



Case Study

Flood, Flow and Flux: Climate variability and effects of the Kafue River regulation on pastoralism in Namwala District, Zambia

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Governing common property resources for pastoralism in floodplains is a challenge. The case of the Kafue Flats in Southern Zambia in Namwala District illustrates how pastoralists have developed multiple resilience strategies to climate variability and altered flooding, flow and flux of the Kafue River between two dams. Accordingly, population in cattle have increased from 123,016 in 2010 to 123,738 in 2011, 128,898 in 2012 to 132,797 in 2013, and 135,306 in 2014 to 139,945 in 2015 and 145, 445 in 2016. This increase has reduced the area available for grazing per cow with respect to access to water and pasture. Compounded by droughts and increase in cattle numbers, the hectarage per cow has continued to decline from 3.8, 2.6 to 1.9 and 3.7, 2.4 to 1.7 in 2005 and 2017 in the Flats, lagoons and dry land respectively. This means that the Kafue Flats is prone to overgrazing in view of combined increased floodplain agriculture, successive droughts and increase in cattle numbers. Thus, due to lack of an enabling legal environment that protect pasture in common floodplains as well as pastoralists' productive assets and livelihoods, climate variability and altered Kafue River flow has threatened the resilience and management of common property resources in Namwala. Grazing and cropping patterns have changed dramatically and flood-dependent livelihoods are threatened. Thus, this study re-conceptualizes the Kafue Flats as a dynamic ecotone ecosystem, one in which new rules for Kafue River governance can sustain pastoralism into a vital economic, ecological and energetic sector.

Keywords: Climate variability, Floods, Flow, Flux, Kafue Flats, Namwala, Pastoralists

INTRODUCTION

The daily lives and livelihoods of an estimated 200 thousand people in Namwala are affected by climate variation and management of common property resources (Churchill, 2010). As climate change increases the frequency and intensity of these shocks, the challenges faced by food insecure pastoralists also increase. Evidence suggests that those societies carrying the heaviest burden due to impacts of climate variability and change are surprisingly the least responsible for greenhouse gas emissions, land use change and have least capacity to adapt. In that regard, Africa is cited to be

hit severely by these impacts because of sensitivity of its core economies; crop cultivation, livestock keeping and water management, to mention but a few (Foster, 1953).

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One of the socioeconomic sectors that will bear the heaviest burden to climate variability is pastoralism given its sensitivity to variations and manmade alterations. Droughts and floods are common manifestations of climate variability. In many African pastoral societies, deterioration of pastures during droughts in particular has resulted into poor health and death of livestock impacting on food and livelihood of pastoralists (Sichingabula, 2004).

The farming and cattle grazing economies in Namwala depend on a rich ecosystem nourished by the seasonal flood cycles of the Kafue River. The flooding patterns of the Flats are now significantly altered by the Itzhi-tezhi (ITT) Dam (constructed 1978 and a newly completed hydroelectric power station in 2016) which regulates water flow for the downstream Kafue Gorge Dam (constructed 1972), a hydroelectric generator for most of Zambia, operated by water right holder; Zambia Electricity Supply Corporation (ZESCO). Seasonal flooding is now often unpredictable in its timing and duration. Vegetation and grass patterns have changed dramatically and flood-dependent livelihoods are threatened by irregularities (Casarotto, 2013). The Kafue Flats has been classified as a highly sensitive ecotone ecosystem which requires major flood management interventions for sustainability due to a number of hydrological changes. In addition to these changes, the depth and areal extent, duration and frequency of flooding in the whole of Kafue Flats has been reduced by ITT dam (Kunz *et al.*, 2013).

However, the above traditional paths of social-ecological relationship 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 onwards, 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. Moreover, the area affected by floods and droughts appears to have expanded. The 1991/92 (worst drought of 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 and 2009/2010 rainfall flooded most communities. Furthermore, the flood, flow and flux of the Kafue River, in addition to cattle diseases, have negatively affected the way of life of the people of Namwala which they have enjoyed for decades. The socio-economic situation has drastically changed and indeed food security situation is threatened. However, pastoralists are learning to live with river altered flow, flux and uncertainty. "The recurrence of droughts has depleted animal grazing resources and drinking water, are negatively affecting the productivity of the livestock sector" (Government of the Republic of

Zambia [GRZ], 2006: 47). Thus, it is assumed that pastoralists within similar agro-pastoral communities and households have responded differently to constraints and opportunities resulting from climate variability and Kafue river governance.

The Kafue Flats is the second biggest flood plain in Zambia after the Barotse flood plains, extending for about 353km long and covering an area of 6 500 km². It comprises of the Kafue main river channel, lagoons and swampy areas (Mulongo, 1985). For most of this river reach, the Kafue meanders through a large flat grassland flood plain called Kafue Flats, with a minimum elevation of 1,065 meters and the height difference between ITT dam and Kafue Gorge being only 15 meters. The Kafue Flats is a very critical sub-basin as it supports hydropower generation, tourism, fishing, farming and livestock. For local people, the major livelihoods in the Kafue Flats are centred on agriculture, particularly livestock rearing (Kalapula, (1976). However, the agriculture sector has generally been performing badly with crop yields fluctuating annually.

Cattle herding has been a very significant part of the livelihood of the people in the Kafue Flats. The Flats have the highest concentration of traditionally owned cattle in Zambia. At the peak of cattle population in the 1970s, the inhabitants of Namwala district, the *Ila*, had 13 heads of cattle for each adult male and were said to be the richest cattle keeping people in Central Africa (Smith and Dale, 1920; Williams, 1984). For this reason, cattle economy is linked to flooding which has implications for the grazing of the animals throughout the year (Jaspan 1953; Rennie, 1978). During the flood period, cattle are made to graze near human settlements just outside villages. During May to June when the floods subside, cattle are grazed in the plains following the receding waters (World Wide Fund for Nature [WWF] (2006). In the dry season, they are taken to some cattle outpost distant from human settlement under the care of young herders. However, there have been major changes in the livelihood systems of pastoralists especially those that arose from river alteration/operation rules. These have had direct impact on pastoralism, as a major economic activity in the area (Mertens, 2013); GRZ/Associated Programme Flood Management [APFM], 2007).

Previous studies on the Kafue Flats concentrated on the downstream impacts of large dams on human settlements, as opposed to consequences of upstream reservoir on economic activities, and in addition to emphasis on quantitative studies that focused solely on hydrological issues. Literature specifically on the Kafue Flats includes pre-dam studies (FAO/UNDP, 1968; Sheppe and Osborne 1971), government and NGO reports (ZEMA/GRID/UNEP, 2013; *Strategy for Flood Management*, 2007; WWF, 2006), anthropology studies (Fielder, 1973; Chabwela, 1994; Haller, 2007; Haller and Merten, 2008), ecological surveys (Casarotto, 2013; Kunz *et al.*, 2013; Ramsar,

2013) and studies on efforts to introduce environmental flows (Churchill, 2010; Casarotto, 2013; Kunz *et al.*, 2013). The definitions and impact of Kafue River flow of these studies on pastoralism is poorly established and requires some in-depth locale social-ecological analysis and monitoring. This study therefore integrated photovoice observations to create a more complete picture on flood, flow and flux of the Kafue River on local pastoralism.

This study therefore focused on flood-related problems in the Kafue Flats on animal husbandry. It traces historical and recent floods in Namwala as well as the widespread reduction in grazing land. It shows how the construction of Itezhi-tezhi dam on the upstream of the Kafue flood plain and Kafue Gorge dam on the downstream and their subsequent operation has changed the flooding, flow and flux regime between two dams and its impact on the growth of grass and the environment in the Kafue Flats. At the same time, it also emphasises that the starting point for Integrated Flood Management (IFM) is a reorientation of the approach to floods and development and the need for pro-active and dynamic planning which takes into consideration the full benefits from new environmental concerns to flood plain ecosystem sustenance and socio-economic issues of local communities in the Kafue Flats in Namwala District.

Flood is high hydrologic extreme resulting from natural or human activities that disturb the hydrological cycle over a period of time resulting into excessive occurrence of water. Drought, on the other hand, relates to low hydrologic extreme resulting from disturbances in the hydrological cycle over a sufficiently long time resulting into significant water deficiency. *Flow* relates to the natural Kafue River downward movement from upstream ITT dam to the downstream Kafue Gorge dam. *Flux* is the condition of continuous change resulting from anthropogenic and man-made change on the quantity of water discharged from the ITT reservoir. Anthropogenic changes include climate variability and change while man-made relates to several large floods and unscheduled releases of water from ITT dam to the Kafue Gorge dam that have resulted into widespread destruction of crops, livestock and homes. In addition, drought years and dam operating procedures have led to widespread ecological changes. At the same time, *Climate variability* refers to variations in the mean state and other statistics (e.g. occurrence of extremes) of the climate on all temporal (time) and spatial (space) scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system, or due to variations in natural or anthropogenic (human induced) external forces.

Thus, in Namwala, the roots of ecological vulnerability are linked to social-ecological systems and unfavorable government policies through ZESCO water rights. This is so because the cattle economy is linked to flooding of the Kafue River and drought which have implications for the

grazing of the animals throughout the year. Large floods and unscheduled releases have resulted into widespread destruction of crops, livestock and homes, while drought years have led to widespread loss of livestock, overgrazing and drying up of pans and lagoons needed for livestock watering. 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. The construction of the ITT dam in 1972 altered the flooding, flow and flux of the Kafue River with increased dry season flooding and reduced rainy season flooding thereby reducing area available for grazing per cow. Compounded by droughts and increase in cattle numbers (standing at approximately 147,000 in 2017), the hectareage per cow has continued to decline from 3.8, 2.6 to 1.9 and 3.7, 2.4 to 1.7 in 2005 and 2017 in the Flats, lagoons and dry land respectively. This means that the Kafue Flats is prone to overgrazing in view of combined increased floodplain agriculture, successive droughts and increase in cattle numbers. Hence, the aim of the study was to determine the effects of the Kafue river governance on pastoral land use in the utilisation and management of common property resources between two dams.

MATERIALS AND METHODS

Namwala District is about 2,175,064 hectares in extent located 170 km North West of Choma town and 350 km from Lusaka, the capital city. It lies along the Kafue Flats with seasonal flooding and pastoralism 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). Namwala District has a human population estimated to be slightly above 101,000 people according to the 2010 Census of Population and Housing. The climate in Namwala, like much of Zambia, is marked by three distinct seasons; (1) the cool-dry season from (April) May to August; (2) the hot dry season from September to October; and, (3) the wet-warm season extending for five months from November to March. The average annual rainfall is 800mm and unreliable, producing drought conditions with much of it falling in December, January and February. The mean maximum and minimum temperature range from 16° C to 34°C in October; and, 7°C to 24 in °C July respectively (Kunz *et al.*, 2013). With its location along the Kafue Flats, Namwala is prone to flooding which comes at different times of the year thereby supporting a rigorous growth of grass species such as wild rice (*Oryza Barthii*) and *Brachiaria sp* ideal for grazing purposes, as pastoralists follow receding flood waters (McLean, 1961). Therefore, the prosperity of the cattle economy is based on the flooding patterns of the Kafue Flats that are now significantly altered (regulated

between ITT and Kafue Gorge Dams). Hence, Namwala was suitable as study area given an expanse common property plain ideal for rearing cattle and harbours the highest concentration of traditionally owned cattle in Zambia. Undertaking a study in the area therefore provided a clearer picture on how pastoral systems cope and or/adapt to the ongoing impacts of unscheduled releases and climate variability and change in this rural part of Zambia. This is because Namwala lies along the Kafue Flats between two dams and has the highest traditionally owned cattle standing at 145,445 in 2016.

Collection of data was done through the use of secondary and primary sources. Secondary data was collected through extensive literature review, while primary data through the use of interview guides from local pastoralists and key informants. Primary information was collected following acquisitions of village population registers in which typical sampling technique was used to identify respondents for household survey while purposive sampling was used to determine in-depth interviews from key informants. Typical sampling is a type of purposive sampling which helped in identifying specific pastoralists who graze their cattle on the Kafue Flats (practice transhumance) in order to provide a local profile on the effects of the Kafue River governance. Thus, 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). But zoning goes beyond data collection and representation, it leads to data management and modeling. It relies on the

principle that it is possible to commit all spatial phenomena, their state, their dynamic and their functioning, to a smaller number of units (Kirsten *et al.*, 2002; Perret, 1999).

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, was utilised from each of the four chiefdoms/zones. This technique was based on the selection of elements (names) with the help of agriculture extension officers, and arrived at six randomly selected cases or household names for each of the five cooperatives. These were household heads; wife or husband. In an event where both are absent, the eldest member of the family was interviewed. Each of the four chiefdoms has more than ten cooperatives but only five cooperatives were randomly sampled in each zone and six respondents purposively sampled to give a spatial proportionate sample of thirty respondents from each chiefdom/zone. Thus, the study engaged a total of 120 household heads; 30 respondents from each of the four chiefdoms namely: Mukobela, Mungaila, Nalubamba and Muchila. It was easy to comprehend this because the population in the study area is clustered with many farmers having their fields on the outskirts of the villages and cattle in the flood plain (Figure 1). For this reason, carrying out research was timely during the farming/rainy season of 2016/2017 when their cattle are on the plateau and Kafue Flats in flood. This enabled the researcher to capture flooding, flow and flux with preceding dry season characterised by water scarcity.

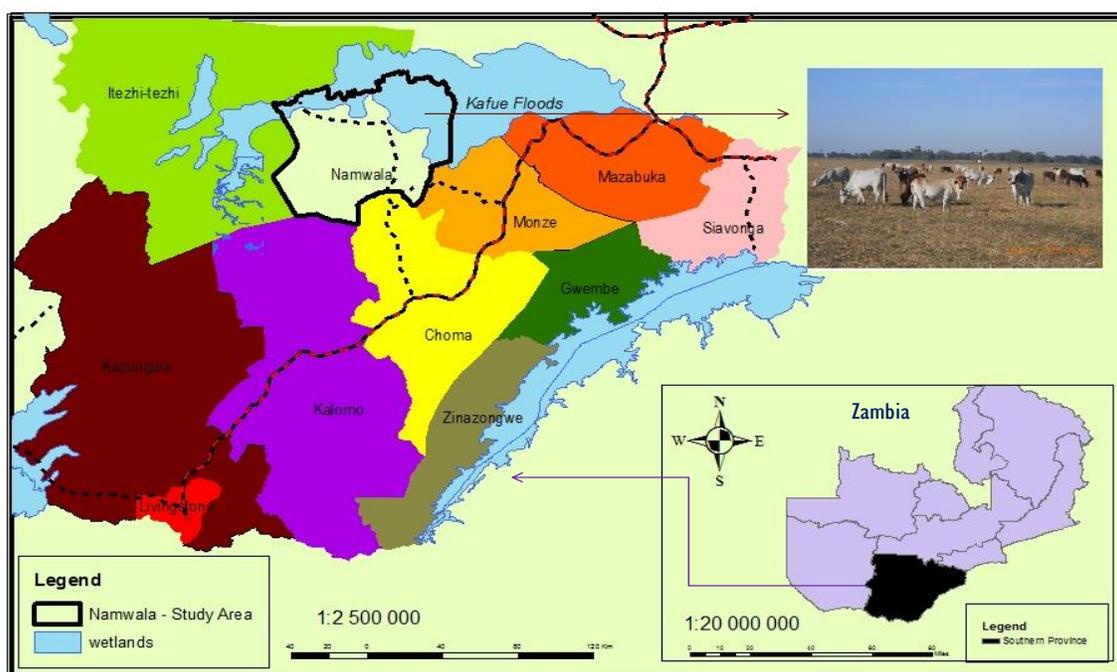


Figure 1: Location of Namwala in Southern Province and along the Kafue Flood Plain
Source: Rusangu University - Department of Geography and Environmental Studies

The thrust of the study was that social-ecological typologies undergo change over time. These changes can be slow and predictable, or they may be fast and unforeseen. Thus, the use of a timeline helped to reveal the longer-term disturbances or shocks related to Kafue River floods, flow and flux on pastoralism since 1978, after the construction of the ITT dam. Thus, long term trend analysis was used to explore historical patterns to capture all major social-ecological disturbances using seasonal calendars. Seasonal calendars are useful tools in rural areas in identifying different activities throughout the year (s), for example production activities, hazards and stresses, periods of hunger, landuse, erosion, rainfall, population, management of common property resources etc. (Kirschten *et al.*, 2002; Matata *et al.*, 1999). In this study, seasonal calendars were drawn to foster understanding of local pastoral systems and trace changes in grazing/water patterns. For this, pastoralists illustrated patterns month by month, cropping patterns, water use, livestock transhumance, pests and cattle diseases. Further, Focus Group Discussions supplemented seasonal calendars by using transect walks and photo voice process. A transect walk is a simple technique used in rural typological studies to ensure that the researcher, together with local pastoralists, explore the spatial differences fully in the area under study (Matata *et al.*, 1999; Mettrick, 1993). In addition, an essential component was photo voice process (Cunningham *et al.*, 2009), in which pastoralists took photographs of what they thought was important about a given social-ecological issue, and then had lengthy interview about the context and motivation in taking each picture. This was followed by transect walks to map locations found in the photos (e.g. grazing lands and water points) and related these to climate variability and change. This gave an opportunity to locals to show outsiders how they used the floodplain for their livelihoods and the flooding patterns (seasonal and dam-induced).

Photovoice as a methodology empowered respondent by being approached as experts in their community to share their knowledge and concerns with a larger audience. The process is collaborative and not highly controlled by the researcher, allowing the participant's true ideas about an issue to surface. It generates a ripple effect as the participant often explains the study to others as s/he is taking photos. Many went out of their way to show their neighbours' conditions as well as their own, or to photograph places or situations they knew the researcher could otherwise not access. The respondents, many using a camera for the first time, took pictures intermittently for six months before photographs were developed. Going through each photo led to a wealth of details about everyday life, cultural assumptions, and physical locales. The process unfolded over six months, but questions on flooding, flow and flux included patterns before and after the construction of ITT dam; so the researcher could see

water conditions change over time and space. Each of these factors increased the breadth and depth of research and was supplemented by interviews. These interviews were extensive conversations with pastoralists and traditional chiefs, followed by walks to map locations found in the photos.

These methods introduce new approaches in understanding pastoralist's resilience to climate variability and weather shocks, including related effects of a highly regulated Kafue River. Hence, the study was exploratory in nature and used both qualitative and quantitative data to allow for descriptions of given geographical phenomena. Thus, the study used Statistical Programme for Social Sciences (SPSS), Quantum Geographic Information System (QGIS) and Excel for statistical data analysis and social network photographics to accompany the interpretations of survey data while Arc GIS was used to generate maps.

RESULTS AND DISCUSSION

Out of 120 respondents in the study area, 92 respondents (76.7 percent) were males while 28 (23.3 percent) were females. A lesser number of women were interviewed because there are fewer female-headed households as compared to male-headed ones. More males and females between 41 and 50 age groups accounted for 52.1 percent of those owning cattle (these are at their prime of 'cattle keeping career'), followed by those in the 31 and 40 age groups who accounted for 30.6 percent. There are fewer people below the age of 30 who own cattle. These own 10.2 percent since they are often just starting their families and are therefore still settling down. In addition, those above 60 represented 7.1 percent only since there are few surviving household heads considering the low lifespan in Zambia in general and Namwala in particular. About 69 (57.6 percent) attended primary school, 16 (13.3 percent) attended secondary school, 7 (5.8 percent) attended tertiary education and 28 (23.3 percent) never attended formal education. In addition, the majority of the people (70.8 percent) interviewed were natives in the study area and owned more cattle. Tribal cousins (*Lozi, Luvale, Mbunda*, and *Luchazi*) constituted 23.4 percent of the sample and many other tribes such as the *Bembas, Tumbukas, Ndebeles* accounted for 5.8 percent and these settled in the study area after retiring from formal employment.

Thus, Namwala has the highest concentration of traditionally owned cattle in Zambia standing at 145,445 in 2016. This cattle population depends on the cycle of flooding of the Kafue Flats and management of water released from the ITT dam to the Kafue Gorge Dam amidst climate variability and change. Figure 2 summarises trends in cattle numbers in the District from 1961 to 2016.

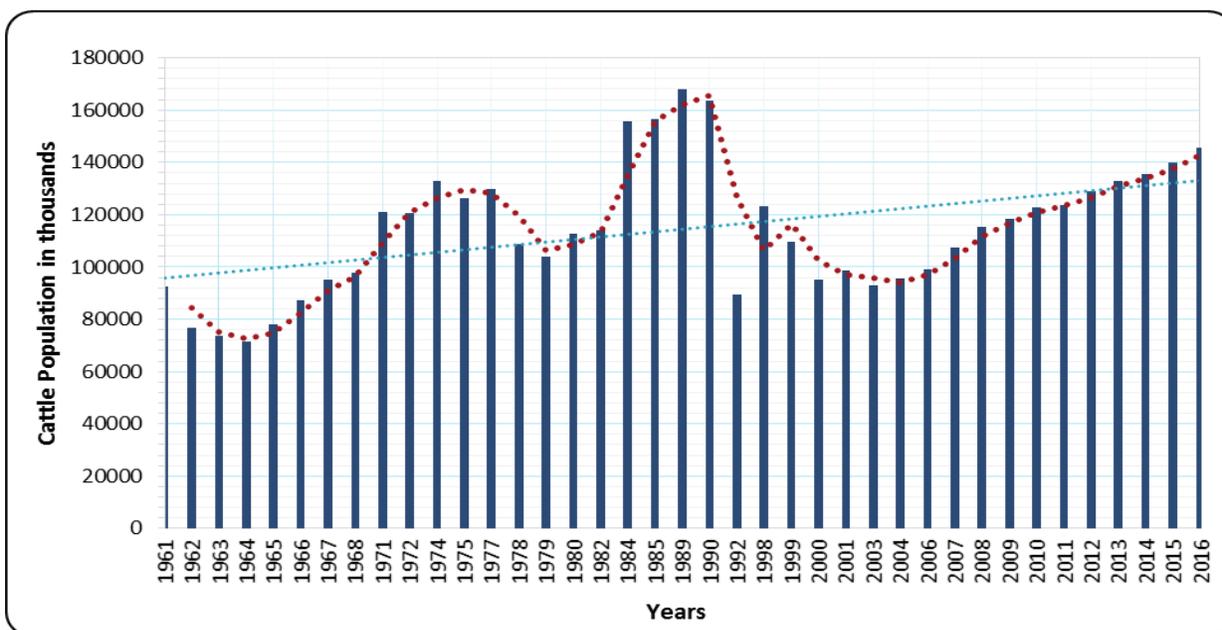


Figure 2: Trends in traditional cattle numbers from 1961-2016 in Namwala.

Itezhi-tezhi and Kafue Gorge dam's operation rules

The operations of the ITT and Kafue Gorge dams have evolved with time through three sets of Rules. These are: (i) Swedish Engineering Consultants (SWECO) Rules; (ii) Southern African Development Community (SADC) Rules; and (iii) Integrated Operating Rules. The first sets of Rules were designed by SWECO and were in operation from 1977 to 1994. These Rules were concerned with maximising hydropower generation from the available water. They made a provision for a minimum release of 55 cumecs and a freshet release of 300 cumecs every March from ITT dam. The second set of rules came as a result of the severe drought of the 1991/92 rainy season and was in effect from 1994 to 2004. Shawinigan Engineering under the SADC project developed the Lower Rule Curves for the two reservoirs. These were to act as a safeguard for hydropower production from severe drought and for dam safety from severe floods coming from upstream of ITT dam. There was no clear instruction for release of minimum or excess flows. The third set of rules developed by Integrated Water Resource Management (IWRM) Project for Kafue Flats are the latest in use. These are aimed at restoring the old habitat without compromising hydropower generation. The Rules aim at improving the timing of the release of excess water from ITT dam for flooding and increasing the recession area during the dry season by drawing down the Kafue Gorge dam. However, all this flooding, flow and flux alterations have negative effects on grazing (Chabwela and Siwela, 1986; Chabwela and Haller, 2007; Wamulume *et al.*, 2011, Casarotto, 2013). The rules are meant to meet ecological requirements for the ITT and Kafue Gorge dam "flatline" river flow differences. Ultimately, these have altered flooding patterns which have also altered different ecosystem in the flats, including pastoralism. The flood,

flow and flux regime has been severely changed to provide consistent levels for downstream hydropower production. Compared with the Kafue River's natural flow regime, the post-dam flow exhibits a reduced flood peak, higher minimum flows, and reduced flows overall. Thus, uncertainties of rainfall inflows and Dam operations have changed dramatically. Peak flood timing has varied widely from year to year, from dam management and rainfall patterns, and secondary releases often occur in the dry season, contrary to rainfall expectations. Infact, ZESCO's water right on the Kafue River has never changed since it was originally obtained despite the evolution of the operation rules.

Improving dam operation rules in order to mimic the natural flooding pattern is important. A freshet that mimics the natural rising and declining curve was found to be best suited to ecological requirements and pastoralism. According to Breen *et al.*, (1997), this strategy allows for a more gradual flooding and recession (rather than 'flash-like'), of an extensive duration. The freshet achieves the smallest flooded area of all considered freshet types, but it is considered that the gradual flooding and longer duration outweigh this disadvantage. The new operation rules also allow for the freshets of different values, depending on the extent of rainfall in a given year. Rainfall to a larger extent influences the timing of the freshet release. In a wet year the freshet can start in January or February, in an average year the freshet can start in February or March and in a dry year the freshet can only start in March. Freshet is a process of water release to meet the environmental requirement for flooding, flow flux and recession of the Kafue Flats..

Records still show that there is usually a delay in releasing of seasonal flood water from ITT reservoir and Kafue

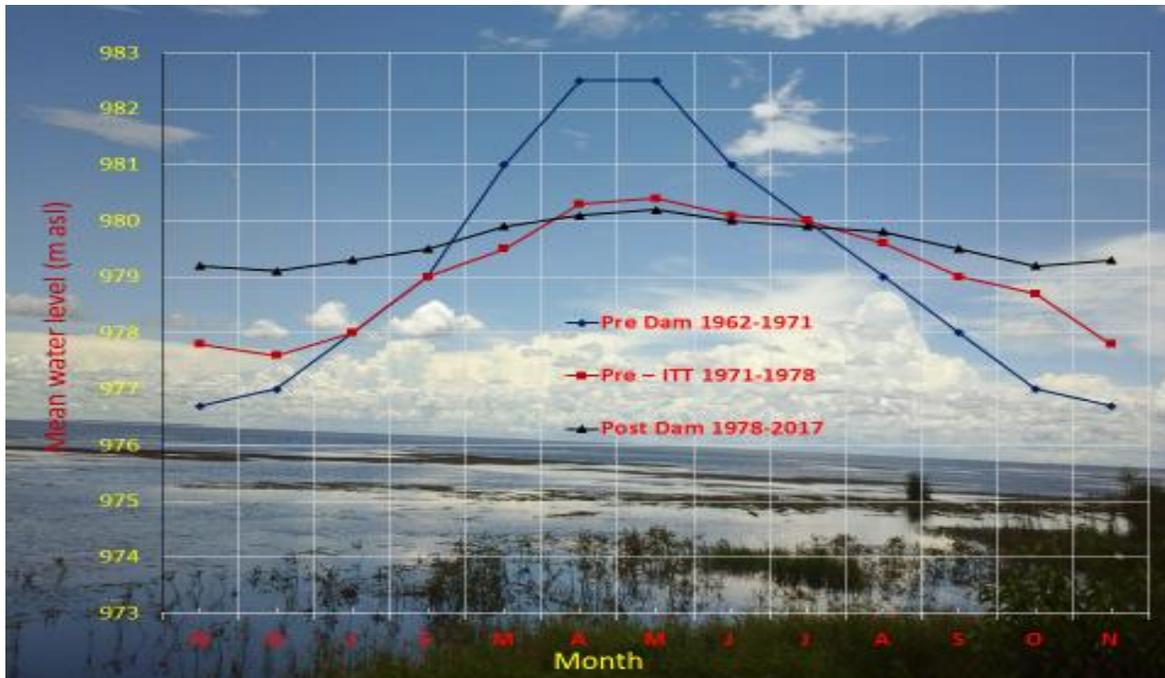


Figure 3: Mean hydrograph at Namwala gauging station for pre-dam and post dams

Gorge for much of the year. This has been attributed to the fact that there is still no full coverage of data collection on rainfall, water levels and discharge; therefore, it is not possible to arrive at an effective assessment of the actual hydraulic and hydrological situation throughout the Kafue Flats. This leads to reservoirs being operated on the safe side in terms of hydropower production only, neglecting other sectors (Figure 3).

Thus, irrespective of the above rules and regulations, the flow regime of the Kafue River at ITT directly affects and alters the timing and extent of the seasonal flooding in the Kafue Flats downstream, thereby affecting pastoralist's transhumance practice. Alterations include lower maximum and higher minimum water levels (Figure 3), and hence a reduced seasonal amplitude throughout the year (from 5 meters pre-dam to 1.3 meters post-dam). As a consequence, seasonally flooded areas in the floodplain have been reduced, while the permanently flooded as well as the permanently non-flooded areas have been increased. This change in hydrological regime induces vegetation shifts, as different vegetation types are strongly linked to the prevailing hydrological regime in the river. For example, at Namwala Pontoon, the river usually remains above 6.7m level from 56 to 190 days. The flood, however, rises more rapidly than it falls. The mean rate of rise is 0.04m/day and the mean rate of fall is 0.02m/day (Figure 3).

Effects of Kafue River regulation on pastoralism

Out of the total 120 pastoralists, 70 percent pointed out that flooding patterns have changed, 61.7 percent outlined

that the flow regime is now problematic whereas 55 percent attributed the changes of the flux nature of the Kafue River as impacting negatively on grasses and their cattle. Those that lamented about untold misery of Kafue River governance with drought related problems constituted 55.8 percent and 52.5 percent pointed to high flooding levels to have disturbed their pastoral systems. Increasingly, traditional or cultural practices of transhumance have been altered with 69.2 percent of the respondents attributed the Kafue River regulation as having changed their way of life. In addition, 55.8 percent of the respondents argued that their pastoral problems with the Kafue Flats (*ibanda*) came after the construction of the ITT dam while 18.3 percent attributed their pastoral utilisation of *ibanda* to the construction of the Kafue Gorge Dam in 1978, for HEP production for the country. Based on novelty and memory, a lesser number of respondents were recorded from those who stressed their problems as a result of Kafue Gorge as compared to ITT. Hence, only a fewer older respondents could remember ecotone ecological conditions of the Kafue Flats before the construction of the Kafue Gorge in 1972.

Other projects such as fishing, commercial agriculture, and tourism and their impact on the Kafue River governance were accounted for by only 3.3 percent of the farmers. These have had less impact on the availability and/or scarcity of Kafue River water and its governance (Table 1). It can be deduced from Table 1 that more responses were recorded from Baambwe and Maala chiefdoms because of their proximity to the expanse common property Kafue Flats than Muchila and Mbeza chiefdoms which are further from the floodplain.

Table 1: Typologies related to Kafue River governance

Typologies related to Kafue River regulation	No. of households from chiefdoms				Total	Percentage (%)
	Baambwe	Maala	Muchila	Mbeza		
Flood	26	28	11	19	84	70.0
Flow	23	26	9	16	74	61.7
Flux	17	22	8	19	66	55.0
During drought years	21	26	9	11	67	55.8
During flood years	19	23	7	14	63	52.5
Cultural related problems	24	27	12	20	83	69.2
ITT dam	19	26	5	17	67	55.8
Kafue Gorge dam	7	9	2	4	22	18.3
Other	1	3	0	0	4	3.3

Effects of climate variability on pastoralism

Zambia's climate is highly variable, with frequent droughts, seasonal and flash floods, extreme temperatures and dry spells. Floods and droughts have increased in frequency over the past three decades, costing the nation an estimated 0.4% in annual economic growth. These trends are expected to intensify in the future. Projected temperatures are expected to increase by 3-5°C by 2100, with average precipitation declining during the early rainy season (October to December) and intensifying thereafter. In the absence of adaptation, rainfall variability alone could keep an additional 300,000 people below the poverty line over the next decade, and reduce annual Gross Domestic Product (GDP) growth by 0.9%. Climate change and variability are in turn affecting agriculture and natural resource productivity, thereby exacerbating poverty and contributing to decline in economic growth (African Development Bank [AfDB], 2013).

In Namwala, droughts and floods, as common manifestations of climatic variations have intensified and increased in recent years. An increase in mean annual temperature of 1.2°C and decreased mean rainfall of 1.8mm/month has been recorded in which rainfall seasons have become less predictable and shorter, with rainfall occurring in fewer but more intense events. Generally, there is a net trend towards more floods and droughts. Mean temperature has increased by 1.3°C since 1990s with a recorded increase in the number of hot days and nights. At the same time, the average precipitation is not projected to change significantly with mean rainfall having been decreasing by 2.3% per decade. However, precipitation variability is expected to increase with early rainy season to become drier, peak rainy season with heavier rainfall periods. This has resulted into climate variation extremes to accentuate with more intense floods; more frequent droughts. This climatic unpredictability has often depleted cattle grazing grounds and disrupted livestock watering due to rise and fall of the Kafue River. Thus, climate variability and change, together with anthropogenic governance of the ITT, have resulted into differential flood, flow and flux related problems of the Kafue River on pastoralism.

Itezhi-tezhi (ITT) Dam's flood, flow and flux related problems

The Kafue hydroelectric dam construction in 1972 was not of regional nature as to include other economic activities that could grow based on the developments. The scheme was purely for such development for generating electric power for the nation. The ITT dam constructed in 1978 to feed the Kafue Gorge dam, on the other end, did not address local needs such as ecological changes in general and grass availability in particular. Among the flood, flow and flux problems include: lack of rainy season flooding and dry season flooding.

The normal annual flooding in the Kafue flats starts in December and ends in May with peak period between February and April. These flows relate closely to the condition of natural flooding. The average annual flooding in the period before the dam was constructed at ITT is much higher than the flooding as a result of the operating rules by ZESCO as observed by 55.8 percent of the respondents. There is a difference of about 35 percent, which means that 25 percent of the Kafue flats do not flood any more, or 1625 km² of land remains unflooded. From different accounts among pastoralists, it is also clear that the lack of flooding has been one of the major problems in the Kafue Flats. Under the flood plain conditions, a flood plain is required to be flooded at least for some time during the flooding period (Welcomme, 1979). This condition is important for the flood plain ecology, spawning fish, wildlife and vegetation and flood recession for aquaculture and livestock grazing. On the other hand, it has promoted the growth of woody weeds in the area where flooding does not occur (*Mimosa pigra*). However, this is no longer the case as climate varies. Also, the endemic Kafue lechwe (*Kobus Lechwe Kafuensis*) and Zebras (*Equus bruchelli*) leave the Kafue National and Lochnivar parks and graze on common property pasture creating competition between cattle and wildlife (WWF, 2004).

Dry season flooding occurs mainly between July and November. This is as a result of the operating rules at ITT which allow a flow of 300 m³per second to feed the lower dam at the Kafue Gorge (Figure 3). Before the construction

of ITT dam, flooding, flows and flux used to be generally confined to the main channel and lagoons, and according to the flood plain conditions, it is required that the flood plain dries up during the dry season (Welcomme, 1979). However, this does not occur in the Kafue flats because of ZESCO operating rules. As a result, a large part of the land (75 percent) is covered with the dry season flooding, meaning that nearly 5000 km² of grazing land is lost to floods during the dry season. The dry season flooding has been the most critical as cattle are expected to be in the Kafue Flats. Thus, the Kafue Flats flooding, flow and flux regime has changed and the floodplain (an 'oasis' of dry season grazing, watering and gardening) does not dry up as it used to be. This has reduced the area for grazing as compared to the situation before the construction of the ITT dam.

Disrupted livelihoods: Flood and flux as consequences altered of Kafue river flow

As with all dams, there are both positive and negative impacts for people, livestock and wildlife. On the positive side, there have been benefits for urban populations (electricity supply) as well as for commercial farmers for whom river regulation ensures a steady supply of water. Less than five percent of households in Namwala have electricity, while 60% of Zambia's electricity goes to Lusaka and the Copperbelt mines. However, many of the negative impacts of the dams are primarily felt by the communities downstream of Itezhi-tezhi who depend on

the Kafue Flats for their livelihoods; particularly pastoralists whose livelihoods revolve around the flats from time immemorial. Pastoralists asserted that altered flow and flux have negative effects on grazing. The year 1994 saw severe floods in the Flats when fishing camps and some settlements along the river were inundated and people were displaced. The effect of the 1994 floods were severe by the fact that the district had not yet recovered from the impact of the preceding 1991, 1992 and 1993 droughts. Namwala also experienced floods in 2000/01. Also, the most recent floods were associated with flashy floods and occurred in various places in the 2005/2006, 2007/2008 and 2009/2010 rainy seasons.

As pointed out above, the cattle economy in Namwala is linked to flooding which has positive impact of provision of sufficient grazing grounds and gardening; an important income generating activity outside general agriculture. Thus, flooding and recession of floods allow local people to practice recession agriculture allowing them to grow more than one crop in a year due to availability of residue soil moisture. However, 52.5 percent pointed out that floods can be quite destructive to agricultural activities (Figure 4). Pastoralists pointed out that the negative impacts of floods affect premature crops and grazing grounds. These impacts are mainly enhanced by what is partly known as "dry season flooding" and this keeps pastoralists glued to one economic activity - cattle husbandry.

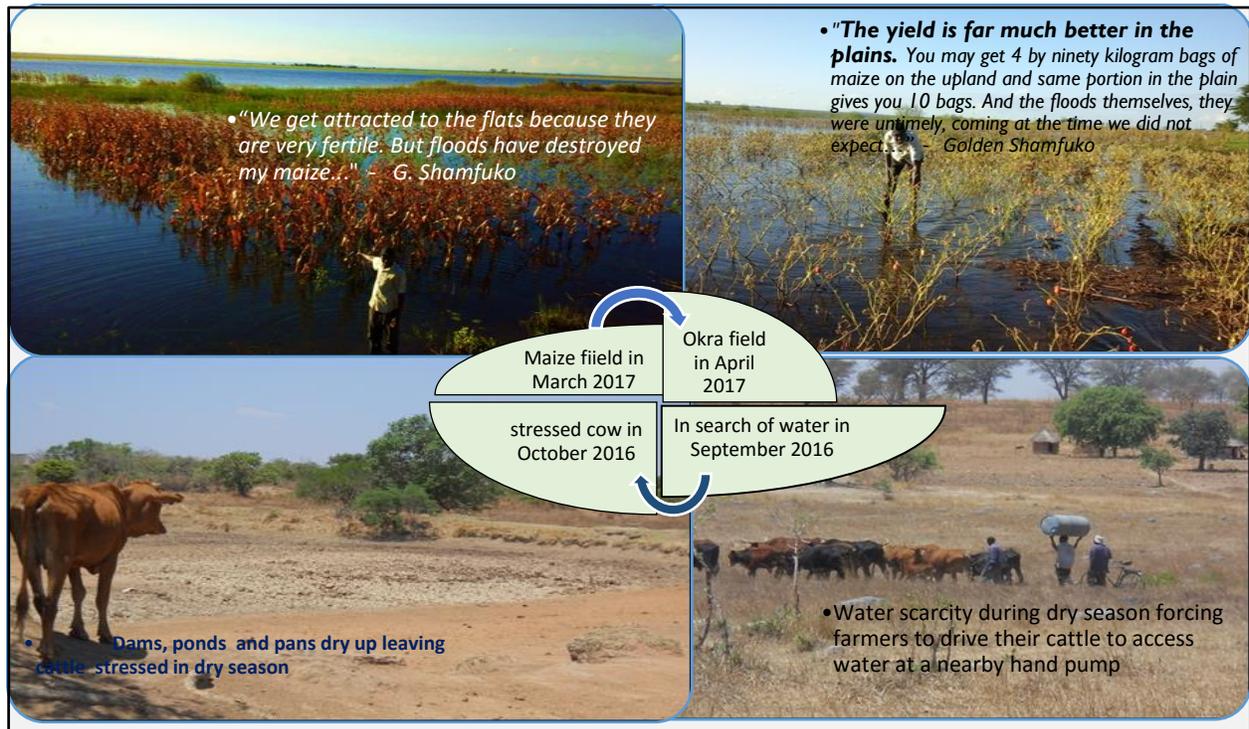


Figure 4: Livelihoods in flux: Cyclical floods and drought in Namwala

Flooding submerges crop land which leads to crop damage in various ways. Crops are sometimes washed away by fast flowing flood waters. Maize, potatoes, 'golden eggs' and cassava crops end up rotting. Even okra, which is water tolerant, is destroyed if it is submerged for more than one week (Figure 4). Many pastoralists asserted that: "the yield is far much better in the plains. You may get four by ninety kilogram bags of maize on the upland and the same portion in the plain gives you ten by ninety kilogram bags but floods usually come at the time we do not expect." Hence, photovoice about variability and adaptation among pastoralists makes tangible the experience of living in a dynamic environment, revealing not only reliance on the seasonal productivity of the Kafue Flats but also concerns at the unpredictability of ITT dam releases and rainfall, which create real consequences for pastoralists' new sources of livelihoods such as gardening. Despite the floods, flow and flux, pastoralists have adapted their livelihoods to the changing seasons, patterns and dam operations.

Uncertainty of rainfall inflows and dam operations worry farmers every year. Peak flood timing has varied widely from year to year. The Kafue flood plain (locally known as *Ibanda*) and upland influences the flux of activities with respect to seasonality (flooded and dry). Most respondents asserted their knowledge about the floodplain cycles and resources, recalling and enriching their own and their neighbours' understanding of the value of *ibanda*. By understanding the Kafue Flats as a rich cultural landscape in which cattle husbandry is closely intertwined with a specific environment, both the pastoralists and the ecotone can begin to be valued more highly towards agriculture in general and pastoralism in particular. Thus, the Flats' seasonality specifically influences activities related to cattle rearing, crop production and fishing. For this reason, the farming and cattle grazing livelihoods that characterize the *Ila* people are dependent on a rich ecosystem nourished by the seasonal rise and flow of the river. Seasonal release of water at ITT Dam and storage at Kafue Gorge Dam has affected herdsman who graze their cattle in the flood plain. Thus, many studies have classified the Kafue Flats as a highly sensitive environment which requires major flood management interventions for sustainability of all sectors (Rennie, 1978; Chabwela, 1994; Haller, 2004; Kunz *et al.*, 2013; Casarotto, 2013). Pastoralists across all zones shared assertions that the natural flooding, flow and flux of the Kafue River are part of their key social-ecological typologies, as they determine the transhumance and livestock management strategies.

Thus, the ability of complex social-ecological typologies to withstand changes partly depends on diversity that supports creativity and adaptive capacity (Folke *et al.*, 2003). Diversity increases the capacity of social-ecological systems to overcome disturbance, learn and change

(Norberg *et al.*, 2008). Pastoralists believe that humans can never manage nature, but rather are dependent on how well land will produce for them: "We pastoralists are happy when land is giving and when it is not we can't do much. We live by and follow the mood of the sky, and herd our livestock in accordance with its mood." For pastoralists, it is more important to consider weather variability and Kafue Flats' ecotone conditions before thinking about the management of the pasture and water as key aspects in managing the commons. All these adversaries came as a result of the construction of Kafue Gorge Dam in 1972 and ITT Dam in 1978 which altered the flood, flow and flux regime of the Kafue River within the Kafue Flats with varying rules.

For the *Ila*, the main activity and source of identity has always been cattle herding. They have developed transhumance system (Figure 5) that is adapted to the seasonal changes in the ecotone ecosystem of the Kafue Flats. After the water recedes between June and July, cattle herds are taken to the banks of the Kafue River and its lagoons (*kuwila*). Most families have their own cattle outposts/cattle camps (*lutanga*). Pasture is communal property. 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 (Figure 5). 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.

Increased incidences of cattle diseases

The 2017 flooding destroyed grazing land and reduced areas and forced cattle to move to the upland at once. At the same time, when cattle get concentrated on the upland, mixing often lead to overcrowding and tick infestation in the few available grazing areas amidst commercialization and fencing of customary land and this increases cross infection diseases. Ticks are responsible for the spread of many cattle diseases. In the Kafue Flats, increase in cattle diseases has been observed and linked to increased presence of ticks, as they are no longer washed away during floods on a yearly basis. The lack of flooding, flow and flux of the Kafue Flats has led to a build-up of ticks leading to high cattle mortality (Chabwela and Siwela, 1986). This scenario, coupled with irregular dipping among pastoralists when animals are in the Kafue Flats has led to high prevalence of tick-borne diseases. The common scenario now is that most years in the district are characterized by late arrival of rains which usually come in late November or December (Haller, 2007). The persistent dry years are linked to various diseases such as corridor disease, which has attracted an annual cattle vaccination called *Chitongo vaccine* against corridor disease.



Figure 5: Transhumance system between the Kafue Flats and the upland

From various field accounts, it was also observed that some pastoralists who lost two thirds of their cattle between 1989 and 1993 due to a massive outbreak of corridor disease (also called east-coast fever; *Theilerosis parva* and locally known as *denkete*) attributed their loss to changes in Kafue River flooding, flow and flux with 70, 62 and 55 percent respectively of the respondents. This sickness is transmitted by ticks, which were less common in the Kafue Flats before the construction of the ITT dam (Marchand and Drijver, 1985) because ticks were drowned by the floods during the rainy season. After the ITT dam was built, there has been less flooding in the Kafue Flats especially in dry years. With this situation, the ticks do not get killed in the same manner as before 1978. There are also more trees and shrubs such as thorny *mimosa pigra* - responsible for covering large grazing areas.

Reduction in arable and grazing land

According to Trapnell and Clothier (1996), the soils of the Kafue flats are alluvial in nature and of sedimentary origin. They are very heavy-cracking clays, sticky when wet and hard, cloddy when dry. The heavy-cracking soils in the plains of these areas are difficult to cultivate except with special skill, care and timing according to their condition. However, receding floodwaters leave silt sediments that support a wide variety of crops and grass. In recent years, there has been a general increase in the recurrence of above normal rainfall conditions resulting in increased flooding, flow and flux of the Kafue River. This has created conditions for flooding when peak flow releases are made from ITT reservoir leading to inundation of crops cultivated in the flood plains and grazing grounds. In 2008, flooding

took place in February which is in the middle of the growing season and most crops were not yet mature. In 2010, however, flooding occurred towards the end of the growing season when most crops were already fully mature. This year (2017) pastoralists reported that floods caused extensive damage to their crops, especially for those in Maala who entirely grow crops in the floodplain. From many firsthand accounts, food security is a primary concern as yields are far better in the Kafue flats than upland as alluvial soils support crops particularly maize (Figure 4). Thus, the temporality of farming livelihoods dependent in the Kafue floodplain is both a productive asset and vulnerability (Disaster Management and Mitigation Unit [DMMU], 2015; Ramsar, 2013).

As outlined above, the traditional producers make use of the extensive used of the annual flooding of the Kafue Flats. The cattle will be on the uplands until during the rainy summer period (November/December to March/April). This is also the time for crop cultivation. The results are critical as the uplands are becoming limited and overstocked with increased development of paddocks (fencing). The upland *hyparrhenia* grasses are palatable when young, but are coarse and less nutritious as they ripen. This results in cattle losing condition. There is no forage for off-season consumption other than stalks available after harvesting on the upland. It is not until about April that the rainy season stops. After this time the floods begin to recede and cattle begin to follow the receding floods on to the Flats. It is until July or even August that the flow is restricted once again to the river channel during which crocodile attacks are high.

The carrying capacity differs depending on the locality and natural vegetation but averages about five (5) hectares per cow. In his 1961 survey, McLean (1961), calculated the number of hectares of different types of available grazing (before the construction of the ITT dam) per animal in Namwala District in 1961 and 1969. Table 2 provides the summary with latest carrying capacity of the Kafue Flats (with a floodplain area of 2145km² in Namwala District) while comparing with cattle numbers in Figure 2. Before and after the construction of Kafue Gorge and ITT dams in 1961 and 1975, the carrying capacity was higher at 5.2, 0.8 and 3.6 and reduced to 3.62, 0.5 and 2.4 hectares per cow in the Flats, lagoons and dry land respectively. The

construction of the ITT dam in 1972 altered the flooding, flow and flux of the Kafue River with increased dry season flooding and reduced rainy season flooding thereby reducing area available for grazing per cow. Compounded by droughts and increase in cattle numbers (standing at approximately 147,000 in 2017), the hectarage per cow has continued to decline from 3.8, 2.6 to 1.9 and 3.7, 2.4 to 1.7 in 2005 and 2017 in the Flats, lagoons and dry land respectively. This means that the Kafue Flats is prone to overgrazing in view of combined increased floodplain agriculture, successive droughts and increase in cattle numbers.

Table 2: Hectares per animal from pre-dams to 2017 in the Kafue Flats

Type of grazing land and when used	Hectares per Animal								Remarks
	1961	1969	1975	1985	1995	2005	2015	2017	
Flats (Jun/Aug to Nov/Dec)	5.2	3.84	3.62	3.45	3.02	4.56	3.88	3.73	Limited use due to droughts and irregular Kafue river flow
Lagoon grazing (Aug to Dec)	0.8	0.6	0.5	2.3	0.4	2.8	2.6	2.4	Capable of carrying higher density as a result of increased incidences of dry season flooding
Dry land rains grazing (Dec/Jan)	3.6	2.6	2.4	2.9	1.9	2.1	1.9	1.7	Danger of overgrazing especially in competition with agriculture due to fertile alluvial soils on the Flats

The grasses of the Kafue Flats are mainly the wild rice (*Oryza Barthii*). They are coarse and are covered with mud and silt following the floods (Figure 6). This makes them very unpalatable to cattle. Other grasses, *Vossia Cuspidata* and *Echinochloa Stagnina* occur along the shores of the river branches and lagoons. They remain green, nutritious and palatable throughout the dry season. When the grass is sufficiently dry, the entire flats zone is burned. The new growth is very nutritious to cattle although comes with first rains. This forces cattle to graze deep in lagoons (Figure 6 - inserted photo), putting them at risk from crocodile attacks and liver fluke disease.

From March/April to July/August, the cattle graze along the margins of the floodplain and slowly on the entire plains area depending on receding water. They will remain here until the rains begin in November/December. From 2011 to 2015, most pastoralists did not take their cattle to the upland due to lack of flooding. But in January (2017), cattle were moved at once due higher rising floods, which killed some cattle as news about flooding was not heard by some pastoralists. *Ila* cattle have remarkable resilience, and provided they survive the rains, two or three months back on the Kafue Flats and by the lagoons can fill out their flesh and double their cash value at the Christmas sale (Felder, 1973). Hence, under present conditions of managing common property resources, and despite increased flooding, flow and flux of the Kafue River, cattle cannot be kept without access to dry season grazing on the Kafue Flats (dry season 'oasis'). Normally, dry years result in a

considerable number of cattle deaths. The ones that survive are usually in poor condition of health. When flooded, the Kafue Flats are infested with *Limnea* snails which are hosts to the parasite carrying liver fluke. Therefore, the bulk of the cattle grazing on the Kafue Flats are normally afflicted with this disease.

The continued reduction of the available surface area for grazing land is due to several reasons, including changing vegetation patterns (invasion by inedible shrubs as land is no longer flooded) and permanent inundation of grassland in the western Flats. In the Kafue Flats, the cattle economy is linked to flooding which has positive impact of provision of sufficient grazing grounds throughout the year (Williams (1984). This concentration of cattle in the Kafue Flats, regarded as a 'common property dry season oasis', has been described as "tragedy of the commons" in this study in relation to Hardin's (1968) study. However, floods destroy grazing land, reduces grazing areas and forces livestock to move to upland. On the upland, flooding forces cattle to overgraze the available land and food insecurity is exacerbated as cattle 'feast' on maize stock of unfenced fields. Those that risk grazing their cattle during the height of flood have their cattle stuck in the mud, leading to higher mortality rate for weak and young animals.

At the same time, there is more flooding in the dry season due to untimely water releases. This has led to a situation whereby the lagoons in the Kafue Flats have more water in the dry season now than before the ITT dam was build.

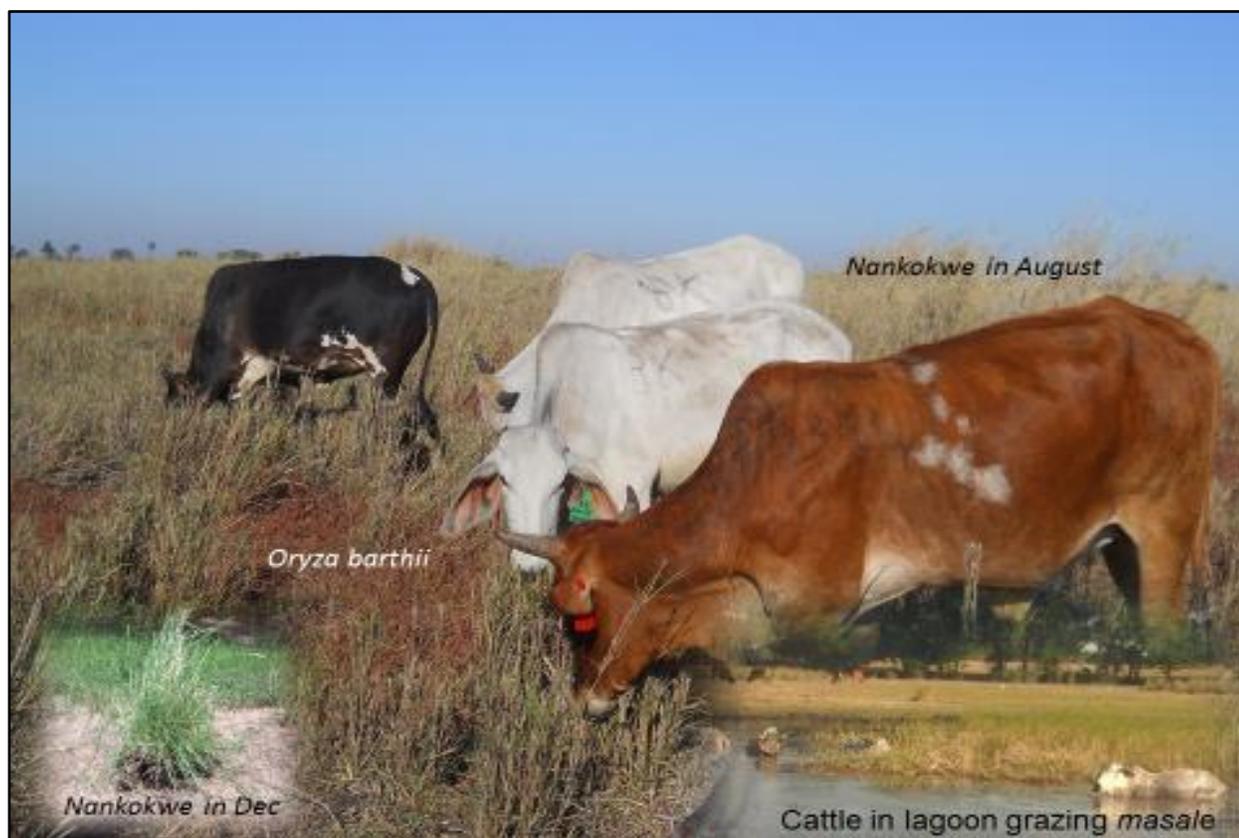


Figure 6: Cattle browsing on *Oryza barthii* and *Brachiaria sp* during dry season

In earlier times, cattle used to feed on the grass in shallow water and swamps that had nutritional *hyperrhenia sp* (*masale*). But today, in order to get access to *masale* (Figure 6), cattle stand deep in the water in dry season. Occasionally, water in these large lagoons during the dry season is sometimes too deep and has less grass and therefore cattle feed on the higher grounds, where they are attacked by ticks and cannot lose them in water. This is one of the indigenous explanations why corridor disease spread in the 1990s (Rees, 1978; McCay, 2002; Simfukwe *et al.*, 2012; Mertens, 2013). Thus, the current situation in Namwala show that vegetation has changed. Several plant and grass species, which were historically growing above the high flood line shifted to lower elevations. Therefore, with cattle population standing at 145,445 as of 2016, the carrying capacity could be reached faster.

Human and property losses

The main factors that lead to incidents of loss of life in Namwala are: high floods, waterborne diseases, flood related plagues and human encounters with wildlife such as crocodiles and hippos. In the flood prone areas of *Chibunze*, *Namisamwe* and *Kakuzu* in Mukobela chiefdom; and *Chilala*, *Chitumbi*, *Kantengwa* and *Busangu* areas in Mungaila chiefdom, pastoralists are vulnerable to diseases associated with floods such as cholera, dysentery, malaria and bubonic plague which claimed fifteen lives in *Chibunze* in 2008. Cholera and dysentery

occurrences are high during the flood periods due to poor sanitation with most affected areas being *Chibunze* and *Kakuzu*, both in Mukobela chiefdom. Namwala district also has had a major incidence of bubonic plague in 2008 due to rats that moved from the flooded areas to the residential areas during peak floods. In addition, heavy floods sometimes destroy economic infrastructure such as roads and bridges, as the case in 2010 when the district was cut off from the rest of the country following the collapse of two bridges at Naminwe, along Choma-Namwala road, 15 km from Namwala town. This resulted into disruption of movement of goods (cattle and beef) and delivery of veterinary services at the time when vaccinations were necessary.

Environmental impact

For the Kafue Flats, flooding is an environmental requirement for sustenance of various components of the ecotone ecosystem. This include the provision of silt for soils, pastures for livestock, grass for thatching, spawning nature of fish in breeding grounds and maintaining biodiversity. However, there has been growing concern about increased economic activities in the Kafue Flats leading to water demand conflicts among various users. This is as a result of the construction of ITT dam on the upstream of the flood plain and Kafue Gorge dam on the downstream and their subsequent operations have

changed the flooding, flow and flux regime of the Kafue River. There are also growing concerns about uncontrolled and unregulated human activities such as: large-scale deforestation caused by high demand for charcoal and timber in Namwala and other towns such as Choma, Monze, Mazabuka and Lusaka due to ZESCO tariffs which were increased by 75% in 2017 alone; poor cultivation practices; reduced flood carrying capacity of the river due to excessive siltation of their beds; and shifting of river courses causing erosion of the banks and formation of new tributaries and lagoons in the flood plain. These have had a negative effect on the ecotone ecology and grass availability for cattle.

Poor nutrition and husbandry practices

The causes of poor nutritional status in the traditional herds are shortage of both feed and water during the dry season (Central Statistical Office [CSO], 2001). The ability to feed cattle adequately throughout the year is perhaps one of the most widespread technical constraints limiting increased cattle productivity among pastoralists in Namwala. Nutrition as a constraint involves lack of provision of quality indigenous pastures, crop residues and feed. Since Zambia has a uni-modal rainfall pattern, major problems facing the pastoralists in Namwala is feeding cattle during the dry season, which normally lasts for six months. Pastoralists pointed out that in years of flood, the sluggish receding flood water destroy grass which could otherwise been used during the dry season. Livestock health is also affected by poor husbandry practices resulting from poor extension system. Pastoralists lack sufficient knowledge about modern husbandry practices such as good housing practices, feed supplementation, and breeding which improves the vigour of calves hence more resilience to diseases and internal parasites. Hence, transhumance is still largely practiced as pointed out by 69 percent of the pastoralists in which the Kafue Flats remains the 'oases' for cattle husbandry. Instead, cattle are grazed in big mixed herds on both the flats and on the plateau during dry and rainy season (FAO/UNDP, 1968). Further, observed established traditional practices among pastoralists do not seem to favour stock improvement because too many bulls are still allowed to run with the herds (Triffen and Mulele, 1994). It is also still common to castrate the best bulls so that they would become large oxen for showing off at traditional local ceremonies such as *Shimunenga* and *Shikaumpa* in Maala and Baambwe areas respectively.

Reorganization and revaluating the Kafue flats for pastoralism

The farming and cattle grazing livelihoods that characterize Namwala are dependent on a rich ecotone ecosystem nourished by the seasonal flooding, flow and flux of the Kafue River. According to Drijver and Chooye

(1995), the Kafue Flats is a seasonally flooded landscape of oxbows, verdant grasslands and wooded levees in central Zambia (Figure 7). Food security is a primary concern in Namwala. Seasonal flux is productive as rich ecotones are nourished by flooding. Therefore, pastoralist's temporality of livelihoods is dependent on seasonal flooding, which is both a productive asset and vulnerability. Accordingly, weather and climate information should be used as integral components for risk management in implementing floods, flow and flux of the Kafue River. ITT Dam was designed for managing seasonal flooding to mimic pre-dam flooding patterns but implementation faltered upon the construction of the ITT dam in 1972. Trade networks, centred on fishing, wildlife, timber, cropping and livestock rearing have been affected. ZESCO therefore should employ improved technology and operating procedures that can allow the flood, flow and flux of the Kafue River to be managed with more nuance and sensitivity to both the economy, ecological and pastoral needs thereby protecting common property resources in the Kafue Flats (Figure 7).

Altered flooding patterns have changed the ecosystem and the flow regime has been severely changed to provide consistent levels for downstream hydropower production. Compared with the Kafue River's natural flow regime (Figure 7), the post-dam flow exhibits a reduced rainy season flood peak, higher minimum flux, and higher dry season flows overall. For this, 78 percent of the pastoralists pointed out that there is inequity of the hydropower transaction as authorities do not care about cattle husbandry but for urban populations and mining in Lusaka and Copperbelt regions respectively. A combined of 6% of households in Namwala and Itezhi-tezhi districts have electricity, while 60% of Zambia's electricity goes to cities. Therefore, pastoralists' activities are within the framework of altered Kafue river flooding, flow and flux. For this reason, it is vital to reconceptualise and revalue the Flats as a complex cultural landscape rather than a utilitarian resource (Figure 7).

Increased dialogue among stakeholders about responsive dam operations and a range of strategies for increasing food security and protecting the commons are critical to regenerating the Kafue Flats (Kalapula, 1976; Chabwela and Haller, 2007). Adjudicating common resources will also be increasingly important. As the floodplain is a zone of vulnerability, it is also of great natural wealth and likely to become an even greater source of uncertainty for local pastoralists' livelihoods and trade networks if its role as a common resource is further threatened. As such, pastoralist's livelihoods are likely to continue to be in flux thereby increasing vulnerability and shift changes in values about new paradigms and new social-ecological typologies, changing seasons, climatic patterns and improve irregular dam operations (Figure 7).

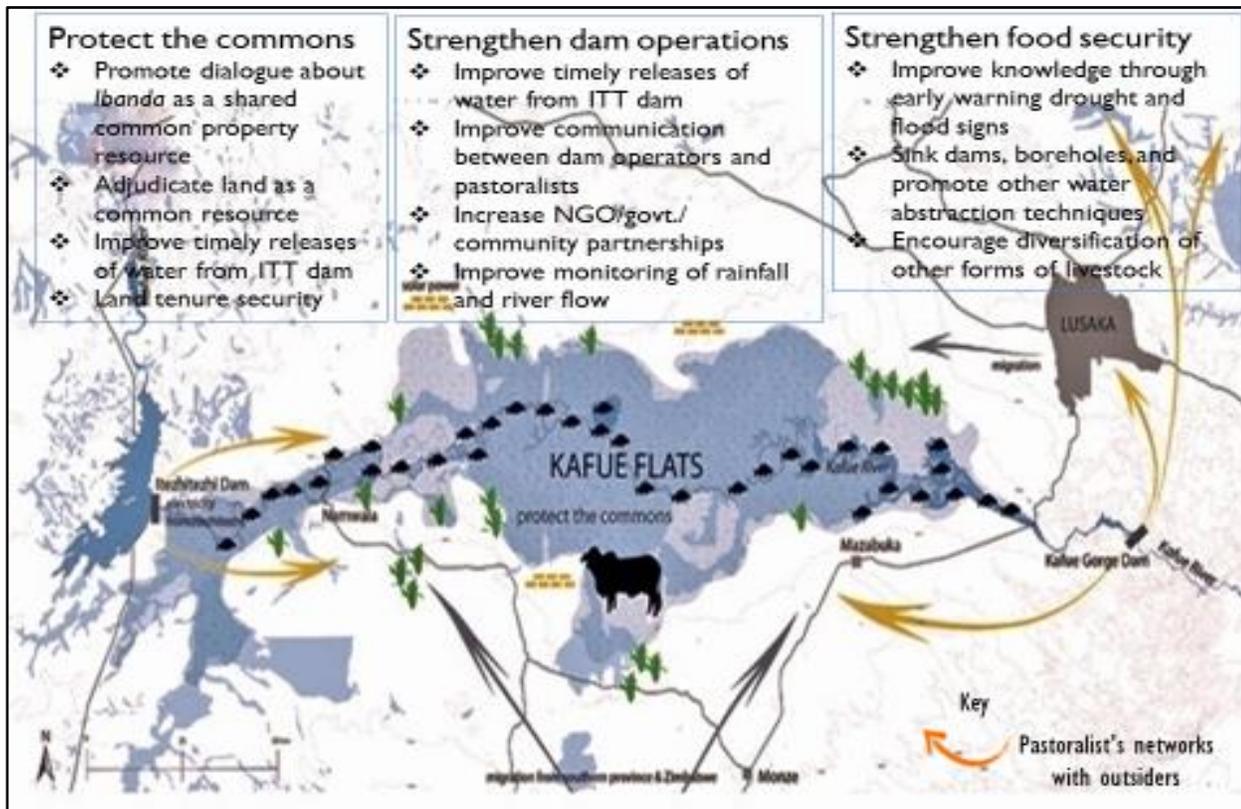


Figure 7: Improving flood, flow and flux on the Kafue Flats for pastoralism

This study re-conceptualizes the Kafue Flats as a dynamic system, one in which environmental river flows, new partnerships and re-valued resources can sustain healthy pastoral communities. Increasingly, stable economies are predicated based on well-managed ecologies that can support development within reasonable bounds. If the Kafue Flats becomes overgrazed, overfished and overdeveloped, or if floods and flows are not restored, it will not be able to support the pastoralists who depend on it. However, if the natural flooding, flow and flux of the Kafue Flats is restored through more sustainable ITT dam operations, it can be a wealth of natural, economic and ecological ecotone resources needed to support grazing and farming livelihoods.

Thus, information about floods, flow and flux is critical in the Kafue Flats. Prior to the commencement of each rainy season, the Zambia Meteorological Department (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). But 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 such as droughts and floods (Table 3).

Pastoralists expressed concern that the movement of cattle from the plains to upland areas is sometimes deadly when news about floods is delayed or not heard (Table 3). Because of these problems, pastoralists in the Kafue Flats should also include activities such as irrigation and diversification to keeping small ruminants such as goats, pigs, sheep, dairy cows and donkeys to ensure constant food security and income generation. The Namwala Farmers Association is implementing some small-scale irrigation initiatives using treadle pumps to grow vegetables for sale. The Zambia Prison Services in Namwala is also producing winter maize/vegetables under irrigation. These initiatives should be spread and strengthened so that pastoralists diversify.

A new focus on the flood, flow and flux of dams on downstream human settlements is important to understand (Table 3). This is because of the Kafue Flats' high habitat value and productivity, and its strategic location between two dams. However, the ways in which a dam can cause subtler impacts on downstream economic and social patterns has been only secondarily documented in the region as scientists have focused on quantitative, hydrological and ecological measures, neglecting new social-ecological implications of Kafue River flow on pastoralism.

Table 3: Resilience and changing values among pastoralists to floods, flow and flux

Typology	Adaptation to changing seasons, climatic patterns and dam operations
Grazing: shifting values	<ul style="list-style-type: none"> ✚ Kafue flats host the largest concentration of cattle in Zambia ✚ Grazing utilises the floodplain as a common property resource regulated by traditional chiefs ✚ Cattle spend rainy season in upland, dry season in the plains ✚ Floods submerge grazing grounds leading to lack of pasture
Farming: vulnerable margins	<ul style="list-style-type: none"> ✚ Soil is more fertile in on clay floodplain than sandy upland ✚ Risk of flooding crops is greater on floodplain ✚ Higher post-dam river levels mean less land for farming ✚ Gardens promoted to fill food security gap during fish ban
Protect the commons	<ul style="list-style-type: none"> ✚ Promote dialogue about the floodplain as a shared resource ✚ Improve river flow alteration to take into account other livelihoods ✚ Adjudicate customary land as held in commons
Strengthen dam operations	<ul style="list-style-type: none"> ✚ Improve communication between dam operations and local pastoralists to lessen impacts on land use ✚ Improve monitoring of rainfall and river flow ✚ Improve computer modelling of dam operations ✚ Increase NGO/government partnerships
Increase adaptation and food security	<ul style="list-style-type: none"> ✚ Funding for additional boreholes, sinking dams, pans and ponds ✚ Encourage community initiatives such as gardening ✚ Fund extension agents for sustainable aquaculture other forms of livestock such as goats, pigs and donkeys
Weather, climate information and early warnings	<ul style="list-style-type: none"> ✚ Fund ZMD to provide timely forecasts at district level ✚ Disseminate information through local community radio stations ✚ Improve communication via multiple media to reach all farmers

Thus, a new generation, new paradigm on fine-grained, qualitative observations about the relationships between local communities and seasonal fluctuations of the Kafue River was concerted with a wider array of varied livelihoods. This case study was therefore useful in assessing the local economy, ecology and how the floods, flow and flux on the Kafue Flats has altered. A new generation and a new paradigm has the capacity to forge new ecological flows (Ostrom and Schlager, 1996) and forge new partnerships to regenerate the Kafue River in ways that are more economically, ecologically and energetically sustainable to local needs (Figure 8).

In order to achieve an economically, ecologically and energetically sustainable Kafue River flooding, flow and flux, it is important to involve all users in restoring the flats. There is however, a problem of lack of scientific information on the current altered flows and soils in the district in general and the Kafue Flats in particular. In the absence of this information, it is feared that utilizing large areas for agricultural production and increasing livestock numbers may lead to increase in soil degradation and consequent sedimentation of the Kafue River. Therefore, detailed soil and land capability studies of the Kafue Flats in Namwala should be undertaken to determine land and

soil types and potential uses, but include traditional grazing practices. This will in turn facilitate efficient and sustainable utilization of the Flats. In view of the entrenched Ila attitudes, traditions and institutions regarding land tenure governance and pastoralism, a rigorous education for behaviour and attitude change should also be undertaken and understood.

It is believed that traditional and institutional changes in the utilisation and governance of common property resources for multiple uses will facilitate effective planning and new sustainable ways of managing floods, flow and flux in ways that will continue favouring transhumance as cattle is the mainstay of the people in the district and as a way of fostering diversification (Figure 8). In Namwala some areas like Muchila and Nalubamba chiefdoms only experience floods when there are above normal rains, otherwise the areas are dry for much of the year and crop harvest is adequate. The major challenge, however, is that pastoralists are forced to travel long distances to take their cattle to the Kafue River at various outposts in search of grass and water during dry season. To enhance cattle health and production in these areas, it is proposed that dams and pans be constructed to harvest rain water in addition to boreholes.

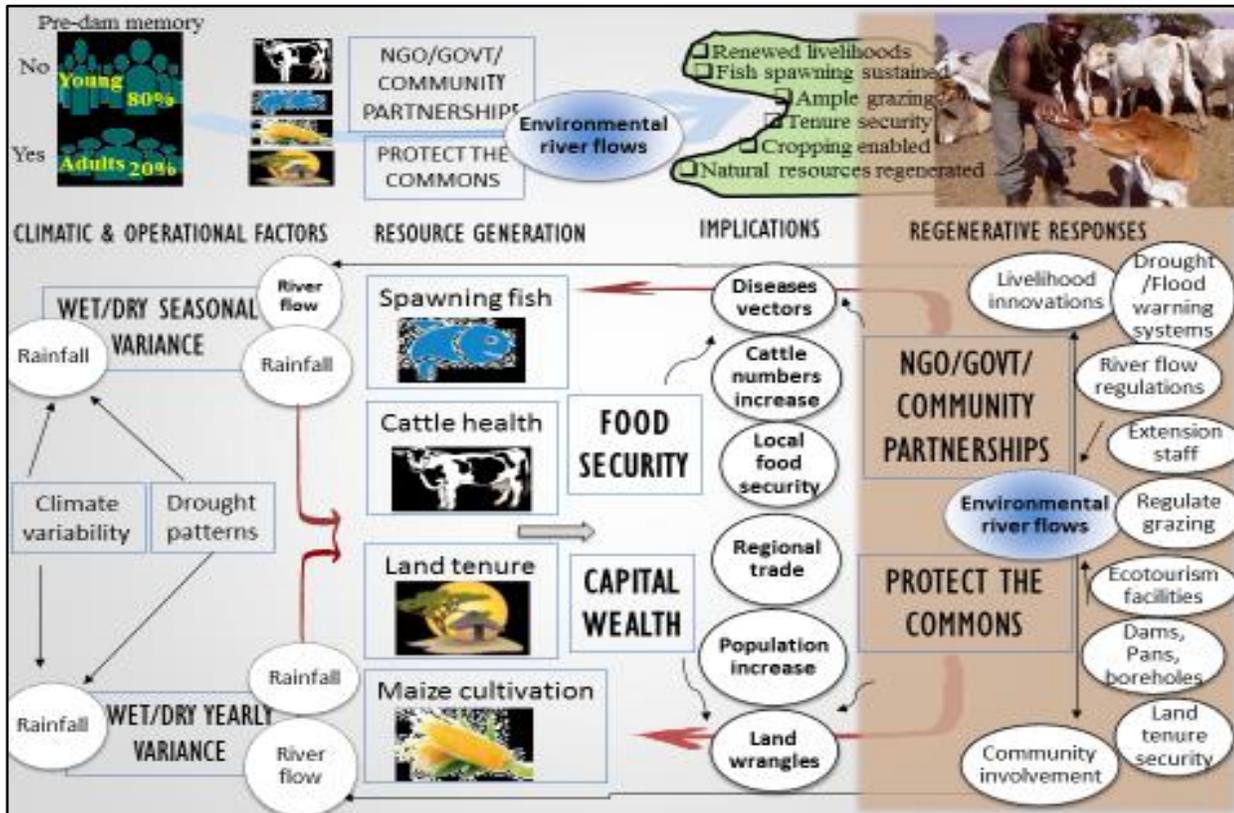


Figure 8: A new paradigm in understanding the flood, flow and flux of the Kafue River

CONCLUSION

The farming and cattle grazing livelihoods that characterize the Kafue Flats in Namwala, Southern Zambia are dependent on a rich ecosystem nourished by the seasonal flood, flow and flux cycles of the Kafue River. However, the flooding patterns of the Kafue Flats are now significantly altered by the Itezhi-tezhi Dam (constructed 1978) which regulates water flow for the downstream Kafue Gorge Dam (constructed 1972), thereby reducing area available for grazing per cow. Kafue Flats’ seasonal flooding is now often unpredictable in its timing and duration. Grazing and cropping patterns have changed dramatically and flood-dependent livelihoods are threatened. Thus, the study focused on climate variability and Kafue River flooding, flow and flux, which elicited fine-grained pastoralist’s own voices and concerns about a given issue; in this case their relationship to the altered floodplain ecosystem. What emerged most clearly is that ecological changes brought by ITT dam manifest themselves as real consequences for pastoralists’ in view of combined increased floodplain agriculture, successive droughts and increase in cattle numbers. Thus, this study expands the discourse about climate variability, dam management, environmental river flows, and the consequences of hydropower projects on pastoralism, which seems to have been neglected. The study also re-conceptualizes the Kafue Flats as a dynamic system, one in which flooding, flow and flux, new partnerships and re-

valued ecotone ecosystem can sustain healthy local communities. Increasingly, stable economies are predicated on well-managed ecologies that can support local developments through nurturing nature. Hence, if the Kafue Flats becomes overgrazed, overfished and overdeveloped, or if floods, flows and flux are not restored, it will not be able to support the pastoralists who depend on it. However, if the natural flood, flow and flux of the Kafue Flats is mimicked or partially restored through more sustainable ITT dam operations, it would result into an economically, ecologically and energetically sustainable Kafue Flats, capable of supporting present and future floodplain dependent livelihoods, particularly pastoralism.

ACKNOWLEDGEMENTS

The authors thank 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.

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Accepted 28 November, 2017.

Citation: Kalapula S, Mweemba L (2017). Flood, Flow and Flux: Climate variability and effects of the Kafue River regulation on pastoralism in Namwala District, Zambia. *Journal of Agricultural Economics and Rural Development*, 3(3): 307-325.



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