

This *Chapter* provides a description of the environmental and social baseline of the proposed Kariba Dam Rehabilitation Works Project, focussing on the proposed Project Area of Influence (AoI), as described in *Chapter 3*.

It is important to gain an understanding of the physical, biological and social attributes of the Project AoI and surrounds, as this will allow for a better understanding of the environment in which the Project is being considered. Consideration of the receiving environment is a prerequisite for the identification of potential environmental and social impacts, and for the applicable mitigation of such impacts.

4.1 PHYSICAL ENVIRONMENT

4.1.1 Physiography

The Zambezi River Basin is located in Southern Africa and drains an area of almost 1.4 million square kilometres extending across eight countries; Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe (Figure 4.1). It covers almost all of the territory of Malawi, over 70 percent of Zambia and almost half of Zimbabwe and is the fourth-largest river basin in Africa.

Figure 4.1 Zambezi River Basin



Source: Zambezi River Basin: Atlas of the Changing Environment (SARDC, 2012)

The river rises at an elevation of over 1,500 metres above sea level in the high plateau between Zambia and the Democratic Republic of Congo (DRC), and flows for a distance of some 2,700 km to where it enters the Indian Ocean about 250 km north of Beira in Mozambique.

The middle Zambezi flows through a series of narrow gorges and fault-defined valleys and has been extensively modified by two hydroelectric dams, namely Kariba and Cahora Bassa. Together, these two dams have inundated more than half of the length of the main river. Floodplains are limited, there are no extensive wetlands, and the ecology of the river is now dominated by the regulating effects of the dams (Timberlake, 1997). At present, the generation of hydropower and agricultural activities are the major water users in the basin and it is believed that agriculture could become increasingly important in terms of water consumption in the future (Beck, 2010).

The Zambezi annual runoff at Kariba comes from a 664,000 km² catchment area. Upper catchment, upstream of Victoria Falls, accounts for 76 percent of it. Lower catchment, between Victoria Falls and Kariba dam, has a more irregular run-off pattern. The cumulative net inflows over the last 50 years have varied over a wide range of 15 to 94 km³ with an average of 43 km³ per year. Evaporation from the 5000 km² reservoir surface is estimated at around 8 km³ per year.

4.1.2

Geology

The Zambezi escarpment is an extension of the Rift Valley and the present day Kariba Dam. The Kariba Dam covers the section of the Rift Valley known as the Gwembe Trough. The steep sided escarpment is composed of Pre Cambrian gneisses, paragneisses and schists, rising over 500 m above the floor of the valley. The geology of the flat valley floor is predominantly Karroo sediments (sandstones, grits, and mudstones) with isolated patches of basalt downstream of Chirundu. Lining the Zambezi River are alluvial deposits, and further inland (where some of the larger tributaries exit the escarpment) there are alluvial fans and superficial (colluvial) deposits.

The Kariba Gorge is a narrow (200 m wide), straight, steep sided gorge of approximately 22 km length. At a point known as Nyamuomba, the gorge opens out into the valley floor and the Zambezi River changes from a fast flowing river into a wider, slower one with sandy islands and braided channels. Downstream of Chirundu the Zambezi River widens further and enters the flood plain area of Mana Pools.

Directly downstream of the Kariba Dam, the north and the south bank of the Zambezi River are dominated by sheared and weathered metasedimentary rocks of the Katanga Supergroup. However, the south bank (on the Zimbabwean side) is overlain by steeply dipping micaceous quartzites whose structural integrity deteriorates downstream (Porada & Berhorst, 2000; Knill & Jones, 1965). The main foliation and lithological trends associated with the Kariba Dam wall are orientated north-west to south-east (Knill & Jones, 1965).

Approximately 20 km downstream of the Kariba Dam wall, the river broadens out as the course of the Zambezi River cuts through the rocks of the Katanga Supergroup, and floods out into the downward faulted graben of the Neoproterozoic Zambezi Belt (Interconsult, 1985), which consists of strongly deformed and resistant basement gabbro-anorthosite intruded gneisses.

The Zambezi River in the area of the plunge pool is lithologically constituted by good quality biotite gneiss. Ground investigations of a core drilled down to 72 m in the middle on the riverbed, downstream of the actual plunge pool scour hole, appears constituted by generally good quality biotite gneiss. This area is quite heterogeneous lithologically in the sense that it has massive passes of quartz-rich material alternating with weaker ferromagnesian micaceous minerals (biotite). However, within the first weathered nine metres, the rock quality designation (RQD) ⁽¹⁾ for the foundation rock is fair to good (Tractebel Engineering France / Coyne et Bellier, 2014).

The top upstream edge of the plunge pool is intersected by a major north east trending fault with subsidiary parallel faults dipping 70° to 80° towards the north west. These shear planes, filled with soft infilling as the major structures show an aperture of about 15 to 20 cm. Their occurrence is only up to an elevation of 356.6 m (Tractebel Engineering France / Coyne et Bellier, 2014).

Other shear planes extend along the right edge of the plunge pool with attitudes of 110°/90° and 320°/70° to 80°. Some ten meters downstream three other parallel faults with 15 to 20 cm soft infilling and with similar attitudes have been mapped (Tractebel Engineering France / Coyne et Bellier, 2014).

4.1.3 *Soils*

The escarpment and sides of the Kariba Gorge are covered in very shallow gravelly and rocky soils (skeletal soils). Further down the side of the gorge, the soils become colluvial and are deeper, reaching to the alluvial deposits along the banks of the Zambezi River.

The Zambezi Valley floor is a mosaic of sandy (siallitic) soils interspersed with areas of clay and sodic / saline deposits.

The alluvial soils along the Zambezi River are a complex of varying deposits of age, depth, texture and colour that mirror the past alterations in the river channel.

4.1.4 *Climate*

The climate of the Zambezi River Basin is typically sub-tropical (i.e. the climate is influenced by the annual movement of the Inter-tropical Convergence Zone [ITCZ]), with the following seasonal patterns:

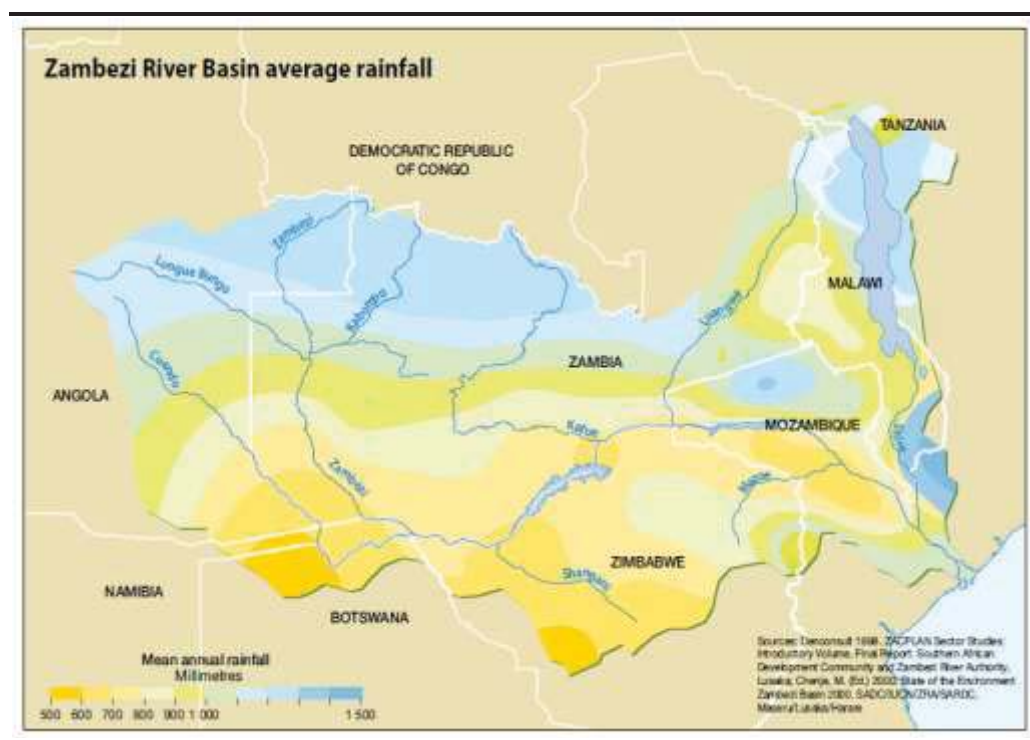
(1) The RQD is a rough measure of the degree of jointing or fracture in a rock mass.

- A hot season from late August through the beginning of the main rains;
- A main rainy season, lasting from October/November through to March/April;
- A post rainy (transitional) season in April/May; and
- A cool season from June through to early August.

The main rainfall season (or austral summer) is generally longer in the northern-most extremities of the basin, and can last for up to six months; whereas, the southern-most extremities can be as short as four months. The cool season (or austral winter) is generally characterised by dry weather across the entire basin, although some rainfall can occur in southern and eastern areas as a result of an influx of cool maritime air (known as the *Guti* in Zimbabwe, and *Chiperone* in Malawi).

Rainfall is higher in the northern parts of the basin (i.e. the upper highland reaches and the areas around Lake Malawi/Niassa/Nyasa) and can reach levels of up to 1,400-1500 mm per year, and lowest in the southern parts of the basin, (e.g. within Zimbabwe), where it can fall to 500 mm per year (*Figure 4.2*). In the upper catchment above Victoria Falls there is a general gradation of mean annual rainfall from 1,500 mm in the north to 700 mm in the south near the Chobe Swamps. Average rainfall intensities are typically of the order of 35 mm per hour due to the predominance of convective storms, and can reach as high as 70 mm per hour for short periods in severe storm conditions (Batoka HES Feasibility Study, BJVC, 1993).

Figure 4.2 *Zambezi River Basin Average Rainfall*



Source: Zambezi River Basin: Atlas of the Changing Environment (SARDC, 2012)

Average temperatures in the Zambezi Basin vary with elevation. During the cool season mean temperatures can fall to 13°C in the higher elevation areas in the south of the basin, and overnight ground-frosts can occur. Mean daily temperatures during the warmest months can reach 31°C in the lower reaches of the Zambezi Valley, and around 23°C in the higher elevation areas. Correspondingly, mean annual evaporation is highest in a belt running east-west across the basin, varying from about 200 mm per month in the October to March period, and 125 mm per month in the cooler months of June and July.

4.1.5

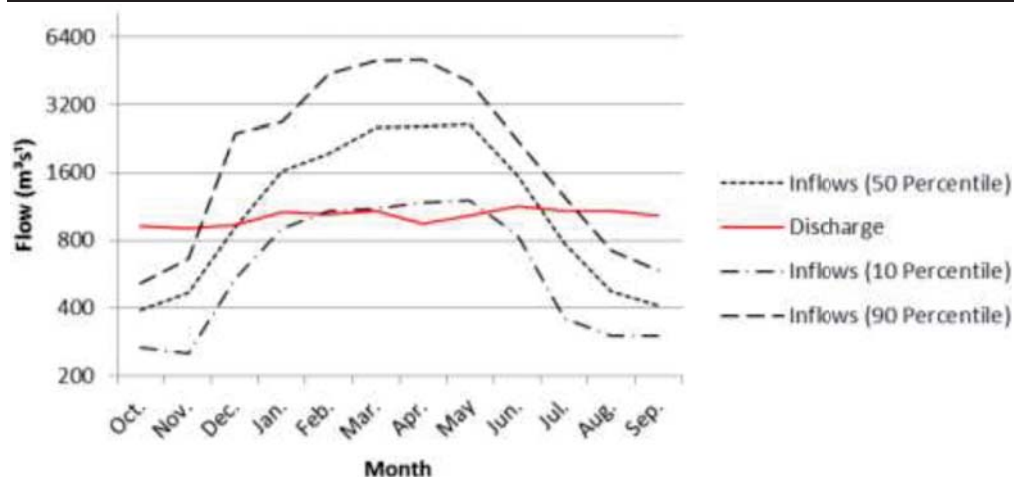
Hydrology

The Kariba Dam inflows provide a sound basis for inferring reference flow durations for the relevant reach of the Zambezi River downstream of the Kariba Dam wall (*Figure 4.3*). Reference flows reflect seasonal variation with typical peaks during February, March and April, while lower flows used to be experienced during September, October and November. The flow duration curves also indicate relatively large variation in reference peak and low flows, as shown by the differences between the 10th, 50th and 90th percentiles for the 1962-2010 period. Post Kariba Dam construction flows (for the period 1993-2013) are illustrated by the red line in *Figure 4.3* and represent an artificial baseflow with a significant digression from the reference hydrograph.

The change in hydrology has impacted on the downslope environment by changing the flow regime, altering the sediment supply and providing a migration barrier for instream aquatic organisms. All three factors act as drivers of ecological change. The Zambezi River downslope of Kariba Dam to Chirundu has lowered its bed by 2 m and the channel has widened between Kariba and Mupata gorges with an average of 200 m. The channel bed degradation and decrease in large flood frequencies impact on downslope floodplain ecology (*Figure 4.4*) (Khan *et al.*, 2014; Mwelwa-Mutekenya, 2014). Concurrently, the channel widening coincided with spill events, as little widening occurred post 1981 (Nugent, 1988; Magadza 2000; Basson, 2005). A subsequent inference is that the increase in bedload capacity is not resulting in additional erosion and that the system probably remains stable under the current discharge regime.

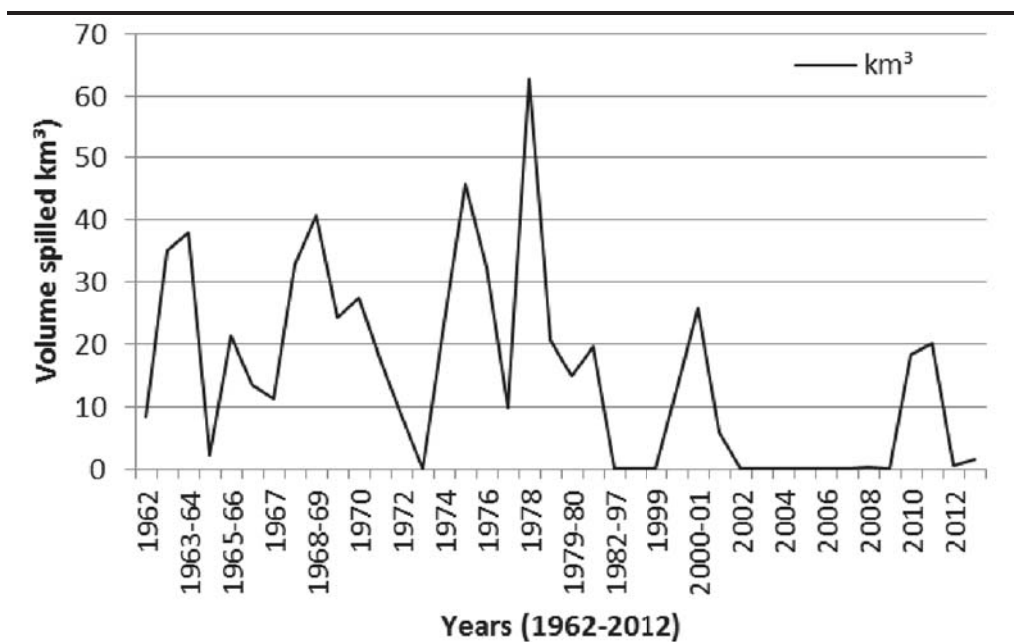
In summary, the existing flows reflect a large digression from reference flows causing altered migration cues, and a change in habitat and cover units for instream aquatic communities. Similarly, channel widening has impacted on the riparian zones and downslope floodplains and swamp areas and the processes associated with these features.

Figure 4.3 *Hydrograph Reflecting Reference (black curves) and existing (red curves) Flow Duration Curves for the Zambezi River*



Please Note: Discharge as measured through the North and South Bank Hydropower Plants.

Figure 4.4 *Graph Indicating Spill*



KEY FINDINGS – Hydrology:

The existing flows reflect a large digression from reference flow conditions, and are considered the main driver of the altered habitat and cover units for instream aquatic communities noted.

Similarly, channel widening has laterally impacted on the riparian zones and downslope floodplains and swamp areas, causing a loss of these habitats due to loss of inundation in these zones. The Ecological Flow Assessment and hydraulic modelling determined boundary conditions for maintenance low flows at a flow of approximately 440 m³/s, while drought low flows were estimated at approximately 93 m³/s. Within the Gorge itself, large flow reductions will be more readily tolerated by the existing aquatic habitat template. However, this is unlikely to be the case downstream of the Gorge, where the habitat template will be more sensitive to flow reductions. It is thus advised that flow reduction (if required) should not exceed the maintenance low flow for extended periods of time.

4.2 BIOLOGICAL ENVIRONMENT

4.2.1 Ecological Areas of Influence

The Direct Area of Ecological Influence (*Figure 4.5*) is defined as the spillway gate construction site and the slipway upstream of the dam wall, the plunge pool and coffer dam downstream of the dam wall, the access roads and the waste rock dump site, and slipway site. The sites of sand extraction and quarries for construction materials are not included as some materials are sourced from far beyond the site, e.g. Chinhoyi and Lusaka.

Figure 4.5 Direct Area of Ecological Influence



Direct Area of Ecological Influence designated by red outline.

Source: Childs, 2014.

The Indirect Area of Ecological Influence is defined as the Kariba Gorge from the Kariba Dam wall to Nyamuomba and downstream from there to include the upper river terraces on both sides of the river as far as the eastern boundary of Mana Pools National Park. It includes the alluvial areas in

Chiawa Game Management Area and Lower Zambezi National Park in Zambia, and the alluvial areas in Urungwe Safari Area and Mana Pools National Park in Zimbabwe (Figure 4.6).

Figure 4.6 *Indirect Area of Ecological Influence*



Indirect Area of Ecological Influence designated by orange outline.

4.2.2 *Terrestrial Flora*

In broad terms the Project Area is covered in woodland, the various types being dependent on the soils and other edaphic factors.

Escarpment Habitats

Generally the escarpment hill tops support open Miombo Woodland that is dominated by *Julbernardia globiflora* and *Brachystegia sp.* These hilltops grade into a Mixed Deciduous Woodland type dominated by *Kirkia acuminata*, *Sterculia quinqueloba* and *Commiphora sp.* further down the escarpment slopes and down the sides of Kariba Gorge. In areas where there is a high density of elephant, an increased grass cover and fuel load, coupled with late dry season hot fires, the woodland has degenerated and become more open shrubland on the Zimbabwean side. In Zambia, tree felling for firewood and construction of houses together with clearing of land for cultivation has also led to a degeneration of the woodland into open shrubland in areas around the urban centres of Siavonga and Chirundu.

Table 4.1 *Important Plant Species associated with the Escarpment Habitats*

Species Name	English Common Name	Local Names	IUCN Threatened Status
<i>Acacia nigrescens</i>	Knob Thorn	Chinanga (Shona) Isinanga / Katopa (Ndebele)	NE but common and widespread

Species Name	English Common Name	Local Names	IUCN Threatened Status
<i>Brachystegia sp.</i>	Msasa (tree)	Igonde (Ndebele) Msasa / Mutatsa (Shona)	-
<i>Calotropis procera</i>	Sodom's Apple		Alien invasive species
<i>Colophospermum mopane</i>	Mopane	Iphane (Ndebele) Mupane / Musharu (Shona) Chanye / Mpane (Nyanja)	NE but common and widespread
<i>Combretum apiculatum</i>	Red Bushwillow	Bonda / Tsingidzi (Shona) Umbhondo (Ndebele)	NE but common and widespread
<i>Combretum microphyllum</i>	Riverine flame-creeper / Burning-bush Combretum	Bambangwenya (Hlengwe) Ganwa-musero / Mupfurura / Mutsiwa Mutzutsu (Shona)	NE but common and widespread
<i>Combretum mossambicense</i>	Shaving brush Combretum / Knobbly bushwillow	Marorwe / Mubondorokoto (Shona)	NE but common and widespread
<i>Commiphora sp.</i>	Corkwood	-	-
<i>Diospyros kirkii</i>	Large-leaved Jackal-berry	Muchenje (Shona)	NE but common and widespread
<i>Ficus sycamorus</i>	Sycamore Fig	Mukuyu / Muonde (Shona) Umkhiwa (Ndebele) Mkuyu (Nyanja)	NE but common and widespread
<i>Hyparrhenia sp.</i>	Thatching Grass		-
<i>Julbernardia globiflora</i>	-	Munondo / Mutondo (Shona) Umtshonkwe (Ndebele)	NE but common and widespread
<i>Kirkia acuminata</i>	White Syringa	Mubvumira (Shona) Umvumile (Ndebele) Mzumba (Nyanja)	NE but common and widespread
<i>Sterculia quinqueloba</i>	Large-leaved Star-chestnut	Kukubuyu (Shona), Umkukubuyu (Ndebele) Mgoza / Msambamfu (Nya)	NE but common and widespread
<i>Tamarindus indica</i>	Tamarind Tree	Musika (Shona)	NE but common and widespread

NE = Not evaluated on the IUCN Red List of Threatened Species

Waste Rock Dump Site, North Bank

PLEASE NOTE:

Chapter 8 of this report considers the key alternatives relevant to the ESIA, including siting alternatives for the waste rock dump.

"Preferred" Site for the Waste Rock Dump - Existing Disused Sinohydro Quarry

The area that was identified as the preferred waste rock dump site (refer to Section 8.1 of this report) is in the existing disused Sinohydro quarry (refer to Figure 4.7) at GPS co-ordinates 16°30'20.58"S 28°45'45.34"E. This area was used as a quarry during the construction of the Kariba North Power Station in the 1970s and has since been abandoned. This alternative is preferred as the capacity of the quarry is large enough to accommodate almost all the

excavation material (an estimated 295,000 m³ of rock) that will be generated through rehabilitation of the plunge pool. Moreover, the site is already highly disturbed.

Figure 4.7 *View of the Existing Disused Sinhydro Quarry (Preferred Waste Rock Dump Site)*



“Alternative” Site for the Waste Rock Dump - Immediately East of the Existing Disused Sinhydro Quarry

A second less preferred alternative waste rock dump site is located immediately east of the existing disused Sinhydro quarry at GPS co-ordinates 16°30'20.30"S 28°45'51.11"E at elevation 593 masl in an area of typical escarpment woodland (*Figure 4.8*). The alternative site is considerably less disturbed, although there were signs wood cutting and fire and the area is grazed by livestock.

Figure 4.8 *Mixed Deciduous Woodland near Sinohydro Quarry (Alternative Waste Rock Dump Site)*



Note: photo taken late dry season and trees are leafless.

As is mentioned in Section 4.1.2, the underlying geology for both sites is gneissic rock with very shallow, sandy and gravelly soils. Dominant woody species include *Julbernardia globiflora*, *Combretum apiculatum* and *Diospyros kirkii*. Grasses were only identified to genus level, including: *Hyparrhenia* sp., *Aristida* sp. and *Schmidtia* sp. No rare or endangered plant species were noted. Weedy species such as *Calotropis procera* were noted, also indicative of disturbance.

“Alternative” Site for the Waste Rock Dump – Ephemeral Stream Adjacent to Access Road

A third less preferred alternative waste rock dump site is located at GPS coordinates 16°30'24.72"S 28°45'37.20"E and elevation of 567 masl. This stream drains from the high ground north and west of the quarry site down a ravine to empty into the Zambezi River just downstream of the north bank turbines. The area is a typical example of tributary riparian woodland. The stream bed was dry at the time of sampling but judging from the structure and nature of its banks, is subjected to periods of high flows of short duration. The stream is fringed by a narrow strip of tall (10-12 m) *Ficus sycamorus*, *Acacia nigrescens* and *Tamarindus indica* trees with an understorey of *Combretum mossambicense* shrubs and *Combretum microphyllum* creepers. No rare or endangered plants were found at the site although these may occur further down the ravine (see Table 4.3 below) and in other patches of this woodland type elsewhere along the Kariba Gorge.

PLEASE NOTE:

Chapter 8 of this report considers the key alternatives relevant to the ESIA, including siting alternatives for the slipway site.

The area that was identified as the preferred slipway alternative site (refer to Section 8.2 of this report) is located on Zimbabwe Parks and Wildlife Management Authority (ZPWMA) land, immediately below the office and housing complex at Peter's Point, at approximate GPS co-ordinates 16°31'52.59"S 28°45'33.60"E. The area constitutes an existing slipway that is used by both ZPWMA and District Development Fund (DDF) as a boat launching site and workshop. Consequently, there is a high level of disturbance and little natural terrestrial vegetation remaining on the site. The access road to the site passes through typical Mixed Deciduous Woodland, co-dominated by *Combretum*, *Sterculia* and *Commiphora* species with some *Colophospermum mopane* (Figure 4.9).

Figure 4.9 *Vegetation Adjacent to Slipway at Peter's Point*



Note: Green trees are *C. mopane*, pale whitish trees are *Sterculia*. No riparian fringing vegetation.

Valley Floor Habitats

The predominant vegetation type is *Colophospermum mopane* Woodland on the heavier soils, with patches of "jesse", a dry forest /dense thicket community of *Combretum* and *Acacia* shrubs with tall emergent *Xeroderris stuhlmannii* and *Pterocarpus lucens* trees on the deep sandy soils (Figure 4.10). Although the jesse thickets are markedly deciduous, they are highly productive areas, providing refuge and browse to a variety of wildlife. The important plant species in this habitat are listed in Table 4.2.

Figure 4.10 *Typical Colophospermum mopane Woodland on Clay Soils, Zambezi Valley*



Note: Dried out pan and spoor of wildlife.

Table 4.2 *Important Plant Species associated with the Valley Floor Habitats*

Species Name	English Common Name	Local Names
<i>Acacia nigrescens</i>	Knob Thorn	Chinanga (Shona) Isinanga / Katopa (Ndebele) Mkunku / Nyamamponombwe (Nya.)
<i>Acacia robusta</i> subsp. <i>clavigera</i>	Splendid thorn	Umgamanzi / Umhlabunga (Ndebele)
<i>Combretum imberbe</i>	Leadwood	Monzo / Mutsviri (Shona) Umtshwili (Ndebele) Chilusa / Nyonja (Nyanja)
<i>Diospyros mespiliformis</i> ,	African ebony / Jackal Berry	Mchenja / Mvimbe (Nyanja)
<i>Faidherbia albida</i>	Ana-tree / Apple-ring	Musangu / Musenga (Shona) Umpumbu (Ndebele) Nsangusangu / Mtubetube (Nya.)
<i>Kigelia africana</i>	Sausage Tree	Mubveve / Musonya / Muvhumati (Shona) Umvebe (Ndebele)
<i>Ludwigia</i> sp.	Aquatic plant	-
<i>Panicum repens</i>	grass	-
<i>Philenoptera violacea</i> [<i>Lonchocarpus capassa</i>]	Apple Leaf / Rain Tree	Mumerafodya (Shona) Ichithamuzi (Ndebele) Chimpakasa (Nyanja)
<i>Phragmites</i> sp.	Reeds	-
<i>Tamarindus indica</i>	Tamarind	Museka (Shona)
<i>Trichilia emetica</i>	Natal Mahogany	Muchichiri (Shona)

Alluvial Soils: Sandbanks, Islands and Riparian Habitat

The alluvial soils are a complex mixture of loose sands, and layers of silt and clays of variable thickness and depths. There is a succession of vegetation types as one moves from the Zambezi River up a series of river terraces and

four fairly distinct types determined by the physical composition, age and height above the Zambezi River can be distinguished (Muller & Pope, 1982 in du Toit, 1982):

- a) The most recently deposited alluvium are clean white sands with thin bands of grey silt that edge the present river channel. These form sandbanks and sandy islands that become colonised by semi aquatic vegetation such as *Ludwigia* sp., *Panicum repens* and *Phragmites* reeds (Figure 4.11). In the drier areas, moving away from the water's edge, *Vetiveria* grass predominates.
- b) *Faidherbia* (*Acacia*) *albida* Woodland which colonises the relatively loose sandbanks and lower unstable river terraces (Figure 4.12). It comprises almost pure stands of *F. albida* trees of variable ages with no understorey of woody plants.
- c) *F.albida* Dominated Woodland is developed from the previous type and has other tree species such as *Trichilia emetica*, *Kigelia africana* and *Philenoptera violacea* (*Lonchocarpus capassa*) present, together with patches of shrubs.
- d) Mixed Riparian Woodland is derived from the above type, where *F.albida* is generally absent whilst those trees adapted to heavier textured soils such as *Acacia nigrescens*, *A.robusta* subsp. *clavigera*, *Diospyros mespiliformis*, *P.violeacea*, *C. imberbe*, *Tamarindus indica* are present, with a well-developed shrub layer and climbers. This type has the highest flora species diversity.

Within the Kariba Gorge, the riparian woodland is a narrow strip of trees of generally Mixed Riparian Woodland (type (d)), that grades into Mixed Deciduous Woodland higher up the slopes.

Figure 4.11 Sandbanks with Riparian Thicket and *Faidherbia albida*



Figure 4.12 *Grassy Channel between E. albida Woodland on River Terraces, Mana Pools National Park*



Cultivated, Urban and Industrial Areas

Cultivated and urban areas are zones of high disturbance and are characterised by a decrease in biodiversity and indigenous plants and an increase in weedy and invasive species.

The peri-urban zones around Siavonga and Chirundu towns, and to a lesser extent, Kariba town were observed to be mostly denuded of tree species, possibly chopped down for firewood.

On the Zambian (north) bank the alluvial areas between Nyamuomba and Chirundu are intensively cultivated. Sugar cane, bananas and a variety of vegetable crops are grown by both subsistence and commercial farmers. On the Zimbabwean bank, immediately downstream of Chirundu are patches of land that was previously under sugar cane and is now under banana plantations.

IUCN Red Data, Rare and Endangered Flora

The checklist of Zambian and Zimbabwean vascular plants (Mapaura and Timberlake, 2004) was analysed for all species recorded from the north of the country. The IUCN status of those species that are known to occur in the study area and those that are likely to occur, were examined according to the Southern African Plant Red Data Lists Database (Golding /SABONET, 2002). Given that there has not been any comprehensive survey of the flora in the Kariba Gorge, it is possible that some species may have been missed.

Table 4.3 below summarises the findings of the desktop review.

Table 4.3 IUCN Red Data Plant Species (SABONET, 2003)

Species	Growth Form (& English Name)	IUCN Threat. status	Habitat / Comment
<i>Asplenium sebungweense</i>	Mesic fern	LR-nt	May occur, not confirmed. Limited distribution in dry forests of Zambia and Zimbabwe
<i>Adenia karibensis</i>	Succulent climber	LR-nt	Endemic. Found in rocky habitat of Kariba Gorge.
<i>Cyclantheropsis parviflora</i>	Creeper	VU	Found in Kariba Gorge.
<i>Rhus lucens</i>	Shrub	LR-nt	Found in Kariba Gorge.
<i>Euphorbia cooperi</i> var. <i>calidicola</i>	Succulent	LR-lc	Found in Zambezi Valley
<i>Azelia quanzensis</i>	Tree (Pod Mahogany)	LR-lc	Mixed Deciduous Woodland. Threatened by logging and wood carving; agriculture
<i>Dalbergia melanoxydon</i>	Tree (Zebra Wood)	LR-nt	Mixed Deciduous Woodland. Threatened by wood carving
<i>Pterocarpus angolensis</i>	Tree (Mukwa)	LR-nt	Escarpment /Mixed Deciduous Woodland. Threatened by logging.

Key to IUCN Threatened Status: LR-lc = Lower Risk Least Concern; LR-nt = Lower Risk Near Threatened; VU = Vulnerable

Note: These species were listed as vulnerable or of conservation concern on 1998 checklist

In Zimbabwe all Aloe species and all epiphytic orchids are Specially Protected Species (Parks and Wildlife Act Chapter 20:14, 1996).

Figure 4.13 *Leaves of Adenia karibaensis (left) and Leaves and Fruit of Cyclantheropsis parviflora (right)*



Source: B Wursten, Zimbabwe Flora website
(http://www.zimbabweflora.co.zw/speciesdata/species.php?species_id=141070)

4.2.3 Terrestrial Fauna

There are two contrasting land uses between the Zambian and Zimbabwean sides of the river and this is reflected in the animal populations. This report only examines the wild life and does not include any domestic animals.

With the exception of the immediate surrounds of the dam wall, and around Chirundu town, the entire stretch of river from Kariba to Mupata Gorge in Zimbabwe is Parks Estate, where all wildlife is protected, and can only be hunted under licence in one of the Safari Areas. Wildlife populations on the Zimbabwean bank are generally healthy and there is a high diversity of species.

In contrast, the section of Zambian riverbank from the dam wall to south of the Kafue River is open land and there is widespread agriculture. Wildlife habitat is reduced and there is human wildlife conflict, particularly with crop raiding elephant and hippopotamus. The wildlife populations in Lower Zambezi National Park and Chiawa Game Management area are contiguous with those in Mana Pools, Zimbabwe and there is undoubtedly movement of the larger animals across the border and between the two National Parks. Both countries are experiencing high poaching pressure, especially for ivory.

Large Mammals

Focal Species

Hippopotamus: Since hippopotamus are closely associated with the riparian habitat, these animals are affected by changes in river flow as flooding or drying out of the sandbanks will alter the availability of grazing. Hippos are fairly sedentary and form family units or pods that are fiercely defended by the breeding male. Territorial conflicts between rival males occur under times of stress due to food shortage or loss of habitat.

A combined boat and aerial survey by Fergusson in 2006 gave a population estimate of 3654 adult hippo for the section of river from Nyamuomba to Kanyemba. The greatest proportion of these (81.75 %) are found in the protected areas.

Elephants: Elephants are much more mobile, moving inland away from the river during the rains, returning to the river when the smaller rivers and pans dry out in winter. As with many other animals, they feed extensively on the *F. albida* pods on the Mana Pools floodplain during the late dry season.

IUCN Red Data Species and CITES Species

Table 4.4 *IUCN Red Data List Species, Specially Protected Species and CITES Species*

Family	Species	Common Name	IUCN Threat. Status	Specially Protected Species	CITES Appendix Species
MANIDAE	<i>Smutsia (Manis) temmincki</i>	Pangolin	VU	Both	Yes
CANIDAE	<i>Lycaon pictus</i>	African Wild Dog	EN	Zambia	Yes
FELIDAE	<i>Acinonyx jubatus</i>	Cheetah	VU	Both	Yes
FELIDAE	<i>Panthera leo</i>	African Lion	VU		Yes
FELIDAE	<i>Panthera pardus</i>	Leopard	NT		Yes
FELIDAE	<i>Felis silvestris</i>	Wild Cat	LC		Yes

Family	Species	Common Name	IUCN Threat. Status	Specially Protected Species	CITES Appendix Species
HYAENIDAE	<i>Crocuta crocuta</i>	Spotted Hyaena	LC		
HYAENIDAE	<i>Proteles cristata</i>	Aardwolf	LC	Both	Yes
MUSTELIDAE	<i>Mellivora capensis</i>	Honey Badger	LC		
BOVIDAE	<i>Kobus ellipsiprymnus</i>	Waterbuck	LC		
BOVIDAE	<i>Syncerus caffer</i>	African Buffalo	LC		
HIPPOPOTAMIDAE	<i>Hippopotamus amphibius</i>	Hippopotamus	VU		Yes
ELEPHANTIDAE	<i>Loxodonta africana</i>	African Elephant	VU		Yes

Key to IUCN Threatened status: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Lower Risk / Least concern

Key to Protected Species: Zambia implies protected in Zambia; Both implies protected in Zambia and Zimbabwe

Of the 13 mammal species on the IUCN Red Data List, three are listed as Specially Protected Species under the Zimbabwe Parks Act (1996) and four under Zambian legislation. Nine species are also protected under the Convention for International Trade in Endangered Species (CITES) which controls the export of these animals and their products.

Small Mammals

Small mammals that are reported to occur within the riparian zone of the Zambezi are rodents such as Canerats (*Thryonomys swinderianus*) and Water rats (*Dasyomys incomtus*) that inhabit dense reed beds and semi aquatic grasses.

Although primarily associated with evergreen forests, Sun squirrel (*Heliosciurus rufobrachium*) were reported to occur in the riverine forest fringes on the Zambian bank of Lake Kariba (Smithers, 1983) and in isolated patches of riverine thickets and forest on the Zimbabwean bank, along the Ruckomeche river (K.Dunham, pers.comm).

Samango monkeys (*Cercopithecus albogularis*) are known to occur on the riverine forest fringing the Zambian bank near Mupata Gorge (own observation).

Reptiles

Python natalensis (*P. sebae*). The Southern African Python is a Specially Protected Species in Zimbabwe. It frequents riparian habitats and rocky outcrops.

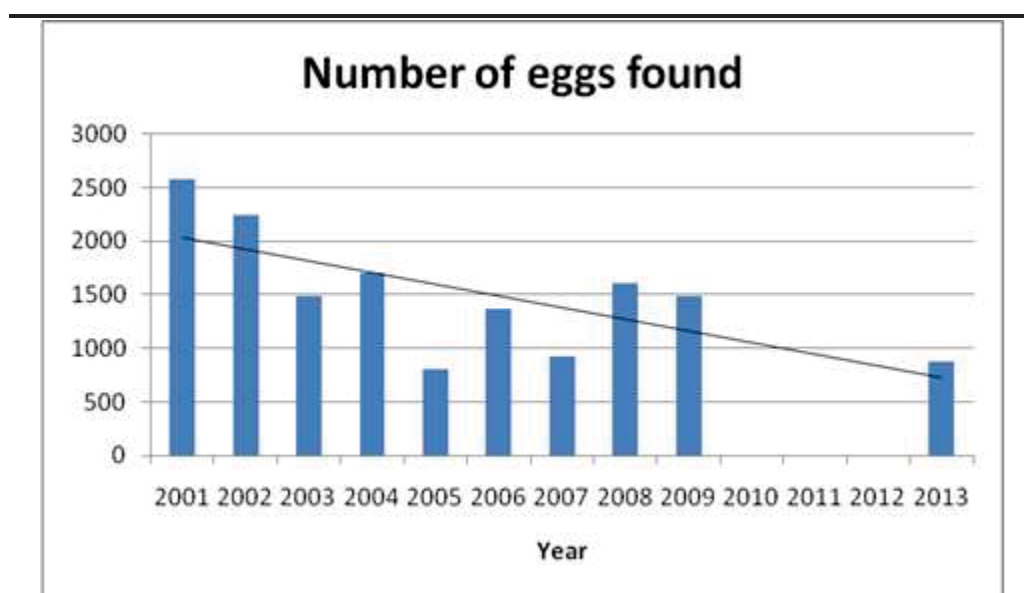
Varanus niloticus (Nile Monitor) and *V. albigularis* (Savanna Monitor) both occur in the project area. These are listed species on Appendix 2 of CITES.

Pelusios subniger (Pan hinged Terrapin) and *P.sinuatus* (Serrated hinged Terrapin) are largely aquatic, only coming onto land to nest and sunbathe. The Pan Terrapin, as its name suggests, is associated more with the inland pans, whilst *P.sinuatus* is commonly found along the river banks.

Crocodylus niloticus (Nile Crocodile) occur throughout the Zambezi River system and is an apex predator in the aquatic and riparian zone, feeding on fish, mammals and birds.

In Zimbabwe, crocodiles are listed on CITES Appendix 2, meaning that export trade is regulated and monitored. In keeping with the concept of conservation through sustainable utilisation, crocodile eggs are collected in Zimbabwe under a Parks and Wildlife Management permit for the section of the river from Kariba Dam wall downstream to the western boundary of Mana Pools National Park. The numbers have declined in recent years due to changes in collection effort and the increase in human disturbance (refer to *Figure 4.14*). Crocodiles are caught in fishing nets and their nests are raided by local villagers.

Figure 4.14 *Crocodile Egg Collection from Kariba to Mana Pools (Zimbabwean Bank) 2001-2013*



Source: Crocodile Farmers Association of Zimbabwe

There were no collections undertaken for the years 2010-2012, but the data still show a decline in numbers.

Fergusson's estimate for crocodiles from Nyamuoba to Kanyemba was 1984 animals, of which 90.6% were found in the protected areas.

Amphibians (Frogs)

Frogs are one of the most vulnerable groups to pollution and habitat change and are therefore useful bio-indicators. Frog skin is highly permeable to water and hence any dissolved chemicals. Since the early part of their life cycle is aquatic and the adult stages more terrestrial, frogs are affected by changes in both environments. Frogs eat a wide variety of invertebrates and in turn are an important food source for a range of other predators.

The frog species in this section of the Zambezi River have not been well documented but the following information was obtained from a professional natural history guide, I Riddell (see *Table 4.5*) in conjunction with a review of du Preez & Carruthers (2009). Riddell recorded a total of 21 species from the Zambezi Valley in general, of which 12 were found at Rifa Camp and 14 species at Mana Pools. None of these are considered to be endangered or threatened, although habitat loss and potential pollution from agriculture on the Zambian bank will undoubtedly have a negative impact.

Table 4.5 *Checklist of Frogs Recorded in the Middle Zambezi Valley*

Species (and Common Names)	Rifa Camp	Mana Pools	Zambezi Valley
<i>Xenopus laevis</i> (Common Platanna)	•	•	•
<i>Phrynomantis bifasciatus bifasciatus</i> (Banded Rubber Frog)	•		•
<i>Hemisis marmoratus</i> (Marbled Snout-burrower)	•	•	•
<i>Hemisis guineensis broadleyi</i> (Guinea Shovelnose Frog)			•
<i>Arthroleptis stenodactylus</i> (Common Squeaker)			•
<i>Pyxicephalus adspersus edulis</i> (African Bullfrog)		•	•
<i>Tomopterna cryptotis</i> (Common Sand Frog)			•
<i>Tomopterna marmorata</i> (Marbled Sand Frog)			•
<i>Hildebrandtia ornata ornata</i> (Ornate Frog)			•
<i>Ptychadena anchietae</i> (Plain Grass Frog)	•	•	•
<i>Ptychadena mascareniensis</i> (Mascarene Grass Frog)		•	•
<i>Ptychadena mossambica</i> (Broad-banded Grass Frog)	•	•	•
<i>Phrynobatrachus natalensis</i> (Dwarf Puddle Frog)	?	•	•
<i>Phrynobatrachus mababiensis</i> (Snoring Puddle Frog)	•	•	•
<i>Chiromantis xerampelina</i> (Foam Nest frog)	•	•	•
<i>Kassina senegalensis</i> (Bubbling Kassina)	•	•	•
<i>Hyperolius marmoratus marginatus</i> (Painted Reed Frog)		•	•
<i>Ametiophrynus (Bufo) gutturalis</i> (Guttural Toad)	•	•	•
<i>Ametiophrynus (Bufo) garmani</i> (Olive Toad)	•	•	•
<i>Ametiophrynus (Bufo) maculatus</i> (Flat-backed Toad)	•	•	•
<i>Schismaderma carens</i> (Red Toad)	•		•
Total count of species	12	14	21

Source: du Preez & Carruthers, 2009.

Birds

With the wide range of habitats from sandbanks and mudflats to thicket, forest and woodlands, there is a great diversity of birdlife in the Middle Zambezi Valley. The river itself is a major migration route for birds moving up and down from the lowland forests and plains of Mozambique, as well as being a seasonal refuge for many species from the highlands of Zambia and Zimbabwe (Irwin, 1981).

This area qualifies for IBA status on the basis of the high avian diversity and the fact that the site is thought to hold more than 1% of a biogeographic population of congregatory waterbird and terrestrial species (categories A3 and A4, Fishpool, 1997).

Focal Species

The following table lists the number of species in each of the main groups of birds associated with the river and riparian habitat. It is drawn from the Rifa Camp checklist of Bird Life Zimbabwe (2014).

Table 4.6 *Bird Species associated with the Middle Zambezi River and Riparian Habitats*

Group	Number of species	Comments: diet, status, threats
Cormorants, Darter	3	Open water; fish
Hérons and Egrets	16	riverbank; Frogs, fish, insects
Hammerkop (SP)	1	riverbank; frogs
Storks, Ibises, Spoonbill	12	Molluscs and other invertebrates in mudflats and water's edge, frogs, fish
Ducks and Geese	8	Aquatic plants, grasses, seeds, insects
Crakes, Moorhens, Coot	8	Insects and aquatic plants
Jacanas	2	Insects on floating waterplants.
Stilt, Painted-snipe, Water Dikkop, Pratincoles	5	Insects and other invertebrates along shoreline. Rock Pratincole breeds within the Kariba and Mupata Gorges.
Plovers, Lapwings, Sandpipers	25	Insects and other invertebrates along shoreline.
Gulls	3	Fish, frogs.
Kingfishers	8	3 of these species are mostly aquatic feeding on small fish, the others are inland species feeding on terrestrial insects
Piscivorous (fish eating) Raptors	3	Osprey is a seasonal migrant; Pel's Fishing Owls roosts and nests in dense canopy of evergreen trees along river banks
Other significant raptors associated with riparian habitat	1	Southern Banded Snake Eagle is closely associated with riparian habitat and nests in tall trees in the riverine woodlands and ravines. This habitat is under threat from clearing for cultivation on the Zambian side, and from high densities of elephants on the Zimbabwean side.
Sandbank nesting birds	3	African Skimmer. Intra African migrant. Endangered in sub region. Nests on low exposed, un-vegetated sandbanks. See text for more details. Southern Carmine Bee eater and White fronted Bee eater both nest in cliffs along riverbanks. Significant colonies along the Middle Zambezi and tributary rivers. Martins, Swifts: several species nest in the cliffs along river banks. None are threatened or endangered species.

SP = Specially Protected.

Birds of Conservation Concern

Southern Carmine Bee Eater (*Merops nubicoides*)

The banks of the Zambezi provide nesting habitat for an estimated 10 000 Carmine Bee eaters which is a significant population and higher than the

threshold for congregatory terrestrial species (category A4ii *sensu* Fishpool 1997).

Figure 4.15 *Southern Carmine Bee Eaters are Intra African Migrants that Nest in Sandbanks along the Zambezi River*



Rock Pratincole (*Glareola nuchalis*)

These are small, fast flying birds that inhabit and nest on the exposed rocks in the middle of fast flowing rivers where there is protection from predators. Rock Pratincoles feed predominantly on emerging aquatic insect larvae, such as caddisflies, that they forage from rocks midstream and on the margins of rivers. They are found along the Zambezi River, and are known to breed in Kariba Gorge and Mupata Gorge. The impoundments of Lake Kariba and Cahora Bassa have greatly reduced the birds' habitat and the diurnal fluctuations in water levels in Kariba Gorge caused by changes in electricity generation from Kariba create a tidal effect of more than one metre which may affect the birds. The effects of human predation have not been evaluated but may be significant (Hockey *et al*, 2005).

The species is a localised, uncommon intra-African migrant that arrives late July-August and departs in December-January to non-breeding grounds in East Africa. Although it occurs elsewhere in Africa, the population in the sub region is considered to be of high conservation concern.

African Skimmer (*Rhynchops flavirostris*)

This bird has a modified bill and flight pattern that enables it to fly just above the water, literally skimming the surface for small fish. It is a localised species found on large river systems with exposed un-vegetated sandbars and islands, particularly on the Zambezi. It is partial intra-African migrant,

arriving in May and departing in December. It has very specific requirements for nesting and lays its eggs on bare sand, often close to the water's edge.

Although categorised as Near Threatened (IUCN) the southern African population is now considered to be Endangered as it is decreasing rapidly due to habitat loss, exploitation and disturbance. Construction of Lake Kariba resulted in loss of breeding sites both up- and downstream of the dam wall. During breeding (dry) season, boats create wakes that wash eggs and chicks into the water. The breeding birds are also disturbed by canoeing safaris camping on islands in the Zambezi River. Eggs are collected for food by local villagers and the chicks used as fishing bait.

Population surveys along the 256 km of Zambezi River between Kariba Gorge and Kanyemba show a decline in numbers: (1981) 100; (1986/1987) 137; (1989) 56; (1991) 36 and no evidence of breeding at the last count. In Jan 1990, the pre-migratory gathering at Rukomeche, Zimbabwe, contained only 12 birds (Hockey, *et.al.* 2005).

4.2.4 *Levels of Habitat Modification*

This *Section* evaluates the level of disturbance to the main habitats and the natural functioning of the ecosystems.

IFC Definitions

The IFC Performance Standard 6 *Biodiversity Conservation and Sustainable Management of Living Natural Resources* classifies habitats under the following three main categories.

Modified Habitat

Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands. Examples of this habitat are the urban areas around Siavonga, Kariba and Chirundu towns, as well as the cultivated fields along the Zambian bank.

Natural Habitat

Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition. Excluding the immediate environs of the various safari camps, the protected areas on the Zimbabwean side of the river are good examples of natural habitats.

Critical Habitat

Critical habitats are areas with high biodiversity value, including:

- e) Habitat of significant importance to Critically Endangered and/or Endangered species;
- f) Habitat of significant importance to endemic and/or restricted-range species;
- g) Habitat supporting globally significant concentrations of migratory species and/or congregatory species; and
- h) Highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes.

Table 4.7 ***Habitat Type and Levels of Modification***

Habitat Type	IFC Classification	Level of Modification	Biodiversity Value
<u>Escarpment Habitats</u>			
a) Miombo Woodland (Julbernardia-Brachystegia)	Natural	Low – medium modification is around towns. Trees are cut for poles (housing) and firewood. Elephant damage in Zimbabwe national parks and safari areas; annual late dry season hot fires in Zambia and Zimbabwe reducing woodland to open shrubland in places	Low – medium. Type is widespread through project area and region
b) Kirkia-Sterculia-Commiphora woodland	Natural		
<u>Valley Floor Habitats</u>			
a) Colophospermum mopane woodland on heavy soils	Natural – some Modified	Low-medium. Localised modification where elephant densities are high.	Medium. Although the type is very widespread, there are some particularly good examples of cathedral mopane woodland in the Parks Estate.
b) Dry forest / thicket “jesse” on sandy soils	Natural	Low-medium. Localised modification where elephant densities are high	Medium-High. Dry forest is a restricted type with high species diversity
<u>Alluvial Habitats</u>			
a) Zambezi river sandbanks	Natural.		
b) Zambezi river riparian woodland	Modification due to absence of natural flood patterns caused by damming of Zambezi river (Lake Kariba).	This type meets the criteria (i), (iii), (iv) listed for Critical Habitat	Very High Biodiversity Value Especially Mana Pools floodplain

Habitat Type	IFC Classification	Level of Modification	Biodiversity Value
Cultivation	Modified	High. Where the cultivation has been intense and long term, the level of modification is high, although some ecological processes still continue, albeit at a reduced rate: e.g. nutrient re-cycling. Invasive or Weedy species are common	Low. Wildlife species absent or in low numbers; habitats highly modified.
Urban	Highly modified	High. Many ecological processes have been compromised, except in suburban gardens. Weedy species common.	Low although there may be more species than in cultivated areas due to the introduction of ornamental plants into gardens.

KEY FINDINGS – Terrestrial Ecology:

The area of direct influence around Kariba and Siavonga towns is already highly disturbed through urbanisation. The impact of the project to the local ecology is therefore not as significant as to the Kariba Gorge itself which is an undisturbed and largely natural habitat and the location of several red listed plant species.

Downstream, the area of indirect influence has two contrasting land use types and therefore different levels of habitat modification. On the Zambian bank from Nyamuomba to Chiawa, the area is disturbed through cultivation but further downstream in the Lower Zambezi National Park, the habitats are natural. The same applies to the Zimbabwe bank which has vast expanses of undisturbed natural habitats. The Zambezi River riparian habitat including the riparian woodlands within the Gorge, the sandbanks and floodplains are critical habitats for several bird species, as well a refuge for large populations of hippopotamus and crocodile.

4.2.5

Aquatic Ecology

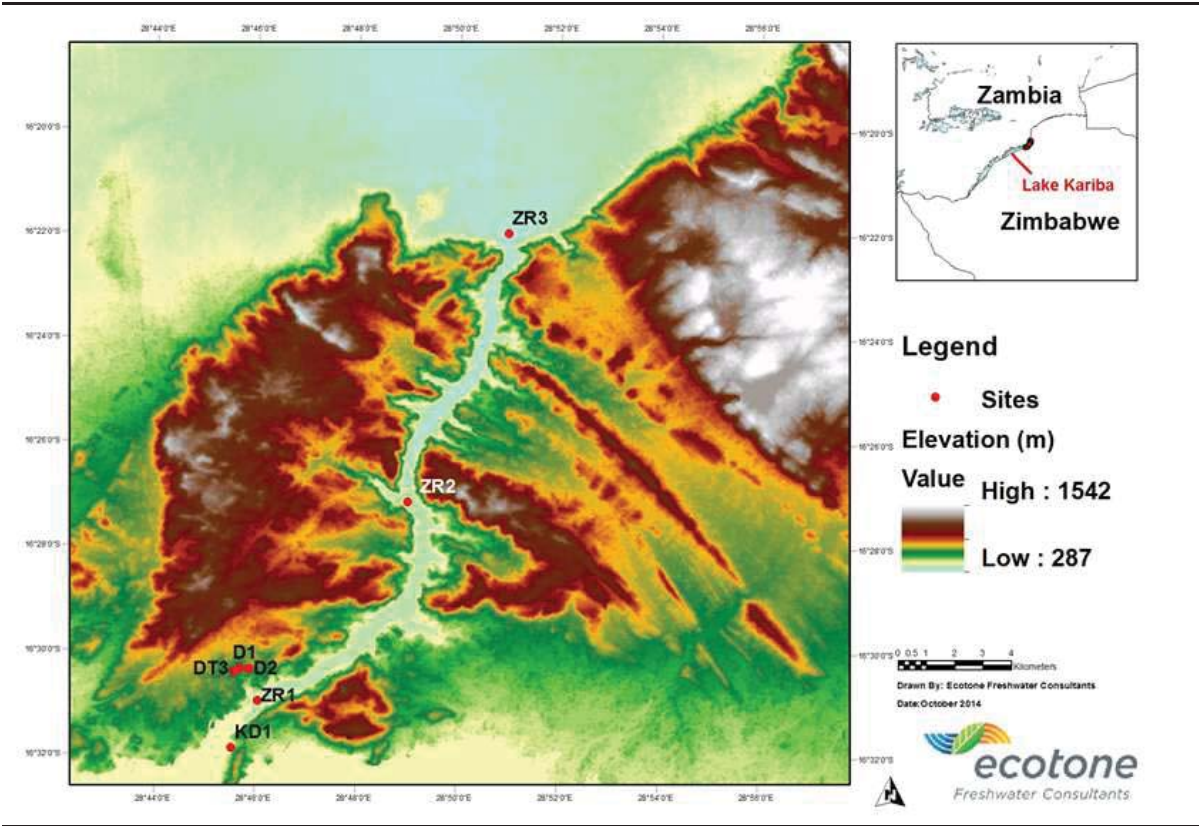
Sampling Sites

Three sites were sampled on the Zambezi River representing a 22 km stretch of river in a continuous habitat unit from downstream of the Kariba Dam wall, to the mouth of the Kariba Gorge (*Figure 4.16*). Site ZR1 is represented by the reach located directly downstream of the Dam wall. Site ZR2 is located a further 10 km from ZR1, within the Gorge, while Site ZR3 is located furthest downstream, approximately 23 km downstream of the dam wall at the end of the Kariba Gorge. Together, the three sites represent the entire available habitat within the downslope area. This stretch of River also forms a hydrological unit, as the volume contribution of tributaries in this reach is not significant. The system at site ZR3, has undergone a large slope adjustment with a large sand bank present mid-channel. Large floodplains are present on both banks; however, due to the flow regulation caused by power generation and the channel degradation experienced in the associated reach, the floodplains are no longer flooded with the same frequency.

During the reshaping of the plunge pool area, rocks, sediment and blasted material will be transported by trucks to the deposit area. The preferred alternative, the disused Sinhydro quarry, represented by site D1 is located in an existing quarry with an alternative waste rock dump site (D2) situated approximately 100 m to the east on a drainage line. An additional site (DT3) was selected for monitoring purposes on an ephemeral stream located approximately 200 m west of the disused quarry. This stream was dry during the September 2014 survey.

Site KD1 is located at an existing slipway on Kariba Dam, to the south of the Kariba Dam wall. The slipway will need to be upgraded and dredged in order for the proposed floating coffer dam to be able to enter the bay and then be transported to the dam wall via a tug boat.

Figure 4.16 Aquatic Baseline Sample Sites



Source: Ecotone, 2014

Water Quality

In situ Results

In situ water quality for sites located on the Zambezi River (ZR1-3) showed slightly alkaline conditions, with low electrical conductivity (ECs) (Table 4.8). Site KD1, on the Kariba Dam reservoir representing the proposed spillway area showed a more alkaline condition and marginally higher salt load than sites ZR1-3 on the Zambezi River, downstream of the spillway. This most likely relates to the lentic and lotic differences between the sites assessed. Site D1, representing the preferred waste rock dump site, the disused Sinohydro quarry site, reflected hyper alkaline and saline conditions. The water in the existing quarry is contaminated, probably through geological exposure and leachate. The pending chemical results will highlight constituents of concern and identify potential toxicity risk factors associated with this water.

Table 4.8 *In situ Water Quality Values Measured during the September 2014 Survey*

Variable	Abb.	Unit	ZR1	ZR2	ZR3	KD1	D1
pH	-	[H ¹⁺ ions]	7.8	7.8	7.6	8.3	9.3
Electrical Conductivity	EC	μS-cm ⁻¹	87.0	87.6	86.9	91.6	6.5*
Total Dissolved Solids	TDS	ppm	62.1	62.8	63.2	65.7	4.6#
Temperature	Temp	°C	23.5	24.9	24	25.1	25.8
* = mS-cm ⁻¹ ; # = ppt							
	Ideal (Kotze, 2002)						
	Tolerable (Kotze, 2002)						
	Intolerable (Kotze, 2002)						

Source: Ecotone, 2014

Please Note: tolerability describes the threshold for sustaining ecological integrity. A loss in ecosystem functioning will occur or can be expected if this threshold is exceeded.

Historical Water Quality

Data analyses for historical water quality (2009-2013) provided by the ZRA for a monitoring point immediately downstream of the Kariba Dam wall indicated circum-neutral pH values (Figure 4.17A). Although the median values fell within ideal threshold values for aquatic ecosystems, some minimum values for 2009 and 2013 fell below the acidic threshold for aquatic ecosystems.

Median EC ranged between 64.5 and 105.0 μS/cm and reflected a categorical annual decrease during the monitoring period. The EC range monitored was roughly comparable to epilimnetic values which range between 75 and 104 μS/cm (Machena et al., 1993). The temporal range in electrical conductivities fell well within boundary conditions for freshwater aquatic ecosystems. The threshold values indicated in Figure 4.17B reflect the minimum and maximum values of the 85th percentiles calculated for each year, and serves as a general guide for future salt load management of the system.

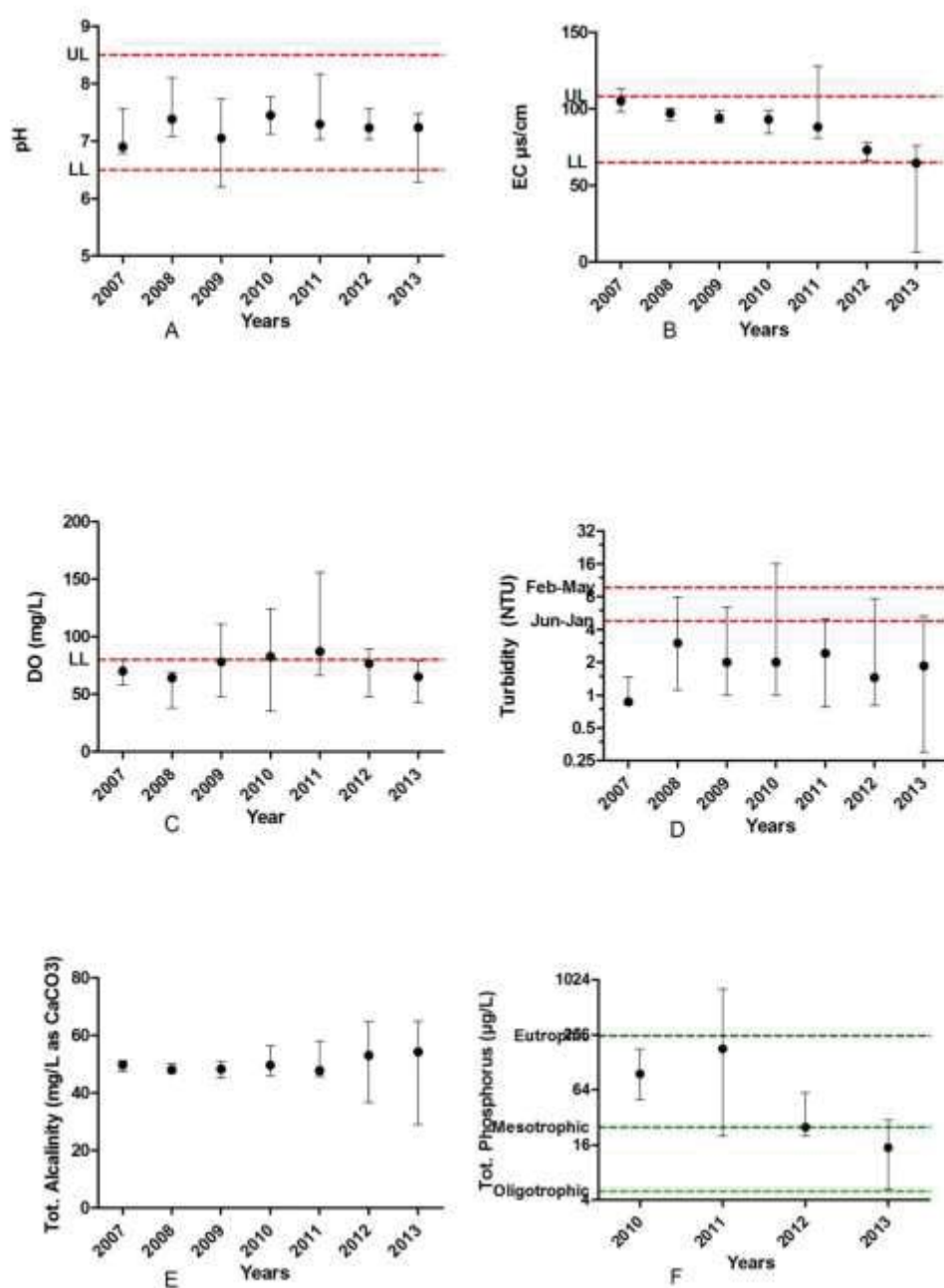
Previous studies indicated saturated and nearly saturated conditions for the epilimnion of Kariba Dam with dissolved oxygen (DO) values ranging between 7.6 and 7.8 mg/L (Begg, 1967; Machena *et al.*, 1993; Masundire, 1998 WCD, 2000). The saturation gradient correlates with a depth gradient, with shallower areas reflecting higher DO saturation. Levels measured during the 2007-2013 monitoring period, generally fell below this recorded value (*Figure 4.17C*). Median values oscillated around the recommended 80% saturation threshold for aquatic ecosystems. Prolonged exposure to levels below 80% has been associated with ecological degradation.

Turbidity levels indicated some seasonal variation which probably relates to the annual thermal mix of nutrient rich hypolimnic water. In general Kariba Dam water reflects low turbidity values due to relatively low nutrient and silt loads and thermal stratification. Thresholds turbidity values are expressed for different periods of the year (February to May, and June to January) and represent a historical median plus 10% for the two periods respectively (*Figure 4.17D*).

Median values for total alkalinity indicates a relatively large amount of temporal variation during the 2007-2013 monitoring period, although the variance has increased systematically since 2010 (*Figure 4.17E*). Other limnological assessments of the reservoir reported total alkalinity values ranging between 41 and 43mg/L (Begg, 1976; WCD, 2000).

A decrease in annual median nutrient levels, as indicated by total Phosphorus, has been measured for the 2010-2013 monitoring period (*Figure 4.17F*). The nutrient classification for water associated with the monitoring point, generally fell within the oligotrophic to mesotrophic range. This observation remains consistent with other studies which indicate total Phosphorus ranges between 0 and 72 µg/L (Begg, 1976; WCD, 2000); although, recent studies have reported increases in mean Phosphorus and Nitrogen levels. Increased nutrient levels have also been attributed to fish cage culture practices and boat usage (Mhlana, 1994).

Figure 4.17 (A) Median Error Graph for pH; (B) EC; (C) Dissolved Oxygen; (D) Turbidity; (E) Total Alkalinity and (F) Total Phosphorus (measured during the period 2007 and 2013, with dashed lines indicating threshold values for water quality constituents)



Source: Ecotone, 2014

KEY FINDINGS – Water Quality:

Water quality fell within threshold values for sustaining aquatic ecosystems. Results from the September 2014 field assessment were consistent with the water quality data provided by the Zambezi River Authority. Water from this reach was characterised by circumneutral pH values and relatively low electrical conductivities. Conversely, water sampled within the proposed rock disposal area (D1) reflected a high alkalinity and salt loads with trace elements potentially posing an ecotoxicological threat. These include Aluminium, Arsenic, Copper, Fluoride, Mercury and Selenium. Due to the possible ecotoxicological threat, any water removed from the quarry should be considered as contaminated and should not be released into the surrounding watercourses.

The analysis of sediment taken at Site KD1 indicated elevated levels of Aluminium, Calcium, Magnesium, Manganese, Sodium and Diesel Range Hydro-carbons. These levels could pose an environmental risk; however, these elements are ubiquitous and may also be attributed to weathering processes.

Habitat Assessment

Habitat Integrity

The instream habitat integrity (IHI) assessment (Kleynhans, 1996) was applied in order to ascertain the change of instream and riparian habitat from natural conditions on a site basis. The IHI assessment provides a tool for assessing habitat by incorporating various factors and potential impacts (Kleynhans, 1996). The habitat integrity assessment revealed that the sites assessed along the Zambezi River reflected a Moderate to Largely modified state (IHI 50 - 69 %), with site ZR1 indicating the largest modification to habitat integrity (*Table 4.9*). The main contributing factors responsible for the decline in both instream and riparian habitat integrity are the flow, bed and channel modification experienced as a result of the construction of Kariba Dam and the associated power generation (*Table 4.10* and *Table 4.11*).

The sites associated with the waste rock dump site were less impacted and classed in C categories, inferring a Moderately modified state, where a loss and change of natural habitat have occurred but the basic ecosystem functions are still predominantly unchanged (*Table 4.9*). Overall IHI scores ranged from 73 – 78 % for these sites (*Table 4.12* and *Table 4.13*).

Table 4.9 *Results for the Index of Habitat Integrity for Study Sites (September 2014)*

Habitat Type	ZR1	ZR2	ZR3	D2	DT3
Instream habitat integrity %	43	64	51	78	72
Instream habitat integrity Class	D	C	D	C	C
Riparian habitat integrity %	59	74	62	78	76
Riparian habitat integrity Class	D	C	C	C	C
Over all IHI %	50.8	69.0	56.8	78.1	73.8
Over all IHI category	D	C	D	C	C
C	A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged				
D	Large loss of natural habitat, biota and basic ecosystem functions has occurred				

Source: Ecotone, 2014

Table 4.10 *Instream Habitat Integrity – Impact Category and Contributing Factors Responsible for the Loss in Instream Habitat Integrity for Sites Located on the Zambezi River*

Criterion	Impact Category			Contributing Factors
	ZR1	ZR2	ZR3	
<i>Water Abstraction</i>	None	None	None	Minimal water abstraction was taking place at Site ZR1.
<i>Extent of Inundation</i>	Moderate	Moderate	Large	The instream habitat is impacted due to the daily fluctuation in extents of inundation associated with the power generation. Site ZR3 experiences a greater impact due to the nature of the reach and the general slope adjustment that has taken place in the associated reach.
<i>Water Quality</i>	None	None	None	The reach indicated circumneutral pH values with low EC.
<i>Flow Modification</i>	Critical	Critical	Critical	The construction of the Kariba Dam has resulted in severe flow modification, altering the natural flow regime of the system.
<i>Bed Modification</i>	Large	Small	Moderate	The highest degree of impact was noted at site ZR1, located directly downstream of the Kariba Dam. Releases from the spillway have resulted in severe scouring of the plunge pool ($\pm$ 80m).
<i>Channel Modification</i>	Serious	Small	Large	The construction of the dam wall and the subsequent alteration in flow has altered the channel characteristics resulting in a change in instream habitat, particularly at site ZR1. Site ZR3, located approximately 23km downstream, has experienced a loss in normal channel forming processes.
<i>Presence of Exotic Macrophytes</i>	None	None	None	None noted at the time of survey.
<i>Presence Of Exotic Fauna</i>	Large	Large	Large	Due to the confirmed presence of <i>Oreochromis niloticus</i> .
<i>Presence Of Solid Waste</i>	None	Small	None	Some litter was observed on the banks at site ZR2, associated with the local fisherman.

Source: Ecotone, 2014

Table 4.11 *Riparian Habitat Integrity – Impact Category and Contributing Factors Responsible for the Loss in Riparian Habitat Integrity for Sites Located on the Zambezi River*

Criterion	Impact Category			Contributing Factors
	ZR1	ZR2	ZR3	
<i>Water Abstraction</i>	None	None	None	
<i>Extent of Inundation</i>	Serious	Serious	Serious	The extent of inundation of the riparian zone in this reach is seriously impacted, especially at site ZR3. The construction of Kariba dam has resulted in the loss of seasonality with a reduction in high flows and flood events causing the associated flood benches and flood plains to become inundation less frequent. This may lead to the terrestrialization of the riparian zone due of a lack of prolonged flooding and fluvial deposition.
<i>Water Quality</i>	Large	None	None	Construction activities associated with the construction of the new powerhouses.
<i>Flow Modification</i>	Large	Large	Serious	The extent of the floodplain has been altered when compared to historical conditions, particularly at site ZR3, resulting in terrestrial encroachment (as mentioned above). Vegetation removal, infill and the deposition of rocks has taken place on both banks downstream of the dam wall (ZR1) due to construction related activities associated with the new powerhouses.
<i>Channel Modification</i>	Serious	Large	Serious	Infill and the deposition of rocks have taken place on both banks at site ZR1 (as mentioned above). Further downstream, at site ZR3, the channel has become more incised and widening of the channel as occurred.
<i>Decrease in Indigenous Vegetation</i>	Moderate	None	None	Construction activities and the dumping of rocks on the embankments has resulted in the loss and clearing of vegetation within the riparian zone.
<i>Exotic Vegetation Encroachment</i>	Small	Small	Small	Limited.
<i>Bank Erosion</i>	Small	Small	Large	Limited bank erosion was noted in the upper reach of the study area, however, severe bank erosion and instability was noted at site ZR3.

Source: Ecotone, 2014

Table 4.12 *Instream Habitat Integrity – Impact Category and Contributing Factors Responsible for the Loss in Instream Habitat Integrity at Sites D2 and DT3*

Criterion	D2		DT3	
	Impact Category	Contributing Factors	Impact Category	Contributing Factors
<i>Water Abstraction</i>	None		None	
<i>Extent of Inundation</i>	None		None	
<i>Water Quality</i>	None		None	
<i>Flow Modification</i>	Moderate	Clearing and infilling activities have taken place in the upper reach.	Large	Instream flow is impacted by a gravel road crossing with flumes that are half filled with sediment. In addition, remains of an old road crossing are present within the channel.
<i>Bed Modification</i>	Moderate	As above	Large	As above
<i>Channel Modification</i>	Moderate	As above	Moderate	Impacts associated with the road crossing and downstream bank scouring.
<i>Presence of Exotic Macrophytes</i>	None		None	
<i>Presence Of Exotic Fauna</i>	None		None	
<i>Presence Of Solid Waste</i>	Small	Limited.	Large	Building rubble present instream with some litter noted.

Source: Ecotone, 2014

Table 4.13 *Riparian Habitat Integrity – Impact Category and Contributing Factors Responsible for the Loss in Riparian Habitat Integrity at D2 and DT3*

Criterion	D2		DT3	
	Impact Category	Contributing Factors	Impact Category	Contributing Factors
<i>Water Abstraction</i>	None		None	
<i>Extent of Inundation</i>	None		None	
<i>Water Quality</i>	Small	Cattle faeces present to a small extent.	None	
<i>Flow Modification</i>	Moderate	Clearing, infilling activities and the dumping of rocks have taken place in the upper reach of the site.	Moderate	Roads and the removal of vegetation have resulted in moderate flow alteration.
<i>Channel Modification</i>	Moderate	As above.	Moderate	As above.
<i>Decrease in Indigenous Vegetation</i>	Large	Clearing and infilling activities and trampling by cattle.	Large	Construction of the road crossing and clearing of riparian vegetation on left associated with the small informal road running parallel to the system.
<i>Exotic Vegetation Encroachment</i>	Small	Present to a limited extent.	Small	Present to a limited extent. (<i>Sesbania sp.</i>)
<i>Bank Erosion</i>	Small	Mild erosion was noted in the upper reach.	Large	Extension erosion (scouring) was noted on both banks.

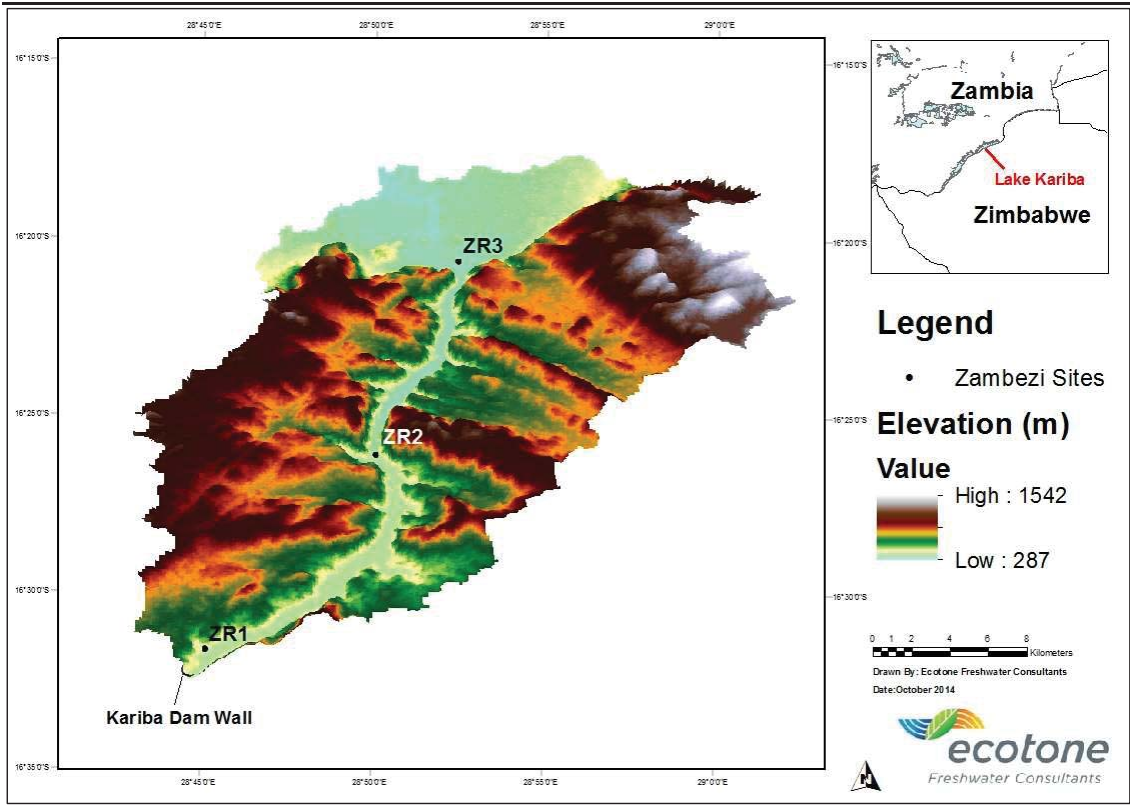
Source: Ecotone, 2014

Catchment Transformation

In addition to *in situ* habitat integrity assessment, the general river reach was also assessed in relation to its catchment and the degree of catchment transformation. The intensity of impacts associated with catchment unitisation is generally well expressed in receiving drainage systems. The DEM results indicated topographic highs directly downstream of the Kariba Dam on both sides of the Zambezi River for approximately 20km, after which the Zambezi River widens out into a low-lying floodplain to the north (Figure 4.18). The EVI results display relatively high vegetation indices, and subsequent high vegetation growth, on the right bank (Zimbabwean side), and moderate to low vegetation indices on the left bank (Zambian side) correlating to areas of little or no vegetation growth (Figure 4.19). Overall, the highest vegetation indices were observed to be associated with the riparian areas of small tributaries entering the Zambezi River, while very little riparian vegetation was notable along the Zambezi River itself, increasing only once the river passes into the downstream floodplain. The lowest overall vegetation indices were notably located on the steep south facing slopes found on both the left and the right banks of the Zambezi River. However, when comparing the EVI results to the topography, the low productivity on the left bank could not be attributed to the raised elevation alone, as the Zimbabwean side displays greater topographic highs than Zambian side (Figure 4.18), with overall higher vegetation indices (Figure 4.19).

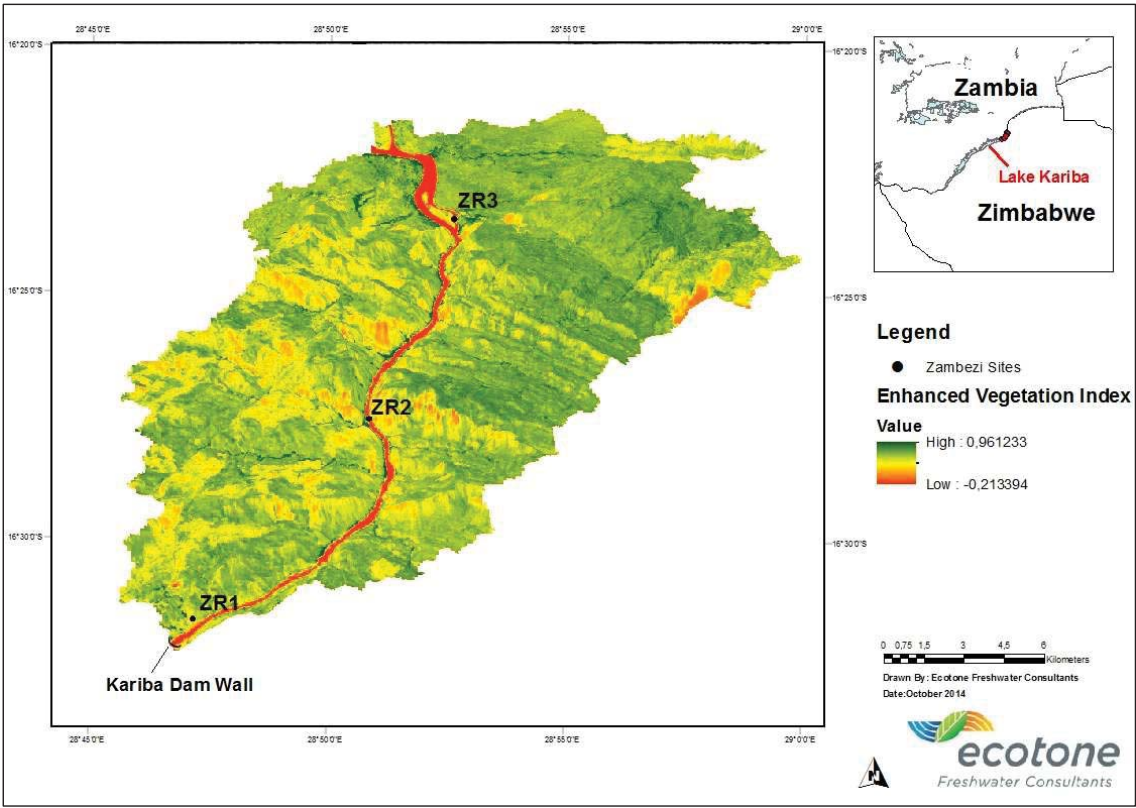
This difference in catchment transformation found on the left bank when compared to the right bank of the Zambezi River, reflects the different historic and current landuses implemented by the two countries bordering either side of the River. The landuse on the Zimbabwean side of the Zambezi River constitutes national parks and nature reserves along most of the length of the middle Zambezi. While on the Zambian side, up to the downstream confluence of the Chongwe River, landuse is dominated mostly by subsistence farming, rural developments and pastoral activities. This elevated landuse puts pressure on the left bank and results in increased surface denudation and subsequent soil erosion and runoff. It could be concluded that any large volumes of sediment input into the Zambezi River downstream of the dam wall would originate predominantly from the catchment region associated with the left bank. Although generally more sparsely vegetated, most of the southward facing slopes in Figure 4.19 indicated higher vegetation indices on the Zimbabwean side than on the Zambian side, suggesting a higher overall catchment transformation on the left Zambian bank.

Figure 4.18 ASTER Based 3D DEM of the Study Site (NASA Landsat Program, 2014)



Source: Ecotone, 2014

Figure 4.19 Enhanced Vegetation Index of the Downstream Reaches of the Kariba Dam (USGS Landsat 8 scene LC81710712014231LGN00, 2014)



Source: Ecotone, 2014

Macroinvertebrate Habitat Availability

Sites assessed showed an Adequate to Poor macroinvertebrate habitat availability in the September 2014 survey (*Table 4.14*). Site ZR1 reflected the lowest habitat availability for macroinvertebrate colonization, lacking both aquatic and marginal vegetation and riffle/rapids section. Marginal and aquatic vegetation was more readily available in the lower reaches. Site ZR2 obtained the highest habitat availability score and was classed as Adequate.

Table 4.14 *Invertebrate Habitat Assessment System Version 2 (IHAS v.2) Scores for Sites assessed during September 2014*

	ZR1	ZR2	ZR3
Stones in Current	15	19	14
Vegetation	0	16	17
Other Habitat	11	17	15
Total IHAS (%)	35.1	70.3	62.2
Class	Poor	Adequate	Poor

Fish Habitat

In general, available fish habitat was dominated by fast-deep and slow-deep flowing water, with substrate and water column being the most dominant cover unit at all sites assessed (*Table 4.15*). Site ZR2 and 3 also showed some overhanging vegetation and aquatic macrophytes present as cover units. The daily and weekly fluctuation in water level does expose shallower riffle rapid section, but these remain largely uncolonised. The rapid fluctuation in water level prohibits invertebrate colonisation and excludes these areas as feeding grounds for fish.

Table 4.15 *Fish Habitat and Cover Ratings Noted for Sites on the Zambezi River Downstream of Kariba Dam*

Habitat and velocity type	ZR1	ZR2	ZR3
Dominant Habitat Type:			
Overhanging vegetation	0.00	9.68	11.11
Undercut banks and root wads	0.00	0.00	11.11
Substrate	50.00	32.26	30.56
Aquatic macrophytes	0.00	25.81	13.89
Water column	50.00	32.26	33.33
Velocity Depth Class %:			
Slow-Deep	62.50	25.81	25.00
Slow-Shallow	0.00	12.90	19.44
Fast-Deep	37.50	41.94	36.11
Fast-Shallow	0.00	19.35	19.44
	Dominant type		

KEY FINDINGS – Aquatic Habitats:

Sites on non-perennial systems (Sites D1, 2 and DT3) fell in C ecological categories and reflected Moderately modified conditions. Roads and stream crossings causing secondary impacts related to bed modification were the biggest reasons for the loss in habitat integrity on these non-perennial systems. Sites located on the main stem Zambezi River (ZR1-3) fell into D, C and D categories respectively, and were affected by flow, channel and bed modification induced by the Kariba Dam and the Power station operations.

Diatoms

Sites on the Kariba Dam (KD1) and the Zambezi River downstream of the Dam (KR1 - KR3) were in a Good and Moderate ecological water quality state according to the diatom community (Table 4.16). The community at sites reflected the following general conditions for the ecological water quality associated with the Dam and River (Table 4.17):

- Alkaliphilious - a diatom community dominated by species with pH preference of >7.
- Fresh-brackish - a community with a preference for Electrical Conductivity of < 500 µs/cm.
- Nitrogen autotrophic sensitive/tolerant - tolerating small to moderate concentrations of organically bound Nitrogen.
- Fairly high oxygen requirements- community requiring >75% Dissolved Oxygen saturation.
- β- Mesoprobous - slightly to moderately polluted conditions.
- Meso-eutrophic - moderate inputs of inorganic nutrients and organic matter.

Forty two diatom species belonging to 15 genera were recorded at sites in the low flow study (Table 4.18). The diatom community from the Kariba Dam (KD1) showed some typically lentic species associated with dam and lake environments and spray zones (*Aulacoseira* sp and *Nitzschia supralitorea*). The ecological water quality was Good (Table 4.16), showing a dominance of species with a preference for oxygenated, Alkaline waters (*Achnantheidium affine* and *Encyonopsis subminuta*). Dominant species were also indicative of pulses in electrolyte loads, and show a preference for calcium, sulphate and carbonates (*A. affine* and *Nitzschia valdecostata*). Organic inputs at the Dam wall are noted in the %PTV score (22.8%).

The proposed slipway site immediately below the Dam (ZR1) was similar in composition to KD1, however the ecological water quality dropped a class to Moderate. The dominance of *Navicula zanonii* and the diversity of the motile general *Nitzschia* and *Navicula* were the cause for the decline in water quality noted below the Dam wall. These motile species can more easily tolerate disturbance and escape the residual effects of continual disturbance, such as sediment and siltation. Site ZR1 also showed a possible impact related to organic pollutants.

Sites ZR2 and 3 on the Zambezi showed a recovery, with a community indicative of Good water quality. Some impact related to nutrients and eutrophication was noted by the dominance of *Gomphonema minutum* and *Fragilaria* spp. as agriculture increases in the downstream section of the river. The dominant presence of the pioneer species *Achnantheidium minutissima* at site KR3 may be indicative of a disturbance in flow in this reach.

Table 4.16 *Diatom Index Scores for Sites on the Kariba Dam (KD1) and the Zambezi River (KR1-KR3)*

Site	No. Species	%PTV	SPI	BDI	Category
KD1	23	22.8	14.1	17.3	Good
ZR1	22	19.5	12.1	13.9	Moderate
ZR2	15	1	16	15.2	Good
ZR3	19	3.8	15.7	16.1	Good

Table 4.17 *Ecological Descriptors for the Diatom Community at Sites on the Kariba Dam (KD1) and the Zambezi River (KR1-KR3) (Van Dam et al., 2002)*

	KD1	ZR1	ZR2	ZR3
pH	Alkaliphilious	Alkaliphilious	Alkaliphilious	Neutral
Salinity	Fresh-Brackish	Fresh-Brackish	Fresh-Brackish	Fresh-Brackish
Nitrogen uptake	Nitrogen Autotrophic Sensitive	Nitrogen Autotrophic Sensitive	Nitrogen Autotrophic Tolerant	Nitrogen Autotrophic Tolerant
Oxygen	Fairly High	Fairly High	Continuously High	Fairly High
Saprobity	β-Mesoprobous	β-Mesoprobous	β-Mesoprobous	β-Mesoprobous
Trophic State	Meso-eutrophic	Meso-eutrophic	Meso-eutrophic	Meso-eutrophic

Table 4.18 *Diatom Species Identified for Each Study Site, September 2014*

Species	KD	ZR1	ZR2	ZR3	Ecological preferences (Taylor <i>et al.</i> , 2007; Koekemoer & Taylor, 2012)
<i>Achnanthyidium minutissima</i> var. <i>minutissima</i>	18	8	8	65	A pioneer species found in well oxygenated, fresh waters.
<i>Achnanthyidium affine</i> (Grun) Czarnecki	123	90	43	23	Clean, well oxygenated, oligotrophic, alkaline, calcareous, fresh waters with moderate electrolyte content.
<i>Aulacoseira</i> G.H.K. Thwaites	20	15	0	0	This genera is usually associated with eutrophic lakes and may be benthic or planktonic.
<i>Cocconeis pediculus</i> Ehrenberg	0	0	2	0	
<i>Cocconeis placentula</i> var. <i>lineata</i> Van Heurck	0	0	6	15	
<i>Cymbella kolbei</i> var. <i>kolbei</i>	1	3	0	0	
<i>Cymbella turgidula</i> var. <i>turgidula</i> Grunow 1875	0	4	0	0	
<i>Diploneis elliptica</i> (Kützing) Cleve	1	0	0	0	
<i>Discostella stelligera</i> (Cleve et Grun.) Houk &	19	21	0	0	
<i>Eunotia minor</i> (Kützing) Grunow in Van Heurck	0	0	14	4	
<i>Eolimna minima</i> (Grunow) Lange-Bertalot	0	1	0	1	
<i>Eolimna subminuscule</i> Lange-Bertalot &	2	0	0	0	
<i>Encyonopsis subminuta</i> Krammer & Reichardt	41	0	0	0	Requires oxygen rich environments.
<i>Fragilaria biceps</i> (Kützing) Lange-Bertalot	0	0	45	0	Mesotrophic to eutrophic waters usually found together with with <i>Fragilaria ulna</i> .
<i>Fragilaria capucina</i> Desmazieres var. <i>capucina</i>	11	0	15	36	Circumneutral, oligo- to mesotrophic waters with moderate electrolyte content.
<i>Fragilaria capucina</i> var. <i>vaucheriae</i> Lange-Bertalot	0	7	0	0	
<i>Fragilaria tenera</i> (W.Smith) Lange-Bertalot	12	20	0	0	
<i>Fragilaria ulna</i> var. <i>acus</i> (Kütz.) Lange-Bertalot	8	10	102	0	Found in mesotrophic to eutrophic, alkaline freshwaters.
<i>Gomphonema augur</i> Ehrenberg	0	0	0	2	
<i>Gomphonema clavatum</i> Ehr.	5	5	33	10	A montane species found in oligotrophic waters but able to tolerate a high electrolyte
<i>Gomphonema minutum</i> (Ag.) Agardh f. <i>minutum</i>	10	4	123	214	Eutrophic waters but not tolerant to more than moderate levels of pollution.
<i>Navicula cryptotenella</i> Lange-Bertalot	1	0	0	0	
<i>Navicula heimansioides</i> Lange-Bertalot	9	0	0	0	
<i>Navicula microcari</i> Lange-Bertalot	0	0	0	4	
<i>Navicula tridentula</i> Krasske	8	0	0	0	
<i>Navicula zanoni</i> Hustedt	19	109	3	3	Normally associated with alkaline waters.
<i>Nitzschia acicularis</i> (Kützing) W.M.Smith	0	2	0	0	
<i>Nitzschia agnewii</i> Cholnoky	0	0	0	1	
<i>Nitzschia dissipata</i> (Kützing) Grunow	0	1	2	0	
<i>Nitzschia filiformis</i> (W.M.Smith) Van Heurck	0	1	0	0	

Species	KD	ZR1	ZR2	ZR3	Ecological preferences (Taylor <i>et al.</i> , 2007; Koekemoer & Taylor, 2012)
<i>Nitzschia gracilis</i> Hantzsch	0	0	0	1	
<i>Nitzschia inconspicua</i> Grunow	0	0	1	0	
<i>Nitzschia intermedia</i> Hantzsch ex Cleve &	0	0	2	1	
<i>Nitzschia lancettula</i> O.Muller	7	19	0	8	
<i>Nitzschia subacicularis</i> Hustedt in A.Schmidt <i>et</i>	16	0	0	4	
<i>Nitzschia supralitorea</i> Lange-Bertalot	33	27	1	3	Found in eutrophic waters with moderate to moderately high electrolyte content,
<i>Nitzschia tropica</i> Hustedt	0	0	0	3	
<i>Nitzschia valdecostata</i> Lange-Bertalot <i>et</i>	33	45	0	2	Found in electrolyte rich waters, favouring waters with high concentrations of sulphates
<i>Rhopalodia gibba</i> (Ehr.) O.Muller var. <i>gibba</i>	3	5	0	0	
<i>Rhopalodia operculata</i> (Agardh) Hakansson	0	2	0	0	
<i>Sellaphora seminulum</i> (Grunow) D.G. Mann	0	4	0	0	
<i>Sellaphora pseudopupula</i> (Krasske) Lange-	4	0	0	0	
		Dominant species			

KEY FINDINGS - Diatoms:

Sites on the Kariba Dam and the Zambezi River downstream of the Dam were in a Good and Moderate ecological state according to the diatom community. The community at sites reflected slightly alkaline, fresh-brackish, oxygenated waters with Moderate pollution. Site (ZR1), downstream of the Dam wall, showed species with a preference for Sulphate, Calcium and Carbonates, where sites further downstream showed an increase in nutrient tolerant diatoms.

Macroinvertebrates

The macroinvertebrate communities in the study area had a low to moderate diversity comprising of mostly tolerant taxa (*Table 4.19*). A total of 23 families were identified in the reach sampled. Of these families only the Heptageniidae and the Baetidae are considered sensitive to water quality. Many expected flow and water quality sensitive taxa were conspicuously missing from the present assemblage, such as various Trichopterans (Caddisflies), Psephenidae (Water Pennies), Perlidae (Stone Flies), Polymitarcyidae (Pale Burrowers) and Tricorythidae (Stout Crawlers). This trend is consistent with various other studies undertaken downstream of highly regulated systems (Bunn & Arthington, 2002; Jalon *et al.*, 1994; Boon, 1993).

The macroinvertebrate assemblage is considered largely modified according to the MIRAI, with reasons for the impact score for the various metric groups given in *Table 4.20*. There was a large loss of families with requirement for various flow conditions, due to the increased baseflow and the loss of seasonality downstream of the Kariba Dam. The change in flow has caused a subsequent change in the level of certain, preferable velocity-depth-habitat biotopes for the macroinvertebrate inhabitation. Sites have lost riffle-run-rapid sequences due to the consistent inundation of these habitat sub-units in the gorge reach, and have thus lost species that have a preference for moderate/fast-shallow waters over substrate. Although all metric show a change from reference, the major driver of change in the system is hydrology, which has a secondary impact on habitat, connectivity and water quality.

Table 4.19 *Aquatic Macroinvertebrates Sampled during the September 2014 Survey with Relevant Abundance and Sensitivity Scores according to Dickens & Graham (2001)*

Taxon	Sensitivity Score	ZR1	ZR2	ZR3
Oligochaeta	1	A	A	A
Potamonautidae*	3		A	
Atyidae	8		A	B
Baetidae 2 sp.	6		B	
Baetidae > 2 sp.	12			B
Caenidae	6		A	
Heptageniidae	13		A	
Leptophlebiidae	9		A	
Coenagrionidae	4		A	B
Corixidae*	3		B	
Gerridae*	5		B	

Taxon	Sensitivity Score	ZR1	ZR2	ZR3
Veliidae*	5		B	
Hydropsychidae 1 sp.	3	C		
Hydropsychidae 2 sp.	6		A	
Hydroptilidae	6			A
Gyrinidae*	5		B	A
Chironomidae	2	A	B	A
Simuliidae	5			A
Lymnaeidae*	3	A	1	B
Physidae*	3		A	
Planorbinae*	3		A	B
Thiaridae	3	A	B	B
Corbiculidae	5	A	B	B
Score		18	93	51
No. of Taxa		6	19	12
ASPT		3.00	4.89	4.25
	Sensitive taxa			
	Moderately tolerant to pollution			
*	Air breathing			
1	1 individual			
A	2-10 individuals			
B	11-100 individuals			
C	101-1000 individuals			

Table 4.20 *Aquatic Macroinvertebrates Integrity as Ascertained by the MIRAI Index for the Habitat Unit/Reach on the Zambezi River Downstream of Kariba Dam Wall*

Invertebrate Metric Group	Calculated Score (%)	Rank	%Weight	Reason for MIRAI output
Flow Modification	46.1	1	100	Absence of Gomphidae, Leptoceridae, Libellulidae
Habitat	47.5	2	80	Absence of Trichopterans, Polymitarcyidae and Tricorythidae
Water Quality	59.4	3	50	Absence of Psephenidae, Perlidae
Connectivity & Seasonality	40.0	4	40	Paleomonidae and Unionida absent from reach
Invertebrate EC			48.1%	
Invertebrate EC Category			D	

KEY FINDINGS - Macroinvertebrates:

The macroinvertebrate assemblage is considered Largely modified due to a knock-on effect from flow regulation from the dam on habitat, connectivity and water quality. A decrease in diversity and a large loss of macroinvertebrate families with requirements for various flow conditions were noted. Although all metrics show a change from reference conditions, the major driver of change in the system is hydrology, which has a subsequent impact on habitat, connectivity and water quality.

Fish Community - Expected and Sampled

Fish assessments, prior to the construction of Kariba Dam yielded 28 fish species, whilst later assessments within and upstream of the Dam yielded 42 species (WCD, 2000). It is likely that the low initial species count may be attributed to under sampling. More recent studies reports 45 species for the middle Zambezi River (Bills and Marshall, 2004), while the IUCN Bio Browser lists 48 possible species. The expected list provided in this report is a combination of the existing information and comprises of approximately 13 families, 28 genera and 51 indigenous species, while 22 species have been sampled in the present survey, representing 9 families and 15 genera (Table 4.21; Table 4.22).

The majority of expected species carry an IUCN conservation status of Least Concern (LC), while two potentially occurring species (*Oreochromis mortimeri* and *O. macrochir*) are Critically Endangered (CR) and Vulnerable (V), respectively. The conservation status of both species, *O. mortimeri* and *O. macrochir*, are attributed to the introduction of the exotic *Oreochromis niloticus*. *Oreochromis mortimeri* is more affected by *O. niloticus* due to hybridisation, while *O. macrochir* is affected by competition and displacement by *O. niloticus*. It should be noted that *O. macrochir* itself has been introduced to Kariba Dam and the middle Zambezi from the upper reaches. The presence of *O. mortimeri* remains to be confirmed following the September 2014 assessment, although the proposed activities are unlikely to aggravate the existing conservation status of this fish.

Chiloglanis neumanni have been sampled downstream of the Dam during the September 2014 assessment, albeit in low numbers and at a single location. This species is listed as Data Deficient (DD) by the IUCN.

The reference fish community for the middle Zambezi River differs from the upper and lower reaches, due to the historical evolution of the River, differences in the nature of the system and the presence of large natural migration boundaries, like Victoria Falls. The reference fish community generally consists of widespread and common species, although several are limited in distribution to the Zambezi and adjacent rivers (*Opsaridium zambezense*, *Synodontis zambezensis* and *Pharyngochromis acuticeps*) and the reach is dominated by Cichlids, Cyprinids, and Mormyrids. Several larger species like *Heterobranchus longifilis*, *Malapterurus shirensis*, *Distichodus mossambicus* and *D. schenga* are found in the Zambezi system only below Victoria Falls, whereas the creation of extensive new limnetic habitats has changed the composition of the fish populations (Timberlake, 1997; Davies, *et al.*, 1986). A post-Dam fish community reflects a dominance of Cichlids, Mochokids and Alestids. Rheophilic fishes such as *Amphilius uranoscopus*, *Zaireichthys rotundiceps*, *Opsaridium zambezense* and *Labeobarbus marequensis* have disappeared from the reach of River affected by Kariba Dam. While some, more tolerant rheophilic species such as *Chiloglanis neumanni* also reflect

a much lower occurrence under current conditions. The frequency of occurrence for fishes with specific migration requirements (most of the *Labeo*, *Barbus* and *Anguilla* species) have also been negatively affected. It is likely that the absence of the smaller *Barbus* species may be attributed to changes in the flow regime and the alteration of instream habitat.

Table 4.21 *Summary Table Showing the Number of Expected and Sampled Fish Families, Genera and Species for the Middle Zambezi*

	Expected	Sampled
Families	13	9
Genera	29	15
Species	53	22

Table 4.22 *Expected and Sampled Fish Showing IUCN Conservation Status*

Family	Genus Species	Common Name	IUCN	Site
Anguilliformes				
Anguillidae	<i>Anguilla bengalensis</i> <i>ssp. Labiata</i>	Indian Mottled Eel	NT	
Anguillidae	<i>Anguilla marmorata</i>	Marbled Eel	LC	
Anguillidae	<i>Anguilla</i> <i>mossambicus</i>	Longfin Eel	LC	
Characiformes				
Alestidae	<i>Brycinus lateralis</i>	Stripped Robber	LC	ZR3
Alestidae	<i>Bycinus imberi</i>	Imberi	LC	ZR1,2,3
Alestidae	<i>Hydrocynus vittatus</i>	Tigerfish	LC	ZR2,3
Alestidae	<i>Micralestes</i> <i>acutidens</i>	Sharptooth tetra	LC	ZR2,3
Distichodontidae	<i>Distichodus</i> <i>mossambicus</i>	Nkupe	LC	
Distichodontidae	<i>Distichodus schenga</i>	Chessa	LC	ZR1,2,3
Cypriniformes				
Cyprinidae	<i>Barbus annectance</i>	Broadstripe Barb	LC	
Cyprinidae	<i>Barbus afrovernayi</i>	Spottail Barb	LC	
Cyprinidae	<i>Barbus fasciolatus</i>	African banded barb	LC	
Cyprinidae	<i>Barbus paludinosus</i>	Straightfin barb	LC	
Cyprinidae	<i>Barbus poechii</i>	Dashtail barb	LC	
Cyprinidae	<i>Barbus radiatus</i>	Redeye Barb	LC	
Cyprinidae	<i>Barbus trimaculatus</i>	Threespot barb	LC	
Cyprinidae	<i>Barbus unitaeniatus</i>	Slender barb	LC	ZR3
Cyprinidae	<i>Cyprinus carpio</i>	Wild Common Carp	Exotic	
Cyprinidae	<i>Labeo altivelis</i>	Sailfin mudsucker	LC	
Cyprinidae	<i>Labeo congoro</i>	Purple Labeo	LC	ZR2
Cyprinidae	<i>Labeo cylindricus</i>	Redeyed labeo	LC	ZR1,2
Cyprinidae	<i>Labeo molybdinus</i>	Leaden Labeo	LC	
Cyprinidae	<i>Labeobarbus</i> <i>marequensis</i>	Lowveld Largescale	LC	

Family	Genus Species	Common Name	IUCN	Site
		Yellowfish		
Cyprinidae	<i>Opsaridium zambezense</i>	Dwarf Sanjika	LC	
Cyprinodontiformes				
Poeciliidae	<i>Aplocheilichthys johnstoni</i>	Johnston's Topminnow	LC	ZR2
Poeciliidae	<i>Gambusia affinis</i>	Western Mosquitofish	Exotic	
Lepidosireniformes				
Protopteridae	<i>Protopterus annectens</i>	African Lungfish	LC	
Protopteridae	<i>Protopterus annectens ssp. brieni</i>	African Lungfish	LC	
Osteoglossiformes				
Mormyridae	<i>Cyphomyrus discorhynchus</i>	Zambezi Parrotfish	LC	ZR1,2,3
Mormyridae	<i>Marcusenius altisambesi</i>	Bulldog	LC	
Mormyridae	<i>Marcusenius macrolepidotus</i>	Bulldog	LC	
Mormyridae	<i>Mormyrops anguilloides</i>	Cornish jack	LC	ZR2,3
Mormyridae	<i>Mormyrus longirostris</i>	Eastern Bottlenose	LC	
Perciformes				
Cichlidae	<i>Oreochromis macrochir</i>	Greenhead Tilapia	V	
Cichlidae	<i>Oreochromis mortimeri</i>	Kariba Tilapia	CR	
Cichlidae	<i>Oreochromis niloticus</i>	Nile Tilapia	Exotic	ZR3
Cichlidae	<i>Pharyngochromis acuticeps</i>	Zambezi River Bream	LC	ZR1,2,3
Cichlidae	<i>Pseudocrenilabrus philander ssp. Philander</i>	Southern Mouthbrooder	LC	ZR1
Cichlidae	<i>Sargochromis carlottae</i>	Rainbow Bream	LC	
Cichlidae	<i>Sargochromis codringtonii</i>	Green Bream	LC	
Cichlidae	<i>Sargochromis giardi</i>	Pink Bream	LC	
Cichlidae	<i>Serranochromis macrocephalus</i>	Purpleface largemouth	LC	
Cichlidae	<i>Serranochromis Robustus</i>	Yellow-belly Bream	LC	
Cichlidae	<i>Tilapia rendalli</i>	Northern Redbreast Tilapia	LC	ZR1,2,3
Cichlidae	<i>Tilapia sparrmanii</i>	Sparrman's Bream	LC	ZR2,3
Siluriformes				
Amphiliidae	<i>Zaireichthys rotundiceps</i>	Spotted Sand Catlet	LC	
Clariidae	<i>Clarias gariepinus</i>	Sharptooth Catfish	LC	
Clariidae	<i>Heterobranchius longifilis</i>	Vundu	LC	
Malapteruridae	<i>Malapterurus</i>	Electric Catfish	LC	ZR1

Family	Genus Species	Common Name	IUCN	Site
	<i>shirensis</i>			
Mochokidae	<i>Chiloglanis emarginatus</i>	Phongolo Suckermouth	LC	
Mochokidae	<i>Chiloglanis neumanni</i>	Neumann's suckermouth	DD	ZR2
Mochokidae	<i>Synodontis zambezensis</i>	Brown Squeaker	LC	ZR1,2,3
Mochokidae	<i>Synodontis nebulosus</i>	Cloudy Squeaker	LC	ZR1
Schilbeidae	<i>Schilbe intermedius</i>	Silver Butter Catfish	LC	ZR3
	Sampled			
	Exotic			
	Introduced			

Fish Community Assemblage Integrity

The community integrity assessment did not differentiate between the three different sites assessed, instead the stream was considered as a reach, and the occurrence of species at each site was used to infer the frequency of occurrence of each species in the river reach. Spatial variations were however noted between sites assessed and are discussed in a separate section below. The present fish community shows a Moderate to Largely altered state in comparison to reference fish assemblages, and fell into a C/D ecological category (Table 4.23). A comparison between the habitat preferences and environmental tolerances of the expected and the sampled community highlighted the following (Table 4.23; Figure 4.20 to Figure 4.24):

- Flow modification contributed the most towards digression from reference condition.
- Secondary factors (related to flow alteration) such as a loss in preferred velocity and depth classes also contributed notably towards the altered state of the present fish community.
- The reference fish community were dominated by species with a preference for slow-deep flowing water associated with overhanging vegetation and substrate. Less than half of the expected fish with the above mentioned preferences have been sampled during the September 2014 assessment (Figure 4.20; Figure 4.21).
- The sampled fish community is proportionally more represented by fish with a tolerance to no-flow conditions, compared to the reference assemblage, which is dominated by moderately tolerant species (Figure 4.22).
- The proportional distribution of fish with different water quality tolerances in the reference community is comparable to the sampled

community, although in much lower abundances (Figure 4.23). This suggests that water quality is probably not a notable driver of change in fish assemblages. As a general rule of thumb, fish that are sensitive to change in flow are also sensitive to alteration in water quality.

- Most of the fish sampled reflected an intra-reach migration requirement. Although not all fish with this requirement are equally affected by migration barriers. A large decline in fish with a specific migration requirement has been noted (Figure 4.24).
- Further contributing to deviation from reference fish assemblages are the alien and exotic species. Of the expected alien fish only one has been sampled, *O. niloticus*. This fish is probably still expanding its range and is likely impacting on other indigenous niche occupiers (Table 4.21).

Table 4.23 *Fish Assemblage Integrity Score and Category as Indicated by the Fish Response Assessment Index (The Table also indicates the extent of alteration in drivers as inferred from preference and tolerance variation between the expected and sampled fish communities)*

	Calculated Score (%)	Overall EC	Description
Drivers		C/D	A Moderate to Large loss in fish community assemblages compared to reference conditions.
Velocity Depth	57.6		
Cover	36.3		
Flow modification	62.0		
Water Quality	19.0		
FRAI	57.6		

Figure 4.20 *Bar Graph Showing the Number of Fish with Specific Velocity-depth Preferences Expected and Sampled*

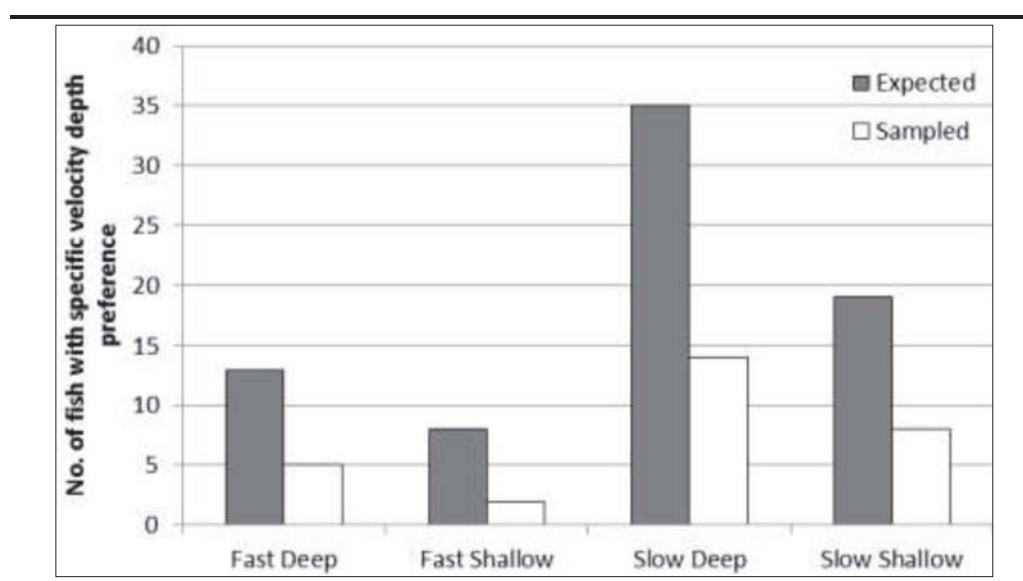


Figure 4.21 Bar Graph Showing the Number of Fish with Specific Cover Preferences for the Expected and Sampled Fish Community

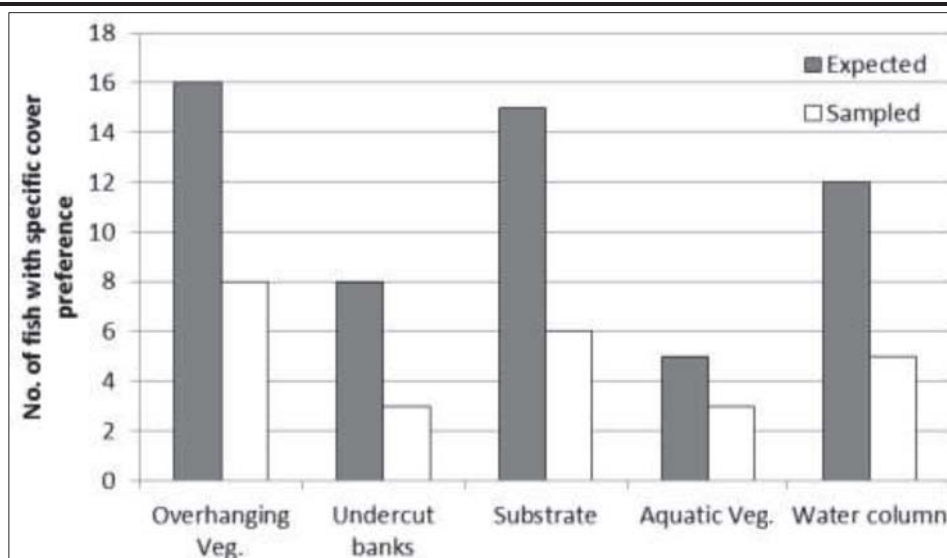


Figure 4.22 Bar Graph Showing the Number of Fish of the Expected and Sampled Community, with Different Tolerances to No Flow Conditions

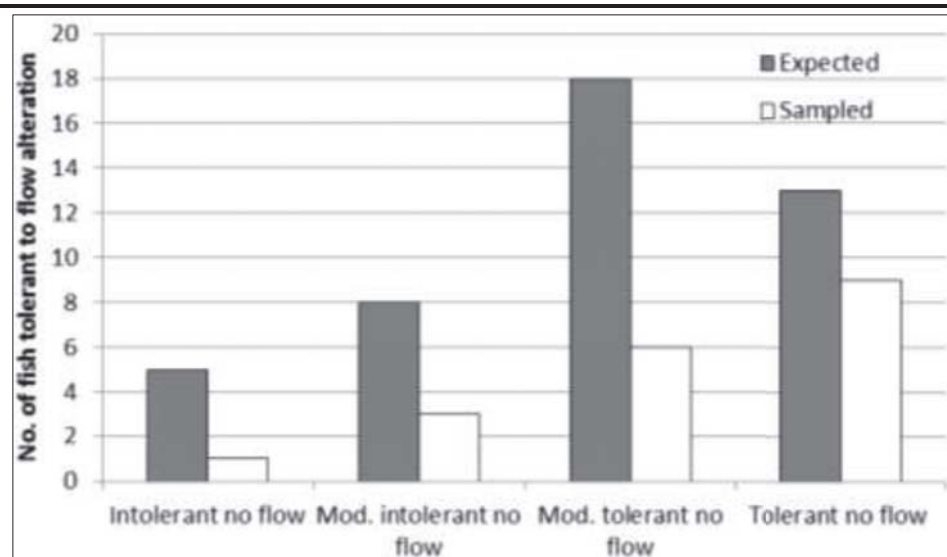


Figure 4.23 Bar Graph Showing the Number of Fish of the Expected and Sampled Community, with Different Tolerances to Changes in Water Quality

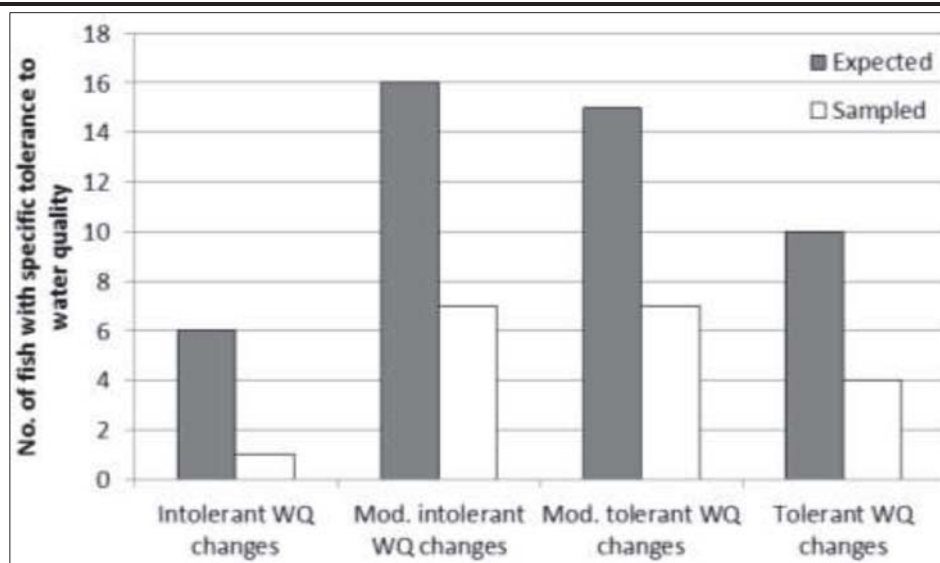
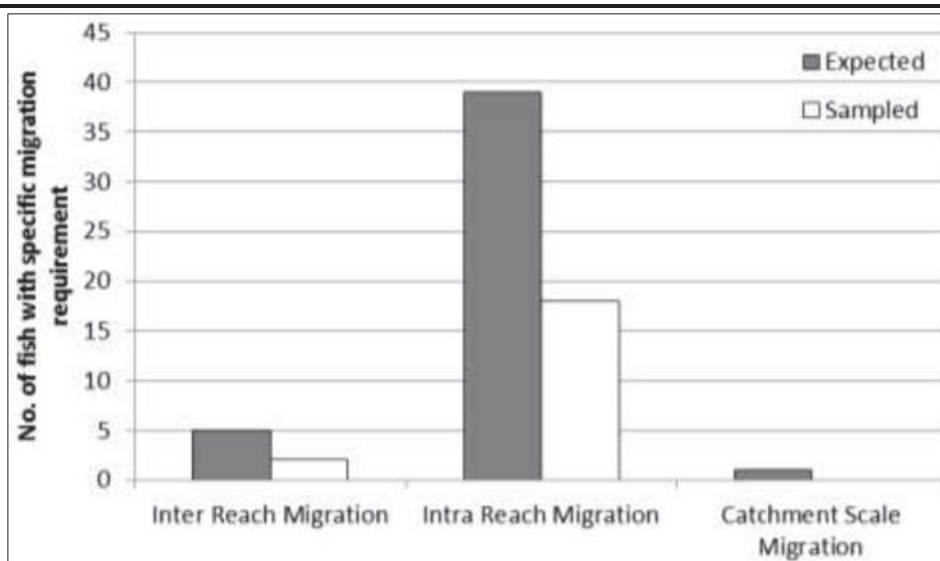


Figure 4.24 Bar Graph Showing the Number of Fish with Specific Migration Requirements for the Expected and Sampled Fish Community



Spatial Variation in Fish Communities

Site ZR1 yielded the lowest fish abundances, number of species and overall diversity score (Figure 4.25 and Figure 4.26). Concurrently, site ZR2 reflected the highest number of species followed by site ZR3, the latter showed a better evenness distribution and subsequently measured a higher diversity. The spatial variation in evenness distribution, between the three sites, is represented in Figure 4.27. Less than 20 percent of the total fish abundance for site ZR3 can be allocated to a single species. Conversely, nearly 50 percent of the fish abundances for site ZR1 are represented by a single species. Impacted

sites are typically characterised by higher abundances of more tolerant species and a displacement or loss of niche occupiers and more sensitive species.

In summary, it can be said that baseline fish assemblages reflected a Moderate to Large change from reference assemblages. The most notable cause for this change is alteration in the natural flow regime and a change in velocity-depth constituents from reference conditions. The assessment further ascertained measurable performance metrics (existing species composition) for future monitoring purposes at three sites downstream of the proposed activities. The results of the fish assessment will be augmented with another high flow assessment.

Figure 4.25 *Line Graph Showing Overall Total Abundances and Species Richness Obtained for Respective Sites*

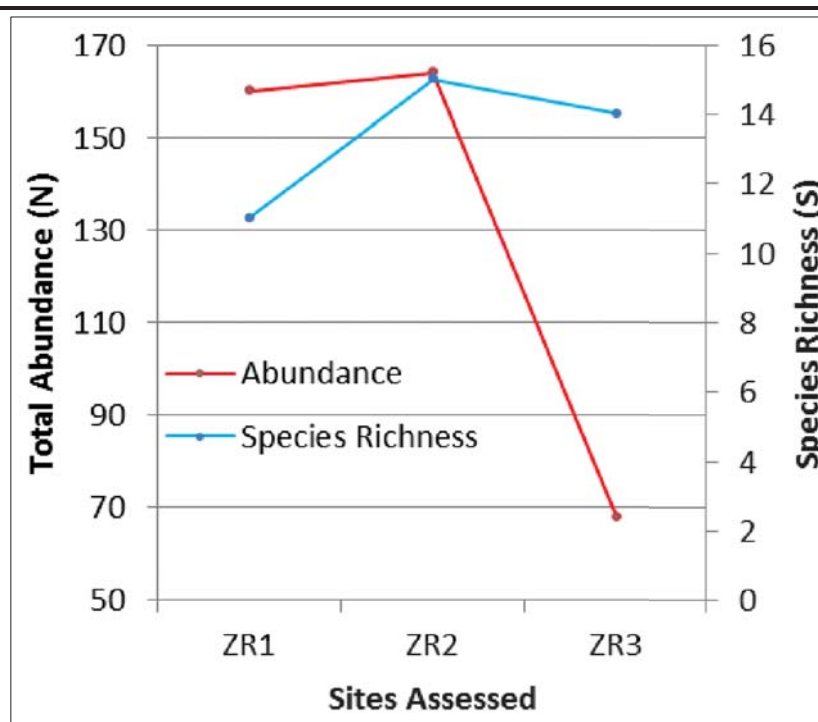


Figure 4.26 *Line Graph Showing Spatial Variation in Fish Diversity and Evenness Distribution for Different Sites Assessed*

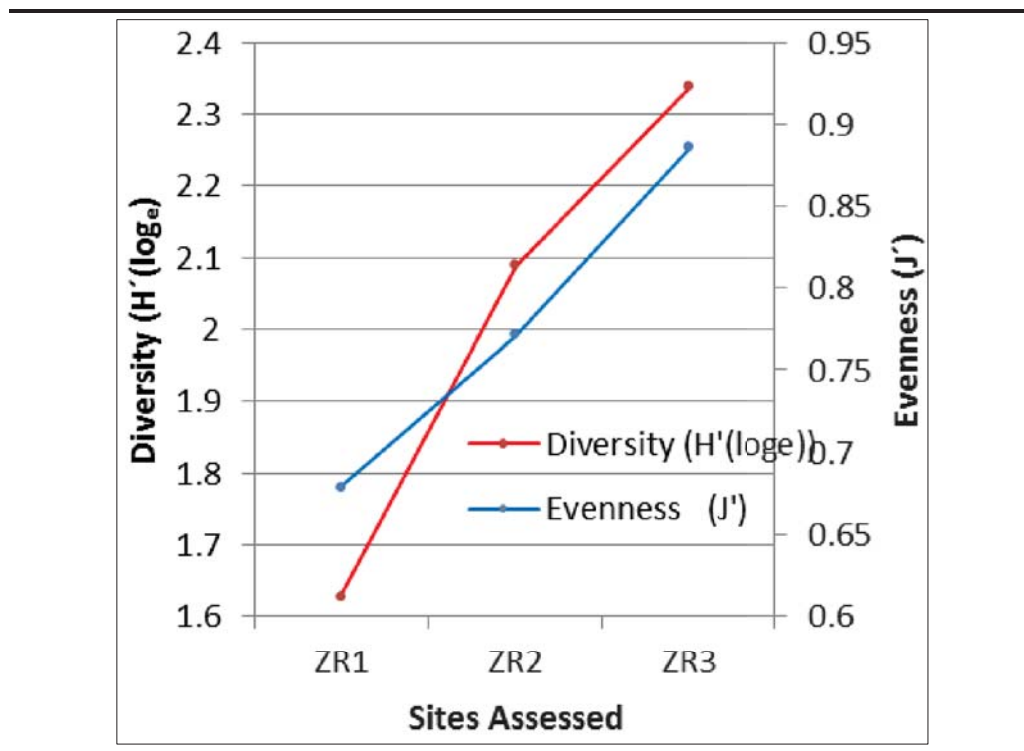
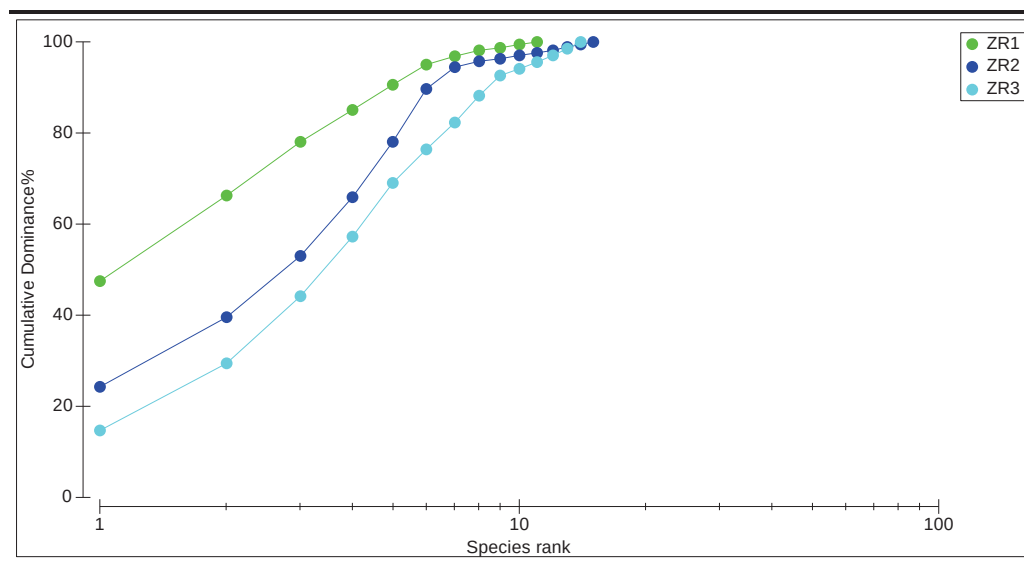


Figure 4.27 *Cumulative Dominance Plot for Fish Assemblages Linked to the Sites Assessed*

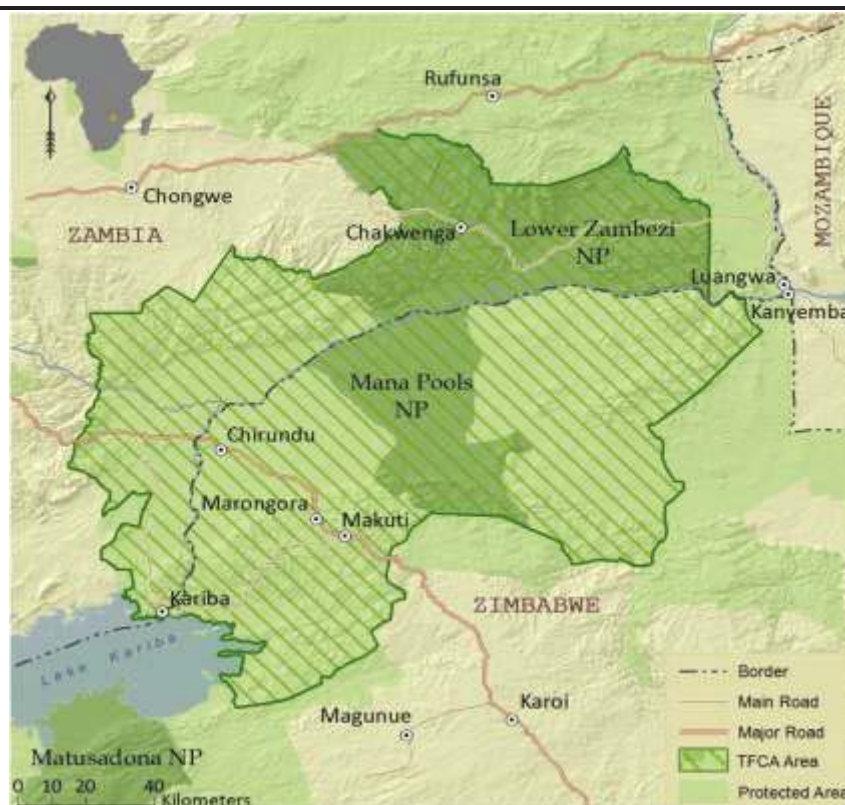


KEY FINDINGS - Fish:

Baseline fish assemblages reflected a Moderate to Large variation from reference assemblages. The most notable cause for this change is alteration in the natural flow regime and a change in velocity depth constituents from the reference conditions. A longitudinal improvement in fish assemblage was noted.

The Project is located within the Lower Zambezi Transfrontier Conservation Area (LZTFCA) (see *Figure 4.28*). In Zambia this Transfrontier Conservation Area (TFCA) includes the Open Area around Siavonga down to Chirundu, Chiawa Game Management Area and Lower Zambezi National Park. In Zimbabwe the TFCA includes the Charara, Urungwe and Rifa Safari Areas between Kariba and Chirundu, Mana Pools National Park, Sapi and Chewore Safari Areas down to Kanyemba.

Figure 4.28 Lower Zambezi Transfrontier Conservation Area



Source: Peace Parks Foundation, 2014.

(<http://www.peaceparks.org/tfca.php?pid=19&mid=1019>. Accessed 11 November 2014)

Mana Pools National Park, Sapi and Chewore are a designated United Nations Organization for Education, Science and Culture (UNESCO) World Heritage Sites based on the area's wildlife populations and outstanding beauty (http://whc.unesco.org/pg.cfm?cid=31&id_site=302). The Zimbabwean side of the LZTFCA is also a regionally Important Bird Area (IBA) (Childes & Mundy, 2001).

While the Project is located in the LZTFCA, the Project's Direct Area of Influence only extends 5km from the Kariba Dam wall into the LZTFCA, and the Indirect Area of Influence extends 10km into the LZTFCA.

The Open Area from Siavonga to Chirundu and further down to Chiawa is largely under agriculture. The Zambian Wildlife Authority (ZAWA) manages

the wildlife in Chiawa and Lower Zambezi, whilst on the Zimbabwean side all the land is protected under the Parks and Wildlife Management Authority. The wildlife areas on both sides of the river are popular tourist destinations.

4.3 *SOCIAL ENVIRONMENT*

This *Section* of the report provides a description of the social environment (which includes economic, health, and cultural heritage aspects) in the Project Affected Areas (PAA). It provides a comprehensive description of the characteristics of the Social Study Area (SSA) and draws on primary data specifically collected for this purpose as well as secondary data sources.

4.3.1 *Social Project Area of Influence*

The Area of Influence (AoI) can be defined as an area likely to be impacted by the Project activities during execution of rehabilitation works. The effects of these can be positive or negative, short or long term or permanent, as well as direct, induced and in-direct.

The AoI is described as:

- The **primary Project site(s)** and related facilities that the Project Proponent develops or controls (such as temporary secondary roads, disposal areas, and construction camps) and the additional areas in which aspects of the environment could conceivably experience significant impacts.
- **Associated facilities** that are not developed and funded as part of the Project but are essential for the Project and without which the Project cannot proceed, and the associated additional areas in which aspects of the environment could conceivably experience significant impacts.
- **Areas potentially affected by cumulative impacts** resulting from other developments known at the time of the impact assessment, further planned phases of the Project or any other existing circumstances.
- Areas potentially affected by impacts from **predictable (but unplanned) developments** as a result of the Project (i.e. induced activities), occurring at a later stage or at a different location.

The social AoI is shown in *Chapter 3*.

4.3.2 *Definition of Commonly Used Terminology in this Section*

- **Project Area**: Refers to the direct locations where the Project activities will be undertaken which include:
 - All secondary roads;
 - The plunge pool;

- The workforce accommodation and storage areas;
 - The slipway; and
 - The spillway gates.
- **Social Study Area (SSA)**: Refers to the area within a five kilometre radius from the Project Sites; including communities namely Micho, Siavonga Town (Zambia) and Mahombekombe and Kariba Heights (Zimbabwe). These communities also form the direct AoI.
 - **Project Affected Areas (PAA)**: Refers to the combination of communities that make-up the Study Area, as defined above.
 - **Indirect Areas of Influence**: include the national and main roads that will be used to transport goods and services to the Project Site; as well as other communities located close to the direct AoI (from 5.1 km and more).

4.3.3 *Approach and Methodology*

The social baseline study was compiled from publicly available secondary data. The secondary data was supplemented by primary data that was collected by way of various social data gathering methods.

Due to the limited project footprint and concomitantly limited expected social impacts, a mini-livelihoods survey was conducted with 40 participants in Mahombekombe and Kariba Heights in Zimbabwe combined with Siavonga Town and Micho in Zambia.

In addition four focus group discussions (FGDs) were also undertaken with representatives of traders, fishermen and two local women's groups (one each in Zimbabwe and Zambia). *Ad hoc* one to one meetings were also held with key informants including health and education officials as well as the district planner in Zambia and the town clerk in Zimbabwe.

Secondary data sources included:

- The most recent Population and Household Census information of both countries;
- Demographic and Health Survey information;
- Research reports from various international NGOs and organisations; and
- Other sources of information identified via the Internet.

4.3.4 *Influencing Factors*

The baseline study presented in this *Section* is influenced by the following four factors:

1. After assessing the size of the Project footprint and the types of activities that will occur, it was noted that the Project will have limited social

impacts; therefore primary data collection was limited to a small sample size.

2. The relatively small sample size means that the results of the study cannot be extrapolated to the wider population of Kariba and Siavona Districts.
3. The tendency of respondents to exaggerate their circumstances means that not all data can be assumed to be purely factual but may also be anecdotal.
4. In certain cases outdated data (information older than five years) has been used due to a lack of current data, as such this data may no longer represent the current reality of the population.

4.3.5 *Governance and Administrative Structures of Zambia and Zimbabwe*

Both Zimbabwe and Zambia have a dual governance system based on elected political governance structures and traditional leadership structures. These systems are recognised as complementary but have different responsibilities.

Administrative Structures in Zimbabwe

Zimbabwe is divided into ten administrative Provinces; eight of which are predominantly rural and two predominantly urban. The urban Provinces are Bulawayo and Harare, which were established in 2005. Each Province is divided into Districts, which are further divided into Wards or Municipalities. Currently, there are 59 Districts which consist of 1,200 Wards. Local government in Zimbabwe is governed by the Ministry of Local Government, Rural and Urban Development (MLGRUD). Key roles and responsibilities of local government legislation are indicated in *Table 4.24* below.

Table 4.24 *Local Government Legislation: Roles and Responsibilities*

Legislation	Roles and responsibilities
• Rural District Councils Act (1996); • Urban Councils Act (1996); • Regional Town and Country Planning Act (1976); • Traditional Leaders Act (2000); and • Provincial Councils and Administration Act (1985).	• Plan and implement local development; • Provision and management of basic services, including health, education, refuse removal, water, and sanitation; • Provision and maintenance of roads; • Provision of housing and serviced stands; and • Provision of social welfare services.

Source: Jaap de Visser, et al, 2010. Local Government Reform in Zimbabwe: A Policy.

Provincial Government

Each Province is administered by a presidentially appointed Ministry of State for Provincial Affairs who is supported by the Provincial Administrator and several ministries. The Ministry of State for Provincial Affairs is the head of the Provincial Councils (PCs) whose members include:

- Mayors and one councillor from each municipality and city council in that province;
- Chairperson and one councillor from Town Councils, Local Boards and Rural District Councils in that province; and
- Representatives from the Provincial Assembly of Chiefs.

The PCs' main functions are co-ordination and development of provincial matters. They are supported by the Provincial Development Council (PDC). The PDC is comprised of –

- Ministry of State for Provincial Affairs as Chairperson;
- Heads of line ministries in the Province including the security Ministries;
- District administrators in the Province;
- Town clerks, town secretaries and local board secretaries in the Province;
- Chief executive officers of Rural Development Councils (RDCs);
- Captains of commerce and industries in the province;
- Heads of parastatals in the province; and
- Heads of civil society organisations in the province.

Provinces also have Councils (which act as urban and rural local authorities). The Councils are divided into Wards (and villages in rural areas or neighbourhoods in urban areas). Each ward is represented by a Councillor elected by a simple majority. Ward boundaries in rural areas do not always coincide with the mosaic of hereditary chieftainships, which are subdivided into areas governed by headmen and village heads. The local government structures are discussed further below.

Local Government -Rural and Urban District Council

Local government comprises of Rural and Urban District Councils. In 2010, Zimbabwe had 60 rural and 31 urban, local authorities. Council areas are divided into wards, each represented by an elected councillor. Local authorities function by, and are structured on, a committee system. These are set up in accordance to Sections 4 to 14 of the Rural District Councils Act and the Urban Councils Act of 1996.

Urban District Council (UC)

The UC comprise of cities, municipalities, town councils, and local boards. Urban Councils are hierarchically organised, based mainly on their size and functions. At the highest level, there are cities/town council (seven) and at the lowest level, local boards (four). Town Councils and Local Boards have Chairpersons and Secretaries as heads of their policy making bodies and management, respectively. Whereas, Municipalities and City Councils have Mayors and Town Clerks and own land within their boundaries, Local Boards and Town Councils do not have that power. Functions of UCs range from the core business of councils which is service provision, to issues to do with allowances, mementoes, and orchestras and bands. To better conduct their

responsibilities, councils have standing committees. Typically, UCs have the following standing committees:

- Finance Committee – responsible for regulating financial affairs;
- Health and Housing Committee - responsible for health and housing matters; and
- Environmental Management Committee - responsible for environmental matters.

Rural District Council (RDC)

RDCs are established in terms of section 8 of the RDCs Act [Chapter 29:13]. RDC boundaries coincide with boundaries of administrative districts, minus UC land and land under national parks. The Act also provide for the appointment of committees of councils; which often consist of:

- The ward councillor representing wards that fall wholly or partly within the urban land;
- Members of Village Development Committees or Neighbourhood Development Committees in the area; and
- No more than two co-opted members per ward in the area.

Each district is administered by the Rural District Council, which comprises of ward councillors, a District Administrator, and a representative of a traditional leader (chief) who is appointed under customary law. Other government functions at district level are administered by district offices of national government departments.

The Act also provides for the appointment of a Town Board for each town. The board is composed of councillors for the town wards and such number of persons, but not exceeding one person fewer than the number of ward councillors. The Town Board has no power to impose levies, special rates, rents or charges. Other committees of the RDCs include the Roads Committee, the Ward Development Committee and the Rural District Development Committee (RDDC). The RDDC consist of:

- The District Administrator as chairman;
- The chairperson of every Council Committee;
- The Chief Executive Officer of council and other senior officials of Council;
- Senior officers of security ministries;
- District heads of ministries; and
- Other interest groups.

Ward Council

In rural local authorities, policy making is done at village assemblies, ward assemblies, and the full Council; in ascending order. The Ward assembly is

made up of all headmen, village heads, and the Councillor for the Ward. The Ward assembly is chaired by a headman, and its technical work is undertaken by a Ward Development Committee, which comprises of an elected Ward Councillor (as the chairperson), Headmen (traditional leaders subordinate to the chiefs), and Village Development Committee representatives.

Wards are further divided into villages. Each village has a Village Development Committee and a traditional leader subordinate to the Headman. The committee is chaired by the village head. The assemblies are chaired by village heads, and are based on the principle of universal participation (in other words by all villagers above 18 years of age). Technical matters of the assembly are handled by a committee that draws on technical input of people from within the village.

Traditional Leadership Structure

The appointment of Chiefs, Headmen and Village Heads is provided for in the Traditional Leaders Act (1998). Chiefs are appointed (and dismissed) by the President to preside over communities inhabiting communal land and resettlement areas. The appointment takes into consideration the prevailing customary principles of succession, if applicable to the community over which the Chief is to preside; and the administrative needs of the communities in the area concerned in the interests of good governance. A Chief qualifies for the payment of a salary, allowances, gratuities and a pension. The Chief's roles include performing of functions associated with the office of a chief as community leader, as well as the maintenance and promotion of community cultural values. Functions further include:

- Promoting and upholding cultural values among members of the community under his jurisdiction, particularly the preservation of the extended family and the promotion of traditional family life.
- Supervising headmen and village heads in the performance of their duties; and discharging any functions conferred upon him in terms of the Customary Law and Local Courts Act.
- Overseeing the collection of levies, taxes, rates and charges payable in terms of the Rural District Councils Act by village heads.
- Ensuring that Communal Land is allocated in accordance with the Communal Land Act.
- Ensuring that the land and its natural resources are used and exploited within legal boundaries.
- Protection of public infrastructure and services.
- Adjudicating in and resolving disputes related to land in his area.

- Maintaining up-to-date registers with all villages' names, their inhabitants and copies of land certificates.

Headmen and Village Heads

The Chief nominates a person to serve as Headman and the Headman is appointed by the Minister ⁽¹⁾. A headman qualifies for a salary and allowances. The Village Heads are nominated by the Headmen, and appointed by the Secretary ⁽²⁾ of the Minister of Local Government, along with the written approval of the relevant area Chief. Village Heads assist Headmen in their duties and they qualify for payment from the rural district council. The duties of Headmen and Village Heads are summarised below in *Table 4.25*.

(1) Minister" means the Minister of Local Government and National Housing or any other Minister to whom the President may, from time to time, assign the administration of this Act

(2) Secretary" means the Secretary of the Ministry for which the Minister is responsible

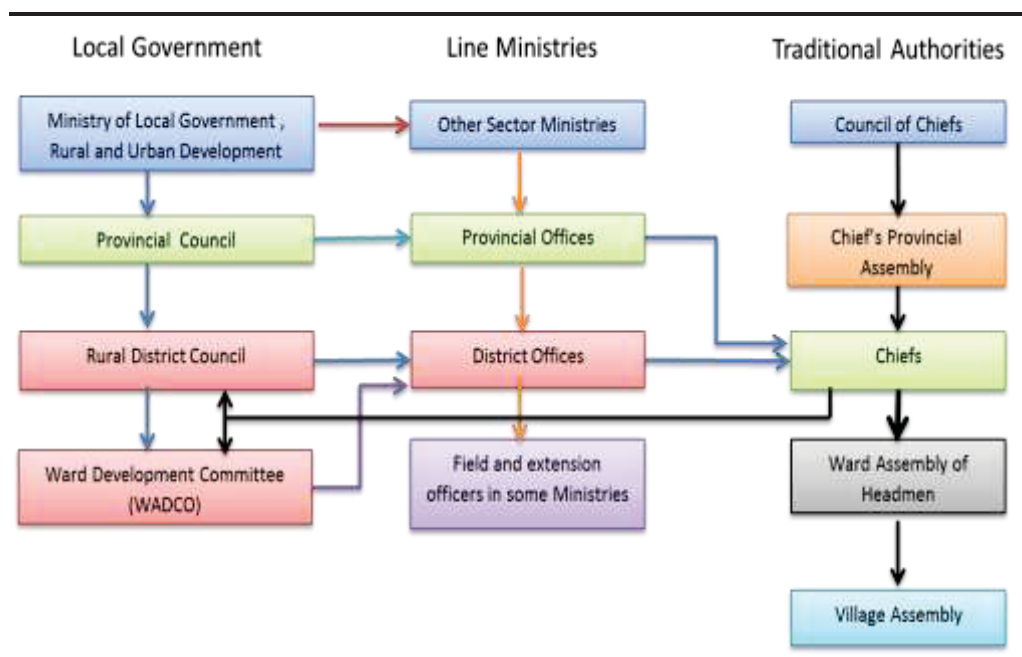
Table 4.25 *Duties of the Headmen and Village Heads*

Headmen	Village Heads
- To report to the police any crime or offence in his area and any actual or threatened public unrest likely to disturb the public peace. - To report all criminal acts, acts of misconduct and violations of customs and traditions to the chief and any other appropriate authority. - To preside over a Ward Assembly when elected as chairman. - To oversee the disposal of settlement rights in Communal Land and the admission of new settlers in the area under him. - To keep an up-to-date register of the villages and Village Heads under him and to keep the Chief and the Rural District Council informed of any changes to the register. - To mediate in local disputes involving customary law on matters such as <i>lobular</i>, elopement, and others.	- To consider requests for settlement by new settlers into the village and, in consultation with the Village Assembly, to make recommendations on the matter to the Ward Assembly. - To settle disputes involving customary law and traditions, and to refer these matters for settlement by the headman. - To preside over the Village Assembly. - To produce, in consultation with the Village Assembly, Village Development Plans for his area and to submit them to the Ward Assembly. - To preside over the Village Development Committee. - To collect levies, taxes and other charges payable in terms of the Rural District Councils Act. - To maintain an up-to-date register of names of the inhabitants of his village, and their settlement permits.

Source: Jaap de Visser, et al, 2010. Local Government Reform in Zimbabwe: A Policy.

Figure 4.29 below illustrates the linkages between the political and traditional governance structures in Zimbabwe.

Figure 4.29 *Links between Political and Traditional Governance Structures*



At national level, governance structures comprise of elected members of parliament. Government functions are performed by the Cabinet of the ruling party through various ministries. These ministries are headed by a Minister at national level and representatives at provincial and district levels.

Provincial Government

Each of the ten Provinces is headed by a Provincial Minister who is appointed by the President. The planning and implementation of provincial social and economic development programmes is done by Provincial Development Coordinating Committees (PDCC). District Development Coordinating Committees (DDCC) was established by the Government in 1995, to co-ordinate development activities at a District level.

Local Government – District Councils

The local governance system is governed by the Local Government Act of 1991 (Cap 281 of the Laws of Zambia), which gives central government supervisory powers over local government and local authorities. The local government structure is a single tier comprising of City, Municipal or District Councils. In general, city councils are located in the urban districts which have higher population numbers and diverse economic activities while the municipal councils cover the peri-urban regions. District councils are located in the rural districts, which have smaller populations that rely on agriculture. Hence, District Councils generate less local tax revenue than City Councils.

Legally, all District Councils are responsible for the provision of services as laid down in the Local Government Act. The Act also stipulates that Local Councils consist of members of Parliament in the District, two Chiefs' Representatives (who are appointed by the consortium of local Chiefs within the District) and all the elected Councillors within the District. Districts are further divided into Wards represented by elected Ward Councillors.

The District elections take place every five years to align with the national elections. The District Council is headed by a Council Chairperson. The Council is responsible for the formulation of all local developmental policies in the District. Furthermore, the Council is required to work in three committees responsible for various service provisions. These committees are:

- The finance, commerce and general purposes committee;
- The plans, works, water and sanitation committee; and
- The staff establishment and social committee.

The District Council employs personnel that manage the affairs of the District, which personnel make up the Administrative Council. The Administrative Council is responsible for executing District Council duties and decisions. The person leading the Administrative Council is the Council Secretary who is

aided by the Deputy Secretary (Administration), Treasurer (Finance), Director of Works (Engineering) and District Planning Officer (Planning).

The DDCC is an advisory committee to the District Council, comprising non-governmental organisations (NGOs), Private Sector and various sector ministerial departments that perform specified Government functions. The main function of the DDCCs is to co-ordinate developmental activities in the District and to formulate and recommend development programmes to the Council for implementation.

Currently, in many districts, there are no sub-district structures recognised by the law. The Village Registration and Development Act of 1971 provided for the establishment of Ward Development Committees (WDC) in each ward but this was only done in some rural areas. The WDCs are chaired by the Ward Councillor and are largely designated by the Councillor. Most peri-urban areas however, have Residents' Development Committees (RDCs) which are not legally recognised. They are established by District Councils and Councillors sit on these committees as *ex-officio* members. In rural areas alongside these structures, traditional leadership have parallel structures to govern their subjects in terms of traditional and customary law.

Traditional Leadership Structures

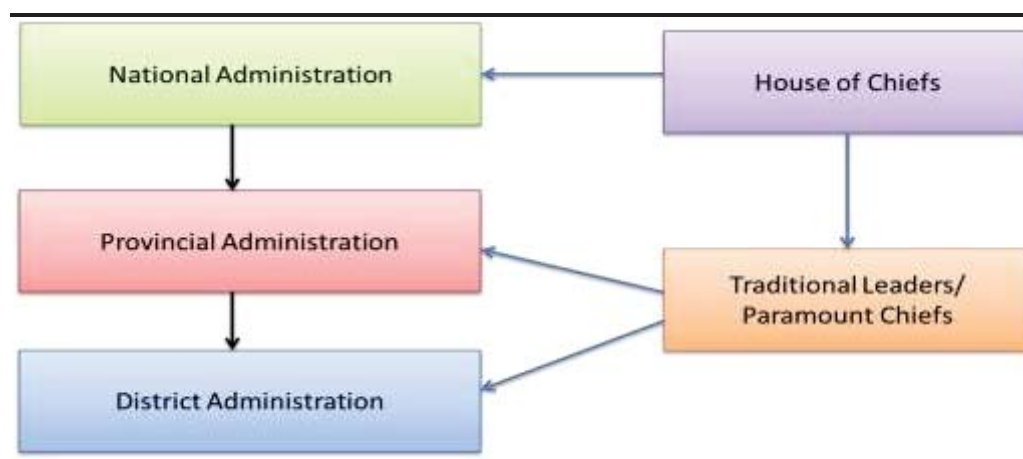
Rural communities of Zambia are led by Chiefs. At national level Chiefs are represented in the House of Chiefs. They act as advisors to the Government with regards to issues relating to the welfare of their respective chiefdoms.

At the village level, the responsibilities of the Chiefs include:

- Dealing with all customary matters in the Districts;
- Governing people in accordance with tribal customs;
- Allocating land through the Headmen/ Headwomen;
- Sensitisation of population for socio-political or developmental activities;
- Conflict and dispute management;
- Representation of villagers at District level;
- Assist District authorities with provision of services in the chiefdoms; and
- Acting as custodians of customary land that falls within their chiefdoms.

The Chiefs are assisted by headmen/headwomen and Councillors in the administration of their chiefdoms. *Figure 4.30* shows the linkages between the political and traditional governance structures in the country.

Figure 4.30 Links between Political and Traditional Governance Structures



4.3.6 Land Tenure and Land Use

This *Section* provides a description of the land tenure systems of Zimbabwe and Zambia as well as their respective land use patterns.

Land Tenure in Zimbabwe

Land rights in Zimbabwe are embedded in four systems of land tenure, namely freehold (private) land, state land, communal land and leasehold (resettlement) land systems. These tenure systems impact and shape the property rights and natural resource access and use regimes in the country.

The freehold tenure system is prevalent in the commercial farming sectors; which occupies about 30 percent of the country's land area; and is characterised by private land ownership. The registered land owner has exclusive property rights and full control and responsibility over the land and everything attached to it, except to the extent that ownership and exclusive control over the land and some natural resources may be limited by statutory provisions.

The communal land tenure system is governed by the Communal Lands Act and is applicable to 40 percent of Zimbabwe's land area, where approximately 66 percent of the country's population resides. According to the Communal Lands Act, all communal land is vested in the State President who has powers to permit its occupation and utilisation in accordance with the Act.

Communal Area inhabitants thus have *usufructuary*⁽¹⁾ rights in communal land. Rural District Councils, on the other hand, have the right to allocate land to qualified persons on behalf of the State. Resettlement areas cover ten percent of the country's surface area and are a product of the post-independence period targeted at relieving population pressure on communal areas.

(1) one having the usufruct of property or one having the use or enjoyment of something.

Land Use in Zimbabwe

The State set aside 15 percent of the country land as protected areas (including national parks). Of these areas two percent is allocated to gazetted/protected forests; 13 percent to national parks; 30 percent is used for commercial agriculture, settlements take up 40 percent and the remaining 15 percent is allocated to other land use types.

An estimated 66 percent of the country's land area is under woodland compared to 24 percent under cultivation and ten percent is used for settlements. The heaviest concentrations of indigenous woodlands occur in the gazetted state forests, national parks, the Eastern Highlands and large-scale commercial farms. Land use classifications are presented in *Table 4.26* below.

Table 4.26 *Land Classification in Zimbabwe*

Land Use	Area (000ha)	% of total
Natural forests	11.60	0.03
Plantations	155.60	0.40
Indigenous woodlands	25,771.40	65.92
Grasslands	1,893.90	4.85
Cultivated land	10,738.10	24.47
Settlements	139.10	0.36
Other	379.40	0.97
Total	39,089.40	100.00

Source: <http://www.fao.org/docrep/005/ab603e/ab603e03.htm>

Land Tenure in Zambia

The Zambian Lands Act No. 27 of 1995 classifies land into two types, namely state land and customary land. All state land is vested in the President and he holds the right to give consent to a person, who wishes to sell, transfer or assign any land to a different party. The Commissioner of Lands administers state land for agricultural, commercial, industrial and residential purposes. Most of the land in Zambia (61 percent) is owned and managed by customary authorities and the remaining 40 percent is owned by the state or privately owned. Of the total customary land in the country an estimated 63 percent (approximately 31 million hectares) is forestland and 24 percent is used for settlements as well as public infrastructure. Approximately five percent of forestland is privately owned ⁽¹⁾.

Customary land is administered by the Chiefs and the headmen acting with the consent of the communities. Customary land may, however, be expropriated by the State if it is required for development purposes in the national interest and in return for compensation by the State to the affected community or household. This is undertaken in line with the local customary law on land tenure and in consultation with the affected Chief and affected local authority.

(1) ILUA, 2009

One key aspect of customary tenure is that it allows free access to land for all members of a community. In customary areas in Zambia individual ownership, concurrent interests and communal interests are recognised ⁽¹⁾. Land can be acquired in the following ways: by simply taking unoccupied land, by being given land as a gift, by the sale of land (with improvements on it ⁽²⁾), by transfer of land in exchange for goods, by transfer of land in exchange of services, by inheritance and by marriage. A stranger to the area must obtain the Chief or headman's permission to settle in the area before he or she can be assigned a piece of land. Similarly, a Chief can prohibit an individual from cultivating in a grazing area.

The security of tenure provided under customary laws is almost equivalent to the security provided under freehold. Any individual who establishes residence in a village can acquire customary rights over the land. Other people are then prohibited from laying claim to such land over which another individual has established rights. The rights are permanent unless they are extinguished by abandonment or death.

Land Use in Zambia

Zambia has a total land area of 752,000 km². The major land uses in Zambia include forestry and game management areas (66 percent - 49.9 million hectares) and agriculture (32 percent) ⁽³⁾. The classification of land uses are shown in ⁽⁴⁾ Table 4.27 below.

Table 4.27 *Land Use Classification in Zambia*

Land Use	Percentage
Deciduous Forest	19.7
Evergreen Forest	1.1
Semi-evergreen Forest	45.4
Other natural Forest	0.2
Wooded Grassland	6.5
Shrubs/Thickets	1.5
Grassland	8.1
Lakes	3.6
Marshland	1.8
Annual Crops	6.2
Perennial Crops	0.3
Fallow	3.2
Barren Land	0.0
Pastures	0.6
Rivers	1.0
Rural built-up areas	0.7
Urban built-up areas	0.0

Source: <http://www.fao.org/forestry/16955-0c90798cee1e59a8542ede210a9834227.pdf>

(1) Individual ownership means that the landholder or occupant has more rights and interests in the land than any other person. The individual owns the land for as long as he wishes. Concurrent interests occur where persons, other than the landholder, can go onto someone's land and use it for their own purposes. Communal interests involve the use of certain tracts of land, which are not individually owned

(2) This is the sale of land which has been developed or has some infrastructure on it, etc.

(3) Game Management Areas are set aside principally to serve as buffer zones around the National Parks.

(4) <http://www.fao.org/forestry/16955-0c90798cee1e59a8542ede210a9834227.pdf>

The Community Based Natural Resources Management (CBNRM) strategies were formulated and implemented in 1988 under the Administrative Management Design Act (ADMADE) conservation program and are primarily carried out in Game Management Areas (GMAs). There are currently 35 GMAs in Zambia. The GMAs are classified as Category VI protected areas ⁽¹⁾ in accordance with the International Union for Conservation of Nature (IUCN) classification system and are protected principally to serve as buffer zones around National Parks. Other uses of GMAs are to serve as hunting areas for safari and non-safari purposes; as photographic areas, for non-consumptive utilization and as settlement areas for local communities that also conduct agriculture amongst their other economic activities.

The experiences from ADMADE led to the enactment of the 1998 Zambia Wildlife Act which makes specific provision for the participation of local communities in wildlife management through local institutional structures known as Community Resources Boards (CRBs). CRBs consist of seven to ten representatives elected by the local community; one representative of the local authority and a representative of the Chief in whose area the CRB have been established. The Chief of the area is referred to as the Patron of the CRB.

There are guidelines on how CRBs must be established. Applications to establish a CRB are made by the traditional leaders to the Zambian Wildlife Authority (ZWA), which then facilitates the election process. CRBs provide the link between ZAWA and the local communities. Other functions of CRBs are set out in *Box 4.1*.

GMAs are an important reservoir of wildlife resources and a cornerstone of the implementation of wildlife management strategies. These institutions also act as a vehicle for the distribution of benefits stemming from wildlife to local communities.

Box 4.1 ***Functions of Community Resources Boards***

According to the Zambia Wildlife Act the CRB performs the following functions:

- negotiates, in conjunction with ZAWA co-management agreements with hunting outfitters and photographic tour operators;
- manages the wildlife under its jurisdiction, within quotas specified by ZAWA;
- appoint Village Scouts to exercise and perform the duties of a Wildlife Police Officer under the supervision of a Wildlife Police Officer in the area falling under CRB jurisdiction;
- in consultation with ZAWA, develops and implements management plans which reconcile the various uses of land in Game Management Areas/Open Areas; and
- performs other functions as ZAWA may direct or delegate to it.

Source: ZAWA website: <http://www.zawa.org.zm/>

(1) Category VI protected areas conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

Conservation/ protected areas closest to the Project Area are highlighted in *Figure 4.31* below.

[illegible]

Zambia has a larger population by a million to that of Zimbabwe. Both countries have more women than men by one percentage. This may be attributed to men migrating elsewhere in search of employment and other economic opportunities. Zimbabwe and the project affected provinces have the majority (over 50 percent) of the population fall in the age bracket between 15 to 64 years; while Zambia as whole, has a younger population at 66 percent (under 15 years) ⁽¹⁾.

The majority of the population in both countries, its Provinces and Districts resides in rural areas. The only exception is the Kariba District where the majority resides in urban areas. Zimbabwe's population has a relatively high number of female headed households (35 percent) as compared to Zambia which has 19 percent female headed households in the project affected Provinces and Districts. Table 4.28 provides a summary of the key demographic indicators mentioned above.

Table 4.28 *Demographic Indicators at National, Provincial and District Levels*

Demographic Indicators	Zimbabwe	Mashonaland West Province	Kariba District	Zambia	Southern Province	Siavonga District
Population Size	13 million	1,5 million	67,820	14 million	1.6 million	89,787
Population Growth	1.1	2.3	-	2.8	2.8	4.4
Population Density	33	-	-	17.4	18.6	26.3
Average Household Size	4.2	4.3	4	5.2	5.4	-
Female and Male Headed Households in %						
Male Headed Households	65	72	-	81.1	82.7	81.8
Female headed households	35	28	-	18.9	17.3	18.2
Gender Distribution in %						
Males	48	48	49	48	47	49.3
Females	52	52	50	52	53	50.7
Age Distribution in %						
Under 15 years	41	22.1	0	66.2	21.2	-
15-64 years	55	81.3	90	31.4	71.3	-
65+ years	4	2.5	10	2.4	2.5	-
Rural/ Urban Split in %						
Urban	33	25	98.7	40	25	35
Rural	67	75	1.3	60	75	65

Source: Zimbabwe National Census Report, 2012; Zambia: 2010 Census of Population and Housing, Population Summary Report. June 2012; Census Report: Mashonaland West Province, 2012; and Siavonga IDP: Status Quo, undated.

(1) Population Census of Zambia and Zimbabwe, 2011 and 2012 (respectively)

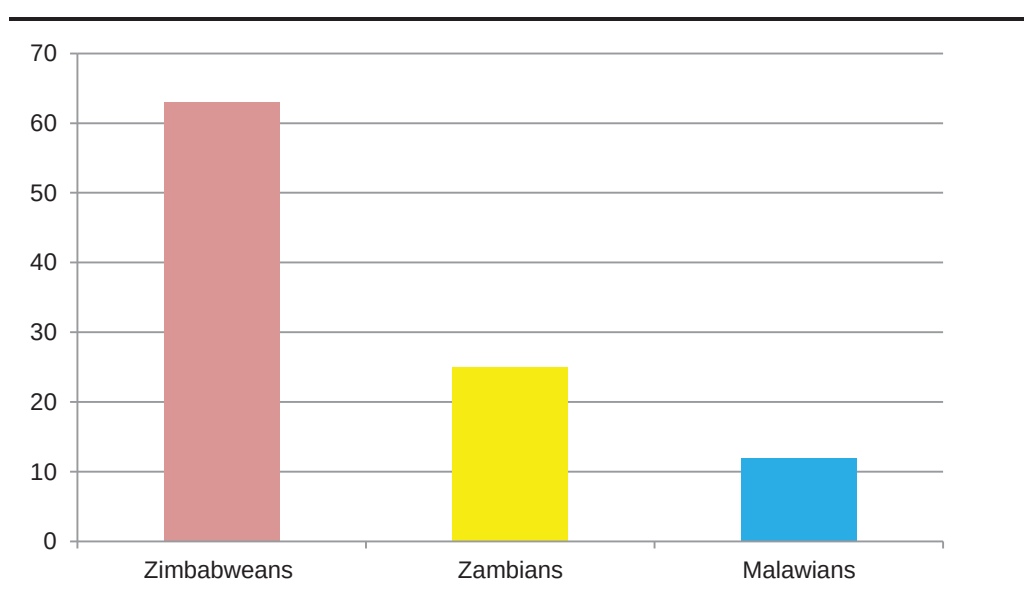
Ward 4, where Mahombekombe is located in the Kariba District, had a population of over 12,500 in 2009. The Kariba Ward (no number available) in the Siavonga District had a population of 16,100 in 2010 ⁽¹⁾.

Ethnicity and Language

In Zimbabwe, population groups are classified in terms of three broad categories, namely African origin/Zimbabweans, Foreigners and Others. Zimbabwean citizens account for 99 percent of the population and Foreigners make-up the remaining 1 percent ⁽²⁾.

As mentioned above, the Zimbabwean population is not classified in accordance to ethnicity but rather citizenship. There are two major tribes in the country, namely the Shona and Ndebele people (82 percent and 14 percent of the population respectively). Mahombekombe and Kariba Heights are located within the Mashonaland region which is dominated by the Shona people and language. The surveyed population in the Mahombekombe and Kariba Heights revealed a population dominated by the Zimbabweans at 63 percent including those born in the area and others born elsewhere in the District or Province. Amongst those interviewed, there were also foreign nationals who lived permanently in Zimbabwe; *i.e.*, Zambians and Malawians as indicated as indicated in Figure 4.32 below.

Figure 4.32 *Tribal-linguistic groups in Mahombekombe and Kariba Heights*



In contrast, Zambians are classified in accordance to their ethno-linguistics (which excludes foreign nationals), with people of Bemba origins dominating the population groups at 27 percent at a national level; followed by the Tonga at 19 percent. Other ethno-linguistic groups include the Chewa (ten percent), Lozi and Nsenga (nine percent), Tumbuka and Ngosi (six percent) Lala and

(1) Siavonga IDP Status Quo, undated

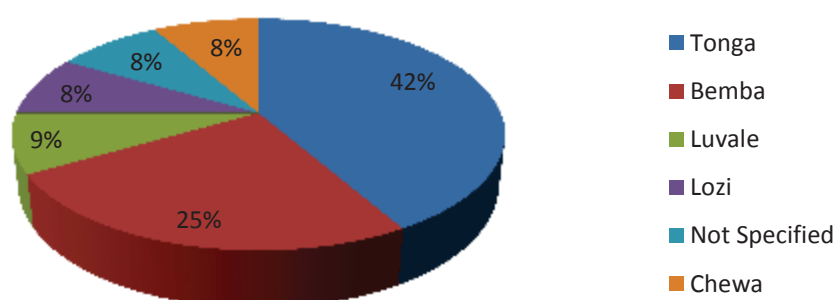
(2) Zimbabwean Population Census, 2012

Kaonde (five percent) and Luanda (four percent) account for the remaining population.

At a **Provincial and District** levels (Southern Province), the Tonga people dominate the population at 70 percent, whilst the other ethno-linguistic groups exist in smaller percentages including the Nyanja (5.5 percent), Lozi (five percent), Ila (3.8 percent), Bemba (2.8 percent), and English at 0.8 percent.

Of the total population surveyed in Siavonga Town and Micho, an estimated 42 percent were of Tonga ethno-linguistic groups, followed by the Bemba's at 25 percent and other ethno-linguistic groups made up the remaining 33 percent as indicated in *Figure 4.33* below.

Figure 4.33 *Ethno-linguistic Groups in Micho and Siavonga Town*



Migration Trends of the Population

National

In both countries, inter-migration are high and it is fuelled by the search for employment and business opportunities. In Zambia, there is a lack of valid data about the numbers of cross-border migrants (both regular and irregular) as well as internal migrants ⁽¹⁾ compared to Zimbabwe. According to the IOM, both inter- and out- migration in Zambia takes place in search of improved livelihoods; *i.e.*, in search of work (i) in the mines of the Copperbelt Province; (ii) on commercial farms; (iii) in small-scale fishing and fish trading; and (iv) as truckers along the transport corridors that link the country with its neighbours. Natural disasters such as droughts and floods also play a major role in inter-migration patterns of the population. It is, however, assumed that the reasons for in-and-out migration in both countries are similar; as such trends have also been observed in other African countries.

In turn, in Zimbabwe, the Provinces of Harare and Bulawayo had the highest in-migration of 49 percent, respectively from 2002 to 2012. These provinces were followed by Mashonaland East at 33 percent and Mashonaland West at 30 percent. The same provinces with high in-migration also experienced the

(1) International Migration Organisation, June 2011

highest out-migration, with Bulawayo and Harare at 39 percent, respectively. Overall, the same provinces also experienced positive net migration; in turn, the other provinces experienced less in-and-out migration resulting in negative net migration rates, as indicated in *Table 4.29* below.

Table 4.29 *Migration Pattern of Zimbabwean Population*

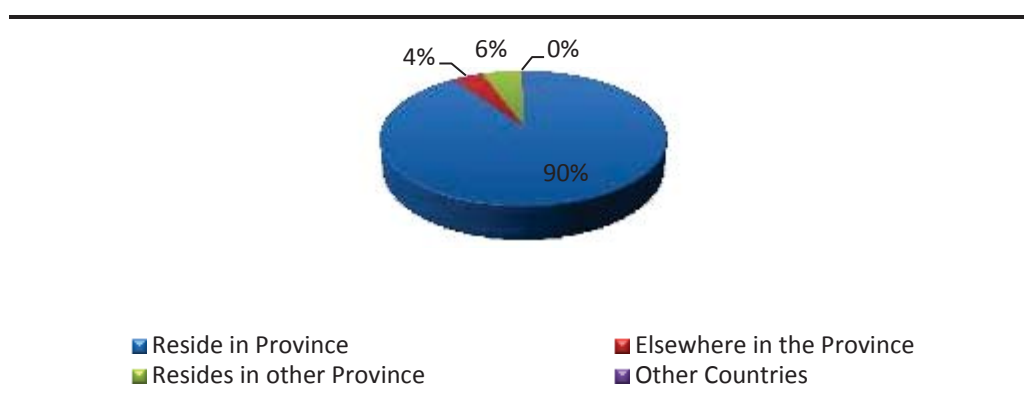
Province	In-migration	Out-migration	Net Migration Rate
Bulawayo	49.1	39.4	19.1
Manicaland	14.8	24.9	-11.8
Mashonaland Central	20.7	23	-2.9
Mashonaland East	32.7	33.9	-1.9
Mashonaland West	29.9	23.9	8.5
Matabeleland North	19.4	20.5	1.3
Matabeleland South	24.9	22.4	-3.3
Midlands	23	25.7	-3.5
Masvingo	15.6	27	-13.5
Harare	49.2	38.6	21

Source: Census Report: Mashonaland West, 2012

Provinces

A similar trend of lack of migration data in Zambia continued to the Provincial levels. In Mashonaland West (Zimbabwe), an estimated 25 percent of the population resided in urban areas. There was a sizeable movement of people from District to District and also from other Provinces. About five percent of the population in Mashonaland West Province usually resided in other provinces and the main contributor was Harare. Overall, approximately 90 percent of the population in the province usually resided within the Province; see *Figure 4.34*.

Figure 4.34 *Migration Trends Mashonaland West Province*



Districts

As with the national and provincial levels, there is no data on population in-migration Zambia. However, from the stakeholder consultation it was clear that a majority of people currently residing in Siavonga Town are migrants

from other parts of Zambia. This portion of the population either works in government, own businesses or trade in the district.

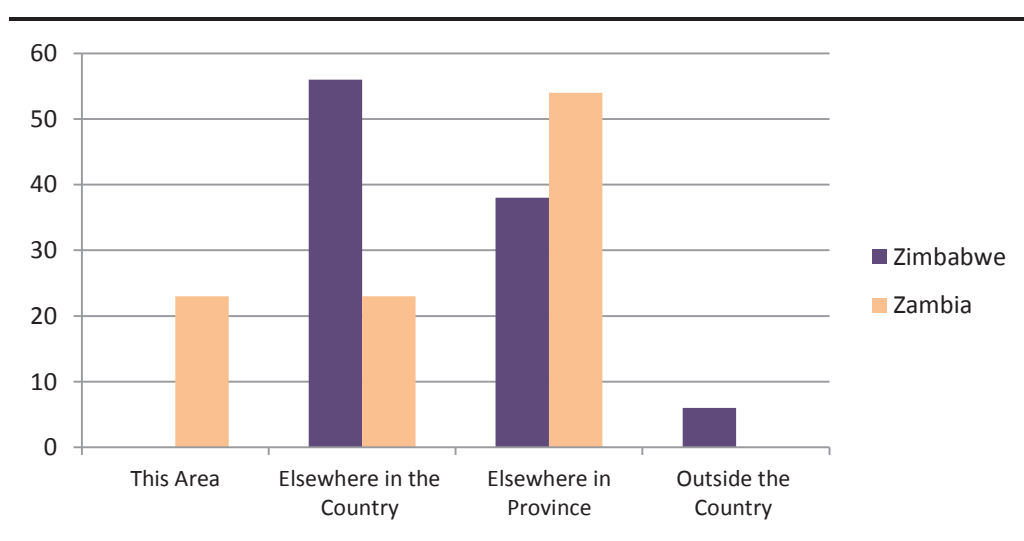
In Kariba Rural District, about 93 percent of the population usually lived in the same district. Four percent was from other districts within the same province, three percent from other provinces with Midlands being the main contributor. Eighty-four percent of the population usually resided in the same district, 10 percent in other districts and six percent in other provinces. Harare and Mashonaland Central were the largest contributors of people from other provinces.

Social Study Area

Of the people surveyed in Mahombekombe and Kariba Heights (Zimbabwe) and Micho and Siavonga Town (Zambia), the majority reported that they were migrants from elsewhere in the province or country. In Zimbabwe, the majority of population interviewed (56 percent) reported that they were from elsewhere in the country; while their Zambian counterparts reported that they were from elsewhere in the Southern province (at 54 percent); see *Figure 4.35*. One foreign national was interviewed in Kariba Heights who reported that she was Malawian.

They all stated that they moved into the areas around Lake Kariba in search of employment and business opportunities within the formal and informal sectors of the economy. One of the District officials in Zambia reported that the majority of the population that reside in the Siavonga moved to the area to partake in the fishing and tourism activities; while a small percentage move to the area work for government (these people include teachers, district officials, and health workers).

Figure 4.35 *Place of Birth of the Population in Percentages*



In the SSA, the broad categories of people who should be considered to have some level of vulnerability include:

- Women;
- The elderly;
- Youth; and
- Disabled or chronically ill persons.

These groups are described in more detail below.

Women

Women are generally regarded as vulnerable in the African social context as they are often expected to fulfil traditional roles of women i.e., taking care of the household and raising children rather than seeking formal employment. In many cases women also lack education, mostly having attained only primary school level education. As such local women are unlikely to seek employment with the Project because of family duties.

The Elderly

The elderly are generally recognised as being vulnerable. The elderly remain in high social standing as long as they are productive; however, they lose this standing once they become dependent on the younger generations for assistance in meeting their basic needs (e.g., housing, water, food). The elderly are usually not in a position to take advantage of the benefits typically associated with large projects such as the Kariba Rehabilitation Project.

Youth

For the purposes of this assessment, youth are quantitatively defined as persons aged approximately 15 to 24 or, recognising variations by cultural context, qualitatively defined by their degree of independence with respect to their ability to secure a livelihood, their relationship status (i.e., marriage, children), and living arrangements.

Youth can be recognised as vulnerable, though in a way distinct from other categories listed above. Being at their physical prime but often facing an unknown future, youth may be seen as both empowered and disempowered. Youth are vulnerable in the sense that they are between dependence (childhood) and independence (adulthood) and, without access to resources and support to enable their transition to adulthood, youth may face a large degree of instability in their lives. Youth only inherit land once they have reached full adulthood and marriage, and until then are dependent on their parents.

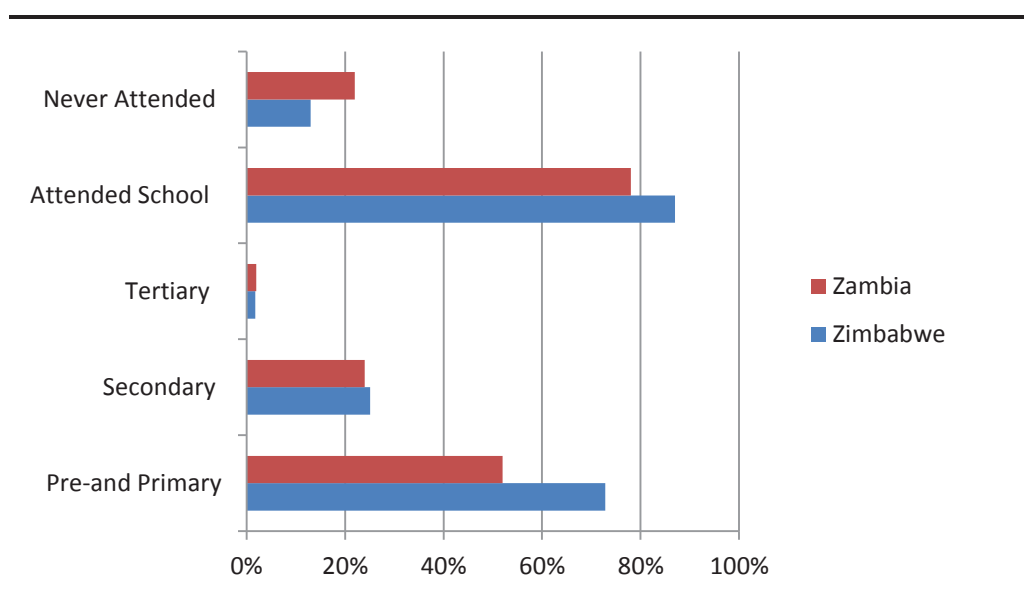
Disabled persons should be recognised as vulnerable as they are unlikely to be able to access the Project benefits but would also be vulnerable to change brought about by the Project. People living with HIV/AIDS and TB can be considered to be disabled as their ability to remain healthy and maintain their livelihoods is often compromised by their illness.

4.3.9 Education System and Services

National

Zimbabwe and Zambia have a dual education system that comprises of primary and secondary schooling. The total number of schooling years in Zimbabwe is 13 while in Zambia it is 15 years. For both countries, primary education takes the most years to complete seven (Zimbabwe) and nine (Zambia) years. The literacy levels of the population in both countries (Zimbabwe and Zambia) are regarded as high, especially amongst the youth (aged 15 to 24 years old); at 96 and 78 percent respectively. There are some youths in both countries that are illiterate as they have not received any schooling; see Figure 4.36 below for further details.

Figure 4.36 Education Levels



Source: Zimbabwe National Census Report, 2012; Zambia: 2010 Census of Population and Housing, Population Summary Report. June 2012

Provinces

A high percentage of the Southern Province population (44 percent) was recorded as illiterate; while in Mashonaland West Province, only 13 percent of was reported as being illiterate ⁽¹⁾. The differences in literacy levels between the two can be attributed to the following (based on general knowledge of the two countries and interviews with locals):

(1) Southern Province: Provincial Development Plan, undated

- After the Zimbabwean independence a significant emphasis was placed at educating the population, to such an extent that the country ended up with a large proportion of its population with having a tertiary education.
- Scattered settlement patterns in Zambia and lower school numbers in rural parts of the country has resulted in lower education levels relative to those in Zimbabwe.

An estimated 57 percent of the population in Mashonaland West were attending school in 2012 ⁽¹⁾. The proportion of the population aged 3-24 years, that had left school at the time of the census was 30 percent. In turn, in the Southern Province; school attendance at primary/basic school level was an estimated 86 percent during the 2000 Population Census. This revealed a three percent increase to primary/basic school level attendance compared to the 1990 Census. In the Southern Province, the numbers of students at secondary school during the same Census year were low at 60 percent. The attendance amongst females was lower at 49 percent compared to their counterparts at 63 percent. This was experienced mainly in the rural areas where early marriages are common practise. This development illuminates the growing imbalance in secondary education provision between the rural and urban areas.

Districts

Kariba had 30 primary schools with a total enrolment of 12,959 pupils comprising of 6,435 (51 percent) boys and 6, 524(49 percent) girls, indicating more boys than girls attend primary school in the area ⁽²⁾. There were 343 trained teachers at the schools; a teacher pupil ratio of 1:36 which is slightly less than the national average of 1:43 ⁽³⁾. Of the 30 schools, three were government owned; four owned by the local Town Council, while 23 belonged to the Rural District Council.

In 2011, Kariba has eleven secondary schools, which comprises of 2,144 boys and 1 698 girls ⁽⁴⁾. The total enrolment for all the schools in 2011 was an estimated 3,842 pupils ⁽⁵⁾. The teacher pupil ratio of 1:22 which is relatively low compared to the national teacher pupil ration of 1:43. Of the 11 schools, only one school was government owned one belonged to the Town Council whilst the remaining nine were owned by the Rural District Council ⁽⁶⁾. It is unclear how this divide in school ownership is derived.

(1) Zimbabwean Population Census: Mashonaland West, 2012

(2) Parliament Research Department: Kariba Constituency, 2011

(3) Parliament Research Department: Kariba Constituency, 2011

(4) Parliament Research Department: Kariba Constituency, 2011

(5) Parliament Research Department: Kariba Constituency, 2011

(6) Parliament Research Department: Kariba Constituency, 2011

Table 4.30 *Schools in Kariba District*

Types of Schools	Number of Schools	Ownership		
		Government	Town Council	Rural District Council
Primary	30	3	4	23
Secondary	11	1	1	9

Siavonga had 64 schools in 2010, these included nurseries, primary and high schools; as indicated in *Table 4.31* below ⁽¹⁾.

Table 4.31 *Schools in Siavonga District*

Type of School	Number	Ownership		Number in Planning Area	
		Govt.	Private	Govt.	Private
High Schools	5	4	1	1	0
Basic Schools	35	33	2	2	0
Community Schools	20	0	0	4	0
Elementary (Pre/Nursery School)	4	0	4	0	4

There has been an increase in school enrolment in the Siavonga District since 2009, which has been attributed to basic education being free. In 2009 an estimated 19,467 pupils were enrolled in Siavonga schools; of which 8,182 (42 percent) were girls while 11,285 (58 percent) were boys, see *Table 4.32* below.

Table 4.32 *School Enrolment in Siavonga District in 2009*

Category of Schools	Year 2009		
	Boys	Girls	Total
Basic Schools (Grades 1 – 4)	4293	2266	6,559
Basic Schools (Grades 5 – 7)	2556	2227	4783
Basic Schools (Grades 8 – 9)	1215	960	2175
Secondary Schools (Grades 8 – 12)	-	186	186
(Mubuyu Christian Academy)	-	-	-
High Schools (Grades 10 – 12)	857	466	1323
Schools for Continuing Education	-	-	-
Community Schools	1885	1840	3725
Interactive Radio Instruction (IRI)	382	334	716
Grand Total	11,285	8,182	19,467

As for the Kariba District, an estimated 7,538 pupils were enrolled in Kariba schools; of which 3,857 (51 percent) were girls while 3,681 (49 percent) were boys, see *Table 4.33* below.

(1) Siavonga District Status Quo, undated

Table 4.33 *School Enrolment in Kariba District in 2012*

School Levels	Male	Female	Total
Pre-School	9.2	9.7	9.4
Primary	56.3	55.7	56
Secondary	33.2	33.2	32.6
Tertiary	2.4	1.2	1.8
Other	0.2	0.2	0.2
Total percentage	100	100	100
Number	3,681	3,857	7,538

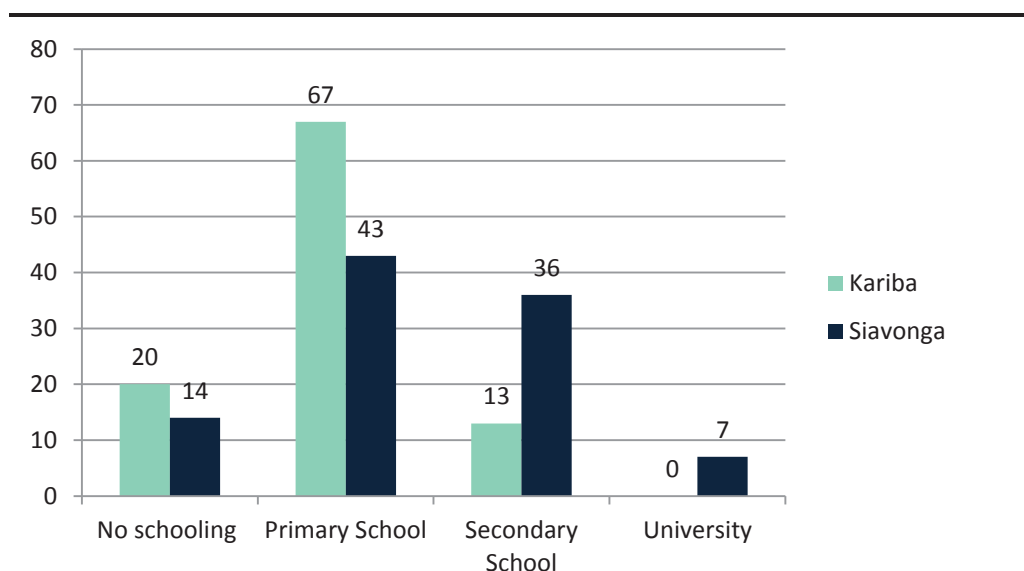
Source: Zimbabwean Population Census: Mashonaland West, 2012

Social Study Area

Amongst the adults interviewed 20 percent in Kariba (Zimbabwe) reported that they had no schooling. In turn, only 14 percent of the participants in Siavonga (Zambia) reportedly had not received any schooling.

Of the same groups, a large portion of the Kariba (Zimbabwe) group had primary schooling (67 percent); while in Siavonga (Zambia) only 43 percent had primary schooling. In contrast, a larger portion of the Siavonga population had secondary level education compared to those from Kariba at 36 and 13 percent, respectively; see *Figure 4.37* below.

Figure 4.37 *Education Levels of the Kariba and Siavonga (Surveyed Population only) in Percentages*



Please Note: the sample size for the surveyed population was 44 for Kariba District and 40 for Siavonga.

4.3.10 *Health Systems and Services*

Health services in Zimbabwe are divided into four levels of care: primary, secondary, tertiary, and quaternary; while the Zambian health services are divided into three levels namely Rural/Urban Health Centres, District

Hospitals and General Hospitals ⁽¹⁾. The Zimbabwean health facilities and health care provided at the different levels are summarised in *Table 4.34* below.

Table 4.34 *Health Care in Zimbabwe*

Levels	Description	Type of health care provided
Primary health care	This type of care is given by village health workers, community-based distributors and at small clinics/facilities. These services are particularly prevalent in rural areas. Primary health care facilities comprise of 78 percent of the total number of health facilities in the country. This level of health care consists of 1,118 rural health clinics, rural hospitals, and urban polyclinics.	Health care at this level tends to be basic prevention, as well as maternity and curative services; most facilities are managed by a nurse, or sometimes a number of nurses in larger urban areas. Complicated cases are referred to the District Hospitals. Primary care facilities are administered by community, ward, and rural health committees, and are under the supervision of the DHO.
Secondary health care	Secondary care consists of facilities that receive patients via referrals from the primary care facilities. These facilities account for three percent of the total number of health facilities in the country. These include 46 district hospitals and five mission hospitals. District hospitals are administered by a hospital and district health committee.	Services at this level should be able to deal with emergencies referred from primary care facilities; in practice, many of these facilities, especially the district and mission hospitals, are the closest health facility for a community, and therefore they also provide primary health care services. For specialty health services, or more complex health matters than what the district health staff can treat, district facilities may refer patients to tertiary health facilities.
Tertiary health care	Tertiary health care consist of Provincial hospitals and account for one percent of the total number of health facilities in the country. There are 7 such facilities available. Tertiary care is also available at some private clinics and hospitals located in Zimbabwe's largest cities. Many of the private clinics tend to be too expensive to afford for most Zimbabweans.	Provincial hospitals receive referral patients from district hospitals and have specialists on their staff to deal with complex health matters. However, the unique and extremely complicated cases are referred to the six central hospitals. These hospitals receive patients from all the provinces of Zimbabwe.
Quaternary/central care	Quaternary or central care consists of six central hospitals distributed over Bulawayo, Harare, and Chitungwiza. These hospitals have the most advanced equipment, staff, and pharmaceuticals for dealing with severe illnesses and medical cases.	The central hospitals have the largest specialist and clinician staff complement. These hospitals are the highest level of health referrals. Central hospitals report directly to the MOHCW.

Source: http://www.healthsystemassessment.com/wp-content/uploads/2012/06/Zimbabwe_Health_System_Assessment2010.pdf

(1) http://www.healthsystemassessment.com/wp-content/uploads/2012/06/Zimbabwe_Health_System_Assessment2010.pdf

The health systems in Zambia are classified into three major categories:

- **First Level Services** – comprising of health posts, rural health centres and district hospitals, where primary healthcare and preventive health services are provided.
- **Second Level Services** – comprising the provincial and general hospitals, which provide the curative care.
- **Tertiary Level Services** – comprising a central hospital and the national university teaching hospital which provide specialized care.

The Zambian health facilities and health care provided at the different levels are summarised in *Table 4.35*.

Table 4.35 *Health Care in Zambia*

Levels	Description	Type of health care provided
Health Posts	These are the lowest levels of health care and are built in communities far away from health centres. Currently, there are 307 Health Posts in the country. These cater for a catchment population of approximately 3,500 in rural areas and 1,000 to 7,000 in the urban settings and are set up within five kilometres radius for sparsely populated areas.	The types of health services offered at this level are basic first aid rather than curative.
Health Centre	There are two types of health centres in the health care delivery system in the Zambia. These include urban health centres or clinics (UHC). These serve a catchment population of between 30,000 to 50,000 people; and Rural Health Centre (RHCs) which serves up to 10,000 people.	The centres act as the first level referral points where a person cannot be assisted at a health post. There were 409 Urban Health Centres and 1,131 Rural Health Centres in 2012.
First Level Hospitals	First level hospitals, also referred to as District Hospitals are found at district level. These serve a population of between 80,000 and 20,000 and provide services such as medical, surgical, obstetric and diagnostic services and all clinical in support of health centre referrals.	These serve as the second and third level referral hospitals. There were 84 first level hospitals in 2012.

Levels	Description	Type of health care provided
Second Level Hospitals	Second level hospitals, also referred to as Provincial or General Hospitals, and they are found at provincial level. They are intended to cater for a catchment area of between 200,000 and 800,000 people.	The services provided include general surgery, paediatrics, obstetrics and gynaecology, dental, psychiatry and intensive care services. These hospitals also act as referrals for the first level institutions, including the provision of technical back up and training functions. There were 19 Second Level Hospitals in 2012.
Third Level Hospitals	Third level hospitals also called specialist or tertiary hospitals and they are the highest referral hospitals in the country. These hospitals cater for a catchment population of approximately 800,000 and above, and	These provide medical services to all complicated cases not attended to at second level hospitals and serves as referral for the third level hospitals. The services provided by this level including surgery, paediatrics, obstetrics, gynaecology, intensive care, psychiatry, training and research. In 2012, there are 6 third level hospitals in the country.

Source: <http://www.moh.gov.zm/docs/facilities.pdf>

The provision of health care is poor in both countries. Their health care budgets are below the Abuja Declaration's goal for health care budgets at a target of 15 percent of a country's total budget. In 2009, the total health expenditure in Zimbabwe was USD 42.5 million, which was a significant increase from previous years and approximately 4.8 percent of their GDP ⁽¹⁾.

The life expectancy in both countries is 57 years and 58 years respectively for Zambia and Zimbabwe. Zambia has a higher death rate to that of Zimbabwe at 11 percent and 10 percent respectively ⁽²⁾. Zambia has a higher birth rate than Zimbabwe at 43 percent in relation to the 32 percent of Zimbabwe.

The prevalence of HIV/Aids is slightly lower in Zambia compared to Zimbabwe at 13 percent and 15 percent respectively ⁽³⁾. It is reported that condom use as a means of HIV/Aids prevention as well as comprehensive knowledge of HIV/Aids is lower in Zambia than in Zimbabwe ⁽⁴⁾. Further information on health indicators for each country are summarised in *Table 4.36* below.

(1) CIA World Fact Book

(2) http://www.unicef.org/infobycountry/zimbabwe_statistics.html;

http://www.unicef.org/infobycountry/zambia_statistics.html

(3) http://www.unicef.org/infobycountry/zimbabwe_statistics.html;

http://www.unicef.org/infobycountry/zambia_statistics.html

(4) http://www.unicef.org/infobycountry/zimbabwe_statistics.html;

http://www.unicef.org/infobycountry/zambia_statistics.html

Table 4.36 Health Indicators

Indicators	Zambia	Zimbabwe
Crude death rate	10.7	9.7
Crude birth rate	43	31.6
Life expectancy	57	58.1
Total fertility rate	5.7	3.6
HIV/AIDS		
Adult HIV prevalence (%)	12.7	14.7
People of all ages living with HIV (estimated number)	1,100	1,400
Women living with HIV (total number)	490	700
Children living with HIV (total number)	160	180
Percentage using HIV preventative measures among young people (aged 15-24), (%), total	4.1	5.1
Percentage using HIV preventative measures among young people (aged 15-24), Comprehensive knowledge of HIV (%), male	40.7	47
Percentage using HIV preventative measures among young people (aged 15-24), Comprehensive knowledge of HIV (%), female	37.8	51.9
Percentage using HIV preventative measures among young people (aged 15-24), Condom use among young people with multiple partners (%), male	43.1	50.5
Percentage using HIV preventative measures among young people (aged 15-24), Condom use among young people with multiple partners (%), female	41.5	38.5
Orphans, Children orphaned by AIDS	670	890
Orphans, Children orphaned due to all causes	1,400	1,200

Source: http://www.unicef.org/infobycountry/zimbabwe_statistics.html;
http://www.unicef.org/infobycountry/zambia_statistics.html

Provinces

In Mashonaland Province, Acute Respiratory Infections (ARI), malaria, skin diseases and injuries are the five major causes of going to a health facility. Tuberculosis (TB), ARI, HIV/AIDS, malaria and other viral diseases are reported to be the top five causes of mortality ⁽¹⁾.

The overall crude death rate in the Mashonaland Province is an estimated 11 deaths per 1,000 people. Chegutu Rural and Hurungwe Districts experience the most deaths at 12 deaths per 1,000 people ⁽²⁾.

(1) Population Census: Mashonaland West Province Report, 2012

(2) Population Census: Mashonaland West Province Report, 2012

The birth rate for the **Mashonaland West Province** was recorded at of 4 children per female. When comparing the birth rate to the education levels of the women; women with higher educational had less children compared to the ones with low education levels ⁽¹⁾. The infant mortality rate is estimated at 65 deaths per 1,000 births and infant mortality was high in rural areas as compared to urban areas ⁽²⁾. This is likely due to rural women not proactively seeking prenatal care.

Extreme poverty is one of the key health problems in **the Southern Province**. An estimated 47.3 percent of the population is affected thereby ⁽³⁾. This despite the fact, that the incidence of poverty has reportedly declined from 73 percent of the total provincial population in 2006 to 68 percent of the total provincial population in 2010 ⁽⁴⁾; thus representing a decline of 5.1 percent in poverty. The incidence of poverty is generally higher in rural areas than urban areas. Female headed households are generally most vulnerable to the incidence of poverty. Poverty is highest amongst those people with a lower level of education, the unemployed and non-farming communities.

The HIV/Aids infection rate in the province is estimated at 14.5 percent. Of those with HIV/Aids, 17.4 percent receive antiretroviral treatment ⁽⁵⁾. The province has a total of 53 health facilities that are able to provide antiretroviral medication to adults and children. In the population age bracket, 15 to 24 years, females have a more comprehensive and accurate knowledge and understanding of HIV/Aids than males ⁽⁶⁾. However, knowledge does not equate to prevention of infection with HIV/Aids and the population between 15 and 24 years, remains at a higher risk than other age groups to be infected with HIV/AIDs.

Districts

The Siavonga District has a health facility for each of its catchment areas. This includes two District hospitals and 12 health posts and centres ⁽⁷⁾. In 2010, malaria, malnutrition, respiratory infection (pneumonia), anaemia, diarrhoea (non-blood), severe diarrhoea with dehydration, and poisoning were the main causes of deaths ⁽⁸⁾.

There are 12 health centres in Kariba District and these consist of one district hospital and five clinics. All the health centres have access roads, access to electricity and sewerage systems. The Kariba Urban Primary Health Level comprises of Nyamhunga and Mahombekombe clinics that provide the first point of contact between the communities, Home Based Care Givers (HBCG) and the formal health delivery system. This level provides

(1) Population Census: Mashonaland West Province Report, 2012

(2) Population Census: Mashonaland West Province Report, 2012

(3) Millennium Development Goals (MDGs): Provincial Profile of Southern Province, 2013

(4) Millennium Development Goals (MDGs): Provincial Profile of Southern Province, 2013

(5) Millennium Development Goals (MDGs): Provincial Profile of Southern Province, 2013

(6) Millennium Development Goals (MDGs): Provincial Profile of Southern Province, 2013

(7) Siavonga IDP Status Quo, Undated

(8) Siavonga IDP Status Quo, undated

comprehensive, promotive, preventative, curative and rehabilitative health services. The crude death rate in Kariba is 10 per 1,000 people. Common illnesses include cholera, malaria, upper respiratory tract infections, HIV/Aids and others.

4.3.11 *Economy and Livelihoods*

This *Section* provides an overview of the economic and livelihood activities in the respective countries, provinces and districts.

National

In Zimbabwe, the growth rate of the gross domestic product (GDP) decelerated to 3.7 percent in 2013, from 4.4 percent in 2012 ⁽¹⁾. According to the African Economic Outlook, the economic deceleration was due to limited sources of capital, policy uncertainty, and the high cost of doing business. In 2013, the economy experienced a decline in most economic sectors that had previously made high contributions to the GDP such as the agricultural and mining sectors. In turn, sectors that had contributed less to the economy in 2012, contributed the most in 2013. These include the wholesale and retail trade, hotels and restaurants sector, manufacturing, other services; finance, real estate and business services and construction sectors; see *Table 4.37*.

In 2013, the “wholesale and retail trade, hotels and restaurants” sector of the economy overtook the agricultural sector and became the highest contributor to the country’s GDP at 15.3 percent. This sector was followed by manufacturing (13.6 percent), and the agriculture, hunting, forestry, fishing sectors at 13.1 percent (which signified a drop of seven percent) ⁽²⁾.

Table 4.37 *Sectorial Contribution to the GDP: Zimbabwe in 2013*

Economic Sectors	Percentage to GDP
Wholesale and retail trade, hotels and restaurants	15.3
Manufacturing	13.6
Agriculture, hunting, forestry, fishing	13.1
Transport, storage and communication	12.8
Other services	12.3
Finance, real estate and business services	11.3
Mining	10.1
Electricity, gas and water	4.3
Public administration, education, health and social work, community, social and personal services	3.7
Construction	3.6

Source: African Economic Outlook: Zimbabwe, 2014

The Zambian economic growth is said to have decreased to 6.5 percent in 2013 due to the fall in agricultural output, particularly maize and cotton ⁽³⁾. The

(1) African Economic Outlook: Zimbabwe, 2014

(2) African Economic Outlook: Zimbabwe, 2014

(3) African Economic Outlook: Zambia, 2014

growth in real GDP was largely driven by manufacturing, mining, construction, transport, communications and the public sector in 2013, see *Table 4.38*. Copper mining remained the economy's main support, and contributed an estimated 70 percent to the country's export earnings. The country's GDP was projected to grow to approximately 7.1 percent in 2014 and 7.4 percent in 2015 ⁽¹⁾.

Table 4.38 *Sectorial Contribution to the GDP: Zambia in 2013*

Economic Sectors	Percentage Contribution to GDP
Agriculture, hunting, forestry, fishing	17.7
Agriculture (of which fishing)	0.5
Mining (of which oil)	2.2
Manufacturing	8.2
Electricity, gas and water	3
Construction	15.1
Wholesale and retail trade, hotels and restaurants	1.9
Transport, storage and communication	3.9
Finance, real estate and business services	9.2
Public administration, education, health and social work, community, social and personal services	2.9
Other services	8.8

Source: African Economic Outlook: Zambia, 2014

The Zambian Government has recognised that there is a lack of diversity in its economy and has outlined growth targets in *Zambian Vision 2030* to create more diverse opportunities. The plan involves continued development of the historically dominant sectors, namely industry and tourism. In addition, emphasis is now being placed on modernising the agricultural sector, improving efficiency and productivity in the services sector and expanding the mining sector ⁽²⁾ further.

Agriculture remains a key livelihood activity, particularly in rural areas. Over 80 percent of the population depends on agriculture-related activities for their livelihoods ⁽³⁾. The government acknowledges the challenges facing the agricultural sector namely:

- Farming activities are mainly undertaken for subsistence reasons. It makes a minimal contribution to the earning of export revenue for the country. Agricultural activities have high production costs further compounded by limited access to long-term financing and credit services.
- The agricultural sector suffers from a shortage of skills, particularly for veterinary and extension services.

As part of addressing the above challenges and growing the agricultural sector, government is planning to improve the allocation of necessary

(1) African Economic Outlook: Zambia, 2014

(2) Zambia Vision 2030

(3) Six National Development Plan, 2011 - 2015

resources to the agricultural sector, increase investments in agricultural infrastructure as well as ensure crop diversification. This is discussed in Box 4.2 below.

Box 4.2 *Government's Plans to Improve Agricultural Activities in Zambia*

To boost **crop and livestock production diversification**, the government plans to expand coverage of the Farmer Input Support Programme to other crops such as soya, cotton, sunflower, and rice.

To alleviate delays in input distribution which impacted negatively on the sector in 2012, government plans to introduce an **electronic voucher (e-voucher)** system from 2013. The e-voucher system is expected to strengthen the role of the private sector in supplying agricultural inputs.

Livestock restocking, streamlining of policy and scaling-up of extension services, irrigation and research are additional policy measures being undertaken to increase agricultural productivity.

Source: African Economic Outlook: Zambia, 2012

Provinces

The economy of Mashonaland West is dominated by the **agricultural sector** and includes commercial, communal and subsistence farming. Commercial crops produced include cereals (wheat and maize), soya beans, tobacco, sugar beans, groundnuts and sunflowers. Over 70 percent of the country's total pig population ⁽¹⁾ is produced in the Province.

Mining: mineral resources are found mainly along the Great Dyke that is in the Kadoma and Gweru Mining Districts in the Mashonaland West and Midlands provinces, respectively. In addition, other mines are scattered throughout the country. Mashonaland West is known for mining gold, silver, chrome, iron pyrites, limestone, nickel, silica and platinum.

Tourism: is focused in and around Lake Kariba and the Chinhoyi Caves. Fishing and other water-based tourism activities are two of the most popular tourist activities.

Other major economic sectors include fishing, construction, law and security, as well as the business and finance sectors.

Agriculture (both livestock and crop production) form the primary economic activity in the Southern Province of Zambia. Crop production is undertaken both on a commercial and subsistence scale. Cash crops include cotton, tobacco and oil seeds; whilst food crops consist of maize and sorghum. More than 90 percent of the Province's income is derived from agriculture ⁽²⁾. Currently, the agriculture sector in the Province has a share of 18-20 percent in

(1) Provincial Strategic Plan: Southern Province, 2008 – 2010

(2) Provincial Strategic Plan: Southern Province, 2008 – 2010

the Gross Domestic Product (GDP) ⁽¹⁾. In *Table 4.39* the food and cash crops production statistics for the 2005/6 production season is illustrated.

Table 4.39 *Food and Cash Crops Production in 2005/6: Commercial and Small-scale*

Crop Type	Commercial ton/ha	Small-scale ton/ha
Small Scale Crops		
Maize	4.43	2.36
Sorghum	0.9	0.47
Millet	5.5	0.3
Commercial Crops		
Cotton	1.6	0.86
Sugar cane	136	-
Tobacco	2.13	1.04

Source: Provincial Strategic Plan: Southern Province, 2008 – 2010

Livestock production is an important activity to both commercial and small-scale farmers. It is also an important cultural heritage activity of the Tonga people. The most popular livestock produced are cattle. However, the cattle population has drastically declined over the past years due to diseases such as corridor disease. The livestock sector in Southern Province comprises around 700,000 cattle; 317,100 goats; 25,100 sheep; 46,200 pigs and 542,500 poultry ⁽²⁾. Poultry production is estimated at one million broiler birds per year. There are 50,000 commercial layers for egg production in the commercial and small-scale sector. This is illustrated in *Table 4.40* following.

Table 4.40 *Livestock Population Trends in the Southern Province*

Livestock	Year				
	2003	2004	2005	2006	2007
Cattle	580,065	613,859	642,252	667,785	784,451
Goats	267,449	291,104	282,589	317,106	332,035
Sheep	20,815	20,646	19,870	25,048	34,593
Pigs	42,967	51,799	42,378	46,200	61,647
Poultry	489,241	585,646	494,293	542,553	600,832
TOTAL	820,472	949,195	839,130	930,907	1,029,107

Source: Provincial Strategic Plan: Southern Province, 2008 – 2010

Forests in Southern Province are estimated to cover an area of about 6,600,000 ha representing more than 70 percent of the total land area of the Province. About half of this area (3,210,000 ha) is gazetted as Game Management Areas (GMA), National Parks (NP) and Forest Reserves (FR). ⁽³⁾. Forests play a vital role in people's socio-economic well-being: it provides food in the form of fruit, tubers, wild vegetables, bush meat, edible insects, mushrooms and honey. Forests are also sources of medicine, wood-fuel and building materials for the rural population. The Joint Forest Management (JFM) of the Province revealed that the contribution of forests to household income in the area

(1) Provincial Strategic Plan: Southern Province, 2008 – 2010

(2) Provincial Strategic Plan: Southern Province, 2008 – 2010

(3) Provincial Strategic Plan: Southern Province, 2008 – 2010

ranged between 5 percent to 70 percent of the household income and averages at 17.1 percent ⁽¹⁾.

Fishing is also an important economic and livelihoods activity in the Southern Province. The fisheries are situated on the middle and lower Zambezi River, Lake Kariba, Lake Itzhi-Tezhi and the Kafue River and flats. The most prevalent fish species in the Province are *Tilapia rendalli* (Red Breasted Bream); *Oreochromis andersonii* (Three Spotted Bream); *Oreochromis macrochir* (Green Headed Bream); *Limnothrissa miodon* (Kapenta) and *Alestes lateralis* (Chitaka) ⁽²⁾. Fish bred in fisheries are the Bream and *Oreochromis niloticus* as is indicated in Table 4.41 below.

Table 4.41 *Fish Production Estimates in Metric Tonnes (all species)*

Fishing Area	2000	2001	2002	2003	2004	2005	2006	2007
Kafue	6,131	6,437	6,437	6,100	6,228	6,062	5,539	6,763
Kariba	8,863	9,306	9,306	8,818	9,003	8,768	8,008	9,776
Lower Zambezi	588	617	617	585	597	581	531	649
Itzhi-Tezhi	2,221	2,332	2,332	2,210	2,256	2,196	2,007	2,450
Total	17,803	18,692	18,692	17,713	18,084	17,607	16,085	19,638
Kapenta Fishing								
	9,176	5,666	4,416	7,481	6,574	6,251	7,659	9,476

Source: Provincial Strategic Plan: Southern Province, 2008 – 2010

Districts and Social Study Area

The economies of the **Siavonga** and **Kariba Districts**, comprises of fishing including (agro-fisheries, subsistence and commercial); tourism (including safaris); agriculture and businesses. The majority of the businesses (excluding tourism) are informal. The local informal markets sell a wide range of goods and services which includes clothing, perishables, and arts and crafts targeted at tourists visiting Lake Kariba.

Trading

Formal and informal trading occur across the Project Area; with formal trading focused mainly on tourism related activities such as safaris, boat cruises, hotels/inns and restaurants. In turn, informal trading is focused on the sale of clothing, and food items inclusive of fisheries resources.

Informal trading serves as the main source of livelihoods for a large portion of the population in both Siavonga and Kariba Districts. Informal trading occurs daily in formal and informal market places in both Project Areas. The markets often consist of a mixture of types of trading structures, such as formally constructed shops or make-shift stalls comprising of tables and crates to display sale goods. Usually the type of structure is indicative of the type of goods being sold (*i.e.* traders who sell groceries often trade in formal

(1) Provincial Strategic Plan: Southern Province, 2008 – 2010

(2) Provincial Strategic Plan: Southern Province, 2008 – 2010

structures while traders selling fish or vegetables, trade from temporary make-shift structures; see *Figure 4.38* below.

Figure 4.38 Some Traders in Siavonga, Zambia



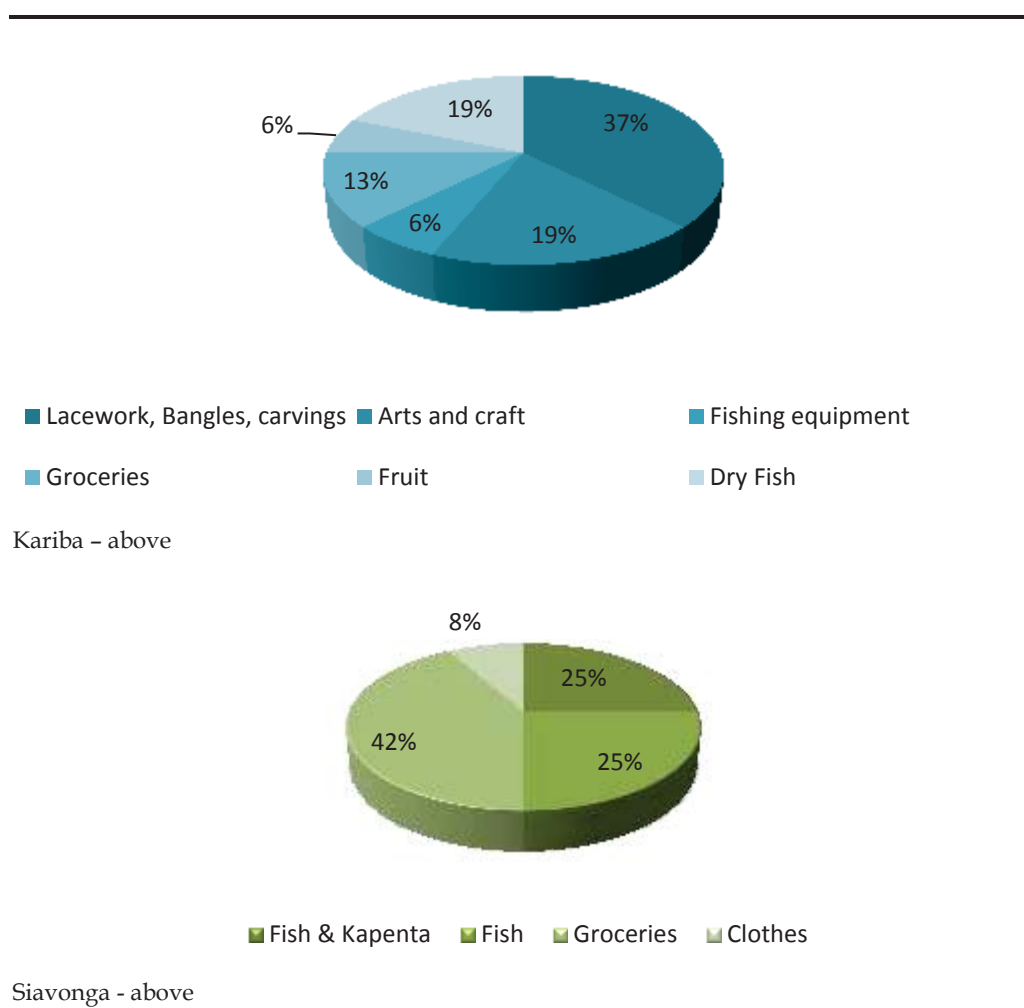
Figure 4.39 Some Traders in Kairiba, Zimbabwe



Traders in government designated trading areas must have a trading license which is issued by the local government. Trading license is renewable and payable on a monthly basis. Informal traders in the Kariba District must pay a rate of five dollars per stall monthly.

Amongst traders interviewed in Mahombekombe and Kariba Heights, approximately 37 percent sold lacework, bangles and carvings; followed by those that sold arts and crafts (at 19 percent) and dried fish (mainly kapenta, also at 19 percent) (refer to *Figure 4.40*). The main fish sellers in Mahombekombe were the fishers (this is not a common phenomenon since in other African countries, only women usually sell fish); whereas arts and crafts and other accessories were being sold mainly by women followed by 24 percent that sell groceries; while 21 percent sell accessories such as bangles, earrings and key chains; and 17 percent are fish traders consisting of a mixture of men and women.

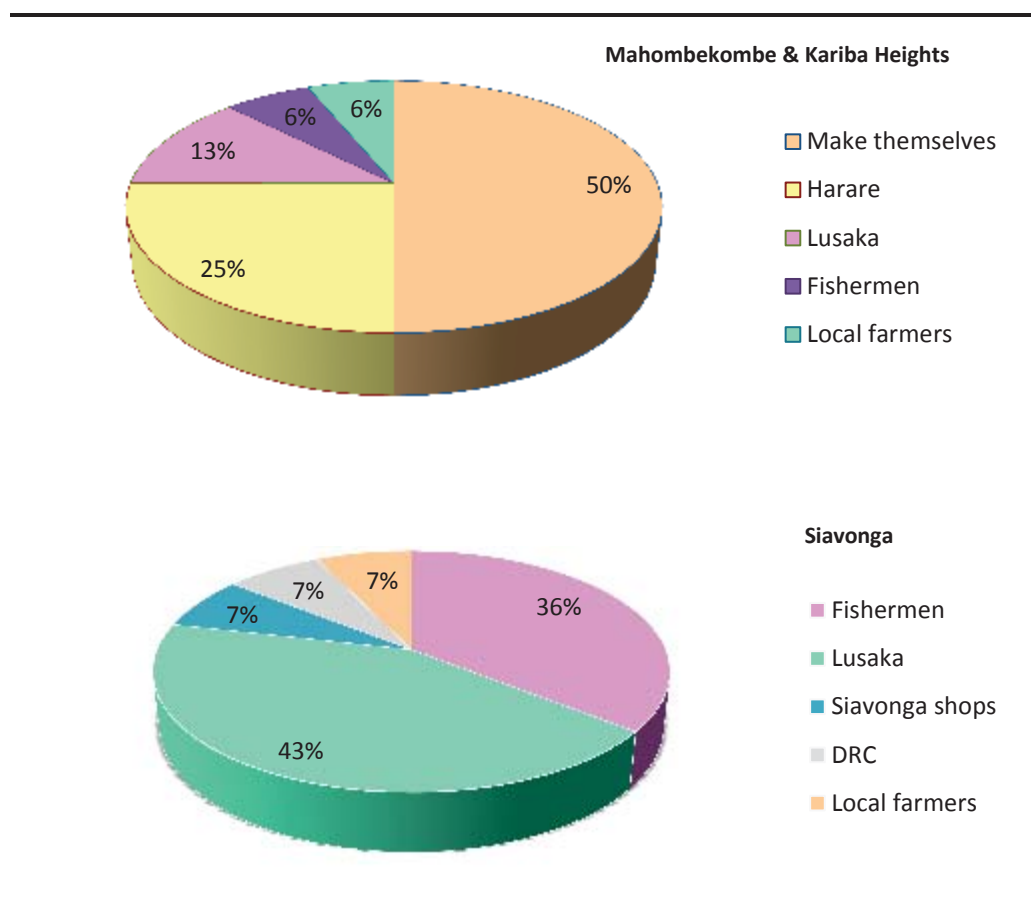
Figure 4.40 *Items Commonly Sold at Local Markets in the Social Study Area*



In Siavonga, the majority of the interviewees traded groceries at 42 percent, followed by those who sold fish (bream and others) and kapenta at 25 percent respectively; see *Figure 4.40*.

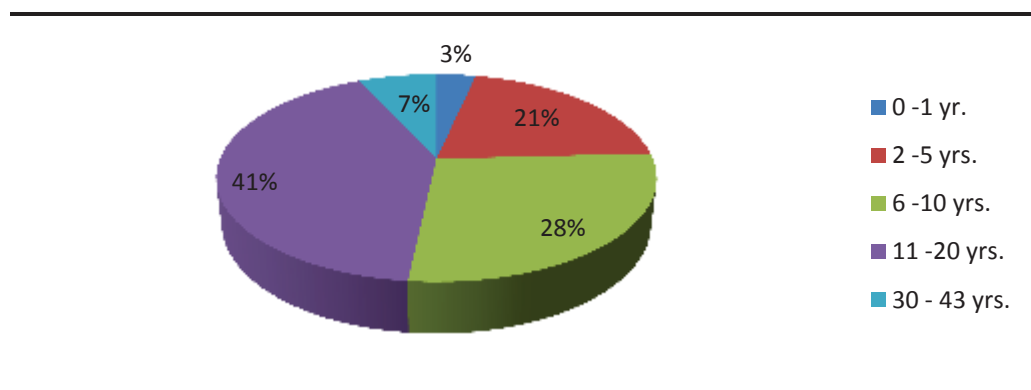
The majority of arts and craft traders reported that they produce their own items; while others purchased items in Harare. Grocery store owners, the majority of clothes sellers and vegetable and fruit traders, purchase the majority of their goods in the large cities *i.e.* Harare and Lusaka. One of the clothes' sellers reported that he often purchases special clothing items from the Democratic Republic of the Congo (DRC). . This is illustrated in *Figure 4.41* below.

Figure 4.41 *Source of Traded Items*



The majority (41 percent) of the traders interviewed have been trading for at least the past eleven to 20 years. Two of them have been trading for over 30 and 43 years, respectively. Only one respondent has been trading for less than a year. This is illustrated in *Figure 4.42* below.

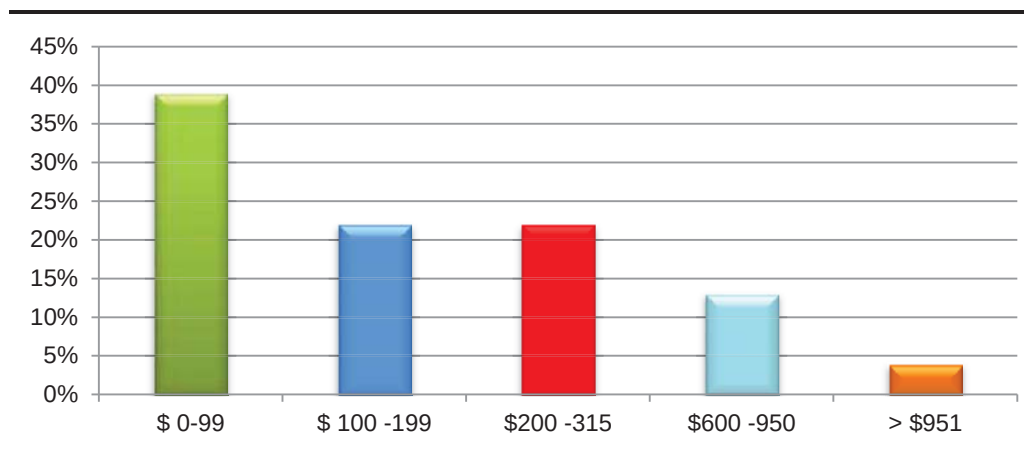
Figure 4.42 *Number of Years as Trading*



The income generated from informal trading activities varies greatly, depending on the type of trading activity. For example, in Siavonga Town fruit and vegetable trader can earn up to eight dollars a month. Fishermen sometimes earn nothing in certain months as they are catching and processing

fish around the small islands across Lake Kariba. People who sell and fix fishing equipment can earn up to USD 4,000 per month in peak-season. Those that sell arts and crafts can earn as little as USD 40 per month during the off-season; but as much as USD 150 to USD 400 during the peak tourist season. The monthly income patterns of traders are presented in broad categories in *Figure 4.43* below. The broad categorisation is needed due to the disparities between categories of data linked to the limited sample size.

Figure 4.43 *Monthly Income of Traders*



Fishing Activities

Fishing occurs on various scales across Lake Kariba, *i.e. at an industrial or commercial scale or at an artisanal and small scale*. The types of fishing that occurs on Lake Kariba include *kapenta* (offshore), gillnet fish (inshore) and limited numbers of crayfish. Commercial and artisanal fishing is discussed in more detail below.

Industrial and Commercial Fishing

The industrial and commercial fishers do not only fish in Lake Kariba. Some of them breed their own fish such as predominantly *tilapia*. One of the most notable commercial fisheries' companies operating from both countries is Lake Harvest Aquaculture. Lake Harvest breed, catch, process and sell its fish to the packaging companies in Harare and Lusaka for on-processing and resale to the public. The Lake Harvest fish is fed special food which has not been modified genetically. Only mature fish are harvested. The feed is imported from Mauritius and it takes between six to eight months for delivery. The delivery timeframes of the feed is one of Lake Harvest's major commercial challenges ⁽¹⁾.

Lake Harvest breeds the fish in floating cages close to islands on the Lake. They employ people from the Siavonga and Kariba Districts. One of the managers reported that Lake Harvest Zambia harvests an estimated 65 tonnes of fish per week. The company employs local people of both sexes and

(1) Pers. Comms, Sept/Oct 2014

provides them with the necessary training to do their work such as diving lessons.

In Siavonga District, the Siavonga Kapenta Industries Limited (S.K.I.) is one of the main kapenta fishing enterprises. The commercial kapenta fishers tend to fish at night when they use high powered lights to attract the kapenta into large “dip nets” suspended just below the water surface.

Artisanal Fishers

The artisanal fishers comprise of local men and incoming participants who moved into the area for this purpose. In both Districts, artisanal fishers must obtain a fishing license from the local government. Although the activities of artisanal fishers are regulated, their knowledge of fishing laws and regulations seemed very limited upon closer questioning. They reported that the fisheries departments gave them instructions on when to fish or not to fish and how much they should pay for their licenses.

- Kapenta Fishing:

Kapenta (*or* *Limnothrissa miodon*) was introduced into Lake Kariba in the 1970's as a potential source of protein and since then their numbers have grown significantly ⁽¹⁾. Currently (2014) it is one of the two countries' major sources of refrigeration-free protein foods, see *Figure 4.44*.

Figure 4.44 *A Typical Kapenta Fishing Boat and Kapenta Packaged for Sale*



The surveyed kapenta fishers in Mahombekombe reported that they only do kapenta fishing. The fishers, fish daily from the period just after dusk to just before dawn except for the days when there is a full moon. Then they do not fish the reason being that the local legend states that the light from the moon frightens the fish away resulting in a reduced catch.

According to the information provided by the fishers, the kapenta are attracted to the fishing rig by surface lights. Underwater lights at depths of as

(1) <http://www.siavonga-zambia.com/kapenta-fishing/siavonga-kapenta-industries.html>

20 to 40 m below the surface attract the kapenta to concentrate at the mouth of the net. The surface lights are turned off after several hours and the net hoisted to the surface to harvest the kapenta.

During a good season an estimated 100 kg of kapenta are caught daily which translates to six tonnes per month. During a bad season, the fishers may harvest as little as 30 to 50 kg and only about one tonne per month.

The processing of the fish occurs onshore. The kapenta is sun dried on stilted racks and then packaged. Packaging is into five kilogram bags which are sold for USD 5 per five kilograms during peak-season. During the off-season, the price increases to USD 6 per five kilograms. The price of kapenta is not regulated so fishers make a joint decision as to when prices should be increased or decreased.

Interviews with the kapenta fishers (in two FGDs of 8 and 9 individuals in Mahombekombe) yielded that the fishers do not own the boats and other fishing equipment or the land on which they operate. They lease the equipment and land from local people. The fishers pay a monthly rental for the use. In addition to the rental amount they are responsible for maintaining the equipment and for refuelling the boats. Transporting of the kapenta to Harare is done with public transport specifically a company by name “Swift Transportation”. They are a courier service and charges per kilogram transported. Other fishers use local busses to Harare and pay about USD 3 per 50 kg bag of kapenta; see Figure 4.45.

Figure 4.45 *Kapenta Drying out in the Sun in Mahombekombe*



- Gillnet Fishing:

The fishers interviewed in Siavonga Town reported that they only undertake gillnet fishing and the fish targeted are bream, bottle fish, tiger fish, and babel fish; see Table 4.42.

Table 4.42 *Percentage breakdown of Fish Type Caught by Gillnet Fishers*

Fish Type	Percentage
Bream	50%

Fish Type	Percentage
Bottlefish	23%
Tigerfish	21%
Barbelfish	6%

The majority of the fishers reported that they fish in sub-basin four and sometimes in sub-basins one and five, respectively. Gillnet fishing is supposed to be undertaken for 20 days a month as per the ruling of the fisheries department; but some of the fishers reported that they fish daily. There are two times of the day that gillnet fishing occurs according to the fishers; some start fishing from four to six in the morning while others reported that they fish from seven in the evening until late at night.

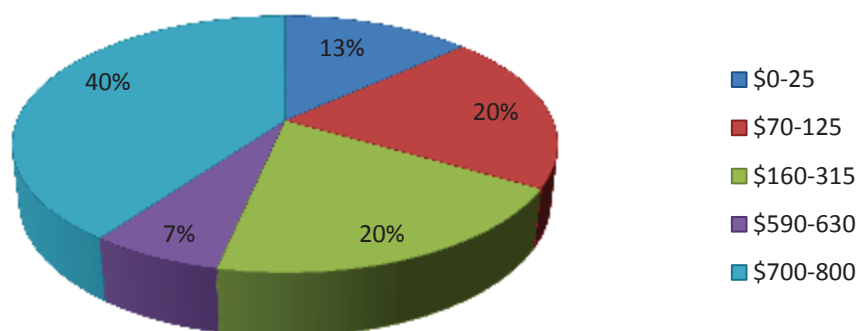
As stated previously, unlike in other African countries where the fish is done by men and the women process the fish; in Siavonga the fishers (who are men) process their own fish (clean and dry /or smoke it). Some fishers tend to migrate to some of the small islands found on the lake to do their fishing. When on the islands they catch and process the fish (*i.e.*, clean and dry it) in preparation for to sell it on their return. The fishers either sell the processed fish to the women or sell it themselves during the ten days that they are not allowed to fish; see *Figure 4.46* fishers returning from fishing.

Figure 4.46 *Fishers Returning from the Fishing Islands*



According to the fishers (both kapenta and gillnet), the personal sell of fish is the most profitable compared to the fishing because when they are on the islands they generate no income. Based on the survey results the kapenta fishers make more money (\$700 to \$800/ month) than the gillnet fishers (\$25 to \$630/ month). The cause for the disparity is unclear it could be based on the sale prices of different fish or the varying catch sizes or other reasons not explained. *Figure 4.47* presents the income generated by fishers in broad income groups which have been influenced by the small survey sample.

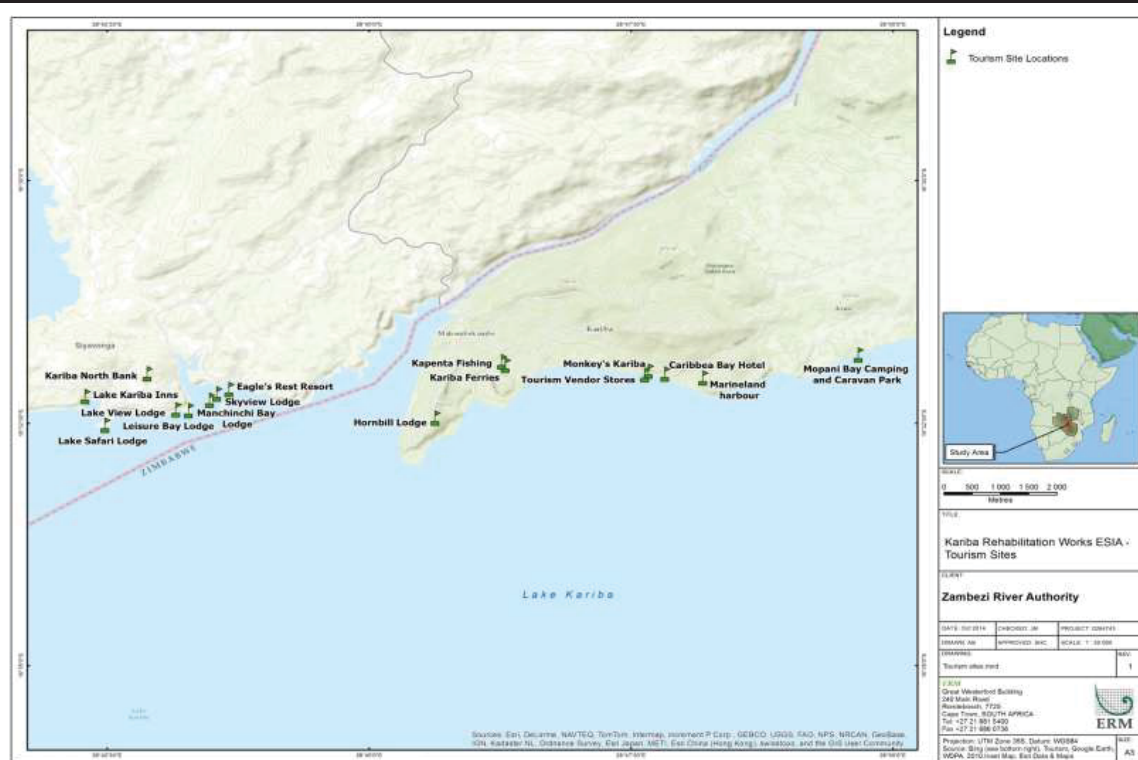
Figure 4.47 *Monthly Income Derived from Kapenta and Gillnet Fishing*



Tourism Activities

Tourism in both Kariba and Siavonga Districts forms an important part of the economy and similarly to the fisheries industry, tourism in the area is driven by the presence of Lake Kariba. Another tourism stimulator in the area are the multiple protected areas found in close proximity to lake (especially on the Zimbabwean side of the boarder), as indicated in *Figure 4.48*.

Figure 4.48 Selected Tourism in Project Area



Tourism in Kariba District

According to the Zimbabwean Tourism Agency (ZTA); there are currently more than 60 tourism operators registered on their database. These include hotels, lodges, tour operators and safaris, as well as speed boats and houseboats. The most popular of tourism operators are indicated in *Table 4.43* below.

Table 4.43 *Some Tourism Operators in Kariba District*

Type of Tourism	Tourism Operator
Hotels	Caribbea Bay Hotel Cutty Sark Hotel
Lodges	Dzimbabwe Mzimkhulu
Safaris	Natureways Mystic Tours
Speed boats and Houseboats	Marineland Zambezi Trader

All tourism operators are expected to register their businesses with the local government and pay registration and operation fees depending on the type of activities undertaken; see *Table 4.44* which indicates the amounts paid by the different operators.

Table 4.44 *Tourism Operators Licence Fees in Kariba District*

Tourism Operations	Registration Fees
Boats (ferries, speed and house boats)	\$350
Safari	\$500
Hunting	\$1,000
Annual Licence Fees (Est)	\$ 300

According to the ZTA, the majority of tourists who visit the area are domestic including government officials (mainly for conferences). There are limited numbers of foreign tourists in the area; the majority comes from Europe and South Africa. Long weekends, such as the Easter and school holidays as well as the festive season bring the most tourists in the area. The majority of which are domestic returners (who reside in other countries). Major events that attraction high numbers of visitors include the tiger fish tournament which is held annually from the 21st to 24th of October; and the half marathon that is held sometime in August annually. These events attract international visitors to the area; see *Figure 4.49*.

Figure 4.49 *Marineland in Zimbabwe*



Tourism in Siavonga District

Similarly to the Kariba District, Siavonga District has a well-developed tourism industry propelled by the presence of Lake Kariba. The industry comprise of hotels, lodges, conference centres, boating, fishing, sunset cruises, canoeing, water sports, bird watching, cultural village tours, visits to the dam wall and power station ⁽¹⁾. Most of the larger hotels/ or lodges focus mainly on hosting conferences in addition to general tourism, while the smaller hotels/ or lodges and resorts focus specifically on tourism and provide a wide variety of tours and other activities ⁽²⁾. In addition, there are one-to- three days canoe safaris and/or river rafting on the Lower Zambezi River as well as overnight in the houseboat charters on the Lake from one-to-ten days cruises.

Unlike the Zimbabwean side of the boarder, there are no protected areas close to the lake on the Zambian side. There are some hippos and crocodiles which are frequently seen on the lake shores. However, there is a variety of birds that have been seen in the area; these include the African fish eagle, *bateleur* eagle, harrier hawk and martial eagle, the sacred ibis, saddle-billed stork, malachite kingfisher and the lilac breasted roller, etc. ⁽³⁾.

Subsistence Farming

Both Districts (Kariba and Siavonga) are situated in provinces known for intensive agricultural activities (commercial and subsistence). However, the locals do not undertake any extensive agricultural activities in the area. A limited number of households (within five kilometre of the dam wall (in Zambia) keep livestock; even so, they struggle to access the water for the livestock especially in the dry season.

Furthermore, in Kariba and Siavonga, to be slightly higher numbers of in-migrants, who moved to the areas in search of employment and business opportunities, as such they do not own land but rent houses and rooms in the

(1) [http:// www.zambiatourism.com/](http://www.zambiatourism.com/)

(2) [http:// www.zambiatourism.com/](http://www.zambiatourism.com/)

(3) [http:// www.zambiatourism.com/](http://www.zambiatourism.com/)

local areas. Even those who sell fruits and vegetables in both Kariba and Siavonga travel to Harare and Lusaka, respectively, to procure these.

4.3.12 *Employment and Unemployment Levels*

Zimbabwe had a higher labour force compared to that of Zambia 87 and 75 percent respectively ⁽¹⁾. In both countries the labour force participation by males was high than that of females; which is a typical trend amongst African countries. Furthermore, the labour force participation is higher in both countries amongst the rural dwellers at 91 and 84 percent respectively in the rural areas and 84 and 66 percent in the urban areas. The data also shows a slightly higher employment rate in rural areas than in urban areas (81 and 66 percent respectively). This is attributed to subsistence and small scale farming being considered employment as farmers earn their livelihoods from the sale of their crops to Government (specifically in Zambia), private agencies, commercially as well as local markets; see *Table 4.45* below.

Table 4.45 *National Labour force Survey in Zimbabwe and Zambia*

Labour force Indicator	Zimbabwe in %	Zambia in %
Size of the Labour force	87	75
Overall Participation of the Labour Force		
Female	85	69
Male	89	80
Labour force Participation – Rural Areas	91	81
Labour force Participation – Urban Areas	84	66

Source: Preliminary Results of the 2012 Labour-force Survey (May 2013); Zimbabwe Labour Force Survey 2011

The agricultural sector is the largest employer in both countries (66 percent - Zimbabwe and 56 percent- Zambia); the agricultural sector was said to employ the majority of the rural population in both countries ⁽²⁾. This can be attributed to the majority of the population of both countries residing in rural areas than urban area.

The urban population of Zambia is employed in the trade, wholesale and retail distribution sector employs 24.5 percent; whilst the urban population of Zimbabwe is involved in the elementary occupations account for 11 percent, service and sales workers 10.5 percent ⁽³⁾. Unemployment is low in both countries at 7.9 and 10.5 percent, respectively. This can be attributed to the economically active population's engagement in agricultural activities; see *Table 4.46*.

(1) Preliminary Results of the 2012 Labour-force Survey (May 2013); Zimbabwe Labour Force Survey 2011

(2) Preliminary Results of the 2012 Labour-force Survey (May 2013); Zimbabwe Labour Force Survey 2011

(3) Preliminary Results of the 2012 Labour-force Survey (May 2013); Zimbabwe Labour Force Survey 2011

Table 4.46 *Employment Status of the Population: Zimbabwe and Zambia*

Indicator	Zambia in %	Zimbabwe in %
Informal Employment	88.7	84
Formal Employment	11.3	11
Unclassified	-	5
Employed	92.1	89.3
Unemployed	7.9	10.5

Source: Preliminary Results of the 2012 Labour-force Survey (May 2013); Zimbabwe Labour Force Survey 2011

Provinces

Mashonaland West Province had a higher labour force participation compared to the Southern Province, 88.4 and 76.4 percent respectively. Similarly to the national trends, the male participation in the employment was high than that of their female counterparts (Southern Province -male participation rate (81.1 percent) than female (71.8 percent) ⁽¹⁾); While in Mashonaland male participation rate was 90.8 percent) and female (86.2 percent) ⁽²⁾.

In both Provinces, the agricultural sector serves as the main employer; employing 58 percent of the labour force (in the Southern Province- and 54.8 percent in Mashonaland West. The unemployment rate in the Southern Province was lower than that of Mashonaland West at 4.8 percent ⁽³⁾, (which is lower than that of the national level of 7.9 percent. Unemployment rate in Mashonaland West is approximately 11 percent ⁽⁴⁾, which is in line with the national rate of 10.7 percent.

Districts

The unemployment rate in Kariba is 22.28 percent, while in Kariba Rural 22.51 percent ⁽⁵⁾, which is almost double that of the National and Provincial unemployment rates. The primary occupation in Kariba Rural is agriculture, which is undertaken by 72.1 percent of the economically active population, followed by services, which employs 9.6 percent ⁽⁶⁾. In contrast, only 17.9 percent of the population in Kariba participation in agriculture, and the services sector is the primary occupation, undertaken by 28.7 percent ⁽⁷⁾. Mining and construction and transport are also prominent occupations in Kariba with 6.2 percent and 6.9 percent of the population engaged in these activities respectively ⁽⁸⁾. This disparity can be attributed to the largely urban nature of the Kariba District.

(1) Preliminary Results of the 2012 Labour-force Survey (May 2013)

(2) Zimbabwe Labour Force Survey 2011

(3) Chapter 6 Economic Characteristics

(4) Zimbabwe National Census Report 2012

(5) Mashonaland West Province Report

(6) Mashonaland West Province Report

(7) Mashonaland West Province Report

(8) Mashonaland West Province Report

There is statistical data on employment for Siavonga District. The District's IDP report states that formal employment is provided by the fishing industry, tourism (lodges), central government, and energy mainly hydro-power generation (ZESCO). In turn the informal sector employs the most people especially, fisheries and trade.

The employment levels within the formal sector of employment are limited to government, parastatals and tourism sectors in both Kariba and Siavonga. However, the informal sector of the economy employs significant number of people in the area who engage in trading as well as artisanal fishing.

4.3.13 Public Infrastructure and Services

This *Section* describes access to public infrastructure and services in the countries, provinces, districts and SSA.

Water and Sanitation

Access to improved water sources in Zambia was lower at 49 percent, compared to that of Zimbabwe where 79 percent have access to an improved source of water. The population in urban areas in both countries have better access to improved, with Zimbabwe at 95 percent in urban areas and 70 percent in rural areas; while in Zambia 83 percent urban and 19 percent in the rural areas ⁽¹⁾.

In Zambia more than half of the households (56 percent) draw their water from an unimproved source. In rural areas of Zimbabwe, tube-wells/ or boreholes are the main source of drinking water (37 percent), followed by protected and unprotected dug wells (21 percent and 17 percent, respectively) ⁽²⁾.

In Zambia, an estimated 36 percent use appropriate water treatment method; whilst only 22 percent in Zimbabwe treats its unimproved water before consuming. The most used method of water treatment in Zambia is chlorine, with 44 percent of households using it in urban areas ⁽³⁾. Boiling the water prior to consumption was another method used in Zambia by the urban population at 26 percent. Both these treatment methods were used less in the rural areas at 19 and nine percent, respectively.

In turn, in Zimbabwe most households using unimproved water sources did not treat its water (78 percent); whilst nine percent of households boil their water, and 14 percent use bleach or chlorine ⁽⁴⁾. The sources, type and treatment regime of water in both countries is summarised in *Table 4.47* below.

(1) Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007

(2) Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007

(3) Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007

(4) Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007

Table 4.47 Household Portable Water Characteristics in Zambia and Zimbabwe

Characteristic	Zimbabwe		Zambia	
Source of drinking water	Households	Population	Households	Population
Improved Source				
Piped water into dwelling/yard/plot	28.8	25.4	41	41.8
Public tap/standpipe	4.7	3.7	14	13.2
Tubewell/borehole	28.4	30.4	0	0
Protected dug well	16	16.5	12.3	12.6
Protected spring	0.7	0.7	0	0
Rainwater	0	0	0	0
Bottled water	0.1	0.1		
Non-improved source				
Unprotected dug well	12.7	13.8	55.8	55
Unprotected spring	2.4	2.6	35	34.9
Tanker truck/cart with drum	0.3	0.2	0	0
Surface water	5.8	6.4	20.7	20.1
Other source	0.1	0.2	3.3	3.2
Percentage using any improved source of drinking water	78.7	76.7	41.1	41.9
Time to obtain drinking water (round trip)				
Water on premises	42.4	39.4	22.2	23.9
Less than 30 minutes	36.1	37.1	54.3	52.7
30 minutes or longer	20.6	22.8	22.5	22.6
Don't know	0.9	0.8	1	0.8
Water treatment prior to drinking				
Boiled	8.6	8.2	15.2	16.2
Bleach/chlorine added	14.4	15.4	27.2	28.9
Strained through cloth	0.1	0.1	0.1	0.2
Ceramic, sand or other filter	0.3	0.4	0.1	0
Solar disinfection	0.1	0	0.1	0
Other	0.6	0.6	0.8	0.8
No treatment	78.1	77.6	65.1	63.2
Percentage using an appropriate treatment method	21.5	22	34.2	36.1

Sources: Zimbabwe Demographic and Health Survey (2011); and Zambia Demographic and Health Survey, 2007

Access to improved sanitation facilities is poor in Zambia especially amongst the rural population 20 percent overall and 11 percent in the rural areas ⁽¹⁾. In the urban centres, water supply and sanitation services are reticulated; however, the infrastructure in many of the towns is old and outdated. This results in the systems being overused and unable to meet demand. In Zimbabwe, an estimated 36 percent of households in Zimbabwe have improved toilet facilities that are not shared with other households ⁽²⁾. Slightly less than half of these households have flush toilets, mainly toilets connected to a piped sewer system (13 percent).

Almost four in ten households in Zambia (39 percent) use pit latrines that are open or have no slab: 27 percent in urban areas and 45 percent in rural areas.

(1) Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007

(2) Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007

Flush toilets are mainly found in urban areas and are used by 26 percent of households, compared with one percent in rural areas. Overall, 39 percent of households in Zimbabwe had no toilet facilities; with only 25 percent in Zambia ⁽¹⁾; see further information in *Table 4.48* below.

Table 4.48 *Access to Sanitation Facilities in Zambia and Zimbabwe in Percentages*

Type of Facility	Zimbabwe		Zambia	
	Household	Population	Household	Population
Improved, not shared facility	30.8	37.3	20.2	23.9
Flush/pour flush to piped sewer system	1.9	13.5	6.8	8.2
Flush/pour flush to septic tank	1.2	2.3	2.5	3
Flush/pour flush to pit latrine	0.5	0.7	0.2	0.3
Ventilated improved pit (VIP) latrine/toilet	16.4	12.6	4.6	5.2
Pit latrine with slab	10.7	8.1	6.1	7.2
Shared facility ¹	18.9	24.2	15.1	13.4
Flush/pour flush to piped sewer system	0.6	11.3	0	0
Flush/pour flush to septic tank	0.3	1	0.1	0.1
Flush/pour flush to pit latrine	0.1	0.7	0	0
Ventilated improved pit (VIP) latrine/Pit latrine with slab	11.5	6.8	0	0
Non-improved facility	6.4	4.4	25.9	38.5
Flush/pour flush not to sewer/septic tank/pit latrine	50.3	38.5	79.8	76.1
Pit latrine without slab/open pit	0.1	0.3	0.1	0.1
Bucket	11.5	9.3	38.5	38.5
No facility/bush/field	0	0.5	0	0
Other	38.6	28.3	25.2	23.5
	0.1	0.1	0.7	0.5

Source: Zimbabwe Demographic and Health Survey (2011); Zambia Demographic and health Survey, 2007

Districts and Social Study Area

The availability of portable water in the Districts varies based on where the household is located. Households based in the urban parts of the Districts have access to pipe water inside the dwelling; while households located in the peri-urban areas have access to communal taps located within 500m of their households. However, communities in the rural areas, access water in boreholes/ or springs, communal taps (with two or more kilometres from the household). Even though some communities have access to communal water taps, the water may not be clean. For instance, in the settlement of Micho, the population complained that the water from the communal taps sometimes comes out with faecal matter in it. This is an indication that the sewage and portable water pipes run to one another at some point and both are leaking which has resulted in the contamination of the portable water.

Similarly to access to water, access to improved sanitation is dependent on the location of the household. The urban population has access to improved

(1) Zambia Demographic and health Survey, 2007

sanitation facilities while the peri-urban communities have a mixture of improved and unimproved sanitation. The rural population uses pit latrines due to a lack of water in the dwelling and required sewage system.

All government offices have access to pipe water and flush toilet facilities in both Kariba and Siavonga.

Transportation

Road Networks

The major urban centres in Zambia are connected via road. The main trunk roads include the Great North Road, which runs from Lusaka through the Central, Northern and Muchinga Provinces, up to the Tanzanian border town of Tunduma. The Great East Road runs from Lusaka through the Eastern Province up to the Malawian border. Other trunk roads include the Lusaka-Livingstone road and the Lusaka-Chirundu border post road. Road passenger transport is operated by private companies. The government of Zambia is currently planning to construct approximately 8,000 km of new roads across the country ⁽¹⁾.

In turn, Zimbabwe has a fairly extensive road network, which connects the urban centres of the country to Harare. The main highways extend out from Harare to neighbouring countries Mozambique, South Africa and Zambia. The general condition of roads has deteriorated due to inadequate funding for regular maintenance ⁽²⁾.

Railway Networks

Zambia's railway infrastructure includes the TAZARA, which runs from Kapiri Mposhi and traverses through Mkushi and Serenje, terminating at the port city of Dar-es-Salaam in Tanzania as well the Railway systems of Zambia. The national railways which are operated as a concession by Railway Systems of Zambia stretch from Livingstone in the Southern Province through Lusaka, to the Copperbelt town of Kitwe. Both the TAZARA and Railway Systems of Zambia operate freight and passenger trains.

Zimbabwe has a rail network that covers an estimated 3,077 km; of which 318 km is belonging to Bulawayo-Beitbridge Railway (Private) Limited. Of the 2,759km maintained by the public sector through the National Railways of Zimbabwe, only 313km (Dabuka to Harare) was originally electrified, but it has been vandalized and is in a state of disrepair. This, coupled with reduced economic activity has negatively impacted the ability to utilise the railway network at its full capacity ⁽³⁾.

(1) Radio broadcast in February 2013

(2) Zimbabwe National Development Plan 2011 - 2015

(3) Zimbabwe National Development Plan 2011 - 2015

Provinces and Districts

The A1 highway is paved and traverses through Mashonaland West Province, from Harare to the Zimbabwe-Zambia border. Further there are two secondary unpaved roads which run in an east-west direction across the Province. The A1 highway crosses the border into Zambia where it becomes the T2 highway and then traverses the Southern Province. In addition, the T1 highway also traverses the Southern Province, and connects Livingston to Lusaka. The T1 further traverses through the Kariba and Siavonga districts. The secondary roads in the districts are mostly paved and though some have potholes.

Modes of Transportation

The commonly used modes of transport in both countries, are bicycles, animal drawn carts and wheelbarrows, specifically in Zimbabwe. This is reflected in *Table 4.49* below.

In Zambia, an estimated 40 percent of the population uses bicycles as their main mode of transport, meaning that one in four people owns a bicycle. In Zimbabwe, a mixture of transport modes is used. The wheelbarrow as a mode of transport is used by 31 percent of people, followed by bicycles at 22 percent, animal drawn carts at 19 percent and cars and trucks at three percent.

Table 4.49 *Modes of Transportation*

Means of Transport	Zimbabwe			Zambia		
	Urban	Rural	Total	Urban	Rural	Total
Bicycle	20.7	23.5	22.6	27.1	47.8	40.6
Animal drawn cart	9.6	23.9	19	0.5	5.7	3.9
Motorcycle/scooter	1.6	0.9	1.1	0.4	0.4	0.4
Car/truck	15.6	3.1	7.3	6.5	0.6	2.7
Boat with a motor	0.6	0.1	0.3	0.2	0.1	0.1
Wheelbarrow	26.5	33.5	31.1	-	-	-
Tractor	1	0.7	0.8	-	-	-
Banana boat	-	-	-	0.3	3.8	2.6

Source: Zimbabwe National Census Report, 2012; Zambia Vision 2030.

4.3.14 *Sources of Energy*

In Zambia, access to electricity is generally limited. According to the Sixth National Development Plan, access to electricity increased from 20 percent of the population in 2005 to 22 percent of the population in 2009.

In 2010, only 3.5 percent of people in rural areas had access to electricity, compared to 48 percent in urban areas. This is largely due to the slow implementation pace of the Rural Electrification Programme. In recent years the country has been experiencing power shortages due to an increased demand by industry and mines, while supply has remained the same. Mining

operations are the primary user of energy in the country ⁽¹⁾. Firewood is the most common source of cooking fuel due to the poor rural electrification position. The high reliance on firewood and charcoal has resulted in increased deforestation across the country.

Hydroelectric power plants are responsible for 99 percent of electricity production in the country with the major sources being Kafue Gorge, Kariba North Bank and Victoria Falls power stations, which produce 900 MW, 600 MW and 108 MW respectively. Other small scale hydropower sources are the Mulungushi (28.5 MW) and Lunsemfwa (18 MW) hydropower plants. The country's hydropower resource potential is estimated at 6,000 MW that could potentially be harnessed to promote economic growth. Installed capacity is approximately 1,788 MW ⁽²⁾.

Zimbabwe's commercial sector is well supplied with electricity, however, wood fuel remains the primary source of energy for domestic use ⁽³⁾. Across the country, approximately 41 percent of households have access to electricity, leaving over half of the country without access to electricity ⁽⁴⁾. This explains the high use of wood fuel as a primary energy source as illustrated in *Table 4.50* following.

Table 4.50 *Access to Energy and Energy Sources*

	Zimbabwe			Zambia		
	Urban	Rural	Total	Urban	Rural	Total
Access to electricity	83.2	13.3	36.9	47.8	3	18.5
No access to electricity	16.8	86.7	63.1	52.2	97	81.5
Cooking Fuel						
Electricity	73.2	5.6	28.4	38.5	1.8	14.5
LPG/natural gas/biogas	0.4	0	0.2	0	0	0
Kerosene/paraffin	5.2	0.2	1.9	0	0	0
Jelly	0.1	0	0	0	0	0
Coal/lignite	0	0	0	0.6	0	0.2
Charcoal	0.2	0.1	0.1	53.1	10.2	25
Wood	19.8	93.9	68.9	7.5	87.8	60
Straw/shrubs/grass	0	0	0	0	0.1	0.1
Other	0.9	0	0.3	0	0	0
None	0.1	0	0	0.2	0.1	0.1

Source: Zimbabwe National Census Report, 2012; Zambia Vision 2030.

Provinces

In Mashonaland West, 43 percent of households have access to electricity. The remaining households rely on charcoal, fuel wood, candles, solar and other alternative sources of energy. Similarly to Mashonaland West, the majority of the population in the Southern Province has no access to electricity. This is

(1) Ministry of Energy and Water Development the Study for Power System Development Master Plan in Zambia Final Report (Summary), 2010

(2) Zambia Vision 2030

(3) Zimbabwe National Development Plan 2011 - 2015

(4) Zimbabwe National Census Report, 2012

despite the province being connected to the national grid and being an electricity producer. The rural and urban poor depend largely on natural resources. Forests provide an important source of energy with 69.3 percent of the population rely on firewood and only 17.8 percent on charcoal for cooking. This has exacerbated the over-exploitation of forest resources in the province.

Districts

There is a large disparity between urban and rural households' access to electricity in the Kariba District. Eighty eight percent of households in Kariba have access to electricity while the remaining 12 percent relies on natural resources such as gas, paraffin and solar power for energy. This is pattern seen across the country, as urban areas typically have better access to electricity than rural areas.

Even though the population of Siavonga reside close to a power station, household connections to the national grid are limited to 18 percent only. The remaining 82 percent of the households use other sources of energy for lighting and cooking; with charcoal being the main source of energy for cooking and solar and battery-fuelled camping-lights being used for lighting purposes ⁽¹⁾.

Similarly to the provincial and district levels; the Study Area has a lack of access to electricity and rely on charcoal, fuel wood, solar and other alternative sources of energy for lighting and cooking. Issues of affordability also play an important part in the lack of access to electricity.

4.3.15 *Culture and Heritage*

While there are no cultural heritages or archaeological monuments or remains, or grave sites in the Project area, the Kariba Dam does hold cultural heritage significance in the region.

Construction of the Kariba Dam

Currently at the Kariba Dam, conservation policies protect cultural heritage. The construction of the Kariba Dam and inundation of the valley represents a culturally significant event in the region. In 1958, engineers created the lake by damming the Zambezi River. Over the next five years, the reservoir flooded 5,580 square km, displacing 57,000 Tonga farmers and destroying habitat. In response to this, conservation-minded writers and photographers expressed shock and alarm (McDermott Hughes, 2006).

Gradually, the artificial lake has been accepted by most. One perspective is that the lake answered a deep European longing for water in inland, in semi-arid Africa, where Kariba Dam did the work of glaciers, carving intricate 'fjords' and 'lochs' in a country that previously lacked any shoreline. This perspective also holds that with the Kariba Dam, Europeans imported their

(1) Siavonga IDP, undated

hydrological heritage. Kariba Dam can be seen as an example of what has been until recently a hidden tension in ecological conservation: the tolerance of history and cultural heritage. It is argued that until now, Euro-Zimbabwean heritage has benefited disproportionately from that tolerance (McDermott Hughes, 2006).

Nyaminyami (Shingai River God) or Zambezi Snake Spirit

Shingai Musasiwa, also known as the Nyaminyami (Shingai River God) or Zambezi Snake spirit, is one of the most important gods of the Tonga people. Nyami Nyami is believed to protect the Tonga people, while also giving sustenance in difficult times. The Nyami Nyami is variously described as having the body of a snake and the head of a fish, a whirlpool or a river dragon, the Nyami Nyami is seen as the god of the Zambezi Valley and the river before the creation of the Kariba Dam. The Nyami Nyami is often depicted as a snake-like being or dragon-like creature with a head of a fish. Carvings of the Nyami Nyami can be found as pendants on jewelry, usually carved out of wood, stone or bone, occasionally ivory, silver or gold both as a fashion accessory and as a good luck charm. It is the traditional role of tribal elders and spirit mediums to intercede on behalf the inhabitants of the Zambezi River valley when Nyami Nyami is angered (Zambezi.com, 2007).

The Nyami Nyami is said to reside in the Zambezi River and control the life in and on the river. Furthermore, the spirits of Nyami Nyami and his wife residing in the Kariba Gorge are god and goddess of the underworld. Some Tonga people hold the belief that the building of the Kariba Dam deeply offended the Nyami Nyami, separating him from his wife. The regular flooding and deaths during the Kariba Dam's construction were attributed to his wrath. Some Tonga believe that once the Kariba Dam was completed that the Nyami Nyami withdrew from the world of men (Zambezi.com, 2007).

KEY FINDINGS – Social:

- The Tourism, trading and fishing are the primary sources of income and subsistence for population.
- Formal employment is mainly provided by the tourism sector, government services and commercial fishing companies.
- Due to a shortage of water for agricultural use, a limited number of people engage in agricultural activities i.e., livestock farming in Micho only.
- The SSA is highly accessible due to the paved public roads and the availability of public transportation.
- Trading of goods and other household items is undertaken daily.
- The population is literate, with a significant number of people having completed primary and some secondary schooling.
- Access to electricity is limited amongst households, because of lack of affordability.
- In settlements such as Micho there is a significant lack of sanitation facilities and where they exist the sewage system is inadequate.
- High levels of water borne illnesses such as malaria (SSA falls within a malaria region) and diarrhoea (unclear reasons).
- All communities have adequate access to primary health care services.