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Indigenous Knowledge Use and its Constraints in Drought Resilience Building: A Case of Rural Gwembe-Zambia

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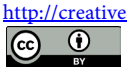


Abstract

Climate variability and the place of indigenous knowledge as part of disaster risk reduction have been gaining momentum in the recent years. The study was aimed at determining indigenous knowledge practices in agriculture, rainwater harvesting and early warning systems and associated constraints towards drought resilience building. A qualitative approach and a case study design with 140 participants comprising household heads, key informants, and focus group representatives was undertaken from six selected drought prone rural communities of Chief Chipepo and Munyumbwe of Gwembe district. Purposive and convenience sampling was utilized with open-ended in-depth interviews. The study utilized thematic data analysis with the aid of Nvivo Pro 12. Findings were that conservation farming was predominantly perceived as indigenous. Rain-water harvesting was largely limited to dug-out ponds, shallow wells and few weir dams. Indigenous early warning systems involved observations of behavior of plants, animal, insects and celestial bodies and local traditional ceremony called *Iwiindi* for the prediction of weather conditions and providing a que for preparedness. It was concluded that while indigenous knowledge use was existent, socio economic, environmental and institutional related constraints affected its widespread use there by affecting resilience building against future drought events. The study contributes to enrichment of knowledge in indigenous knowledge practices in the stated segments which were context specific but replicable in areas with similar characteristics. Documentation of indigenous practices with potential to enhance drought related resilience building was recommended.

Keywords

Indigenous Knowledge, Drought Resilience Building, Agricultural Practices,

Early Warning Systems, Rain Water Harvesting

1. Introduction

There has been a growing interest in the role of indigenous knowledge towards reducing hazard risks over the years. Following the devastation of 2004 Indian Tsunami, rare success stories of how people from Indonesia, Myanmar and Thailand survived the event through the use of indigenous knowledge were collected. Over the years even technocratic institutions such as UN have embraced the need to incorporate indigenous knowledge as a way to ensure communities take a leading role in their affairs (Briggs, 2013; Quilo et al., 2015). The use of indigenous knowledge and practices across the globe have been acknowledged with a growing prominence in climate change adaptation and in the world where modernity and technology tend to be prevalent (Hiwasaki, Luna, & Shaw, 2014).

One common feature of indigenous knowledge is that it involves a non-formal means of dissemination from one generation to the other. Furthermore, when it comes to surviving hazard risks and consequences communities tend to know exactly how to respond, prevent, mitigate, prepare and recover, based on their understanding of their environment and interactions.

There are several scholars who have contested how indigenous knowledge has potential to play a critical role in disaster risk reduction and community development. It has been affirmed generally that indigenous knowledge has a place in saving lives and property from consequences of disasters. Scholars such as Athayde et al. (2015) posit that often times the traditional knowledge of a community has been tested of its sustainability and effectiveness in contributing towards their well-being and minimizing the adverse effects of natural hazards. Iloka (2016), argues further that areas that are prone to hazards are known to identify themselves with certain traditional knowledge that has been acquired through observation, experience and passed on to other generations. Dube and Munsaka (2018) affirm this argument and state that communities that are allowed to incorporate indigenous knowledge freely in ongoing risk reduction activities often exhibit a level of resilience in surviving an eminent natural disaster with minimum external support.

In light of climate change and recurrence of natural hazards, during the World Conference on Science in 1999 held in Hungary, it was recommended that there was need to integrate scientific and indigenous knowledge especially in the field of environmental management and development. To support this assumption, the Hyogo Framework of Action's third (3) priority focused on education and knowledge exchange especially of indigenous knowledge. The emphasis was on the importance of information management exchange and how relevant it was to harness traditional knowledge and cultural heritage to be shared to different community targeted audiences (UNISDR, 2016).

The Sendai Framework for Disaster Risk Reduction 2015-2030 promotes the incorporation of indigenous knowledge to complement scientific knowledge in the arena of disaster risk assessment (UNISDR, 2015). There is therefore a deliberate recognition that community's indigenous knowledge provides an invaluable contribution to development and implementation of mechanisms such as early warning, making it an important component in the field of disaster risk reduction.

Locally, Ngulube (2016) asserts that in Zambia indigenous knowledge systems exist and that they play a major role in adapting to extreme weather events. He posits further that early warning predictions using observations and studying behaviors of animals, insects, birds, trees, winds and temperatures among others tend to be similar across indigenous communities in the country. On the other hand, there has been a bemoaning that as much as indigenous knowledge has been said to be cardinal, its popularity has continued to dwindle over the past years as its custodians pass away. This suggests that due to lack of documentation, critical aspects of it in most communities have been lost leaving the current generation with not much to hold on to. Other arguments around indigenous knowledge is that disaster management practitioners have under-played the role of indigenous knowledge systems claiming the lack of scientific evidence and consistency. It has been argued that in fact, disaster risk reduction practitioners whose bias is towards modern technology tend to under-appreciate indigenous knowledge seen as inferior to scientific knowledge, (Iloka, 2016; Dube & Munsaka, 2018). In relation to selected rural drought prone communities of Gwembe, there has not been sufficient information on indigenous practices present and their associated constraints affecting resilience building over the years.

Two models underpin the study namely the Disaster Pressure and Release model (PAR) and Disaster Resilience of Place model (DROP). The PAR model by Wisner et al. (2004) cited in Blaikie et al. (2014) is premised on the fact that vulnerability of a community is often influenced by hidden processes that tend to affect the livelihood elements. Its assumptions further suggest that until such hidden processes are reversed, a community would not grow towards resilience against climate related hazards. The hidden processes are what could be seen as constraints to growth towards resilience building. On the other hand, the Disaster Resilience of Place Model (DROP) by Cutter (2020), highlight the interconnectedness of vulnerability and resilience within a particular community as being context specific. The theory further underscores the fact that every community has inherent adoptive, adaptive and transformative capacities that enables it to exhibit inherent resilience often triggered by hazard experience. It further argues that until the said three strand capacities are fully utilized, a community remains exposed to disaster risks.

From the PAR model, hidden processes sustaining community vulnerability can be likened to constraints faced in the use of indigenous knowledge including those with potential to reduce drought risks. Inherent capacities as suggested by

the DROP model justify the use of indigenous knowledge in the bid to survive or withstand a natural hazard, devised from their own understanding and interaction of the environment. The argument forming the conceptual framework therefore is that multi-level constraints faced by drought prone communities in relation to using indigenous knowledge as part of drought risk reduction often tend to sustain the community's vulnerability to the said hazard. On the other hand, addressing the said constraints tend to usher a community towards resilience growth that heightens its ability to withstand future related hazards, notwithstanding the need to upgrade livelihood elements.

Study Objectives

The general objective of the study was to determine constraints associated with indigenous knowledge use for drought risk reduction among selected rural communities of Gwembe district. Specific objectives were focused on identifying indigenous related Agricultural practices, rainwater harvesting and Early Warning Systems present in the community and their associated constraints to their use. The study hinged on the following questions: What indigenous agriculture practices have been present among the households and their faced constraints in drought risk reduction? What indigenous Rainwater harvesting initiatives have been eminent in the community and their associated constraints in reducing drought risks? What indigenous early warning systems have been common in the targeted community and their associated constraints towards reducing drought related risks.

2. Materials and Methodology

2.1. Study Design

The study was underpinned by interpretivism as a philosophical disposition, anchored on qualitative approach with the design being a case study of the six selected rural communities of Chief Munyumbwe and Chipepo. A case study for the selected study location was appropriate in enabling the extraction of contextual details of what could be deemed as constraints in the use of indigenous knowledge in risk reduction approaches and provide theoretical generalization (Yin, 2013; Tsang, 2014).

2.2. Study Setting

The study targeted Gwembe district in the Southern Zambia being one of the districts within the ecological zone I, about 260 km from the capital Lusaka, known with recurrent below average rainfall ranging between 600 and 800 mm. To be specific, communities from the two main chiefdoms being Chief Munyumbwe (Lukonde, Fuumbo and Lumbo) and Chief Chipepo (Chipepo, Chabboboma and Kkoma) area were the key study sites.

Gwembe is known to have been among the most vulnerable areas in Zambia especially to recurrent drought and occasional flash floods. The vulnerability of

the district has been noted in most yearly Vulnerability and Assessment Committee reports (VAC). Topographically, the terrain is known to be mountainous with steep slopes and fast-flowing-fast-drying ravines undulating which often result in highly erosive land creating gullies. The dwellers of the district are the Gwembe Tonga, whose major livelihood has been agriculture, livestock production as well as fishing for those in close proximity to Lake Kariba. A historical study by a historical study by Colson and Scudder (2018), showed that the people of Gwembe once lived along the banks of Kariba Lake due to alluvial soils and sufficient pasture for their livestock such as cattle and goats. For the construction of the Kariba dam, displacement was obvious triggering food insecurity leading to increased vulnerability of the district over the years, (Makondo, Chola, & Moonga, 2014; Mulenga, 2021; Zambian Vulnerability Assessment Committee Report, 2015; Khoza, van Niekerk, & Nemakonde, 2022).

2.3. Study Population

The district of Gwembe according to Central Statistics Office Report (2010) had about 10,288 households translating to a population size of 52,711. The targeted rural communities in Gwembe district had a total of 5520 households. It must be noted that the population details were based on 2010 Census report as the current 2022 similar report was not yet published at the time of data collection.

Inclusion and exclusion Criteria

Selected rural communities of Gwembe district largely rain-fed agriculture dependent were targeted in the study.

Inclusion criteria involved selected communities known to have been exposed to risk reduction related projects and initiatives for the span of 2011-2021 The said communities furthermore were familiar with drought events as the most common hazard among them. The study therefore excluded communities that did not meet the stated criteria.

2.4. Sample Size and Sample Technique

Considering that sampling in qualitative studies has not been so definite as understood from various existing "rules of thumb" of various scholars, the study leaned on the minimum of 50 study participants. In line with Boddy (2016) rule of thumb of between 5 - 50 participants, and Daniel (2019) suggesting a minimum of 35 participants, the study determined a sample size of up to 140 participants. The determination of the sample size was also guided by the principle of being clear of the categories of specific persons to be subjected to extraction of primary data.

In this study major categories included household heads, traditional, community leaders and development agency project staff as key informants. Additionally, focus group discussions with an average of 10 community representatives formed part of the targeted sample. A summary of sample size categorization is shown in **Table 1**.

Table 1. Sample size summary.

No	Study Participants	Sample Size
1.	Household Heads	34
2.	Traditional Leaders	12
3.	Community Leaders	12
4.	Agency Project Staff	7
5.	Government Officers	2
6.	Focus Group Participants	73
	TOTAL	140

Source: Field Data.

For the current study two major sampling techniques adopted were convenience and purposive sampling. Convenience sampling involved selecting household heads who met a set out criterion, were easily accessible, willing and available within the targeted geographical proximity (Etikan, Musa, & Alkassim, 2016; Creswell & Creswell, 2017). Purposive sampling involved selecting key informants who were privy to livelihood or resilience building related interventions in their community and included traditional, community leaders and development agency project staff. Furthermore, purposive sampling was used in identifying community members for representation in focus groups of men and women exposed to disaster risk reduction related interventions.

2.5. Data Collection and Analysis

A multiple data collection approach for primary data was deployed targeting the various study participants as categorized above. In-depth-open ended interviews were administered among household heads, key informants and focus groups in each of the six targeted rural communities of Gwembe district. For triangulation, field observations of available infrastructure and amenities that play a role in drought risk reduction efforts were undertaken and some photos were captured. These were done during transect walks and the use of mapping to ascertain key physical features of communities. Considering issues of language, local data entrants familiar and fluent in Tonga were engaged and trained for easy translation of the interviews for the participant that were in need of translation.

Data analysis was undertaken using thematic analysis method with the aid of Nvivo Pro.12 which is a highly qualitative analysis software. Nvivo is among the common computer software that has been gaining its widespread use in the recent past, largely to deal with qualitative data. The software has been known to be versatile in dealing with large qualitative data from interviews, focus groups, and observation notes among others. It has been maintained that Nvivo among some of the merits is that it provides comprehensive overview of a research project and facilitates immediate search and retrieval of data. Besides that, it can allow for visualizing selected texts and codes by means of diagrams, (Zamawe,

2015; Maher et al., 2018; Dhakal, 2022).

In describing the process of Nvivo usage in the study, files were created according to the transcribed notes representing various categories of study participants, and later imported on the software. Based on the major themes of indigenous agriculture, rainwater harvesting and early warning systems, parent codes and child codes (subthemes) were created to ensure comprehensive data capturing before actual analysis.

Ethical Consideration

The study being qualitative in nature requiring interactions with various study participants endeavored to uphold among others the principle of Informed Consent, Confidentiality, Privacy, Anonymity, beneficence and justice.

3. Study Results

The results have been presented in line with the study objectives focused on;

- Agricultural indigenous practices and associated constraints to its use;
- Indigenous rainwater harvesting practices in the area and associated constraints to widespread use;
- Indigenous early warning systems present in the targeted communities and constraints faced to its use;

1) Indigenous Agricultural Practices

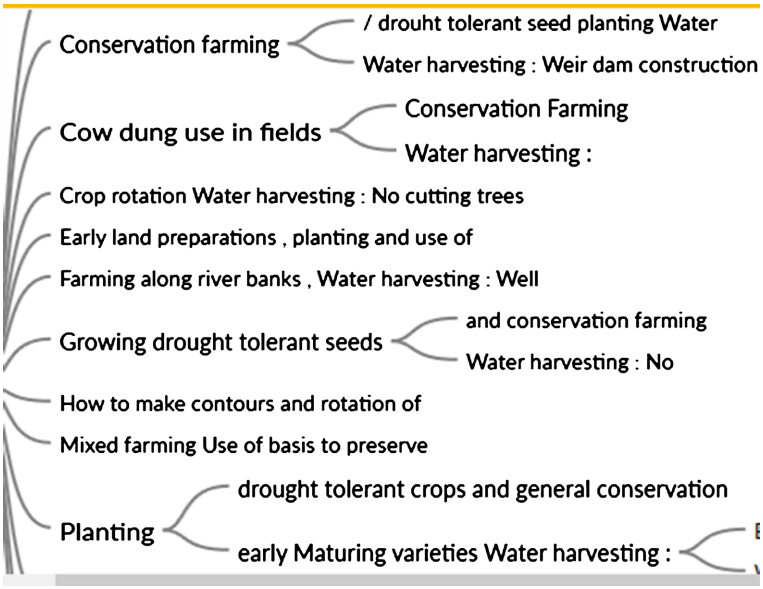
Findings showed that conservation farming and its related techniques were predominantly perceived to be indigenous. Related techniques from various interviews included; *Early Land preparation* which involved minimum tillage and use of basins or stations for seed. *Early planting and use of drought tolerant seed* such as millet, sorghum, cow-peas and cassava which were preserved for future recycling. *Soil Enrichment* involved the use of ant-hill soil, wood ash, animal manure and crop residuals as opposed to burning them during land preparation. *Harvesting sprouting vegetables* during off season such as pumpkin leaves, sweet potatoes leaves and wild okra among others were revealed to be indigenous to the area and common among women and young girls. *Use of natural herbs* such as aloe vera for livestock disease management of skin disease in goats, swine fever in pigs and new castle disease in chickens were mentioned. *Crop rotation* including cash crops such as cotton and groundnuts using a span of two years apart was cited.

Nvivo generated Word Tree showing prevalence of key words expressed by study participants on common agricultural indigenous practices can be seen in Figure 1.

Affirmation of the claims on common agricultural indigenous practices can be seen in the following verbatim expressions;

Participant One:

Some of the indigenous knowledge identified include selecting and preservation of recycled seeds such as drought tolerant seeds; the use of cow dung and other livestock manure for soil improvement remains ongoing in families. Others



Source: Field Data.

Figure 1. Illustration of common agricultural indigenous practices for drought risk reduction.

are scare-away strategies of stray animals from fields including birds and monkeys which often attack sorghum and millet fields (Household Head-Chabbobboma).

Participant Two:

Indigenous knowledge can also be seen in the way we dry and preserver food such as field vegetables like pumpkin leaves. For soil improvement apart from livestock manure, our forefathers taught us how to use ash and ant-hill soils to spread on the surface of the fields (Household Head-CHIPEPO).

Participant Three:

Traditional knowledge to us is seen from application of livestock manure in fields from cattle, goats and chickens. Our elders always emphasize on the need to plant early to capture first rains and increase chances of some reasonable yields. As safe play, we also have been engaging in cash crop cultivation to reduce the risks of loss. Alongside that, crop rotation has been part of our tradition and we are used to it (Household Head-LUKONDE).

2) Indigenous Knowledge in Rain Water Harvesting

Rain water harvesting indigenous practices among study participants were predominantly dug-out ponds done in dried streams or rivers, shallow wells dug within available dambos and weir dams in selected communities with access to streams. Weir dams involved using sand bags to create an embankment and some field pictures depicting the above stated practices is shown in **Figure 2**.

3) Indigenous Knowledge in Early Warning Practices

Early warning system and practices included observations of changes in the environment such as plant, animal, insects and celestial bodies' behaviors. Thus, depending on the interpretation of those signs, households would engage in activities they deemed protective of their livelihoods.

Shallow well locally called *cikala,* done within a dambo

Dug out pond in sand banks of the dry river

Locally known as *ka weir kanini* or *ka dambwa*-made of sand bags or concrete to create an embankment and conserve or harvest rainwater.

Source: Field Data.

Figure 2. Pictorial depiction of indigenous rainwater harvesting practices.

A related local tradition called *Iwiindi* ceremony which involved ancestral worship and consultation of the forecasted season was cited as part of early warning system. Summary of various expressions from participants on the incorporation of indigenous knowledge in Agriculture, Early warning and Rain Water Harvesting is tabulated in Table 2.

4) Constraints to Indigenous Knowledge Use

Common constraints faced in the incorporation and use of indigenous knowledge practices as part of drought risk reduction included the following:

Lack of scientific evidence with a gradual deviation from use of indigenous knowledge especially among the younger generation. *Non-dependability* of indigenous early warning predictions was said to be common hence justifying a higher reliance on early warning information shared by Zambia Agriculture Information Services (ZANIS) as well as through agricultural extension officers. *Perceived negative influence* of modern education was also cited to be a determinant to low and usage of indigenous practices.

Table 2. Responses on indigenous knowledge practices.

Data Source	Indigenous Knowledge Practices		
	Early Warning Systems	Rain-Water Harvesting	Agricultural Practices
<Files\\ HH001-CHABBOBOMA> 1 reference coded [1.74% Coverage]	Awareness of signs for drought from traditional perspective	Digging of wells to help with watering small gardens	Use of Drought tolerant recycled seeds and avoiding deforestation
<Files\\HH 001-CHIPEPO> - § 1 reference coded [0.59% Coverage]	Nothing pronounced	Our community is near the lake. So indigenous knowledge has been so much on doing gardening along the lake shores	Use of basins to preserve water for the seed
<File\\HH001-FUMBO> 1 Reference coded [4.57% coverage]	We no longer use much of traditional interpretations of signs because they are mostly not dependable	Use of Weir dam	Planting of more trees Contour ploughing Conservation Farming
<Files\\HH 001-KKOMA> - § 1 reference coded [2.22% Coverage]	Use of signs such as Increase in wild fruits eg *masuku* and an influx of bird type not seen in years.	Having small dams around our communities for water harvesting	Use of natural herbs in treating livestock; Use of aloe-vera plant; Tree planting; Traditional seed selection for next agro season.
<Files\\HH 001-LUKONDE> - § 1 reference coded [2.30% Coverage]	Nothing much apart from learning interpretation of some signs for rains or drought	Building weir dams using sand bags	Use of livestock dung/droppings for soil improvement; Practicing Crop Rotation; Cash crop planting such as groundnuts, sunflower and cotton; Planting early Maturing varieties of seed.
<Files\\HH 001-LUUMBO> - 2 REFERENCES CODED [4.66% Coverage]	We rely on news by Ministry of Agriculture via Radio; We no longer use much of traditional interpretations of signs because they are mostly not dependable.	We have no water harvesting techniques	Use of Ash to spread in the fields; Use of anthills to spread in fields; Conservation Farming and use of drought tolerant sees such as millet/sorghum.

Source: Field Data

Scotching of crops from the use of livestock manure when there was insufficient rainfall was cited as an eminent constraint apart from challenges of transporting ant-hill soil for soil enrichment, in cases where one's field was further away. *Lack of arable land* for farming purposes was constraining potential engagement in conservation farming which demanded reasonable land size.

Other constraints included low yields in traditionally recycled drought tolerant crops, weak intergenerational knowledge-transfer by the elders to the younger generation, harsh weather conditions and severe weed production due to minimum tillage. Table 3 illustrates some constraints indicated in the use of indigenous knowledge.

Table 3. Responses on associated constraints in indigenous knowledge use.

SOURCE	RESPONSES ON CONSTRAINTS	
1	<Files HH 006 –Kkoma 2 references coded [5.71% coverage]	Limited knowledge among the young generation, lack of trust and confidence in indigenous knowledge and impact
2	<Files HH CHABBOBOMA 005> 2 References coded [5.71% coverage]	When less rain, cow dung scotches crops, Some early warning indicators are not dependable, Growth of weed due to minimum tillage can be severe and labor intensive.
3	<Files HH 005-LUMBO> 2 References Coded [5.71% Coverage]	Not widely used as it is deemed to be outdated Some indigenous knowledge is not dependable e.g. sign interpretation of droughts.
4	<Files KII 001-ORGANISATION EFZ> 1 reference coded [2.74% coverage]	Lack of widespread indigenous knowledge or information among the current generation. There is a general tendency that most indigenous knowledge is outdated and has no impact.
5	<Files KII 002 ORGANISATION MINISTRY OF AGRIC> 2 References coded [3.92%]	Most indigenous knowledge has been on narrations and therefore based on recall memory. There is no documentation of the same to perpetuate into the next generation. Thus most of it has been lost along the way.
6	<Files KII 005-ORGANISATION WORLD VISION-1 Reference Coded [2.30% coverage]	Lack of evidence in indigenous knowledge impact as sometimes it is contrary to what happens in reality.

Source: Field Data.

4. Discussion of Findings

1) ***Agriculture Practices***

One clear unexpected study result was the predominant citation of conservation farming and its techniques perceived as indigenous. An obvious explanation to these findings is linked to the duration the said practices have been present in the community and passed on.

2) ***Rain Water Harvesting***

Study results on indigenous rainwater harvesting practices suggested a primary focus for water conservation towards gardening, livestock nourishment and domestic use which subsequently was used for harvesting rains.

3) ***Early Warning Systems***

The results surrounding early warning systems are an evidence of traditionally understood local practices as an aid in forecasting weather conditions and heightening preparedness plans. Stemming from a close interaction with the environment and subsequent interpretation of observed changes, the locals were able to attach possible meanings based on passed on information or past experiences. Whether the attached predictions came to pass or not remains the interpretation of the locals influencing their perception of some of these indigenous early warning efforts.

4) ***Indigenous Knowledge Constraints***

The constraints faced in incorporating indigenous knowledge as a tool for drought risk reduction as indicated in results section of this paper are generally

categorized as social-economic and environmental in nature. Socio-economic factors relate to resource accessibility and availability. On the other hand, environmental factors relate to both natural and built environment of the communities, which tends to be restrictive of indigenous practice use in the bid to reduce drought associated risks.

4.1. Study Affirmations

1) *Indigenous Agricultural Practices*

The results under agricultural practices where conservation farming and its techniques was predominantly perceived as indigenous is consistent with scholars such as Biratu and Asmamaw (2016), Aliabadi, Ataei and Gholamrezai (2022), Yanou, Ros-Tonen, Reed, and Sunderland (2023). Their findings indicated generally that small holder farmer perception on climate variability and conservation farming was perceived as a necessary approach to adopt in the light of flood or drought experiences, and not necessarily as climate change adaptation. The said studies also showed that majority of rural communities adopted conservation practices and associated techniques based on their own interest due to the poor soils and weather variability they had encountered.

The results on the common use of indigenous drought tolerant seed on the other hand is consistent with Awotide et al. (2016) in Nigeria; Singh et al. (2016), in India; Tesfaye et al. (2018), in Southern Ethiopia and Amondo, Simtowe, Rahut, and Erenstein (2019) in Uganda. These findings revealed that the said seed proved to have resistance to heat and high temperatures, with minimal moisture requirement, there by justifying its appropriateness in the light of dry weather conditions.

The common use of ash, anti-hill and animal manure for soil enrichment are also in agreement with the findings of Sangma, Tomer, and Kumar (2017) in India, who alluded to usage of ash as a local commodity for various purposes such as a pest control. Similarly, results by Agboola, Adekunle, and Ogunjimi (2015) in Nigeria and Macnight Ngwese, Saito, Sato, Agyeman Boafo, and Jasaw (2018), in Ghana showed that allowing animals to sleep in farms for the sole purpose of dung droppings for soil fertility was common. Findings of Mubanga and Umar (2014) revealed similar cases of application of cow dung and other animal droppings and rotation of drought tolerant crops to allow regeneration of land.

The results on the use of plant products such as aloe vera plant and other herbs in the treatment of livestock diseases is congruent with findings Agboola et al. (2015) in Nigeria and Luseba and Tshisikhawe (2013) in South Africa. Their findings indicated how traditional use of neem, neem oil, neem dried leaves for the control of pest and diseases was common as pest control and treatment of livestock diseases against tick and worm infestations. The results confirm further the findings of Dzoyem et al. (2020) in Cameroon and Birhanu and Abera (2015) in Western Ethiopia, Kanene (2016) in Zambia and Zimbabwe which commonly pointed to inevitability of ethnic veterinary medicines in keeping animals healthy.

2) ***Rain Water Harvesting***

The results on available indigenous rain water harvesting practices tends to be consistent with the findings of Kibassa (2013) in Tanzania, Funder, Mweemba, and Nyambe (2014) in Namwala and Wuta et al. (2018) in Zimbabwe. Their findings pointed to the use of dambos, dug-out ponds and shallow wells with water drawn using buckets or treadle pumps as being widespread among small scale farmers. The study results are affirmed further by Kakoulas, Golfinopoulos, Koumparou, and Alexakis (2022) whose study revealed that generally in Africa what predominates rain water harvesting is the use of ponds and basins.

3) ***Early Warning Systems***

The results on indigenous early warning systems are consistent with various studies from different regions. Quilo et al. (2015) in Zamboanga Peninsula of Southern Philippines alluded to weather forecast based on animal and plant behaviour to warn of any eminent disaster and facilitate their preparedness. In further generic agreement despite the difference in hazard type were findings by Syahputra (2019) in Aceh Province of Indonesia where nature was used to predict danger of floods and earthquakes. Within the African region other studies in congruent are that of Chisanga, Mvula, and Taban (2017), Dube and Munsaka (2018), Macnight Ngwese et al. (2018), Rukema and Umubyeyi (2019). From Zambian scenario, studies in affirmation include by Mapedza et al. (2022), Mbewe (2019), Mubanga and Umar (2014). Their findings generally alluded to environmental observations and subsequent predictions of danger giving a que for preparedness.

From discussions above, despite differences in some studies undertaken in other regions beyond Africa, what is common is the existence of traditional interpretations from observed changes in environment. While the interpretations and subsequent predictions of eminent danger may differ but the approach is generic and common across various communities.

In relation to constraints faced in the general incorporation of indigenous knowledge in risk reduction efforts, other studies in affirmation include;

Other scholars such as Muyambo, Bahta & Jordaan (2017), Macnight Ngwese et al. (2018), Rukema and Umubyeyi (2019), affirmed the study findings on socio-economic factors being constraints in the use of some indigenous practices. They alluded to a sense of lack among most households with no assets to convert to consumable income to enable them procure farming tools or equipment. In the same vein, Nyadzi, Ajayi, and Ludwig (2021) agree further that that there was a sure trend of indigenous knowledge declining due to modernization. Similar findings were seen from Agboola et al. (2015) in Nigeria and Effiong (2017) who alluded to lack of inputs and credit facilities, irritating odor of organic product, labour intensiveness in some farming systems, Weak intergenerational transfer as a constraint tends to be similar to the findings of Adam, Othman and Halim (2021), which showed a common observation that Agriculture Indigenous Knowledge (AIK) was slowly becoming extinct due to weak intergenerational information transfer.

4.2. Study Differences

1) ***Agriculture Practices***

It is worth noting that some findings of the current study were contrary to other reviewed studies. From Aliabadi, Ataei, and Gholamrezai (2022), uprooting trees known to have high water demands is in contrast to the findings of this study which showed a trend of promoting afforestation instead and avoiding cutting of trees. Another contrast was on soil enrichment where Macnight Ngwese et al. (2018) in Ghana, pointed to animals sleeping in the farm for the purpose of dung dropping to enhance soil fertility. In this study animals are often kept in kraals for security instead. In fact, results showed that during drought events, one of the constraints faced was that of increase in theft of animals. Furthermore, from the same study, avoidance of early planting was contrary to conservation farming principles of early land preparation and early planting.

The differences noted justify how the findings are context specific and peculiar to the study location under focus depending on the levels of interaction with the environment coupled with unique traditions and practices.

2) ***Rain Water Harvesting***

The study findings on indigenous rainwater harvesting practices are contrary to findings of Saxena (2017) in Rajasthan, Kibassa (2013) who alluded to the use of underground tanks and hanging pieces of clothes on the edge of the flat roof tops respectively.

Constrast in the findings is also seen from Kihila (2018), Mganga et al. (2019) and Wuta et al. (2018) whose findings alluded to rock catchment system, ferro cement tanks, roadside rechannelling of rain water into grass land, construction of water cisterns to place by corners of a roof.

Some differences noted above could suggest possible options of rain water harvesting for the study location and enhance resilience building against effects of recurrent drought or dry weather conditions generally.

At the same time the findings indicate the perceived vulnerability of the communities in the area of water security, slowing down progression towards tangible resilience building.

3) ***Early Warning Systems***

From the above discussions on EWS, the major contrast worth mentioning is the difference in hazard type and interpretations behind the observed behaviours or plants, insects, animals and celestial bodies to mention just a few. The contrasts in hazards are seen from Mapedza et al. (2022), Dube and Munsaka (2018) whose studies focused on flood areas while Syahputra (2019) were focused on earthquakes and tsunamis.

5. Summary of Indigenous Knowledge Use in Drought Risk Reduction

The overall synthesis of the results of the study is that areas of agriculture, rain-

water harvesting and early warning systems had practices observed as indigenous in nature stemming from locally devised ways of surviving drought effects. As part of drought risk reduction initiatives, indigenous agricultural practices involved engagement in conservation farming and its associated techniques such as early land preparation, basin making, minimum tillage, early planting, use of animal manure, drought tolerant seed and herbal plants for livestock disease management. Rainwater harvesting practices were largely limited to the use of dug out-ponds within dried river or stream, shallow wells and dambos apart from weir dams for few communities with access to rivers. Furthermore, indigenous early warning systems involved predictions from observed behaviour in animal, plant, celestial bodies and consultation of ancestral spirits through local traditional ceremonies to heighten preparedness. However, the use of indigenous practices was largely affected by socio-economic and environmental factors which were observed as constraining to its widespread use among households.

5.1. Strengths and Limitations

The above results on indigenous practices as a tool for drought risk reduction give some in-depth understanding of what is distinct in the study area. They give insight on some constraining factors to wider use of indigenous practices in risk reduction, affecting resilience growth against dry weather conditions generally.

However, one limitation is that the study did not interrogate the level of resilience among households that were active in indigenous agricultural practices. Secondly, investigations on indigenous rainwater harvesting practices study did not consider duration of water conserved in order to establish its direct or indirect impact on household livelihoods in terms of water security. Thirdly indigenous early warning systems associated interpretations and predictions were not scientifically validated.

Evaluating the above results however, there is need to consider future in-depth studies in line with some of the study limitations indicated for each segment. This would in turn aid communities with the relevant interventions that enable them to not only absorb, or adapt to climate change but rather progresses them to a higher resilience against future hazards.

5.2. Conclusion

From the aforementioned, the study concluded that while benefits from indigenous practices were eminent in the light of drought risk reduction efforts, widespread use was declining over the years. The conclusion was also that the state of community livelihood capitals such as economic, natural, constructed, individual and social elements determined the extent to which practices were devised locally and considered indigenous. This suggested a possible underplay of the potential indigenous knowledge holds in drought resilience building among households and community at large notwithstanding the place of scientific verification. In fact, a growing tendency of Western science gaining promi-

nence over indigenous knowledge only affects household self-reliance and the quest for grassroots' participation in managing climate variability while striving for transformative resilience against future hazards.

5.3. Implications and Recommendations

The consistency in the findings of indigenous initiatives with studies of different regions implies common inherent capacities of communities. On the other hand, inaccessibility and deprivations in environmental conditions suggest a myriad of constraints to resilience building. Worth noting are contrasts in the findings which confirm unique underlying micro and macro forces distinguishing communities.

This justifies the identification of context specific interventions with practical solutions in reducing risks and improving resilience.

In line with the theoretical framework of the study, the PAR model demonstrates how constraints faced in indigenous knowledge implementation are hidden and tend to weaken a community to a drought hazard. The initiatives highlighted however can be seen as efforts of inherent capacities of households devised to build resilience to future similar events as suggested by the DROP model.

Based on the results of this study, it is recommended that indigenous knowledge and practices in agriculture, rainwater harvesting and early warning systems deemed effective in drought related risk reduction be documented and validated for possible incorporation in formal DRR plans. Furthermore, a framework of addressing key constraints to low usage of indigenous knowledge proven effective in drought risk reduction is incorporated in project planning and implementation among development agencies, in order to heighten resilience building. Upgrading and improvement of community livelihood capitals remain key to gradual efforts of addressing key constraints and minimizing household vulnerability sustenance towards high level transformative resilience against drought or dry weather events.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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