POLYCENTRISM: A CASE STUDY ON WATER ACCESS AND MANAGEMENT IN COMMUNITY-BASED WATER TENURE IN MAKOPA AND SIMUKALE VILLAGES

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Carol Emma Mweemba, Barbara Van Koppen, Giriraj Amarnath

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Authors

Carol Emma Mweemba[1], Barbara Van Koppen[2] Giriraj Amarnath[3]

[1] World Vision, Lusaka, Zambia

[2] International Water Management Institute, Pretoria, South Africa

[3] International Water Management Institute, Colombo, Sri Lanka

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Table of Contents

1. Introduction

1.1 Background

Integrated customary land and water tenure are particularly relevant in polycentric governance. As a concept, polycentrism was first coined in the 1960s to imply complex governance forms with multiple decision-making phases. Each level of the decision-making centre holds and operates some level of self-government (Ostrom et al., 1961). In the recent past, polycentric governance in the management of water resources, land, forestry and other resources has emerged as one of the most important terminologies used to understand the multi-dimensional layers of decision-making processes by different actors and players to respond to community needs (Muller, 2012; Nagendra & Ostrom, 2012).

Community actions in managing ground and surface water, storage and conveyance are the bottom-up starting point in polycentrism. Since long, communities have practised age-old solutions to address water infrastructure, storage, conveyance, and water access for domestic and productive uses. Techniques for storage when water resources are abundant act as buffers for water and use in dry periods. Conveyance infrastructure brings water in the quantities and quality where and when water is needed for domestic and multiple productive benefits for multi-faceted livelihoods. However, with growing water needs among different users – domestic and productive and by inter or intra-community users, there has been a growing need for better recognition and support among users and, as needed, better to manage the water resource (Muller, 2012).

While community solutions are crucial to maintaining community structure and enhancing access opportunities, workable resolutions are mobilized into next-layer governance interventions through vertical integration processes. External financing of water infrastructure, for example, requires that communities meet specific essential criteria to qualify for support to access better water technology for drinking, domestic and productive uses. Top-down decisions requiring communities to adhere to prerequisites to be eligible for external funding exemplify vertical polycentrism.

In this vertical link, the understanding of community-based water tenure remains a grey area in its role for efficient resource use towards achieving community development, food security and eliminating poverty. With limited understanding, the top-down criteria for support risk missing opportunities to better follow communities' own solutions and mobilize their resource, technical, institutional, social and financial assets.

Water is central to life as it is needed for food, agriculture, energy and industrial purposes (FAO, 2017; Guillaume and Shigemitsu, 2021). At the household level, access to safe and clean water is at the core of sustainable development. The availability of adequate water supplies enhances good human health and well-being while reducing the disease burden of water-borne diseases (Prüss-Üstün, 2008; WHO, 2019). Water also promotes gender equality. When accessible, it alleviates domestic spheres dominated by females, such as fetching water for consumption and other domestic uses over long distances (ILO, 2019). However, the challenge still exists in the world today. Women and girls are disproportionately responsible for fetching water in a household posing a gender impact on inadequate water supply.

However, adequate water supplies also enhance opportunities for children to attend school (Freeman et al., 2012) and for women and men to participate in all livelihoods (van Houweling et al., 2012), reduce household poverty, and generate sufficient food baskets and income. Yet, water access, especially in rural areas, has remained inadequate for many years compared to access in urban areas. While 89% of urban people have access to improved water supply services, access to improved water supply in rural areas is estimated at 51% (World Bank, 2020). This is a slight improvement from 2015, when only 44% of the rural population had access to essential drinking water services, a significantly low percentage compared to their urban counterparts, at 86% (NWSSC, 2018). Moreover, rural agriculture-based livelihoods of smallholders and pastoralists depend in many more ways on water than urban livelihoods.

Moreover, the growing climate change impacts seen in drought occurrences (see Agrawal, 2008; Boko et al., 2007; Malhi and Wright, 2004; Smit et al., 2001) have exacerbated water access challenges. Water quantity and quality are reduced with poor and unpredictable rainfall patterns (Thurlow et al., 2009). Sustainable livelihood activities that depend on water, such as farming, also threaten to pose a risk of increased vulnerability and poverty among those affected. The critical challenges of water access and climate variability experienced in rural areas have encouraged all levels of institutions (formal and informal) to create systems that support and manage farming, water, land and forest resources for the benefit of poor people. At the community level, people have, since time immemorial, responded to climate variability and continue to live up to such measures with the management of land, forests, water resources and agriculture.

Further, through the bottom-up and top-down polycentric governance, district and national levels have instituted governance structures and critical decision-making processes that reduce the water access gap between rural and urban areas and enhance access for the rural poor for domestic and productive use. They have also instituted measures that respond to adaptation and coping mechanisms to lessen the

impacts of climate change and variability among the rural poor. For example, when water resources dry up, collectively, communities have built consensus to prioritize productive water for livestock and forego small-scale agriculture and backyard gardens because livestock cannot wait to get water. In the same way, communities have strategically aligned rules of access, equity and sustainability when managing public water resources and infrastructure to ensure no one is left behind from accessing and benefitting from shared public sources. These self-governance initiatives intra or inter-community highlight horizontal polycentrism in managing public infrastructure.

Community actions to deal with climate variability are apparent in agriculture and water resource management. However, with growing threats of droughts, land and water scarcity, climate change increases uncertainty about accomplishing farm-based activities that are primarily the mainstay of the agrarian community (Hertel and Rosch, 2010; World Development Report 2010, 5). This situation has continued to perpetuate poverty among the rural poor, most hit by the impacts of climate change. Moreover, with population increases, people's needs are also growing exponentially, putting a strain on the already limited resources during droughts. The risks also augment because of climate change.

Nonetheless, the bottom-up polycentric governance recognizes how rural communities have responded to climate variability in their local governance of land, forests, water resources, cropping and livestock, and their health and hygiene in agrarian livelihoods.

Insights into communities' integrated horizontal polycentric decision-making about their multiple water sources to meet their multiple needs through public infrastructure and self-supply are still limited, but attention is growing.

In the recent past, the concept of 'water tenure' has gained impetus. Whereas interest is continually highlighted in land and forest tenure – for example, we note how discourses around securing land and forest tenure take dominance (FAO, 2020) and means of securing such resources are well thought out, water tenure defined as 'relations among people, whether formally or customarily defined, between people with regard to water' (FAO 2020) is just gaining momentum. Communities worldwide have devised their own strategies in an integrated manner. For example, there are notable investments in infrastructure for self-supply to enhance access, though with stronger claims by the people who invest in the infrastructure than others. In most instances, the rights to use, access and control water resources stem from land tenure rights (Querol, 2019). However, without secure and adequate water tenure, people remain vulnerable to insecure access and poverty (FAO, 2016).

Yet, growing momentum on community-based water tenure provides an opportunity for people to take advantage of local systems to organize and relate to one another about access and use of land, water and other existing resources using formal or informal rules and agreements (USAID, 2006; FAO, 2016). More so, this is prudent because, in customary systems, access to and use of resources – land, water, and forests- are regulated through community-based tenure among people living within predefined locations (Troell and Keene, 2022).

Furthermore, customary rights to the naturally available surface and groundwater resources are evident, mostly linked to the land resource. Because land tenure is closely related to claims of water resources that run through and exist within the land, the access and management of water resources follow pre-existing claims of water access and control on private or public land. This is called the 'land-water' nexus.

In many ways, water is a connector linking with land tenure and other natural resources. In rural areas, customary or traditional land is an essential resource for livelihood and significantly reduces poverty for the rural population (Henriques et al., 2011; Molla et al., 2018). Traditional land is well recognized as underpinning the livelihoods of the rural population. Traditional land has served communities in agriculture, pastoralism, tourism, and forestry (Busiingye, 2002; USAID, 2016).

Traditional land remains fundamental for resource use in rural development. This is, at best, only partially the case for customary water tenure appurtenant to customarily governed land. Land tenure is closely related to the claims to surface water resources flowing over the land or staying in lakes and ponds or to groundwater reserves under the land, both for smallholder and pastoralist communities. Land tenure also recognizes the growing interdependencies among water, land, food and agriculture that ensure well-managed resources to meet the ever-increasing demands of the ever-increasing populations. Although the customary land claims are well recognized, however, there is hardly any understanding of this land-water nexus as yet.

Conflict is also rife in conditions with undefined tenure that guarantees one's access, use and control of water resources. As such, water continues to be at the centre of people's lives, and the need to control its access and use has grown exponentially among people. Still, the means of conflict resolution are not known yet.

However, these many linkages are still hardly understood. This study seeks to fill these knowledge gaps.

1.2 Objectives of the Study

The objective of this study is to map community solutions to deal with climate variability and how information is mobilized into or interfaces with the next layer of government interventions that brings new perspectives in understanding how local solutions can be better mobilized into external solutions to climate change adaptation through horizontal and vertical integration processes, with a focus on living community-based water tenure in rural Zambia.

Unlike legislation in many other African countries that ignores and overrides customary water tenure, Zambian national water resource legislation partially recognizes customary water tenure. In particular, at the national level, Section 63 of the Water Resources Management Act addresses customary water tenure as follows: “A person who intends to apply for a permit to use water for any purpose, other than for domestic and non-commercial purposes, in a customary area and that use is likely to substantially affect the supply of water for domestic and non-commercial purposes for the occupants of that customary area, that person shall, prior to making an application to the Director-General (a) obtain approval of the traditional authority in that area; and (b) put in place alternative means for securing water for domestic purpose”.

Therefore, this study intends to highlight access rights and management to community water resources and land in rural areas of two low-income communities. This is achieved by comparing bottom-up living integrated customary land and water tenure and vertical and horizontal decision-making processes at different levels of governance.

1.3 Rationale and Justification

Climate variability and climate change threaten agriculture-based livelihoods worldwide and in Zambia’s low-income rural areas. In Zambia, droughts and reduced rainfall patterns, particularly in Agro-ecological Region I, have been a significant feature that people have lived with for a long time. Some scientific studies reveal that droughts have increased over the years (MTENR, 2007). Thurlow et al. (2009)'s study of rainfall patterns conducted from 1976-2006 pointed out more aggravated and recurrent droughts in the 1990s and 2000s (specifically 1991/1992, 1994/1995 and 2004/2005 farming seasons). To date, the impacts on agrarian communities that rely on rain for crop production and general livelihood are undebatable. Vegetable gardening reduces. Cattle and other livestock die when there is too much dryness because they lack water and grass for grazing. This further pushes small-scale farmers into extreme poverty as livelihood assets are lost due to inadequate water supplies.

Similarly, water supply for domestic and productive uses is impacted. Trends show that the water table decreases in groundwater aquifers and some extreme cases, drying up during the dry season (Nyambe and Feilberg, 2007). Moreover, most rural communities lack adequate and developed technologies to draw groundwater sources to improve household water access (Chongo, 2011). This also exacerbates the problem of inadequate water supplies for domestic purposes. Improving access to water will become even more critical with climate change and variability.

Surface water sources in streams and rivers also dry up during the dry season. However, as the primary renewable water source is rainfall, water resources are recovered in ground and surface sources with the onset of rain.

As climate change risks augment, adaptation solutions are devised at different layers of governance. At the national level, the focus is on policies and plans that respond to vulnerabilities to climate change (Mustafa, 1998; Smit et al., 2001). On the other hand, intermediate-level governance promotes community adaptation capacities with agriculture, forestry and water technologies that enhance adaptive community capacities (Mweemba, 2019). For example, the importance of developing water harvesting and storage technologies solutions in years of rain surplus is emphasised to lessen water shortages in low-income rural agrarian communities and enhance livelihoods (Mweemba, 2019). However, such solutions should respect, protect and build on what communities are already implementing as promising, climate-smart solutions.

Communities also build their own coping strategies for climate variability to adapt to climate change. As observed by Scientific Scholars, vulnerabilities and risks to communities are reduced when people adopt adaptation and coping mechanisms that are available within their realms and those that have been used for time immemorial (Jain, 2007; Neubert et al., 2011). For example, when the streams dry up, rural people dig shallow wells or scoop holes in the streams' beds to find groundwater used for gardening and stock watering. However, such coping and adaptation mechanisms only last a few months and support productive activities for a short time before scoop holes in the stream and river beds dry out completely.

However, little is known about horizontal polycentric decision-making at the community level and the interface between communities and the lowest government tier. Yet, it is crucial to building on existing solutions and priorities that communities have dealt with seasonality, floods and droughts since time immemorial.

Of course, climate change adaptation measures in Zambia are broad, e.g., early warning, crop choice, and forestry. However, this study focuses on adaptations to strengthen resilience to water variability because:

(i) climate change is mainly manifest in exacerbating seasonal variability and unpredictability in water resource availability and more extreme events; (ii) there is still a significant knowledge gap in understanding communities' polycentric decision-making in integrated water tenure, including links between land and water (iii) government in Zambia and elsewhere is already committed from national to the local level to improve access to water, in any case for domestic uses/human rights to water, with necessary arrangements between communities and lowest tiers. NGOs are also horizontally integrated into those local government spheres. So the case of polycentrism in water has potential lessons to learn about polycentric decision-making for other fields.

2. METHODOLOGY

2.1 Introduction

This section presents the methodology used during the study. In this regard, we explain the selection of the study sites and the underpinning reasons for site selection. This section also presents the research design, sample population and the methodology used to sample participants at all levels, i.e., community, intermediate or district and national, to develop a comprehensive assessment of the horizontal and vertical polycentric governance in customary land and water tenure. Finally, the section shows data collection methods used to gather data from research participants.

2.2 Research Design

A case study methodology was employed to compare bottom-up living integrated customary land and water tenure and generate an in-depth understanding of multi-faceted community-based approaches used by rural communities in the management of land and water access.

The study followed a case of two communities; one matrilineal, the other patrilineal – to provide qualitative data that underpins contextual land and water-related situations in Zambia. In addition, an in-depth analysis of the study sites that differed in lineage delivered observations on gender and power relations in the management of land and water tenure issues that are particular for each location.

2.3 Sampling of Study Site and Research Participants

This study mapped out two communities in Zambia. Makopa Village in Nyimba District of Eastern Province and the Simukale village in Monze District of Southern Province. Two criteria were used to select the study sites. The first entailed selecting one predominantly matrilineal location and the other patrilineal to understand whether there are significant differences between the two types of customs in relation to land access, water access and resource use for domestic and productive activities. The comparison also looked at different power relations in matrilineal and patrilineal communities. Makopa Village is an area that is predominantly matrilineal[1], or based on kinship with the mother or the female line, whereas Simukale Village is patrilineal.

The second sampling level involved research participants in the study—first, key informants and second, participants in the focused group discussions. Key informants were chosen based on two criteria –a) being leaders of the community and b) having lived in the community for an extended period to have sufficient information that was of interest to the study. Two key informants were interviewed in the two communities – two from each study site.

On the other hand, participants in focused group discussions were selected by ensuring that all groupings within the community were represented. The following criteria were used for the selection; gender, age, water users, agriculturalists, pastoralists and leadership positions held within the community. This ensured holistic views from all community members and the collection of information representative of all opinions from residents of the study sites. A total of four focused group discussions were conducted, with a composition of between eight to twenty participants in each group.

At the intermediate or district level, sampled key informants comprised water service providers, implementers of water and climate change projects and the local authority to assess bottom-up, top-down decision-making in the land-water tenure nexus. In addition, six key informants were interviewed at the district level in Nyimba and Monze districts.

At the national level, key government officials working in water resources management were sampled purposively for the study. Further, NGOs and government wings working on climate change adaptation were included as key informants in the study to understand how climate change and interventions

[1] A matriline is a line of descent from a female ancestor to a descendant (of either sex) in which the individuals in all intervening generations are mothers – in other words, a "mother line". In a matrilineal descent system, an individual is considered to belong to the same descent group as their mother.

impact the land-water nexus. Three (3) government and NGO representatives were interviewed during the study.

2.4 Data Collection

Literature was reviewed on gender, and land tenure, vertical polycentric decision-making in water supplies, and general background information. The case study for primary data collection focused on the local community scale, where women and men managed multiple sources to meet their domestic and productive needs through self-supply and, to a more considerable extent, through infrastructure financed by the government, NGOs or other external support agencies. To this effect, three main steps were employed to collect the data – participatory mapping exercises, qualitative community interviews in the form of key informant interviews, focused group discussions and in-depth interviews with key informants at the district and national levels.

a) Participatory Mapping[2]

Through a focused group discussion, participants were asked to draw existing surface or groundwater sources within communities that are significant for domestic and productive purposes by community members. Further, participants were asked to locate on the paper map existing land, forests, fields and grazing areas within their communities to show holistic resources that support community development.

All resources and identified features were marked and given a local name agreed upon by all participants as a correct representation of the named resource or element. Once completed, all participants reviewed the information provided to ensure that information provided was an accurate representation of resources on the ground.

To better understand available resources, transect walks were conducted in addition to discussing available resources with research participants. Transect walks also provided an opportunity to observe critical features recited and document the relevance of the resource to the community's access and use.

b) Qualitative Community Interviews

[2] Participatory mapping entails organising and plotting information based on its organizing and plotting information on the manifestation, distribution, access and use of resources within the economic and cultural area of a specific community.

Two types of qualitative interviews were conducted at the community level—interviews with community leaders and focused group discussions with community participants (Figure 1).

The first stage of community interviews was conducted with community leaders, i.e., traditional leaders or their representatives. Interviews with community leaders provided insights into community dynamics and general living situations. Interviews with community leaders also brought insights into family lineages and how they are organized in matrilineal and patrilineal communities. Further, this discussion stage also investigated power and gender relations in matrilineal and patrilineal societies to understand whether there were significant differences in access to resources among matrilineal and patrilineal societies.

Interviews with community key informants were done on a face-to-face basis. These criteria of discussions were used to allow all ambiguous issues to be clarified during meetings.

Community interview guides were administered to groups of males and females and mixed groups through focused group discussions. Creating variations in the types of interviewees was necessary to understand response patterns in cases where interviewees were diverse and in situations where only one gender was present. Among the research participants were committee members of water points, leaders in church groupings and cooperatives and ordinary community members of different ages and gender that did not belong to any committee or community grouping.

Figure 1: A women's focus group discussion in Makopa Village

As land tenure is closely related to claims of surface water flowing through the land and groundwater systems, research subjects through focused groups devoted time to highlighting how they access and claim water from ground and surface water sources. Communities also provided insights into how they cooperate over water access and management within their contexts. The study further explored dynamics in water access and use with the advent of climate change and what adaptation measures were implored to advance community well-being, coping and adaptation strategies.

c) District and National level Key Informant Interviews

At the district and national levels, data collection focused on policy recommendations on processes used to implement water resources and infrastructure for public use. These spanned from sourcing funds, working with communities to assess community needs of the resources and setting community priorities to determine what water infrastructure was best suited for communities and conducting actual implementations.

District and national-level in-depth interviews with key officials working in the water departments were done to investigate laws and policies that support water and land governance at the community level.

3. FINDINGS: CONTEXT

The case discussed in the document presents polycentric governance in water access and management of customary water tenure in Makopa and Simukale villages. Below are brief descriptions of each study site to provide contexts of pertaining conditions. The section also highlights the importance of the land-water nexus in family lineage and water tenure systems.

3.1 Makopa Village in Nyimba District

Makopa village is situated in Nyimba district in the Eastern Province of Zambia. Nyimba district is located in the Southern part of the Eastern province. It has an estimated area coverage of 12,500 km2.

Makopa village covers the northern part of Nyimba district. The area is generally characterized by poor infrastructure and has more or less been marginalized in the district's economic development. The maintained gravel road is the chief developed progressive feature of the area. The area generally lacks

sufficient surface year-round water sources and has a few developed water infrastructures, such as boreholes and wells. The lack of adequate water and other resources perpetuates poverty in the area. The local people had little clout in district politics and limited influence on decision-making processes on issues affecting their daily lives, such as inadequate water supply due to marginalization and high poverty levels.

Economically, Makopa village relies on crop farming of rainfed crops for home consumption and sale. Maize and groundnuts are the most dominant crops grown in the district. Most farmers depend on rainfed agriculture due to limited options for accessing water during the dry season. Available streams that hold water during the rainy season dry up during the dry season, leaving people without access to surface water. Fewer farmers practice pastoralism with limited numbers of cattle. Instead, most poor people have small livestock such as goats, pigs, and chickens that support their livelihoods when they need to raise income for home use.

Nyimba is dominated by the Nsenga-speaking people, who are dialects of Nsenga Luzi found in the Luangwa valley. Nyimba people are known for their rich matrilineal culture, which influences their way of life, beliefs, behaviours, practices, and how others perceive them. Traditionally, the people of Makopa village and Nyimba district trace their relations through their mothers. In this society, the female line is seen as the rightful owners of the land. This also extends to the succession of kingships. The power and authority of a sitting headman/woman are only handed over to the subject's female relatives and traced back in a matrilineal line. If a male chief dies, his children cannot inherit the chieftaincy – instead, his sister's children are entitled to have a claim of power.

The power and authority held by chiefs and headmen/women remain critical denominators in allocating resources such as land and water. Tenure of land and resources within the land the traditional leaders preside is, by default, assumed by traditional leaders. As the holders of the rights to land within their jurisdictions, they decide where and who should gain access to land resources. Defacto, the allocation of land resources with existing water resources also places traditional leaders responsible for allocating customary water rights to individuals assigned to the land. Nonetheless, even though traditional leaders seemingly govern the land and its resources through their mandate as land allocators, in practice, interactions among communally or family-owned water users influence the governance of access and management of water resources.

Culturally, customary marriages predominate both patrilineal and matrilineal societies. Once the marriage rites are done, the woman moves in with the man or his family. In patrilineal societies, this is not debatable. On the other hand, matrilineal societies allow men to move in with the woman's family, particularly if the man has no adequate means of providing for his wife. As a man, ownership of land and other assets is of the essence that can be used for farming and other livelihood activities that support the wife. Absent these, the couple will live with the wife's family if they have assets and land that the newly married couple can use for productivity and earning a living. Therefore, a newly married couple will be provided with a piece of land by the host family, where they will build their house and be given a piece of land for farming.

3.2 Simukale Village in Monze District

Simukale village is situated in Monze district of Southern Zambia. Monze district is a small district with a population of 163,578 people (based on the 2000 Census of Population and Housing). However, the 2022 population Census findings are yet to be published – indicating that the population might have increased over a decade. The district is about 180km southwest of Lusaka, the capital city of Zambia. It is also situated about 300km from Livingstone, the tourist capital of Zambia, situated further South.

Economically, the district – and Simukale in particular, is dominated by agrarian farmers whose mainstay is crop and livestock farming. Most people highly depend on crop production as their main livelihood activity. Major cash crops grown are rainfed, including maize, groundnuts, cotton and sunflower. In the dry season, people also grow vegetables on small plots and in the backyards for household consumption and sell them to sustain their livelihoods. However, with limited water resources to sustain livelihoods, poverty levels have risen steeply over the years. Population growth and growing water demand for domestic and productive equally threaten social and economic development in rural areas. As households' livelihoods depend on land and water for survival, resolving water challenges for productivity remains critical to the growth and development to reduce high levels of poverty within the community. Moreover, poor households' livelihoods depend on day labouring in crop farms of wealthier farmers.

Culturally, though falling in a region with dual kinship – matrilineal and patrilineal, Simukale village is principally patrilineal. Patrilineal societies have a kinship system in which family lines are derived through paternal lines. Essentially, this implies that children are recognized by the names or families of their fathers. In this society, the role of a man and a woman are clearly defined. Men are the primary

providers for the family and hold significant power and authority in running homes. In addition, men prepare for their children's future by ensuring that their offspring are given land for farming when they grow up and given livestock as an inheritance to improve their livelihoods.

3.3 Land-water Nexus in Family Lineage and Water Tenure

In African culture, it is not uncommon for households or families to hold and claim access to land and water resources that have been within the family for generations.

> *"…My father owned this land and passed it on to me. His father also passed it on to him and his brothers. Now that I have sons, I will equally allocate pieces of land to them when they are older". —Male respondent in Simukale village.*

Kinship plays a crucial role in land access vis-à-vis water tenure. In the study sites, field experience has shown that land passed on through family lineages using informal rules and agreements is legitimate, and owners are recognized to hold rights to the land. In patrilineal communities, the responsibility of ensuring sons have access to resources as they age rests on the father and father figure of the family. As already alluded to in the earlier sections, the father passes on land for farming to offsprings – particularly sons that are recognized primary providers for the family when they take a wife.

When parents allocate land to male children in patrilineal societies, the male offspring will retain rights to the land and manage and use the land independently. Traditions that recognize the passage of land customarily also pass on land rights that owners can enjoy for decades. Pieces of land allocated traditionally are considered legitimate, and it is unexpected for any member of communities to contest any given piece of land and water.

At the same time, kinship is significant in determining the family's identity and a critical feature that helps to understand societies (Radcliffe-Brown, 1950; Hull, 1980). Lineage influences many aspects of human development, such as rulership, titles, and access to property, including land in traditional culture. In matrilineal societies, inheritance of property, such as land, may be left to each family to decide how they pass on property to their children. This includes water resources that run through the land and all infrastructure existing within the land.

However, the female family still claims children from a couple and may pass on land to their offspring. Their ethnicity and clans are also obtained from the maternal lines. Ethnicity lines, therefore, enhance rights to land and all resources within it. Moreover, stronger relations among female relatives than among

male relatives puts children in female-dominated families at a better advantage in a matrilineal society. Just like access to resources, the succession of rulership follows the lineage of female subjects[3].

In such circumstances, family inheritance, though significant, is primarily characterized by unwritten rules and based on local practices and norms (Cotula et al., 2004). Though essential to share land resources and, by default, water with offspring and relations within families, the unavailability of written contracts weakens the security of the recipient of complete claims if individuals that passed on the inheritance pass on. In the absence of enforced paper agreements, verbal agreements are considered unsafe and do not ensure unlimited access to resources.

Several examples have been noted where when the one holding the family together as a head of the family passes on, those that remain may contest the rights for other members to continue accessing land with water resources.

> *"My uncle that gave me this piece of the land died a couple of months back. His older children asked my wife and me to stop using the land he had allocated to us before he died. They are now using our water troughs to water their cattle within our land. And they have not sought permission to do so. And really, there is nothing we can do but let them have the land and everything in it because we do not have any document to substantiate our claim".—Male respondent in Simukale Village*.

Women's vulnerability to denied access to land increases when discourses about their inability to perpetuate family ties begin to be discussed. An exceptional example was given about the situation in Makopa, a matrilineal society,

"…If a widowed woman living on a piece of land they owned with her late husband decides to remarry, they are not allowed to stay within the compound if the land they occupy belonged to the late husband's family. Instead, they should move away and leave that piece of land for children born from the first marriage".—Community leader, Makopa.

Similarly, in patrilineal communities, a female family member's marriage may also hinder accessing resources held in the family.

[3] In matrilineal society, the female line is seen as the rightful owners of the land because it is believed that only a female knows the biological father to her children. If the man's side is allowed to pass power and leadership using patrilineal lines, the belief that children fathered by another man from another clan may end on the throne unrightfully. Therefore, when a seating chief or traditional leader dies, the system does not permit children that he has to be next in the line of chieftainship. Only children born from the blood female relative to the deceased chief are entitled to inherit the chieftaincy.

Second marriages, in which the wife moves to the husband, in both societies limit women's ability to own land within their rights. In patrilineal societies, a woman's access to land and water resources is heightened when linked to a man's ownership of such resources. For females born in patrilineal societies, their share of inheritance is affected and dispossessed if their guarantee is no longer available to perpetuate their right to own land and resources (Yao, 2014).

In matrilineal systems, females that join the families through marriages are also disadvantaged in owning land and resources within it. However, the females born within the family lineage have strong claims to land and water resources because their customs permit them to claim rights to land and resources. Therefore, the level of vulnerability is lessened among women in such societies.

However, whereas kinships, power, family associations and relations determine one's claim to land and water resources within it, other claims at open or surface water sources such as streams and rivers, lakes, and ponds, other claims to water resources exist. Access rights are legalised among people residing within a predefined location. Water access rights are important for domestic and productive. For example, small gardens and livestock water needs are widespread among smallholder and pastoralist communities. Competitions for land allocation and spaces in the proximity of water resources are rife because proximity to surface water defines how well one's access will be. In villages, headmen/women or council of elders are the central authorities to land allocation. To a large extent, their role in land allocation provides some degree of indirect influence on the allocation of water resources. Once allocated a piece of land adjacent to surface water or water flowing through the land, one can typically claim riparian rights that guarantee rights to access water for productive use. However, others can still claim rights of way to the resource.

Further, streams and rivers that transverse through privately owned land have restricted public access. For example, smallholder farmers with vegetable gardens will claim riparian rights to surface water that flows within their land and will use water from open sources that flow through their land. Within those rights, the bundle of rights also emerge: absolute governance of water resources and land, alienation and exclusion rights from access by externals.

Like open sources, family-owned water sources and infrastructure used for domestic uses, such as deep and shallow wells, existing within private land are used and controlled by private owners. Neighbours and other people who require access to wells may request water from the wells. They need permission

to access and use water from family-owned sources. However, they cannot claim any water rights to the wells.

4. HORIZONTAL AND VERTICAL POLYCENTRIC GOVERNANCE IN WATER ACCESS AND MANAGEMENT FOR DOMESTIC AND PRODUCTIVE USES AT COMMUNITY- AND LOCAL GOVERNMENT-LEVELS

4.1 Water for Domestic Uses

In all homesteads, people use domestic water supply for drinking, washing clothes, cooking, washing hands and body, cleaning dishes and utensils, including cleaning surroundings (Shan et al., 2015; Howard et al., 2020; Crouch et al., 2021). In rural areas globally and Zambia in particular, boreholes with hand pumps and boreholes mechanized with water reticulation systems, hand-dug wells, and wells equipped with drills and surface sources such as streams and rivers, dams, and dykes provide important sources of domestic water supply. However, in most instances, the importance and access to domestic water sources vary from location to location. In most cases, this is based on the availability of water supply or water infrastructure with safe and clean water and the proximity of the water source to people's homesteads.

In Makopa and Simukale communities, boreholes equipped with hand pumps are the most important sources of water used for drinking and domestic purposes. They are accessed mainly by the general public within the community (Figure 2). As respondents clarified, Simukale village has four boreholes equipped with hand pumps. Each section of the community relies on the borehole closer to their homesteads. In addition,

> *"three of the boreholes are accessible to the public within the community, and a single household uses one because the user laid a claim on it despite it being implemented for the general public,"—Female respondent in a focused group discussion in Simukale village.*

Additionally, all boreholes, including the one with a single user, were implemented with external funds by the government through the local authority.

> *"Two boreholes closer to one of the dams cater for drinking, washing clothes, bathing and cleaning surroundings. The two boreholes do not support any livelihood or income-generating activities in the rainy and dry seasons. The nearby dam supports livestock*

watering and other productive uses. The third, with public access, in addition to being used for domestic purposes and drinking, also supports minor productive activities such as stock watering of small livestock like goats and pigs because it is situated further from the dams and other surface water sources. The last one is a single-use borehole, and the owner uses it as they please,"—Female respondent in a focused group discussion in Simukale village.

On the other hand, Makopa village has one public borehole.

> *"The borehole is accessible to a total of 76 households that reside within this village and in the neighbouring village,"—Female respondent in a focused group discussion in Makopa village.*

There is also a borehole in the distant fields outside Makopa village belonging to another village that is accessible to the people of Makopa when the main borehole within their community breaks down and is not accessible. However, in that distant field, Makopa has no claim to the land or the borehole they use when in dire need of water. Therefore, the Water Point Committee for the borehole has to permit and grant them access to water.

Additionally, Makopa village has boreholes within the community that have limited access, and only a few households can get water.

> *"There is also a borehole belonging to the school though it has limited access to the general public… only households close to the school get water from the borehole. However, these are allowed to get water from the school borehole because the public borehole is further from their homesteads,"—Female respondent in a focused group discussion in Makopa village.*

Makopa village also has a borehole belonging to a community health care facility not accessible to the general public. Therefore, water access at the health care facility is limited to patients and staff living close to the facility.

Figure 2: Most important sources of water for drinking

In both communities, public boreholes equipped with handpumps are essential to meet drinking and domestic water needs. They are also crucial for their reliability in providing water throughout the year. While other sources, such as wells, dry up during the dry seasons, water from boreholes with hand pumps is available all year round. Moreover, boreholes equipped with handpumps also increase the proportion of people within a community with access to clean and safe water. On the whole, borehole infrastructures provide the required water needs to the general public.

Other water sources for drinking and domestic uses in Makopa and Simukale villages include deep and shallow hand-dug wells. Simukale village, for example, has four family-owned hand-dug wells.

Water from the well is generally considered safe for drinking, and when correctly built and with good maintenance, wells provide a consistent supply of clean water and sometimes may last all year round. In addition, well-maintained water wells also have low or no bacterial load that would make the water unsafe for human consumption. Therefore, there are limited treatments required for drinking water.

Two of the wells in Simukale are well-covered and protected from contamination and use pulleys to lift water from the well. The other two lack adequate infrastructure to protect them from contamination and lack easier means of drawing water. Users rely on make-shift pulleys to draw water from underground using ropes connected to buckets or any open jerry cans.

In Makopa village, however, there is only one privately owned deep hand dug well equipped with a hand drill. For most poor people in rural communities, the cost of constructing a water well is still considered high.

Further, shallow wells and scoop holes are essential sources used by many to access drinking and domestic water.

Additionally, newer sources of water emerge during the rainy season. For example, people collect rainwater falling on iron sheets to fill buckets during the rainy season. This water is mainly used for cooking and washing. However, there is no permanent technology to harvest rainwater during the rainy season that would last a considerable amount of time during the year.

4.2 Vertical and Horizontal Polycentric Governance: Community-level Domestic Water Access and Use

Enhancing solutions for access to domestic water supply has entailed collectively or individually innovating processes that enhance access to water for household use for drinking and domestic supply. Responses from Local authority respondents at the district and national levels can be grouped as follows:

- Developing wells for self-supply;
- Sharing water resources inter and intra-community;
- Prioritising water needs; and
- Management of water sources

4.2.1 Developing Wells for Self-Supply to Enhance Water Access

Developing water infrastructure for self-supply is a solution that respondents highlighted as a critical contributor to enhancing water access by private families with the ability to invest in such technologies.

"… Those with money put up their family wells to solve water problems we face in this community […] and there are no external funds that contributed to putting up the wells,"—Male respondent in a focused group discussion in Simukale village.

Only a few can afford to build family wells for convenience. Such water sources provide water access to the owners or households that invest in having a water source within their premises. In addition, with permission, a few external persons may access water from privately owned deep hand-dug wells for drinking and domestic uses.

What comes out clearly from community decisions is that people are motivated mainly by the need to reduce vulnerabilities that expose people to poor access to drinking and domestic water. People are also encouraged to ensure that water for domestic use is available to take away the burden from children drawing water at the expense of attending school and men and women failing to participate in income-generating activities that rely on water due to inadequate access.

Poorer households also improvise with low-cost technology options for domestic water supply, such as scoop holes. In most cases, scoop holes do not require any financial investment to construct. In Makopa

village, such wells are seasonal. They are developed to respond to pressing needs at a particular time. When other reliable water sources are made available, such sources will no longer be in use.

"The village has uncountable temporal hand-dug shallow wells and scoop holes belonging to private individuals. These are dug in the beds of the streams when water in the streams dry up or is significantly reduced,"—A village community leader in Makopa Village.

4.2.2 Sharing of Water Resources

Findings indicate that, in both villages, people practice intracommunity sharing of water for domestic uses. In Makopa village, however, there is also intercommunity sharing of water sources due to the inadequacy of safe and clean water sources at people's disposal that are required to provide access to drinking and domestic purposes. The two communities share one public borehole for drinking and domestic uses.

Aside from inter and intracommunity sharing, multipurpose uses also enhance water sharing. For example, boreholes are primarily used for drinking and domestic purposes. The same applies to hand-dug wells and some scoop holes. However, though these sources are mainly used for drinking, they also serve as multipurpose sources. As exemplified by a male respondent in Makopa village during the focused group discussion,

> *"All the hand-dug wells and scoop holes are used for drinking, bathing, washing and cleaning of surroundings… at times, owners of the shallow wells and scoop holes also use them for gardens and stock watering*". *—Male respondent in a focused group discussion in Makopa Village.*

In other instances, shallow wells are used as alternative sources.

> *"…water from shallow wells is used when the borehole breaks down or when there are too many people at the borehole sources,"— Male respondent in a focused group discussion in Simukale village.*

This means people will use shallow hand-dug wells as alternative sources only when the primary source is unavailable. When public boreholes are fully operational, the hand-dug shallow wells are hardly used. Water usage from shallow wells is also limited because the water in the wells is considered unsafe for drinking and domestic use. Moreover, in later times of the dry season, most of the shallow wells dry up, posing a challenge to access to the users and, therefore, unreliable.

Intercommunity sharing is mainly driven by the push to look for alternative sources in another community when primary sources within the community are inadequate to support existing water needs.

4.2.3 Prioritising Water Needs for Domestic Uses

Although boreholes and hand-dug wells cater for all domestic water uses, sometime in the year requires that some access is limited to specific uses that are critical for survival. Therefore, throughout the year, the priority use of the borehole equipped with hand pumps is to ensure water access for drinking and cooking. In the dry season, when alternative water sources are no longer available because of drying up, communities will ensure that people can only get water for drinking and cooking at the borehole. Other water needs such as bathing, cleaning surroundings and laundry are redirected to shallow wells and other seemingly unsafe water sources to leave the borehole for domestic water use. Moreover, when clean sources get congested, people tend to get water for laundry and bathing at less clean sources to allow clean sources to be used for drinking and cooking.

Similarly, access to family-owned wells for non-owners is usually limited to drinking and domestic uses only. Outside domestic uses and drinking, i.e., productive uses, are not permitted to ensure water does not run out. For example,

"… Non-owners of the wells are only allowed to use them for drinking and domestic uses without using the water sources for gardening and other productive activities,"—Female respondent in Simukale village.

4.2.4 Vertical Polycentric Governance: Participatory Planning at the Interface with Local Government

In rural areas, the borehole infrastructure is the most common water source for drinking and domestic public use. When developing water infrastructure for public supply, vertical and horizontal polycentric decisions are made, and processes are to be followed at district and community levels, respectively. Local Authority representatives at the District and National levels elaborated that there are five processes to be followed when developing community boreholes. The processes mentioned also collaborated in different literature, including the Rural Water Supply and Sanitation Operation and Maintenance Implementation Manual & User Guide, the National Rural Water Supply and Sanitation Programme and the Village Water, Sanitation and Hygiene Education Committee – Roles and Responsibilities Training Guide. As a result, the following phases emerge in participatory planning to develop community boreholes:

a) Identification of water access gaps by the community

b) Application for prioritized water infrastructure construction/project by the community

c) Assessment of community prioritized infrastructures by Local Authority

d) Award and implementation of water infrastructure

e) Operation and maintenance of infrastructure

The first tier is mainly the responsibility of the community. Community needs are identified collectively among households that desire to apply for a borehole. In the second phase, the community, as beneficiaries of the water supply service, has the responsibility to request the service from the local authority by application. The third stage of the participatory planning process is assessment. The local authority assesses community-prioritised infrastructure to verify whether the community requires the water applied for. There are forms used to map out contextual situations on the ground and gaps identified during the verification processes. Once verified that the community needs the borehole, the local authority sources funds to implement the infrastructure in the fourth stage. They also engage contractors to drill the infrastructure. The local authority supervises all contractors and drillers working to implement water drilling. The last step is sustaining the infrastructure by ensuring that all aspects of the infrastructure work optimally consistently. This stage is also an ongoing process for the entire lifespan of the borehole infrastructure.

Phase 1: Identification of Water Access Gap and Challenges

Communities that see gaps and need for water call upon meetings to discuss water access challenges faced within communities and propose solutions to overcoming such challenges.

> *"When we identify that the community has inadequate water supply and complaints of inadequate water perpetuate, we call upon a community meeting where we agree that there is a need for a water infrastructure to be implemented. This follows with deliberations about the different water challenges people face… everyone from all community groups* [women, men and young people*] must be present for the meeting, to build community consensus in decisions arrived at" —Female respondent during focused group discussion in Simukale village.*

This phase allows collective views from all community members to voice out existing conditions and problematic issues faced by all. The meeting is also intended to allow for various opinions by various people about their needs to be highlighted. The diverse needs expressed are further assessed, from which priorities on which needs to address are agreed upon.

For public infrastructure implemented using external funds such as boreholes, community members within the villages will have access to water for domestic use. Access to public water sources is open to village or community occupants. Access is guaranteed to everyone, provided they meet the required prerequisites, such as contributing to sustaining the water infrastructure.

Within the spheres of access to water, de facto rights hold for everyone residing within the predefined location with a public water source. At the same time, rights to access can be withdrawn for households that fail to meet obligatory measures that govern access rules. This means that, in practice, access and claim to communally owned water are typically based on fulfilling laws within the communal rights access that legitimatise one's ability to continue enjoying the use of the publicly owned water resources.

During the initial meeting, community members should agree on which preferred sites they recommend should the application for boreholes be approved. The difficulty in substantiating water tenure remains if not corroborated with land within which open and surface sources flow and groundwater sources exist. For example, the development of public water boreholes requires all community members to have the right to access and use the infrastructure. Therefore, only public land, if unavailable, privately owned land is transformed into public land through community formal and informal means led by village leaders and enforced through local systems.

> *"We choose sites to put up any public water infrastructure on no man's land to lessen undue claims to the water resources by land owners in the future. However, suppose water experts advise that the site we select does not have sufficient groundwater resources* [and] *and propose another site which is on privately owned land; in that case, the land owner will surrender and sign over that portion of the piece of land so that it becomes public property. In addition, the recommended radius of 100m right around the water infrastructure is signed over to the community for water infrastructure development".— Female respondent in a focused group discussion in Makopa Village.*

Experience has taught developers of water resources about the dangers of hijacking water resources if no measures are put in place to protect the most vulnerable. Currently, water project implementers put in efforts to protect the capture of water resources by dishonest individuals. For example, when no public land can be found for water resource development, those who give up their land for community water development do so with full knowledge of the water being for public use. Further, the sharing of water resources is governed by rules of access set by communities and as recommended by the developers, i.e. government or NGOs. Such practices limit undue claims to water resources communally owned.

Phase 2: Application for Water Infrastructure Development

Select community members, preferably those proposed to be members of the Water Point Committee, draft an application to solicit water infrastructure from the local authority. The application should be backed by evidence of a constituted Water Point Committee, also called the Village Water, Sanitation and Hygiene Education (VWASHE) Committee, to show how the water point will be sustained once awarded. The Water Point Committees are designated to manage and sustain the borehole infrastructure through elective processes.

> *"The community appoints the water point committee members through the voting processes". —Female respondent in a focused group discussion in Makopa village*.

Local authority guidelines (Ministry of Local Government, 2010) recommend an equal number of males and females should comprise the Committee membership. For example, where ten members are required, it is recommended that five are males and five are female to promote gender equality. This has been collaborated through community interviews:

> *"…In terms of gender, an equal number of males and females are supposed to be voted into membership in the committee. For example, if the committee requires ten members, the group comprises five males and five females,"—Male respondent in Makopa village.*

However, when one gender is unwilling to participate in governing water resources, the gender with more willing participants tends to dominate.

In addition to showing evidence of having collaboratively selected a water point committee, the application covers suggested sites where to sink the borehole and minutes of the community deliberations highlighting water needs.

Further, the application is accompanied by a required once-off monetary contribution. Under Local Authority guidelines under the Ministry of Local Government and Housing, every community contributes a once-off fee of 1,500 Zambia Kwacha (equivalent to $95) to construct the new borehole. In addition, communities are required to gather building sand and stones, readily available within their localities, towards the construction of the borehole infrastructure. This contribution promotes ownership among users and enhances the sustainability of the investment.

At this stage, vertical integration is introduced more evidently when people request for public borehole infrastructure for domestic uses, primarily funded through external sources. All community-level decisions, i.e. raising 1,500 Zambian Kwacha and having a Water Point Committee in place, are arrived at

through recommendations made by the district-level government that support infrastructural development. In the study sites, communities have to meet all the local authority's requirements for water infrastructure investment (Ministry of Local Government, 2010).

> *"…The community should show that they* [community] *collaboratively decided on the location or site to implement water infrastructure and agreements on community contribution towards construction and post-implementation of infrastructure. They should also agree on how each community member will contribute towards sustaining the water infrastructure and what rules will govern the use and access of water from the public infrastructure. Such regulations and agreements are made during a community meeting where all discussions are documented and the minutes included as part of the formal application submitted to the Local Authority to request for the water infrastructure to be implemented". —A representative of the Local Authority in Nyimba* District.

This top-down vertical recommendation by the local authority to the communities is used to create structure in the selective processes for communities that should be prioritized for water investment. As a result, communities adhere to the recommendations to avoid risks of not being prioritized for water infrastructure investments.

Phase 3: Field Appraisal to Verify Proposed Project and Assessment of Community Priorities

Once the Local Authority receives the application, a team of Technical experts from the district office conducts site visits to appraise the contents of the application and assess the community's eligibility to qualify for a water infrastructure to be implemented in their community.

> *"As a Technical District Team, we follow with a field appraisal to find out how the community determined their needs; capture the population of people affected by the lack of water access, how many people will be accessing the proposed water infrastructure". [..] District Teams also have to ensure that they validate that sites chosen would benefit all people in a given community, "[…] Communities should also choose two sites where they would want their infrastructure implemented. Those are the sites where the contractor is taken when they go to put up boreholes. The site with better assessment in terms of water yield will be used as a site for implementation".—Local Government Representative from Nyimba District.*

During the assessment, a team of experts from the District Office calls community members to verify the information provided in the application. Where communities feel the information being verified is not what was initially proposed, they will voice out and provide correct feedback that will be used to make a final decision about awarding the community with water infrastructure.

Some of the considerations by the local authority when determining a community's eligibility to qualify for a borehole or water supply is whether or not all prerequisites have been followed. For example, a community that expresses interest in a water supply infrastructure, such as a borehole, is required to show community consensus and participation in determining the need for the infrastructure.

> *"When a community expresses the need for a water infrastructure, they are supposed to have a meeting and given an application form where they apply for the infrastructure to be developed. The meeting minutes held as a community should also be attached to the application".—Representative of the Local Authority in Nyimba District.*

The community should show that they collaboratively decided on the location or site to implement water infrastructure and agreements on community contribution towards construction and post-implementation of infrastructure. They should also agree on how each community member will contribute towards sustaining the water infrastructure and what rules will govern the use and access of water from the public infrastructure. Such regulations and agreements are made during a community meeting where all discussions are documented and the minutes included as part of the formal application submitted to the Local Authority to request for the water infrastructure to be implemented.

Further, the precondition for a community's application to be approved must show that the location or sites selected for borehole implementation are universally accessible by all to avoid undue claims of public infrastructure by private land owners should the infrastructure be implemented in their land, however, if no suitable public land is available for implementing the public borehole infrastructure. In that case, community leaders, preferably traditional leaders, engage land owners for land suitable to give up small pieces of land to accommodate borehole infrastructure. Such individuals would have to relinquish and sign over to the community a radius of 100m right around the proposed site for borehole infrastructure to be implemented. Such documented agreements are submitted as part of the application process for water infrastructural development to the Local Authority. While this process enhances community participation in water supply services, it also protects users from dishonest individuals who hijack public water infrastructure meant for the community. When no proper attentiveness is put in place when implementing water supply infrastructure, those with power and influence go back on their agreements

to use their land to provide water access for the entire community. This leaves the most vulnerable at a disadvantage of inadequate access to water services and negates the government's efforts in working towards fulfilling its international and regional human rights obligations to provide sustainable access to water supply among its people, especially the most vulnerable and to contribute towards poverty alleviation of Zambia's rural population.

Phase 4: Award and Implementation of Water Infrastructure

Once all prerequisites are met, contractors are engaged by the local authority and guided to proceed with drilling the borehole. Subsequently, the contractors go on-site to install borehole infrastructure for communities.

In contrast to these arrangements for public infrastructure, implementing private water sources such as boreholes, hand-dug wells, and other shallow wells does not require any form of due process to be followed. Owners source funds at the household level and will develop their water infrastructure according to specifications that are suitable for their needs. The only requirement that private individuals must meet is registering all boreholes drilled with the Water Resources Management Authority (WARMA).

Phase 5: Operations and Maintenance of Borehole Infrastructure

After the award of the water point, the last stage is the responsibility of the users. Water point beneficiaries are responsible for the borehole or water point operation and maintenance. Intra-horizontal networks are created to support and sustain the management of the water infrastructure.

> *"The boreholes have water committees that support the maintenance of the water infrastructure",—Female respondent in a focused group discussion in Simukale village.*

This stage encompasses all operations and preventative measures to ensure infrastructure is maintained and repaired. The borehole should be maintained comprehensively, from the hand pump, the superstructure and the surroundings. For example, the borehole should be protected from being accessed by livestock, and no vandalism should occur to the infrastructure. The Water Committees devise rules prohibiting children from handling public infrastructure to avoid damage. Community members are also encouraged to clean the surroundings of the public borehole, avoid doing laundry or growing crops and vegetables too close to the public infrastructure and contribute to fencing the borehole infrastructure to keep livestock from reaching the borehole directly.

Further, community monetary contributions are crucial at this stage to ensure that the infrastructure is well maintained and all parts that need replacing are done within the shortest time when the borehole

breaks down. The Water Point Committees develop rules enforcing promoting financial contributions towards the sustenance of public infrastructure. For example, the Water Committee ensure that each user meets their obligation to contribute a specific amount monthly or annually to a pool of funds used to fix the public infrastructure when it breaks down or requires replacements of damaged parts. Like elsewhere in rural Zambia, Simukale and Makopa villages make annual contributions, mostly paid after marketing crop harvests, because that is when people tend to have financial resources. When the borehole breaks down, money contributed by the community is used to repair and pay for broken-down parts.

4.3 Water for Productive Uses

Productive water use activities include brick-making, irrigated vegetable and crop cultivation and livestock watering (Figure 3). Sources of water for productive purposes take different forms.

Figure 3: Main productive activities that rely on water use

Makopa and Simukale villages rely on streams, dams and shallow wells to access water for productive purposes. Makopa village does not have developed multipurpose infrastructure such as dams, dykes, reservoirs or any form of water irrigation canals and technology to support productive activities. However, the primary productive water sources in Makopa village are seasonal streams.

“In this village, we rely on Lwangazi Stream, Nyalwela Stream and Nsimba Stream to do our gardening, water our livestock and also make bricks to build houses",—Male respondent in a focused group discussion in Makopa village.

Makopa village relies on naturally occurring surface streams that transverse communities and provide water for productive uses. The streams are multipurpose, catering for small-scale irrigation of cash crops and home consumption, e.g., bananas, beans, tomatoes and onions. No conveyance technologies, such as canals or pipes, are developed in the streams to support the irrigation of crops. For example, people accessing water from streams use buckets to water their vegetables. The streams are also used to water livestock within the community and are also accessed by neighbouring communities.

Despite their significant importance in offering livelihood opportunities to people, streams are seasonal. They dry up midyear or towards the end of the year, beginning in September and October. This causes the majority of people to stop their crop irrigation activities. Others opt to dig scoop holes (Figure 4) in the streams' beds to find groundwater used for gardening and stock watering.

Moreover, the drying up of the streams and other surface water sources leads people to use available boreholes equipped with hand pumps to access water for livestock and a few other productive activities.

Figure 4: Scoop holes dug in the stream or river beds to access water during the dry seasons

Simukale village has two streams on the outskirts of the village. One is on the far west, almost outside the village and the other traverse through the village. The streams are seasonal and are mainly used for livestock watering. However, people who reside near the streams also use them for gardening and crop production before they dry up.

Simukale village also has two dams(Figure 5). The two dams are the most prominent sources of water for productive activities, i.e. livestock watering and crop irrigation and are the most reliable,

"…this village has two dams – Simukale dam situated in the central parts of the village and Chilobelobe dam on the periphery of the village… Chilobelobe dam is the most reliable source for productive activities because it holds large volumes of water, is big and never dries up even in the dry season"—A village community leader in Simukale Village.

Details about the development and governance of the dams and their use in Simukale village are presented in the subsequent section.

Figure 5: Most important sources of water for productive purposes

4.3.1 Vertical Governance of Water Sources for Productive Uses

When developing dams, similar participatory processes to the borehole processes are used (Refer to 4.2.4). Both dams were implemented by the government in the 1970s through the Ministry of Agriculture – mainly to serve as multipurpose water sources intended to relieve challenges of productive water people were facing.

> *"The dams were just developed as pools of water where people could take their cattle for drinking. Some used the dams to irrigate their crops using traditional methods – use of*

buckets – because there were no deliberate efforts to equip the dams with irrigation technology"—A village community leader in Simukale Village.

In areas where communities rely on farming (crop and pastoral) as their mainstay, governments prioritize investments in infrastructure such as dams to provide adequate water supplies that impact nearly every individual and household within the community. For example, given the necessity of such investments, the government, through the Ministry of Agriculture, constructed canals to enhance irrigation activities in Simukale villages in the early 2000s.

"*…however, in the early 2000s, the Community Irrigation Cooperative for Chilobelobe dam, a composition of several villages that used the dam, engaged the government through the Ministry of Agriculture to support the development of canals to enhance agriculture and irrigation in the community.* [As a result] *canals were constructed to channel and convey water to fields and gardens for people using it for irrigation purposes,"—A village community leader in Simukale Village.*

One of the key reasons to develop canals and other water conveyance infrastructure in dams, dykes or any other reservoir is to promote alternative income-generating activities and enhance food security for users. In addition, the development is also intended to encourage locals to progress economically and diversify in livelihood opportunities (Bazin et al., 2011).

Irrigation canals and the developed water supply networks allowed communities to advance their multipurpose use for economic, social and environmental activities. With improved conveyance of water from the source to fields, most users enjoyed easy access to water when tending to their crops. As a result, there was also increased production and productivity in agricultural activities.

Access to water was open to all households from several villages to use water for irrigation. In addition, sub-divisions by the Community Irrigation Cooperative of land for crop growing allowed communities to foster economic growth within their villages and households and also provide a higher standard of living for their households through generating income from crop production.

However, access to essential water sources was lost without maintenance and proper safety measures.

"Access to water using irrigation canals lasted two years only before people began vandalizing the pipes and parts that conveyed water from the dam to the fields. All the valves used to regulate and open or close the water was stolen. In addition, as the investment was initially costly, the government did not make any efforts to build new

infrastructure. There was also no maintenance of the infrastructure. Currently, the canals do not work, and people have gone back to using buckets to get water for irrigation,"—A village community leader in Simukale Village.

At Simukale dam, however, not everyone benefits from irrigating their gardens. Households that own land around the dam are the majority of beneficiaries and users of the dam. People with fields not close to the dam face challenges because they have to have oxen and oxcarts to get water from the dam to use for productive purposes, such as watering gardens at home or in fields far away from the dam. Further, Simukale dam does not have any conveyance technologies to assist in obtaining water from primary sources to field sites. Irrigation methods require one to rely on buckets to draw water from the dam to the fields.

With the impacts of climate change affecting crop production, the lack of conveyance technologies compounds people's vulnerability to the effects of climate change. Climate-smart adaptation to extreme events increasingly requires using and accessing water technology that strengthens people's climate resilience. In addition, it offers the best alternative to enhance agricultural productivity to maintain sustainability in incomes at the household and community level.

4.4 Vertical and Horizontal Polycentric Governance: Community-level Productive Water Access and Use

4.4.1 Developing Shallow Wells to Enhance Water Access

Some of the horizontal solutions in water for productive uses include building small ponds to capture and store rainwater to water crops for a few months in a year before they dry up. Like domestic water uses, respondents also indicated that they made scoop holes in rivers and stream beds to access water – no matter how limited the access may be. The kind of infrastructure, collectively or individually improvised, is primarily guided by people's financial ability to create a water resource that meets their needs. Sometimes, groups of people/households may organize themselves to develop simple infrastructure such as troughs for cattle drinking in areas where open sources are far off to water livestock.

"We have a few troughs just next to the main borehole where we put water for cattle, goats and pigs to drink in the dry season".—Male community representative in Makopa village.

4.4.2 Sharing of Water Resources

Water for productive uses is shared intra and inter-community. Seasonal streams in the study sites are accessible to several villages within a predefined location. Livestock from several villages is watered in the same streams when water is available, mainly in the rainy season. In the dry season, water sharing, particularly intra-community sharing, for livestock happens at select boreholes within communities. (Details about sharing of water for productive uses are also elaborated in the preceding sections under 4.2.2)

4.4.3 Prioritising Water Needs for Productive Uses

When water is sufficient in ground and surface water sources, the need to prioritize any productive activity over another is irrelevant. All productive activities that support livelihoods are supported with available water resources. The rainy season gives opportunities for all productive activities to access water equally.

However, as surface water sources such as streams, rivers and scoop holes dry up or begin to dry up midyear to later in the year, people start to forego some productive activities. The first to lose water access are small-scale gardens that people put up to support their household for household consumption and sale.

> *"When water is significantly reduced in the surface water sources, it creates a challenge of limited productivity. We don't continue with our gardening activities to generate income because we know that water is not available. As a result, almost everyone stops growing vegetables. This limits income for families at the household level"—Female respondent in focused group discussion in Makopa village.*

When gardening is stopped, there is little money available for household use. With limited livelihood opportunities, people tend to look for alternative income sources. For example, some would go to town to look for jobs to get wages to feed their families. This shows that the burden of limited water access has far-reaching implications for disrupting family cohesion because it pushes heads of families to live away from their homes in search of income.

Stopping gardening means water is reserved for livestock that cannot wait until the rainy season to drink. The dry season poses complications for livestock because they tend to die of thirst.

"… in the dry season, we lose a lot of cattle because we do not have sufficient water for them. Even grazing is a problem, so we do our best to ensure the little water available is reserved for livestock,"—Male respondent in a focused group discussion in Makopa village.

Few open sources that still have water will serve livestock like cattle. However, small livestock, such as goats, pigs etc., is prioritized at boreholes as they do not require large volumes of water to drink. Nonetheless, large cattle are sometimes also allowed to get water at boreholes when the situation is dire and demanding or when surface water sources are far from homesteads.

4.5 Gender Dynamics in the Management of Water Infrastructure

In every society, the roles played by women and men differ based on the existing stereotyped gender norms. For example, some literature suggests that productive and income-generating activities are considered roles for men as heads of households (Bradshaw, 2013). On the other hand, women are assumed to be in a weaker state to bargain for positions that bring income. Other reports have related women's roles to include reproductive activities that include childbearing, childcare, and household chores are stereotyped to belong to women (OXFAM, 2018).

In Makopa and Simukale villages, gender roles and connotations influence women's and men's participation in critical decision-making processes at home and within communities. At different levels of water infrastructure, development and management, women and men are seen to contribute to various levels of degree.

Moreover, the lineage systems followed within communities contribute to informing what kinds of contributions will come from men and what roles women will perform. In a patrilineal society, for example, decision-making at the household level is dominated by men. This is typical for communities where men are positioned as reference points for knowledge and hold a *'high'* level of importance. For what should ideally be typical of any human being, men in such societies will tend to dominate as a naturalized ideological construct practised for many years (Lindemann, 2012). This may also be naturalized contexts since colonial times (Lindemann, 2012). However, in matrilineal societies, women dominate decision-making processes in a matrilineal society. However, this is mostly exclusively within families and does not always extend to decision-making processes that affect entire communities.

In water access and management for domestic uses, the role of women and men, particularly in rural areas, still follow pre-existing stereotypes, irrespective of the lineage systems practised within communities. For example, when there is no running water in a home – which is the case for most homes in rural areas, Makopa and Simukale villages included – women and girls are responsible for getting water for household use and drinking for the family. The implication is that women and girls are most affected by the lack of water access and must walk long distances to get water. In addition, women's productive activities at the family level are challenged because women spend long hours accessing water, and children sometimes tend to miss school to assist the family in getting water at home.

In some drier parts of the country, where distances to getting water for domestic purposes are very far, men participate in getting water using bicycles and oxen-drawn carts. Nonetheless, women still carry buckets of water on their heads to provide water access to the households.

As women are most burdened with water challenges, they keenly contribute to offering solutions that enhance access to water and deliver more efficient and sustainable management of water infrastructure at public water infrastructure. In a matrilineal society, women leading in such processes are more pronounced than their male counterparts. This is because women, compared to men, are willing to take on roles and responsibilities to sustain infrastructure for water resource management. For example, the ideal situation is to have an equal number of males and females in committee memberships. However, when one gender is unwilling to participate in governing water resources, the gender with more willing participants tends to dominate – and in this case, it is usually the women. In matrilineal communities where women have learned to stand firm and find solutions that support their well-being in water resource management and access, they give time, without hesitation, to ensuring water infrastructures are maintained. What is clear from this is that where women are the active providers in the family, their influence extends to managing resources such as water for domestic uses that enhance their well-being.

The same goes for development projects. Women are more willing to participate in development activities than men. A practical example of savings groups[4] is dominated mainly by women because they are more in touch with problems they face at the household level and always want to support their children better when they engage in development issues that improve the family's welfare. In agricultural cooperatives, women still dominate in terms of participation. By default, women's mere presence and participation

[4] According to World Vision Zambia's Annual Report of (2020), Savings groups allow members to accumulate funds in a safe, suitable and flexible manners. With the funds accumulated, members can borrow for use in productive activities, acquire assets and send children to school and later pay back at low interest rates

enhance their decision-making powers in matrilineal societies. This means they outnumber the men's dominance in such activities.

In patrilineal societies, on the other hand, men take the lead in decision-making processes, and roles and responsibilities are pretty pronounced that are in decision-making processes. Men usually take up high leadership positions at the village level. Regarding decision-making processes in water resource management, men, like women, participate, and both sexes make up good numbers of required persons to ensure the sustainability of water resource infrastructures. The decision about what kind of water infrastructure to implement is arrived at by the entire community comprising both men and women. This is achieved through consensus built during meetings where the whole community will decide what infrastructure to put up and where it will be implemented. In patrilineal societies, therefore, we see a fair balance of decision-making processes between the two genders.

These gender dynamics and levels of influence extend to how external supporters and district-level decision-makers prioritize who to work with for the successful implementation of the project. In communities where women actively participate, such as in matrilineal societies, government and NGOs identify the role that women play in advancing development agendas and therefore promote development propositions through women; because women are early adopters and success rates of development projects among women are higher compared to men. It was realized that men don't always prioritize development issues and meetings; therefore, they are seemingly left out when participating in development activities. As water projects and other forms of development are designed to reduce vulnerabilities within communities, working with early adopters promises high success rates. Women also take up initiatives in development more than men.

Further, some cooperatives prefer to work more with women than men, and therefore, women representatives are always larger in numbers than men. Cooperatives and projects that women lead show more that they have a sense of ownership in the project, prudent usage of resources and capital etc., from the implementer's point of view, they automatically lean more towards working with women than men. When given seed capital to multiply, the women will work hard to achieve their goals. In contrast, the men would tend to misuse the resources, meaning additional investments must be provided without graduating to the next level. At the end of the project cycle, cooperatives led by women will have achieved the required results and worked in an organized way. External project implementers excel as they want to be associated with those who succeed because that is how they measure their success rate to get more funding. With such experiences, project implementers also

recommend that women take up leadership positions in development work to instil the level of seriousness and ownership required for the project's success.

4.6 Challenges Related to Domestic and Productive Water Use and Access

Grouping domestic and productive water-related challenges raised by the respondents, the following four sets of challenges emerge: inadequate quantities of water, poor water quality for drinking, long distances covered to access water in the dry season, breaking down of water infrastructure, increased conflict at available sources and lack of conveyance technologies.

4.6.1 Inadequate Quantity of Water

In the rainy season, groundwater sources in boreholes, deep and shallow wells, are sufficient for drinking and other domestic uses. Similarly, surface water sources such as streams and rivers used for laundry, cleaning surroundings and bathing are equally adequately available. Surface water sources also provide much-needed water resources to water gardens. Livestock also has sufficient water supplies from nearby open sources within the community. Like water availability, there is also excellent and adequate grazing grass for livestock within communities during the rainy season.

However, the challenge comes in the dry season when open water sources in streams and rivers dry up. Domestic uses get affected. Firstly, the option of water harvested from rain into buckets and basins to use for domestic purposes is not available anymore to supplement available water sources. Consequently, boreholes get overcrowded because too many people need access to water for various uses at single sources. Therefore, everyone only gets a limited volume of water to cook and drink to allow others to use the water. Moreover, because many people want access to limited water sources, long queues are formed at boreholes, and people take extended periods to access water.

Regarding productive water, the change in seasons from rainy to dry also poses significant challenges in reduced water quantities required for productive purposes. Most of the water that fills up in open sources, such as streams during rainy seasons, is lost back to the atmosphere during the dry season through evapotranspiration (Nyambe and Feilberg, 2007). Consequently, reduced access to water resources hampers productive activities. In addition, the drying up of open sources causes productive activities to stop at streams and rivers. Stopping gardening also affects families because of limited sources of income.

4.6.2 Poor Water Quality for Drinking

Although not-so-frequent water quality tests are conducted, boreholes equipped with hand pumps and deep wells have reasonably good quality water free of harmful bacteria. However, when they are not available to supply drinking, and domestic water needs to communities, people opt to access water for drinking and domestic use from surface sources such as streams and scoop holes with compromised water quality. Moreover, such sources are also accessed by livestock such as pigs, goats and cattle for drinking and, therefore, unsafe for human consumption. Nonetheless, as options for water access are few, people still use such sources to get drinking water to avoid queuing at the available safe boreholes for long periods.

Further, the rainy season also brings the challenges of turbid water. From December to around March/April, water is turbid until the deep and shallow wells, streams, and rivers clear up. During this period, communities continuously complain that the quality of water they drink is not good enough. Although water quality may be safe, water users in rural areas perceive murky water as unclean. Moreover, whether the water is contaminated or not is insignificant to users. Communities only understand the need to consume water palatable enough to the eye. This has caused some households to avoid water from open sources with high turbidity levels. Therefore, they shift their access to borehole infrastructure to get water or deep wells constantly clear throughout all seasons. In addition, only when water in open sources clears up the muddy look would people return and start getting water for drinking from there.

4.6.3 Long Distances to Access Water in Dry Seasons

When sources of water closer to homesteads are no longer available, people are forced to walk long distances to get water. This consumes time spent accessing water, especially by women and children and reduces time spent working on their productive businesses and school, respectively.

Moreover, when distances to getting water for domestic purposes are very far, men tend to contribute by using motorized means, bicycles and oxen-drawn carts to get water. However, the majority of people lack such facilities and still have to carry water on their heads for a long distance. The burden on women is even more as primary home water providers. Irrespective of the distance, women still carry buckets of water on their heads to provide water access to the households.

4.6.4 Breaking Down of Water Infrastructure

Although boreholes with hand pumps are generally the most reliable water sources and serve most of the population, they break down from time to time. Therefore, they are not accessible for extended periods. As a result, people use alternative water sources for drinking and domestic purposes when this happens. Alternative water sources most in use include shallow wells dug in the river/stream beds, shallow hand-dug wells, water from open sources such as streams and distant boreholes located further from primary sources. In addition, in the rainy season, water harvested from rain is an alternative water source for drinking and domestic uses.

4.7 Water-related Conflicts

4.7.1 Conflicts of Water Scarcity

At the community scale, water resources concerning human and livestock populations are not equally distributed; therefore, water scarcity is a problem that some community members face from time to time more than others. In the dry season, this challenge exacerbates, causing people to compete for limited water resources for domestic and productive needs.

> *"In the dry season, when too many people are required to use the single water source to get water for drinking and other uses, people fight if some parties are greedy in borehole utilisation and refuse to allow others to get water within a specified period. For example, if one family comes with lots of water containers, e.g. 20 containers, to get water, they will want to fill out all their containers without allowing others a turn to get. They also deny those with few containers a chance to get water before them. Being the only one drawing water at the borehole for a long time causes conflict because they take too long to finish and give turns to others".—Female respondent in a focused group discussion in Makopa village.*

One of the most significant water-related conflicts in the study sites is egocentric access to water by a few individuals within a community. Selfish tendencies, exacerbated by the selfish characters of some individuals and, to a lesser extent, intra-community hierarchies and power relations, primarily contribute to disharmony when the need for water is rife with competing demands. However, when water is adequate, particularly in the rainy season, and can be accessed from several water points and sources, including deep and shallow wells, and surface sources, there is no competition.

4.7.2 Non-compliance with Access Rules as Drivers to Water Conflict

Conflicts also arise when rules of access are not followed. For example, at public boreholes, all users must make an annual or monthly contribution in monetary form towards the maintenance of the infrastructure.

> *" In this community, the rule is that everyone should contribute towards borehole maintenance […] those who refuse or fail to pay maintenance fee should not be allowed to get water for drinking or any other uses they need. However, those in committees tend to favour those close to them and still allow them to get water without paying for borehole maintenance". —Male respondent in focused group discussion in Makopa village.*

When non-compliant individuals seek favours from those charged with the responsibility to man the borehole infrastructure and request that they get water without any form of payment, compliant water users do not appreciate this behaviour.

> *Moreover, you will find that even our leaders with some level of influence and authority would sometimes deliberately exploit their power and not pay for maintenance yet continue to use water knowing that no one will confront them for payments". —Male respondent in focused group discussion in Makopa village.*

Not paying maintenance fees by leaders is seen as taking advantage of their authority. When communities that have paid for the maintenance of the water resource learn of such situations, mayhems arise, usually targeted at the Water Committee Members for allowing such to occur. In extreme cases, Makopa village voted to have Water Committee Members that allowed such to be removed from office and new ones appointed.

When the situation remained unresolved, compliant water users refused to pay for future infrastructure maintenance. Not only does this distort the rules of water access and take away opportunities to sustain public water infrastructures, but it also limits the power of the Water Point Committee to discipline water users not abiding by the set regulations.

4.7.3 Increased Conflict to Meet Multiple Water Needs during the Dry Season

When other water sources dry up, available sources must meet the community's multiple water requirements. For example, as surface water sources are no longer available, activities such as livestock watering are pushed to boreholes that become the most reliable sources that remain consistent during the dry season— increasing the frequency of accessing the borehole. As opposed to just acting as

sources for drinking and cooking, the dry season promotes even more uses of the boreholes; they cater for drinking and domestic purposes and stock watering, such as goats and pigs. In extreme cases where alternatives wholly run out, cattle are also watered at boreholes by putting water in basins for cattle to drink.

However, as uses become numerous at boreholes, there tends to be too much congestion to get water for domestic uses and provide water for livestock. As a result, water access conflicts increase at available public boreholes due to competing needs that a limited number of water sources within a community must meet. In addition, incidences of breaking down of the boreholes increase, a situation that further challenges people to access adequate water supplies for domestic and productive uses.

4.7.4 Conflicts Resulting from "Capturing" of Public Water Infrastructure

Although notably, undue claims of public water resources are negligible, incidences of water resource capture occur where people claim access and management of shared water resources. This would happen when due processes that protect the infrastructure are not adequately followed during project implementation. Simukale village highlights an incidence of infrastructure hijacking of a public water resource that should have benefited the entire community,

> *"…when people from the council came to assess the site of selection, our headman misled staff from the local authority and took them to the location not agreed on by the community [*a site closer to his homestead*]. Community members were shocked when they heard drilling machines putting up a borehole at the wrong spot […] For a borehole that should have been put up for the community. The new site is not centrally located and does not favour the location to be accessed by the rest of the community members". — Male respondent in a focused group discussion in Simukale Village.*

Ideally, chiefs and headmen are key authorities and link to community development projects, including water projects, proposed by external development such as government and NGOs. They provide leadership and guidance in the community regarding myriad issues of benefit to communities. They also preside over disputes within natural resources, including water. However, grievance and conflict mechanisms become distorted when they are at the centre of holding undue claims or capturing water infrastructure that disadvantages people. Significantly, this leaves communities muddled without means of addressing grievances for injustices experienced – leaving them to boycott accessing water resources to express displeasure and muttering among themselves.

Hijacking the public water infrastructure, such as the borehole to be implemented in proximity to someone's household, is also a significant source of conflict. For example, in Simukale village, conflicts ensued within communities when the chief misled project implementers to put up the public water borehole infrastructure close to their home, away from the site chosen collaboratively through community participation processes.

> *"I would say people from the Council, and their drillers come in good faith and are willing to do the right thing […] they are sometimes influenced by community leaders to change sites for the borehole […] the community leader diverted the borehole to be sited at a location that was not agreed on by the community. He showed the drillers a site closer to their homesteads. People just heard drilling machines working on a borehole that should have been put where community members agreed that it should be drilled […] the new site is not centrally located and does not favour the location to be accessed by the rest of the community members". ". —Female respondent in focused group discussion in Simukale village.*

Communities also boycott using the borehole infrastructure altogether, making it challenging for the borehole to work at an optimal level.

> *"…the disadvantage of such selfish behaviour is that it causes the borehole infrastructure not to work optimally. The boreholes are designed to have at least 25 households or about 250 people using them. This means that water will run continuously, and the pipes won't rust. This is also what the local authority recommends […]. Still, when the target community boycott using the borehole, that single household using it won't even enjoy the benefit because the low frequency of use will cause some parts not to work well, pipes will rust, and there is a build-up of iron content in the water". —Female respondent in focused group discussion in Simukale village.*

To the community, it is a loss because many people still won't have access to clean and safe water. To the government, this is a waste of investments when few or no people benefit from an infrastructure installed to alleviate water problems among the rural poor.

4.7.5 The Role of Traditional Leaders in Conflict Resolutions for Water and Natural Resources

Conflicts related to water access continue to generate concern, thus accentuating the importance of addressing the clashes using practical solutions created and accepted by those affected. Therefore, the

Water Point Committee leaders resolve that everyone follows rules of accessing water and maintaining the water infrastructure irrespective of who those affected associate with or whatever position they hold in society. If that fails, a traditional community leader – a head person, is engaged to resolve the conflict.

> *"…Those that refuse to pay are taken to the traditional leaders to answer why they are refusing to pay for a service they use". —Female respondent in a focused group discussion in Makopa village.*

Traditional leaders, including chiefs and headmen/women, have the authority to preside over communities within their jurisdiction. This accentuates the mandate to provide leadership over water disputes within their villages. At a minimum, traditional leaders are expected to be impartial in offering peaceful dialogues between parties in conflict and even find solutions to problems presented before their council.

Depending on the dispute, those guilty may be asked to pay a fine by the traditional leaders to appease disgruntled complainants and restore peace. According to research participants, suppose people deny paying a maintenance fee for the borehole while accessing water from the resource; the local headman/woman penalises the offender when the subject is brought before their council to preside over. This is because the headman/woman is the ultimate authority or leader at the community level. As respondents indicated,

> *"…The traditional leaders will sometimes fine people that refuse to pay for maintaining the water infrastructure as guided by the community rules […], but they* [traditional leaders] *also try to appeal to community members to cooperate and do the right thing for the good of the community" —Female respondent in a focused group discussion in Makopa village.*

However, when the traditional leaders entrusted with the power to mediate are at the centre of the problem, as was the case for Simukale village, conflicts never get resolved. Those disgruntled and affected by the injustice portray passive-aggressive behaviours that stop people from complying with rules that enhance the sustainability of the water infrastructure while accessing water. For example, they boycott making payments until they see the traditional leader complying while continuing to draw water from the borehole.

5. VERTICAL AND HORIZONTAL POLYCENTRIC GOVERNANCE AT DISTRICT AND NATIONAL LEVELS IN WATER RESOURCE MANAGEMENT

5.1 Intermediate/District level Vertical and Horizontal Integration in Water Access

Polycentrism at the district or intermediate level works through vertical and horizontal integration. Institutions working in water resource development and management primarily enhance access to water supply among citizens, especially the rural poor. As contained in the National Rural Water Supply and Sanitation Programme (NRWSSP), the government of Zambia promotes access to water for most of the rural population that is reliable, equitable, and adequate in quantity and quality through the provision of boreholes. However, closing up the access gap between urban and rural people and working towards achieving universal and equitable access to safe and affordable drinking water for all, as contained in the SDGs[5], requires robust efforts.

Laws and policies governing procedures for implementing water supply services are developed and enacted at the national level through parliament proceedings. Vertically, the rules are passed down to areas of implementation at the intermediate level. For example, the Local Government Act No. 2 of 2019, enacted by parliament, progresses through vertical integration to points of execution. The responsibility of providing primary access to water supply for drinking and domestic uses lies with the Local Authority under the Department of Housing and Infrastructure Development in the Ministry of Local Government and Housing. The Local Authority enhances and provides water supply services to areas within their jurisdictions. Local authorities have also been empowered to make by-laws and set guidelines and standards for water supply services.

Local authorities also operate through horizontal integration. For example, at the district level, local authorities account to peer departments and NGOs operating within the district through District Development Coordinating Committee (DDCC) meetings to provide updates and show progress on their work, challenges faced and what could be done to improve people's well-being. In addition, district officers have the responsibility to account to each other for transparency and ensure that policy guidelines and procedures are followed.

[5] Sustainable Development Goal 6. https://zambia.un.org/en/sdgs/6

Further, efforts to promote access to water for the rural poor by NGOs and private partners operating within the districts also promote horizontal integration across organizations – acting as equal contributors through funding water projects implemented by local authorities. The division of roles and responsibilities is clear, and the collaboration is well-defined. However, vertical integration is also seen when local authorities play a supervisory role or provide technical expertise to works implemented by private partners and NGOs to develop water resources. In this scenario, no work is implemented without the sanction of the local authority. This is the most common type of collaboration seen at the district level. As the responsibility of developing water resources lie with local authorities, all NGOs and private individuals have to implement their programmes within the guidelines and rules that govern the local authority in developing rural water supply services.

5.2 National-level Vertical and Horizontal Integration in Water Access

The current decision-making mechanisms at the national level, through to the province and district levels, follow existing institutional and legislative guidelines in various national documents that look at water supply and sanitation in Zambia. The National Water Supply and Sanitation Policy of 2020, anchored on the Vision 2030 and the Sustainable Development Goals, stipulates measures to guide the development and implementation of national plans and development programmes to enhance water supply and sanitation at all levels. The policy's main aim is to drive universal access to clean and safe water and adequate sanitation for the people in Zambia. Polycentrism is witnessed through policy guidelines that promote vertical integration of decision-making from national and provincial onto district and local levels. Other examples are seen in guidelines provided in policy measures, such as the 2010 National Water Policy. For example, the policy guidelines in the 2010 National Water Policy, among other provisions, support the provision of adequate, safe and cost-effective water supply and sanitation services considering environmental protection at all levels, national, provincial, district and local. Some of the policy objectives focus on guiding governance structures to implement water supply and sanitation services to enhance sustainable service delivery; provide for the implantation of strategies, maintenance, rehabilitation and operation of infrastructure for water supply and sanitation; and provide guidelines for improving resource planning, mobilization, utilization and reporting for sustainable and equitable water supply and sanitation service delivery.

On the other hand, the Water Supply and Sanitation Act No 28 of 1997 guides how water supply and sanitation services should be implemented. Utility companies regulated under the National Water Supply and Sanitation Council (NWASCO) provide water supply and sanitation services in urban areas. In contrast, in rural areas, guidelines offer for local authorities to provide water supply and sanitation services. In addition, the "Vision 2030" provides long-term goals to ensure significant increases in access to clean water and adequate sanitation for the population and offers guidelines to integrate sustainable water resource management.

Further, policy measures and guidelines also take into consideration several national and international instruments and commitments to which Zambia is ascribed, such as the Sustainable Development Goals, Agenda 21 and Agenda 2063, to ensure that Zambia's programmes are integrated with the regional and global development frameworks.

All the aforementioned legal and policy guidelines provide vertical integration from the national level and filter through to district-level governance in water supply and sanitation services.

6. VERTICAL AND HORIZONTAL POLYCENTRIC GOVERNANCE IN OTHER ADAPTATIONS TO CLIMATE CHANGE

In the preceding sections, the report has highlighted what sector-based support agencies in the water sector often overlook: how communities collaborate holistically through horizontal networks to prioritize pressing water needs for basic domestic needs and livestock when primary sources dry up. In addition, we noted how communities employ smart water management decisions to adapt to the impacts of droughts but forego small-scale crop growing and gardening in the dry season to let water be used for livestock. Finally, this section briefly touches on the applicability of this analysis for three other climate adaptation interventions: early warning, diversification in agriculture and forestry management.

6.1 Community-level Vertical and Horizontal Integration

Predictions of weather and seasonal changes and indigenous knowledge of observing the behaviour of certain insects and plants give rural people ideas of the kinds of weather expected during the rainy season. In Simukale village, respondents confirmed they had used unverified bottom-up climate and rainfall patterns predictions to determine the kinds of crops they would grow in a particular season.

Horizontal integration is explicit because people already know how to adapt when faced with limited access to water due to climate variability and the impacts of climate change.

Like elsewhere in rural Zambia (Mweemba, 2019), Makopa and Simukale village recounted that: (i) they dug scoop holes in river and stream beds to get water when sources dried up; (ii) they travelled to urban centres to find low-paying jobs to earn income when farming activities failed; (iii) cut down trees and burnt charcoal for sale to earn money when crops failed due to droughts. While horizontal decisions arrived to help communities cope and solve immediate livelihood challenges, some solutions are not sustainable. For example, indiscriminate cutting down trees for charcoal production poses an enormous threat to environmental degradation. This has far-reaching implications on further advancing climate change variability and impacts and is unsustainable for future generations. In a similar study, it was observed that cutting down trees potentially affected the mitigation of greenhouse gases with the depletion of trees, mainly since trees act as carbon sinks for carbon dioxide emitted into the atmosphere (Mweemba, 2019).

Nonetheless, vertical solutions are proposed to support communities' adaptation to climate change. Unfortunately, in climate change interventions, there is also a risk that the focus is mostly on meeting donor needs in project implementation for climate change adaptation. For example, projects funded to manage the forest by an NGO will be communicated to the target community about the project and expectations from either party. Unfortunately, in such top-down approaches, community participation is limited because proposed interventions are not necessarily based on an analysis of local adaptation needs for the community. Instead, to a great extent, interventions are implemented to meet donor requirements and what donors perceive would enhance the adaptive capacities of communities.

For example, interviews with district officials heard how available funding would not cover water infrastructural projects for water to irrigate or provide technology for livestock to have year-round access, even if that was what the community prioritised. Instead, NGOs will fund activities as stipulated in their proposals even if solutions do not align with community needs. For instance, they will fund forestry management and tree regeneration activities and will not change their plans to support the community's pressing needs. Nonetheless, this is not to say community participation is absent in climate change adaptation projects. There are examples elsewhere and in different contexts where bottom-up approaches have been used to draw on farmers' ideas of what would enhance adaptive capacities to agriculture and general livelihood.

However, despite well-written and funded projects that may exist to support communities, such projects may not always resonate with what communities believe in. A community that has relied on the forest to survive for wood and charcoal to cook may not see the need to preserve the forestry without adequate alternatives provided. They also practice tree-cutting to clear fields for crop production. Not everyone will listen and follow when asked to stop such practices and save the environment. However, motives may drive people to participate in top-down initiatives and respond to adaptation initiatives. Incentives of accessible and free farming inputs such as fertilizers and seeds are examples of support promised to be provided to villages that adopt zero-cutting down trees within a given forest management zone.

For this reason, communities will adhere to the recommendation about the proposed initiative effortlessly because they stand to gain if they change their behaviour. This situation exemplifies the risk that adaptation practices at the community level are primarily externally driven and channelled to meet organizational standards that initiate them. Donor requirements sometimes require rigorous efforts of actors' to recommend and provide directives that satisfy project requirements to meet what they perceive as well-intended measures for community adaptation.

6.2 Intermediate/District level Vertical and Horizontal Integration

District-level government interfaces with national policies and implements climate change adaptation activities in communities. All these governance processes are implemented through vertical integration decision-making processes. For example, the district-level government will provide information about practical and modern adaptation strategies that communities can benefit from to reduce the impact of climate change in agriculture and serve as early warning mechanisms to adapt to climate change impacts. In Makopa village, for example, the Ministry of Agriculture provide climate information about looming droughts and weather forecasts before the planting season.

> *"…we receive messages on our phones about the weather patterns. For example, we are informed about rainfall amounts or whether we should expect a drought before each farming season," —Male respondent during a focused group discussion in Makopa Village.*

Similarly, government officials interface with communities to provide real-time climate data on early warning systems on the occurrence of predicted climatic conditions that may lead to droughts or floods in a given year.

> *"…we have Agricultural Extension Officers that live around here, and they go around providing us with information about climate and weather and also the types of crops to plant". " —Male respondent during a focused group discussion in Makopa village.*

Early warning systems are intended to improve response strategies and adaptation at the community level. While this information is essential, the significance of the data is accentuated when communities use the information correctly to respond to adaptation needs in agriculture and water access in the community. Community participation, however, has been noted as a strong driver that can highlight the importance of legitimatizing externally channelled measures to support community adaptation initiatives. For example, the government began training community members to promote information dissemination to enhance adaptation and coping in agriculture.

> *"Farmers, also known as 'Rain gauge Minders', are trained by Zambia Metrological Department (ZMD) on how to conduct weather forecasts and also on how to collect rainfall data during the rainy season. Once trained and they begin collecting the required data, the information is sent to ZMD that helps to interpret the information before it is transmitted to the Ministry of Agriculture and onwards to communities". —NGO respondent in Nyimba District.*

Further, the supervisory role played by the district-level government when working with partners such as NGOs in implementing climate change adaptation programs is founded on vertical integration practices. While NGOs exist within the district, implementing programs is designed to fit into government policies and should respond to community needs. The district-level government generally possesses devolved powers to implement community projects. They are therefore mandated to oversee activities implemented by partners such as NGOs that possess broad-based resources to improve the implementation of activities and projects for rural Development.

7. CONCLUDING DISCUSSION

7.1 Conclusions

Findings of the study have highlighted the importance of the availability of adequate water supply for various uses in rural communities whose livelihoods are centred on the water to thrive. In Makopa and Simukale villages, groundwater sources remain the most important sources of water for drinking and domestic uses and significantly provide the much-needed supply for community use. For public use,

boreholes with hand pumps implemented using external financing are the most critical water sources for drinking and domestic use. Firstly, they have water throughout the year and do not dry up – guaranteeing access for drinking and domestic uses all year round. Secondly, they cater to large populations within a location or intracommunity – and the tenure of public water infrastructure is open to all members of the community that meet the rules of access, such as making monetary contributions for maintenance. There is also intercommunity sharing of water resources at public infrastructure. For example, in Makopa community, more than one community uses one public infrastructure to access water for drinking and domestic uses. In intra and inter-community sharing of water resources, horizontal integration governs decisions at the community level that promote access rules. We also see intra-horizontal decisions that support the management of public infrastructure that is communally owned. The most central management system for public water infrastructure is through local water committees that ensure the infrastructure is well maintained and sustained. Critical decisions and regulations are also obligatory to all users and essential in managing equitable and fair water access at communal sources. Notable strong horizontal integration within and among communities is enhanced when communities agree on standards and rules of access at collective water sources.

Vertical integration is introduced when people rely on infrastructure that is externally funded. Rules of access are also externally recommended to the community by developers or donors. To access public infrastructure for domestic and productive uses, communities must meet specific criteria to qualify for access.

While all public boreholes may be open to everyone's use, some boreholes, despite being implemented using government funds, are not accessible to the general public. These primarily serve public government institutions such as schools and health facilities. Access to such facilities is limited to ensure an undisrupted supply to government public institutions that are adequate supply for institutions. Public access to such sources is also limited to lessen congestion at the water source and reduction on breaking down the infrastructure resulting from overuse and congestion.

Further, in Makopa and Simukale villages, public boreholes are multiple-use facilities due to multiple water needs at the community level. For example, some public boreholes used for drinking are essential sources that cater to livestock watering. For one, this is because there are no alternative sources close by, particularly in the dry season, that could serve productive activities. This implies that the non-availability of surface water sources in the dry season drives the high use of boreholes to cater for productive water use in some locations. This creates high reliance on available boreholes, a situation

that causes congestion at available sources, increased breakdowns of the facilities, inadequate supply and conflict among competing users.

Alongside public boreholes, Makopa and Simukale villages have private sources, such as deep wells, used for drinking, domestic use, and irrigation. Private owners develop their own rules and decisions about the use and access of water. Because they claim water rights at their private sources, they also decide how external households will rely on their water sources for drinking, domestic and productive uses. As a result, external users that seek access to private family water wells conform to the set rules and regulations of the owners. Unfortunately, some water wells are seasonal and dry up during the dry season. In such instances, owners will also get water from communally-owned water boreholes, which creates additional strain on the public boreholes.

In addition, the analysis has shown that there are equally important sources, such as scoop holes, that are important water sources for domestic use. Scoop holes are developed to respond to pressing water needs that arise momentarily in a household when clean and safe sources are unavailable. However, when other more reliable and safe sources are available, such unclean and unsafe sources cease to be in use.

As regards productive activities – including gardening and crop production, livestock watering and brick making, surface water sources are the most important sources of water. These include streams, rivers, dams and scoop holes. Infrastructure such as dams implemented using government financing is open for public use and is communally owned. In Makopa village, there are no developed dams or any other reservoirs to support productive activities. Therefore, streams are the most critical sources for productive activities. Unfortunately, streams are seasonal and only have water for a few months of the year. Dry periods of the year pose a challenge because water dries up, and people are forced to stop all forms of gardening and crop farming. This reduces their access to income that would ideally be realised from selling vegetables. Moreover, with reduced surface water opportunities, some livestock migrates to get water from boreholes – creating further congestion at limited public boreholes used for drinking and domestic uses.

Although options for water access for drinking, domestic and productive water are available within Makopa and Simukale villages, there are several challenges people continue to face. The most significant is inadequate quantities for water use during the dry season. When seasonal wells and surface sources dry up, the communities have limited options to get water. Overcrowding increases conflicts, and

competition for limited water at the remaining water sources characterises day-to-day events. As such, people can only access limited amounts of water. Some activities, such as gardening and crop production, do not even receive water at specific periods in the year and have to stop completely. While stopping crop production may seem like a solution to saving the limited water resource for more pressing needs such as livestock watering, it has far-reaching implications on family cohesion. As there are limited opportunities for heads of households to support household activities when crop production is stopped, they have to leave their families and travel to urban locations to look for alternative livelihood opportunities. This leaves children alone within the homestead to fend for themselves. This alludes to disruption in family unity and may bring about other more severe complications of families breaking.

However, with known water challenges faced, horizontal and vertical integration occurs at the community level highlighting how people organise themselves to manage water, land and forest resources. Communities organise themselves and come up with locally sought decisions to respond to social problems and pressures that leave them with limited options for water, land and resources to support their livelihood activities. We observe horizontal integration embedded in the relations created to bring various resources (monetary, skill, and leadership, among others) to enhance access opportunities for water. Age-old solutions and decisions to improve water access are used collectively or individually in Makopa and Simukale communities. For example, excavating the river beds to get to groundwater is a solution that enhances access to productive activities in dried-up places. People also organise themselves to develop simple water troughs for livestock watering at boreholes when open surface sources dry up, or they are far off. A few well-to-do farmers put up deep wells using their investments to provide water supply for their households and possibly share with a few neighbours.

Furthermore, while water tenure may seemingly favour all users in theory, in practice, not all people benefit from the resources if their cultivated land is situated further from the primary water sources. This is because the means of irrigation are constricting. Moreover, the lack of conveyance technology at the dams, for example, to support irrigation, further limits people from the full benefits that result from having a communal dam within their location. Therefore, as complete access to use public water from such infrastructure is key to reducing poverty and enhancing food security, land tenure should collaborate alongside water tenure that ensures comprehensive benefits, especially for the marginalised communities. In addition, conveyance infrastructure that runs over the land should be promoted.

In rural communities, verbal agreements or informally agreed-upon rules guarantee access to water and use intra or inter-community. Loosely, this shows that water is not territorial. All households that contribute to the development of water infrastructure by participating in accessing the infrastructure from the local authority secure their rights to access and use water. Participating in securing water resources as a community on land in public domains gives it dominion for communities to claim access to water resources. At privately owned land, while formally secured water tenure claims may be achieved through long or short rental contracts of land with water resources, traditional and customary tenure is secured through the passage of property rights through families and lineage systems. People claim water wells and weirs on land that their elders or parents would have passed on to them.

Similarly, a traditional leader may pass on water rights to subjects by allocating land that holds surface and groundwater resources. While this may not be universally recognized as a legitimate passage of land and water rights internationally, its applicability is sufficient to cover one's access and rights to land and water resources in rural Zambia. Moreover, it will sufficiently protect several rights and securities to continue accessing water on allocated pieces of land. However, the question is whether neighbours asking for a right of way to the source can be denied such access. So there are no strict legitimate exclusion rights.

In customary systems, streams and dams are often described as open access by people within the communities and frequently described as communally owned by the people residing within the locations in proximity to the water sources. This is what is contained in theory. In practice, however, streams traversing pieces of land in private hands are claimed by the owners of the land. For land that is passed on through family lineage systems, the legality to access the land and to control access to water resources that exist and transverse through the land is backed by the narrative that the land belonged to their parents and had been in their family for years and now passed on to them for use. Even concerning crop cultivation, no outsider may grow crops on the land and use water resources for productive activities close to the stream if they have no rights to the land.

When water is sufficient and readily available, it reduces the burden on women fetching water for drinking and domestic purposes over long distances. In Makopa and Simukale villages, the responsibility of bringing water for drinking and domestic uses still lies with women because the types of infrastructure used are not developed to the level of allowing people to access water from their households or within their compounds.

Further, such impacts are universally experienced and comparable between matrilineal and patrilineal societies. In both sites, the burden of obtaining domestic water lies heavily on the women and children. When there is a water shortage for domestic and drinking, the impacts are most felt by those with inadequate opportunities to gain access.

While water tenure may be contested to fulfil competing water needs, the burden for each user is most felt by those affected. When livestock does not have sufficient water supplies, the men are responsible for taking the livestock to surface water sources that have, and in most cases, these might be in distant places.

Climate change impacts have continued to be felt among poor communities with reduced rainfall patterns, limiting agricultural productivity in rural areas and exacerbating hunger. With this understanding, people have instituted coping mechanisms to support their agrarian livelihoods. For example, when the streams dry up, people dig scoop holes in the streams' beds to find groundwater used for gardening and stock watering. It alleviates water challenges for an extended period to allow people to continue accessing the required water for crop and livestock watering.

Moreover, with climate change's impacts on crop production, the lack of conveyance technologies limits people's ability to cultivate required crops for improved home consumption and income generation. Therefore, adapting and coping with the impacts of climate change requires robust use and access to climate-smart and resilient technology that offers the best alternatives to enhance agricultural productivity and maintain sustainable incomes at the household and community level.

On the other hand, externally financed climate change adaptation projects have been instituted. This report proposes that such projects should advance local adaptation practices and enhance coping mechanisms for climate change's impacts. This also requires that communities adhere to the prerequisite measures they are given to qualify for funding. Nonetheless, we still see community participation as critical for buy-in, ownership of infrastructure, and sustainability build-in.

Age-old solutions continue to inform adaptive practices at the community level. For example, using indigenous knowledge, people continue to use bottom-up approaches to predict rainfall and weather patterns. However, with projects promoting environmental protection and smart farming activities, decisions are passed on from high levels to communities highlighting vertical integration in decision-making processes.

7.2 Key Actions and Recommendations

Investment in public boreholes should continue to be prioritised to ensure extensive coverage of people accessing water resources, ensuring equitable access and guaranteeing communal tenure in the ownership, access and use of communally owned sources. Moreover, in many ways, having access to public sources close to people's homesteads lessens the burden of walking a long distance to access water while allocating time to other home chores and productive activities.

In many ways, local solutions to water access are known. And age-old experiences provide people with knowledge on strategically aligning decisions with existing contexts to respond to water resource problems, such as water scarcity for domestic and productive uses and agricultural productivity. When designing projects to be used by communities, community participation should therefore be at the centre of all water development agenda to attract interest, support and ownership and ensure that recommended solutions address the real needs of the communities and represent community voices. Passing down development agendas with no community voices lessens community interest in seeing water infrastructure as their own, and care provided to it might not be sufficient to ensure sustainability. The case of vandalism to the dam canal and other conveyance infrastructure in Simukale village shows that the notion of participation in its development did not allow for opposing views to be brought together and take away the ambiguity of not knowing how to ensure infrastructure is maintained. The clue as to how water infrastructure should be sustained remains in the community's interest to protect the infrastructure.

In practice, we cannot separate water tenure from the land because water resources exist where the land is. So to have complete access and claim of the water resources, communal water rights should apply for users to surface water sources adjacent to privately owned land. Moreover, land should be opened to the general public who needs to access water resources at public dams if benefits are realised for all. Local arrangements and agreements should include how people get parcels of land to use public infrastructure without prejudice. Otherwise, in theory, surface sources, e.g. dams, are said to benefit the entire community; in practice, only a few will benefit, leaving the majority in the same positions of poverty and without access that do not favour economic and social growth. If such is not probable, the need for the development of conveyance should be emphasised to accommodate all people that need to use the infrastructure.

The impacts of climate change are already being felt, and the available solution is to adapt. Without adaptation, implications on the communities and most poor will be grave and retrogressive. There is a need for government to invest in water solutions that will respond to enhancing livelihoods for communities. Rural people rely on agriculture as their mainstay. Improving the availability of water infrastructure such as dams will increase access to productive uses and maintain good incomes at the family level.

Early warning of looming droughts or floods is important in adaptation to climate change. Unfortunately, not all people have access to technology, such as phones, that broadcast messages about weather patterns for particular seasons to inform recommended agricultural practices that promote high yields in agricultural produce. To increase the number of people with such kind of knowledge, it would be prudent to have a community campaign e.g. “tell your neighbour” campaign, to broadcast early warning messages. In addition, the involvement of community leaders such as local chiefs and Ward Development Committees would enhance the authenticity of the messages because these have authority within communities and their words are usually believable by community members.

Further, when droughts are announced through early systems, having more water boreholes remains one of the most important measures to enhance adaptive capacities at the community level. This has the potential to improve access to water even when severe shortages are experienced.

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