

SOCIO-ECONOMIC SURVEY OF THE ZAMBIAN COMPONENT OF THE ZAMBEZI RIVER CATCHMENT: AN ANALYSIS OF THE HUMAN USE OF THE NATURAL ENVIRONMENT FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

A baseline survey was carried out in 2016 in response to a call by the United Nations Development Programme, Global Environment Facility Small Grants Programme for managing the environment and resources in Zambia. It focused on supporting the creation of global environmental benefits and safeguarding the global environment through community and local solutions that complements and adds value to national and global level actions. Key areas of the study included; biodiversity, international waters, climate change, land degradation and persistent organic pollutants. The latter, in particular were considered to be an area of concern to human health. Literature review of key documents; key informant interviews, focus group discussions, and field observations were used to collect secondary and primary data. Common resources challenges identified were illegal harvesting of forestry products such as logging, hunting, fishing and land degradation. Use of persistent Organic pesticides was insignificant particularly in the upper and middle catchment areas.

Keywords: Tree Bark, Bee Hive, Illegal Use, Community, Resources, Poverty

INTRODUCTION

The Zambezi River in southern Africa together with its tributaries forms the fourth longest on the continent, stretching 2,650 km (1,650 mi) long and draining an area of approximately 1,300,000 sq. km (approx. 502,000 sq. mi). It rises out of a marshy bog near Kalene Hill at about 1524 m (about 5000 ft) above sea level at Kalene hills in Ikelenge district and flows in a double S curve to eastern Angola and traversing back into western Zambia. It forms boundaries of six countries; Zambia, Angola, Namibia, Botswana, Zimbabwe and Mozambique (Microsoft Encarta, 2009; Encyclopaedia Britannica, 2010). Along its course are several natural and manmade features of international repute; Victoria Falls one of the world's greatest wonders and smaller Ngonye Falls and numerous cataracts and the man-made Kariba and Kahora -Bassa dams which are two of Africa's largest hydroelectric dams are some of the examples. At regional level, it is segmented as follows; i) upper Zambezi catchment - from the source to Victoria Falls, ii) middle catchment- from the Victoria Falls to Cahora -Bassa in Mozambique, and iii) lower catchment- from Kahora – Bassa to the Indian Ocean (Christine and Bulkley, 2008) (Fig. 1).

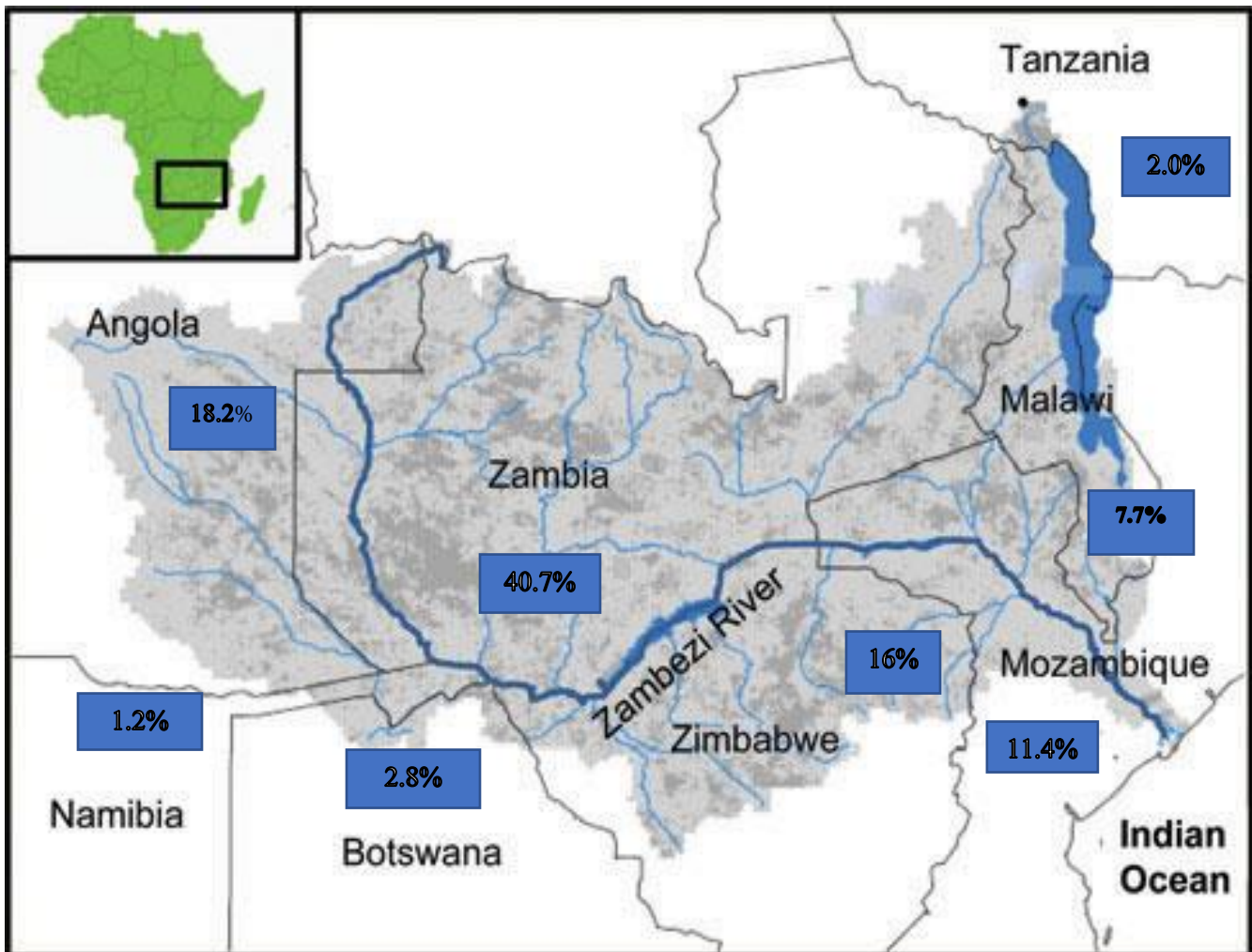


Fig. 1: The Zambezi River catchment and the percent (%) proportion shared by each country (Modified after: Christine and Bulkley, 2008)

At national level, the river is generally segmented based on Agro-ecological regions from areas of high rainfall to low rainfall as follows; upper Zambezi landscape Agro-ecological region III, Middle Zambezi landscape in Agro-ecological region II and Lower Zambezi Landscape in -Agro- ecological region I

The people along the Zambian component of the Zambezi are predominantly the *Lozi* group who dominate much of the middle landscape and utilize the flooding of the Barotse plains with an agricultural economy supplemented by animal husbandry and fishing, *Tonga* group, *Goba* speaking and *Nsenga* groups of Feira. The Zambezi River therefore, is a very important feature to the economy of the people *bonafide* in its catchment and the country as a whole.

It is on this account that the Zambezi Landscape Baseline Assessment was carried out in response to a call by the United Nations Development Programme Global Environment Facility Small Grants Programme (UNDP, GEF SGP) for managing the environment and resources in Zambia. The call focused on supporting the creation of global environmental benefits and safeguarding the global environment through community and local solutions that complements and adds value to national and global level actions.

The baseline survey provided the subsisting general environmental outlook of the Zambezi catchment referred to as Zambezi landscape. Key areas of focus included; Biodiversity, International Waters, Climate Change, Land Degradation and Persistent Organic Pollutants (POPs). The POPs in particular are considered to be an area of concern to human health (Cunningham and Cunningham, 2007). These are chemicals used to kill unwanted pests and weeds and may in the process be collected by rainwater runoff and carried into streams. Some of these chemicals are biodegradable and quickly decay into harmless or less harmful forms, while others are nonbiodegradable and remain dangerous for a long time. When animals consume plants that have been treated with nonbiodegradable chemicals, such as chlordane and dichlorodiphenyltrichloroethane (DDT), they are absorbed into the tissues or organs of the animals (Microsoft Encarta, 2009). When other animals feed on these contaminated animals, the chemicals are passed up the food chain. With each step up the food chain, the concentration of the pollutant increases. This process is called biomagnification. Drinking water may also be contaminated with such chemicals from widespread agricultural use.

Objectives and Outline of the Survey

The main objective of the baseline assessment was to assist SGP National Coordinator (NC) and National Steering Committee (NSC) to provide data on the identified thematic areas. The specific objectives were to: i) elaborate the Zambezi landscape - wide baseline, ii) develop Zambezi landscape strategy that will guide grant-making with typology of projects proposed, and set indicators for selected SGP strategic initiatives identified, iii) provide information about the current state of the Zambezi landscape, through consultations with local communities and stakeholders which can be used as a basis for setting goals and desired outcomes for OP6, iv) outline key challenges, on environmental issues, and identify the opportunities for community and CSO actions, and v) provide background information for the development of the Zambia Country Programme Strategy Finalization.

MATERIALS AND METHODS

Study Area

The baseline exercise was undertaken in the Zambezi Landscape which predominantly lies in the Zambezi River catchment (Fig. 2). It extends from the North-western Province in Mwinilunga district through Western province and parts of the Southern Province. The source lies in Agro – ecological Region III receiving more than 1400 mm of rainfall annually (GRZ, 2007; Shela, 2000). The soils are very acidic due to excessive leaching as a result of high rainfall. It then enters Agro-ecological Region II which receives between 800 and 1000 mm of rain annually, and exits through Chirundu/Chiawa area in Agro-ecological Region I which is found in the Luangwa-Zambezi rift valley and receives less than 800 mm annual rainfall.

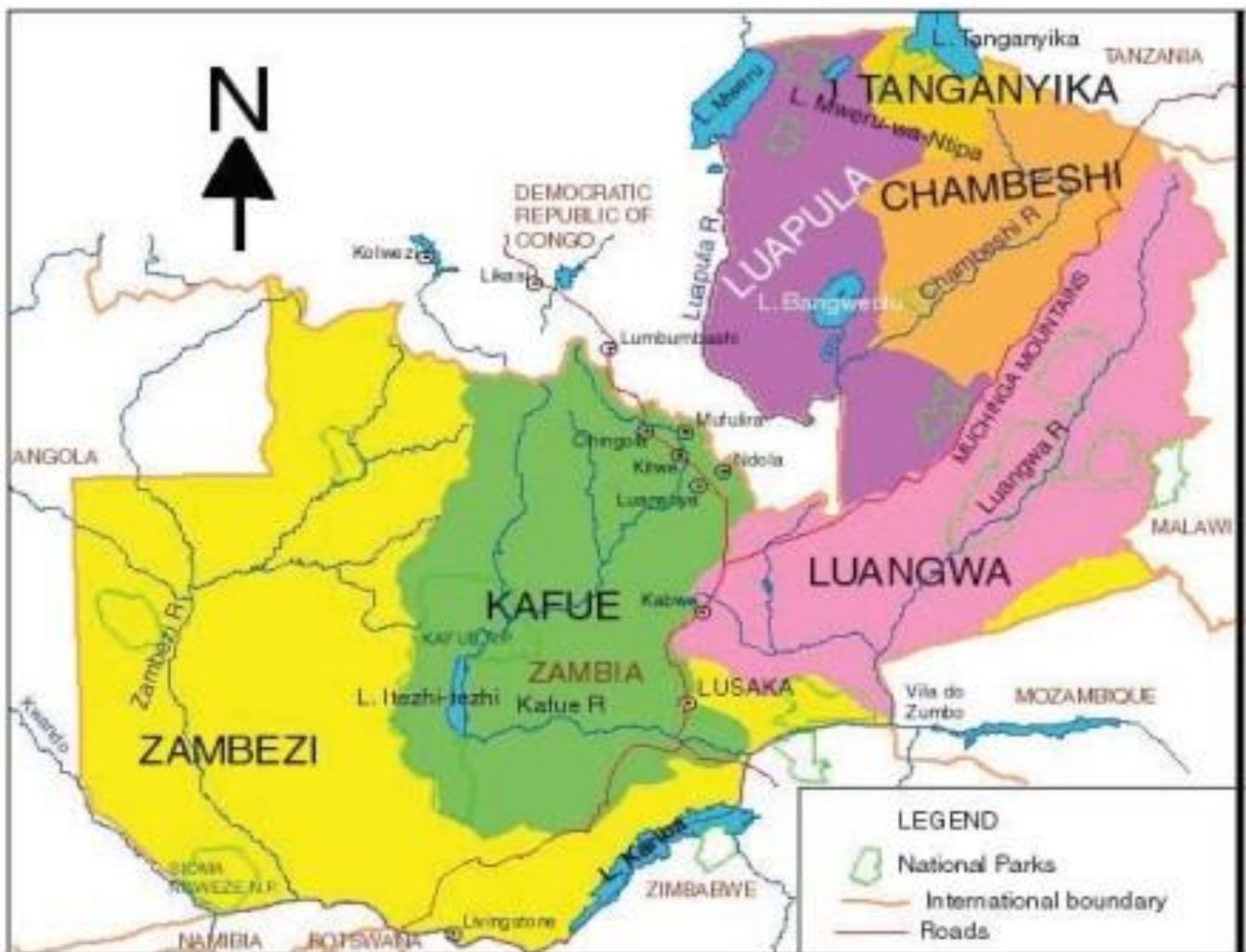


Fig. 2 Main river catchment areas in Zambia

Research Design

The main steps used to design the research involved; i) dividing the Landscape into upper, middle and lower catchment areas, ii) identifying towns to be visited in each of the three identified catchment areas, iii) developing questions and guidelines for conducting interviews, iv) stakeholder mapping, v) conducting interviews and follow-ups with additional interviewees identified during the first course of interviews, vi) conducting field visits and making direct observations, vii) supplementing interview data with selective review of literature from credible sources, viii), analysis of interview notes, ix) synthesis of results and drafting of report, and finally x) internal peer review.

Subdivision of the Landscape

The Zambezi landscape was divided into three river segments based on Agro-ecological regions from areas of high rainfall to low rainfall as follows:

Upper Zambezi landscape in Agro-ecological region III: High rainfall region (about 1,500 mm) and densely forested and has the the source of the Zambezi River. Middle Zambezi landscape in Agro-ecological region II: Medium rainfall region (800 – 1,000 mm) and moderate forest cover with flood plains. Lower Zambezi Landscape in Agro- ecological region I: Low rainfall region (less than 800mm), deforested region with visible signs of soil erosion.

Data Capture Techniques

Desktop Review

An intensive desk review was carried out targeting key sources such as; the Fifth and Sixth National Development Plans; National Adaptation Programme of Action (NAPA), Zambia Policy on Environment, Water Policy, Environmental Management Act No. 12 of 2011, climate change Acts and Plans, Zambia Vision 2030 and UNDP GEF Project documents, journal publications and textbooks were reviewed among others.

Field Data Collection

Key Informant Interviews

Interviews were conducted with government officers from key line ministries involved in natural resources management as well as the private sector and Non-Governmental Organizations (NGOs). Government institutions included the Forestry Department (FD), Department of Fisheries (DOF), Department of National Parks and Wildlife (DNPW), Zambia Environmental Management Agency (ZEMA), Department of Agriculture, Department of Livestock. On the political side of stakeholders, were District Commissioners.

Data from tradition leaders were obtained through their representatives, since most traditions do not permit direct interrogation of the Chief as a custodian of local customs. Direct communication with the Chief through interviews would be considered a taboo in many ethnic groups. Primary and secondary school teachers were also interviewed since they play an important role in knowledge and skills transfer.

Focus Group Discussions

In areas where community based natural resources management structures exist, Focus Group Discussions were conducted with community leaders and members of Village Action Groups (VAGs) and other Community-Based Organizations (CBOs) directly or indirectly responsible for natural resources management.

Field Observations

Visits to purposely selected sites within the three segments of the river catchment were conducted. Sites visited were, Mwinilunga in Upper Zambezi Landscape (Agro-ecological zone III), Sioma in Middle Zambezi Landscape and, Sinazongwe and Chirundu districts in the Lower Zambezi Landscape. Observations made on natural resource utilization were recorded. Field observations made were based on human livelihood activities commonly practiced in each catchment area. For example, in the Upper Zambezi the natural resource livelihood activities were honey production and harvesting of forest products. At bee keeping sites we observed and recorded the type of bee hives used. Where tree barks were used, an attempt was made to identify the tree species debarked based on the field guides by Palgrave (2002), Moll (2011) and Storrs (1995) and personal experience extending over a period of more than thirty years. In some instances, particularly when there were no sprouting shoots, tree species were identified based on the appearance of the bark and cross section of the cut stem. Information was also obtained on the replacement period of bee hives and the quantity of honey harvested from each bee hive.

RESEARCH FINDINGS

Upper Zambezi Catchment

Social Economic and Livelihood Activities

The major livelihood activities in Mwinilunga were purely subsistence agriculture of mainly; cassava (*Manihot esculenta*), and bulrush or finger millet (*Pennisetum glaucum*; *Eleusine coracana*). This is however, surprisingly also the country's largest producer of pineapple (*Ananas comosus*). Bee keeping (*Apis* spp) is also practiced and the product supplied to Forest Fruits (FF), a private company which is the major market for the honey. The FF operates an out-grower scheme with about 5,000 beekeepers in the district. Each keeper had an average number of 200 traditional tree bark hives. The FF supplied 20litre plastic bucket containers for storing honey (Fig. 3a, b).



Fig. 3a) The 210 plastic drum containers loaded with bee honey awaiting transportation for export to foreign markets, b) plastic bucket containers supplied to bee keepers under the out-grower scheme, Mwinilunga, Zambia
All beehives used by the 5,000 members of the out-grower scheme were made of cylindrical tree bark hives debarked from mainly *Brachystegia* spp; (*Brachystegia spiciformis*, *Brachystegia bohemiai* and *B. longifolia*) while *Julbernardia paniculata* pollen was recorded to be the best in the production of clear honey as also earlier recorded by Storrs (1982). The bee hives had a capacity to produce 20 - 30 litres of honey each, and were mainly stacked at the fork of trees or hooked to hang from a branch (Fig. 4, a, b). The life span of these tree bark hives was only up to 8 years after which they are replaced. All the trees observed during the survey from which barks and been removed for the preparation of bee hives had died (Fig.4c, d).



Fig. 4 a) Bee hives made from tree bark suspended by hooking it on a branch, b) placed on tree fork, Mwinilunga, Zambia



(c)

Fig. 4c, d Dead *Brachystegia* spp after being debarked to make bee hives.

*(d)

The ring barking of trees to make bee hives puts into question the efficacy and long-term sustainability of this traditional bee hive making technology.

The area also supports pineapple growing by small holder farmers (Fig. 5). The collective effort of small scale farmers cumulatively yields large quantities for the urban market. In general terms, however, the Lunda speaking people of Mwinilunga are traditionally hunters and gatherers with little interest in agricultural activities. It would therefore, be assumed that the growing of pineapple is a consequence of the high rainfall regime which naturally favours this water loving plant rather than being an acquired skill.



Fig. 5 Research team members in a pineapple garden near the Zambezi River source, Mwinilunga

With regard to crop diversification, the Department of Agriculture and partners such as World Vision, Zambia National Farmers Union (ZNFU) promoted crop diversification from an entirely cassava dependent subsistence agriculture to include other crops such as soya beans (*Glycine max*) and maize (*Zea mays*). Livestock particularly cattle (*Bos spp*) and goats (*Capra hircus*) have also been introduced in the area to take advantage of the abundant pasture land (Fig. 6).



Fig. 6 Chitunta plain with abundant pasture for herbivores, Mwinilunga, Zambia

Biodiversity

The upper Zambezi is part of one of the highest rainfall cells in the country and as such, has unique biodiversity. The vegetation communities contain many woodland species (Chidumayo and Gumbo, 2010). The area is especially noted for the crytosepalum forest and the watershed plains. The canopy dominants are miombo species of the genera *Brachystegia*, *Julbernardia*, *Isoberlinia*, and *Marquesia* spp. Prominent in the under storey are *Monotes* and *Uapaca* spp. Interspaced in these vegetation communities are tall spired termite mounds of the termite *Macrotermes* spp. The *Julbernardia paniculata* is one of the preferred sources of flowers for bees in honey production. As a result, honey harvested from the region is said to be unique and the best honey due to its organic character with the minimum chances of being polluted.

Land Degradation, Persistent Organic Pesticides and International Waters

There were no significant signs of large-scale land degradation observed. Worth noting however, were the following; i) slush and burn practice in subsistence agriculture which degrades forests from primary to secondary, coupled with late wildfires and the loss of certain trees which are ring barked for the production of bee hives. In addition to slash-and-burn agriculture, local communities used late fires to open up the bush for the purpose of hunting rodents.

With respect to Persistent Organic Pollutants (POPs), their use was not immediately apparent during the survey as all agricultural activities are still at subsistence level. Disputes regarding the use of international waters were not evident as the source is entirely within the national boundaries with intact riverine forests and actively flowing tributaries Lunga and Lwakela. No commercial or licenced fishing activities were observed in the upper reaches.

Mid -Zambezi Catchment

Livelihood and Economic Activities

In the Mid- Zambezi Landscape of Western province, particularly Sioma District which was until 2013 part of Shangombo District; the major livelihood activities were; fishing, cattle herding on the Barotse floodplains, maize, rice (*Oryza sativa*) and cassava.

Maize was the most important crop but was normally negatively affected by frequent droughts and floods. Other crops grown are sorghum (*Sorghum vulgare*), millet (bulrush and finger millet (*Pennisetum glaucum*; *Eleusine coracana*), rice, cassava, sweet potatoes (*Ipomea batatas*) and beans (*Phaseolus vulgaris*). Livestock reared include cattle, goats (*Capra spp*), pigs (*Sus spp*) and chickens (*Gallus gallus*), but cattle is the major livestock under traditional husbandry. Fishing mainly artisanal is done along the Zambezi, Lueti and Kwandu rivers.

Natural Resources' Use challenges

The harvesting of Rosewood (*Guibourtia coleosperma*) (Fig. 7a, b, c) was mainly illegal but was noted to be an important source of income. Poaching of game as earlier noted by Jachmann (1998;2000) and illegal harvesting of 'devils' claw' (*Harpagophytum procumbens*) were fairly significant in the Sioma area (Fig. 8a, b, c).





Fig. 7a, b) Logs of Rosewood (*Guibourtia coleosperma*) awaiting transportation to Lusaka



Fig. 7c) Loaded truck with Mukula (*Pterocarpus chrysothrix*) and Rosewood logs en-route to Lusaka. (Notes: Horse and vehicle number plate deliberately omitted from the picture for security reasons)

Illegal logging of Rosewood, and *Mukula* (*Pterocarpus chrysothrix*) is a major challenge in the district. Authorities from the Forestry Department and Agriculture attributed this to many factors among them; corruption among traditional leadership who sometimes receive inducements from illegal loggers, and timber harvesters obtaining authority from Lusaka without prior knowledge or consent of the local custodians.



Fig. 8 Devils claw (*Harpagophytum procumbens*) a) Fruit showing claws from which the name is derived, b) creeping stem and, c) tuber which is harvested for mainly illegal export

With regard to the development of tourism, a project funded under the Kavango -Zambezi Transfrontier Conservation (KAZA) to restock the Simalaha plains is underway and this may likely promote nature tourism which will provide opportunities for job creation and income generation.

Lower -Zambezi Catchment

Livelihood and Economic Activities

Agriculture and fishing were the dominant livelihood activities particularly in the Sinazongwe area. Fishing on Lake Kariba by both commercial and artisanal fishers are mainly dependent on a fresh water sardine locally called *Kapenta* (*Limnothrissa miodon*), tiger fish (*Hydrocynus vittatus*), breams (*Oreochromis* spp) and others. Livestock reared include cattle and small ruminants mainly goats (Fig. 9) and to a lesser extent sheep. Because of the dry conditions, pastures are very poor, which contributes to the poor body condition particularly in the latter part of the dry season (August to early November) (ZCRS, 2003). Keeping of cattle in Chirundu is further constrained by the areas' proximity to a Game Management Area and National Park which are reservoirs for tsetse fly (*Glossina* spp) which carries protozoan parasite that causes trypanosomiasis in cattle and sleeping sickness in humans.



Fig. 9 Small livestock, goats (*Capra* spp) in Chiawa village, Lower Zambezi, Zambia

Crops grown include maize, sorghum, millet, beans and cowpeas (*Vigna* spp). Food insecurity is relatively high caused by recurrent droughts (DSA, 2005). Efforts to mitigate crop failure have been undertaken through the introduction of drought tolerant crops such as improved sorghum and millet varieties. Currently the Zambia Agricultural Research Institute (ZARI) is implementing an Ecosystem-Based Adaptation for Food Security (EBAFoS) project aimed at promoting drought tolerant varieties to improve food and nutritional security. Its performance and expected outputs in the area are yet to be assessed.

In the Chirundu area in particular, communities also earn extra income through wage employment in large commercial farms and tourism activities (Fig. 10a, b; c)



Fig. 10 a) Banana (*Musa* spp) plantation, b) Elephant (*Loxodonta africana*) in Lower Zambezi National Park, as a tourist attraction



Fig. 10c Boat cruising as a recreation activity, providing employment opportunities for local communities in Chiawa area.

Biodiversity

The area is rich in animal biodiversity currently mainly restricted to Chete and Sekula wildlife sanctuaries on Lake Kariba, Chiawa Game Management Area and Lower Zambezi National Park. Some of the species found include hippo, buffalo, elephant, eland, kudu, impala, zebra, common waterbuck and bushbuck. Various species of resident and migrant species of birds and herptiles are also abundant. The islands (Chete and Sekula) are also important fish spawning areas. However, poaching activities are high and the fish spawning grounds around these islands are also threatened by illegal fishing activities as also earlier recorded by Thieme *et al.*, (2005) who noted this as being widespread across many other water bodies in Africa and Madagascar. On the main land, there were many recorded incidences of human-wildlife conflicts, especially as humans compete for space and fish with crocodiles or when livestock is taken to the lake or river for water as also earlier reported by Chomba and Nyirenda (2013)..

Land Degradation

Residents of Sinazongwe utilize the alluvial soils along the river valleys to cultivate crops while cattle grazing is also carried out in the same area. These activities combined, often cause loss of vegetation cover. During the rainy season gullies form which transport sediments which are eventually deposited on river beds (Fig. 11a, b, c). This was prominent in the Sinazongwe area and was very visible along the tributaries of the Zambezi River.



Fig. 11: Soil erosion, a) river bed deposition, b) river bank erosion and, c) gully erosion and sediment deposition on river beds in Sinazongwe Area of Lower Zambezi

Conservation of Biodiversity

The Conservation Lower Zambezi (CLZ) an NGO operating under the auspices of lodge owners in the Lower Zambezi and Chiawa Game Management Area (GMA) facilitates resource protection in the area through Environmental Education, knowledge and skills transfer to school going pupils on wildlife and environmental management. Additionally, CLZ also trains teachers and community members on issues relating to human animal conflicts, poaching, and fire management. The Operations

department of CLZ conducts anti-poaching patrols using an aircraft to deter poaching incursions, enhance animal abundance and diversity on which sustainable tourism is based.

CONCLUSION

The Zambezi River basin is a diverse and valuable natural resource for Zambia. Its waters for instance, are not only critical to Zambia's sustainable economic development and poverty reduction but for the entire southern African subregion (World Bank, 2010; Red Cross and Red Crescent, 2010). The catchment is inherently rich in a myriad of environmental goods and services which support the basic needs of more than 40million people of the riparian countries. It is critical for example, to hydropower production, agriculture and food security, fish production and tourism.

This survey like many others in the past therefore, underscores the need for increased investments to optimize its potential in agriculture, fisheries, tourism and power generation, while maintaining environmental quality.

On the aspect human livelihoods, it was observed that in western province in particular, livestock ownership, subsistence crop production and capture fisheries, were the dominant human livelihood activities. This conclusion is in tandem with the earlier report by World Bank (2010), which provided the basic statistics of 25% of the population being livestock herders and more than 50% being involved in capture fisheries. To justify these use levels, World bank (2010) further segregated house hold income by source as follows; fish 43%, flood plain grazing 29%, and subsistence crop production 22%, a pattern that might still persist to date.

With this proven direct link between communities and primary extraction of natural resources as a source of livelihoods, the provision of baseline data on use of international waters, loss of biodiversity in some areas, land degradation, potential threats of POPs would be useful in ensuring that the resources of the catchment are safeguarded to support sustainable socio-economic development in the Zambezi catchment as outlined below:

Community Based Natural Resources Management

The Community Based Natural Resources Management is virtually absent in areas outside the GMAs and KAZA area. In the KAZA project area for instance which is a wildlife based transboundary project involving Namibia, Angola, Botswana Zimbabwe and Zambia, there are well established and functional Community Resource Boards (CRBs) comprising village members in surrounding areas. Village Action Groups (VAGs) are formed in each of the villages and are responsible for monitoring and conserving natural resources.

Unsustainable Resource Use Practices

The best example is the use of tree bark bee hives in the upper Zambezi catchment. Local communities in the upper Zambezi catchment prefer to use tree bark bee hives because it is assumed and, in some instances, proven that, i) modern hives are too expensive to buy or difficult to construct due to lack of carpentry skills, ii) occupancy by bees is low in modern beehives and bees abscond or leave the hives after the first harvest, and iii) modern bee hives are heavy, not well shaped and difficult to handle and place or hang on trees, and yields are low.

International Water

The use of international waters of the Zambezi was generally harmonious with few exceptions; i) on Lake Kariba the Zambian authorities have not strictly complied with the restriction on the number of *Kapenta* rigs, while their counterparts on the Zimbabwean side have fully complied with the quotas, ii) in the mid Zambezi region the fish ban during the spawning season is not recognized by the Baroste Royal Establishment community leaders who allow local people to continue harvesting fish during the fish breeding season. Additionally, on the Namibian side the fish ban is not enforced.

Biodiversity

The Zambezi catchment has a wide range of natural resources with varying degrees of threats. In the Mwinilunga area, the major concerns are; i) species specific debarking for the construction of bee hives (see Fig.4c), ii) wild fire, and iii) illegal logging. In the Sioma area, the major threats are; i) illegal logging, ii) illegal harvesting of devil's claw, and iii) poaching. In the Sinazongwe- Chirundu area, major concerns are; i) soil erosion, ii) poaching, iii) illegal fishing methods, and iv) inability to restrict the number of *Kapenta* rigs on lake Kariba.

Persistent Organic Pollutants

There were no issues of POPs in the upper and mid Zambezi catchments. In the Chiawa area however, there are commercial farms growing irrigated crops but these were all compliant with the Zambia Bureau of Standards and the Zambia Environmental Monitoring Agency's regulations and did not use POPs. The use of persistent pesticides in exterminating tsetse fly particularly in wildlife areas such Chiawa GMA remains a potential area of concern for the future as also noted by Moore (2007).

Land Degradation

Land degradation was more prominent in the Sinazongwe and Chirundu districts which are also located in the driest ecological region of the country with dry spells and droughts being more common here than any other part of the country as earlier reported by Sichingabula, (1998). Crop cultivation on slopes and river valleys as well as over grazing are the main factors influencing soil erosion. In North western province, the main factor was late fires which causes damage to woody vegetation and reduces soil cover. At the Zambezi River source, employees of the National Heritage Conservation Commission and the Forestry Department who are supposed to be the custodians of the forest reserve, are engaged in forest clearance to grow pine apple for sale (see Fig. 5).

Institutional Coordination

Several institutions mandated to manage natural resources and the environment exist but are not adequately funded to carry out their functions effectively and are also not coordinated to supplement each other's effort. For instance, staff in the Departments of Forestry, at district level, have not updated inventory of forest resources, yet some of their forest reserves are located in Game Management Areas and can use structures established by the Department of National Parks and Wildlife to reach out to communities to sensitize and raise awareness on the value of forests and the need to collectively safeguard them. The issuance of logging licenses is also fragmented and uncoordinated. The lack or inadequate coordination is one of the major factors

contributing to the high incidences of illegal logging around Sioma and Western Province in general (see Fig. 6). At local level, traditional leaders have been known to allocate Rosewood trees to private individuals including Chinese nationals to harvest often without the consent of the Department of Forestry and *vice versa*.

Community Livelihoods

The major sources of livelihoods are largely at subsistence level. The major ones include; traditional agriculture mostly maize cultivation, livestock rearing, hunting, bee keeping and fishing. Despite having the abundant water resources, vegetable gardening is very limited and aquaculture virtually absent. On lake Kariba, *Kapenta* a fresh water sardine (*Limnothrissa miodon*) is the major livelihood activity of communities along the shoreline.

RECOMMENDATIONS

From the foregoing, it is evident that the Zambezi Landscape has numerous challenges that impact on the communities and biodiversity in general. For instance, dry spells and drought as a consequence of climate change impact negatively on biodiversity (Smith, 2006), and human livelihoods. Lack of capacity by key players and communities in sustainable management of natural resources limits their ability to cope with the negative effects of climate change. This is a big challenge affecting most third world countries as also noted in India by Uberoi (2002). Because of the lack of capacity, the monitoring of resources through local community structures is virtually non-existent in the Zambezi Landscape. This poses a challenge for the sustainable utilization and management of natural resources. In view of the above, a number of recommendations have been suggested as follows;

Community Based Natural Resources Management

Capacity building of the local communities is inevitable in a number of areas including; i) diversification of livelihood activities to enhance their ability to respond to challenges of climate variability, ii) raise awareness levels of communities and traditional leaders to preserve valuable timber yielding tree species iii) establish functional community structures such as Community Resource Boards and Village Action Groups to improve community involvement in managing resources and curtailing illegal uses.

International Waters

To address all areas of conflict regarding the use of international waters particularly the non-compliance with the agreed number of *Kapenta* rigs on Lake Kariba and the non-observance of the fish ban. With regard to non-recognition of the fish ban during the spawning season, it will be critical to engage the Barotse Royal Establishment community leaders who allow local people to continue harvesting fish during the fish breeding season and also to engage the Namibian authorities to find out why the fish ban is not enforced.

With regard to the use of abundant water resources of the Zambezi River to enhance community livelihoods, it was observed that the potential for fish production in the catchment is underutilized. For example, lagoons on the Zambezi River have the potential for cage culture. So far, not many interventions are in place to improve fish breeding and aquaculture.

To ameliorate this deficiency, training community members to provide the needed skills to undertake cage and pond culture technologies on the Zambezi River, would be an important avenue of ensuring availability of fish protein to the community. Vegetable gardening would also be a productive way of using the abundant water resources which are currently underutilized.

Use of Tree Bark Bee Hives in the Upper Zambezi Catchment

Efforts have been made by both the private and public sectors to educate the local community on the need to shift to conventional modern hives made of timber. However, the traditional bee keepers argue that the modern hives are not as productive compared with the traditional ones.

This is an area that requires comprehensive research to verify the claimed challenges. Provision of empirical evidence to disapprove the claims would be inevitable otherwise the community will still reject the adoption of new technologies especially that previous efforts by key stakeholders aimed at promoting modern hives have revealed that the community is not willing to adopt them, even when provided for free.

Biodiversity

The biological resources of the catchment are not fully understood. There may be need for instance, to conduct a thorough assessment of species that have commercial value. Once that is done, mechanisms to promote resource beneficiation of the local communities can be put in place.

In summary therefore, it would be necessary to carry out the following activities;

- i. Conduct a survey/inventory of natural resources (fauna and flora) such as tree species of commercial value and their impact in the surrounding communities
- ii. Bee keeping and honey production should be enhanced as this would help reduce poverty and at the same time preserve forest resources.
- iii. Build the capacity of the community-based organizations such as CRBs and VAGs in managing local resources through training and skills transfer in diversification of livelihood initiatives using natural resources such as; forest management, bee keeping, fish farming, fire management, conservation farming, and water resources management.
- iv. Part of the proceeds from sustainable utilization of natural resources in the region be used for community development projects such as education, health, fish farming (cage and pond culture), livestock production and community-based tourism.
- v. Conduct research and propagation trials of devil's claw for sustainable supply to the market.
- vi. Government and NGOs to provide logistical and technical support to institutions such as such as the Forest Department in monitoring and policing of use of forestry resources.

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