the Limpopo province.

Figure 1: Map of the Limpopo province

3.4.1.1 Vhembe district

Vhembe is one of the five districts of the Limpopo province of South Africa. It is in the northern part of the Limpopo province, sharing borders with the Beitbridge district in Zimbabwe and the Gaza province in Mozambique. All Venda Bantustan areas are part of the Vhembe district, which means that all the *Vhavenda* communities in Limpopo province are found in the Vhembe district. However, some areas were part of the former *Gazankulu* Tsonga Homeland. Most of the people residing in the Vhembe district speak the Tshivenda language, while others speak Tsonga and Northern Sotho. In the Tshivenda language, Vhembe means Limpopo River. The Vhembe district comprises four local municipalities, namely *Thulamela, Musina, Makhado* and *Collins Chabane*. The study was conducted in the *Thulamela* Local Municipality, *Tshidzivhe* village.

Figure 2: Map of the Vhembe District

3.4.1.2 *Tshidzivhe* village

The Tshidzivhe village is in the Thulamela Local Municipality in the Vhembe District Municipality. From the indigenous knowledge of water sources and sacred sites available in the *Thulamela* Local Municipality, the researcher deemed the *Tshidzivhe* village suitable for this study. In *Tshidzivhe*, the *Tshatshingo* pothole can be found naturally along with the source of water, the *Tshirovha* River. The researcher chose the *Tshidzivhe* village because the community still abides by the African indigenous knowledge methods of water conservation and management. In the *Tshidzivhe* village, indigenous knowledge holders and African indigenous protocols are followed to address water conservation and management issues. Therefore, the researcher intended to tap into these indigenous ways of addressing water conservation and management.

3.5 STUDY POPULATION

The study population refers to a group of individuals selected to participate in a study (Ojovan & Loshchinin, 2015). The targeted study population for this study was from the *Tshidzivhe* village, as indicated in the table below.

Table 1: Targeted population and justification

Category	Justification
Traditional leaders • Chief • Headmen	They are the custodians of culture and every aspect of it. They promote, protect their culture, and ensure rules concerning water use, management, are followed.
Traditional health practitioner • Diviner	They were chosen because of the experiences and knowledge about water conservation and water use for ritual purposes.
Elderly community members	They were selected because of the knowledge that they gained through experience in water conservation and management.
Farmers • Animal Farmers • Crop Farmers	Farmers need water every day, and they are expected to conserve and manage water for the present and the future.

3.6 SAMPLING

Sampling is a process of selecting units (organisations, people) from a population of interest, and the results will represent the whole population (Lance & Hattori, 2016). This study employed non-probability sampling.

3.6.1 Non-probability sampling

Non-probability sampling is a sampling method in which it is not known which individual from the population will be selected as a sample (Yin, 2014). This sampling method provides a specification of characteristics that exist in each population. It is believed that in non-probability sampling, there is an even distribution of characteristics within the population.

The researcher selected non-probability sampling because it was cost-effective, time-saving, and it provided direct access to the participants. The research study is qualitative; therefore, non-probability sampling was an excellent method to assist the researcher in generating knowledge of African indigenous knowledge methods of water conservation and management. In addition, non-probability sampling helped

the researcher in collecting relevant knowledge from the experts. In this study, purposive sampling, a sub-type of non-probability sampling, was used.

3.6.1.1 Purposive sampling method

Purposive sampling is a sampling process that is also known as subjective sampling; this is where the researcher depends on his or her judgement when selecting members of a population to contribute to the study (Lance & Hattori, 2016). In this study, the chosen sample possessed rich knowledge and experience of African indigenous knowledge methods of water conservation and management (Robert, 2010).

Purposive sampling is a non-random sampling method that allows the researcher to decide what needs to be known and plan to find relevant people who are willing to contribute to the study on the virtue of the knowledge and experience they possess. Thus, the researcher was able to meet with all the selected participants and collect relevant information to the study.

3.7 DATA COLLECTION METHODS

Data collection is a process of acquiring information (Barrett & Twycross, 2018). The main objective for collecting data was to capture the information in which the analysis brought about sound answers to the questions posed to the participants (Hammersley, 2013). To ensure that data collection goes accordingly, the researcher deemed it fit to build rapport with the participants.

3.7.1 Rapport

Rapport is a congenial and close relationship between people or groups who share a common background or understand each other's feelings towards a certain thing (Rogers, 2015). A rapport enables one to establish or realise shared characteristics and perspectives between two people or groups (Falkestrom, Hatcher, Skjulsvik, Larsson & Holmqvist, 2014). In this study, a rapport enabled the researcher to establish a friendly relationship with participants made it possible for the researcher to understand the participants' perspectives on African indigenous knowledge and water conservation and management.

Building a rapport was imperative for the researcher to ensure trust between the researcher and the participants. For this study's purpose, the researcher deemed it suitable to familiarise himself with the *Tshidzivhe* area and the people living there. The researcher was at an advantage because he knew one of the relatives of the royal house. They assisted in making appointments with participants and introducing the researcher to the chief and other participants of the study.

The researcher did not experience challenges with meeting participants because the relative of the chief is an influential person in the village. During this process, the researcher identified that some community members are members of an organisation called *Dzomo la mupo* (Voice of Earth) that seeks to preserve sacred sites and promote culture. This assisted the researcher in gaining the attention of the bond created with the organisation's phangami (leader). To add, *Dzomo la mupo* has a good relationship with the University of Venda as it actively participates in community engagement, thus relations were cemented.

According to the *Vhavenda* culture, when a person introduces himself, it is important to give a detailed background of where a person comes from and their parents. In this regard, the researcher gave brief information on personal identity and family background. The researcher is from the royal family, and this served as an advantage because he observed protocols in a good way, such as *u losha* (respectful greeting while bowing down). After building a rapport, data were collected in the following manner.

3.6.1 One-on-one semi-structured interviews

A one-on-one semi-structured interview is a method of collecting data in which the interviewer conducts the interview directly with the participants according to the framework of questions that allows new ideas or questions to be asked as a result of the responses of participants during data collection (Edwards & Holland, 2013). In this type of interview, the researcher did not research to examine a theory (Hammersley, 2013). A set of semi-structured arranged questions was used, but the researcher was not confined to follow this order and added questions depending on the research

track. In one-on-one semi-structured interviews, the same order of questions is used, but it is changed depending on the direction of the interview. Additional questions can also be posed following the participants' responses (Denzin & Lincoln, 2011).

The researcher conducted one-on-one semi-structured interviews with participants from all the different categories as mentioned above. This was done because the researcher wanted to learn different perspectives that participants were sharing. One-on-one semi-structured interviews allowed the researcher to capture the emotions and attitudes of the participants regarding the African indigenous knowledge methods of water conservation and management. To add, one-on-one semi-structured interviews made it easy for the researcher to rephrase questions when participants could not understand them. The sample of the one-on-one semi-structured interview questions is attached as an appendix.

3.6.1.1 Fieldwork

The researcher conducted one-on-one semi-structured interviews with participants that were selected from the categories shown above. The researcher made appointments with the participants, and when he met them, he introduced himself and explained the purpose of the study. However, they agreed to participate, and they had to sign a consent form (see attached appendix). An ethical clearance letter was also presented to the participants after explaining that the researcher was a student from the University of Venda. This assisted in establishing a peaceful and comfortable environment for the interviews to be done. From the various semi-structured interviews conducted, one is summarised to understand how data were collected.

The researcher arrived at the house of the participant and bowed (*u losha*) to greet respectfully. After explaining the purpose of the study as mentioned above, the participant wanted to know why the researcher was interested in African indigenous knowledge in the modern day where the youth seem not to care about it. The researcher engaged with the participant to show how important it is for the youth to study and be passionate about African indigenous knowledge. This was done by linking it to water conservation and management.

At this stage, both the participant and researcher were comfortable for the one-on-one semi-structured interview to commence. Then, the researcher started asking questions, as shown in the appendix. After that, other additional questions were asked depending on how the participant responded to the first questions. The interview guide was prepared in English; therefore, the researcher had to translate it into Tshivenda to avoid language barriers.

The participant would at times deviate from the content of the questions; however, the researcher was patient enough to pay attention to the participant. Some of the mentioned things did not contribute to the purpose of the study but allowed the researcher to see things differently. The researcher ensured that responses were recorded in writing and a tape record. The researcher asked the participants for consent to record the semi-structured interviews.

After the one-on-one semi-structured interview, the researcher also had a casual conversation with the participant, which was very edifying. This was done to enable the researcher to learn information and perspectives that were not shared during the semi-structured interviews.

One-on-one semi-structured interviews were used because of their potential to elicit the quality of information on the African indigenous knowledge methods of water conservation and management to be captured on one-on-one interaction. The one-on-one semi-structured interviews enabled the researcher and participants to discuss the subject in more detail. The researcher was able to rephrase questions when participants did not understand them. Furthermore, the researcher prompted the participants to stimulate their interest in responding to questions and talking about other issues related to African indigenous knowledge methods of water conservation and management. This made participants more comfortable answering questions without limiting themselves. Lastly, during the semi-structured interviews, the researcher observed participants' gestures and facial expressions, noting them down because they had relevance to what they were saying.

3.6.2 Focus group discussion

Focus group discussion is a research method of information collection where a group of people to participate is chosen to discuss their knowledge and thoughts based on a prepared subject by the researcher (Collis & Hussey, 2013). A focus group discussion allows the researcher to study the participants in a more natural conversation pattern than a one-on-one interview. Moreover, this method gives a quick way to learn from the participants. Thus it became well known and most preferred (Harding, 2013). A focus group discussion is commonly conducted with participants who possess similar backgrounds or experiences related to the topic of the study.

3.6.2.1 Fieldwork

The researcher used his primary contact in *Tshidzivhe* to set up an appointment for a focus group discussion. The focus group discussion was conducted once with three participants who are elderly community members because they possess knowledge and experience of African indigenous knowledge methods of water conservation and management.

The researcher ensured that he arrived early to honour the commitment that participants had made. The researcher bowed *(u losha)* before the elders as a sign of respect. Introductions were made, and then the researcher explained the purpose of the study and presented the informed consent. Participants were very happy to see a young person concerned about African indigenous knowledge and the , natural environment's wellbeing, particularly water. After few minutes of casual conversations with each other, the focus group discussion commenced.

The session took place where tribal meetings are held *(Khoroni)* at the royal kraal. The focus group discussion lasted for about two hours. The researcher respectfully set ground rules that allowed the discussions to run well and not lose direction. The ground rules were based on respecting one another and opinions to avoid unnecessary conflicts. With the permission of the participants, an electronic device was used to record data. The researcher also took notes to be used in the analysis of the study.

The researcher selected a focus group discussion to collect data because it was less expensive and not time-consuming, as the researcher interacted with different people at once. This method was helpful in this research study because it allowed the participants to elaborate on issues concerning African indigenous knowledge methods of water conservation and management in a free and relaxed discussion way. The answers given also allowed the researcher to learn new informationrelevant to the topic. The aspects around African indigenous knowledge were discussed in more detail without arguments that led to conflict between participants. The participants professed words of encouragement to the researcher after the focus group discussion.

3.6.3 Non-participant observation

Non-participant observation is a data collection method in which the researcher observes the participants without actively participating in the activities that are being studied (Ciesielska & Boström 2018). This method of data collection is employed to understand a phenomenon by going to the relevant community or area of study (Baker (2006).

When using non-participant observation, the researcher carries out the general scope to get an overview of the setting, and then focus is given to narrow the portion of activities or elements that are of interest to the researcher and, finally, to investigate how those elements relate to the study that is being conducted (Baker, 2006). The researcher identifies, through observation elements or activities that provide answers to the research questions (Ciesielska & Boström 2018). The non-participant observation was conducted to appreciate situations that could not be captured through the one-on-one semi-structured interviews and the focus group discussion.

3.6.3.1 Fieldwork

After the one-on-one-semi structured interviews were conducted, the researcher asked for permission to go to the *Tshirovha* River where he saw the *Tshatshingo* pothole, an important part of the *Vhavenda* heritage, particularly the *Tshidzivhe* people. One elderly man volunteered to accompany the researcher. On their way there, the researcher initiated a conversation by asking questions about the nature of the *Tshirovha* River.

During this tour of collecting data, the researcher managed to take pictures of aspects of African indigenous knowledge methods of water conservation and management to edify the study. The researcher observed that the river is covered by different types of trees, as indicated by participants during the one-on-one semi-structured interviews.

Non-participant observation is generally used to appreciate situations that cannot be as quickly captured through other methods of collecting data. This means that non-participant observation allowed the researcher to observe the situations discussed during the one-on-one semi-structured interviews and focus group discussion about African indigenous knowledge methods of water conservation and management. The researcher could also describe aspects of water conservation and management that participants could not share.

3.7 DATA ANALYSIS

Data analysis is a method of studying, changing and exhibiting evidence to learn valuable evidence, backing up and suggesting decision-making (Chekanov, 2016). It is also defined as the method in which data are collected and organised so that important information can be derived from it (Xia & Gong, 2015). In this study, thematic analysis was used.

3.7.1 Thematic analysis

Thematic analysis is a method of analysing data in qualitative research which focuses on identifying, assessing and recording forms or themes within data (Hammersley, 2015). It is a method in which themes are well related to information because they arise from it (Guest et al., 2012). Furthermore, the method assisted the researcher by providing a description and understanding of the answers that participants gave.

The researcher collected data and analysed it according to themes. This method assisted the researcher when moving the assessment from a general study of the evidence to develop themes and discover patterns (Hammersley, 2015). The researcher developed themes from the questions and other important information gathered from the participants during data collection.

3.8 DELIMITATION OF THE STUDY

Delimitations are referred to as features limiting the scope and defining the study's margins (Dimitrios, & Antigoni, 2019). The following limitations were encountered during the study.

3.8.1 Reluctance in participating

At the beginning of the interactions with the participants, they were reluctant to contribute and provide answers because they thought they were being exploited. However, the researcher explained more about the importance of the study in terms of preserving African indigenous knowledge and ensuring it is mainstreamed in water conservation and management. It was also indicated that the information they are providing is essential in providing solutions to water scarcity challenges. The researcher also indicated that the information that participants were giving would be helpful to generations to come.

3.8.2 Attending to responsibilities

During data collection, there was a challenge with participants having to attend to their responsibilities. These included cell phone conversations, which took much time. However, the researcher was patient and allowed participants to engage in other activities. Although some time was consumed, the purpose of data collection was achieved.

3.8.3 Inability to interview government officials

The researcher could not interview the government officials, as indicated in the research proposal, because the Covid-19 lockdown protocols had to be followed as people were working from home. The requisition that the researcher made took time to be approved, and when it was approved, the relevant officials were not available. However, this did not hinder the study's progress as the researcher consulted online literature and depended on the data collected with other participants.

3.9 MEASURES TO ENSURE TRUSTWORTHINESS

It is the researcher's responsibility to ensure that a comparable model is followed to ensure trustworthiness when undertaking a qualitative inquiry. Trustworthiness refers to the ability of the researcher to be trusted by the participants because of his truthfulness and honesty. In this study, credibility and conformability were ensured.

3.9.1 Credibility of the study

Credibility is when the researcher confirms the truth in the conducted study (Babbie & Mouton, 2010). In credibility, the researcher must ensure that the research conducted is acceptable. In this research study, the researcher consulted the documents appropriate to the African indigenous knowledge methods of water conservation and management to ensure credibility of the study's findings. The researcher also went to the study area to meet participants of the study and to observe the elements related to this study at the *Tshirovha* River in the Tshidzivhe village. The researcher ensured that the collection and presentation of data encompasses direct quotations from the participants.

3.9.2 Conformability of the study

Conformability refers to the extent of objectivity of the findings of the research (Gunawan, 2015). The findings of the research study were derived from the responses of the participants. This included ensuring that the researcher is not biased and does not twist the participants' explanations to satisfy certain narratives (Gunawan, 2015). To avoid bias, the researcher positioned himself as a learner during data collection to prevent taking advantage because he speaks the same language as the participants. Furthermore, although information exists on the internet regarding African indigenous knowledge, the researcher deemed it fit to learn from the participants' perspectives in Tshidzivhe. In this regard, objectivity was also ensured. To ensure the conformability of the study, the researcher made a record of the information gathered that provided a highlight on the data analysis steps. This assisted him in producing the results of the research study that reveal the participants' responses.

3.10 ETHICAL CONSIDERATIONS

Ethics are a set of moral principles that control or influence a person's behaviour (Hammer, 2017). Ethical consideration is one of the most critical aspects of research. Ethical concerns have meaning due to their in-depth nature in qualitative research (Polit & Beck, 2014). The consideration of ethical issues becomes more prominent when conducting interviews and focus group discussions. Sometimes participants become stressed while expressing their views or opinions during interaction with the researcher or other participants (Polit & Beck, 2014). In a proper research study, mainly qualitative research, ethical issues and standards are critically considered. Ethical issues are generally addressed at a societal or individual level. The ethics that the researcher followed in this study are presented below.

3.10.1 University of Venda ethical clearance

Ethics are a way of life that encompasses structuring and recommending what is right or wrong (Yunt, 2017). Ethical clearance is a research consideration representing the decent practice of research and conduct consisting of trustworthiness, accuracy, and fairness. The researcher used an ethical clearance letter to show that he understands the ethical standards of genuine research (Care Search, 2015). In this study, the researcher presented his research proposal to the University Higher Degrees Committee (UHDC) and was given an ethical clearance certificate to collect data. Ethical clearance protected both the researcher and the participants from any harm.

3.10.2 Confidentiality

Confidentiality is a form of rules or commitment that does not allow access or places restrictions on certain information (Surmiak 2018). It is also understood as an agreement of non-disclosure. The two or more parties involved in or exposed to a certain kind of information agree that the information will not be accessed by an outsider (Fan, 2015). Confidentiality goes hand in hand with privacy, referred to as keeping information from the people who are not supposed to have it (Abdekhoda, Dehnad, & Khezri,(2019). To ensure that confidentiality was maintained, participants were not required to reveal their names or personal identities, and their responses were treated with utmost confidentiality. This assisted participants to be comfortable and contribute to the study.

3.10.3 Informed consent

Informed consent means that the participants have a complete understanding of the study conducted for them to give the researcher permission to conduct a research study (Babbie, 2010). The choice of the participants to take part in a study and avoid exploitation is based on the provision of informed consent by the researcher. It is important that the participants understand the study purpose and how it affects them. The researcher explained the expectations to the participants and to decide whether they want to be part of the study. Then, a consent form was furnished for them to sign.

3.10.4 African indigenous protocol

The ethical clearance brought about observing African indigenous ethics in their different nature. The researcher did not go to the chief on his own to obtain permission to conduct his study. A relative of the royal house assisted the researcher in acquiring permission. This is where the researcher explained the purpose of the study. Afterwards, the researcher was introduced to the chief and proper arrangements were made for data collection. The African indigenous protocol that was used is *u losha,* as it is the most important part of greeting. After greeting, the researcher introduced himself in his personal and student capacity before explaining the purpose of the study.

3.10.5 Coronavirus prevention measures

The researcher had to go back to the study area for further clarification of his study during the coronavirus pandemic. Proper measures had to be followed to prevent the risk of infection and limit the coronavirus spread. The researcher ensured that hand sanitisers were used, and social distancing was observed between the researcher and participants.

3.11 CHAPTER CONCLUSION

In this chapter, the research methodology and design were well expounded. The information above that qualitative research design allowed the researcher to learn or discover issues about African indigenous knowledge methods of water conservation and management can be deduced from the information above. This is because of the

close involvement of the researcher and the direct interaction with the participants in the study area. One-on-one semi-structured interviews focus group discussion, and non-participant observation assisted the researcher with the collection of data. Questions that were asked to the participants were derived from the research topic and objectives. The data collected from the participants are presented in the next chapter.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1 INTRODUCTION

This chapter presents and analyses the study's findings in *Tshidzivhe* village regarding African indigenous knowledge methods of water conservation and management. The findings thereof came from the outcome of semi-structured interviews, focus group discussions and non-participant observations. Thus, the themes outlined below emanate from the research questions and other prominent issues during the study findings.

4.2 DEMOGRAPHIC PROFILE OF THE PARTICIPANTS

This part of the study presents the demographic profile of the individuals who participated in the one-on-one semi-structured interviews and focus group discussions to achieve the objectives of the study of an exploration of African indigenous knowledge methods of water conservation and management. The table below shows the demographic profiles of participants.

Table 2: Demographic background of participants

Category	Pseudonym	Age	Gender	Marital Status
Traditional Leader	Participant A	45-55	Male	Married
Traditional Health Practitioner	Participant B	50-60	Female	Single
Farmers	Participant C Participant D	65-70 50-60	Female Female	Married Single
Elderly Community Members	Participant E Participant F Participant G Participant H Participant I	60-70 70-75 60-70 40-50 45-55	Male Male Female Female Female	Married Married Single Single Married

The above table shows the demographic profile of the participants who were part of this study. The researcher collected data , from participants through semi-structured interviews; five also participated in a focus group discussion. As indicated, data were collected from a traditional leader, a traditional health practitioner, two farmers who are mainly into crops (these farmers also possess rich knowledge about animals they use) and three elderly community members.

4.3.1 Contemporary water challenge in Vhembe district

To centralise and show the relevance of this study in the current day, the researcher consulted with some diverse sources to find out what has been happening regarding water challenges and issues around water conservation and management. To achieve this, the researcher consulted newspaper reports and followed some television programmes for three months (October to November 2019). During this time, the researcher explored credited contemporary poor water conservation and management matters that are alleged to have exacerbated the water crisis. This was also done to unearth the undermining of the traditional institutions from taking part in regulating the thorny issue of water conservation. This way of collecting data was employed as a primary investigation to orientate the researcher to the insider views properly. In this regard, the researcher followed two newspaper reports, one television programme and an organisation called *Dzomo la mupo* to achieve this blueprint. These are discussed below.

4.3.1.1 Newspaper reports

Regarding newspaper reports followed, the researcher followed cases reported in Limpopo and these were selected purposively.

(a) SABC News Online: 24 November 2019, 7:47 PM SABC: Limpopo still experiencing water shortages

“Residents in some parts of Modimolle in Limpopo are still experiencing water shortages despite assurances from authorities that the situation is being addressed. In 2018, the area faced threats of a day zero arriving because of low dam levels. The Modimolle-Mookgopong Municipality has indicated that its bulk water supply has been

unable to meet the demand, leading to water restrictions. The municipality has also been struggling to service a R10 million debt it owes to Magalies Water."

Phagameng extension 10, George Maluleka, says it has been hard to sustain his brick laying business due to the shortages. "Shortage of water is a serious problem, and my brick laying business is badly affected. Sometimes we can go for a week or weeks without water. We are suffering. I thought getting a small water tanker will help me, but there is no difference. It never gets full because of low pressure. So the government should help us by also providing water trucks with this side."

> The Limpopo MEC for Cooperative Governance, Basikopo Makamu, says the municipality receives the necessary support to deal with the water challenges. "The challenge of water is a challenge that, as a province, we are taking it very seriously. We are working very closely with the municipality. You will notice that this municipality is a water service authority; the grants meant for water go directly to the municipality. I have been here before, trying to work with them to support, mainly to provide services because, at one time, the municipality had challenges. ,As a result, we will be launching this refurbished pump station, which will provide water in the entire Modimolle Mookgopong."

Analysis

It can be deduced from the above newspaper article that the water shortage is a continuing stress point in the Limpopo province. What is now described as "water-shedding" (water accessible for certain hours of the day, usually in the morning and evening) on various social media platforms has been experienced by Modimolle and Mookgopong when they were threatened with a day zero – meaning the day the water dries up.

Seemingly, in Modimolle, the challenge of water shortage did not start in November 2019. It is indicated that the dam level decreased in 2018 when residents almost experienced a water day zero. The question arises as to how the problem was solved. This could mean that solutions implemented were not sustainable. Thus, a year later, a water shortage was experienced again.

The residents of Modimolle think that the government should provide water trucks to deliver water. On the other hand, the solution to be provided by the Limpopo Member of the Executive Council (MEC) for Cooperative Governance, Basikopo Makamu, to refurbish the pump station, which will provide water in the entire Modimolle-Mookgopong area. The solutions above are suitable for water supply and water access; however, water conservation and management seem to be left out. Therefore, the immediate water supply without proper measures to manage and conserve water may not be sustainable.

The bid to supply water seems to be costing the government money because, as indicated in the article above, the municipality owes Magalies Water money. This means the government has been buying water from Magalies Water. The mandate of Magalies Water is to supply industries and communities with water when there is a need. In 2003, Magalies Water decided to explore selling water to assist municipalities in improving their water services to communities. Moreover, in all the municipality's endeavours, they have neglected African indigenous water conservation methods and management methods. This means that when water is not conserved and managed well, it results in the overuse of money by the government to support the lives of the people.

(b) Limpopo Mirror 4 October 2019: Makwarela: Makwarela has Two Boreholes but No Water in the Taps

"The Makwarela community outside Thohoyandou is seeking answers from Vhembe District Municipality as to why the water taps in their yards are still running dry, even though a new borehole was drilled two years ago."

Community leader Thivhileli Mutobvu said they had notified Vhembe Municipality several times but to no avail. Two boreholes had been drilled in the area two years ago; one at Makwarela stadium and the other one at the Makwarela community hall. However, although a transformer has been installed for the pump, no water is pumped from the new borehole. Currently, water is pumped from the borehole at the stadium to water tanks at the Makwarela community hall, from where it is supposed to be

pumped to the primary school and then to the residents' taps. But no water is being pumped to the tanks at the Mbaleni Primary School or the community. Residents have resorted to buying water from people with private boreholes.

Matodzi Ralushai, Vhembe district's communication officer, said Makwarela had grown fast,, affecting planning. However, he said progress was being made in resolving the water problem. Speaking to Ground Up, Mutobvu said some residents had to walk far to buy water. Rebecca Muruba, a pensioner, told Ground Up that her poultry farming business had been badly affected by water shortage. "Since our taps ran dry, my business has become expensive to run. Chickens need a lot of water, especially during hot periods. Currently, I am using R700 per month to buy water from those who have boreholes at their homes." Another woman, who did not want her name published in poultry farming, said she had to hire a private car at R100, a trip to fetch water from a borehole 12 km away. She uses 25 buckets of water every week.

This newspaper article supports a claim made in the first chapter of this study that water seems unavailable even in places where it is known to be abundant. In the Vhembe District Municipality, there are different water sources and ways in which residents can access water. However, this seems to be a dream of some residents in Vhembe, following the water shortage in Makwarela that has been reported many times to the Vhembe District Municipality, but to no avail. This is critical, and it could mean a lot to the public. To add, the municipality does not know where to get water to supply residents. The unavailability of water, in this case, can be associated with a lack of or poor water conservation and management methods. The water shortage seems to be affecting people in different ways according to its various uses. Some businesses are affected due to the need of water, while others spend money on buying water. The zero results of water pump can be associated with a lack of groundwater that must also be conserved and managed accordingly.

The article states very clearly that residents have resorted to commercial schemes for water access and supply. This only shows how desperate community members are without proper access to and supply of water. This resulted in hygiene issues arising. As community members seek answers from the government, one can also observe

that there is an element missing in the activities of addressing the water challenge in Makwarela. Although Makwarela is a peri-urban area, a considerable component exists of the rural life informed by African indigenous knowledge. Therefore, where applicable, indigenous knowledge methods of water conservation and management can solve the challenges faced.

4.3.1.2 Television programme

The researcher followed various television programmes that broadcast issues around water in South Africa. These included news reports, dramas, “soapies”, and documentaries. However, the researcher purposively selected the television show Zwamaramani which mainly focuses on daily thorny issues found in communities. The researcher chose Zwamaramani because of one programme that thoroughly tackled water challenges, especially concerning wetlands.

(a) Zwamaramani (27 November 2019) – Wetlands

On a television programme, Zwamaramani, broadcast by the South African Broadcasting Commission (SABC 2) on 27 November 2019 at 21h:00, the focus was on water challenges, conservation and management, with particular attention to wetlands. Wetlands were presented as water sources and a place where water is cleaned before it flows into rivers and is used by human beings and other living creatures. It was mentioned that water is always simmering at the wetland, and reeds and jersey plants grow there. Therefore, a call made during the programme was that wetlands must be protected. The protection of wetlands was noted important as they are the ones that most communities primarily depend on.

During the programme, video reports taken by SABC 2 (Zwamaramani) in *Sambandou* and *Mahunguhwi* village were broadcast. Among the people in those videos were members of the royal council from the two villages who expressed that community members ill-treat wetlands. The activities of wetlands’ ill-treatment that were reported to be common included digging and extracting soil and agricultural activities. This has been supported by viewers who shared their views through Facebook messages and WhatsApp videos that were also broadcast during the programme.

Figure 03: *Zwamaramani*

The above pictures have been taken from the *Zwamaramani* programme. The other picture on the right contains a message that a viewer sent through Facebook showing the importance of wetlands.

It was indicated on the programme that people must take care of the environment they live in as an approach to water conservation and management. In the programme, viewers were introduced to one community project on water conservation and management in *Tshandama, Nyahalwe* River. The project resorts under the Department of Environment, Forestry and Fisheries and will be discussed below.

The community members. Mr Musetsho, the guest in the programme, mentioned that the conservation and management of wetlands need communal attention where community members help each other solve the challenge faced by the wetlands. Since time immemorial, communal attention to challenges has been a practice of the indigenous people that has enabled them to sustain themselves and their environment. Therefore, indigenous knowledge can play a role in the protection of wetlands and other natural sources of water. Mr Musetsho further mentioned that “natural resources have been borrowed to us, and we have to pass them on to future generations”.

Analysis

As shown on *Zwamaramani*, wetlands are not taken care of by members of the communities. These members of the communities who mistreat wetlands are the ones who are supposed to benefit from the same wetlands in various ways. With the challenge of water shortage in South Africa, the natural water sources continue to endure the pressure placed on them by human beings. This can lead to several issues such as increased soil erosion, reduction of groundwater and loss of flood plain. Resultantly, rain is likely to cause damage because there is no place to contain rainwater, instead to overflow. During the floods in the Vhembe district in February 2020, learners could not go to school because the rainwater was well contained in the reservoirs. As reported in the *Limpopo Mirror* on 15 February 2020, many people were affected in different ways.

"Pupils were not attending school as workers and teachers failed to report for duty on Tuesday. Many of the region's dams and rivers are overflowing, following the heavy downpours. Several families reportedly lost groceries, furniture and other belongings. Motorists who are staying in mountainous areas were forced to park their vehicles near the main tarred road because they could not use the damaged and slippery roads."

It can be deduced that when water sources are kept alive, and water is conserved and managed accordingly, floods can be prevented. As a result, all the rainwater becomes useful and causes no damage to the people, plants, buildings and animals. The solution provided by the guest of *Zwamaramani*, Mr Musetsho, that communities must work together in mitigating the ill-treatment of wetlands seems to be an invitation for the use of a community-based approach to water conservation and management, usually referred to as indigenous knowledge. Unfortunately, the use of indigenous knowledge seems to be ignored, even in rural areas. This can be supported by a report on *Zwamaramani* on the ill-treatment of wetlands in *Sambandou* and *Mahunguhwi*. One can relate the ill-treatment of wetlands to the absence of indigenous knowledge to solve wetlands-related challenges in different ways.

4.3.1.3 Concluding remarks

The above newspaper articles and television programme that were analysed emanated from the media regarding the water challenges in the Limpopo province. The challenges presented above are associated with water access, supply and conservation, and management, resulting in a water shortage for community members in the Limpopo province. In *Zwamaramani,* it was indicated that wetlands are poorly treated and they must be protected. It can be concluded from the discussion above that water shortage is a serious challenge, not only in the Limpopo province but throughout South Africa as a whole. This challenge seems to be exacerbated by a lack of proper methods of conserving and managing the available water by the South African government and the citizens.

4.3.1.4 Projects by organizations dealing with water challenges

In the Limpopo province,, there are different programmes, organisations, and projects dedicated to addressing challenges affecting natural resources. The role of these programmes, organisations and projects include conserving and managing natural resources in support of the Vhembe biosphere. The researcher purposively selected two initiatives in the Vhembe district that are discussed below.

(a) Dzomo la mupo (voice of earth)

Dzomo la mupo is an organisation that works to recuperate cultural diversity in South Africa. *Dzomo la mupo* is based in the Vhembe district in Limpopo. This organisation is well known for supporting local communities to govern their ecology through different activities such as providing awareness of the value of indigenous trees, growing indigenous seeds, inspiring and leading intergenerational learning and, ultimately, bringing back respect and confidence in the effectiveness of indigenous knowledge systems. The wellbeing of water sources and water, in general, is one of their concerns and areas of practice.

Dzomo la mupo was established by Mphatheleni Makaulule in 2007 after realising that indigenous forests and cultural values are fading, thereby causing destruction and discomfort in the natural environment. Therefore, the role of *Dzomo la mupo* is to refurbish the natural order of the environment. One of the core activities of *Dzomo la*

mupo is the protection of sacred sites because they play an essential role in the lives of indigenous people. The vision of *Dzomo la mupo* is to protect nature in all its forms, particularly indigenous forests, wetlands and sacred sites, and to advance indigenous skills of agriculture to support agroecological farming and to preserve nutritional food security.

Dzomo la mupo works with different schools in the Vhembe district in its biodiversity revival activities through meetings and intergenerational learning facilitation to transmit knowledge to the younger generation and celebrations. The knowledge of cultural biodiversity allows learners to appreciate the relationship and interactions between people, culture and the natural environment. *Dzomo la mupo* believes that when learners are knowledgeable about cultural biodiversity, they understand how life is today and how they can apply customs, ideas, norms and values in their society to improve their lives. *Dzomo la mupo* also works with indigenous knowledge holders, who are regularly invited to share their knowledge about cultural biodiversity and how it informs the lives of indigenous people.

In indigenous communities, women, especially *makhadzi,* are known to be the custodians of the indigenous knowledge of the protection of sacred sites and indigenous forests. Elderly people, in general, possess rich knowledge and experience of governing the ecosystem to maintain the order of the natural environment and the balance between cycles of seasons that regulate climate. These people have realised that sacred sites play an intrinsic role in providing the maintenance of human and environmental well -being and being in a place where biodiversity is abundant. They are also the sources of the systems of water that gives life to the communities. This is demonstrated by the activities of *Dzomo la mupo* that are associated with water conservation and management. When sacred sites are destroyed, the environment collapses and affects the livelihood of the communities. Therefore, the commitment of *Dzomo la mupo* in protecting sacred sites has an intrinsic role in indigenous living and indigenous water sources near those sacred sites. This is because cultural beliefs are associated with sacred sites contribute to the conservation and management of indigenous water sources near those sacred sites.

The massive demolition of forests along rivers and mountains in the Vhembe district is a challenge that has led to countless losses in nutritious food. *Dzomo la mupo* has a programme on seed recuperation to mitigate the challenge of forests demolition, which includes water conservation and management activities that will enable water sources to contain enough water for different uses by indigenous people. This is important because a seed is at the centre of the indigenous ways of living, it denotes the cycle of life; it gives life while supporting biodiversity. Therefore, for a seed to grow and produce, there must be water used to ensure its growth. *Dzomo la mupo* advocates for an inclusive process of improving seeds to ensure that they are planted, protect water sources, and contribute to the protection of forests. Several seeds from local plants are recovered and improved, including indigenous vegetables, fruits and other indigenous trees. *Dzomo la mupo* also encourages people in different communities to start their nurseries. They grow indigenous trees that can be planted where forests have been destroyed, particularly near indigenous water sources. Plantations of indigenous trees are an important part of water conservation and management, and it is discussed below in the following themes. The following discussion looked at the different sources of water used by the *Vhavenda* people.

Analysis

It can be deduced from the above discussion that *Dzomo la mupo* are rooted in African indigenous knowledge. However, *Dzomo la mupo* acknowledges that cultural values associated with the care for the natural environment are dwindling and causes destruction and discomfort in the natural environment. As such, African indigenous water sources seem to be affected the most, as they cannot provide clean water and enough water. Therefore, the security of African indigenous water sources and their aptitude to provide enough safe and clean water are some of their concerns and areas of practice.

Seemingly, *Dzomo la mupo* acknowledges the role of elders in the African indigenous communities as custodians of indigenous knowledge. This is demonstrated through intergenerational engagements that take place during their involvement with learners from different schools. Intergenerational engagement is an essential aspect of African indigenous practice in water conservation and management. This is because African

indigenous knowledge has been stored in elders' memories and transmitted orally from one generation to another.

African indigenous knowledge of water conservation and management is likely to be kept alive through teaching and practice through *Dzomo la mupo*. This is because the meetings and intergenerational learning hosted by the organisation can enable learners and teachers, elders, and children to appreciate their interactions with culture and the natural environment while promoting and protecting African indigenous knowledge associated with water conservation and management.

(b) Working for a wetlands rehabilitation programme, Limpopo province (Tshandama Nyahalwe River project)

As stated before, the South African government has a programme that is called Working for Wetlands. This programme operates on the mandate of protecting, rehabilitating and sustainable use of wetlands. After acknowledging that South Africa is endowed with amusing biodiversity, the programme was established, which is currently facing severe water challenges as wetlands and other reservoirs run dry. According to UNESCO (2000), South Africa will be amongst the African countries considered subject to water scarcity. Therefore, water conservation and management are vital. As a result, the Working for Wetlands programme was born.

Although the primary purpose of the Working for Wetlands programme is to protect and rehabilitate the wetlands, it also seeks to create jobs, support small enterprises and transfer skills to marginalised groups who are primarily African indigenous people in the rural areas. The Working for Wetlands programme is under the Natural Resources Management (NRM) Programme in the Department of Environment, Forestry and Fisheries. This programme is a combined initiative with the Department of Water and Sanitation (DWS) and the Department of Environment, Forestry and Fisheries. In this way, the Working for Wetlands programme results from a commitment between these government departments in the protection, rehabilitation and sustainable use of wetlands.

The Working for Wetlands programme employs workers through the Expanded Public Works Programme (EPWP) with the assistance of local small-scale enterprises. It is guided by the National Water Act, No. 36 of 1998, which embraces the importance of protecting water resources. Therefore, the government deemed it suitable to implement effective strategies to conserve wetlands and rehabilitate degraded ones through the Working for Wetlands Programme. This was done in response to the realisation that South Africa is losing wetlands and is failing to maintain those still in existence.

In the Limpopo province, Working for Wetlands operates in the Vhembe district in a village called *Tshandama,* situated north of Thohoyandou. The wetland receiving attention of the Working for Wetland programme is *Nyahalwe*. The *Nyahalwe* wetland is located at *Nyahalwe* River, which is an offshoot of the *Mutale* River. The surrounding area of *Nyahalwe* has been widely cultivated for subsistence and small-scale production of the crop. The important use of this land has extended to the wetland, thus leaving it exploited and drying up. Working for Wetlands has been active in rehabilitating wetlands in the Limpopo province, including Nyahalwe wetland, since 2010.

Analysis

It can be deduced that wetlands have been misused and considered valueless through conversion to different land-use activities such as agriculture. Although agriculture is an essential aspect in improving livelihoods and the economy of the country, exploitation of water resources remains a poor practice that would compromise the production of agriculture in the long run because it is not a sustainable practice. Therefore, one can indicate that exploiting wetlands for agricultural use is an activity that does not seem to provide security in future.

Currently, wetlands are acknowledged as natural assets that provide an extensive range of free services, functions and products to people and other living beings. During the study, the researcher learnt that wetlands were not respected because of misconceptions about wetlands, including that wetlands must have a river flowing

through them. Wetlands that did not have water flowing through them or were not wet on surface were deemed to be unimportant and suitable for exploitation.

It is evident that the Working for Wetlands programme promotes community participation while benefiting community members with jobs and skills. However, t, However, there appears to be an important element missing in their activities: the use of African indigenous knowledge. The *Nyahalwe* River is surrounded by African indigenous communities which have conserved and managed water sources with their knowledge. Therefore, the knowledge they possess can offer solutions to the protection and rehabilitation of wetlands and ensure their sustainable use.

4.3.1.4.1 Concluding remarks

The above discussion revealed that water scarcity and supply are serious challenge in South Africa. It has been reported that community members have engaged in protests for water, and the government cannot provide efficient support. It was evident during the discussion that for all government endeavours to meet the public's water needs, it is never enough. Thus, *Dzomo la mupo* and the Working for Wetlands programme work to preserve natural sources of water as they can provide sustainable water for community members and solve water challenges. There seems to be a need for African indigenous knowledge in water conservation and management. This is because rural areas rich in African indigenous knowledge seem to be the ones enduring this challenge. The following discussion looks at the African indigenous water sources, storage and community activities.

4.3.2 African indigenous water sources, storage and community activities

The researcher deemed it suitable to explore other indigenous water sources storage and ceremonies as informed by the discussion on the previous theme. This was done to explore the relationship between indigenous African sources of water, African indigenous water storage, and African indigenous community activities with water conservation and management. These are discussed below.

4.3.2.1 African indigenous water sources

A water source is referred to as any significant build-up or collection of water on earth's surface (Tobiason Bazilio, Goodwill, Mai & Nguyeni, 2016). These water sources are also referred to as water bodies; they collect and move water. The researcher did not want to assume that the participants know and understand the indigenous sources of water better and posed a question to the participants to give information on the indigenous water sources.

In this study, the researcher discovered that water sources are understood in two ways; the physical and spiritual. This is because indigenous water sources are places where indigenous people access or collect water. On the other hand, indigenous water sources are also understood as spiritual hubs where spirits communicate their existence through the water. This means that indigenous water sources are holistic because they perform different roles for the indigenous people, as mentioned above.

In addition, it was discovered during this study that an indigenous source of water is supported by a combination of different natural resources such as trees, stones and aquatic animals. For example, when a river has no water, it is not regarded as a river but as *muedzi* (valley). Plants such as *Mutu (Syzygium cordatum Hochst), Munengeledzi (Salix mucronata Thunb), Mueneene (Anthocleista grandiflora Gilg)* and *Munadzi (Rauvolfia caffra Sond)* are commonly found in the area surrounding water sources. This means that a source of water cannot exist and function on its own. One participant mentioned the following regarding the origins of some dominant sources of water in the Vhembe district:

Participant A:

> "There are more than 50 springs in this area. This whole *Thathe-Tshidzivhe* area was a *deme* (jungle) where wild animals reside, and several springs and rivers are found. Different rivers that are found in Venda have originated here in *Thathe-Tshidzivhe*. These rivers are *Mutale, Nzhelele, Tshinane, Tshirovha*. This includes *Mutshundudi, and Luvuvhu rivers* also come from the same line of mountains related to the ones in *Thathe"*.

The study discovered that there are different indigenous sources of water, namely *maroroma* (wetlands), *tshisima* (spring), *mulambo* (river), *isha* (lake) and *mvula* (rain). These are discussed below:

(a) Maroroma (wetlands)

A wetland is an environment flooded by water, either permanently or seasonally, where oxygen exists (Adamus, 2016). A factor that distinguishes a wetland from other landforms or bodies is the characteristic vegetation of aquatic plants (Dorney, Savage, Tiner & Adamus, 2018). According to the *Vhavenda* people, *maroroma* (wetlands) is a part of the land that is dominated by marshes or swamps. Although, in wetland areas, many trees do not dry up, such as jersey, midima, and *midulu* trees (fern). The study revealed that Vhavenda people describe *maroroma* (wetlands) as manufacturers of water. This is because more water is found in *maroroma* (wetlands) that flows to form rivers and streams that provide water to the communities.

The study also discovered that *maroroma* (wetlands) hold several meanings; these meanings are not limited to water storage, water purification, reservoirs of biodiversity, cultural values, recreation and tourism and climate. In this regard, the researcher asked a question so that participants could explain it in detail. Participants indicated no one goes to a wetland to store water; however, wetlands hold rainwater forall-natural resources and human beings. Rainwater stored in wetlands flows into rivers, gives life to plants, and when there are more plants, animals get enough food and soil erosion is avoided. The availability of plants is also known to purify the water since animals do not draw water from the heart of the wetlands. The researcher also learnt from the participants that amongst the Vhavenda people, wetlands are not only indigenous sources of water, they play an essential role in the cultural beliefs of the people.

The researcher learnt that participants believe that *maroromani hu na vhutshilo kha uri nwana a bebiwe a tshile* (there is life in the wetland, a child must be born and live). This is because there are many medicines from the wetlands to be used for newborn babies. However, the participants could not disclose more because of the secrecy attached to that.

Participant B noted the following in that regard:

> "There are rituals that are associated with wetlands. For example, when a child is born, an umbilical cord is buried in the wetland (*uvhulunga*), and that is when it is said *"nndu yo naka"* (the house is clean), meaning everything is in order, a child can now be seen by anyone who visits the house".

The researcher probed about burying umbilical cords in the wetlands with regard to water conservation and management. Participants mentioned that Vhavenda people deemed it fit to bury umbilical cords in the wetlands because, culturally, an umbilical cord is not supposed to be dumped anywhere or left where anyone can see it, for it causes diseases to the child. The researcher also learnt that although burying umbilical cords in the wetlands was common, and other people would only dig a hole in the home yard and bury it there where no one can see it.

The study discovered that for as much as wetlands are water sources, other people regard them as a proper dumping site. This is because anything that is buried in the wetlands does not produce a bad smell. However, the question of water conservation and management was posed to participants. In this regard, participants mentioned that when umbilical cords and other things as mentioned above are buried or dumped in the wetlands, the water is polluted and cannot be consumed. *Vhavenda* people do not consume water from the wetlands and the river because it is dirty. Rivers usually get water from the wetlands; therefore, water from the river is also not consumed. The researcher also learnt that the same water is commonly used by farmers and for washing laundry. The participants also believe that those who bath and do laundry at the river are not harmed by the water when doing such activities.

Participant E argued that:

> "In Tshivenda culture, it is believed that when an umbilical cord is buried in the wetland, children behave and act calmly and politely. Nowadays, umbilical cords are dumped in the dustbins; hence there is a challenge of moral decay on youth. ,However, wetlands are calm,

> and that should be the result of children after burying umbilical cords in the wetlands."

This belief and practice have always influenced indigenous people to conserve and manage water. This is because the absence of wetlands in their communities would mean that there will be land and air pollution from the things dumped on the land. When umbilical cords are not buried at the wetlands, indigenous people believe that it would result in a high child mortality rate due to diseases that believe that it would result in a high child mortality rate due to diseases caused by not burying umbilical cords in the wetlands. The researcher also learnt that although human beings do not consume water from the wetlands, wetlands have an intrinsic ecological role. Many birds and mammal species depend on the wetlands for food, water and shelter. Wetlands also accumulate rainwater, thus reducing flood risks.

Participant B added the following:

> "A lot of things happen at the wetlands, and it is sometimes beyond the comprehension of a human being. *Rine vho maine musi ri tshiya zwithuni zwashu* (when we do our things as traditional health practitioners), we cut our hair and bury them in the wetlands. The purpose of this is to ensure that we are calm; you do not just throw the hair anywhere. This water source provides a great interconnection of physical and the spiritual world".

The researcher learned that Vhavenda people believe that no water source can be used for such rituals. This means that the presence of wetlands informs the continuity of traditional health practitioners' rituals. Consequently, they become key people in advocating and practising water conservation and management.

(b) Tshisima (spring)

A spring is understood as a point where ground water flows to the surface, or water flowing that assembles to provide living beings access to water (Buono et al., 2018). Most of the springs in the *Vhavenda* communities were found near the wetlands to collect clean water.

The study also discovered that once the spring is found, members of the community gather to *u kapa tshisima* (clean the spring) by removing mud, stones and grass where the water is simmering. After cleaning the spring, a small semi-circle is constructed using stones, grass and sand. This semi-circle is constructed to provide a convenient water collection point for the community members and protect the water from simmering haphazardly and from pollution by people and animals. The study also discovered that African indigenous trees such as *munambala (Rubus pinnatus Willd), mueneene (Anthocleista grandiflora Gilg)* are planted in the area to serve as *nguvho ya tshisima (a* blanket of the spring) that protects the spring from direct sunlight.

Participant H added the following:

> "A water source is not supposed to be exposed to the sun because direct sunlight leads to drying up of water sources. When water is exposed to the sun, the land becomes dry and fails to support spring containing water. Trees also reduce pollution and the risk of flooding the spring by heavy rains".

The study discovered that in the springs that most community members depend on, a channel is created that discharges water to a place far from the heart of the spring, where the spring begins. Pipes are used to taking water to a place convenient for the people while ensuring the spring stays in good condition. This is done to avoid pollution that can be caused when many people go to draw water at the same time. The researcher asked for permission to observe some of the *zwisima* (springs) found in *Tshidzivhe.* After a one-on-one semi-structured interview, the researcher was accompanied to see one *tshisima* (spring) not far from the residential area. The spring is shown in the picture below.

Figure 04: *Tshisima* (Spring) in *Tshidzivhe* Area
Source: Taken by the researcher, Budeli Andani Edgar

As can be seen, the above picture shows a spring, which is an essential source of water in the indigenous communities. The pipe shown in the picture takes the water from the centre of the spring to where community members can access water without polluting the spring. The spring provides the community members with potable water that can also be used for domestic purposes.

The researcher went to the spring and found it was protected with different kinds of indigenous trees,, including a banana tree. The researcher then asked why a banana tree was found near *tshisima*. Participants indicated that it was found there, and after they realised that it is beneficial for the protection of an indigenous water source, it was also protected. The researcher learnt from the participants that the banana tree is not harmful to the water source and does not absorb a large amount of water. Participants' main purpose for the presence of banana trees at *tshisima* was that it provides shade for the *tshisima* with its long leaves.

The researcher asked to see the origin of the spring, but the participant who accompanied him said that it is protected and people are not allowed to go there. He mentioned that it is not possible to go to the heart of the spring since water is not drawn there.

The researcher realised that the pipe shown in the picture did not stop releasing water and wondered how the community ensures that water is not wasted. In this regard, one participant stated the following:

Participant I:

> "Water must not go to waste. The community needs enough water. Therefore, it was ensured that people do not go to the heart of the spring unless they are cleaning it. Therefore, a pipe was put in so people can only draw water that they can use. When water is not drawn, it runs off and deposits into the *Tshirovha* River so that it is useful again".

A pipe has been installed to ensure that people who access the spring to draw water do not cause harm to the spring. The pipe shown in the picture has running water from the spring every day and night. Water flows into a stream that deposits the water into the *Tshirovha* River. This is a technique that was employed to ensure that water is conserved and managed.

(c) Milambo (rivers)

A river is a natural flowing watercourse (Pearce, Forde, Willox & Smit, 2015). A river originates in the mountains and flows downwards in a channel to the sea, a lake or another river to continue the hydrological cycle (Wilson et al., 2018). A river is an important natural resource for humans, flora and fauna.

The study discovered that a river crosses land, hills, and plains on its journey to its water. Participants indicated that a river starts in mountainous areas where land level shifts and changes as it flows, causing the formation of waterfalls by large rocks, and that is where the water picks up strength and speed. When the water reaches the

plains, it flows at a slower pace, and if it comes across obstacles, it just flows around them.

According to the *Vhavenda* people, a river is a flowing watercourse. According to participants, as the river flows slowly, there is a point where the water gathers and may seem no to be flowing, forming the shape of a dam. These points are called *mativha.* They were primarily used as a source of agricultural water for farmers who are not far from the river. Participants added that when traditional health practitioners and other community members have cleansing ceremonies, they go. The farmers prefer *mativha* because it is an area that has abundant water; thus, the flow of the river is not disturbed. The researcher also learnt from participants that the *mativha* possess cleans water because as the water flows in the river through *that*, it carries all the things that may pollute the river, such as plastics.

Participant, I added the following:

> "*Mativha* was used for recreational purposes when children went to a river to do laundry, herding animals, and bath. They would also swim in *tivha* because it is more conducive than the other part of the river. Men bath at the upper stream, at a hidden space, where you would not see any woman. This is where they also do laundry. When one moves downstream, especially where one can cross to the other side of the river, women are found bathing and doing laundry."

It was not clear how the above relates to water conservation and management. However, some participants assumed that the chemicals from the soaps used upstream have disappeared by the time water reaches downstream, in the distance between where the men and the women bath and do laundry. Even so, the researcher wanted to know why women bath and do laundry at a place that is in the open and people can pass at any time. The participants indicated that it was for safety purposes because it is not far from the part of the river where people cross over to the other side of the river. When men want to cross over the river, they would call with a loud voice to ask for permission.

(d) Mvula (Rain)

Rain is understood as droplets of water condensed from the water vapour in the atmosphere and then become heavy enough to fall to the earth drawn by gravity (Monjo, 2016). Rain is an important element in the cycle of water responsible for providing fresh water on earth. In addition, rain offers conditions that are proper for different types of ecosystems.

The study discovered that *Vhavenda* people consider rain the most important water source because rain provides water to all indigenous sources of water. However, the study also found that despite that rainwater provides indigenous sources with water, people still harvest or draw water directly from the rain. For example, during a semi-structured interview with one farmer, the farmer had the following to say:

Participant C:

> "Whenever there is rain, *Vhavenda* people take out *Khali* (big pot), an indigenous container to collect water. This container is put under the roof where water can flow from the roof to it, and some containers are just put directly so that water directly fills the container. The first water of the rain is not harvested because it is believed to be not pure. Therefore, one must wait for few moments until they are convinced, then they should put their containers for collecting rainwater. *Vhavenda* people, especially farmers, construct ponds in their homesteads or fields for agricultural purposes. This helps to draw water closer to where activities of agriculture are taking place".

The researcher sought clarity about the *khali,* the container that participants mentioned above, and answers provided are discussed further on in this study. However, as the researcher probed to find the reasons behind putting containers in different locations, and discovered that water was not used for the same purposes. Water containers that were placed next to a house where water flows from the roof wereere mostly used for consumption, while containers put in an open space were mostly accumulating water for washing dishes, growing plants in a homestead garden, and bathing.

The study also discovered that rainwater is also beneficial to most indigenous trees. To add, the researcher learnt that people do not water most indigenous trees, they require rainwater for growth. Therefore, without rainwater, indigenous trees cannot survive. According to Vhavenda people, the study also found different types of rain, which are *Mudaphondo, Tsinyamatanga* and *Tseula*. The participants were well versed with their times and patterns, thus managing their water to sustain them when there is no more rainwater. The different rain seasons and rainwater are discussed below:

(e) Different types of rain

Participants mentioned that it is to recognise that there are different types of rain known among the *Vhavenda* people. This is the knowledge that the forefathers had and used to shape their activities in life. Every kind of rain represented a season. Seasons influenced lifestyles and how *Vhavenda* people behave towards rain and water in general. The types of rain narrated by the participants are as follows.

- ***Mudaphondo***

Mudaphondo is heavy rain that comes around *khubvumedzi* (September) and ends in February. This rain is known to cause death to animals and damage trees and buildings because it is heavy. In addition, animals die because they have no proper shelter, and the rain brings coldness.

- ***Tsinyamatanga***

Tsinyamatanga means destroying *matanga* (crops that are left in the field after harvesting). This type of rain is known to come around the *tshifhefho* season (autumn) when people enjoy *zwikoli* (corn). This is the time that *mavhele* (maize) dries and is harvested for grinding and other uses.

- ***Tseula***

Tseula is rain that is commonly known as plant-growing rain. This rain comes after the winter season when the land is dry. After *Tseula,* plants start to grow, and the land looks green. After *Tseula*, people begin to prepare to go into the

field because the land will no longer be dry, and plants are growing. The rain prepares the soil for growing seeds and other plants.

Despite all these indigenous sources of water, there is also a water storage aspect that participants identified. They indicated that these storages were used whenever people have drawn water from the different sources that have been discussed above. According to the participants, water was stored in various ways, such as *khali* and homestead ponds, depending on the purpose. These are discussed below.

4.3.2.3 African indigenous storage of water

According to the *Vhavenda* people, indigenous water storage is a place where ,helpful water is stored. The researcher followed up on this to find out if there is a possibility to store water here that is not useful. In this regard, participants indicated that the people could draw water from these sources only if they wanted to use it. This means that one was not allowed to draw water that would not be put to good use. The study discovered that, although what a person had to do with water drawn from the sources was not regulated, people knew that they could only fetch water from an indigenous water source when they need that water. This was an excellent approach to water conservation and management and ensuring that water is not contaminated.

Participants in a focus group discussion indicated that water was stored mainly for two purposes: to use during dry seasons and avoid going to indigenous water sources every day because these are mostly far from residential areas. This has ensured that the indigenous water sources were not contaminated because people only go there at different times and on otherdays. In that way, water was conserved and managed.

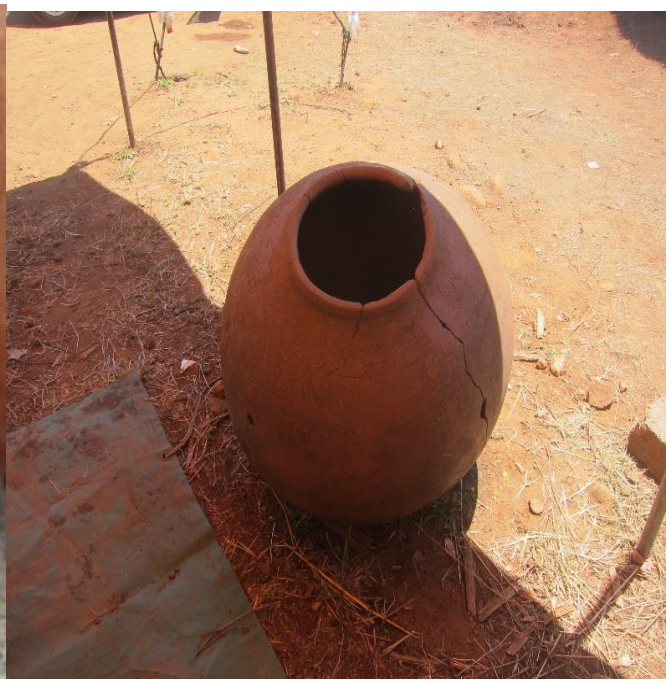
Participant F:

> "Water was stored in *nkho* (big rounded pot), which was made of clay soil. People did not take these *khali* to the indigenous water sources; however, they used *mvuvhelo* (small rounded pot-shaped). The difference between these two is that *mvuvhelo* is small; one could carry it from the indigenous water source with water. Its opening is also small so that water is not wasted or lost while walking home from

> the water source. On the other hand, *Nkho* are big, and they have big openings; these were used to store water that has been drawn using *mvuvhelo. Nkho* also has a wide opening to allow easy access to the water stored in it."

The researcher heard that *Vhavenda* people used to make *nkho* and *mvuvhelo* using clay soil. After making these *nkho* and *mvuvhelo*, they are kept in a place called *biseloni la khali* (a place where pots are burnt), a small hole. *Nkho* and *mvuvhelo* are burnt to make them strong enough to serve their purpose to collect and store water. The small hole is prepared in a way that it contains fire. Dry grass and small tiny wood *(thasana)* are placed on the ground for *nkho* and *mvuvhelo* to be placed on top. When *nkho* and *mvuvhelo* are placed at *biseloni la khali*, grass and wood are put inside, and fire is lighted from both inside and outside the *nkho* and *mvuvhelo*.

The researcher wanted to know how the participants knew when *nkho* and *mvuvhelo* are strong and ready to be used. In this regard, participants mentioned that when burning *nkho* and *mvuvhelo,* one must wait until they change colour to reddish; that is when it is ready for use. A stick is also used to hit *nkho* and *mvuvhelo*; if they produce a loud sound, it is a confirmation that they are ready to be used. If there is no sound, they are taken back to the fire until they are ready. The following are pictures of *nkho* and *mvuvhelo.*



:Mvuvhelo ***: Nkho***

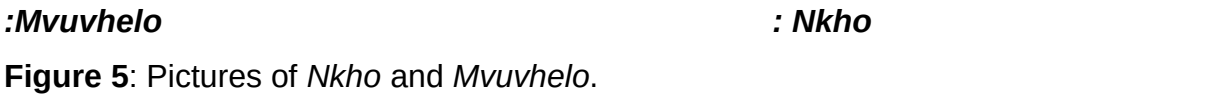


Figure 5: Pictures of *Nkho* and *Mvuvhelo*.

The above pictures show *Vhavenda* indigenous water storages that are made of clay soil. On the left is *mvuvhelo*, which is used to collect potable water from the spring. On the right is *nkho*, which is potable water storage.

The researcher learnt that *nkho* and *mvuvhelo* store domestic water, particularly for cooking and drinking; therefore, they are made strong by the fire to avoid water absorption and clay dissolving into the water. In addition, they are made so that they can be washed inside, thus ensuring that water contained in it is not contaminated. Participants also emphasised that each of these water storages has a lid covering it to protect the water from contamination.

4.3.2.4 African indigenous community activities associated with indigenous sources of water

Different activities take place in the African indigenous communities. These activities are positioned to develop, improve and spiritual. The study discovered that some of these activities are associated with indigenous African sources of water, in line with water conservation and management. Over the years, these activities have proved to be effective and helpful to African indigenous communities regarding water conservation and management. These are explained below.

(a) Khoro

Khoro is a social network where people meet and talk about meaningful issues, share thoughts, visions and create awareness about them. *Khoro* takes place at the chief's house in a place or building designated for the community gathering called *tshivhamboni.* These gatherings occur at any time during the year when there is a matter or anything concerning the community and its wellbeing. For example, water conservation and management is an issue that communities in Venda gather and talk about to bring solutions to challenges facing it.

Participant A:

> "During *khoro,* different issues are stressed about the community and its property. Whenever the indigenous sources of water and other natural resources seems to be under stress, community members do not just walk around saying it to anyone. Instead, all serious matters are taken to *Vhakoma* (chief's right-hand man), who will then present it to the chief, and call a *khoro* meeting. This can include people cutting trees from the indigenous water source or causing any harm to the water source. *Khoro* will serve as a court where the person will be subjected to a penalty or fine if found guilty. This serves as a punishment and an example to others that water sources must be treated with care".

It can be deduced that during *khoro,* people who mistreat indigenous water sources were exposed; hence people had reasons to take good care of them. The study discovered that people would not cause harm to indigenous water sources because they might be subjected to punishment. The study also noted that most rules regarding indigenous sources of water were emphasised during this gathering. This allowed community members to remember the rules and, ultimately, water was well conserved and managed.

(b) Thevhula

Thevhula is a ceremonial activity that royal families host to send requests and give thanks to their ancestors. *Thevhula* is not an everyday ceremonial activity that involves everyone in the community, but only the chief and his family. *Thevhula* usually takes place in *Khubvumedzi* (September), when the community members prepare themselves to go to the fields to plough. The researcher wanted to know why *thevhula* is conducted in *Khubvumedzi* (September) and posed this question to the participant. As such, the researcher learnt from the participants that it is when *Vhavenda* people expect rain; however, it is commonly believed that they must ask for it. This ceremony is important because rainwater received benefits communities for agricultural purposes, it also provides enough to cater to all their different uses of water. This means that people will not be forced to use water allocated for other services to satisfy

current demands. For example, domestic water will not be used for irrigation, and there will not be people who do not plough due to a lack of water.

The researcher learnt from the participant that *thevhula* is more of an indigenous African ceremony of prayer than a Christian ceremony, which seems to be dominant in modern times. Royal families pray to their ancestors who are guardians of their community, presenting all their community needs while giving thanks for the things that took place since the last *thevhula*. The researcher wanted to know how people communicate with ancestors during *thevhula*, and the following is an example given by one participant.

Participant A:

> "*Ri khou livhuwa ndimo na khano zwo fhiraho zwa ri nea zwiliwa ra fushea. Zwino ri humela masimuni u lima, ri humbela mvula uri mvula ine uitela ri tshi kana ri vhe na khano yavhudi*". (We are giving thanks that we managed to plough during the previous year, and we had enough food. Therefore, we are going back to the fields to plough, and we ask for the rain so that we have good production)".

The researcher asked the participant if other things are presented to the ancestors during *thevhula*. In this regard, one participant indicated that it is not only rain that is requested during *thevhula* but everything that has to do with the community's wellbeing. The chief can ask that there are no diseases to affect the community; there is peace and any other significcommunity's critical need . This is because the well-being of the community and its members is perceived holistically. This researcher learned a strong relationship between people and the environment they live in; thus, water conservation and management are important.

Consequently, different aspects of culture or activities in the African indigenous community-run well when people and the environment are in good condition. Through *thevhula,* the community members can receive good health that allows people to participate in activities of the community, including water conservation and management. The researcher also learnt from the participants that when people are

sick, they need water for healing purposes; thus, water conservation and management are vital.

The study discovered that no royal family or chief performs *thevhula,* but only those from the *vhangona* group; *masingo* do not perform *thevhula*. *Vhangona* people are said to be the original inhabitants of Venda, while *masingo* have migrated from central Africa through the Limpopo River.

(c) U Kapa Tshisima (Cleaning the spring)

There are times during the year in which *Vhavenda* elderly women gather to clean a spring. Culturally, spring is only cleaned by elderly women who have reached menopause because these women are deemed suitable to be in contact with a spring for cleaning purposes because of the belief that they are clean. The process or activity of cleaning the spring is called *u kapa tshisima,* which suggests that something is removed.

The study discovered that there are times that spring is polluted; therefore, it is the responsibility of elderly women to clean it. Spring is also cleaned after the rain deposits of unwanted soil and other pollutants such as plastic, papers or dead insects into the spring. The women use their hands to remove the dirt that can sometimes hinder water from coming to the surface. The removed soil is not thrown away but used to strengthen the wall built with stones.

The study also discovered that if it time to clear the grass around the spring, the women would do so walk comfortably to and from the spring. The women also plant trees to protect the spring if they see the need. In the end, spring is cleaned and protected, which is the most essential part of water conservation and management that contributes to better hygiene. The following discussion looks at the different uses of water.

4.3.2.5 Concluding remarks

It can be deduced from the above discussion that there is an intimate relationship between African indigenous water sources, storage, and community activities and

water conservation and management. There are different sources of water that provides the community with water for various purposes. The above discussion shows that water storage spaces are commonly used to store domestic and agricultural water, while community activities are commonly for the well-being of water sources and people who use them. Also, there are different water conservation and management approaches associated with water sources, storage, and community activities; however, these approaches have been founded on one common background – African indigenous knowledge. The following discussion looks at the different uses of water in the African indigenous community.

4.3.3 African indigenous uses of water

The study ought to give an extensive water usage by African indigenous people, after drawing and directly using it from the indigenous African sources of water. This is also in line with African indigenous knowledge methods of water conservation and management. Therefore, the researcher deemed it fit to explore African indigenous uses of water to understand better the relationship between the uses of water and water conservation and management as it is a focal point of this study. The study discovered that there are different uses of water in African indigenous communities. The researcher did not want to make assumptions that participants know and understand these other uses of water better. In this regard, a question was posed to participants to understand their knowledge, and share experiences on the different water uses from thevarious sources of water presented above. The responses given by participants are discussed below.

4.3.3.1 Healing and ritual uses of water

Through the ages, water has been widely used by people from different cultures and religions. Participants mentioned that water had been used for healing purposes among the African indigenous communities since time immemorial. It was learnt from the participants that African indigenous people use water when performing their rituals or libations. To add to this, the study also discovered that water been used as a fundamental element in medicine preparations and medicine. Participants mentioned that water is a nutrient required by the human body. The following is what one participant shared:

Participant B

> "A person who does not drink water may not live well, and they can easily contract sicknesses because their bodies may not function well. Water is important in helping the skin to look good, digestion and maintaining good temperature. If all these things are absent, a human body is exposed to sicknesses. Water is also consumed to treat hiccups and headache; when a person has a hiccup or headache, it is generally known that the first thing they will ask for is water."

It was learnt from the participant that water is understood to be medicinal because of the health benefits it holds for human beings. This enabled African indigenous people to respect the water and engage themselves in conservation and management of indigenous sources of water because they provide a daily essential. The researcher performed a follow-up on water being a fundamental element in the preparation of medicines. In this regard, a question was posed during a semi-structured interview with a participant and the following was mentioned.

Participant B:

> "Water is a very important element in the preparation of medicine. Water is commonly used, mixed with traditional medicine to treat diseases that require medicine to be consumed. For example, when a person has a toothache or pains, the bucks of *munzere* (*Bridelia micrantha* Baill) tree are ground and mixed with water; the patient gargles while spitting out the water. Water is also used in practices of healing the pains of those who are grieving. A day after the funeral, people who were very close to the deceased gather in a house and medicine mixed in water is given to them, administered using a branch of *Bopha (English name not known)* tree on the back, chest, hands and feet for acceptance that a person close to them has passed on."

The researcher posed a question to the participants regarding the quality of medicine; whether mixing water with medicine does not reduce the effectiveness of the medicine. The researcher learned from the participants that some medicines could not be work without water; hence water is added. The study also discovered that other than the completeness of medicine, the medicine must be consumed or applied with ease and free from harm, hence it is essentialto add water. As African indigenous people regard water as medicinal, it does not dilute the quality of medicine it is mixed with. Furthermore, the healing of grieving people suggests the importance of water in spiritual healing, which is an important aspect of the lives of African indigenous people.

The study discovered that African indigenous people believe a spiritual relationship between water and ancestral spirits. Participants added that this is demonstrated through performing rituals at the rivers and mostly springs. The researcher could not assume that it is generally known which rituals participants were referring to. In this regard, the researcher asked participants to provide a ritual that involves the use of water.

Participant G:

> "When African indigenous people perform their *u phasa* (libation), rituals where they communicate with their ancestral spirits, water is used. For example, a *makhadzi* of the family or a traditional health practitioner communicates with ancestors. In the process, water is consumed and not swallowed but spitted out to the ground. During this practice, requests and gratitude are presented to the ancestors according to the situations taking place: whether a person is sick, they ask for assistance, for good luck and any other need they have."

The study discovered that water used for healing and ritual purposes must strictly be from an indigenous source of water. This is because of the perception that natural sources or flowing water is pure and are believed to be appropriate for sacred practices. The purity of flowing water and water from natural sources results from the different African indigenous knowledge methods of water conservation and management that are to be discussed. Participants mentioned that stationary water is

not considered for healing purposes unless it has been collected from an indigenous water source. Flowing water signifies a bond that exists between the indigenous water source, ancestors and the living. Several medicines used by *Vhavenda* people necessitate water use; therefore, water conservation and management are essential.

4.3.3.2 Domestic use of water

Water is commonly used for domestic purposes in different *Vhavenda* communities, as in other parts of the world. The researcher learned that domestic water is generally used in a homestead for human consumption and contact with the human body. Other domestic uses of water include bathing, laundry, washing dishes and cooking.

The study discovered that domestic water was commonly collected from three indigenous sources of water for different purposes. The researcher learnt from the participants that water from the *tshisima* (spring) was used for human consumption and cooking. On the other hand, rainwater and water collected from *mulamboni* (river) were used for other domestic activities such as washing dishes, laundry and flooring. Rainwater was occasionally used for consumption and cooking. The researcher asked one participant during the one-on-one semi-structured interview why rainwater was used for consumption occasionally. The following is what the participant said:

Participant F:

> "African indigenous people used spring water for consumption because the water was always clean and cold, which is good for consumption. Rainwater was collected using *nkho* (water container) that stored water for other activities, and they were usually not as clean as stored edible water. People would only consume rainwater when they could not get spring water due to a large number of people collecting water which slow the pressure of spring to give enough water. Sometimes it would be long queues that last until late when it is dark."

As the researcher continued to probe what the participant mentioned, it was learnt that they had to boil it to kill any bacteria in it for one to consume rainwater. Participants

mentioned that this is a practice that served them for many years, and it proved to be effective. This shows how African indigenous communities were conscious of basic hygiene related to water consumption.

The study discovered that bathing and laundry mainly were not done at home but the river. The participants mentioned that this is an old practice. One participant added that there was no ndishi/masambelo au tambela (dish) in which one could bath properly at home. Participants mentioned that only elderly people who could not go to the river bathed at home, and their water was boiled using *khali* (a big pot). According to the participants, bathing at home is a modern practice that the Europeans introduced and indigenous people would only wash their faces at home.

It was discovered that men and women went to the river in groups for security purposes. The researcher was curious about the arrangement in terms of bathing at the river since men were in their group and women in their group. As such, the researcher learnt from the participants that women and men did not bath at the same points of the river. Bathing places are known as *tshitamboni* (a bathing place). There is *tshitamboni tsha vhanna* (men bathing place) and *tshitamboni tsha vhafumakadzi* (women bathing place). These places were far from each other. However, *tshitamboni tsha vhafumakadzi* was often near a road or place where there is a way to the other side of the river. This was done for security purposes to guard against rape or other criminal activities as women could quickly call for help.

The study also discovered that when men and women go to *tshitamboni*, they will take some of their clothes to wash them before or after bathing. This is an essential aspect of water conservation and management to ensure that the water at home lasts a long time. The researcher wanted to know how dishes were washed at home since there were no basins. In this regard, the participants answered as follows to the question posed:

Participant G:

> "*Vhavenda* people were aware that they could not wash dishes in the river. As such, they made bowels with clay soil to wash dishes and

> hands before and after eating. It was commonly known that these bowels and other kitchen utensils were bought from the *vhalemba* group and other people who had the skills made for themselves and their families."

The researcher discovered from the participants that much of the water used at home was not thrown away. African indigenous people ensured that water used for one purpose was usually kept and then used to irrigate vegetables planted in a home yard. This is a practice of water conservation and management that ensures the sustainable use of water.

4.3.3.3 Agricultural purposes

Water is crucial for agricultural purposes. *Vhavenda* people are known for inhabiting places surrounded by agricultural soil and water; thus, these people have managed to use water for agricultural purposes. Water is used to sustain livestock and grow produce such as fruits and vegetables. Participants indicated that livestock did not get their potable water at home or in the kraal; shepherds of livestock took them to the river twice a day – when the sun rises and the sun sets. This was not only because it is the time the livestock needs water, but it is also a major contribution to water conservation and management. Other times of the day were meant for other water users to access water without congestion, which would result in water pollution.

It was revealed that African indigenous people built water channels from their indigenous sources of water, especially rivers. These water channels carried water to the ponds that have been constructed to accumulate irrigation water. Participants added that the ponds were also used to collect rainwater during rainy seasons. Therefore, the researcher wanted to know how plants were irrigated with water from the ponds. In this regard, a question was posed to participants, and the following is what one participant said:

Participant C:

> "African indigenous people did not have the sprays and pipes that could be used for irrigation as these are modern irrigation methods.

However, from the ponds that were constructed some channels discharged water to the furrows. The furrows were created in a way that one furrow would have two or three branches to direct water to the plants."

Source: Heavy rains coming, a chance for water harvesting (FarmBiz Africa 2017).

Figure 6: Picture of a Pond used for Irrigation

The picture above shows a pond constructed to collect and store water for irrigation, as explained above. The above picture of a pond does not tell how deep it is, but the study discovered that the depth and size of a pond depend on the size of the land. If the land is big, the pond will also be broad and deep to store enough water. A pond is dug to a certain depth, as the farmer requires. Some ponds have stairs that allow easy access into and outside the pond for those working on it, especially when cleaning it.

The pond in the picture above has been covered by plastic that strengthens the soil to avoid water absorption into the ground. At the end of it, there is a channel that discharges water to irrigate the crops. The pond collects rainwater that is used for irrigation during dry seasons.

The researcher learnt from the participants that plantations were organised in rows. As one furrow irrigates one row, the water would be discharged to the next one accordingly. Participants mentioned that this is how they used to ensure that a large amount of water is not wasted on the ground but fulfils the purpose of irrigation. This information is critical, as it tallies with what is in the literature relating to the Egyptian shaduf, as shown in the picture below:

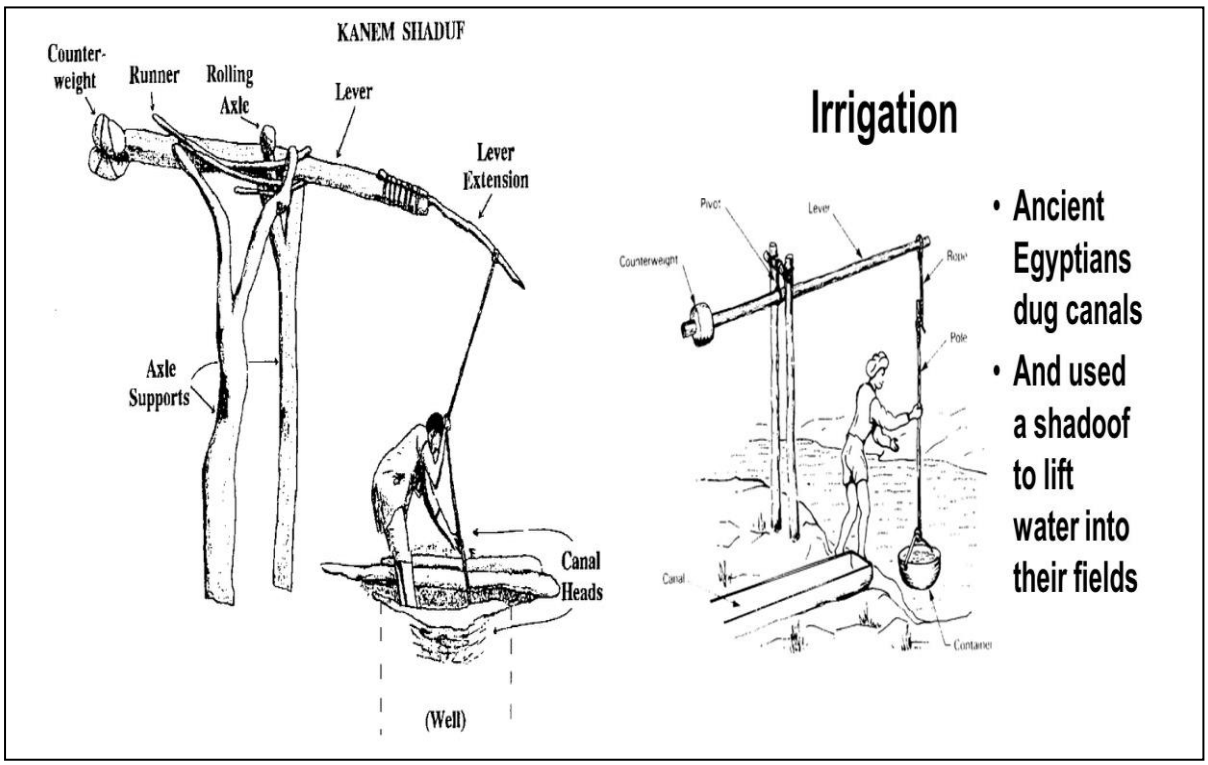


Figure 7: Picture of a Shaduf (Shadoof) used for irrigation

Source: The Pre-Shortzian Puzzle Project (David Steinberg, 2012)

A shaduf is an early old-time crane-like tool with a lever mechanism that the ancient Egyptians used for irrigation (Potts, 2012). As shown in the picture above, according to Stavros et al. (2015), a shaduf has a large pole that is balanced on a crossbeam with a rope; it has a bucket on one end with a counterbalance at the other. The counterbalance assists when water is being lifted out by pulling the rope after lowering the container into the river. The farmer raises the bucket of water by pulling down on the weight and then empties the bucket on the field. The containers were usually made of clay soil or animal skin.

The shaduf came to use when Egyptians built reservoirs from mud and bricks to store the water when it rained (Graham, 2006). The reservoirs had a connecting network of channels that water was released into and the channels. The shaduf would then be used to draw water from the channels, increasing productivity and irrigating crops during dry seasons. A shaduf is still a common tool in many indigenous communities in Africa (Potts, 2012).

The researcher discovered that a Shaduf is a tool related to some of the irrigation practices, but not all participants knew what it is. Although it has been mentioned above that ponds had a channel to discharge the water to furrows, there were instances where containers had to be used to draw water from the pond to irrigate crops. This was mostly done when water was below the point where the channel can discharge water to the furrow, depending on how deep the pond is.

The study discovered that amongst the *Vhavenda* people, it was not common for people to plough and plant at home. The researcher learnt from the participants that this was because people stayed far from water sources; therefore, it would be difficult to irrigate their plants daily. Participants indicated that crops were commonly planted in the homestead because they depend on rainwater. This means that when crops are planted at home, no one is responsible for irrigation, thus water collected for domestic use is conserved. The researcher wanted to know if other plants were planted in homestead gardens and how they were irrigated. The following is what one participant had to say:

Participant D:

> "One must use water appropriately, safely and effectively to yield good production. Water is administered differently to plants, depending on the types of plants. Some plants do not require a lot of water and those that require a lot of water. This is because most indigenous vegetables grew naturally and depended on rain for growth. Other vegetables such as *phuri* (Butternut) and thanga (Squash) were planted during the rainy season, depending on growth. All vegetables that were planted at home required irrigation

> of a small amount of water daily. These vegetables include spinach, cabbage, onions, and tomatoes which are not indigenous; however, they are commonly consumed".

It can be deduced that African indigenous people practised their agricultural activities according to the seasons and weather patterns. It was indicated plants planted according to seasons, which means that plants that require a considerable amount of water to grow were planted during the rainy season. This practice ensured that water is not overused, thus allowing African indigenous people to conserve water and manage it for future use.

4.3.3.4 Concluding remarks

It can be deduced from the above discussion that African indigenous uses of water are intertwined with water conservation and management. It can be noted that each use of water was accompanied by a measure through which water must be used sustainably and kept clean where possible. African indigenous knowledge provides African indigenous people with principles attached to their different uses of water that are positioned to achieve water conservation and management for the benefit of their communities. Consequently, the discussion above depicts an existing relationship between African indigenous water and water conservation and management uses.

4.3.4 African indigenous knowledge methods and teachings of water conservation and management

This part of the study looked at the African indigenous methods and teachings of water conservation and management. The researcher discovered that the methods and teaching of water conservation and management have always had a strong relationship. A method would have a teaching, and teaching would have a method related to water conservation and management. The researcher engaged with participants during data collection, and the following surfaced from their responses.

Since time immemorial, African indigenous communities have had teachings and methods they used in water conservation and management. During this study, African indigenous teachings and methods of water conservation and management were

aimed at ensuring sustainability of indigenous African sources of water. African indigenous education of water conservation and management was passed down orally and sometimes through experiences and observations from one generation to another. The researcher learnt from participants that African indigenous teachings and water conservation methods were understood in two ways: the spiritual aspect and the physical aspect of water conservation and management. The spiritual parof water conservation has always been explained through *zwifho* (sacred sites) while the physical aspect was not entirely influenced by spirituality; however, some methods and teachings of water conservation and management are common. These will be discussed below under the use of control and taboos to teach water conservation and management.

4.3.4.1 The presence of *Zwifho* (sacred site) near water sources for water

A sacred site is a place that is believed to be connected to God or the gods for cultural or spiritual purposes and fit for veneration (Samakov & Berkes, 2017). Generally, a place is a sacred site after something of importance to a religion, or spiritual belief has happened at that place. Other places are sacred sites because a person attached to a given religion or spiritual belief lived there, died there, or his or her body is kept there. Special visits are made occasionally to the sacred sites by those who are attached to them for veneration.

The researcher discovered that the participants perceived *zwifho* as places of the gods that people visit to perform rituals on special days according to events that are taking place in life. Certain families, clans or royal families are attached to *zwifho*, primarily because of their history of existence in a location. *Zwifho* is used as burial sites and places of veneration where people communicate with their gods or ancestral spirits. The ancestral spirits are believed to provide solutions and guidance to activities that take place in the community. They ensure that there is peace and balance between human beings, animals and the natural environment.

Participants indicated that *zwifho* had served African indigenous communities in different ways , to teach about water conservation and management through taboos for many years and continue to do so. Generally, African indigenous teachings of water

conservation and management used by the *Vhavenda* people were in the form of taboos. The researcher learnt from the participants that taboos had an element of control measures regarding the use of resources. This was a peculiar way of imparting the important social and cultural values that contribute to - society's well-being and advancement through water conservation and management. In many activities in the African indigenous communities, taboos inspire conformity.

Participant F added the following:

> "Taboos have been used to teach all community members about how one behaves and responds to the indigenous water sources. There are two types of taboos: the surface taboos, which bring fear and encourage penalties, and true taboos that are more practical in terms of consequences. These taboos are highly revered, and no one would know whether a taboo is a surface or true one, particularly because most of them were in the form of stories. This allowed African indigenous people to live in peace and harmony with their water sources and natural environment at large".

The researcher could not assume that the use of taboos associated with *zwifho* in the African indigenous teaching of water conservation methods and management methods is generally known. In this regard, the researcher probed from what the study discovered, as explained above, to show the relationship between *zwifho* and water conservation and management. The following is what one participant had to say.

Participant G:

> "African indigenous communities used taboos to communicate important aspects of their day-to-day activities. In many African indigenous water sources, there is a sacred component that African indigenous people respected. The general belief informed the spiritual component attached to indigenous water sources in the ancestral beliefs. In contrast, the other was informed by the availability of *zwifho*. However, they served the same purpose of water conservation and management. The ancestral spirits residing

> in *zwifho* areas are the caretakers and protectors of water. Water conservation and management have been shaped by the belief in ancestral and water spirits with likes and dislikes about water conservation and management; mostly, these likes and dislikes are associated with sanitation. Water spirits are hidden forces that secure water sources from misuse and pollution. The use of taboos is a common practice among our communities that that has been applied to teach and help protect indigenous water sources from harm. The taboos prohibited several human activities such as throwing objects into the water".

The study discovered that the likes and dislikes of the ancestral spirits were presented as taboos. The researcher learnt from the participants that taboos did not only apply at *zwifho* areas but also in any area closer to an indigenous water source. Participants also indicated that there were not allowed near African indigenous water sources, which were strictly controlled by the traditional leaders, traditional health practitioners and elders of the community. Over-practising these activities were presented as taboo. These are discussed below.

(a) Taboos and control over the use of resources associated with water conservation and management

The study discovered there were control measures over water conservation and management. Disobeying control measures over the use of resources or the over-use resources was understood as a taboo. The researcher deemed it suitable to explore different control measures and taboos that African indigenous people depended on for water conservation and management. These are discussed below.

(i) Control over cutting of trees

The researcher discovered from the participants that trees play an essential role in protecting water and that no one may cut trees surrounding the water. The *Vhavenda* people believe that trees close to a water source, particularly rivers, serve as *nguvho ya mulambo* (a blanket of the river) covering and protecting the river. Participants indicated that trees protect African indigenous water sources from the sun. T prohibits

humans and animals from accessing the source from any point, which might lead to pollution. The participants indicated that trees ensure that indigenous water sources do not run out of water. Participants suggested that the sun leads to water evaporation water evaporation, leading to indigenous water sources running out of water. Trees ensure that the sun does not shine directly on indigenous water conservation. Participants explained that water that is protected from the sun is always cold, which is the nature of water from indigenous sources. The following is the opinion of one participant:

Participant F:

> "Thorny trees known as *Luanakha* and other indigenous trees protect indigenous sources of water from pollution caused by animals that may enter from any point of the water source. They also protect these animals and human beings from drowning, which is also not good for the water".

During non-participant observation, the researcher observed numerous pine trees that have been planted around *Tshidzivhe* and the surrounding areas for commercial purposes. Furthermore, the researcher learnt that the area was selected for planting pine trees because of the abundance of water in the land as pine trees need a lot of water. In this regard, the researcher posed a question to one participant regarding how control was ensured to maintain a balance between indigenous trees that are beneficial to indigenous water sources and ensuring that pine trees do not harm the indigenous water sources. The following is what the participant had to say.

Participant E:

> "When the operating company was planting the pine trees, an instruction was given to them from the community through the chief, that wherever they find a source of water, they should not tamper with it. They were told not to cut any tree they find surrounding a water source. When planting pine trees, they were told to be away from the water source at a distance of not less than 10miteres from

> both sides. This allowed for the protection of indigenous trees that are not toxic to indigenous water sources".

This demonstrates that African indigenous people are more concerned about environmental wellbeing as they depend on it for survival. researcher learned that African indigenous people value their indigenous trees, not only for their service in the protection of their water sources but also as medicines, food, and wood. The relationship existingis that when medicine and food from indigenous trees are consumed, water from the indigenous African sources is usually essential.

During a non-participant observation, the researcher learnt that the use of wood for different purposes is common among the African indigenous communities. The researcher posed a question about what happens to the dry wood of the trees that are close to indigenous water sources. The question came about because of a casual conversation between the researcher and participants, as indicated in the rapport. Participants indicated that harvesting dry wood from trees surrounding the river is prohibited. These woods are supposed to be left by the river until they decompose without anyone in the community exploiting them. Even debris from the trees (*makukwe)* drifting in the water was not to be used. Because of these prohibitions, the people would not take debris to their homestead.

Participant F:

> "It is only when the *tshikona* dancers call a traditional healer to burn the collected debris to enable the drum to produce quality sound. *Vhavenda* people have a saying that 'ngoma *dza tshikona dzi aravhedzwa makukwe'* (*Tshikona* drums are strengthened by the smoke of debris while burnt, and the skin of the drum faces the fired). Unfortunately, this is not done in a homestead where people reside because no one can use them as firewood".

The researcher learnt from the participants that a prohibition on harvesting debris was a respected taboo among the *Vhavenda* communities. Participants mentioned that

people respected this taboo and that it was rare to find cases where a person would harvest debris. As this was explained, a concern was raised by one participant in a focus group discussion that the current generation does not respect this taboo; as such, the community faces water-related challenges. The researcher learned that when taboos are not respected, there are consequences; some are already visible in water-related challenges.

The researcher observed an event where one of the community members was cutting down the trees for firewood without permission from the chief. The researcher learnt that the community member was given an order not to cut any tree at this specific place, even though it was a stand that has been allocated to someone related to him. The chief summoned him to enquire after the matter but the researcher could not attend the proceedings of the matter. Although the place in which trees were being cut down was not near a water source, this shows how African indigenous people relate to trees and the enforcement of protocols to be followed before a tree is cut down or any product of a tree is extracted.

Participants mentioned that a tree is like a human being; it should not just be killed or cut down because it is useful for a specific purpose. People were only allowed to cut down dry trees. The people in the African communities sought permission from the chief to cut down trees. The chief would then direct where they could cut down trees. However, in some cases, an area that seems to have dry trees would be mentioned.

(ii) Control over killing aquatic animals

The study discovered that aquatic animals form an important part of indigenous sources of water. Aquatic animals such as fish, frogs and crabs are commonly found in the indigenous water sources, especially in rivers and wetlands. The *Vhavenda* people condemned the inconsiderate killing of animals in and around water through taboos that provided control measures for killing such animals, including aquatic animals such as frogs and crabs.

The researcher learnt from participants that there was control over the killing of animals that can be consumed, mainly fish. To ensure that water sources do not run

out of fish, the killing of small fish was prohibited –big fishes could be consumed, but small ones had to grow and procreate other fish.

The researcher asked participants about animals that people did not consume. They indicated that it was taboo to kill animals that people do not eat; this was often associated with malice as the taboo was also in place to allow other creatures to live freely. The researcher posed a question to one participant on what the consequences would be if inconsumable animals are killed, and the following is what one participant had to say.

Participant F:

> "According to *Vhavenda* people, good way of living includes respecting people, natural resources and animals that people live with. Therefore, people lived in harmony with domestic, wild, and aquatic animals. In terms of aquatic animals, it was taboo to kill a frog because one would suffer *phadi* (scabies).

The researcher wanted to know what *phadi* is and asked the participants. One participant indicated that *phadi* is extremely itchy pimples that contain visible fluid. *Phadi* develops between fingers, under the arms, on the hands, waist and anus. Participants indicated that a medicine is made of the bark of certain indigenous trees and water, which must be scrubbed on the pimples. The bark of these trees can only be found by a traditional health practitioner, apart from a few individuals who may also be knowledgeable.

The researcher further asked the participants whether one would kill a frog and not suffer from *phadi* illness. In this regard, participants mentioned that it was rare that a person would deliberately kill frogs and other aquatic animals. It was further mentioned that the understanding is that if one kills an animal without the purpose of eating it, they will eventually suffer the consequences, even if it takes years, although it may not be *Phadi*.

The study discovered that the control over killing aquatic animals and the taboo associated with it encouraged African indigenous people to consider other animals. Furthermore, the researcher learnt from the participant that control over the killing of aquatic animals ensures that the natural order of the food web and the food chain is not disturbed. In this regard, the study discovered that water conservation and management play a central role in supporting the food web and the food chain in such a manner that people feed on plants and animals, some of which feed on aquatic animals, and all these living beings depend on water for survival. Therefore, this practice ensured that there is enough clean water for subsistence activities.

4.3.4.2 Time allocation

Time allocation is the distribution of time to various activities or people and is important when planning and managing the amount of time given to activities or people to ensure that objectives are met (Tarver, 2017). According to Tarver (2017), when time is allocated, the opportunity for time to be wasted on things that are not important is limited. Therefore, there is an intimate relationship between efficacy and time. This means that when time is allocated, activities are carried out y effectively.

The study revealed that African indigenous people divided their time into three parts: morning, afternoon and evening or night. Different activities were allocated to these three times of the day. Morning time is for people to prepare themselves for the day's activities. In the afternoon, people are busy working, and in the evening or nighttime, families spend time together before going to bed.

It also became evident from the study that time allocation was practised for access to water. This was considered an essential approach to water conservation and management. The researcher learnt from the participants that it is necessary to regulate access to water for various reasons, such as to reduce pollution, and that fetching water from indigenous African sources was informed by the daily activities people engage in. As such, people would usually bring water to be used instantly. The researcher posed a question to participants regarding who allocated the time and how was time allocated for water access. The following are the replies of some of the participants:

Participant G:

> " No one allocated time to water access. It is a natural order that was found and must be respected. This order is intertwined with how human beings and animals relate to the environment".

Participant H added the following:

> "Women and children fetch water from the rivers and springs in the morning for domestic use. Thus, a common saying that '*Mu ka madi ua fhinduwa ano salela u ka madzikwa'* (One who fetches water must wake up early; those who stay behind fetch unclean water). Midday and the rest of the day were given to the livestock until the sunset when women and children will be going to fetch water for the last time. Night hours and early morning before sunrise was allocated for wild animals. Vhavenda people *say u fhinduwa hanu nido vhuya na tangana na zwipuka zwi tshi ya madini* (If you keep on waking up early in the morning one day, you will come across wild animals on their way to get water). This is said to people who wake up early to fetch water at the time in which wild animals are expected to be in the rivers and springs."

This demonstrates a systematic way that ensured that all users of water could access it without competition. The different water users from indigenous sources,, mentioned by the participants in this study, were human beings, domestic animals and wild animals. After realising that animals are also included as water users, the researcher questioned why human beings allocated time for animals to access water. The participants indicated that the land was given to them by *nwali* (God). Therefore, It is their responsibility to ensure that all- users share all natural resources.

4.3.4.3 Oral tradition

Oral tradition is referred to as a way in which human beings receive, preserve and communicate their art, ideas, knowledge and cultural materials from one generation to the next (Schoenbrun, 2017). Oral tradition encompasses the traditions, knowledge and memories of a cultural group. It is about remembering and transmitting preserved

cultural knowledge through speech. The participants indicated that oral tradition had played an intrinsic role in teaching African indigenous knowledge of water conservation and management through African indigenous games and storytelling.

(a) Indigenous African games

There are different types of games in the world that different people participate in. Other games have been and are still played for commercial purposes; however, games are tools for socialising and creating an environment for learning for African indigenous people. These games are referred to as indigenous African games. The study discovered that indigenous African games provided an opportunity for children and other community members to learn about the cultural beliefs, practices and values by doing, which enabled them to share a common worldview according to their culture.

The study discovered that, as with any other games, for African indigenous people, indigenous African games are a form of exercise, and development of psychological stability and practical skills, informed by the situations in their communities. African indigenous games are mostly played for enjoyment and making friends. Participants hailed African indigenous games for their potential to allow them to narrate the realities of their community while developing talents and skills. The researcher also learnt from the participants that some indigenous games served to prepare children for adulthood. One game that has been identified to have contributed to addressing African indigenous knowledge of water conservation and management is *mahundwane.*

The researcher wanted to know what *mahundwane* is and the role it plays in water conservation and management. In this regard, a question was posed to participants, and the following is what was mentioned.

Participant H:

> *"Mahundawane* is a game that is played by children, reflecting on real-life situations, where children imitate the daily activities of households in their communities. During *mahundwane,* children learn or live the life of old or married people. It is usually the older ones who play as parents and younger ones as children. When

> playing *mahundwane*, children build small structures imitating the different houses in their community. These structures are built with stones; some go to an extent where they build shacks that are conducive for them to play during cold days. Children bring food items to the *mahundanwe* game, such as tomato, onions, utensils, and other tools used when cooking. When food items are not available, children use mud to cook, using tins as pots. Activities are coordinated by older children than others, who give instructions on what must be done. Girls assume motherly roles while boys assume fatherly roles, and the rest are expected to live like children."

Participants explained that *mahundwane* has an intrinsic role in teaching water conservation and management through its principles and the imitation of how African indigenous communities live and conserve and manage water. Although *mahundwane* is played during the day, children can divide the time into three parts – morning, afternoon and evening. They also find a way to have different weekdays if they have enough time to play. The researcher learnt from the participants that as children play, there is a time in which they go to the river to collect water. In African indigenous communities, water is usually collected in the morning and evening, thus the time for that is imitated during *mahundwane.*

The study discovered that when children are cooking during *mahundwane,* they also emphasise the water conservation using the same teachings they received from their parents. Water is commonly used for cooking or mixing with mud to imitate how food is cooked and wash the tins they use. The researcher learned from the participants that it was rare for the children to waste their water. Children ensured that they save water for the following day to avoid constantly going to the river.

(b) Storytelling

Storytelling is an ancient form of communicating to listeners through speech and gesture to expose elements and images of a given story while stimulating the imagination of the listeners (Zuofa & Olori, 2015). Before b introducing written words in Africa, storytelling was used to narrate historical events and teachings from one

generation to the next (Tuwe, 2016). In addition, African indigenous people used storytelling to communicate their history and their cultural heritage.

The study discovered that storytelling is a form of creative art practised for many years to pass messages while entertaining and teaching children in the African indigenous communities. . Elders performed storytelling at night before children went to sleep. The participants indicated that storytelling was performed at night because it was regarded as family time when everyone is home. In addition to this, one participant mentioned the following.

Participant I:

> "Elderly people used to gather their children and grandchildren during the evening before bedtime to tell stories. The storytelling would be commonly narrated while children are seated around the fire. These stories were meant to entertain children; however, there was a lesson learn at the end of each story. The stories encompassed myths, legends, tales and proverbs."

The researcher discovered that storytelling explained the worldview of African indigenous people in all aspects of life, including water conservation and management. Water conservation and management were taught in the form of storytelling to make sense of things and shape the behaviours of community members towards the water. The researcher learnt from the participants that the modern world depends on books to teach. Still, storytelling provides a platform for the teller and listeners of the story to interact on a direct and personal level. ,In addition, stories told had a huge element of sacred sites and how they are associated with natural sources of water, particularly springs, wetlands and rivers.

Elders, who were storytellers, played a significant role as principal educators and entertainers in the African indigenous communities. It can be deduced that storytelling played an intrinsic role in teaching African indigenous knowledge of water conservation and management. Children learnt African indigenous perspectives,

principles, beliefs and practices of water conservation and management that allowed them to share a common worldview with the rest of the communities they inhabited.

3.3.4.4 Concluding remarks

It can be deduced from the above discussion that water has a spiritual presence in the ancestral world. It became clear that methods and teachings on water conservation have been influenced by culture and people's experiences. Plants and animals areessential in the practice of water conservation and management. Therefore, it can be concluded that African indigenous people perceive water sources as part of the life cycle that must be taken care of because of their potential in people, plants, and animals. The study also discovered that African indigenous teachings and water conservation methods and management are facing many challenges discussed below under the following theme.

4.3.5 Challenges facing African indigenous teachings and methods of water conservation and management

Indigenous water sources are facing several challenges in the present day. The participants expressed their concern about the indigenous water sources that do not supply them with enough water anymore. The study discovered that water sources are drying up. Still, researchers could not assume that participants know about the state of the water problem in their community. In this regard, a question was included to determine the participants' views to determine the participants' views about the current water problem. The following is the answer of one of the participants.

Participant C:

> "We are worried about our rivers, wetlands and springs because they do not seem to be efficient enough anymore for us as people, livestock, animals and plants. If one looks at other countries whereby water is scarcer than here, it can be learnt that there is a huge imbalance in their lives. Therefore, African indigenous people in our country are also likely to experience the same, unless something is done about our indigenous sources of water."

One of the main subjects that some participants brought to the researcher's attention during the one-on-one semi-structured interviews regarding the challenges causing water problems were taboos. The study discovered that there are different taboos that African indigenous people employed in water conservation and management. As such, participants indicated that undermining taboos is a significant challenge that causes water problems. This is discussed below.

4.3.5.1 Undermining taboos

Taboos are customs of a society or a religious group that put restrictions on certain activities or outlaw relationship with a person, place or thing (Liveris, 2017). ,The belief or understanding informs a taboo that something is excessively repulsive or too sacred (Sicotte, 2017). For example, African indigenous communities have always subscribed themselves with the belief in the supernatural being through their ancestors and ancestral spirits. This is a practice , rooted in their culture and that support it. These taboos have been appreciated and revered by all community members as well as members from other communities. However, during data collection, participants expressed a concern that people seem to be neglecting and undermining taboos that have always been imperative in water conservation and management. The following is what one participant had to say.

Participant B:

> "Water has a strong spiritual component, and people submit themselves before these ancestral spirits by respecting the taboos that provide guidance on water use activities, conservation, and management. Thus, the challenge of water scarcity is somehow a punishment or consequences for disrespecting the indigenous water sources as well as the ancestors through undermining taboos that have been set to be obeyed."

The study discovered that taboos played an indispensable role in the conservation and management of water. According to participants, undermining of taboos is perceived as a direct disregard of the protection and management of water, hence the water challenges faced by various African indigenous communities. Taboos

created the situation where African indigenous communities noted the sacredness of their beliefs. Such sacredness excluded African indigenous communities from causing harm to natural resources such as fish, plants, animals and others. Consequently, some trees are not just harvested because of these taboos, and other forms of farming and hunting are not allowed as they directly or indirectly impacting the water. The following are some of the taboos that participants identified in line with water conservation and management.

(a) Taboo on killing water snakes

The study discovered that most indigenous water sources, particularly rivers and springs, are guarded by a snake residing in them. Participants explained that the snake is not poisonous and the purpose of its existence is to ensure that the water does not run out. Members of the community or any individual are prohibited from killing this snake. According to the *Vhavenda* culture, if a snake is killed, the indigenous water source will dry up and no longer provide water.

The researcher learnt from the participants that those who see the snake that lives in the water gives it away to pass, and if people scream out of fear, it goes back to its residing place. The snake drinks the water from the indigenous water sources. According to the participants, there is nothing wrong with the snake drinking water because it guards the water sources, and it is the nature of things that people will share natural resources with animals. The researcher was curious about the arrangement of people collecting water and snakes having to drink the same water because of an assumption that it cannot be proper that the snake drinks the same water the people are collecting. In this regard, a question was posed to the participants, and the following is what one participant had to say.

Participant F:

> “There are times of the day in which people collect water from their respective indigenous water sources. African indigenous people collect water in the morning and early in the evening. On the other hand, the snake drinks water during the day in the afternoon and at night when no one is there. People who have seen the snake in

> different communities usually see it at night and during the day when they pass by the indigenous water source or men who bath at the river late in the evening".

It can be deduced that African indigenous people have lived with animals, sharing natural resources, particularly water. The participants reported the snake having a sacred relationship with water or indigenous water sources, just as human beings do. In communities where this relationship and the taboos are disrespected, there are serious water crises.

(b) Taboo on the domestic use of wetland water

The study discovered that African indigenous people have always been concerned about their health. In this regard, it was found that it was taboo to consume water from the wetlands. The researcher learn from the participants that, apart being an indigenous source of water, vhavenda people used wetlands as dumping sites. The study discovered that dead animals, the remains of a woman who had a miscarriage, umbilical cords and other things that were not meant to be seen by the public were buried in the wetlands.

Participant G:

> "It is taboo to drink or cook with water from the wetlands. Wetlands are storages for the dirty things that are harmful to the health of human beings. For example, an umbilical cord cannot just be cast anywhere, and a dog that has died can cause air pollution. The water from the wetlands must be allowed to make its way to the river without disturbance".

It can be deduced that this taboo is deeply rooted in the hygiene of human beings. The researcher learnt from the participants that when things are buried in the wetlands, the chances of people seeing them again are not high due to the mud that absorbs them. When water flows from the wetland to the river, it is also not supposed to be consumed. As discussed above, underwater uses, people were not allowed to consume water

from the river because of the dirt it contains from the wetlands. People were only allowed to use water for other uses, but not for consumption.

(c) Taboo on bathing at the spring

The study discovered that the role of spring was to provide African indigenous communities with potable water. However, participants added that African indigenous people restricted several water-related activities in the spring through taboos. For example, it was learnt from participants that it was taboo to bath in the spring, and the researcher wanted to find more information on this taboo. The following is what one participant said.

Participant E:

> "The spring gives people water that is good for human consumption. *Vhavenda* people managed to maintain their cleanliness for ages. If a person is found bathing in spring, they would be regarded as a hooligan of the community and face charges. The person would be taken to the tribal court, where their punishment is presented. Punishments would differ according to times and situations, sometimes depending on person's social status to be punished. For example, one would be required to work on a farm, pay with an animal, or be denied contact with other community members. Traditional leaders made sure that the value in the taboo is revered through these punishments and ensuring that a person is exposed to the community for their wrongdoing".

The researcher learnt from the participants that it was not common to hear about a person who was found bathing in spring. This is because people respected this taboo and understood that they would consume the same water. It was also discovered that the taboo brought fear to the community members; a punishment would get a bad name to an individual and their family. In this way, African indigenous people respected the taboo that restricts them from bathing in the spring.

It can be deduced that African indigenous people used taboos to protect a spring from the people and protect them from sickness through taboos. Water-related sicknesses are caused by bacteria that can be absorbed by taking a bath in the spring because the water does not flow as it doen in a river. This taboo maintained the spring's well-being to keep the water clean for human consumption and other activities.

As can be noted from the above taboos, natural resources were conserved and preserved, thus hindering exploitation of such natural resources that would spur water challenges. One key issue with taboos was that they carried serious punishment if not followed. One participant indicated that taboos were customary key guards in the conservation and management of water. The participant told a story that narrated how taboos were key:

Participant F:

> "Taboos are there to shape the behaviour of people according to the *Vhavenda* culture and worldview. Taboos serve as the authority to teach what is culturally considered acceptable, which makes an individual a member of the community. Many taboos bring about the element of fear that prohibits people from engaging in culturally immoral activities. Hence, taboos encourage and discourage certain behaviours of the African indigenous people who part of a given cultural group. Although some of these taboos instil fear on African indigenous people, their purpose is not that people should live their lives in a state of fear, but to promote what is culturally accepted as good behaviour".

The researcher learned that different taboos were presented as rules, depending on how crucial they were. For example, taboos associated with water were commonly presented as rules because of their importance in the lives of the African indigenous people. eople who did not respect the taboos would face the consequences such as punishment by the community or ancestors. However, participants indicated that the advent of western knowledge limited the value of these taboos in the lives of African

indigenous people; thus, the current generation does not seem to be respecting the taboos.

4.3.5.2 Concluding remarks

As seen from this part of the study, undermining taboos associated with water conservation and management is problematic. African indigenous communities used taboos for many years as a way to conserve and manage water. Thus, taboos have been an integral part of the lives of African indigenous people and their interaction with the natural environment. However, the study established that undermining taboos has led to different water challenges associated with conservation and management while indigenous African sources of water are drying up. The study also discovered that African indigenous knowledge of water conservation and management is disappearing. The following discussion looks at the factors that lead to the disappearance of African indigenous knowledge of water conservation and management.

4.3.6 Factors leading to the disappearance of African indigenous knowledge of water conservation and management

African indigenous knowledge has enabled indigenous people to survive and provide solutions to their problems (Netshivhambe, 2017). However, African indigenous knowledge has received little attention in modern society, slowly disappearing (Onwuegbuzie, 2017). Factors leading to the disappearance of African indigenous knowledge of water conservation are presented below, as given by participants. Participants have also presented these factors as significant contributors to the ineffectiveness of African indigenous knowledge methods of water conservation and management.

4.3.6.1 Lack of systematic documentation

African indigenous knowledge was transferred orally from elders to the children (Hlalele, 2019). However, it was reported to be facing the risk of disappearing in the current day because methods of storing information have changed. The study discovered that many aspects of African indigenous knowledge dnot been systematically documented as stored in the elders' memories . The lack of systematic

documentation has led to African indigenous knowledge being considered lower than western methods, leading to the challenge of water and African indigenous knowledge methods of water conservation and management. Some participants mentioned that if African indigenous knowledge methods of water conservation and management had been documented, they would still be practiced today.

The study discovered that other challenges associated with the lack of systematic documentation of African indigenous knowledge are the dominance of western methods and knowledge sources to solve water-related problems previously solved by African indigenous knowledge. One participant mentioned the following in contribution to the lack of documentation of African indigenous knowledge methods of water conservation and management.

Participant G:

> "Some aspects of African indigenous knowledge of water conservation and management have been constructed with the involvement of secrecy embedded in clans or families. These secrets are not to be exposed to anyone outside the family or clan. This is because there are practices that they do, and they want to protect their tradition as a clan or family. In other cases, some taboos are associated with revealing secret knowledge to the people outside the clan."

The study discovered that a challenge associated with the secrecy of African indigenous knowledge methods of water conservation and management is that the western and other foreign values have been enforced on African indigenous people. As such, the knowledge that is not disclosed is regarded as useless and based on myths. This makes it difficult for African indigenous communities to practice all aspects of their water conservation and management knowledge. As a result, African indigenous knowledge methods of water conservation and management disappear. The researcher learnt from some participants that it is important to document African indigenous knowledge to preserve it and ensure its prosperity and sustainability in solving the problems of the indigenous people.

4.3.6.2 Colonisation

Colonisation captures land and its people, imposing governance on them by people from another location (Yin, 2016). It is a process of conquest that comes with the enslavement of the people in their native land. Furthermore, colonialism comes with activities that destroy the colonised land's norms and values and submit to those enforced on them (Higgs, 2015). This study discovered that colonisation contributed to the loss of African indigenous knowledge of water conservation and management.

The study discovered that African indigenous people's cultural norms and values were phased out during the colonisation processes. Participants indicated that the way of life in African communities changed in that the knowledge and practices of the African indigenous people were not regarded as necessary. The norms, values, knowledge and practices that were deemed important were western-based. The African indigenous knowledge was labelled as embryonic and non-scientific.

Participant E:

> "Before the advent of the western people *musi mahayani ro dzula* (an expression that in the villages where we lived in peace), we lived life according to our culture, and we were satisfied. When colonisation took place, the lives of African indigenous people were economically, socially, spiritually and politically affected. Europeans enforced their worldviews on our grandfathers and forced them to live according to European standards. Our African indigenous knowledge was lost during the process,, including water conservation and management".

The study discovered that the advent of colonisation in African indigenous communities gave rise to a great loss of identity of the African indigenous people, which directly and indirectly impacted the disappearance of African indigenous knowledge methods of water conservation and management, as discussed below.

4.3.6.3 Loss of cultural identity

Culture is referred to as values, beliefs and patterns of behaving and thinking that are learnt and shared and are characteristics of a group of people (Heine, 2015). Cultural

identity is how people define themselves according to a culture they are subscribed to (Guerrero, Andersen & Afifi, 2017). It is an extent to which a person represents their culture in terms of values, beliefs, ways of life anddoing things.

During a focus group discussion, participants agreed that although they live in a democratic country, the aftershocks of colonisation are still affecting the lives of African indigenous people in many ways. The participants mentioned that this was evident through the life that people live today because most people do not live according to their African indigenous ways of life. It was discovered from the study that this loss of cultural identity affected how people see water and natural sources of water, which is not from a cultural perspective, but just a resource that should be exploited. Some participants strongly expressed that when they neglect their own cultural identity, they harm themselves in the long run. The researcher asked a question about the harm that people have caused themselves through the loss of cultural identity. One participant had the following to say.

Participant F:

> “People have lost their way of life; they no longer care for cultural aspects of life. There is a serious problem when it comes to water conservation and management, and any person can see it. Rivers are polluted, trees are being cut, and royal families,, as well as traditional healers that are supposed to perform water-related rituals, seem to have forgotten their roles in society. Greed has also corrupted the traditional leaders who give residential areas in floodplains and riverbanks”.

The above shows that culture is essentialin giving people identity, which helps them live in harmony with their natural environment. When cultural identity is lost, howpeople define themselves also disappears and negatively impacts how they relate to water conservation and management activities.

4.3.6.4. The dominance of Christianity in the African culture

The study discovered that one of the significant contributors to the disappearance of African indigenous knowledge of water conservation and management is the dominance of Christianity in the African culture. During the advent of Christianity in Africa, African cultural beliefs were viewed as rife with evil practices. The practices of African indigenous people were labelled as barbaric and practices of heathens. Participants mentioned that Christianity contributed to the loss of African indigenous knowledge of water conservation and management. The following is what one participant had to say.

Participant G:

> "When missionaries came to African communities, they disregarded African cultural beliefs while enforcing theirs. African indigenous knowledge was generally not appreciated in churches. African people were told to change their names and leave their African ways of doing things to. Christian world can accept them. This did not only affect people but how they relate to natural resources. Indigenous natural resources are under stress currently. Our land is dry, there is no water, we are supposed to have rituals as Africans to call for rain, but Christianity is completely against that, and people are afraid to be called heathens".

The study discovered that the spiritual aspects of African indigenous water sources and water conservation and management had been stripped off due to the enforced conversion to Christianity. African indigenous people do not follow their indigenous ways of water conservation and management; hence, this knowledge disappears. Participants mentioned that although African indigenous knowledge of water conservation and management was orally passed on from one generation to another, it was protected, preserved and promoted through practice. This means that by practicing water conservation and management, African indigenous knowledge continues to exist.

4.3.6.5 Neglecting African indigenous education

African indigenous education is a process in which knowledge, skills and traditions of a culture that have been inherited are passed from one generation to the next (Njoki, 2019). African indigenous education is a form of learning in the African communities (Nyoni, 2019). However, the study discovered that even though South Africa has achieved independence and was no longer colonised or under apartheid governance, education in the country still neglects African indigenous education.

The study discovered that the western education system did not accommodate African indigenous education. The education introduced in South Africa disregarded indigenous knowledge while promoting WSK and referring to it as the only recognised and good education. This led to the neglect of the African education system by African indigenous people to be well recognised and be regarded as relevant in the sphere of western life. In the long run, this also affected African indigenous knowledge of water conservation and management as it could not conveniently pass to the younger generation.

The education curriculum that was introduced around the 1990s (Outcomes-Based Learning (OBE)) and the National Curriculum Statement (NCS) that followed it were not clear about their promotion of African indigenous education. The current curriculum (Curriculum Assessment Policy Statements (CAPS)) seems to be introducing the aspects of physical education (PE) to bring the element of indigenous knowledge into the classroom. This has been demonstrated by the introduction of indigenous games at schools. Even though CAPS is trying to introduce indigenous knowledge, much of it is western-based, thus limiting learners in learning African indigenous knowledge.

Some participants indicated that African people are trapped in the schemes enforced by western education while neglecting their knowledge and education system. Much of what was and is still taught in the schools portraits African indigenous knowledge as inferior, thus young people do not believe it is vital in the current day.

Participant H:

> "I remember during apartheid in our country (South Africa), African indigenous languages were damaged because they were not regarded to be as equal as English and Afrikaans. African indigenous knowledge was perceived as insufficient knowledge while promoting their western knowledge and education. As a result, some of our people disregarded our indigenous knowledge systems due to the re-definition and socialisation imposed on them and favoured the ideologies of the apartheid government. Eventually, Africans abandoned and disrespected their knowledge system, and it is one of the reasons our natural environment, especially water sources, are under stress".

The above discussion shows how promoting western education and referring to African indigenous education as inferior led to confusion in the African countries. It can be deduced that African indigenous water conservation methods and management methods would have been very effective had they still been practiced to date. The study discovered that Africans had abandoned their African indigenous knowledge, resulting in African indigenous knowledge of water conservation and management disappearing because of disuse.

Participant I:

> "There are children who believe that water comes from the tap. I once went on a trip with secondary school learners to visit sacred sites around Venda. We went to a resort where there is a swimming pool with warm water on our way back. Learners argued and said that the geyser is boiling the water".

It can be deduced from the above statement that even in democratic South Africa, the education system still does not promote African indigenous education. The report made by the participant above shows that schools do not teach learners about the indigenous sources of water. This means that those indigenous sources of water suffer because people do not know their importance. As a result, African indigenous

knowledge methods of water conservation and management disappear as it is not taught.

The study also discovered that in some settings where African indigenous education is taught, the teaching methods are not African. Thus the education is diluted in the process. People who are more exposed to western education have also been reported to disregard the African indigenous knowledge. Participants expressed that the aftershock of colonialism and apartheid are still affecting them, as they are sometimes denied or given limited platforms to practice their indigenous knowledge. This is because where African indigenous knowledge is practised, little recognition is provided. There is always an attempt to understand African indigenous knowledge and its practices through values and foreign perspectives.

Participants mentioned that African indigenous knowledge was not learnt in the classroom. There were African indigenous knowledge ways of knowing that allowed African indigenous people to understand indigenous African sources of water and conservation and management. One participant also mentioned during the focus group discussion that these ways of knowing or acquiring information are also disappearing in the current day. The ways of acquiring knowledge were limited to water conservation and management and extended to all aspects of life in the indigenous communities. These ways of acquiring African indigenous knowledge are discussed below in association with water conservation and management.

(a) African indigenous knowledge ways of acquiring knowledge

This part of the study presents the findings of some features of the African indigenous knowledge education neglected. The African indigenous knowledge education is offered as ways of knowing or acquiring information. These are explained below in four categories.

(i) Community-based knowledge

Community-based knowledge is the knowledge that has been acquired through folklore activities. Children receive this knowledge through storytelling, proverbs, music and playing games. In this way, children also learn the knowledge of water

conservation and management suitable for their age, which is informed by the activities they engage in. Therefore, the African indigenous knowledge they acquire allows them to know how to behave at or near indigenous water sources.

The study revealed that parents and elders responsible for folklore activities spend their time watching television with their children; therefore, community-based African indigenous knowledge of water conservation and management is not shared. Children do not play indigenous games; they listen and sing foreign music that does not address their social realities. Some participants indicated that African indigenous knowledge of water conservation and management is well preserved, promoted and protected when passed to younger generations through folklore activities.

(ii) Clan-based knowledge

This is the knowledge the people of a particular clan keep. The study discovered that in an African indigenous community, a clan becomes the custodians of water knowledge because of their association with water sources or how they are known to conserve and manage water. These clans are often given the responsibility to look after the wellbeing of indigenous water sources.

The study discovered that most clan-based knowledge of water conservation and management is not used anymore. The study that one factor contributing is the western education that has looked down upon the African ways of acquiring knowledge. The participants mentioned that when people marry women from other cultural groups, the clan-based ability loses its value because their wives doubt it.

(iii) Undisclosed knowledge

Participants defined undisclosed knowledge as knowledge that has been inherited. The study discovered that people known to possess inherited knowledge in African indigenous communities are the traditional health practitioners. Participants indicated that traditional health practitioners inherit knowledge from their ancestors, which allows them to know the nature of their environment better. The study discovered that the ability to understand the natural world and the supernatural world allowed traditional health practitioners to play a role in water conservation and management.

The study discovered that most traditional health practitioners are not applying their inherited knowledge in water conservation and management activities. One participant said that the knowledge exists, but is not used, because the current world does not give traditional health practitioners the respect and recognition they deserve. It does not acknowledge their role in water conservation and management.

(iv) Society-based knowledge

Participants described society-based knowledge as knowledge acquired through the structures of a society based on gender and age. The study discovered that when children are born, they go through different stages of life and rites of passage that are relevant to their age and gender. Participants mentioned that children go to other initiation schools that prepare them for the next stage of life.

The study discovered that in most initiation schools, such as *Murundu or Mula* (an initiation school for boys), no particular knowledge is learned about indigenous knowledge of water conservation and management. However, the principles that are learnt at the initiation school are applied in water conservation and management. Boys are taught to respect people and the natural environment, which allows them to follow the rules set by traditional leaders. In most cases, they act as police that oversees and safeguard indigenous sources of water.

It was found during the study that these ways of acquiring African indigenous knowledge allowed African indigenous communities to live in a good manner. The above ways of acquiring African indigenous knowledge seem to have been categorised in a systematic way that covers all the aspects of human life, such as physical, mental and spiritual. Hence, spiritual knowledge is the knowledge that has been inherited. The acquisition of this knowledge, which is based on different stages and situations in life, ensured that the relevant information was known according to time, age and gender. This is the most important part of African indigenous education. The participants mentioned that negligence of African indigenous ways of knowing and acquiring information led to a significant loss of family history that was a key resource to water conservation and management. This is discussed below.

4.3.6.6 Family loss of history

Family refers to a group of people related to each other on the grounds of consanguinity or affinity (Bryant, 2016). However, the family referred to in this part of the study has a consanguinity relation. History refers to the previous events and the findings, collection, memories, organisation, presentation, and interpretation of information about these events (Wang, 2019). Therefore, family history refers to past events, discoveries, collections, memories, organisation, presentations, and interpretations of a given family.

The study discovered certain aspects of African indigenous knowledge that different families were custodians of this knowledge due to a long history of associations with the practices in the society. However, many families lost this history because they have neglected their indigenous knowledge, and, as a result, it changed how people see the world (Robinson & Raven, 2019). The study discovered that most indigenous water sources are located near sacred sites. These sacred sites are under the authority of certain families, which means that those families are the custodians of certain knowledge. The study discovered that the current generation seems not to care much about their family history and attachments to sacred sites. As a result, the necessary rituals and protocols related to water conservation and management are not observed. Therefore, African indigenous knowledge of water conservation and management disappears. One participant mentioned the following.

Participant B:

> "Sacred sites are spiritual places; however, the current generations only see them as just physical places that have nothing to do with water. Indigenous water sources are becoming exploited. African indigenous knowledge of water conservation and management disappear because relevant rituals and practices are not considered by the current generation that has lost family history".

The study discovered that there were also clans known to be the custodians of specific indigenous water sources. These clans have a long history of residing close to an indigenous source, particularly a spring. Participants mentioned that springs are

usually given clan names. Therefore, it becomes the responsibility of the people in that clan to look after the spring. The study also discovered that some springs were given to certain elders to be responsible for them in some other cases. The responsibility was then passed to the next generation.

The participants mentioned that water was used reasonably when clans and individuals had a responsibility to oversee the well-being of a spring. One participant notthat all the activities that took place would be reported to the chief or the king as he is the ultimate decision-maker and overseer of the whole community.

4.3.6.7 Concluding remarks

This part of the study presents that African indigenous knowledge of water conservation and management is at risk of disappearing. This knowledge was stored in elders' memories and transmitted orally from one generation to the next. There have been different factors that affected its nature, storage and use. As indicated above, the factors contributing to the disappearance of African indigenous knowledge of water conservation and management have also led to ineffective methods. Therefore, it can be concluded that there is a need to systematise documentation and acknowledge the potential of African indigenous knowledge methods of water conservation and management.

4.3.7 Possibilities of integrating African indigenous knowledge and western knowledge in water conservation and management

The study discovered that there been debates and several literature on the significance of integrating indigenous knowledge and western knowledge. The researcher deemed it fit to explore the possibilities of integrating African indigenous knowledge and western knowledge in water conservation and management. Unfortunately, the researcher could not reach the government officials of water conservation and management, and further efforts should be made to interview them. As a result, the views captured were those of the participants from the indigenous community and a few scholars.

The researcher learned that African indigenous knowledge is not commonly recognised, although it plays an intrinsic role in water conservation and management. The study found that indigenous knowledge is beset in various ways such as ostracism, corruption and rejection of ways of doing things because it is stored in the memories of its custodians. Participants mentioned that the rejection of indigenous knowledge is perpetuated by the encouragement of the dominance of western culture. This has also been clearly articulated by participants to be the case, even in water conservation and management. The following is what one participant said.

Participant A

> "African indigenous knowledge, in general, has been ignored in the past, and the modern society continues to do so. Some people only use African indigenous knowledge when it favours them or for monetary gain in the expenses of the knowledge holders. The ignorance towards African indigenous knowledge contributes to its exclusion from water conservation and management activities by both African indigenous communities and water conservation officials in the government. Currently, African indigenous knowledge methods of water conservation require more attention for their potential to sustain communities and the environment.

The study discovered that while giving the necessary attention to African indigenous knowledge of water conservation and management, it is also important to recognise western science relating to water conservation and management. This means that there is a need for a holistic approach to water conservation and control which can be achieved through integrating African indigenous knowledge and western science of water conservation and management. As such, the researcher learnt from the participants that this would serve as a way to close the gap between African indigenous knowledge and western science in terms of water conservation and management while ensuring that African indigenous knowledge does not disappear but takes a stand in comprehensive engagements on water conservation and management.

The integration of African indigenous knowledge and western science is believed by scholars to be an excellent approach to water resources management (Kirk 2012). The study discovered that some participants share the view that integrating African indigenous knowledge and western knowledge in water conservation and management may have great potential for establishing sustainable solutions to water challenges. This can be achieved by acknowledging both knowledge systems for their intrinsic and diverse roles in water conservation and management.

The researcher learnt from the participants that African indigenous knowledge has been compared with western science. On the other hand, Chandra (2014) opines that it is essential not to forget the competition between indigenous knowledge and western science. We must find a remedy to close the gap that keeps African indigenous knowledge and western science at odds. This motivated the researcher to determine how the integration of African indigenous knowledge and western science of water conservation and management should be done. The following is what one participant said.

Participant G:

> Integrating African indigenous knowledge and western knowledge in water conservation should be based on solving water-related problems and not a competition between knowledge systems. African indigenous knowledge and western science must be integrated so that they improve the activities of water conservation and management. These two knowledge systems must complement each other in the conservation and management of water. It is also important that the integration of African indigenous knowledge and western knowledge in water conservation rebuild a strong relationship between human beings and environmental systems, which will benefit water conservation and management activities.

Although some participants believe that integrating the two knowledge systems could be beneficial for water conservation and management, some believe it would not

benefit indigenous knowledge but rather corrupt it. For example, one participant stated the following:

Participant H:

> "There is no need to integrate African indigenous knowledge and western science of water conservation and management; they can be used in their different rights. Western science has not been successful in many things in rural areas. Thus, it may not be important to integrate. Integration of these knowledge systems on water conservation and management will result in African indigenous knowledge being corrupted by western science since it is the one that has been recognised as valid. This means that different elements and the true essence of African indigenous knowledge will be dominated, resulting in African indigenous knowledge not recognised."

Other challenges of integrating African indigenous knowledge and western science of water conservation and management are based on how scientists generally perceive indigenous knowledge. According to McGregor (2004), indigenous knowledge is embedded in the cultural beliefs and stories of creation. As such, indigenous knowledge tallies poorly with western science-based explanations that are developed through validated institutions of practice. As a result, scientists consider indigenous knowledge to be not systematic because it lacks cognitive justification, and because of that, it is not applied in the global context. McGregor (2004) adds that dialogues about the potential of indigenous knowledge are usually held in English, which leads to translation complications that result in loss of meaning and poor articulation or understanding of concepts.

4.3.7.1 Concluding remarks

The study explored the possibilities of integrating African indigenous knowledge and western knowledge in water conservation and management. It can be deduced from the above discussion that the two knowledge systems can work together to make water conservation and management effective. However, all the participants do not

share this idea, as others claim that the true essence of African indigenous knowledge will be removed in the process.

4.4 CHAPTER CONCLUSION

This chapter presented and analysed the findings on African indigenous knowledge methods of water conservation and management. African indigenous knowledge has been at the centre of the activities of water conservation and management. It can be deduced that African indigenous people respected and lived in peace with their natural resources. Although this is the case, there are challenges faced by African indigenous knowledge and its potential in water conservation and management. It can be concluded that interventions are needed to ensure that African indigenous knowledge and western science support each other to ensure that water conservation and management succeed.

CHAPTER FIVE

FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

The previous chapters outlined different matters that contributed to providing answers to the research questions while ensuring that the study's objectives are met. This study presents African indigenous knowledge methods of water conservation and management. Furthermore, this chapter presents a final reflection on the research. It summarises key findings of the study by revisiting African indigenous knowledge methods and their rationale in water conservation and management. This chapter also provides the conclusion and recommendations based on the research study's findings on African indigenous knowledge methods of water conservation and management in the *Tshidzivhe* village in the Vhembe district.

5.2 FINDINGS

As hinted in the introductory part, study's findings on African indigenous knowledge methods of water conservation and management emanate from the following questions that were pursued.

1. What are the African indigenous knowledge teachings and stories of water conservation and management?
2. Are the African indigenous knowledge methods of water conservation and management effective?
3. What are the factors leading to the disappearance of indigenous knowledge of water conservation and management?
4. What are the possible palliatives to ensure that indigenous methods of water conservation and management operate on an equal footing with the Eurocentric methods?

The findings from these questions are given below:

5.2.1 African indigenous knowledge teachings, stories and methods of water conservation and management

The researcher discovered that African indigenous teachings and water conservation and management stories have always had a strong relationship. The causal link was

as follows – a method would have a teaching, and teaching would be acquired from applying water conservation and management methods. African indigenous teachings and water conservation methods were understood in two ways – the spiritual and physical aspect of water conservation and management. The spiritual of water conservation has always been explained mainly through the existence of *zwifho* (sacred sites), while the physical aspect was not entirely influenced by spirituality. However, some methods and teachings of water conservation and management are common, even when association with *zwifho* does not exist or in places where there are no *zwifho* at all.

Zwifho areas have been reported to have served African indigenous communities in different ways to teach about water conservation and management through taboos for many years and continue to do so. Taboos are traditions of a society that prohibit people from certain practices or activities or outlaw relationships with a person, place or thing. Generally, African indigenous teachings of water conservation and management used by the *Vhavenda* people were in the form of taboos. In water conservation and management, taboos were used to teach all community members about how one should behave and respond to the indigenous water sources. These taboos usually prohibit the cutting of trees and the killing of aquatic animals. Some of the taboos that participants during data collection highlighted restrict members of the community from bathing in the spring, killing aquatic animals and water snakes, and domestic use of wetlands water. Although participants did not give an example of stories they told, the researcher learnt that a narration of history on how indigenous people lived together with water sources for years is an integral part of their cultural heritage associated with water conservation and management.

A method of teaching water conservation and management that indigenous people used was allocating their daily activities according to time. Women and children used to fetch water from the rivers and springs in the morning for domestic use. Thus, a common saying that *'Mu ka madi ua fhinduwa ano salela u ka madzikwa'* (One who fetches water must wake up early; those who stay behind fetch unclean water). Midday and the rest of the day were given to the livestock until when the sun sets when women and children will fetch water for the last time. Night hours and early mornings before

sunrise were set aside for wild animals. This demonstrates a systematic way that ensured that all users of water could access it without competition. This was considered an important approach to water conservation and management that regulated access to water for various reasons, including pollution reduction and that fetching water from indigenous African sources was informed by the daily activities that people engage in. As such, people would usually fetch water to be used instantly. This method also allowed livestock and animals to have peaceful access to water

The findings of this study presented oral tradition, particularly African indigenous games and storytelling, as important methods of water conservation that played an intrinsic role in educating community members, especially children. African indigenous games enabled African indigenous people to develop psychological stability and practical skills about water conservation and management, as informed by the situations in their communities. *Mahundawane* is an indigenous game played by children, reflecting the real-life situations where children imitate the daily activities of households in their communities. During this game, water conservation and management are demonstrated by children as they imitate what they observed from the elders in the community concerning water conservation and management.

On the other hand, storytelling explained the worldview of African indigenous people in all aspects of life, including water conservation and management. As indicated above, participants did not present any specific story related to water conservation and management; however, during data collection, the researcher learnt that a narration of history on how indigenous people lived together with water sources for years is an important part of their cultural heritage associated with water conservation and management. Storytelling was an important method of conserving and managing water. It allowed children and other African indigenous communities to learn African indigenous perspective, principles, beliefs, and practices of water conservation and management that allowed them to share a common worldview with them the rest of the communities they inhabited. Water conservation and management were taught in the form of storytelling to make sense of things and shape community members' behaviours towards the water.

Other forms of teaching water conservation and management in the African indigenous communities was through observations, imitation and apprenticeship. The study discovered that observation and imitation are common ways children learn to conserve and manage water within African indigenous communities. Observation is understood as a way of acquiring information through watching activities and participating in such activities. In African indigenous communities, children observe elders when conserving and managing water. After observation, children exercise their knowledge through imitation. Imitation is the activity of replicating the behaviour or actions they have observed. In this way, children in the African indigenous communities learnt to conserve and manage water.

The findings of the study indicated that apprenticeship is an important aspect of teaching water conservation and management. Apprenticeship is a process in which the new generation of practitioners is trained to acquire a particular skill. It is on-the-job training that affords the certain trainee competence. In this case, the new generation of practitioners and trainees consists of young people within African indigenous communities expected to be custodians of water sources and conservation and management activities.

This method of teaching water conservation and management is usually practiced in families and clans that are custodians of water. A clan becomes custodians of water knowledge because of their association with the water sources or how they are known to conserve and manage water. These clans are often given the responsibility to look after the wellbeing of indigenous water sources. Parents teach or train their children in water conservation and management as it is their responsibility to do so. This means that when elders die, the new generation retains the custodianship of water sources and its conservation and management as a family responsibility to the community.

5.2.2 The efficacy of African indigenous knowledge methods of water conservation and management

Tstudy's findings indicated that African indigenous communities were leaders in the production of knowledge and well-grounded strategies that enabled intelligent water conservation and management. The environment is a primary source of livelihoods,

hence the need to conserve the water bodies and related aspects. African indigenous knowledge of water conservation and management has been developed over a long period through active interactions between and interdependence with the natural environment and passed down orally from one generation to another.

The study found that African indigenous knowledge methods of water conservation and management were effective. This is because these methods were used to convey messages related to water conservation only and communicate all aspects of life in an African indigenous society. The findings of the study indicated that taboos were instrumental in guiding and restricting behaviours that would cause harm to water sources, such as pollution, cutting trees and killing aquatic animals

The systematic way of accessing water sources at different times effectively allowed human beings, livestock, and wild animals to have their fair share of the water provided by their environment. As indicated in the previous chapter, this allowed for reducing pollution and competition of water that would possibly result in death and injuries among human beings and animals.

Oral tradition, particularly African indigenous games and storytelling, was efficient as water conservation methods that played an intrinsic role in educating community members, especially children. Through oral tradition, the worldview of African indigenous people in all aspects of life, including water conservation and management, was explained. This was an important method of conserving and managing water. It allowed children and other African indigenous communities to learn African indigenous perspective, principles, beliefs and practices of water conservation and management that allowed them to share a common worldview with the rest of the communities they inhabited.

The study's findings also indicated that the efficacy of African indigenous knowledge methods of water conservation and management is not evident in modern society. This is because African people have abandoned their ways of living, and their understanding of indigenous knowledge of water conservation and management is compromised. As such, African indigenous teaching methods of water conservation is

not applied. The findings indicated a need to revisit oral tradition as it can still be applicable in modern society to teach children and serve as a point of reference for activities associated with African indigenous teachings and methods of water conservation and management.

5.2.3 Factors leading to the disappearance of African indigenous knowledge of water conservation and management

The diverse responses presented by participants indicated that African indigenous knowledge of water conservation and management is disappearing. The study discovered that different factors and outside the indigenous communities' setup contribute to the disappearance of this knowledge. Although African indigenous knowledge of water conservation and management still exists, participants mentioned that little attention is given to modern society.

The study discovered that many aspects of African indigenous knowledge not been systematically documented as stored in the elders'stored in the elders' memories. This is one factor leads to the disappearance of African indigenous knowledge of water conservation and management as it lacks systematic documentation relevant to the current and future generations. Other factors leading to the disappearance of African indigenous knowledge of water conservation and management include colonisation, the dominance of Christianity in African culture, neglecting African indigenous education and loss of family history.

The study's results show that colonisation contributed to the loss of African indigenous knowledge of water conservation and management. This is because, during colonisation, African indigenous people's cultural norms and values were marginalised and not condoned. These values had an intrinsic role in understanding the African indigenous philosophies associated with water conservation and management. The norms, values, knowledge and practices that were deemed necessary were Western-based. The African indigenous knowledge was labelled as embryonic and non-scientific, resulting in it disappearing.

Participants also indicated that the dominance of the Christian religion and the forced conversion to Christianity led to the disappearance of African indigenous knowledge of water conservation and management. The findings indicated that spiritual aspects of water conservation and management are phased out as community members become Christians. This is because Christian values do not condone African practices, particularly those associated with spirituality.

The study's findings also indicated that families had lost their traditions and history that are important for water conservation and management. There are families within African indigenous communities that were custodians of African indigenous knowledge of water conservation and management due to a long history of residing near water sources and associations with water conservation and management practiceswater conservation and management practices in society. Now many have neglected their indigenous knowledge and, as a result, changed how people perceive the world, particularly the younger generation. African indigenous people do not consider African indigenous knowledge of water conservation and management, thereby exacerbating the nature of its disappearance.

5.2.4 Possible palliatives to ensure that indigenous methods of water conservation and management operate at an equal footing with the Eurocentric methods

The responses given by participants indicated the different perspectives that were given regarding the integration of African indigenous knowledge and western knowledge of water conservation and management. Some participants indicated that integrating these two knowledge systems on water conservation and management will improve water conservation and management activities and help build and rebuild the relationship between people and their natural environment. Other participants shared that the integration of African indigenous knowledge and western science of indigenous knowledge will not work well because African indigenous knowledge will be corrupted and its true essence will be dominated, resulting in African indigenous knowledge being undervalued and not recognised.

The study found a need to close the gap that keeps African indigenous knowledge and western science apart. Participants indicated this when they realised that there are conflicting views among them about how African indigenous methods of water conservation and management can operate at an equal footing with the Eurocentric methods. The need to give attention to both African indigenous knowledge and western science became an important matter of discussion between participants and the researcher. The study found that a solution to the conflicting views should integrate African indigenous knowledge and western science for water conservation and management. This approached was believed by some participants to have the potential to close the gap between African indigenous knowledge and western science in terms of water conservation and management while ensuring that African indigenous knowledge does not disappear but takes a stand in comprehensive engagements on water conservation and management. Integrating African indigenous knowledge and western knowledge in water conservation would then rebuild a strong relationship between human beings and the environmental systems, which will benefit activities associated with water conservation and management.

5.3 CONCLUSION

The problem of the study outlined that water is scarce in South Africa, which has become a serious challenge as most reservoirs that were thought to be sufficient are running low and dry. This is exacerbated by the fact that only one form of knowledge (WSK) is being used to conserve and manage water. In this way, the dominance of WSK in water conservation and management has threatened the acceptance and recognition of indigenous knowledge systems in water conservation and management. Key to this failure is the allegation that there is too much interference on the indigenous scene, undermining deeply entrenched traditional institutions that had been active players in conserving and managing water. Currently, little knowledge exists about the African indigenous knowledge methods of water conservation and management, which has been hailed for water security and sustainability. These stringent bottom-up governmental management strategies are falling short in enhancing sustainable conservation and management of water.

The above problem informed the aim of the study, which was to explore the African indigenous knowledge methods of water conservation and management in the Limpopo province of South Africa. This study noted that through the years of active interaction and interdependence with the natural environment, African indigenous knowledge was successful in developing strategies for water conservation and management. This knowledge was passed down from one generation to the next; however, there is now a need to document it systematically. The study unveiled that African indigenous knowledge methods of water conservation and management have been neglected in most areas. In some areas, these methods are still effective, particularly in rural areas. In areas where African indigenous knowledge methods are not neglected, water conservation and management are not a concern; on the other hand, people now prefer western science. Because of this, some African indigenous knowledge methods of water conservation and management are disappearing.

5.4 RECOMMENDATIONS

The study suggests the following recommendations:

5.4.1 Awareness campaigns and educational programmes on the role of African indigenous knowledge in water conservation and management

During the study little exists about the importance of African indigenous knowledge methods of water conservation. There is a need for relevant agencies or organisations such as *Dzomo la mupo* and the Vhembe Biosphere Reserve to have awareness campaigns and educational programmes about the role of African indigenous knowledge in water conservation and management. This will influence rural communities, policymakers and water agencies to consider African indigenous knowledge methods of water conservation and management.

5.4.2 Systematic documentation of African indigenous knowledge of water conservation and management through the education curriculum

The study unearthed that African indigenous knowledge methods of water conservation and management were not systematically documented as they were stored in the elders' memories. Therefore, there is a need for this knowledge to be documented systematically in a way that favours modern society through websites,

databases, libraries, data files, archives and social media. The study recommends that African indigenous knowledge should be adequately instituted through inclusion in the education curriculum.

5.4.3 Future research on African indigenous knowledge of water conservation and management in advancing rural livelihoods

The study revealed that African indigenous knowledge had been an essential instrument for rural communities in conserving and managing water. However, there are other areas or gaps that the study identified, and it would be key for these gaps to be pursued by future researchers. As such, this study recommends that future studies be conducted on how African indigenous knowledge of water conservation can contribute to the advancement of rural livelihoods.

5.4.4 Integration of African indigenous knowledge and western science of water conservation and management

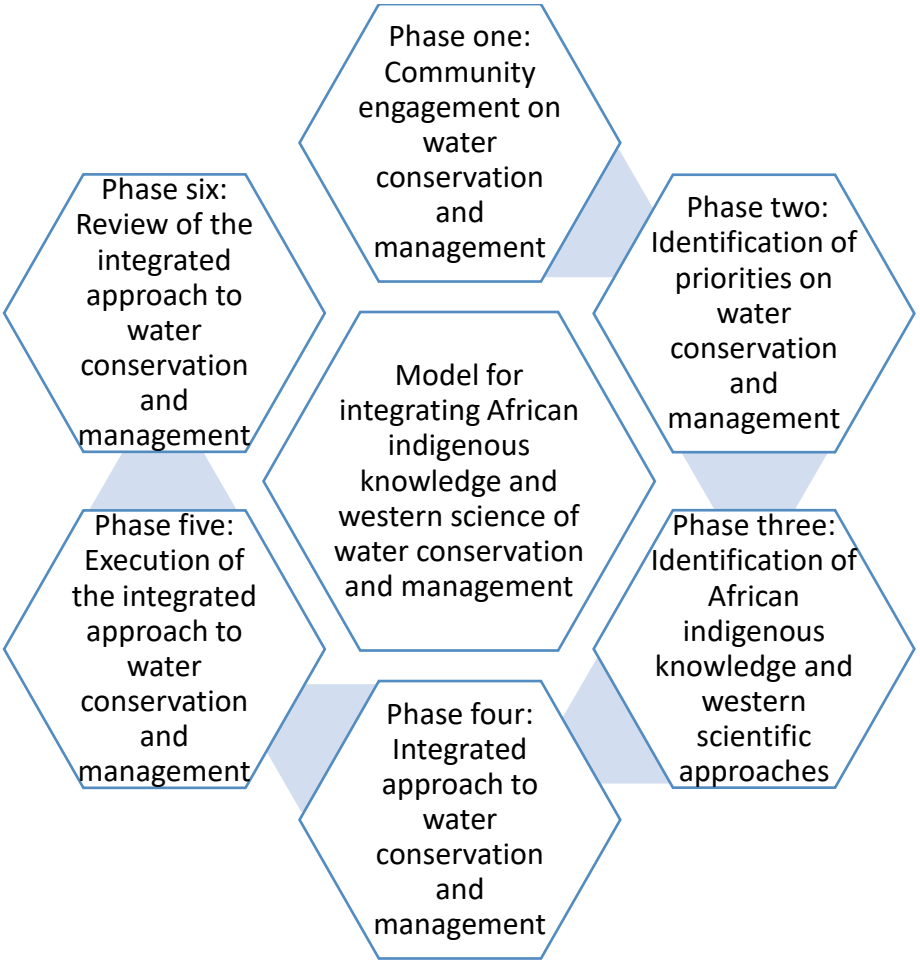
The study noted a need for African indigenous knowledge and western science to work together in the conservation and management of water. Therefore, the Department of Environment, Forestry and Fisheries, the Department of Water and Sanitation, and indigenous communities' government with its relevant stakeholders such as Vhembe Biosphere Reserve should work together in an attempts to find ways in which these knowledge systems can work together for water to be appropriately conserved and managed. The study noted that African indigenous knowledge was sidelined in various activities, including water conservation and management. Therefore, this study also recommends that a representation of African indigenous people should be prioritised. During this integration, African indigenous culture and traditional and spiritual aspects of water conservation should also be considered (Gumbo & Van der Zaag, 2001). This integration should be in different ways through policy and education.

Part of this analysis to bring about the integration of African indigenous knowledge and western science of water conservation and management is to ensure that relevant stakeholders are all part of the process. The study also proposes that there should be a committee or structure to facilitate the integration process. The committee should include traditional leaders, community liaison officers (from African indigenous

communities or rural areas), local higher education institutions, the Department of Environment, Forestry and Fisheries, the Department of Water and Sanitation, agricultural extension officers and rural development officers. The following is a proposed model for integrating African indigenous knowledge and western science of water conservation and management.

5.4.4.1 Model for integrating African indigenous knowledge and western science of water conservation and management

As learnt from Mercer et al. (2010), this proposed model is how African indigenous knowledge and WSK of water conservation can be integrated. The model looks at the different knowledge systems to find a way in which they can work together to achieve success in activities of water conservation and management. The following diagram presents the proposed model of the different phases, which are then explained below.



Model Citation: Developed by the researcher based on the information obtained from the field and literature.

(a) Phase one: community engagement on water conservation and management

Community engagement is an association and participation in an organisation for the prosperity of the community. It is a process that involves the facilitation of communication, involvement, and the sharing and exchange of knowledge or resources to achieve the desired outcomes for any given organisation (Johnston, 2018). Concerning water conservation and management, the community engagement process will be the first phase towards understanding the needs, perceptions and anticipations of indigenous or rural communities. This can be achieved through dialogues with the indigenous people in their areas to understand better the context of their environment and build sustainable relationships between indigenous communities and stakeholders on water conservation and management. This will help understand the prospects and challenges of integrating African indigenous knowledge and western science of water conservation and management (Mercer et al., 2010). The community engagement will be facilitated by the community liaison officers, intermediaries between the different stakeholders.

(b) Phase two: Identification of priorities on water conservation and management

When rapport has been built during community engagement, knowledge has been shared, and there is clarity about the challenges and prospects. It will be important to identify areas that should be prioritised for integrating African indigenous knowledge and western science of water conservation and management. This is where a review and a re-visitation of the main problem are rigorously undertaken to identify factors involved in exacerbating the challenge of water conservation and management. This will help set priorities on the activities that should be given more attention depending on the nature of the problem (Mercer et al., 2010). The Department of Water and Sanitation will facilitate this aspect, with the assistance of the Department of Environment, Forestry and Fisheries and traditional leaders who will be representing their communities, rural development officials, agricultural extension officers and institutions of higher learning. This will help provide a comprehensive overview of what must be prioritised for water conservation and management.

(c) Phase three: identification of African indigenous knowledge and western scientific approaches

This phase is about identifying African indigenous knowledge and western scientific approaches used previously to conserve and manage water and are used currently. It is an important phase that helps identify and understand the successes and failures of African indigenous knowledge and WSK to find an appropriate solution. This helps to locate areas where one knowledge system was successful and where not, or where there is a need for improvement to complement each other. When the African indigenous knowledge and western science of water conservation and management approaches are identified, it will help develop more relevant, applicable, and beneficial (Mercer et al., 2010). The Department of Water and Sanitation will be expected to facilitate the identification of modern approaches to water conservation. At the same time, agricultural extension officers share their experiences with farmers in terms of their ways of conserving and managing water. In addition, much of African indigenous knowledge identification will be facilitated by traditional leaders as they are the custodians of knowledge and practices within their communities.

(d) Phase four: an integrated approach to water conservation and management

An integrated approach is based on identifying the African indigenous knowledge and western scientific approaches to water conservation and management. This process involves analysing data obtained in phases two and three to solve the challenges facing water conservation and management. The stakeholders review this approach to see if it addresses the identified challenges and aligns with the priorities. The newly developed knowledge from African indigenous knowledge and western science is then ready to be used (Mercer et al., 2010). This integrated approach will be based on what the stakeholders conclude and deem suitable for water conservation and management.

(e) Phase five: execution of the integrated approach to water conservation and management

This is the most important phase that involves the application of the integrated approach to water conservation and management. It includes the activities involved in

water conservation and management as per the details of an integrated approach. This is where African indigenous knowledge and western science are used in one context to conserve and manage water. Community liaison officers and rural development officials should be expected to facilitate the integrated approach to water conservation and management.

(f) Phase six: Review of the integrated approach to water conservation and management

When the integrated approach to water conservation and management has been executed, it is important to review the whole process to see what worked and what did not. This phase involves analysing the challenges that were encountered and the faults that an integrated approach had. After the review, an integrated approach to water conservation and management is more likely to improve and be more beneficial. All stakeholders will be expected to be part of this stage, giving feedback on the integrated approach to water conservation and management.

REFERENCES

Abdekhoda, M., Dehnad, A. & Khezri, H (2019). The effect of confidentiality and privacy concerns on adoption of personal health record from patient's perspective. Health Technol. 9, 463–469. https://doi.org/10.1007/s12553-018-00287

Aboyade, W.A. & Adeyemo, O.O. (2019). The role of the library in the acquisition, preservation, and dissemination of indigenous knowledge and cultural heritage in Nigeria. *American Research Journal of Humanities & Social Science*, 02(08): 39-44.

Adamus, P. (2016). *Manual for the Wetland Ecosystem Services Protocol (WEST).* Oregon State University.

Adjei, P.O., Busia, A.K. & Bob-Milliar, G. (2017). Democratic decentralization and disempowerment of traditional authorities under Ghana's local governance and development system: a spatio-temporal review. *Journal of Political Power*, 10(3): 303-325.

Adom, D., Kquofi, S. & Asante, E.A. (2016). The high impacts of Asante indigenous knowledge in biodiversity conservation issues in Ghana: the case of the Abono and Essumeja townships in Ashanti region. Department of General Art Studies, Kwame Nkrumah University of Science of Technology, Ghana. *British Journal of Environmental Sciences,* 4(3): 63-78.

Adrianna Danuta Surmiak (2018). Confidentiality in Qualitative Research Involving Vulnerable Participants: Researchers' Perspectives. Research Ethics in Qualitative Research. Vol. 19 No. 3.

Adu-Gyamfi, Y. (2011). Indigenous beliefs and practices in ecosystem conservation: response of the church. *Scriptura* 107: 145-155.

African Partnerships for Sustainable Growth. (2017). Advancing the Afrikan lions'

Ajayi, O.C. & Mafongoya, P.L. (2017). *Indigenous knowledge systems and climate change management in Africa*. CTA, Wageningen: The Netherlands.

Alexandre, K. (2014). *The notion of authority: a brief presentation*. Verso.

Ali, I., Alharbi, O.M.L., Tkachev, A. Galunin, E., Burakov, A. & Grachev, V.A. (2018). Water treatment by new-generation graphene materials: hope for bright future. *Environmental Science and Pollution Research*, 25: 7315-7329.

American Water Works. (2003). *Water sources*. American Water Works Association.

Amonum, J.I., Ikyaagba, E.T. & Maa, F.S. (2017). The role of customs and taboos in the conservation of Agogo Pond in Chito Stream in Ukum Local Government Area of Benue state. School of Agriculture and Agricultural Technology, The Federal University of Technology, Akure, Nigeria. *Applied Tropical Agriculture,* 22(2): 166-172.

Annekie Joubert (2011). Rain songs and the observance of the rain cult amongst the Lobedu people of Queen Modjadji. *South African Journal of African Languages*, 31(1).

Asiedu, J. (2020). Reviewing the argument on floods in urban areas: a look at the causes. *Theoretical and Empirical Research in Urban Management*, 15(1): 24-41.

Asogwa, L.S., Okoye, J.J. & Oni, K. (2017). Promotion of indigenous food preservation and processing knowledge and the challenge of food security in Africa. Journal of Food Security, Vol. 5, No. 3, 75-87

Attari, Shahzeen Z. (2014). Perceptions of water use. *Proceedings of the National Academy of Sciences*, 111(14): 5129-34.

Babbie E & Mouton J (2010). The practice of social research. Oxford University Press Southern Africa (Pty) Ltd: Cape Town

Babbie, Earl (2010). The practice of social research (12th ed.). Belmont, Calif: Wadsworth Cengage. ISBN 978-0495598411.

Baldwin, C., Bradford, L., Carr, M.K., Lorne, D., Jardine, T. & Jones, P., Bharadwaj, L. & Lindenschmidt, K. (2018). Ecological patterns of fish distribution in the Slave River Delta region, Northwest Territories, Canada, as relayed by traditional knowledge and Western science. *International Journal of Water Resources Development*, 34(2): 1-20.

Baofu, P. (2014). *Beyond natural resources to post-human resources: towards a new theory of diversity and discontinuity*. Cambridge Scholars Publishing, 309.

Barbara, M. & Andrew, F. (2015). Ethics: theory and contemporary issues, Concise Edition. Cengage Learning.

Barrett D, Twycross A (2018). Data collection in qualitative research. Evidence-Based Nursing;21:63-64

Beal, C.D., Gurung, T.R. & Stewart, R.A. (2016). Modelling the impacts of water efficient technologies on energy-intensive water systems in remote and isolated communities. *Clean Technologies and Environmental Policy*, 16: 1713-1723.

Behailu, B.M., Pietilä, P.E., & Katko, T.S. (2016). Indigenous practices of water management for sustainable services: case of Borana and Konso, Ethiopia. *Sage Journal*. Special Issue – Traditional Wisdom.

Behnke, N.L., Klug, T., Cronk, R., Shields, K.E., Lee, K., Kelly, E.R., Allgood, G. & Bartram, J. (2017). Resource mobilization for community-managed rural water systems: evidence from Ghana, Kenya, and Zambia: *Journal of Cleaner Production*, 156: 437-444.

Belachew, B. & Mezgebe, A.H. (2019). Evaluating indigenous structural technologies of Konso people, Ethiopia. *International Research Journal of Engineering and Technology*, 06(02).

Berazneva, J. Byker, T.S. (2017). Does forest loss increase human disease? Evidence from Nigeria. *American Economic Review*, 107(5): 516-521.

Besada, H. & Werner, K. (2015). An assessment of the effects of Africa's water crisis on food security and management. *International Journal of Water Resources Development*, 31(1): 120-133.

Biratu, K. & Kosa, O. (2020). The roles, challenges and opportunities of Gadaa System in resolving water conflict: the case of Borana Oromo. *Open Journal of Social Sciences*, 8: 19-31.

Blignaut, J. & Van Heerden, J. (2009). The impact of water scarcity on economic development initiatives.Water SA, 35(4):415 – 420.

Boamah, A.D. (2015). *Akan indigenous religio-cultural beliefs and environmental preservation: the role of taboos*. Canada: Queens University.

Branson, N. (2016). *Land, law and traditional leadership in South Africa*. Africa Research Institute.

Brown, P.T., Wenhong, Li., Cordero, E.C. & Mauget, S.A. (2015). Comparing the model-simulated global warming signal to observations using empirical estimates of unforced noise. *Scientific Reports*, 5: 9957. Bibcode:2015NatSR...5E9957B.

Brugger, J., Feulner, G. & Stefan, P. (2017). Severe environmental effects of Chicxulub impact imply key role in end-Cretaceous mass extinction. 19th EGU General Assembly, EGU2017, proceedings from the conference held 23-28 April, 2017 in Vienna, Austria, p. 17167.

Brundtland, G.H. (1987) Our Common Future: Report of the World Commission on Environment and Development. Geneva, UN-Dokument A/42/427.

Bryant, L.E. (2016). Nuclear Families. *The Wiley Blackwell Encyclopedia of Family Studies*, pp 1-3.

Buono, J., Sharma, S., Kumar, A., Mahamuni, K., Bisht, B., Adiraju, S., Shabong, L. & Kasturirangan, A. (2018). Spring protection and management: some case histories from across India's mountainous regions. *Ground Water Development-Issues and Sustainable Solutions*, 329-337.

Buthelezi, M. & Yeni, S. (2016). *Traditional leadership in democratic South Africa: pitfalls and prospects*. Nelson Mandela Foundation.

Butler, D., Ward, S., Sweetapple, C., Astaraie-Imani, M., Kegong, D., Farmani, R. & Fu, G. (2016). Reliable, resilient and sustainable water management: the safe & sure approach. *Global Challenges,* 1(1): 63-77.

Canvas, C. (2014). Public awareness and safeguarding traditional knowledge: challenges and conflicts in preserving and representing Karitz/Kanerjing in Xinjiangf, PR China. *Water Science and Technology: Water Supply*, 14: 758-765.

Care Search. (2015 update). Ethics Approval.

Carrera, L., Warren, A., Van Beek, E., Jonoski, A. & Giardino, A. (2017). Collaborative modelling or participatory modelling? A framework for water resources management. *Environmental Modelling & Software*, 91: 95-110.

Chanson, H., Brown, R. & McIntosh, D. (2014). Human body stability in floodwaters: the 2011 flood in Brisbane CBD. In L. Toombes, *Hydraulic structures and society – Engineering challenges and extremes*. Brisbane, Australia. Proceedings of the 5th IAHR International Symposium on Hydraulic Structures (ISHS2014), pp. 1-9.

Chekanov, S. (2016). *Numeric computation and statistical data analysis on the Java Platform*. Springer.

Chen, J., Shi, H., Sivakumar, B. & Peart, M.R. (2016). Population, water, food, energy, and dams. *Renewable and Sustainable Energy Reviews*, 56: 18-28.

Chen, X., Yang, S., Yang, L. & Chen, X. (2015). *A benchmarking model for household water consumption based on adaptive logic networks. Procedia Engineering. 13th Computer Control for Water Industry Conference, (CCWI2015)*. Sharing the best practice in water management.

Cheserek, G. (2005). *Indigenous knowledge in water and watershed management: 'Marakwet' conservation strategies and techniques*. School of Environmental Studies, Moi University.

Chief, K., Meadow, A. & Whyte, K. (2016). Engaging Southwestern tribes in sustainable water resources topics and management. *Water*, 8(8): 350.

Chigbu, U.E. (2015). Repositioning culture for development: women and development in a Nigerian rural community. *Community, Work & Family*, 18(3): 334-350.

Chikozho, C., Danga, L. & Saruchera, D. (2017). Articulating the history and major departure points evident in post-apartheid South African national water policy and law. *Physics and Chemistry of the Earth*, Parts A/B/C. 100: 270-277.

Chilisa, B., Major, T. & Khudu-Petersen, L. (2017). Community engagement with an African-based relational paradigm. *Qualitative Research*, 17(3): 326-33.

Cleaver, F. (2012). *Development through bricolage: rethinking institutions for natural resource management*. London, England: Routledge.

Cole, M.J., Bailey, R.M., Cullis, J.D.S. & Mark, G. (2018). Spatial inequality in water access and water use in South Africa. *New Water Policy,* 20(1): 37-52.

Coombes, B., Johnson, J.T. & Howitt, R. (2014) Indigenous geographies III: methodological innovation and the unsettling of participatory research. *Progress in Human Geography*, 38(6): 845-854

Creswell, J.W. (2012). *Educational research: planning, conducting and evaluating quantitative and qualitative research*. Upper Saddle River, NJ: Prentice-Hall

Cuthbert Casey Makondo & David S.G.Thomas (2018).Climate change adaptation: Linking indigenous knowledge with western science for effective adaptation. Environmental Science & Policy Volume 88, Pages 83-91.

Da Silva, D., Pereira, S.B. & Vieira E.O. (2020). Integrated water resources management in Brazil. In: Vieira, E., Sandoval-Solis, S., Pedrosa, V. & Ortiz-Partida J. (Eds), *Integrated water resource management*. Springer.

Daniel, B.K. (2018). Empirical verification of the "TACT" framework for teaching rigour in qualitative research methodology. *Qualitative Research Journal*, 8(3).

Defrance, D., Delesalle, E. & Gubert, F. (2020). Is migration drought-induced in Mali? An empirical analysis using panel data on Malian localities over the 1987-2009 period. *Working papers. DIAL Développement, Institutions et Mondialisation.*

Denver, S.L. (2015). *Native peoples of the world: an e-encyclopedia of groups, cultures and contemporary issues*. Routledge, pp. 24-25.

Department of Environmental Affairs (DEA). (2015). *The national climate change response monitoring and evaluation system framework*. Department of Environmental Affairs: Pretoria.

Desai, N. (2014). A study on the water pollution based on the environmental problem. *Indian Journal of Research*, 3(12): 95-96.

Diawuo, F. (2015). Exploring the African traditional belief systems in natural resource conservation and management in Ghana. *The Journal of Pan African Studies,* 8(9): 115-131.

Dieter, C.A., Maupin, M.A., Caldwell, R.R., Harris, M.A., Ivahnenko, T.I., Lovelace, J.K., Barber, N.L. & Linsey, K.S. (2018). *Estimated use of water in the United States in 2015*. Circular. U.S. Geological Survey.

Dika, G.G. (2016). The role of indigenous knowledge in rangeland management in Yabello Woreda, Southern Oromia, Ethiopia. *Arts Social Sciences Journal*, 7: 172.

Dlamini, P.N. (2017). *The use of information and communication technology tools in managing indigenous knowledge in the province of KwaZulu-Natal, South Africa*. Department of Information Studies at the University of Zululand, South Africa.

Donnenfeld, Z., Crookes, C. & Hedden S. (2018). *A delicate balance: Water scarcity in South Africa. Southern Africa Report*. Institute for Security Studies.

Doreen Chandra (2014). Re-examining the Importance of Indigenous Perspectives in the Western Environmental Education for Sustainability: "From Tribal to Mainstream Education" Journal of Teacher Education for Sustainability 16(1). DOI: 10.2478/jtes-2014-0007

Dorney, J., Savage, R., Adamus, P. & Tiner, R. (2018). *Wetland and stream rapid assessments: development, validation, and application*. Elsevier Douglus, I. (2018). The challenge of urban poverty for the use of green infrastructure on floodplains and wetlands to reduce flood impacts in intertropical Africa. *Landscape and Urban Planning,* 180: 262-272.

Drinan, J.E. & Spellman, F. (2015). *Water and wastewater treatment: a guide for the nonengineering professional.* 2nd ed. CRC Press, p. 140.

Du Plessis, A. (2017) Challenges and policy recommendations. In: *Freshwater challenges of South Africa and its Upper Vaal River*. Springer.

Dziegielewski, B. J.; Kiefer, C. (2010). "Water Conservation Measurement Metrics: Guidance Report" (PDF). American Water Works Association.

Eberbach, K., Kubera, A., Okoth, N.I. & Watanabe, A. (2017). *Contemporary, traditional leaders: a study on land and governance in South Africa.* School of International and Public Affairs: Columbia University.

Eggimann, S., Mutzner, L., Wani, O., Schneider, M.Y., Dorothee, S., Beutler, P. & Maurer, M. (2017). The potential of knowing more – a review of data-driven urban water management. *Environmental Science & Technology*, 51(5): 2538-2553.

Evan Tarver (2017). Time Allocation: The Delicate Art of Saying No vs Saying Yes. Business, Self Improvement.

Eychaner, J.H. (2015). *Lessons from a 500-year record of flood elevations*. Association of State Floodplain Managers, Technical Report 7.

Falkestrom, F., Hatcher, R., Skjulsvik, T., Larsson, M. & Holmqvist, R. (2014). Development and Validation of a 6 item Working Alliance Psychotherapy. *Psychological Assessment*, 27(1): 169-83.

Farah, P.D. & Tremolada, R. (2014). Intellectual property rights, human rights and intangible cultural heritage. *Journal of Intellectual Property Law*, 9(2).

FarmBiz Africa. (2017). *Heavy rains coming, chance for water harvesting. Dam liner full of water*, 20 September 2017.

Fatta-Kassinos, D., Dionysiou, D.D. & Kümmerer, K. (2016). *Wastewater reuse and current challenges*. Springer.

Ferrand, E. A. & Cecunjanin, F. (2014). Potential of rainwater harvesting in a thirsty world: a survey of ancient and traditional rainwater harvesting applications. *Geography Compass*, 8: 395-413.

Findlay, S.J. & Twine, W.C. (2018). *Chiefs in a democracy: a case study of the 'new' systems of regulating firewood harvesting in post-apartheid South Africa. School of Animal, Plant and Environmental Sciences*: University of the Witwatersrand.

Fondahl, G., Filippova, V. & Mack, L. (2015). Indigenous peoples in the new Arctic. In B. Evengard, O. Nymand Larsen & O. Paasche (Eds), *The New Arctic,* pp. 7-22. Springer.

Friesen, J., Sinobas, L.R., Foglia, L. & Ludwig, R. (2017). Environmental and socio-economic methodologies and solutions towards integrated water resources management. *Science of the Total Environment*, 581-582.

Fusch, P.I., Fusch, G.E. & Ness, L.R. (2017). How to conduct a mini-ethnographic case study: a guide for novice researchers. *The Qualitative Report,* 22(3): 923-941.

Galvan, J. L. (2015). *Writing literature reviews: a guide for students of the social and behavioural sciences.* 6th ed. Pyrczak Publishing.

Gara, K. (2006). *Konso water and Gods*. Perugia, Italy: Museo Tamburo Palante.

Gaye, C.B. & Tindimugaya, C. (2019). Review: challenges and opportunities for sustainable groundwater management in Africa. *Hydrogeology Journal*, 27: 1099-1110.

Geiser, C.H., Okun, M.A. & Grano, C. (2014). Who is motivated to volunteer? A latent profile analysis linking volunteer motivation to frequency of volunteering. *Psychological Test and Assessment Modelling,* 56: 3-24.

Gergen, K.J. (2015). *An invitation to social construction*. 3rd ed. SAGE Publications: London.

Getso, B.U., Mustapha, A., Abubakar, M.M. & Tijjani, A. (2018). Assessment of borehole water quality for domestic use in three selected wards in Wudil Local Government Area, Kano State. *Journal of Environmental Science Studies*, 1(1).

Gondo, R. & Kolawole, O.D. (2019). A review of customary and statutory water management institutions in Botswana and Zimbabwe. *Botswana Journal of African Studies,* 32(1).

Gondo, R. & Kolawole, O.D. (2019). Sustainable water resources management: issues and principles of water governance in the Okavango Delta, Botswana. *International Journal of Rural Management,* 15(2).

Gondo, R., Kolawole, O.D. & Mbaiwa, J.E. (2019). Dissonance in customary and statutory water management institutions: issues of cultural diversity in the management of water resources in the Okavango Delta, Botswana. Environment, Development and Sustainability 21: 1091-1109.

Gondo, R., Mogomotsi, P.K. & Mogomotsi, G.E.J. (2018). Integration of indigenous knowledge systems in natural resources management in Hurungwe District, Zimbabwe. *International Journal of African Renaissance Studies – Multi-, Inter- and Transdisciplinarity*, 13(1).

Goransson, G., Norman, J., Larson, M., Alen, C. & Lars-Rosen, L. (2015). A methodology for estimating risks associated with landslides of contaminated soil into rivers. *Science of the Total Environment*, 4(1): 472-481.

Gosling, S.N. & Arnel, N.W. (2016). A global assessment of the impact of climate change on water scarcity. *Climate Change*, 134(3): 371-385.

Government of the Republic of Zambia. (2010). *National Water Policy*. Government of the Republic of Zambia: Lusaka.

Grace Cheserek (2005). Indigenous Knowledge in Water and Watershed Management: 'Marakwet' Conservation Strategies and Techniques. School of Environmental Studies, Moi University

Grafton, R. Q. & Hussey, K. (eds) (2011) “Introduction,” in Water Resources Planning and Management. Cambridge: Cambridge University Press, pp. xx-xxii. doi: 10.1017/CBO9780511974304.003.

Graham, F. (2006). *The technology of Mesopotamia*. The Rosen Publishing Group, p. 27.

Guerrero, L.G., Andersen, P.A. & Afifi, W. (2017). Close encounters: communication in relationships. 5th ed. Thousand Oaks: Sage Publications, pp. 27-29.

Guest, Greg; MacQueen, Kathleen; Namey, Emily (2012). Applied thematic analysis. Thousand Oaks, California: SAGE Publications. p. 11.

Gunawan, J. (2015). Ensuring trustworthiness in qualitative research. *Belitung Nursing Journal*, 1: 10-11.

Gurung T.R., Stewart R.A., Beal, C.D. & Sharma A.K. (2015). Smart meter enabled water end-use demand data: platform for the enhanced infrastructure planning of contemporary urban water supply networks—*Journal of Cleaner Production.*

Hammer, Marilyn J (2017). Ethical Considerations for Data Collection Using Surveys. Vol. 44 Issue 2, p157-159. 3p. 1

Hammersley, M. (2013). *What is qualitative research*? London, Bloomsbury.

Hammersley, M. (2015). Sampling and thematic analysis: a response to Fugard and Potts. *International Journal of Social Research Methodology,* 18(6): 687-688.

Harris, N., Goldman, E.D., Weisse, M. & Barrett, A. (2018). *When a tree falls, is it deforestation*?. World Resources Institute.

Haumba, E.N. & Kaddu, S. (2018). Documenting and disseminating agricultural indigenous knowledge for sustainable food security in Uganda. *African Journals Online*, 12(1).

Heine, S.J. (2015). *Cultural psychology.* 3rd ed. New York: Norton & Company.

Heleta, S. (2016). Decolonisation of higher education: dismantling epistemic violence and Eurocentrism in South Africa. *Transformation in Higher Education,* 1(1).

Helland, J. (1980). *Social organisation and water control among the Borana of Southern Ethiopia. Kenya, Nairobi*. International livestock centre for Africa.

Hermoso, V., Abell, R., Linke, S. & Boon, P. (2016). The role of protected areas for freshwater biodiversity conservation: challenges and opportunities in a rapidly changing world. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 26(S1): 3-11.

Herrin, J.A. (2019). *What is a worldview*. Edinburg Theological Seminary.

Higgs, P. (2016). The African Renaissance and the decolonisation of the curriculum. In V. Msila & Gumbo, M. T. (2016) *Africanising the curriculum: Indigenous perspectives and theories,* pp. 1-16. Stellenbosch, South Africa: SUNMeDIA.

Hlalele, D.J. (2019). Indigenous knowledge systems and sustainable learning in rural South Africa. *Australian and International Journal of Rural Educatio*n, 29(1).

Hoffman, P.T. (2015). *Why did Europe conquer the world?* Princeton University Press, pp. 2-3.

Hrachowitz, M., Stockinger, M., Heye, B. & Andreas, L. (2019). Effects of deforestation on catchment travel time distributions and the role of water holding capacity in the root-zone. *Geophysical Research Abstracts*, 21:1.

Inonge, D., Milupi, M.S.M. & Chileshe, B. (2020). *Traditional ecological knowledge and sustainable practices among the Lozi-speaking people of Zambia*. The University of Zambia, School of Education.

Intergovernmental Panel on Climate Change (2007). Climate Change will Increase the Danger of War.

Issa, A.O., Owoeye, P.O. & Awoyemi, O.O. (2018). Attitudes and the practice of documentation of indigenous knowledge by the traditional health practitioners in Kwara State, Nigeria. *Library Philosophy and Practice (e-journal)*, 1678.

Jang, Eun-Young; Jimenez, Robert T (2011).A Sociocultural Perspective on Second Language Learner Strategies: Focus on the Impact of Social Context. Theory into Practice, v50 n2 p141-148.

Johnston, K.A. (2018). Toward a theory of social engagement. In K.A. Johnston & M. Taylor (Eds.), *The Handbook of Communication Engagement,* pp. 19-32. Hoboken, NJ: Wiley

Kabogo, J.E., Anderson, P.E., Hyera, P. & Kajanja, G. (2017). Facilitating public participation in water resources management: reflections from Tanzania. *Ecology and Society*, 22.

Kasongo, K. (2010). Impacts of globalisation on traditional African religion and cultural conflict. *Journal of Alternative Perspective in the Social Sciences*, 2.

Kelland, K. (2017). Study links pollution to millions of deaths worldwide.

Kelly, S., Cunningham, R., Plant, R. & Maras K. (2019). *Water scarcity risk for Australian farms and the implications for the financial sector*. Institute for Sustainable Futures: UTS Printing Services.

Khan M.L., Khumbongmayum A.D. and Tripath, R.S. (2008). The sacred groves and their significance in conserving biodiversity: an overview, International Journal of Ecology and Environmental Sciences 34: 277-291.

Kideghesho, J.R. (2008). Co-existence between the traditional societies and wildlife in western Serengeti, Tanzania: its relevancy in the contemporary wildlife conservation efforts. *Biodiversity and Conservation*, 17(8): 1861-1881.

King'asia, M.I. (2018) *Involving the marginalised: the role of Sengwer religious worldview in the conservation of natural environmental resources in Embobut Forest, Kenya*. Moi University.

Kiptum, A. & Sang, A. (2017). Ground water level variability and their cost implications: a case of Keiyo North Sub-County, Elgeyo Marakwet County, Kenya. *Africa Environmental Review Journal*, 2(2).

Knüppe, K. & Meissner, R. (2016). Drivers and barriers towards sustainable water and land management in the Olifants-Doorn Water Management Area, South Africa. *Environmental Development*, 20: 3-14.

Knutsson, G. (2014). The role of springs in the history of Sweden. *Vatten — Journal of Water Management and Research*, 70: 79-86.

Koenane, M.L.J. (2017). The role and significance of traditional leadership in the governance of modern democratic South Africa. *Africa Review*, 10(1).

Koon, W.K. (2015). *How the ancient Chinese looked after their drinking water*. South China Morning Post.

Korstjens, I. & Moser, A. (2018) Series: practical guidance to qualitative research. Part 4: Trustworthiness and publishing. *European Journal of General Practice*, 24(1): 120-124.

Kreft, S., Eckstein, D. & Melchior, I. (2017). *Global Climate Risk Index*. https://germanwatch.org/de/ download/16411.pdf.

Krige, E.J. & Krige, J.D. (1980). The realm of a rain Queen: A Study of the Pattern of Lovedu Society. *Oxford*: Oxford University Press.

Kumar, K.S. (2014). Water conservation and sustainability: an utmost importance. *Hydrology Current Research*, 5(2).

Lance, P. & Hattori, A. (2016). *Sampling and evaluation: a guide to sampling for program impact evaluation*. Chapel Hill, Borth Carolina: MEASURE evaluation, University of North Carolina.

Lin Fang (2010). A Sociocultural Perspective of Mental Health Service Use by Chinese Immigrants

Liveris, Leonie B. (2005). *Ancient taboos and gender prejudice: challenge for orthodox women and the church*. Hampshire: Ashgate Publishing Limited.

Loreti, E., Veen, H. & Perata, P. (2016). Plant responses to flooding stress. *Current Opinion in Plant Biology*, 33.

Lowe, Roy; Yasuhara, Yoshihito (2013), "The origins of higher learning: time for a new historiography?", in Feingold, Mordecai (ed.), History of Universities, 27, Oxford.

Lssozi, A. (2012). Values and participation: the role of culture in preserving and environmental education among the Baganda. *The Journal of Sustainability Education*, 7(3): 88-99.

Lynda M. Baker (2006) Observation: A Complex Research Method. Library trends. Vol. 55, No. 1

Mabeta, J., Mweemba, B. & Mwitwa, J. (2018). Key drivers of biodiversity loss in Zambia. *Biodiversity Finance Initiative* (BIOFIN) – Zambia.

Maffi, L. (1998). Language: a resource for nature. *Journal on the Environment and Natural Resources Research*, 34(4): 12-21.

Malgorzata Ciesielska & Katarzyna Wolanik Boström (2018). Observation Methods. Qualitative Methodologies in Organization Studies. pp.33-52. DOI: 10.1007/978-3-319-65442-3_2.

Malindi, M.M. (2018). *The impact of globalisation on African languages and cultures: a study of selected discourses*. University of North West, p. 7.

Mangena, M. (2016). *African ethics through ubuntu: a postmodern exposition.* PhD Dissertation. Department of Religious Studies, Classics and Philosophy, University of Zimbabwe.

Mary, F.D. (2015). Private data, public safety: a bounded access model of disclosure. *North Carolina Law Review*, 94(1).

Matata, A.C. & Adan, A. (2018). *Causes of climate change and its impact in the multi sectoral areas in Africa – Need for enhanced adaptation policies*. Umma University Repository.

Mathewson, Kent (2004). "Drugs, Moral Geographies, and Indigenous Peoples: Some Initial Mappings and Central Issues". Dangerous Harvest: Drug Plants and the Transformation of Indigenous Landscapes. Oxford University Press. p. 13.

Maybury-Lewis, David (1997). Indigenous Peoples, Ethnic Groups and the State. Needham Heights, Massachusetts: Allyn & Bacon. ISBN 978-0-205-19816-0.

Mberu, B.U. & Ezeh, A.C. (2017). The population factor and economic growth and development in sub-Saharan African Countries. *African Population Studies,* 31(2): 3833-3844.

McGregor, D. (2004). Traditional ecological knowledge and sustainable development: Towards coexistence. In M. Baser, H. Feit & G. McRae (Eds.), *In the way of development, indigenous people, life projects and development.* London: Zed Books, pp. 72-91.

Mehta, L., Movik, S., Bolding, A., Derman, B. & Manzungu, E. (2017). *The politics of integrated water resources management (IWRM) in eastern and Southern Africa.* African Books Collective, pp. 1-29.

Melese, S.M. (2016). Effect of climate change on water resources. *Journal of Water Resources and Ocean Science*, 5(1): 14-21.

Mercer, J., Kelman, I., Taranis, L. & Suchet-Pearson, S. (2010). *Framework for integrating indigenous and scientific knowledge for disaster risk reduction*. Journal Compilation Overseas. Development Institute, Blackwell Publishing: USA.

Mirti, H,. Wallender, W.W., Chancellor, W.J. & Grismer, M.E. (1999). *Performance characteristics of the shaduf: a manual water-lifting device*. ASAE, St. Joseph, MI: USA.

Mitsch, W.J. & Gosselink, J.G. (2007). *Wetlands.* 4th ed. John Wiley & Sons: New York, p. 582.

Moahi, K. (2005). Documenting indigenous knowledge systems in Africa: prospects and challenges. *ESARBICA Journal,* 24: 75-87.

Mohale M.R & Phaahla P (2014). Khelobedu cultural evolution through oral tradition. Thesis, Masters of Arts in African Languages. University of South Africa.

Mohsen, T.-J.T.H. (2013). Review of ancient wisdom of Qanat and suggestion for the future water management. *Environmental Engineering Research*, 18: 57-63.

Monjo, R. (2016). Measure of rainfall time structure using the dimensionless n-index. *Climate Research*, 67(1): 71-86.

Moorberg, C.J. (Ed). (2019). *Soil and water conservation: an annotated bibliography*. New Prairy Press eBooks.

Mosha, D.B., Vedeld, P., Kajembe, G.C., Tarimo, A.K.P.R. & Katani, J.Z. (2016). Reflections on evolving water management institutions and institutional bricolage: a case of irrigation schemes in Iringa Rural and Kilombero districts, Tanzania. *Water Policy,* 18(1): 143-160.

Mosley, L.M. (2014). Drought impacts on the water quality of freshwater systems; review and integration. *Earth Science Reviews*, 140: 203-214.

Moyo, G.G., Chikuni, M. & Chiotha, S (2016). Community knowledge in restoring trees in controversial forest hot spots: a case of Nkanya, Lesuwa rivers catchment area in Zomba Malosa Forest Reserve, Malawi. *Open Science Journal*. 1(3).

Mpiri, D.B. (1995): Restocking rejuvenated agro-pastoral areas and sustainable livestock management. In: T. Tandigar (Ed.) *The African Pastoral Forum, Working Paper Series,* 4, January, pp. 16-18.

Mpofu, V. (2016). *Possibilities of integrating indigenous knowledge into classroom science: the case of plant healing*. Witwatersrand, Johannesburg.

Muaz, Jalil Mohammad (2013), Practical Guidelines for conducting research. Summarizing good research practice in line with the DCED Standard.

Mudege, N.N. (2005). *Knowledge production and dissemination in land resettlement areas in Zimbabwe: the case of Mupfurudzi*. PhD. Thesis, Wageningen University: Wageningen.

Mugane, J.M. (2015). *The story of Swahili*. Athens, Ohio: Ohio University, p. 255.

Muller, M. (2015). The 'Nexus' as a step back towards a more coherent water resource management paradigm. *Water Alternatives,* 8(1): 675-694.

Muller, R. (2008). Rain rituals and hybridity in Southern Africa. *Verbum et Ecclesia*, 29 (3), 819-831.

Musambo, M. (2017). *An evaluation of performance of water distribution networks in Lusaka city: a case for the Hillview South water project*. University of Zambia Research Repository Online.

Musekiwa, N. (2012). The role of local authorities in democratic transition. In E. Masunungure & J Sumba (Eds), *Democratic transition,* p. 242.

Musingafi, M.C.C. (2011). Integrated water resource management, challenges and prospects for potable water supply governance in Zimbabwe and South Africa: comparative perspectives from selected local authorities. Unpublished Doctoral dissertation, North West University.

Musyimi, P.K., Nduru, G.M., Huho, J.M. & Opiyo, F.E. (2018). Households' perceptions on impact of drought on water resources in Makindu sub-county, Kenya. *African Research Review*, 12(3).

Musyoki, A., Thifhufhelwi, R. & Murungweni, F.M. (2016). The impact of and responses to flooding in Thulamela Municipality, Limpopo province, South Africa. *Jàmbá: Journal of Disaster Risk Studies*, 8(2): 166.

Narrative: the quest for a sustainable future for all. Proceedings of the 24th Annual FIDIC-GAMA Conference, 7-10 May, Cape Town.

Nath, R., Nath, D., Li, Q., Chen, W. & Cui, X. (2017). Impact of drought on agriculture in the Indo-Gangetic Plain, India. *Advances in Atmospheric Sciences*, 34(3): 335-346.

Nedelman, M. (2018). *Fertility rates cut in half since 1950 – but the population is still growing*. CNN.

Nellemann C & Corcoran E (2010) Dead Planet, Living Planet- Biodiversity and Ecosystem Restoration for Sustainable Development: A Rapid Response Assessment. United Nations Environment Program, GRID-Arendal.

Netshivhambe, N.E. (2017). The importance of documenting indigenous African sheet music. *,* 4: 107-117.

Ngara, R.M. (2013). Indigenous system and the conservation of natural resources in the Shongwe Community in Gokwe District, Zimbabwe. *International Journal of Asian Social Science*, 3(1): 20-28.

Ngulube, P. (2016). *Handbook of research on social, cultural, and educational considerations of indigenous knowledge in developing countries*. IGI: Global. University of South Africa: South Africa.

Njoki, N.W. (2019). African indigenous education. In: *Gender and institutional development in Africa. Gender, development and social change.* Palgrave Macmillan.

Nkebukwa, A. (2007). *The generation and dissemination of information on HIV/AIDS in rural Tanzania: an assessment through a gendered grassroots AIDS model.* PhD Thesis, Department of Sociology, University of Dar es Salaam: Tanzania.

Nyambe, I.A. & Feilberg M. (2009). *Zambia National Water Resources Report for WWDR3*. The Government of the Republic of Zambia, Lusaka.

Nyoni, J. (2019). Decolonising higher education curriculum: an analysis of African intellectual readiness to break the chains of a colonial caged mentality. *Transformation in Higher Education,* 4.

Obiora, A.C. & Emeka, E.E. (2015). African indigenous knowledge system and environmental sustainability. *International Journal of Environmental Protection and Policy*, 3(4): 88-96.

Ojovan, M.I. & Loshchinin, M.B. (2015). Heuristic Paradoxes of S.P. Kapitza Theoretical Demography. *European Researcher*, 92(3): 237-248.

Oladapo, O.S. & Ogundele, A.T. (2018). Indigenous knowledge systems of conserving natural resources in the Erijiyan community, Ekiti State, Nigeria. *International Journal of Geography and Environmental Management*. 4(2).

Onuora-Oguno, A.C. (2019). African perspective of education: a catalyst for the desired Africa of tomorrow. In: *Development and the right to education in Africa.* Palgrave Macmillan.

Onwuegbuzie, H. (2017). The role of diaspora in disseminating indigenous knowledge entrepreneurship. *Journal of International Business Research and Marketing,* 2(4): 20-34.

Osei-Tutu, P. (2017). Taboos as informal institutions of local resource management in Ghana: why they are complied with or not. *Forest Policy and Economics*, 85(1): 114-123.

Osemudiame, O.M. (2017). African traditional knowledge system as innovative strategies for shared natural resource management in Africa. *Ethiopian e-Journal for Research and Innovation Foresight*, 9(2).

Owa, F.D (2013). Water Pollution: Sources, Effects, Control and Management. Mediterranean Journal of Social Sciences. Department of Integrated Science, Federal College of Education; Okene Kogi State, Nigeria. Vol 4 No 8.

Owusu, P.A., Asumadu-Sarkodie, S. & Ameyo, P. (2016). A review of Ghana's water resource management and the future prospect. *Content Engineering,* 3(1).

Padmanabhan, M. (2019). Spiritual reawakening: the sacred revival of water. Unpublished document submitted in partial fulfilment of the requirements for the degree of Master of Architecture (Professional). Unitec Institute of Technology, Auckland: New Zealand.

Pandey, V., Mittal, R. & Sharma, P. (2017). Documentation and application of indigenous traditional knowledge (ITK) for sustainable agricultural development. *Asian Journal of Agricultural Extension, Economics & Sociology*, 15(3): 1-9.

Paradies, Y. (2016). Colonisation, racism, and indigenous health. Journal of Population Research, 33: 83-96.

Parahoo, K. (2014). *Nursing research, principles and issues*. 3rd ed. Palgrave McMillan, Hampshire.

Patton, M.Q. (2015). *Qualitative research and evaluation methods*. 4th ed. SAGE Publications: Thousand Oaks, California.

Pearce, J.M. (2015). Applications of open source 3-D printing on small farms. *Organic Farming,* 1(1): 19-35.

Pearce, T., Forde, J., Willox, A. & Smit, B. (2015). Inuit traditional ecological knowledge (TEK) subsistence hunting and adaptation to climate change in the Canadian Arctic. *Arctic,* 68: 233-245.

Pereira, L.S. (2017). Water, agriculture and food: challenges and issues. *Water Resources Management*, 31: 2985-299.

Pernecky, T. (2016). *Epistemology and metaphysics for qualitative research*. London: UK: Sage Publications.

Phillips, D.I.W., Osmond, C., Williams, M.L. & Jones, A. (2017). Air pollution in early life and adult mortality from chronic rheumatic heart disease. *International Journal of Epidemiology*, 46(1): 1107-1114.

Pickering, J. & Nyapisi, T. (2017). A community left in the dark: the case of Mapela. In *In Good Company.* 2nd ed. *Conversations around transparency and accountability in South Africa's extractive sector*. Open Society Foundation for South Africa: Cape Town.

Pires, A., Morato, J., Peixoto, H., Botero, V., Zuluaga, L. & Figueroa, A. (2017). Sustainability assessment of indicators for integrated water resources management. *Science of The Total Environment*, 578: 139-147.

Plänitz, E. (2019). Neglecting the urban? Exploring rural-urban disparities in the climate change – conflict literature on Sub-Sahara Africa. *Urban Climate*, 30.

Polit, D.F. & Beck, C.T. (2014). *Essentials of nursing research appraising evidence for nursing practice*. Lippincott Williams & Wilkins Philadelphia.

Popova, U. 2014. Conservation, traditional knowledge, and indigenous. *American Behavioral Scientist,* 58(1). doi:10.1177/0002764213495043.

Potts, D.T. (2012). *A companion to the archaeology of the ancient near East.* John Wiley & Sons, 264.

Pyke, M.L., Toussaint, S., Close, S.P, Dobbs, R.J., Davey, I., George, K., Oades, D. Sibosado, D., McCarthy, P., Tigan, C., Angus, B. (Jnr), Riley, E., Cox, D., Cox, Z., Smith, B., Cox, P., Wiggan, A. & Clifton, J. (2018). Wetlands need people: a framework for understanding and promoting Australian indigenous wetland management. *Ecology and Society,* 23(3):43

Ralph, P. (2018). The two paradigms of software development research. *Science of Computer Programming*, 156.

Rapolaki, R.S. & Reason, C.J.C. (2018). Tropical storm Chedza and associated floods over south-eastern Africa. *Natural Hazards,* 93: 189-217.

Remmington, G. (2018). The transforming tradition: the aflaj and changing role of traditional knowledge systems for collective water management. *Journal of Arid Environments*, 151: 134-140.

Roba, G.O. & Yildiz, F. (2019). Indigenous mechanisms of preserving sacred natural sites in Guji Oromo, Adoola Reedde and Anna Sorra districts, southern Ethiopia. *Cogent Food & Agriculture*, 5(1).

Robert, H. (2015). *Wheelmove Sprinkler Irrigation Operation and Management*. Utah State University.

Robinson, A.L. (2019). *Colonial rule and its political legacies in Africa.* Oxford University Press.

Robinson, D.F. & Raven, M. (2019). Recognising indigenous customary law of totemic plant species: challenges and pathways. *The Geographical Journal*, 186(1): 31-44.

Rogers, D. (2015). Further validation of the learning alliance inventory: the roles of working alliance, rapport, and immediacy in student learning. *Teaching Psychology*, 42(1): 19-25.

Rohli, R.V. & Vega, A.J. (2018). *Climatology* (4th ed.). Jones & Bartlett Learning.

Rose, D., Bell, D. & Crook, D.A. (2016). Restoring habitat and cultural practice in Australia's oldest and largest traditional aquaculture system. *Reviews in Fish Biology and Fisheries* 26(3): 589-600.

Rosenthal, G. (2018). *Social interpretive research. An introduction*. Göttingen: Universitätsverlag Göttingen.

Ross, K., Delaney, C., Beard, N., Fuller, K., Mohr, S. & Mitchell, C. (2014). Smart metering enables effective demand management design: a case study to demonstrate that an early mixed-method baseline analysis is essential to designing robust, cost-effective demand management programs in remote communities. *Water*, 41: 81-87.

Rothman, J. (2014). The meaning of "culture". *The New Yorker*.

Runyan, C.W. & D'Odorico, P. (2016) *Global deforestation*. Cambridge University Press: New York.

Saina, C.K. (1996): Drought and Famine Coping Strategies and Environment among the Keiyo living in Kerio valley, Kenya. Unpublished M.Phil. Thesis, Moi University, Kenya.

Saladin, M. (2016). Rainwater harvesting in Thailand – learning from the World Champions.

Samakov, A. & Berkes, F. (2017). Spiritual commons: sacred sites as core of community-conserved areas in Kyrgyzstan. *International Journal of the Commons*, 11(1): 422-444.

Saurombe, A. (2017). *Towards a regional policy and legal instrument for the protection of indigenous knowledge systems in Southern Africa: handbook of research on social, cultural, and educational considerations of indigenous knowledge in developing countries*. IGI Global Disseminator of Knowledge.

Sayi, S. (2019). Taboos and ideological values of Ndebele society. *Southern African Journal for Folklore Studies,* 29(2): 1-10.

Schoenbrun, D.L. (2017). Oral tradition. In A. Livingstone Smith, E. Cornelissen, O.P. Gosselain & S. MacEachern (Eds.), *Field manual for archaeology in Africa*. Royal Museum for Central Africa, pp. 253-256.

Scotland, J. (2012). Exploring the Philosophical Underpinnings of Research: Relating Ontology and Epistemology to the Methodology and Methods of the Scientific, Interpretive, and Critical Research Paradigms. English Language Teaching, 5(9), pp.9-16.

Segre, M. (2015). *Higher education and the growth of knowledge: a historical outline of aims and tensions*. New York: Routledge.

Segre, Michael (2015). Higher Education and the Growth of Knowledge: A Historical Outline of Aims and Tensions. New York: Routledge. ISBN 978-0-415-73566-

Shahrokh, E.M. & Dougherty, E. (2014). Effect of separate sampling on classification accuracy. *Bioinformatics*, 30(2): 242-250.

Shava, S. & Nkopodi, N. (2020). *Indigenising the university curriculum in Southern Africa: indigenous studies: breakthroughs in research and practice.* IGI Global Disseminator of Knowledge.

Shiferaw, D., Takele, S. & Hailemichael, A. (2017). Indigenous practices of Ganta community in protecting natural resources, Gamo Gofa Zone, Ethiopia. *International Journal of Environmental Protection and Policy*, 5(5): 74-83.

Sicotte, P. (2017). Social taboos. *The International Encyclopedia of Primatology*. John Wiley & Sons.

Simon K (2011). Developing a theoretical framework. Dissertation and Scholarly Research: Recipes for success. Seattle. WA: Dissertation Success LLC.

Simon Marginson & Thi Kim Anh Dang (2016). Vygotsky's sociocultural theory in the context of globalization. Asia Pacific Journal of Education Volume 37, 2017 - Issue 1.

Simon, J.L. (2019). *The economics of population growth*. Princeton Legacy Library: Princeton University Press.

Sithole, S. & Mathonsi, N. (2017). The incompatibility of traditional leadership and democratic experimentation in South Africa. *African Journal of Public Affairs*, 9(5).

Soeters, J. Shields, P. & Rietjens, S. (2014). *Handbook of research methods in* military studies*. New York: Routledge.

Speranza, C.I., Kiteme, B., Wiesmann, U. & Jörin, J. (2016). Community-based water development projects, their effectiveness, and options for improvement: lessons from Laikipia, Kenya. *African Geographical Review*, 37(30): 192-208.

Stanglin, Doug (2017). "Global pollution is the world's biggest killer and a threat to survival of mankind, study finds.

Steinberg, S. (2012). The Pre-Shortzian Puzzle Project. Bringing old New York times crosswords into the digital age. Picture courtesy of FAO Corporate Document Repository. New York Times, 31 July 2012.

Stephen, K.A. & Kasim, H. (2015). Qualitative and quantitative research paradigms in business research: a philosophical reflection. *European Journal of Business and Management*, 7(3).

Tapfuma, M. & Hoskins, R. (2020). *Visibility and accessibility of indigenous knowledge on open access institutional repositories at universities in Africa. Digital Libraries and Institutional Repositories: Breakthroughs in Research and Practice.* IGI Global Disseminator of Knowledge.

Thanh, N. & Thanh, T. (2015). The Interconnection Between Interpretivist Paradigm and Qualitative Methods in Education. American Journal of Educational Science, 1(2), pp.24-27.

Thenya, T. & Ngecu, W.M. (2017). Indigenous strategies and dynamics of resource utilization in tropical wetland. A case study of Yala swamp, Lake Victoria Basin, Kenya. *International Journal of Arts and Commerce*, 6(2): 21-39.

Theofanidis, Dimitrios, & Fountouki, Antigoni. (2019). Limitations and Delimitations in the Research Process. Perioperative nursing (GORNA), E-ISSN: 2241-3634, 7(3), 155–162. http://doi.org/10.5281.

Thom, D., Rammer, W. & Seidl, R. (2017). Disturbances catalyze the adaptation of forest ecosystems to changing climate conditions. *Global Change Biology*, 23: 269-282.

Tobiason, J.E., Bazilio, A., Goodwill, J., Mai, X. & Nguyeni, C. (2016). Manganese removal from drinking water sources. *Current Pollution Reports*, 2: 169-177.

Tonorgbevi, A.E. (2016). *Indigenous knowledge in water resource management in the Upper Tano River Basin, Ghana*. University of Cape Coast.

Tuwe, K. (2016). The African oral tradition paradigm of storytelling as a methodological framework: employment experiences for African communities in New Zealand. Proceedings of the 38th African Studies Association of Australia and the Pacific (AFSAAP) Conference: 21st century tensions and transformation in Africa. Deaking University, Australia.

UNECE. (2018). Water scarcity: Acting in transboundary basins and addressing health impacts.

United Kingdom Essays. (2018). *The advantages and disadvantages of the colonialism history essay*. UKEssays.

United Nation International Strategy for Disaster Management (UNISDR) (2009). Disaster risk reduction. Geneva Switzerland.

United Nations Educational, Scientific and Cultural Organisation (UNESCO) (2016). *Gadda systems, an indigenous democratic socio-political system of the Oromo. Intangible Cultural Heritage*.

United Nations- Water (2018). World Water Development Report. Nature-based Solutions for Water.

UN-Water. (2018). *World Water Development Report 2018: Nature-based Solutions for Water*. Geneva: Switzerland.

Verschuuren, B. (2016). *Religious and spiritual aspects of wetland management.* Sociology & Anthropology of Development Group, Wageningen University and Research Centre, Wageningen: The Netherlands.

Vision Africa Regional Network (VAREN). (2015). *Realising the human right to water and sanitation – Zambia, Policy brief*. VAREN, Lusaka

Visser, M. & Brühl, J. (2018). A drought-stricken Cape Town did come together to save water. *Daily Maverick*. Available at: https://www.dailymaverick.co.za/article/.

Wako, G. (2020). Gender from an indigenous perspective: the indigenous rights of women among the Borana Oromo Gadaa system and misconceptions in modern approaches. *Journal of Indigenous Knowledge and Development Studies*, 1(1).

Walmsly, N., & Pearce, G. (2010). Towards Sustainable Water Resources Management: Bringing the Strategic Approach up-to-date. Irrigation & Drainage Systems, 24(3/4), 191–203.

Wang, Y.M. (2019). Understanding the spiritual meaning of Jerusalem in three Abrahamic religions: Jerusalem – Religious and Peacebuilding. *BRILL*, 6: 229-248.

Wark. K. (2014). Weaving indigenous and sustainability sciences: diversifying our methods workshop. In J.T. Johnson, R.P. Louis & A. Kliskey (Eds), *Weaving indigenous and sustainability sciences: diversifying our methods (WIS2DOM) workshop report*. National Science Foundation: Arlington, VA, pp. 101-103.

Wasongo, O., Kambewa, D. & Bekalo, I. (2011). Community-based natural resource management (p. 194). In W.O. Ochola, P.C. Sanginga & I. Bekalo (Eds.), *Managing natural resources for development in Africa. A resource book*. Nairobi, Kenya: University of Nairobi Press, 2011, pp. 165-210.

Weber, H. & Sciubba, J.D. (2019). The effect of population growth on the environment: evidence from European regions. *European Journal of Population*, 35(2): 379-402.

Whittingham, E., Booker, F., Townsley, P., Turner, R., Ford, R., Forster, J., Cattermoul B., Campbell J., Morrish N. & Marsh, J. (2014). *Future of reefs in a changing environment: an ecosystem approach to managing Caribbean coral reefs in the face of climate change. Future of Reef in Changing Climate project*.

Wigginton, N.S. (2015). Fertilizing water contamination. *Science*, 18 September.

Wilson, R., Pierce, T., Jones, K., Fleifresser., B., Davis, G. & Jones, G. (2018). Indigenous land management in peri urban landscapes: an Australian example. *Society & Natural Resources*, 31 (3):. 335-350.

Woodward, E. & McTaggart, P.M. (2015). Transforming cross-cultural water research through trust, participation, and place. *Geographical Research,* 54(2): 129-142.

World Health Organization. (2017). *Safely managed drinking water – thematic report on drinking water 2017.* World Health Organization: Geneva, Switzerland.

Wright, A. (2002). *Sustainable water supplies for remote communities of indigenous people. The first step: water conservation*. CRC for Water Quality and Treatment: Centre for Appropriate Technology.

Xia, B. S., & Gong, P. (2015). Review of business intelligence through data analysis. Benchmarking, 21(2), 300-311. doi:10.1108/BIJ-08-2012-0050

Yannopoulos, S., Lyberatos, G., Theodossiou, N., Li, W., Valipour, M., Tamburrino, A. & Angelakis, A. (2015). Evolution of water lifting devices (pumps) over the centuries worldwide". *Water*, 7(12): 5031-5060.

Yaw Agyeman Boafo, Osamu Saito, Sadahisa Kato, Chiho Kamiyama, Kazuhiko Takeuchi & Miri Nakahara (2015). The role of traditional ecological knowledge in ecosystem services management: the case of four rural communities in Northern Ghana. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 12: 1-2, 24-38.

Yin, Robert K. (2014). Case study research: Design and methods. Thousand Oaks: Sage publications.

Yunana D.A., Shittu A.A., Ayuba, S., Bassah, E.J. & Joshua W.K. (2017). Climate change and lake water resources in sub-Saharan Africa: case study of Lake Chad and Lake Victoria. *Nigerian Journal of Technology* (nijotech), 36(2): 1-14.

Yunt, J. (2017). *Faithful to nature: Paul Tilich and the spiritual roots of environmental ethics*. Barred Owl Books.

Zalewski, M., Fazi, S. & Wolanski, E. (Eds) (2018). Ecohydrology for water, biodiversity, ecosystem services, and resilience in Africa. *Ecohydrology and Hydrobiology*, 18(2): 93-95.

Zhenga, D. & Shi, M. (2017). Multiple environmental policies and pollution haven hypothesis: evidence from China's polluting industries. *Journal of Cleaner Production*, 141: 295-304.

Zuckermann, A.D.G. (2015). *ENGAGING – A guide to interacting respectfully and reciprocally with aboriginal and Torres Strait Islander people, and their arts practices and intellectual property*. Australian Government Indigenous Culture Support.

Zuofa, C.C. & Olori, C.N. (2015). Appraising adult teaching methods in Nigeria: Analysis of the effect of some teaching methods on adult learners. *American Journal of Educational Research*, 3(9): 11331137. doi:10.12691/education-3-91