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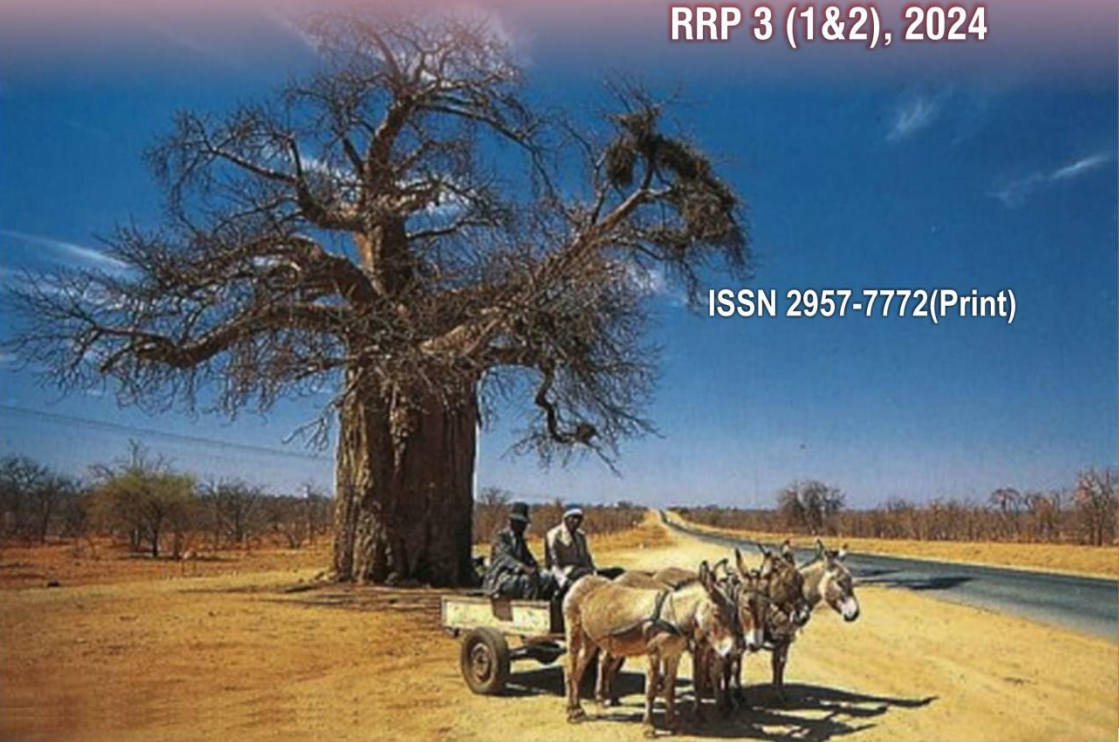

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JOURNAL PURPOSE

The purpose of the *Review of Rural Resilience Praxis is* to provide a forum for disaster risk mitigation, adaptation, and preparedness.

CONTRIBUTION AND READERSHIP

Sociologists, demographers, psychologists, development experts, planners, social workers, social engineers, economists, among others, whose focus is on rural resilience.

JOURNAL SPECIFICATIONS

Review of Rural Resilience Praxis

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SCOPE AND FOCUS

In as much as the urban economic trajectory is increasing by each day, the rural economy, especially in many developing countries, still comprises a great proportion of the extractive and accommodation industries. Retaining some spaces as rural areas remains critical given the integral role rural areas play in providing ecosystem services to both wildlife and humanity. In this light, rural resilience as practice beckons for critical studies especially in the face of the ever-threatening extreme weather events and climate change that then impact on the livelihoods and lifestyles of the rural communities. Review of Rural Resilience Praxis (RRRP) comes in as a platform for critical engagement by scholars, practitioners, and leaders as they seek to debate and proffer solutions to the rural sectors' sustainable growth trajectory, which is resilient to the vagaries of climate change. This journal is also aimed at championing the philosophy of the right to be rural. The issue of conviviality between the different constituencies of the sectors, compiled with the competing challenges of improving rural spaces while also making the conservation, and preservation debates matter is the hallmark of this platform of critical thinking and reflection. The journal is published bi-annually.

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A total number of words: 5000-7000 words and set in 12-point font size width with 1.5 line spacing.
Language: British/UK English
Title: must capture the gist and scope of the article
Names of authors: beginning with the first name and ending with the surname
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Groundwater Depletion and its Implications for Rural Livelihoods in Zimbabwe

FELIX MADYA[1], CHRISTINE CHIVANDIRE[2], NYASHA NDEMO[3] AND ENOCK MUSARA[4]

Abstract

This study critically explores the adverse impacts of groundwater depletion on the livelihoods of people in the rural areas of Zimbabwe. Water is one of the most important aspects of rural livelihoods in Zimbabwe as most of these livelihoods are centred on agriculture. We proffer the argument that, owing to the adverse effects of climate change, water scarcity has become more common in most areas and its effects are being felt and adversely experienced among the livelihoods in various rural settings where the supply of clean water has always been a major problem. This study is based on primary and secondary data with primary data collected through field surveys. Many rural residents were interviewed through questionnaires on how the depletion of water is a major crisis and threat to their livelihoods. Secondary data sources including articles, journals, books, report documents and case studies from various recognised publications. The data was analysed using qualitative techniques and presented using thematic analysis. The findings claim that the depletion of groundwater is a major threat to the livelihoods of the rural population. The reduction of groundwater has led to the abandonment of agricultural livelihoods by the people in Zimbabwe's rural areas. The depletion of groundwater is a result of continued use with failure to recharge. Due to the chain of reliance on agriculture and crop cultivation in rural areas, most livelihoods are affected by the groundwater crisis. There are no more or less surplus products to trade for other goods or income and those relying on selling labour continue to suffer more and migrate to urban areas for better opportunities thus having an impact on population distribution in rural areas. Lack of other means of acquiring water and outbreak of diseases have a huge influence also on livelihoods. The study concludes that rural livelihoods need to be rethought and ways must be sought of ensuring

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robust and sustainable rural communities. It is proposed that smart technologies should be used for rural livelihoods.

Keywords: *agriculture, water table, climate change, sustainable, poverty and reservoir*

INTRODUCTION

This study aims at discussing the impacts of the depletion of groundwater towards rural livelihoods in Zimbabwe. Aromolaran *et al*. (2019) posit that groundwater is an essential commodity that affects livelihoods at a universal level.

The International Labour Office (2019) avers that water plays a vital role in ensuring equitable, productive and sustainable rural economies thus enabling employment creation through various functional rural livelihoods. It can be said that in Zimbabwe rural livelihoods revolve around farming activities hence the reason they are most likely to be affected by the level of rainfall, ground water. Rural livelihoods have proved to be lucrative for investors in rural areas through the production of cash crops (Steel and van Lindert, 2017). Archarya (2006) argues that in developing countries such as India, agriculture is the major livelihood for families residing in both farm and non-farm sectors hence there is a need for a sustainable groundwater supply for the success of these livelihood programmes. Dobricic (2013) argue that agriculture remains the main livelihood base for people in lower-income countries and it has stimulated poverty reduction and economic growth.

For the sustainability of rural livelihoods that are centred on agriculture, there is a need for investing in technological change in terms of the lowering table to limit groundwater use and use water efficiently. Other rural livelihoods include livestock production, hunting, fishing and gathering and most of these require water as a major input for their success hence the need to look into the effects of groundwater depletion on rural livelihoods. FAO (2014) argues that groundwater is the main limitation to agricultural production as most smallholder farmers have poor access to water leading to the decline of farming livelihoods that are most depended on by the rural people.

Water is scarce in Zimbabwe's rural areas and people hardly find water for domestic use. Although groundwater is very important for livelihoods in the

rural area, the lack of alternatives to source water is a major crisis as there is less planning and management of water sources as it is noted that there are few water reservoirs such as dams that can be a source for irrigation water. Besides the depletion of groundwater, rural livelihoods are threatened by the impacts of climate change, outbreaks of diseases and lack of support from the government. Boreholes can be counted in these areas that are of very old technology hence their use for rural livelihoods is an expense. It is concluded that with the depletion of groundwater, interventions are required to make water available for rural livelihoods with various technologies to draw water from beneath. The study proposes the sustainability of rural livelihoods through the installation of boreholes and taps to make life easier for rural livelihoods. It is also proposed that the diversification of livelihoods through the introduction of other forms of livelihoods for supplementation. It is recommended that clean and smart farming methods should be embraced that are water-saving and requires less water.

CONCEPTUAL FRAMEWORK

This section frames the conceptual underpinnings on which this study is grounded. Livelihood is conceptualised by Acharya (2006) as adequate stock and flow of food and cash with an individual or family to meet its basic needs. Hussain (2005) argues that a livelihood is the sum of ways in which households obtain the things necessary for life both in good years and in bad. It can be approached as a method used by a household to gain food, clothing, shelter, water and healthcare and all other important basic needs that are required for survival and improvement of living standards. Chambers and Conway (1991) assert that livelihoods comprise people, their capabilities and activities required for means of living and access to assets both material and social resources. It is argued that the acquiring of livelihoods in rural areas depends on four principles that are production-based livelihoods, labour-based livelihoods, market-based livelihoods and transfer-based livelihoods and these livelihoods have different rates of groundwater dependency that this study explores (Mpande, 2016). The availability of basic inputs for production-based livelihoods is vital and, in this case, it should be applauded that water is one of the most essential inputs for agricultural production.

There is a tendency to reliance on rural livelihoods as each one of them in some instances relies on the other and making water a reliance of all hence the effect caused by the unavailability of water tends to highly impact the chain.

Labour-based livelihoods consist of labour sales by landless households and smallholder farmers and in this case, they require job creation in the farms and fields of the producing households. Barbier and Hochard (2014) argue that the availability of land is fundamental to rural livelihoods. Mpande *et al*. (2010) argue that the choice of rural livelihood is determined by the availability of a wider range of choices. Therefore, those with limited choices end up selling their labour for survival in the farms and fields of the wealthy rural residents and looking for non-agricultural livelihoods to sustain themselves such as selling. Chambers and Conway (1991) argue that the ability of livelihoods to cope with and recover from stress and shocks, makes them sustainable to provide sustainable livelihood opportunities for the next generation. Thus, the absence of water or its shortage means no, or fewer activities being done by the producers hence the impact on those who rely on them for their income. The market-based livelihood that is mainly the sale of agricultural products is another variety of rural livelihoods practiced across the globe. Goyal and Pereira (2022) identify the transition from agricultural livelihoods to lesser dependent livelihoods as diversification rather than a lack of land and inputs for farming. This implies the sale of surplus goods produced by the farmers in exchange for money or other goods equivalent.

Lastly, transference of food and remittance is another form of rural livelihood for people with disabilities, those old age and those with no income earning asserts thus who live in extreme poverty. This group of people look forward to their next meal and income from the government through social welfare and non-governmental organisations. FAO (2019) argue that whole agriculture remains the major source of income and food security for rural households, the extreme poor diversify their sources of income in non-agricultural activities. In this case, this study intends to proffer ways in which rural livelihoods can adapt and sustain themselves from the risk of water shortage due to the depletion of groundwater. This study needs to analyse the level of groundwater depletion in Zimbabwe's rural areas, examine the various sources of groundwater used to sustain livelihoods in these rural areas and as well identify how they are coping with groundwater-related challenges. Again, it seeks to identify the implications of water depletion on the outcomes of the livelihoods and the effects on the operation of these rural livelihoods in various areas. Below is a diagram that explains the reliance of rural livelihoods on water and how rural livelihoods are intertwined for the benefit of all who reside in the rural areas.

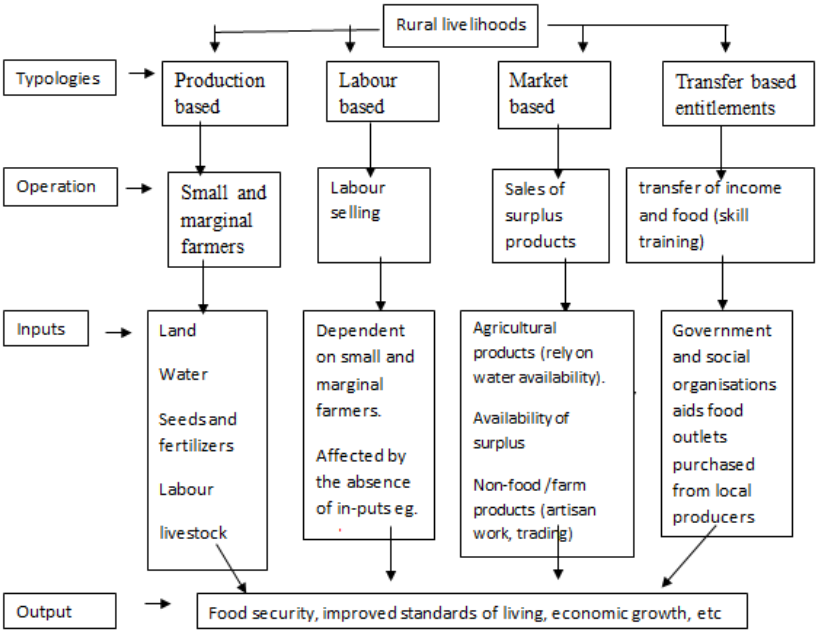

Figure 1: *Conceptual Framework: The Interconnection of Rural Livelihoods and Groundwater* (Authors, 2023)

LITERATURE REVIEW

In this section we critically explore pertinent literature with a view to ascertaining a research gap in available literature. Water is described as a life-sustaining resource that is significant to rural agricultural development and influences the livelihoods of millions of people in rural areas across the globe (Mohamed 2021). The scarcity of water is noted to imply the sustainability of rural livelihoods. Water is one of the tops that have recognised international concern as noted by its acknowledged role by the United Nations 2030 Agenda for Sustainable Development and it is noted to be vital for poverty eradication and sustainable green growth (UN, 2015). Thornton *et al*. (2019) revealed that 3.4 billion people live in rural areas with most of this population deriving its income from various livelihoods such as livestock raising, small-scale agriculture and fishing.

The International Labour Office (2019) is of the view that the sustainable management of ground water and the ability to provide for sufficient water infrastructure and its accessibility is important for the improvement of rural

livelihoods and their expansion as their sustainability results in job creation for rural people and the expansion of the economy while the failure to address water issues affect negatively the operation of these livelihoods. The United Nations Declaration on the Rights of Peasants and Other People Working in Rural Areas (2018) asserts that access to natural and productive resources for instance water is increasingly becoming a challenge for rural population and their livelihoods as the depletion and scarcity of water resources is rapidly increasing. UNDP (2010) argue that the threat of climate change is the greatest challenge to rural livelihoods in most developing countries. Onyekuru and Marchant (2014) support the view that climate change is projected to have adverse impacts on rural livelihoods. ILO (2013) is of the view that rural livelihoods radiate around the agro-food sector and this relies heavily on the availability of water for irrigation that uses 70 % of the available water in the rural areas.

Dobricic (2013) argue that the problem of groundwater scarcity has increased in Palestine and has affected communities relying on agriculture who depend primarily on water as the source for irrigation. OCHA (2012a) argues that agriculture in the Jordan Valley is dependent on water for irrigation and due to the depletion of water, the livelihoods slowly diminished. Aromolaran *et al*. (2019) argue that the output of livelihoods is directly and indirectly affected by the scarcity of water leading to losses being incurred. In the Jordan Valley, farming is the livelihood for rural people and is flourishing due to the availability of the largest spring known as Auja Spring. However, the rampant decrease of the spring water and the lowering of the water table has resulted in large losses in the irrigation and the destruction of the agricultural sector in the Jordan Valley in Palestine (Dobricic, 2013). Rumman (2012) is of the view that the increased scarcity of water has affected agriculture and livelihoods of rural population in Palestine. The implications of the absence of groundwater for livelihoods are seen as the cause of the migration of people from one place to the other especially along the river basin where cultivation is at play thus leading to the siltation of these water sources (Goyal and Pereira, 2022).

Pereira (2021) also argues that the depletion of groundwater has led to the conflict between human life and wild beasts as they move closer to water sources near the river basins. The depletion of water is noted in the Jordan Valley as the spring ceased to flow all year round for two decades as it only provided water in winter thus leading to the loss of livelihoods in which the people based on irrigation for their banana plantations (Dobricic, 2013). Brooks and Trottier (2012) also noted that in 20009 the spring only flowed for

16 days thus indicating the intensity of water depletion and the effects on the local livelihoods. OCHA (2012b) argues that the depletion of water has led to the decreased amount of cattle, abandonment of irrigations and the reduction in agricultural land in the rural areas of Palestine as people opt to sell their land for other developments such as winter houses thus losing their livelihoods and land to be farm worker for the Israelites with only farmers with private wells surviving the water depletion. Besides that, a shift to more resilient crops is noted as the farming of bananas is abandoned for resilient crops such as eggplants, palm trees, dates, herbs and zucchini (Dobricic, 2013).

Castaneda et al. (2018) argue that the most extreme poor about 80 per cent reside in rural areas. The availability of rural livelihoods can be their beak-even-point from poverty and a way of generating income and developing rural economies. In Africa, it was revealed that 70 per cent of the rural population is involved in farming activities as their source of income (Davis et al. 2010). In Asia and Latin America, half of the rural population is in farming activities. (Davis et al. 2010). FAO (2019) supports this view by arguing that rural livelihoods are based on agricultural activities where most people work in their own farms or agricultural wage employment due to high reliance on agriculture, the community is highly vulnerable to climatic shocks and weather events. the impacts of climate change have a greater role to play in the depletion of groundwater due to the rising temperatures and reduced rainfall that limits groundwater recharge thus affecting the performance of rural livelihood that highly depends on water. Climate change is noted to pose a massive threat to development in developing countries at most (Dube and Phiri, 2013).

Bruce, Rosendo and Brown (2010) argue that if climate change issues remain unaddressed at local levels, the African continent is at risk of becoming a global food crisis epicentre epicentre. Dobricic (2013) is of the view that agriculture is directly dependent on climate and climatic changes are likely to have adverse impacts on agriculture and water sources. This is already noted in the failure of rural livelihoods and agricultural projects that are being affected by lack of water and the rise in temperatures. Precipitation and temperature pattern changes are noted in the SU-Saharan Africa region with rainfall becoming hard to predict (Holmgren and Oberg, 2006; Dube and Phiri, 2013). Dube and Phiri (2013) blame climate change for the increasing poverty rate in Africa and high temperatures accompanied by low precipitation. In Nigeria, it is noted that increased sunlight intensity and insufficient rainfall are the major cause of water scarcity for rural domestic

use and livelihoods as the reservoirs and rivers end up drying due to the dropping of the water table (FAO, 2012; Aromolaram *et al*., 2019). Low rainfall has led to the lowering of groundwater table due to a lack of recharge.

Agriculture production is observed to be reduced due to the decreasing precipitation levels and the increase in temperatures (Nhemachena, 2007; Biggs *et al*., 2008). Davis *et al*. (2010) asserts that 90 per cent of rural households are involved in farming as their main livelihood. Dobricic (2013) note the same in the Jordan Valley where an estimate of 50% decrease in precipitation is projected by the latter part of the 21st century. Chenoweth (2011) argues that infiltration to the groundwater has reduced due to the decrease in precipitation leading to the lowering of groundwater and the reduction of its availability thus affecting farming livelihoods on that the people depend. Henceforth, not only in Africa the problem of groundwater depletion has been experienced by also in the Middle East. Dube and Phiri (2013) assert that rural economies are dependent on agriculture and livelihoods depend on crop production that is adversely affected by the negative developments in agriculture. Simatele *et al*. (2012) are of the view that in Africa, climate change is undermining the efforts to protect livelihoods. Aromolaran *et al*. (2019) argue that in Nigeria, rural livelihoods are done using water that is fetched from far away sources thus taking much of the people's time walking long distances to find water. The scarcity of water is recorded to be one of the most pressing issues in Nigeria's rural areas and people depend on their water supply for irrigation, domestic use and livelihoods (Aromolaran et al. 2019). Costa et al. (2016) explain the difficulties associated with obtaining water in rural areas as they argue that due to a lack of piped water in rural communities, wells are being dug deeper and deeper over time to reach underground water reservoirs. The depletion of water in Nigeria's rural areas has also been noted to be because of population increase and the number of people relying on livelihoods hence the increase in demand for water that has led to its shortage (Rortter and Van Keulen, 2008). The cost of pumping water is noted to be high in Nigeria as the boreholes require maintenance and electricity to operate the pumping machines that is not always available thus resulting in water scarcity for the livelihoods of rural people including fish farming, irrigation, and other crop production (Aromolaran *et al*., 2019). Losses are incurred as people spend more money acquiring enough water to run their livelihoods activities and the reduction of products produced. It is also argued that in Nigeria, water unavailability contributes to the choice of crops and the farming system. It is revealed that rural households in Nigeria perceived a negative effect of water depletion on

their livelihoods due to the increase in expenses encountered in energy and time consumed to obtain water (Aromolaran *et al*., 2019).

Due to the depletion of groundwater, alternatives are searched by various people that tend to be costly and increase the cost of running the livelihood as they ought to drill prolific boreholes that can sustain them all year round. In the Eastern Cape in South Africa, it is noted that livelihoods are centred on agricultural production that is on its decline as most people are now concentrating and specializing in intensive home gardening due to the unavailability of water (Thronton *et al*., 2019). It is noted that there is reduced farming livelihoods in rural areas as compared to the past where it is the most common source of income and most people are turning to non-farming activities (Mphande *et al*., 2016). In Madagascar, the scarcity of water has influenced the livelihoods of the people as most rural citizens rely on agriculture, fishing and stocking as their source of income and food supply for family (FAO, 2008). Mphande (2016) addresses livelihoods as an individual's ability to obtain necessities in life such as food, shelter, clothing and water hence any activities related to the search for these can be identified as a livelihood. In Sub Saharan African countries such as Nigeria, Kenya, Malawi and Tanzania and in India an Asian country, it is recorded that farmers are opting for diversification instead of farming as their only livelihood that has proved to be unsustainable due to the challenges it is facing hence leading to their failure to support their families through it (Mphande *et al*., 2016).

Small-scale businesses, including the selling second-hand clothes, scrapped material and car parts, hawking and readymade food are increasingly becoming more common sources of income in the rural areas of the above-mentioned countries (Mphande *et al*. 2016). A transition has also been noted arising from lack of rain and underground water from the farming of maize to drought-resistant crops such as sorghum, and millet among others (Thierferlder *et al*., 2015). On the other hand, Goyal and Pereira (2022) argue that due to the scarcity of water, there is a diversification from agricultural livelihoods to lesser water-dependent livelihoods in rural areas such as small businesses, tourism, mining, reliance on forest resources and livestock herding. Goyal and Pereira (2022) argue that agriculture is vulnerable to water deficit, and this arises to the emergence of various pests that reduces agricultural production and the capacity to gain income from it thus the reason why there is a shift from agriculture.

Water is at the midpoint of human life and all the livelihoods they rely on for their living but it is noted that its depletion has raised much concern regarding

rural livelihoods that are at risk due to water-related risks associated with them. Orr *et al*. (2009) assert that water-induced risks are rising with the increase in global exploitation of water resources throughout the universe that has resulted in the damage to the ecosystem leading to climate change. Climate change is in the run towards the inaccessibility of ground water that is the major source of rural livelihoods as it causes prolonged droughts that lead to reduced water supply leading to water insecurity and extreme lowering of groundwater levels. Goyal and Pereira (2022) support this view as they argue that rural communities are mostly affected and at risk of water depletion that has impacted their agricultural livelihoods and household activities that in most cases end in people dumping their water-related livelihoods and looking for other alternatives to earn income that is in some instance illegal. Garrick and Hall (2014) argue that water-induced risks can be grouped into four categories that are inadequate quality, decreased resilience systems shortage of water and excess water. Noting these categories, all have adverse implications on rural livelihoods. The focus of this study agrees with the idea that the inadequacy of water and its lack of accessibility due to the depletion of groundwater resources is a major crisis that affects not threaten the livelihoods but even human lives as water is the centre of all living things. In this case, the safeguarding of water sources and their access and availability for human livelihoods and development is essential for rural development and the growth of the economies of these marginalized environments. Garrick and Hall (2014) call for the protection of water sources against pollution and several water-related disasters that may lower the functionality of rural livelihoods.

METHODOLOGY

This study is based on a desktop review in which as number of available literature from the past studies was reviewed for the purpose of this study. Secondary data was collected from various literature, official documents and publications from recognised organisations as a way of supplying this study with vivid information that is reliable and valid as per the records. Articles, documents, reports and books among other secondary data sources were used to gather the information presented in this study. Case study analysis through the reviewing of past studies on the impacts of groundwater depletion on rural livelihoods and how various livelihoods are affected by the problem and how different communities are coping up with the situation making sure that their livelihoods continue to be functional. A qualitative research design was used for the study in dealing with qualitative data related to the study and its analysis. The research findings were presented in a thematic way so as to have clear descriptions of the results in a way that is easy to interpret by the end users.

FINDINGS

Dube and Phiri (2013) revealed that groundwater is not recharging in areas such as Matopo due to low rainfall and the change in precipitation patterns with rainfall starting late and ending earlier than the previous patterns before the crops even mature thus straining the local livelihoods. The depletion of groundwater is seen to affect livestock in rural areas due to drought and lack of enough grazing for the animals. The unavailability of fresh grazing areas is negatively affecting rural livelihoods, especially among the people relying on gardening as goats and cattle break into their gardens for fresh pasture. The change in rainfall patterns and prolonged droughts have affected the pastures leaving them with dry grass and fewer reservoirs for animal drinking water and the lowering of the water table leaves the surface dry thus resulting in poor pastures that will force domestic animals to break into fields and gardens leading to severe losses on the farmers.

Apart from that the depletion and unavailability of water for rural livelihoods is connected with conflicts among the families and the society. It is found out that the failure of livelihoods due to shortage of water results in disputes among families as most of them rely on these livelihoods as their source of income and food. Henceforth, their failure means that there is no or little food for consumption and no income to run the families thus leading to fights and in some serious cases divorce due to the failure to provide for the family. Gender-based violence is recorded to emanate from the poor operation of livelihoods that have left many rural women victims of it.

The results obtained indicated that the water table is rapidly lowering in most rural areas. The effects of groundwater depletion are noted in most rural areas as the residents' report that in the past the water table used to recharge as noted with the rising level of water in the wells but in the meantime, the water table continues to lower down as the water is used thus affecting agricultural livelihoods. This is seen through the withering of banana trees and their drying thus leading to losses on the people in most areas within the Manicaland Province. It is said that water scarcity is driven by climate change as reflecting backward, water was available in all areas hence people are now walking 2-5km to get water for their livelihoods that lowers the extent of the livelihoods as most resolve to farming on a very small portion of land. The results also argue that in Mudzi and Manicaland, livelihoods are affected among the people who used to do early farming in wetlands as these areas are now dry due to groundwater depletion caused by high temperatures thus most people have lost their livelihoods that they relied on for their income through

the sale of fresh maize and rice. The depletion of groundwater in most parts of the country led to the abandonment of livelihoods.

CASE STUDIES

GWANDA

Gwanda is located in the southern part of Matebeleland and the southern part of Zimbabwe. Zimbabwe Vulnerability Assessment Committee (ZIMVAC) (2011) argues that this area is a low-lying area and mostly known to be the hottest and driest part of the country with erratic rainfall and animal husbandry remains the major livelihood supported by rain-fed cultivation of sorghum, sweet potatoes, pulses and maize (ZIMVAC 2011; Chitongo et al, 2019). It is revealed that though maize is the main crop for most livelihoods, sorghum and millet are being cultivated to mitigate the effects of drought (Chitongo, 2019). In other words, water shortage has resulted in the shift from maize production to small grains production. Chitongo (2019) revealed that drought-resistant crops are adapted as a solution to climate change and depletion of water as they have deep, fibrous and extensive root systems that help they to produce a good yield in rainfall below 300mm. It is argued that water is a scarce commodity due to the uneven distribution of water sources and frequent and periodic droughts that lead to the drying of dams around July and August thus leaving the community in the struggles to acquire household water requirements (Chitongo, 2019).

Hove *et al.* (2022) have revealed that there is less rainfall to support agricultural activities during the major cropping seasons in Gwanda that results from unpredictable weather patterns. ZIMVAC (2011) has revealed that livelihoods in Gwanda district are highly reliant on agro-pastoral production systems due to the high temperatures and dry weather experienced in the area. Though livestock is the major livelihood that offers cash income in Gwanda, the shortage of water is the main reason for hardship in livelihood management as livestock herds migrate to as far as Botswana for pasture and water (ZIMVAC 2011). Hove *et al.* (2022) argue that the main species of livestock kept in the area are cattle, donkeys, goats and poultry. In other words, it can be said that the main livelihood system in Gwanda is the production-based livelihood though there is market-based livelihood noted by activities such as gold mining, beer brewing and local and cross border employment (ZIMVAC 2011). Of several strategies are adopted to cope with the water shortage in Gwanda to keep the livelihoods going such as increased crop spacing, conservation agriculture, livestock water and feed supplementation, intercropping and moving livestock to better grazing

(Chitongo, 2019). United States Agency for International Development (USAID) (2021) and Hove et al. (2022) argue that horticulture and irrigation schemes are noted to be another way of survival in Gwanda District through the farming of leaf vegetables, tomatoes, green mealies and onions. Hove *et al.* (2022) due to groundwater depletion, access to irrigable gardens is a struggle for the people as they must travel a distance of 5km or more to reach the gardens in Pulipeli village and use a bucket irrigation system that is labour intensive thus leading to a reduced portion of land irrigated. In short, it can be said that agricultural livelihoods in Gwanda struggle to survive due to harsh weather conditions and extreme water shortage as noted by the absence of water for domestic use. It should be applauded that the region have mitigation and resilient ways of coping with water depletion for the survival of their livelihoods that is supposed to be done for household to continue earning income for their families.

MUZARABANI

Muzarabani District is located in the northern Lowveld of Zimbabwe and experiences extreme climatic conditions (Manyani, 2017). Murwira *et al*. (2012) revealed that Muzarabani District is mostly affected by severe dry spells and seasonal droughts. Muzarabani district is made up of communal and large-scale farming as some of the livelihoods that people acquire income from. Mavhura and Manyena (2018) argue that the cultivation of crops in this district is mainly done along water courses. Unlike Gwanda and Mudzi, Muzarabani experiences floods due to the spilling off of water from the Kariba dam that affects its livelihoods (Murwira *et al*. 2012; Manyani, 2017) revealed that flood recession cultivation promotes the cultivation of crops twice a year with no irrigation as the soil will remain moist till the end of June, thus indicating the availability of groundwater and a higher water table to allow for such livelihood to progress. On the other hand, Manyani (2017) found out that water was one of the major challenges to the survival of livelihoods as detected by the depletion of groundwater and the lowering of the water table that leads people to resort to digging wells to obtain water for market gardening and for their livestock that also dries up before the rain season. Mavhura *et al*. 2013). Small-scale farming is mostly practised in the district and is mainly done in the wet season through the cultivation of maize and cotton as they rely on rain-fed agriculture (Delele *et al*. 2015). Livelihoods also continue in the dry season where small-scale bucket-irrigation is done in the gardens and vegetables and maize are planted (Mavhura and Manyena, 2018). Manyina (2017) revealed that maize, pearl millet, sorghum, cotton and finger millet are the most grown crops in the region. various forms of livelihoods are done in Muzarabani as noted by the

presence of wild fruit gathering, mining, trade and livestock rearing among others (Manyani, 2017). Manyani (2017) argue that water scarcity is one of the major challenges that affect the district's livelihoods. Sango and Godwell (2015) argues that the gathering of wild fruits in Muzarabani is affected by the change in climatic conditions and the fruits have become scarcer affecting the households relying on them. Due to water depletion, livestock owners migrate in search of water to as far as Musengezi or Zambezi River where they camp during the hot and dry seasons (Manyani 2017). Thus, like any other rural areas, Muzarabani is also a victim of groundwater depletion as noted by its livelihood operation.

MUDZI

Mutami and Chazovachii (2012) revealed that farming is one of the livelihoods that is done on Mudzi with most households growing maize for subsistence and commercial purposes. ZIMVAC (2011) argue that Mudzi is a lowveld zone associated with extensive rain-fed cultivation of maize, groundnuts and maize and cotton production and animal husbandry. Food and Nutrition Council (FNC) (2022) revealed that informal trading, carpentry, welding, gold panning and small-scale mining are some of the livelihoods that are carried out in Mudzi that fit in the third category of livelihoods that is the market-based. Landless households are noted to rely on gold panning, casual labour and petty trade (ZIMVAC 2011). Food and Nutrition Council (FNC) (2022) support this view as they argue that agriculture is the primary livelihood in the district and the poor with no livestock opt for casual labour including working in other people's fields and looking over their livestock area as a way of acquiring income. Mutami and Chazovachii (2012) argue that Mudzi is a semi-arid region that receives 40-650mm of rainfall annually, with high temperatures that affect livelihoods in this area. The change in rain seasons is identified as the cause for groundwater depletion due to insufficient water table recharge as the rain season now starts in December and ends in February, unlike in the past when the rain season expanded from October to April thus affecting the cropping seasons (Mutami and Chazovachii 2012). Due to continued crop failure because of insufficient water and moisture, the households in Mudzi have resolved to the production of small grains that are drought-resistant such as sorghum, rapoko and millet (Mutami and Chazovachii, 2012). Thus, water depletion has affected maize production in the region and livestock production as noted by the severe loss of cattle and minimal loss recorded among sheep and goats due to lack of pasture and unavailability of water in the dry seasons (De la Fuente 2008). Food and Nutrition Council (FNC) (2022) also revealed that a shortage of water for livestock is being experienced that is resulting in large trekking distances and

water stress causing the death of livestock. The depletion of groundwater can therefore be argued to be the major cause of livelihood failure in Mudzi District.

DISCUSSION

The types of livelihoods differ with regions and the ecological conditions of that area. Though water is a major input for rural livelihoods, it is noted that the failure of these projects does not only arise from the depletion of water but also the unavailability of other inputs such as capital, fertilisers and machinery to easy their work. The lack of basic inputs such as human capital where one has the knowledge, personality and social behaviour to handle a livelihood can be noted as a threat to the success of rural livelihoods (Mphande *et al*., 2016). In other words, lack of training, experience and skills on how to handle a livelihood regardless of the availability of water is a red flag for failure. Though groundwater is very important for livelihoods in the rural area, the lack of alternatives is a major crisis as there is less planning and management of water sources as it is noted that there are few water reservoirs such as dams that can be a source for irrigation water. Besides the depletion of groundwater, rural livelihoods are threatened by the impacts of climate change, an outbreak of diseases and a lack of support from the government. Boreholes can be counted in these areas that are of very old technology hence their use for rural livelihoods is an expense. The success of rural livelihoods depends on many factors and in most instances these contributors of successful and sustainable rural livelihoods are ignored and neglected. Access to credit loans is essential in facilitating the growth of rural livelihoods due to the lack of capital for most rural poor residents. Besides that, the lack of linkages with the urban areas has affected the market for rural households as they find it difficult to sell their products.

CONCLUSIONS AND RECOMMENDATIONS

It is concluded that with the depletion of groundwater, interventions are required to make water available for rural livelihoods using various technologies to draw water from beneath. The study proposes the sustainability of rural livelihoods through the installation of boreholes and taps to make life easier for rural livelihoods. The study recommends the drilling of community boreholes to help keep rural livelihoods going especially irrigation, gardening and other farming-related projects that are abandoned due to the scarcity of water. It is also proposed that the diversification of livelihoods through the introduction of other forms of livelihoods for supplementation. It is recommended that clean and smart farming methods should be embraced that are water-saving and require less

water. The study proposes a transition from basically cultivated crops such as maize to more resistant crops that can survive less water and cope with its shortage such as small grains. It is recommended that there is a need for the embracement of integrated water resources management in rural areas through community engagement and awareness where citizens are given the mandate to safeguard the available underground water sources in their communities such as boreholes and springs. The study recommends the coordination of non-governmental organisations such as Care Zimbabwe, Caritas, World Vision and many others and their aid in drilling boreholes in Zimbabwe's rural areas and helping with the supply of crop seeds that take a short time to harvest as a way of sustaining rural livelihoods. The study recommends the adoption of strategies, policies and other legal instruments to guide water use and its management in rural areas.

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