Rusangu University International Journal for Interdisciplinary Journal
April 2026 Volume 1, Issue 1: 5 - 17. ISSN: 2960-1126

Climate change early warning signs and use of indigenous knowledge among Pastoralists in Namwala, Zambia

Shepande Kalapula
Kwame Nkrumah University
Corresponding Email: shepandekalapula@gmail.com

ABSTRACT: Climate variability and change is one of the environmental stresses that have impacted negatively on the Zambian economy. In Namwala District in Southern Zambia, a study was conducted among pastoralists with the aim of understanding early warning signs to climate change. The objective was to determine pastoralists' local perceptions to climate variability and establish early local warning signs and use of indigenous knowledge in weather forecast. The study used typical sampling technique in the selection of household heads and was exploratory in nature. The findings established that the majority of pastoralists (85%) have heard climate change information from a combination of sources including radio (45%), relatives, friends and neighbours (32%), agriculture and veterinary extension officers (25%), television (8%), and internet through mobile phones (5%). The findings further show that early warning signs and use of indigenous knowledge manifested in form of tree leaves sprout and flowering (65%), clouds and weather conditions (56%) and insects and animal behaviour (51%) as the best-known weather forecast indicators for the majority of the respondents, followed by astronomical celestial bodies (40%) and bird chirping (34%). Thus, local perceptions and indicators of climate variability and change shows that there was a growing understanding among pastoralists that climate variability and change were happening and are continuously affecting their livelihoods. The study concludes that although extreme weather events are unavoidable, weather and climate information at local level should be identified, understood, and interpreted using local early warning signs and indigenous knowledge with scientific approaches, methods and tools. It is recommended that although pastoralists have built up sufficient adaptive capacity to live with change and uncertainties, they should be understood together with other relevant partners in gathering, processing and forecasting early warning information to achieve Sustainable Development Goal number 13 on Climate action.

Keywords: Early warning sign, Kafue Flats, Indigenous knowledge, Pastoralists

1. INTRODUCTION

Climate variability and change is one of the environmental stresses that have impacted negatively on the Zambian economy (ECZ, 2000). Early warning system is a system of data collection to monitor people's access to food, in order to provide timely notice when a food crisis threatens and, thus, to elicit appropriate response (Davies *et al*., 1991). In Namwala District, the Kafue Flats, one of the most sensitive wetlands in Zambia, has been subjected to untimely flooding. Thus, climate variability and change have manifested through the occurrence of extreme climatic events, such as droughts and floods, both of which have disrupted agricultural activities. In dry years, agricultural production is often low resulting into diversion of national financial resources to relief activities. Although extreme weather events such as droughts and floods are unavoidable, there is now a general recognition that the Zambia Meteorological Department (ZMD) can provide forecasts and warnings of occurrences of these extreme events to minimize economic disruption, damage to property and loss of life (Umar, 2021). Accordingly, weather and climate information should be used as integral components for risk management in implementing weather related programmes.

Breidlid (2013, p. 31) defines indigenous knowledges (IK) as "knowledges produced in specific historical and cultural context." And as a way of contrasting the indigenous knowledge production to Western knowledge, Breidlid (2013) quotes Semali and Kincheloe (1999) who posited that indigenous knowledges are not "generated by a set of pre-specified procedures or rules and are orally passed on from one generation to next" (Semali and Kincheloe, 1999, p. 40) in Breidlid (2013, p. 31). This, in a way, shows that indigenous knowledges do not have to be validated by or viewed in the positivist manner as Western knowledge is.

'*Indigenous*' means local or native to the local people of the society under consideration. Indigenous Knowledges systems, therefore, promote the culture and tradition of the indigenes and emphasises that these knowledges and practices need to be respected and recognized as treasures which can contribute to the development of the society. Semali and Kincheloe (1999, p. 3) state that: "...indigenous knowledge reflects the dynamic way in which the residents

of an area have come to understand themselves in relationship to their natural environment and how they organise that folk knowledge of flora and fauna, cultural beliefs and history to enhance their lives."

The economy in Namwala depends on the utilization and management of the Kafue Flats (a common property resource [CPR]) for pastoralism. It is also endowed with fertile alluvial soils in the Kafue Flats and cycles of flooding which support cropping and cattle husbandry respectively. However, climate variability and change affect the optimal utilization and exploitation of CPR. Therefore, timely and accurate weather forecasts and warnings are needed for assessment, exploitation and management of CPR. In this regard, water resources management agencies use climate and weather information to enable them effectively and objectively allocate water rights to various users (Mertens, 2013; Casarotto, 2013; Churchill, 2010; Chabwela, 1994).

The observed climate variability in Zambia, as elsewhere in the world, is attributed to both natural processes and anthropogenic activities. Southern is one of the worst drought prone Provinces in Zambia with most of the people depending on agriculture in general and cattle husbandry in particular. In Namwala, the roots of ecological vulnerability are linked to social-ecological systems and unfavorable government climate related policies.

Despite the ecological importance, rich natural resource base, economic significance of and functional values of the Kafue Flats' ecotone ecosystem, the floodplain is reported to be the most ecologically disturbed wetland in Zambia.

Thus, vulnerability to drought and floods has increased in Namwala as farmers lack modern mapping of early warning signs and knowledge to climate change and variability. Pastoralists and agro-pastoralists have, in the past, adapted very well to climate variability and change. However, these populations have become vulnerable to climate variability in large part because their ability to predict, mitigate, manage, respond and recover from shocks caused by floods and droughts have been constrained. Therefore, as climate variations ranging from short term droughts to long-term climate shifts occur, the ability of pastoralists to forecast their agricultural activities and livelihoods in their traditional lands using traditional early warning signs and knowledge systems has been altered, particularly when these fluctuations are layered with other social-economic stresses.

The study objectives were to: (i) Determine pastoralists' views of climate variability and climatic induced risks (ii) Understand local perceptions and indicators of climate variability and change (iii) establish early warning signs and use of indigenous knowledge in Namwala.

2. LITERATURE REVIEW

Mitigating the adverse impacts of extreme hydro-meteorological events such as floods has been recognized internationally Mchombu (2021) as one of the essential components of sustainable development and poverty alleviation, as well as one of the key measures required for the achievement of the internationally agreed-upon United Nations' Sustainable Development Goal (SDG) number thirteen (13). In Namwala, flood and drought related management strategies pursued over the years have been largely reactive up to now and made in response to flood threats, rather than proactive.

Furthermore, the increasing challenges of population pressure and cattle on natural resources, the need for economic development, the increasing climate variability and potential climate change and variability, will tend to make unsustainable the current practices through which we predict floods and droughts at local level. There is therefore the need for a paradigm shift, to move away from flood and drought control towards flood management and adaptation (Chanda and Mbewe (2022); Chanda *et al.,* (2023).

Such a paradigm shift requires a proactive approach rather than reactive actions - a move towards a culture of prevention by managing the risks of and living with floods and droughts by incorporating local knowledge and local signs Integrated Flood Management is an approach being promoted by Associated Programme on Flood Management (APFM), a joint initiative of WMO and the Global Water Partnership (GWP), which seeks to predict, mitigate, manage, respond and recover from shocks caused by hazards thereby maximising benefits from natural resources and minimizing food insecurity, cattle mortality and loss of life (Scott, 2004; Chilombo *et al*., 2019).

However, the traditional pastoral paths of social-ecological systems are set to change. Over the last four decades, Namwala District experienced an increased mean annual temperature of 1.2°C, and decreased mean rainfall of 1.8mm/month, whereas rainfall seasons have become less predictable and shorter, with rainfall occurring in fewer but more intense events. Both average annual temperature and rainfall are projected to increase by 3.6°C and 3% respectively by 2100. From 2000 to 2009, the intensity and frequency of droughts and floods and the number of people affected have also changed, with a net trend towards more floods and, over a longer time-period, droughts (Mwelwa, 2004).

Moreover, the area affected by floods and droughts appears to have expanded. The 1991/92 (worst drought in the century), 1997/98, and partial droughts from 2001-2005 and 2011-2015 left nearly two thirds of the district with little

or no rainfall while the 2006/07, 2009/10and recently 2016/17 has flooded most communities. Furthermore, weather shocks and cattle diseases such as corridor disease and many others, have reduced livestock numbers.

These social-ecological typologies have negatively affected the way of life of pastoralists in Namwala which they have enjoyed for decades. The socio-economic situation has changed and indeed food security situation is threatened. "The recurrence of droughts has depleted animal grazing resources and drinking water, thus negatively affecting the productivity of the livestock sector," (GRZ, 2006: 47). Thus, pastoralists within similar agro-pastoral communities and households are likely to respond differently to constraints and opportunities resulting from climate variability and Kafue river regulation based on timely forecasts and their knowledge.

In Zambia, assessment of flood and drought damage is carried out by the Disaster Management and Mitigation Unit (DMMU), Ministry of Agriculture and Cooperatives, Ministry of Energy and Water Development and the Famine and Early Warning System Network (FEWSnet) assisted by other institutions co-opted in the assessment team formed for a specific and occasional incidence of any devastating hazard. The assessments are usually quantitative targeted at populations affected, if there are lives and property lost, and the extent of damage to infrastructure.

Due to financial constraints, there is often considerable time lag between occurrence of damaging hazards and assessment surveys and compilation of relevant reports. The DMMU is responsible to coordinate such assessment activities through report writing. The coordination mechanism is adequate but is always constrained by lack of financial resources. Because of this there is a great dependence on financial and material support from cooperating partners. In the area of hydrological data collection, analysis and database management are significant institutional weaknesses that have led to considerable data gaps and reduced reliability of forecast information.

According to DMMU (2015: 33), "seasonal rainfall forecasts is generated and disseminated by ZMD by September and submitted to DMMU and other relevant authorities/departments." Bureaucratic delays in information dissemination from DMMU to provinces and districts leave farmers without reliable weather information. In Namwala, this has led to pastoralists relying on using local knowledge and traditionally known early warning signs. Early warning refers to the provision of timely and effective, through relevant institutions that follow individuals exposed to any hazard, to take action to avoid or reduce their risk and prepare for effective response.

This above situation has exacerbated pastoral problems in Namwala because of living in a varied and dynamic environment. The Kafue Flats was the most appropriate unit for mapping early warning signs and use of local knowledge among pastoralists in Namwala considering the interdependence of Kafue Flats' uses and the relationship between land, water development and pastoralism which depends on the flood, flow and flux of the Kafue River.

Flooding is important in the Kafue Flats (Manford, 2025) because it provides spawning for fish, fertile grounds for farming, pasture for livestock and wildlife. In this situation, flood control would not be the best option as the benefits of flooding outweighs the disadvantages caused by droughts. In such cases it is desirable to cope with floods and droughts through various adaptation measures such as: land use regulations and redevelopment policies, disaster preparedness and response planning and mapping early signs using indigenous knowledge.

Smallholder farmers have been adopting different adaptation strategies to respond to the impacts of climate change, a process that is influenced by access to and use of agricultural information (Manda, 2017). Indeed, access to this information is very crucial in promoting smallholder farmers' adaptation to climate change (Mengistu, 2019). Moreover, Mwalusaka (2021) advised that if climate change adaptation and development are to be sustained, access to and use of agricultural information are going to play a pivotal role.

The research gap therefore was that literature does not show *pastoralists' perceptions and indicators towards climate variability and change* and how they use *early warning signs and indigenous knowledge* to adapt to climate change.

The objectives of this study were therefore to address this knowledge gap. While there is abundant knowledge about the cultivation of traditional staple crops, there is widespread lack of knowledge about the increased climatic variability specifically among *pastoralists due* to lack of *early warning signs and indigenous knowledge* to adapt to climate change. Information was lacking on how communities were detecting whether they were going to have a flood or drought and indicators to predict the weather. These signs be used to diversify production. The gap is lack of accurate local *indigenous knowledge* to adapt to climate change unreliable as modern weather forecasts and agricultural advice usually mislead farmers and negatively impact their production.

3. METHODOLOGY

Namwala District is about 2,175,064 hectares in extent located 170 km North West of Choma town and 158 km from Monze and 350 km from Lusaka. It lies along the Kafue flats with seasonal flooding being prevalent (Sheppe and Osborne, 1971). Pastoralism depends on a rich ecosystem nourished by the seasonal flood cycles of the Kafue

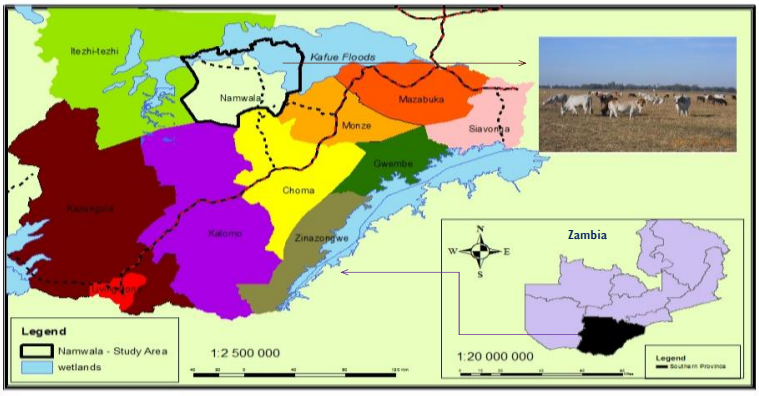
River although seasonal flooding is now often unpredictable in its timing and duration, threatening flood-dependent livelihoods (Figure 1).

Large scale District Spatial Zoning was used to allow more pastoralists discern a variety of different social-ecological typologies affecting them. Zoning is a geographical delineation of spatial units representing an acceptable degree of homogeneity, and according to some relevant criteria and to some scale of analysis (Lhopitallier et al., (1999).

Within Zones, the study used typical sampling technique in the selection of household heads along the frontiers of the Kafue flats. Since most pastoralists belong to cooperatives under the government sponsored Farmer Input Support Programme (FISP), complete checklists of all the farmers, who are also pastoralists, were utilised. This technique was based on the selection of elements (names) at equal intervals, to arrive at six randomly selected household names for each of the five cooperatives in each chiefdom, giving a spatial proportionate sample of thirty respondents from each chiefdom.

Thus, the study engaged a total of 120 household heads; 30 respondents from each chiefdom. In addition, timeline and seasonal calendars were used in identifying different activities throughout the year (s), for example production activities, hazards and stresses, land use, erosion, rainfall, population, tree cover, etc. (Kirsrten *et al*., 2002). Descriptive statistical methods were used to organize and summarize data based on themes, categories, and patterns to generate maps.

Figure 1: Location of Namwala District in Southern Province



4. FINDINGS

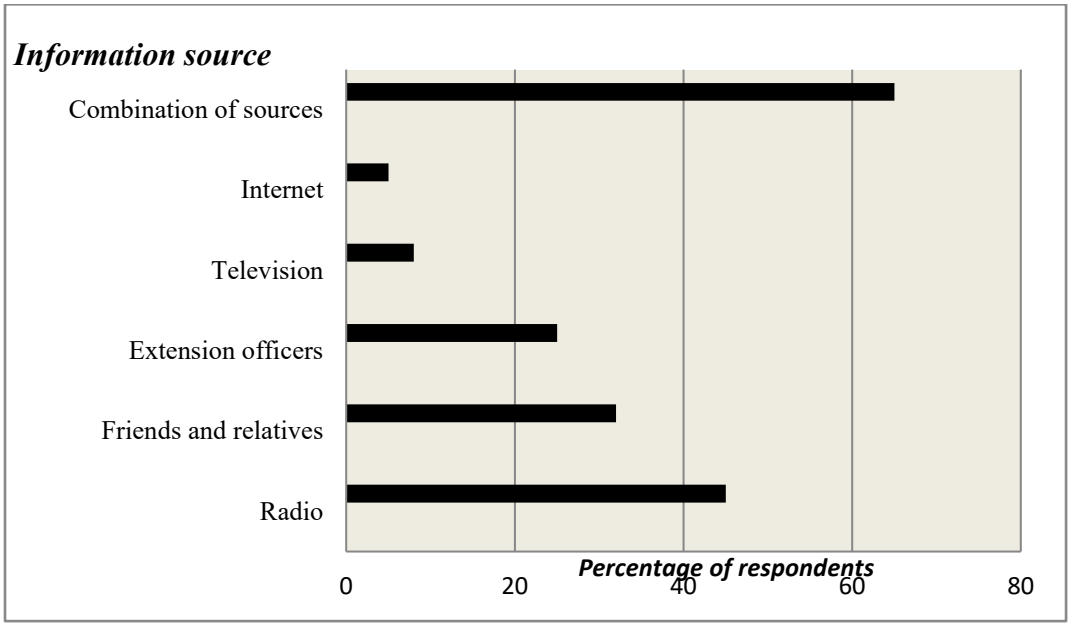
4.1 Pastoralists' views of climate variability and climatic induced risks

Climate variability and change adaptation literature suggests that expectations of the impacts associated with climate variability are an important determinant of adaptive responses. To examine pastoralists' perceptions of climate variability and climatic induced risks, information was gathered on their views about the impacts of climate variability and change on pastoralism particularly on water and grass, and their views on managing weather/climatic risks on their farms (Figure 2).

The majority of pastoralists (85%) in this study indicated that they had heard, read, or seen information related to climate variability and change on a daily basis or several times a week. Figure 2 shows that the main sources of information about climate variability and change came from a combination of sources including radio (45%), relatives, friends and neighbours (32%), agriculture and veterinary extension officers (25%), television (8%), internet through mobile phones (5%) and a combination of all sources (65%).

Overall, the results indicated that while 80 percent of the pastoralists perceived that climate variability had negative effects on pastoralism in Namwala, no responses were recorded to indicate that climate variability and change would result into positive effects on pastoralists. On the other hand, only 5 percent of respondents did not respond to this question.

Figure 2: Sources of climate variability and change information



Source: Field data

In addition, the questionnaire presented pastoralists with various statements about potential effects of climate variability on various aspects of agricultural production. They were asked to indicate the level with which they agreed or disagreed with the statements using Likert Scale (e.g., 5point Likert scale) responses. With regard to the potential negative impacts of climate variability and change on pastoralism, 82 percent of respondents indicated that there were more cattle diseases associated with climate variability, while 78 percent believed that there were more extreme weather events resulted into water and grass shortages. Further, 67 percent of respondents indicated that there were increased deaths of cattle (and money) due to perceived increased variations in climate.

However, pastoralists were generally not in agreement about the potential positive effects of climate variability on pastoralism in Namwala. In addition, 88 percent pointed out that more floods during rainy season benefit their cattle as lagoons get filled up. They explained that lagoons and pans served as dry season '*oasis*' for grazing and livestock watering for their cattle, particularly in the Kafue Flats. The results also show that 85 percent of pastoralists agreed with the statement that crop growing season is now shorter, with the majority of respondents indicating that there were strange crop diseases they suspect of having come as a result of climate variability.

4.2 Local perceptions and indicators of climate variability and change

Table 1 shows that there was a growing understanding among pastoralists that climate variability and change were happening and are continuously affecting their livelihoods which depended on agriculture in general and pastoralism in particular. Although climate variability was not physically measured, it was quantified based on changes in forms of livelihoods, values, customs, perceptions and world views.

The study shows that households understood the indicators of climate variability as increase in drought (n=117; 97.5%), changes in floods, flow and flux of Kafue River (n=116; 96.7%), increased temperatures (n=112; 93.3%), weather variability/ unpredictability (n=111; 92.5%), increase in livestock diseases (n=92; 76.7%), increase

in flooding of *ibanda* (n=75; 62.5%), decrease in *ibanda* (floodplain) grasses (n=73; 60.8%), had the highest responses from the majority of the respondents. On the other hand, short planting season (n=68; 56.7%), food shortages (n=64; 53.3%), decrease in crop productivity (n=63; 52.5%), decline in amount of rainfall (n=54; 45%), drying of wells and boreholes (n=41; 34.2%), increase in pests (n=38; 31.7%) and increase in wind conditions (n=19; 15.8%), had lowest responses (Table 1).

Table 1: Percentage responses on local indicators of climate variability by chiefdom. Source: Field data

S/N	**Local indicators of climate variability**	**Overall Percent**	Mungaila (n=30)		Mukobela (n=30)		Muchila (n=30)		Nalubamba (n=30)	
			Number	%	Number	%	Number	%	Number	%
1	Increase in drought	97.5	30	100	29	96.7	28	93.3	30	100
2	Changes in floods, flow and flux of Kafue River	96.7	30	100	30	100	28	93.3	28	93.3
3	Increase in temperature	93.3	30	100	30	100	28	93.3	24	80
4	Weather variability/ unpredictability	92.5	27	90	28	93	30	100	26	86.7
5	Increase in livestock diseases	76.7	27	90	25	83.3	21	70	19	63.3
6	Increase in flooding of *ibanda* (floodplain)	62.5	26	86.7	19	63.3	13	43.3	17	56.7
7	Decrease in *ibanda* grasses	60.8	23	76.7	25	83.3	12	40	13	43.3
8	Short planting season	56.7	11	36.7	16	53.3	18	60	23	76.7
9	Food shortages	53.3	23	76.7	17	5.7	13	43.3	11	36.7
10	Decrease in crops	52.5	23	76.7	17	56.7	12	40	11	36.7
11	Decline in amount of rainfall leading to drying of lagoons and streams	45	9	30	10	33.3	17	56.7	18	60
12	Drying of wells/boreholes	34.2	8	26.7	9	30	13	43.3	11	36.7
13	Increase in pests	31.7	7	23.3	6	20	11	36.7	14	46.7
14	Increase in wind conditions	15.8	5	0	3	0	6		5	0
15	*Others	38.3	12	40	9	30	13	43.3	12	40

NB: Others*: Seasonal changes, disappearance of morning dew and disappearance of rare bird species

4.3 Mapping of early warning signs and use of indigenous knowledge in Namwala

Local environmental weather predictions involve the use of observations of the natural environmental and space indicators, supported by experience of the past to foretell the start of the rainfall in the following season in order to plan farming activities in advance (Senanayake, 2006). A successful weather prediction could lead to increased food production because farmers were able to implement informed decisions on when, where and what to plant, and hence ensured quality food production. Wrong predictions, on the other hand, may result in an inappropriate implementation of agronomic practices and adaptation strategies which may lead to poor quality of agricultural produce.

Current observed climate changes and variability pose challenges in the provision of accurate and reliable weather predictions and forecast information. However, effective coping and adaptation strategies for the management of the effects of climate change and variability could be attained through accurate weather and climate predictions, which helped pastoralists in making informed decisions on their farming activities leading to increased food productivity (Norberg *et al*., 2008). Going by this, results among local pastoralists in Namwala show that they still depended on monitoring local environmental weather indicators (Table 2).

Table 2: Local indigenous knowledge and environmental weather indicators

Indicator	**Frequency (n = 120)**	**Percentage (%)**
Tree leaves sprout and flowering	78	65

Clouds and weather conditions	67	55.8
Insects and animal behaviour	61	50.8
Astronomical celestial bodies	48	40
Bird chirping	41	34

Source: Field data

The findings in Table 2 shows that weather forecasts and indicators in form of tree leaves sprout and flowering (n=78; 65%), clouds and weather conditions (n=67; 56%) and insects and animal behaviour (n=61; 51%) were the best-known weather forecast indicators for the majority of the respondents, followed by astronomical celestial bodies (n=48; 40%) and bird chirping (n=41; 34%).

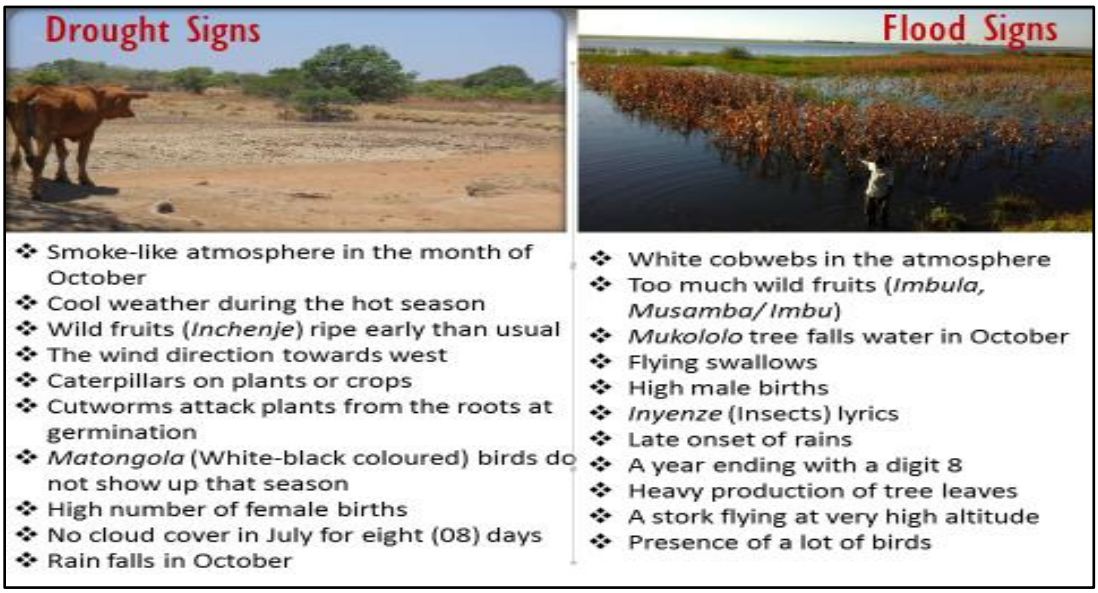
The majority of respondents' aged 60 years and above-mentioned tree flowering, tree leaves sprout and astronomy as important local weather indicators than any of the other age groups. However, results showed that participants in all chiefdoms shared the view that most of the trees which were used in the predictions for the imminent rainfall, had been cut for making charcoal, burning bricks, firewood and building poles. In addition, it was noted that increase in drought conditions affected birds' and insects' habitats and populations, also made them migrate to other areas in search of food and suitable habitats.

Pastoralists also highlighted that some of these '*environmental songs'* appeared as usual, indicating the imminence of rainfall, but it did not rain. These were regarded as factors, which contributed to the decline in awareness of indigenous environmental weather indicators and predictions among pastoralists. This left precious IK among the elders. Similarly, an increase in drought conditions, which affected agricultural activities, resulted into less involvement of people (especially youth) in farming activities which was the only way of passing over the knowledge through observing and sharing of the past experiences. For instance, participants mentioned the disappearance of the *African ground hornbill birds* (*ba moomba*), which had predicted imminent rainfall through chirping.

In order to enhance community effective preparedness and interventions from either drought or flooding, pastoralists need to be aware of natural signs, which help them to predict the rainfall pattern for the coming season. This helps pastoralists to determine the amount of rainfall that they expect to have. This local knowledge on these early warning signs was explored in focus group discussions during the mapping of local knowledge.

Thus, the study probed on how communities were able to detect whether they were going to have a flood or drought. Pastoralists explained that there were phenomena or signs, which they used as indicators to predict the weather. The senior members of community gave these signs. Figure 3 illustrates some of the early warning signs and local knowledge.

Figure 3: Drought and flood early warning signs in Namwala



Source: Field data

Drought (locally known as *chiyumayuma)* has been affecting mainly pastoralists that are found on the upland (Muchila and Mbeza chiefdoms) of Namwala district. These have brought with them risks that have impoverished the pastoralists, leaving hundreds of households vulnerable and unable to stand on their own. Droughts have similar signs to their occurrence and pastoralists used local knowledge to identify them.

On the other hand, floods *(locally known as chilobe)* mainly affects communities that are found on the low or flood plain (Baambwe and Maala Chiefdoms) of Namwala district and have brought with them risks that have increased the vulnerability of the communities. Herders detect all these disasters by early warning signs. For these, the study relied on the experiences from older members of the community that had experienced perturbations over a long period of time.

About 70% of the pastoralists stated that such experiences helped them to prepare for either drought or flood. Of particular interest is the use of natural phenomena such as nesting behaviour of birds, incidences of insects, timing of the fruiting of certain species and the flowering of specific trees. Others include the sounds of insects, migration and appearance of rare bird species.

The study also established that pastoralists have a variety of signs such as wild fruit availability, as well as wind direction among others to predict how the season will pan out. They talked about how God balances between wild fruits availability and crop production thereby ensuring that there is always a constant supply of food in years of plenty and in years of dry season. They pointed out that detecting whether there is going to be a season of shortage or a season of plenty at an early stage helps in carrying out activities that help households to mitigate the hazards and survive even the severest of drought impacts.

Furthermore, farmers stressed that important components such as preparedness, prevention and mitigation help them to obtain and use early warnings of impending hazards or threats. There are limitations and obstacles to the timely forecast of extreme events, however, a number of factors can also limit the effectiveness of warnings in influencing local behaviour. This is because the perception of risk is not universally the same. In many cases, pastoralists may be aware of risks, but believe that they have no alternatives to their present location and behaviour.

In addition to the climate warning signs, the following were the local pastoralists' perceptions on climate change and variability in their quest to improve livelihoods:

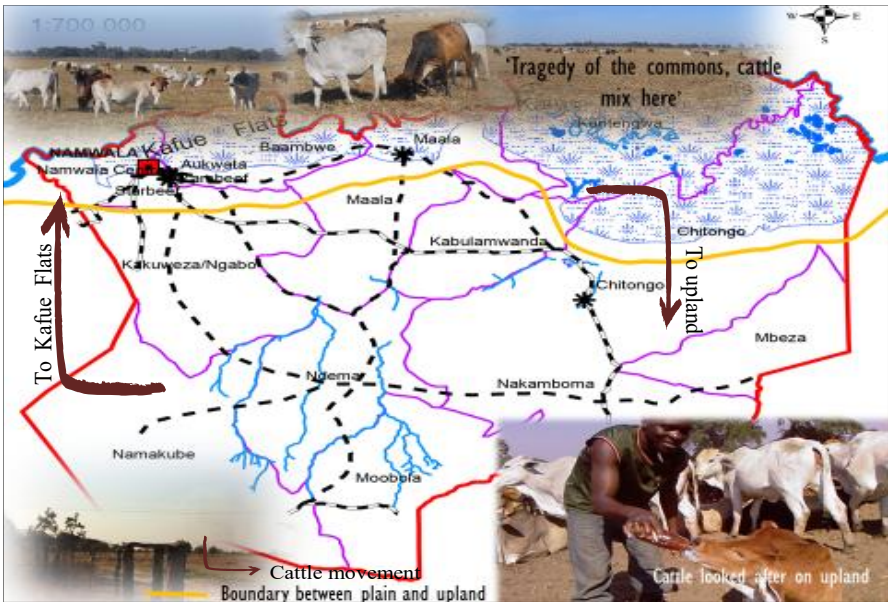
1. Change in wind regimes: strong winds are normally expected in July but of late they are at times experienced in April/May;
2. Changes in temperatures: in recent times, February/March has become comparatively colder. September has become cold and windy;
3. Changes in onset and cessation of rainfall: there is a delay in the onset of rains in recent times varying between November and mid December instead of end of October. There is a noticeable early cessation of rains in recent times; ending in February instead of March.
4. Some areas that had no trees have now forests and *mimosa pigra* shrubs especially in plains; a sign of climate variability and change in terms of shifts in local rainfall, in addition to flooding, flow and flux of altered Kafue river water regimes;
5. A lot of anthills have developed in the plains; a sign of changes in the local weather and climate conditions. This is an indication of increasing water recession and dryness;
6. A noticeable reduction in bird population such as the black storks; a sign of bird migration due to changes in weather and climate conditions. Some birds and animals have been found dead in the wild in addition to higher cattle mortalities to strange and unknown diseases; and
7. More gray haired people now even among people below 30 years; this could be attributed to climate variability and change. In addition, there are also more people, especially men in communities along the Flats with rotten teeth. This is attributed to unsubstantiated facts that there are new chemical effluents from the Copperbelt region, concentrated in Kafue River as the river flows from Itezhi-tezhi Dam to the Kafue Gorge Dam. The majority of those affected are males who spend whole dry season (about eight months or more depending on the season, from April to December on rotational basis) at various cattle outposts along the Kafue Flats.

5. DISCUSSION

Analysis of data revealed that local knowledge enables pastoralists to adapt to change and uncertainty, along a varied floodplain environment. According to their description, knowledge combining is a practice that allows natural resource users and other interest groups such as local communities, government officials, donor agency experts and scientists, to build knowledge together, on the basis of which they explore uncertainties and events of complex ecosystems and their management (Folke *et al.,* (2003). Pastoralists have a particular knowledge system that exists

locally among them and this knowledge is relevant to indigenous ecological and socio-economic dynamics. In local communities, they talk to each other about weather conditions and continued discussion on this topic helps them to assess the current weather conditions for herd movements and grazing (Figure 4). The information that pastoralists shared about local changes happening in their communities was related to long-term trends, descriptive and specific. For example, one pastoralist in Baambwe recounted: "*We have ibanda (plain), where we have our dry season pasture, and for the past few years we quickly lost our grass because of irregular water regimes*."

Figure 4: Transhumance system between the Kafue Flats and the upland in Namwala



Source: Field data

Thus, pastoralists' knowledge about upcoming weather events is generated on the basis of consultation with each other. For example, in the face of upcoming drought/flood, pastoralists get mutual perspectives about making distant cattle movement, while others split their herd. "*Last year (2024) cattle became so weak that once they went to the river, they would get stuck in the mud and we helped them to stand, but others would die in the process, and we share this information*," explained one respondent.

This was in reference to the consecutive drought years that ravaged the district in 2019. Pastoralists also shared their concerns related to changes in vegetation and how this affects herd composition. More than 70% pastoralists expressed concern that the pasture in the Kafue Flats is becoming less suitable for raising cattle as *nankokwe* (*Brachiaria sp)* is diminishing due to consecutive recent droughts (Figure 4).

In other words, pastoralists like to share their knowledge in a familiar way, orally and face to face, from parents to children, pastoralists to pastoralists and community to community as explained by a headman in Maala: "*I tell my children where to graze the herd, what the weather would be like today and I remind them about herding practices*." Another elderly pastoralist from Mbeza shared: "*I became a herder because of my uncle who was a very experienced pastoralist in our village. It is important to follow these 'golden rules', as they have a great impact and leave behind a lot of knowledge with you. Now I nag my sons and tell them to do this or don't do that. My sons are becoming effective pastoralists too."* In this way, local pastoral knowledge is transmitted from one generation to another.

For the *Ila*, the main activity and source of identity has always been cattle herding (Fielder (1973). They have developed transhumance(*kuwila*) system that is adapted to the seasonal changes in the ecosystem of the Kafue Flats by following climatic and weather conditions in the floodplain (*ibanda*). After water recedes between June and July, cattle herds are taken to the banks of the Kafue River and its lagoons (Manford , 2025). Most families have their own

cattle outposts/cattle camps (*lutanga*). Pasture is communal property and so is the Kafue Flats. The animals are taken back to the villages in December or January when the water rises again (*kuboola*).

The transhumance nature of the *Ila* people means they move cattle with flood level, not only based on announcements but also on mutual local knowledge. Whereas pastoralists do have permanent settlements on the upland (*mulundu*), the movement of cattle during the dry and wet periods is greatly imbedded in their culture irrespective of recent flood, flow and flux.

Although extreme weather events such as droughts and floods are unavoidable (Walker, 1989), there is now a general recognition that the ZMD, for example, can provide forecasts and warnings of occurrences of these extreme events to minimize economic disruption, damage to property and loss of life to local farmers. Accordingly, weather and climate information should be used as integral components for risk management in implementing drought and flood management programmes (DMMU, 2005). This can be integrated by incorporating local knowledge in form of climate and weather warnings and signs and local languages (*Ila* or *Tonga*) as these can easily be identified, understood and interpreted by pastoralists.

As outlined above, the Kafue Flats are suitable for livestock farming and fishing. The altered flooding, flow and flux of the Kafue River should also be utilized to ensure food security and income generation through timely forecast. It is against the above that the study encourages networks and strengthening the ZMD and integration of local knowledge in effective approaches, methods and tools for disaster risk reduction and share ideas on how best methods could be enhanced to educate and warn pastoralists using the locally available early warning systems. Thus, the Department of Agriculture at district level should source for more rain gauges as part of early warning tools for each of the four chiefdoms to help in the forecasting of weather. At the same time, it is also important to incorporate local early warning knowledge, systems or signs with the scientific ones as used by the ZMD and DMMU.

Therefore, living with variability, change and uncertainty entails networking with other relevant partners in gathering, processing and forecasting of meteorological and early warning information. This is because within the early warning systems there must be built-in realities of community structures and a commitment to making all information freely available, in local languages, something similar to studies by Food and Agriculture Organisation [FAO] (2006).

This is important as such information could be used to educate farmers in the district on how to plan their farming activities given a prevailing weather forecast, disaster management and preparedness to withstand shocks caused by a particular hazard. Therefore, learning to live with change and uncertainty entails production adjustment, improved Kafue river flow, technology and effective forecasting among pastoralists to accept disturbance, surprise and crisis as part of transformation and process of social-ecological typologies of living in a varied environment.

It has also been observed that the strategies used by pastoralists to track climate variability in the past and now are working less effectively (Gunderson *et al*., 2002). This is because floods tend to be rapid onset whereas droughts are slow onset. For this reason, flooding as a result of altered flows is controllable whereas drought events are immutable (Breen *et al.,* (1997). Thus, based on frequency and severity, rare or low-probability events of great severity such as drought are the most difficult to mitigate, and vulnerability reduction may demand risk-aversion measures beyond those justified by local technocrats (ZEMA/UNEP, 2013).

Thus, information about floods, flow, flux and drought is critical in Namwala. Prior to the commencement of each rainy season, the ZMD issues a seasonal rainfall forecast in order to provide some indication of the likelihood (timing and nature of the rains) of the coming season. These forecasts enable local pastoralists to make informed decisions and plan appropriately for their activities (i.e., supplementary feeding).

However, this information does not reach all pastoralists. Thus, limited weather and climate information and early warnings is received by pastoralists due to absence of national transmission signals for radio and television reception. Instead, weather and climate information and early warnings should be disseminated through community-based radio stations working under the radio-internet (RANET) system, among them Itezhi-Tezhi and Namwala FM. This information is useful in planning their activities especially in times of disasters.

From the above observations among pastoralists, it is envisaged that mapping of early warning signs and use of local knowledge in Namwala would result into the improvement of the living conditions of rural communities (Simfukwe *et al.,* 2012) measured by: higher total agricultural production of staple food crop; greater food self-sufficiency through timely planting and harvesting; timely transhumance of cattle in the Kafue Flats; preparation/treating of flood/drought related diseases and pests; more varieties of vegetables in gardens in the Kafue Flats plus healthier diet of food consumed per day; adoption of soil and water conservation practices; and lower rate of malnutrition through improved incomes and milk consumption.

6. CONCLUSION AND RECOMMENDATIONS

Floods and droughts are natural phenomena and they need timely and effective early warning signs, mapping and use of various forms of knowledge to minimize their impacts. Mankind has always been overwhelmed by floods/droughts due to the magnitude of loss of life and property. It is important to implement a versatile flood/drought forecasting and warning system to ensure effective collection, transmission and timely analysis of climate variability and change related data and prompt dissemination to end users.

In Namwala, this applies to pastoralists who live in a varied environment characterized by Kafue Flats' and Kafue Rivers' flood, flow and flux. Relevant authorities and affected communities are usually taken unaware when flood-causing rainfall occurs. Accordingly, the upper catchments receive higher rainfall while the lower plains receive relatively low rainfall. Establishing an effective flood and drought forecasting and warning system, therefore, forms part of the overall climate variability and change management policy. Thus, climate signs and use of indigenous knowledge in Zambia in general and Namwala District in particular are vital in understanding flood and drought disaster risk reduction measures.

For this reason, the study recommends that both electronic and print media could play an important role in spreading information and promoting community participation about an impending season. There is a general poor perception among local pastoralists that dissemination of weather and climate information and early warnings through Lusaka based broadcasting stations such as Zambia National Broadcasting Corporation (ZNBC) is not appropriate for rural communities due to poor reception and language barrier – as most pastoralists do not read/and or understand English. Local participants recommended that weather and climate information and early warnings be disseminated through community-based radio stations working under the radio-internet (RANET) system using local languages (*Ila* and *Tonga*). In terms of effective early warnings for disaster preparedness, respondents recommended the use of local radio stations (Namwala and Itezhi-tezhi) and preferably public speaker systems on 4x4 vans and speed boats; and/or helicopters and low flying aircrafts to distribute flyers written in local languages. This study therefore envisions that when weather and climate information and early warnings are timely received, local pastoralists would use the information in planning their cropping and transhumance activities for agricultural activities in general and livestock husbandry in particular. This is important as such information could be used to educate pastoralists in the district on how to plan their farming and pastoral activities given a prevailing weather forecast. Therefore, learning to live with change and uncertainty among pastoralists entails utilising local perceptions and indicators of climate variability and early warning signs using indigenous knowledge and timely weather forecast to accept disturbance, surprise and crisis as part of their resilience and transformation process.

Acknowledgements

The author thanks all the key informants, pastoralists, Chiefs Mukobela, Muchila, Nalubamba and Mungaila, the village headmen, all government officials and the people of Namwala who furnished us with the information used in this study.

References

Breen, C. M., Quinn, N. W., & Mander, J. J. (1997). *Wetlands conservation and management in Southern Africa: Challenges and opportunities* (Summary of the SADC Wetlands Conservation Survey Reports). Harare, Zimbabwe: IUCN.

Breidlid, A. (2013). *Education, indigenous knowledges, and development in the global South.* New York, NY: Routledge.

Casarotto, C. (2013). *Water economics and governance in the Kafue River Basin, Zambia* (Doctoral dissertation, University of Zurich, Switzerland).

Central Statistical Office [CSO]. (2000). *Agricultural and pastoral production (small and medium holdings) 1999/2000 report.* Lusaka, Zambia: CSO.

Chabwela, H. N. (1994). *Status of wetlands of Zambia: Management and conservation issues.* Lusaka, Zambia: Environmental Council of Zambia (ECZ).

Chanda, P., & Mbewe, S. (2022). Participatory approaches in agricultural information dissemination: Improving adaptation among smallholder farmers. *African Journal of Rural Development, 10*(4), 256–272.*

Chanda, S., Banda, P., & Moyo, G. (2023). Agricultural information use and decision-making among smallholder farmers in Zambia. *African Journal of Agricultural Research, 18*(2), 112–124.*

Chilombo, S., Chishimba, G., & Banda, J. (2019). Challenges faced by smallholder farmers in accessing agricultural extension services in Zambia. *Journal of Agriculture and Rural Development, 12*(3), 45–58.*

Churchill, A. (2010). *Flood, flow, flux: Livelihoods on the Kafue Flats, Zambia.* Virginia, USA: University of Virginia, American Society of Landscape Architects (ASLA).

Davies, S., Buchanan-Smith, M., & Lambert, R. (1991). *Early warning in the Sahel and Horn of Africa: The state of the art. A review of the literature* (Vol. 1, Report No. 20). Sussex, UK: IDS.

Disaster Management and Mitigation Unit [DMMU]. (2015). *Disaster management operations manual.* Lusaka, Zambia: Office of the Vice President, Government of the Republic of Zambia (GRZ).

Fielder, R. J. (1973). The role of cattle in the Ila economy: A conflict of views on the uses of cattle by the Ila of Namwala. *African Social Research, 15*, 327–361.*

Folke, C., Colding, J., & Berkes, F. (2003). Synthesis: Building resilience and adaptive capacity in social-ecological systems. In F. Berkes, J. Colding, & C. Folke (Eds.), *Navigating social-ecological systems* (pp. 328–352). Cambridge, UK: Cambridge University Press.

Food and Agriculture Organisation [FAO] & United Nations Development Programme [UNDP]. (1968). *Multipurpose survey of the Kafue River Basin: Zambia* (Vol. 1). Rome, Italy: FAO/UNDP.

Government of the Republic of Zambia [GRZ]. (2006). *Fifth National Development Plan 2006–2010.* Lusaka, Zambia: Ministry of Finance and National Planning (MoFNP).

Gunderson, L. H., Holling, C. S., Pritchard, L., Jr., & Peterson, G. D. (2002). Resilience of large-scale resource systems. In L. H. Gunderson & L. Pritchard, Jr. (Eds.), *Resilience and the behavior of large-scale systems* (pp. 3–20). Washington, DC: Island Press.

Kirsten, J. A., Perret, S., & de Lange, A. (2002). *Agriculture development in drought-prone Southern Africa.* Pretoria, South Africa: University of Pretoria Press.

Lhophitallier, G., Ellis, C. K., & Gillis, M. (1999). *Assessment of land use patterns and agrarian systems: Principles of zoning.* Pretoria, South Africa: University of Pretoria Press.

Manford, M. (2025). The symbolic concepts of transhumance [Kuwila] in the Kafue Flats among the Tonga people of Mwanachingwala, Hamusonde and Mungaila in Southern Province, Zambia. *British Journal of Multidisciplinary and Advanced Studies, 6*(1), 23–36. https://doi.org/10.37745/bjmas.2022.04213

Manda, P. (2017). Information and agricultural development in Tanzania: A critique. *Information Development, 18*, 181–189.

Mchombu, K. J. (2021). *Sharing knowledge for community development and transformation: A handbook.* Oxford, UK: Oxfam.

Mertens, J. (Ed.). (2013). *Centre Environment and Sustainability (CCES)/African Dams Project: An integrated water resources management study.* Zurich, Switzerland: CES/ADAPT.

Mengistu, D. (2019). Farmers' perception and knowledge of climate change and their coping strategies to the related hazards: A case study from Adiha, Central Ethiopia. *Journal of Agricultural Sciences, 2*(3), 138–145.

Mwalusaka, N. (2021). Agricultural information sources used for climate change adaptation in Tanzania. *Library Review, 62*(4), 266–292. https://doi.org/10.1108/LR-12-2011-0096

Mwelwa, E. M. (2004). *The application of the monthly time-step Pitman rainfall-runoff model to the Kafue River Basin of Zambia* (Master's thesis). Rhodes University, Grahamstown, South Africa.

Norberg, J., Wilson, J., Walker, B., & Ostrom, E. (2008). Diversity and resilience of social-ecological systems. In J. Norberg & G. Cumming (Eds.), *Complexity theory for a sustainable future* (pp. 46–79). New York, NY: Columbia University Press.

Rennie, J. K. (1985). Traditional society and modern developments in Namwala. In *Proceedings of the National Seminar on Environment and Change: The Consequences of Hydroelectric Power Development on the Utilisation of the Kafue Flats* (Lusaka, April 1985). Lusaka, Zambia: University of Zambia, Kafue Basin Research Committee.

Scott Wilson. (2004). *Integrated Kafue River Basin strategic environmental impact assessment study.* Lusaka, Zambia: ZESCO Limited.

Semali, L., & Kincheloe, J. L. (1999). Introduction: What is Indigenous knowledge and why should we study it? In L. Semali & J. L. Kincheloe (Eds.), *What is Indigenous knowledge? Voices from the academy* (1st ed., pp. 3–57). New York, NY: Routledge.

Senanayake, S. G. J. N. (2006). Indigenous knowledge as a key to sustainable development. *The Journal of Agricultural Sciences, 2*(1), 1–10.

Sheppe, W., & Osborne, T. (1971). Patterns of use of a flood plain by Zambian mammals. *Ecological Monographs, 41*(2), 179–205.

Simfukwe, T., Casarotto, C., Kainda, T., & Tembo, G. (2012). Rural household water use in the Kafue River Basin in Zambia. In *Proceedings of the World Congress on Water, Climate and Energy* (Dublin, May 2012).

United Nations Development Programme [UNDP]. (2022). *Strengthening climate resilience of agricultural*

livelihoods in agro-ecological regions I and II in Zambia: Annual performance report CY2021. https://www.greenclimate.fund/document/2021-annual-performance-report-fp072-strengthening-climate-resilience-agricultural

Walker, P. (1989). *Famine early warning systems: Victims and destitution.* London, UK: Earthscan Publications.

Williams, G. J. (1984). The Kafue hydroelectric scheme and its environmental setting. In G. J. Williams & G. W. Howard (Eds.), *Development and ecology in the lower Kafue Basin: Papers from the Kafue Basin Research Committee of the University of Zambia.* Lusaka, Zambia: University of Zambia, Department of Biology.

World Wide Fund for Nature [WWF]. (2006). *Agriculture, water and environment in the Kafue River Basin* (Issue No. 5). Lusaka, Zambia: WWF.

Zambia Environmental Management Agency [ZEMA], GRID-Arendal, GRID-Sioux Falls, & United Nations Environment Programme [UNEP]. (2013). *Zambia: Atlas of our changing environment.* Lusaka, Zambia: ZEMA, GRID-Arendal, GRID-Sioux Falls, and UNEP.