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Chapter 10

Integration of Ecological and Socioeconomic Factors in Securing Wildlife Dispersal Corridors in the Kavango-Zambezi Transfrontier Conservation Area, Southern Africa

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Additional information is available at the end of the chapter

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Abstract

Transfrontier conservation areas (TFCAs) are being established throughout southern Africa to integrating biodiversity conservation and rural development at the transboundary landscape scale. Among the nine TFCAs that have been established over the past 20 years, the Kavango-Zambezi (KAZA) TFCA) is the most grandiose in terms of size (≈ 520,000 Km^2), number of partner countries involved (five), elephant (Loxodonta africana) population (≈ 199,031, which is the largest on the African continent), and encompasses 36 protected areas of various categories, interspaced by communal and private lands. The TFCA concept aims to ensure that key ecological processes continue to function where borders have divided ecosystems, and wildlife migration corridors. Attainment of this ecological objective is however being constrained by the anthropogenic threats, mostly poaching, and habitat fragmentation. These threats are being aggravated by the increasing human population, climate variability and underdeveloped rural livelihoods. To restore ecological processes, the following tactics have been recommended: (a) strengthening of transboundary law enforcement to effectively reduce poaching, and illegal offtake of timber; (b) establishment of "Stepping Stones" in the form of conservancies and fishing protected zones at wildlife crossing point on the major river systems; (c) reducing dependence on woodfuel, and ensuring sustainable provision of affordable and reliable modern sources of energy; (d) adoption of the commodity-based trade standards in the production of beef for the export market to reduce the impact of veterinary fences on the dispersing wildlife; (e) implementation of early-season burning around all the sensitive biomes to protect them from the destructive late dry season fires; (f) adoption of conservation agriculture as a tool for improving land husbandry, intensification of agriculture,

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and decreasing the likelihood of cutting down forested areas to plant new agriculture fields; and (g) reducing the impact of climate variability on wildlife by providing artificial water – guided by environmental impact assessments. To enhance the socio-economic development of the local communities and win them as allies in securing the wildlife dispersal corridors, the following actions should be adopted: (a) promotion of community-private partnerships in ecotourism development – alongside the establishment of a revolving loan fund to enable local communities' access flexible source of capital for investment in ecotourism and auxiliary business opportunities; (b) promotion of biodiversity stewardship as an incentive for the local communities to commit their land to the sustenance of the wildlife dispersal corridors; (c) reducing human wildlife conflicts, through macro, meso and micro-level land-use planning to spatially delineate land committed to various categories, including protected areas, wildlife dispersal areas, and developed and communal areas; and (d) promotion of harmonised enabling policies and legislation to facilitate slowing down of human population growth, which is one of the prime triggers of habitat fragmentation in the KAZA TFCA.

Keywords: transfrontier conservation, securing wildlife dispersal corridors

1. Introduction

Transfrontier conservation areas (TFCAs) are being established throughout southern Africa as a means of integrating biodiversity conservation and rural development at the transboundary landscape scale. A TFCA can be defined as a part or components of a larger ecoregion that straddles the border between two or more countries, encompassing one or more protected areas as well as multiple-resource areas for the use of communities and private landholders, managed for the sustainable use of natural resources [1].

The TFCA concept recognises that borders are political rather than ecological and aims to ensure that key ecological processes continue to function where borders have divided ecosystems and/or wildlife migration corridors. The commitment by the Southern African Development Community (SADC) to establish TFCAs has been formalised in its regional treaties, such as those on Wildlife Conservation and Law Enforcement Shared Water Resources and Tourism, and has been accepted by the New Partnership for African Development (NEPAD) as a tool for promoting conservation of the shared biodiversity and promoting tourism development for the benefit of rural development [2].

At least nine TFCAs have been established in southern Africa over the past 20 years; among these, the Kavango-Zambezi (KAZA) TFCA (**Figure 1**) is the most grandiose in a number of aspects, such as size (≈ 520,000 Km^2), number of partner countries involved (Angola, Botswana, Namibia, Zambia and Zimbabwe) and elephant (*Loxodonta africana*) population (≈ 199,031, which is the largest on the African continent), and encompasses 36 protected areas (national parks, conservancies, game management areas and forest reserves), which are interspaced by communal and private lands.

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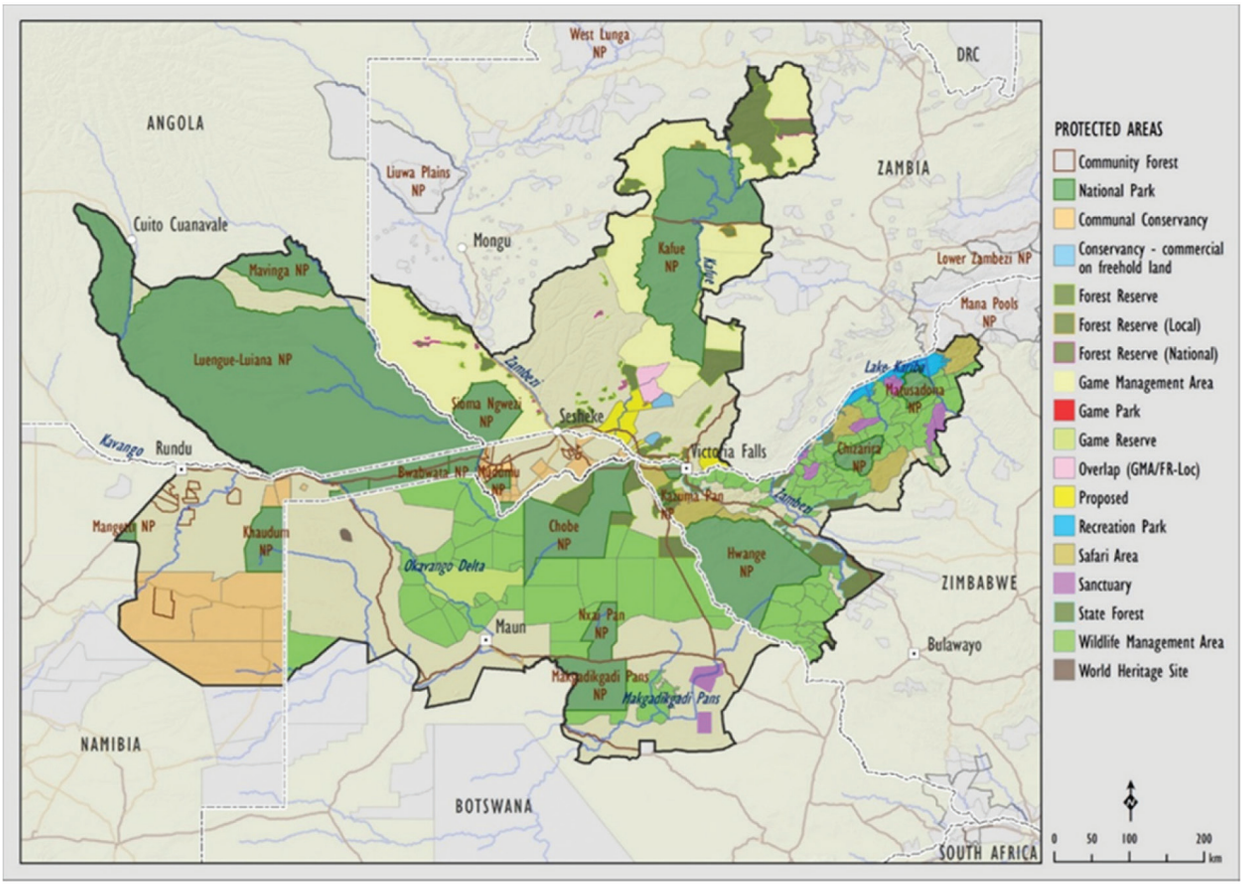

Figure 1. Map of KAZA TFCA, showing various land uses.

Formally established in June 2011, the objectives of the KAZA TFCA are primarily to:

(i) Protect the internationally shared biodiversity, including ecosystems and watersheds/water basins.

(ii) Increase the area available for wildlife and plant populations, thereby reducing the extinction risk due to stochastic events.

(iii) Re-establish seasonal wildlife migration routes and interconnectivity among the 36 protected areas (national parks, community conservancies and forest reserves) that occur in the KAZA TFCA

(iv) Increase economic opportunities for the local communities who bear the opportunity cost of interacting with wildlife, especially the wide-ranging species that traverse through communal areas to access resources, such as water and forage which are spatially far apart.

Attainment of the ecological objective of re-establishing seasonal wildlife migration routes and interconnectivity among the thirty-six protected areas in the KAZA TFCA to increase the area available for wildlife is however constrained by anthropogenic (human-induced) threats, which manifest on the ecosystems with potential to degrade and fragment valuable habitats and negatively impact on the wide-ranging terrestrial wildlife species.

In this chapter, we briefly elucidate on the factors that facilitate natural dispersal of wildlife in KAZA TFCA; highlight the anthropogenic threats that impinge on the viability, functioning and sustenance of the wildlife dispersal corridors (WDCs); and recommend a suite of tactics/strategies that would facilitate permeability of wildlife through the fragmented landscapes in the KAZA TFCA.

2. Factors that facilitate natural dispersal of wildlife in the KAZA TFCA landscape

Long-distance dispersal of terrestrial wildlife in the KAZA TFCA from one habitat patch to another has been observed for a number of the wide-ranging species, including the African elephant (*L. africana*), zebra (*Equus burchellii*), buffalo (*Syncerus caffer*), wildebeest (*Connochaetes gnou*), lion (*Panthera leo*), wild dog (*Lycaon pictus*), etc. Through telemetry studies, the priority wildlife dispersal corridors have been mapped (**Figure 2**). Movement of wild animals through these dispersal corridors and other unmapped areas can be influenced by a variety of factors, including local population condition (e.g. crowding and food availability), which trigger intra- and interspecific competition—resulting in some animals moving in search of suitable habitats and food resources which are scarce in space and time. Environmentally, stochasticity (e.g. weather and species interactions) may also contribute to substandard conditions in the local environment, which may affect changes in the animals' dispersal. Social systems, on the other hand, such as those relying on a single adult male for reproduction (e.g. a harem breeding system), may also force juvenile males born into a particular unit to disperse [3, 4].

Climate variability may also influence dispersal of wildlife in the KAZA TFCA. Although throughout the earth's history climate has always changed with ecosystems and species evolving and some getting extinct, the future projections of climate change on the African continent are of great concern. For instance, it is projected that by 2050, average temperatures in Africa are predicted to increase by 1.5–3°C, with warming likely to be larger than the global annual mean warming throughout the continent and in all seasons. Over the long term (2081–2100), an increase of 3–6°C is projected, with most of this warming in southern Africa to occur in Namibia, Angola and Botswana [5], which are covered by the KAZA TFCA. Furthermore, rainfall is likely to decrease, and by 2080, the proportion of arid and semiarid lands is likely to increase by 5–8%, and agriculture yields from rain-fed agriculture could be reduced by as much as 50%. These climate change scenarios have potential to affect ecosystems and species ability to adapt—affecting species abundance and distribution, community assemblages and functioning, loss of genetic diversity and change in ecosystem structure and functioning [5].

With respect to the free movement of wildlife in the KAZA TFCA, the most likely impact of climate change will be on the range and abundance shifts. The changing climate will stimulate

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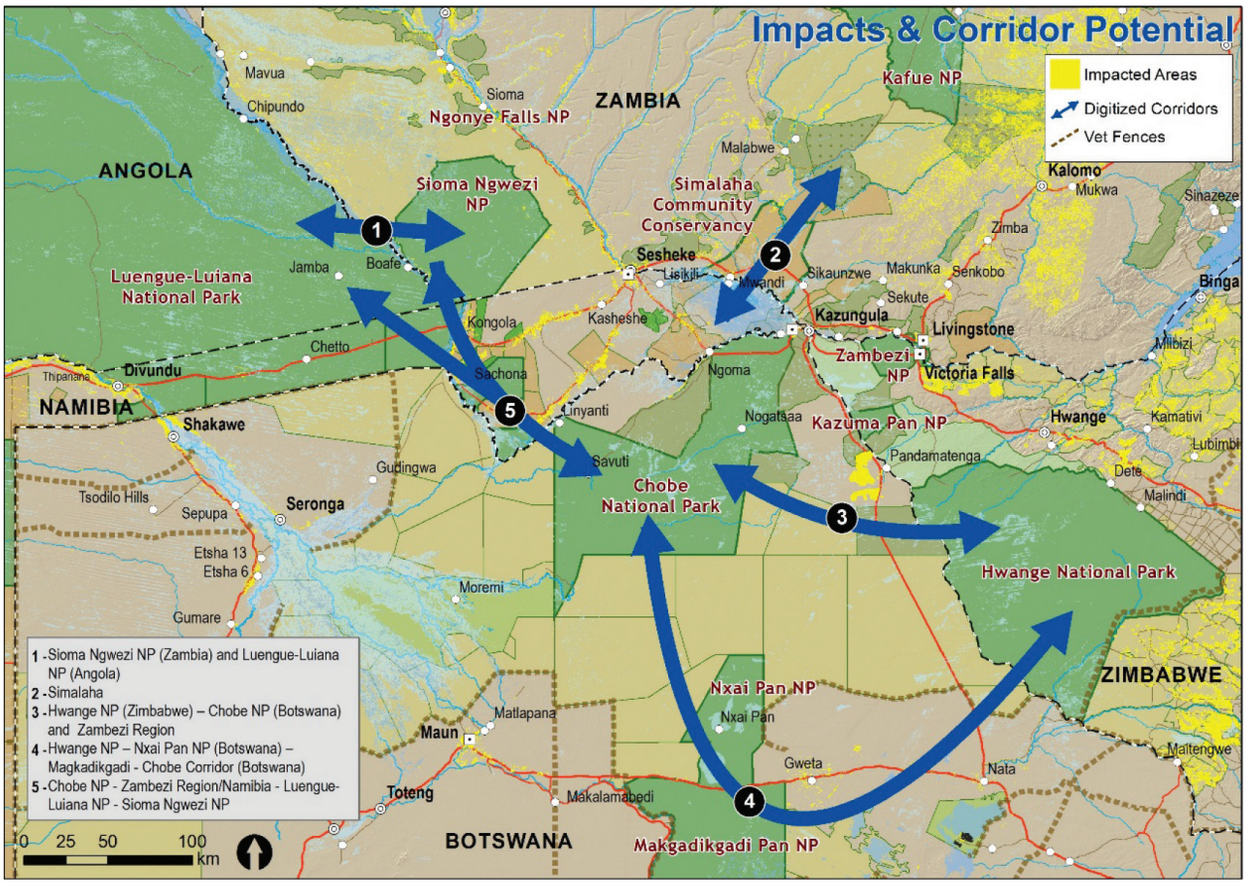

Figure 2. Priority wildlife dispersal corridors in the KAZA TFCA.

species-level changes in range and abundance, life cycle and behaviour and, over time, genetic evolutionary responses. These changes will in turn be linked with changes in natural disturbance patterns (**Figure 3**) and changes in ecosystem structure and function [5]. Species that are not easily dispersed will respond more slowly to climate change, likely

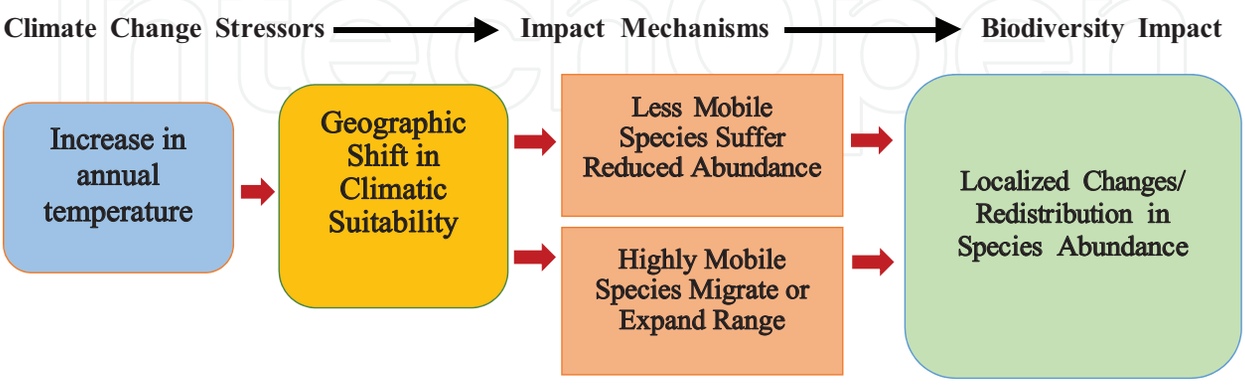

Figure 3. Climate change impacts on range and species abundance [5].

resulting in range contractions and reduced abundances. However, while the impact of climate change will be experienced throughout the KAZA TFCA, the Hwange-Makgadikgadi-Nxai Pan, Hwange-Kazuma-Chobe (**Figure 2**) and Khaudum-Ngamiland, which currently experience severe shortage of natural water, will be most affected.

3. Anthropogenic threats most pertinent to wildlife dispersal in the KAZA TFCA

3.1. Poaching

Three types of poaching [6] take place in the KAZA TFCA. These include:

(i) *Subsistence poaching*: typically targeting small game to meet subsistence needs, characterised by low technology (e.g. the use of traps and snares).

(ii) *Commercial poaching*: operating within organised syndicates that target commercially valuable species, e.g. elephants, lion, leopard (*Panthera pardus*), black rhino (*Diceros bicornis*), white rhino (*Ceratotherium simum*) and others. Commercial poachers use advanced technologies, including firearms, GPS, mobile phones, etc. Commercial poaching has devastating impact on wildlife populations on the African continent [7, 8].

(iii) *Hybrid form of poaching*: combining commercial and subsistence poaching, typically engaged in commercial hunting for bushmeat, which is a common phenomenon in east and southern Africa, including KAZA TFCA.

In the KAZA TFCA, poaching of valuable species such as the African elephant is serious, as exemplified by the number of carcasses observed during the 2015 wildlife aerial censuses coordinated by the African Elephant Without Borders (EWB) in the region (**Figure 4**).

The most affected elephant population is in the Angolan component of KAZA TFCA, where the number of carcasses represents about 43% of the live elephants, followed by Zambia (12%) and Zimbabwe (8%), implying that the illegal offtake of the elephant is very high in some parts of the KAZA TFCA. Considering that this TFCA has the highest number of elephants (≈199,031) on the African continent, the increasing international demand for ivory on the black market will continue to exert pressure on the KAZA elephant populations, more especially due to the projected human population growth (**Figure 5**) and if the socioeconomic status of the local communities living in and around the KAZA TFCA continues to be underdeveloped. Already the illegal offtake of elephant in Sioma Ngwezi National Park (Zambia), which forms part of the KAZA TFCA (**Figure 1**), exceeds the intrinsic growth capacity of the species.

The WDCs that are most threatened by poaching are Sioma Ngwezi-Luengue-Luiana NPs, Simalaha (Chobe National Park, Kafue ecosystem), Hwange-Kazuma-Chobe and Chobe-Zambezi floodplain/Namibia-Sioma Ngwezi-Luengue-Luiana NPs (**Figure 2**).

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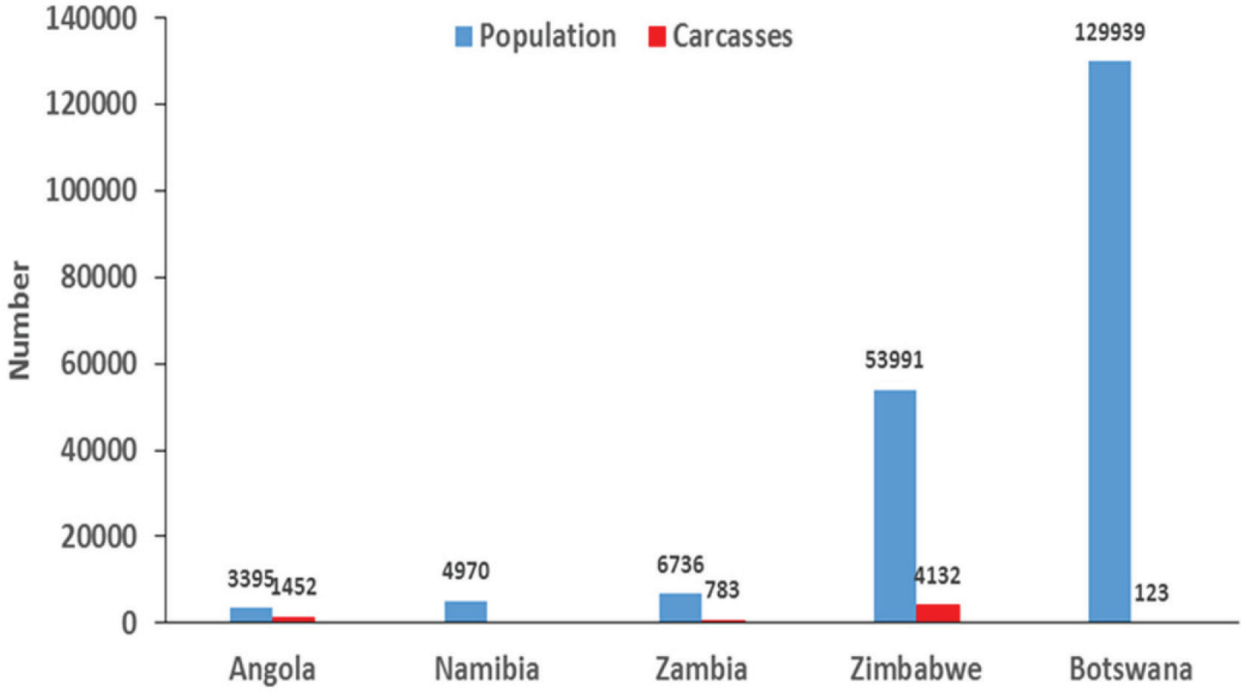

Figure 4. Elephant population and carcasses observed during aerial surveys in the KAZA TFCA in 2015 (EWB, *pers. com*).

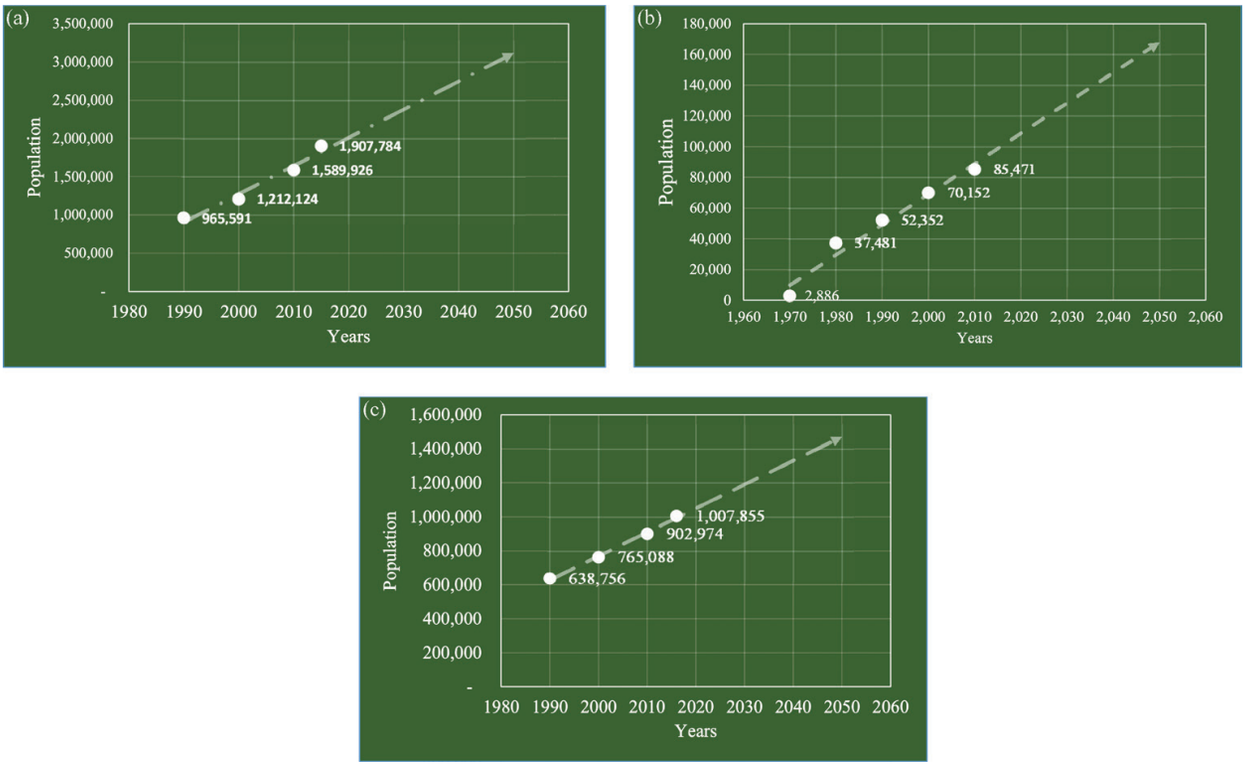

Figure 5. (a) Population of southern province of Zambia (http://www.geohive.com/cntry/zambia.aspx), projected to 2050. (b) Population of Zambezi Region of Namibia (http://en.wikipedia.org/wiki/Demographics_of_Namibia), projected to 2050. (c) Population of Western Province of Zambia (http://www.geohive.com/cntry/zambia.aspx), projected to 2050.

3.2. Human population growth

Figure 5(**a–c**) illustrates the current and projected human populations in the KAZA TFCA, where the most populous areas by 2050 will be the Southern Province of Zambia (**Figure 5a**), Zambezi Region of Namibia (**Figure 5b**) and Western Province of Zambia (**Figure 5c**), where the population densities will be 35, 20 and 11 people per km^2, respectively, by 2050. While these population densities may not be outrageously alarming, the semiaridness of these areas and the dominance of the Kalahari sands, which are not suitable for agriculture, imply that the population densities will be higher than what would be sustained, more especially as the human settlements and cultivation are often in areas that have the most fertile soils, such as river banks and floodplains, which are also vital for wildlife to access water and forage, which are far apart within the TFCA landscape.

The projected population growth will affect the natural resource base in many ways. First, it will trigger increased demand for arable land, food, water and other essential materials, such as firewood. Second, expanded agricultural activities will lead to encroachment into the remnant wilderness areas (forests and woodlands), including wildlife dispersal corridors that facilitate ecological linkages among the 36 protected areas in the KAZA TFCA. Third, the degradation of the natural resource base in turn will impinge on the people's livelihoods, particularly rural communities. Besides habitat fragmentation and degradation, expanding human populations and settlements will trigger increased human-wildlife conflicts and poaching—both for the enlarged local consumption of bushmeat and for the illegal trade of wildlife trophies—more especially, among the socioeconomically underprivileged communities, who depend on natural resources and are vulnerable to criminal syndicates' influence to poach and supply wildlife trophies for illegal trade.

The WDCs most threatened by the projected population growth include Simalaha (Chobe National Park-Kafue ecosystem) and Chobe-Zambezi floodplain/Namibia-Sioma Ngwezi-Luengue-Luiana NPs (**Figure 2**).

3.3. Veterinary fences

Veterinary fences in the KAZA TFCA have been erected to control the spread of livestock diseases in order to protect the European Union beef market. These fences have been implicated in curtailing movement of migratory wildlife species such as giraffe (*Giraffa giraffa*), tsessebe (*Damaliscus lunatus lunatus*), wildebeest, zebra, buffalo, elephant and others, with some animals dying from dehydration and entanglements in the fences, thus contributing to the decline of wildlife species [9]. The WDCs most threatened by veterinary fences are Khaudum-Ngamiland, along the border with Namibia; Hwange-Makgadikgadi-Nxai Pan, along the southern tip of Hwange National Park; and the Chobe-Zambezi floodplain/Namibia-Sioma Ngwezi-Luengue-Luiana NPs.

3.4. Charcoal production and illegal timber extraction

There is high demand for bioenergy in some parts of the KAZA TFCA. Even in the electrified communities, the high cost of electricity has prevented a move away from dependency on bioenergy. In the Zambian component of KAZA, for instance, charcoal production facilitated by

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poor regulatory mechanisms is a serious problem, causing deforestation and habitat degradation around the Kafue National Park, thus aggravating habitat fragmentation. Deforestation due to charcoal production is being heightened by illegal extraction of hardwood timber, such as Zambezi teak (*Baikiaea plurijuga*) and others. The WDCs most threatened by charcoal production and/or timber extraction are Simalaha (Chobe National Park, Kafue ecosystem), especially on the Zambian side; Chobe-Zambezi floodplain-Sioma Ngwezi ecosystem; and Chobe-Zambezi floodplain/Namibia-Sioma Ngwezi-Luengue-Luiana NPs.

3.5. Uncontrolled bushfires

Uncontrolled bushfires are a common phenomenon in the KAZA TFCA with potential to modify the physiognomic characteristics of the KAZA landscape. Although all wildlife corridors are threatened by uncontrolled bushfires, those with high human populations, currently and in the future, are the most prone to bushfires, such as Simalaha (Chobe National Park, Kafue ecosystem) and Chobe-Zambezi floodplain/Namibia-Sioma Ngwezi-Luengue-Luiana NPs.

4. Ranking of the threats to wildlife dispersal corridors in KAZA TFCA

A qualitative ranking of the threats to WDCs on a scale of 0–5 is shown in **Table 1**, where a score of 0 = no threat, 1 = negligible threat, 2 = low threat, 3 = moderate threat, 4 = high threat and 5 severe threat. Based on ranking of the aggregate threat scores, the most threatened WDCs, requiring multiple strategies and concerted effort to mitigate the threats, are the Simalaha (Chobe National Park, Kafue ecosystem) and Chobe-Zambezi floodplain/Namibia-Sioma Ngwezi-Luengue-Luiana NPs (**Figure 2**).

WDCs	Habitat fragmentation	Poaching	Charcoal	Timber extraction	Bushfire	Climate change	Veterinary fences	Mean score
Simalaha (Chobe-Kafue ecosystem)	5	5	5	5	5	2	0	**3.9**
Sioma Ngwezi-Luengue/Luiana National Parks	5	5	5	5	5	2	0	**3.9**
Chobe-Zambezi Region/Namibia-Luengue/Luiana National Parks	5	5	0	4	5	2	0	**3**
Hwange-Makgadikgadi-Nxai Pan	1	3	0	0	5	3	4	**2.3**
Khaudum-Ngamiland	1	2	0	0	4	3	4	**2.0**
Hwange-Kazuma-Chobe	1	3	0	0	4	3	0	**1.5**

Table 1. Summary of key threats to the WDCs in the KAZA TFCA.

The anthropogenic threats discussed above fragment wildlife habitats and constrain free transboundary movement of wildlife. The most affected species in this regard is the African elephant, whose 65% of the total population of approximately 199,031 is concentrated in the Botswana component of the KAZA TFCA, primarily due to better law enforcement by the government of Botswana, which uses the military to protect the country's wildlife resources, and the human population is generally low, enabling the elephants to roam quite freely without significant conflicts with the human socioeconomic interests.

The presence of large elephant population in the Botswana component of KAZA TFCA is however ecologically of great concern, more especially as most of them are concentrated in the Chobe National Park, resulting in local densities of about four animals per km^2 especially in the riverfront of this park. Since elephants employ strategies such as bark stripping, breaking major branches and uprooting trees and shrubs when browsing [10, 11], there is concern that at high densities elephants will negatively affect plant community structure, function and species richness [12, 13].

High numbers of elephants in the savannah ecosystems, such as those common in Botswana, have been implicated in the mortality of trees due to intensive forage and fire [14], reduction of seedling recruitment and promotion of grass production where trees are removed, as well as altering vegetation structure and nutrient cycling [15-17]. The disappearance of *Acacia* woodlands in the Chobe National Park, Botswana, is suspected to be due to the elephants' pressure in conjunction with other species, such as impala (*Aepyceros melampus*), which may prevent woodland regeneration and growth of seedlings due to foraging.

In view of the high concentration of elephants in Botswana, one of the ecological benefits of the KAZA TFCA is the re-establishment of the seasonal migration routes of the elephant to relinquish pressure in Botswana, alongside the other wide-ranging wildlife species (e.g. zebra, wildebeest, buffalo, etc.). The strategies discussed in the ensuing sections of this chapter are aimed at mitigating the anthropogenic threats to restore the ecological processes in the KAZA TFCA and enhance the socioeconomic well-being of the local communities who bear the opportunity cost of interacting with wildlife in this TFCA.

5. Strategies for securing wildlife dispersal corridors in the KAZA TFCA

To mitigate threats to the biodiversity and facilitate permeability of wildlife through the KAZA TFCA fragmented landscape, a combination of strategies would be essential to address these threats, as well as create the enabling incentives for the local communities to participate in securing the wildlife dispersal corridors. The following strategies (not necessarily listed according to importance) should be considered in securing the wildlife dispersal corridors in the KAZA TFCA.

5.1. Restoring ecological processes

The purpose of restoring the ecological process is to enable free movement of wildlife based on the natural factors, such as local population conditions (e.g. crowding and food availability),

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stochasticity (e.g. weather, species interactions/intra- and interspecific competition), phenology of the forage species, social systems and climate variability. These natural systems should be re-established by abating threats to the wildlife species and their habitats, through:

5.1.1. Strengthening transboundary law enforcement to effectively reduce poaching and illegal offtake of timber

In view of the high incidents of poaching, especially of high-value wild animals, such as elephant for their ivory, and offtake of hardwood timber, joint law enforcement operations in the KAZA TFCA should be a priority, focused on, among other, tactics:

(i) Waiving restrictions of the free movement of law enforcement personnel, weapons and vehicles used in pursuit of poachers and contraband of wildlife trophies and timber syndicates in the KAZA TFCA region.

(ii) Harmonising the penalties for all wildlife offences, including mandatory minimum penalties for poaching and illegal trafficking of wildlife, wildlife trophies and timber. Penalties prescribed should be appropriate and sufficient to deter reoffending.

(iii) Ensuring the KAZA TFCA partner countries' wildlife legislation adequately covers all key issues of wildlife crime and trafficking including the classification of key offences as serious crime.

(iv) Training of magistrates to ensure that they are well versed in the relevant legislation and understand the effect of wildlife crime on the economies of the KAZA TFCA partner countries.

(v) Cooperating in transboundary pursuit of poachers and waiving restrictions in pursuing poachers beyond the international boundaries to ensure effective apprehension of transboundary poachers.

(vi) Waiving restrictions for repatriation of exhibits from country of seizure to the country of prosecution.

(vii) Establishing functional transboundary radio communication networks.

(viii) Harmonising law enforcement in-service training, e.g. intelligence gathering and sharing.

(ix) Establishing joint database on poachers in order to identify and appropriately punish repeated offenders.

(x) Standardising the calibre of weapons used for law enforcement.

(xi) Standardising the incentives for the law enforcement personnel, such as field rations and bonuses.

(xii) Standardising monitoring of law enforcement effectiveness through application of the Spatial Monitoring and Reporting Tool (SMART).

(xiii) Standardising Law Enforcement Strategies, specifically focused on, among others: capacity building for protection of key wildlife populations; wildlife crime investigation, evidence collection, the use of legal tools, prosecuting procedures and identi-

fication of species targeted for illegal trade; collection, collation and analysis of information relevant to criminal exploitation of flora and fauna; and dissemination of this information to focal points in each partner country in a timely manner so that appropriate action can be taken to counteract illicit activities.

(xiv) Ensuring sufficient and well-trained wildlife crime investigators are in place and able to handle wildlife crime scenes and cases appropriately and effectively.

(xv) Standardising research-based investigative and forensic procedures to successfully curb contrabands in wildlife trophies and timber resources.

(xvi) Usage of remote cameras that beam images in real time to law enforcement headquarters, with a whole suite of sophisticated devices to reduce the chance of them being stolen or destroyed.

(xvii) Standardising integration of the military to augment the wildlife law enforcement as a means of effectively protecting wildlife resources in the KAZA TFCA.

(xviii) Establishing a KAZA TFCA-wide covert network of informants to assist tracking and apprehending poachers and smugglers of wildlife trophies and timber. This should be linked to standardised and robust incentive framework/bonus system to ensure sustainability of the informant system.

5.1.2. Establishment of 'stepping stones' for the dispersing wildlife

Stepping stone as used in this context denotes one or more separate patches of habitat in the intervening space between ecological isolates (such as protected areas) that provide resources and refuge to assist animals to move through the fragmented landscape [18]. Establishment of new 'stepping stones'/unfenced conservancies should be guided by objective assessment to determine the optimality for biodiversity conservation, using the following equation [2, 19]:

$$BCOP = [BC\text{-}CC\text{-}(BA\text{-}CA)] > 0 \quad (1)$$

where, BCOP is the biodiversity conservation option, BC is the benefits of biodiversity conservation (e.g. estimated potential income from ecotourism; sustainable game meat production through ranching; payment for ecosystem services, such as carbon sequestration/estimated value of carbon credits; etc.), CC is the direct costs of conservation/management of the conservancies (e.g. surveillance, monitoring, etc.), BA is the benefits of alternative land use (e.g. pastoralism, commercial agriculture, subsistence agriculture, etc.) and CA is the costs of alternative land uses (pastoralism, agriculture, etc.)

Examples of stepping stones exist in the KAZA TFCA, such as the Game Management Areas in Zambia—managed in partnership between the local communities and the state—fenced Simalaha Community Conservancy in Zambia, unfenced Sekute Community Conservancy in Zambia and Community Conservancies in the Zambezi Region of Namibia. Besides these, there is potential for establishing fishing protected zones on the major rivers, such as the Zambezi, Chobe and Kafue rivers, which would serve the dual purpose of providing safety to the breeding fish and the wildlife crossing these river systems.

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The Namibia Nature Conservancy has mapped and initiated the process of establishing the fishing protected zones in the Zambezi Region of Namibia (Denis Tweddle, *Pers com*), while the African Wildlife Foundation (AWF) has mapped potential Fishing Protected Zones on Zambian side (Stratum V: Sesheke-Mambova Rapids) of the Zambezi River [20], within the Simalaha (Chobe National Park, Kafue ecosystem) wildlife dispersal corridor.

5.1.3. Reduction of deforestation and habitat degradation in the wildlife dispersal corridors

As deforestation due to charcoal production is a major problem, especially on the Zambia side of the Simalaha (Chobe National Park, Kafue ecosystem) WDC, promotion of efficient and sustainable energy production should be done through:

(i) Reducing dependence on wood fuel and ensuring sustainable provision of affordable and reliable modern sources, such as solar, biogas, photo-thermal applications, wind energy and mini- and micro-hydropower

(ii) Encouraging the establishment of forest plantations/woodlots in critically wood-deficit areas

(iii) Improving the technology of charcoal production and utilisation by:

- Training of charcoal producers in better organisation and management of charcoal production using the traditional kilns
- Developing stoves that are efficient and convenient to users and which produce minimum carbon emissions
- Ensuring that information on carbon emission levels and efficiency of stoves is disseminated to promote public awareness
- Facilitating participation of various stakeholders such as non-governmental organisations, industry, researchers and government departments responsible for energy in stove development and dissemination

5.1.4. Reduction of the impact of veterinary fences on the dispersing wildlife

The impact of veterinary fences should be reduced by adoption of the commodity-based trade (CBT) standards in the production of beef for the export market in the KAZA TFCA. CTB is based on the premise that deboned and properly matured beef from which visible lymph nodes have been removed is considered to present a 'very low' risk of transmitting foot-and-mouth disease (FMD) and several other infectious agents [21, 22]. To ensure sanitary safety of the meat produced under CBT, a variety of proven risk amelioration methodologies should be employed in the management of risk along the value chains, including:

a. Compulsory systematic vaccination of cattle for fresh meat of cattle.

b. Veterinary authorities should require an international veterinary *certificate* attesting that the entire consignment of *meat* comes from animals that:

- Have remained in the *exporting country* for at least 3 months prior to *slaughter*
- Have remained, during this period, in a part of the country where cattle are regularly vaccinated against FMD and where official controls are in operation
- Have been vaccinated at least twice with the last vaccination not more than 12 months and not less than 1 month prior to slaughter
- Were kept for the past 30 days in an establishment and that FMD has not occurred within a 10-km radius of the establishment during that period
- Have been transported, in a vehicle which was cleansed and disinfected before the cattle were loaded, directly from the establishment of origin to the approved abattoir without coming into contact with other animals which do not fulfil the required conditions for export
- Have been slaughtered in an approved abattoir which is officially designated for export, in which no FMD has been detected during the period between the last *disinfection* carried out before *slaughter* and the shipment for export has been dispatched
- Have been subjected to ante-mortem and post-mortem inspections for FMD with favourable results within 24 h before and after slaughter

c. Ensuring that meat comes from deboned carcasses:

- From which the major lymphatic nodes have been removed
- Which, prior to deboning, have been submitted to maturation at a temperature above + 2°C for a minimum period of 24 h following slaughter and in which the pH value was below 6^0C when tested in the middle of both the *longissimus dorsi*.

The Zambezi Region/Namibia part of KAZA TFCA has piloted CBT of beef [24]; therefore, lessons can be derived from Namibia for replication in the KAZA TFCA as a strategy to reduce dependence on fencing to control zoonotic transboundary animal diseases.

5.1.5. Reduction of fire-induced degradation of habitats

The strategy for fire management in the KAZA TFCA should be nested within the early-season prescribed burning around all the sensitive biomes to protect them from the destructive late dry season fires. This strategy, if diligently executed and timed properly in its implementation (e.g. burning a month after end of the rainy season), can reduce the risk and impact of the late dry season bushfires on the valuable ecosystems.

5.1.6. Reduction of encroachment into the wildlife dispersal corridors through adoption of conservation agriculture

Conservation agriculture (CA), which embraces many sustainable farming approaches (e.g. organic farming, climate-smart agriculture, etc.), should be promoted in the KAZA TFCA as a tool for improving land husbandry, intensification of agriculture, improving crop

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yields per unit area of land and, hence, decreasing the likelihood of cutting down forested areas to plant new agriculture fields. CA if properly designed and implemented can restrain encroachment into the wildlife dispersal corridors. Implementation of CA should be done by competent agriculture development agencies. In addition, the agriculture researchers, under the Consultative Group for International Agricultural Research (CGIAR) umbrella, should be encouraged to provide advice on the most agro-ecologically suitable crop cultivars that should be promoted under CA in the KAZA TFCA. The CA success to contribute to agriculture intensification, food security and biodiversity conservation will depend on:

a. **Design**: in designing the CA farming practices, a number of factors should be considered in an integrated manner, including crop management/husbandry, livestock husbandry, soil and water management, agroforestry and integrated food and energy systems.

b. **Sustainability strategy**: the CA farming programme in the KAZA TFCA should be based on 'smart subsidies', with implementable exit strategies, which put a time limit on the support provided to the smallholder farmers, in terms of farming inputs and extension services. The smart subsidies should be provided to help smallholder farmers to accumulate productive and financial assets and enable them to finance full-priced inputs from their own savings after termination of the subsidy support (e.g. 2–3 years), and this should be the basis for building sustainability and capacity of the smallholder farmers to continue with CA farming without external support in the KAZA TFCA.

c. **Capacity building of smallholder farmers to participate in the tourism supply chain**: for the smallholder farmers to accumulate sufficient productive and financial assets to enable them to finance full-priced inputs, they need access to markets for high-value farm produce, such as vegetables, fruits and animal products, such as meat, milk and eggs. The tourism sector offers great opportunity for the farmers to participate in the supply chain. Promoters of CA farming in the KAZA TFCA should jointly assist smallholder farmers in forming associations, which should play important roles in:

   - Dialoguing with lodge owners on the products in demand, in terms of quantities, quality and supply frequency
   - Establishing and administering trust accounts into which part of profits made from sales of agricultural produce could be deposited for reinvestment in CA farming practices
   - Facilitate farmers' access to grants, credit and agricultural markets
   - Negotiating partnership arrangements with the private sector where required
   - Promoting collectiveness in the adoption of technological innovations in CA farming

Promoters of CA should also train smallholder farmers in producing high-value products, including packaging and transportation to the markets, as well as brokering contractual agreements between the lodges and the farmers for the supply of agriculture produce.

d. **Monitoring and evaluation**: the KAZA TFCA should standardise monitoring the performance of CA farming practices, based on standardised:

- Indicators for assessing the impact
- Annual targets/benchmarks for each indicator
- Instruments for gathering data and analysis
- Frequency of reporting on the performance

e. **Learning framework**: dissemination of information on CA farming practices' performance and their impacts on food security, biodiversity conservation and household income should be a necessary precursor to adoption of these farming systems in the KAZA TFCA. Promoters of these farming systems should be compelled to incorporate information dissemination as a medium for providing 'proofs-of-concept' examples of successful CA practices' contribution to improved agricultural intensification, productivity, biodiversity conservation and human well-being. A web-based platform should be established for the KAZA TFCA to provide space where promoters of CA farming practices should share their knowledge and experiences on these farming systems and engage in processes of mutual learning and store information, tools and methodologies for assessing the performance and impacts of these farming systems and store material from workshops, publications, etc.—to be accessed by agricultural practitioners, KAZA TFCA partner countries, researchers, farmers, donors, etc.

5.1.7. Supporting voluntary adjustment of settlement away from the wildlife dispersal corridors

Some local communities in the KAZA TFCA seasonally move between floodplains and uplands—as an adaptive, transhumant strategy for meeting their subsistence needs. These movements interfere with the free movement of the dispersing wildlife. To obviate this problem, many local community members, especially residents in conservancies in the Zambezi Region of Namibia are volunteering to adjust their seasonal movements within the Chobe-Zambezi floodplain/Namibia-Sioma Ngwezi-Luengue-Luiana NP WDC to enable free passage of wildlife. This unprecedented positive gesture by the communities should be fully harnessed through provision of social amenities, such as water for domestic, livestock, small-scale irrigation/conservation agriculture and fish ranching. The Climate Resilience Infrastructure Development Facility (CRIDF) has supported some of the local communities that have volunteered to adjust their seasonal movement. The KAZA Secretariat should mobilise further donor support to continue with this important initiative, which should be integrated into the biodiversity stewardship programme proposed in Section 2 below.

5.1.8. Reduction of the impact of climate variability on wildlife

Provision of water, incorporating climate-smart technologies (e.g. solar energy), especially in the Hwange-Makgadikgadi-Nxai Pan; Hwange-Kazuma-Chobe; and Khaudum-Ngamiland WDCs, where water is currently scarce and likely to worsen with the changing climate, is recommended. Provision of artificial water has been implicated in habitat degradation due to animal concentration around waterholes. Therefore, there is a need for careful consideration, guided by environmental assessment in spatial allocation of artificial waterholes for wildlife in the drier parts of the KAZA TFCA.

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5.2. Support for socioeconomic development of the communities that interact with the dispersing wildlife

The long-term sustenance of the WDCs in the KAZA TFCA depends on the local communities' appreciation and support to their security and management. To encourage community participation in securing and managing the WDCs, the following should be promoted:

5.2.1. Wildlife economy in agriculturally marginal areas and WDCs

This should be done through:

5.2.1.1. Ecotourism

The KAZA TFCA is well endowed with aesthetically appealing features, such as the Victoria Falls, large rivers (Zambezi, Kafue and Chobe), rich and diverse wildlife species, including the avifauna, and diverse cultures, including the relic cultural artefacts, which offer opportunities for investments in ecotourism. Ecotourism offers the highest hope for rural communities living in agriculturally marginal areas, and its prominence becomes even higher as agriculture production is constrained by poor soils which in the KAZA TFCA landscape are dominated by the Kalahari sands, and productivity is further aggravated by the frequency of natural episodic events (such as drought) and increasing agricultural production costs, in terms of input.

Although the tourism sector in the KAZA TFCA is currently dominated by the private sector, local communities can also tap into ecotourism businesses by entering into partnerships with the private sector—formalised by contractual agreement between the community (usually represented by a Community Development Trust or Association) and the private investor. The main driving force for community-private partnerships stems from the fact that while some communities have valuable tourism assets, such as wildlife traversing through their areas, or in the community conservancies, they do not have the capital and expertise to set up profitable ecotourism enterprises on their own, hence the need for private partners to leverage capital and technical expertise. For this arrangement to function, there is need for the:

a. Establishment of the community collective natural resource governance institutions, such as trusts or associations, which should represent the community's interests in:
- Consolidating their rights to land and biodiversity assets
- Negotiating partnership arrangements with private investors in the management of land, natural resources and tourism development
- Promoting collectiveness in harnessing equitable sharing of benefits from ecotourism in the wildlife dispersal corridors, as well as other protected areas, where the communities would have a stake in ecotourism development

b. KAZA partner countries to proactively provide harmonised policy and legal enabling environment for communities to use their customary land and wildlife as collateral in securing partnerships with the private investors in biodiversity conservation programmes and ecotourism development

c. Communities to guarantee commitment of their land to biodiversity conservation and contribute to the management inputs and processes through provision of human capital and indigenous knowledge of the local resources

d. NGOs to contribute to local institutional capacity building, conflict resolution in natural resource use—ensuring equitable sharing of benefits between the communities and private investors from ecotourism and biodiversity conservation—and contribute to management inputs through fundraising and investments in the management processes of community conservancies and monitoring their performance against their management objectives, inputs and outputs (e.g. biodiversity threat abatement and contribution to sustainable rural livelihoods).

To build the community investment capacity, mechanisms for providing capital and business assistance should be developed, such as through establishing:

5.2.1.1.1. Revolving loan fund

The revolving loan fund (RLF) could be used for the development and/or expansion of community enterprises. The fund could be a self-replenishing pool of money, utilising interest and principal payments on old loans to issue new ones. Establishment of a RLF would provide access to a flexible source of capital, more especially as local communities are generally unable to access loans from commercial banks due to lack of collateral. The RLF should be built on sound interest rate practices and not perceived as free or easy sources of financing. The RLF should be able to generate enough interest rate return to replenish the fund for future loan allocations. Eligible uses for RLF loans would include investment and operational capital for the development of conservation agriculture, participation in the supply chain, ecotourism enterprises and auxiliary businesses (e.g. curio production, beekeeping, aquaculture, transport services for tourists, etc.). The loan duration would range from 3 to 6 years, depending on the loan amount taken by the community investors.

Initial capitalisation of a revolving loan fund could come as grants to the fund, from a combination of public sources (e.g. tourism levies, state lottery, visa fees, etc.), donors, private sector and philanthropic organisations. The RLFs would be invested in projects with above average risks, which most commercial banks would not consider funding. It is therefore critical that the borrowers are held to standard financial requirements in loan security. Before a loan is issued, the following requirements would be satisfied:

- Business plan, including cash-flow projections
- Business experience and management information
- Credit history and financial statements (in the case of business expansion)
- Sufficient collateral/signed guarantee to refrain from encroachment into the WDAs and poaching and any unsustainable land-use practices

As a public investment instrument, the RLF is expected to result in public goods, namely, locally developed enterprises that sustainably contribute to socioeconomic development of

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the local communities. Community borrowers, therefore, would address performance measures, which should be developed by the KAZA TFCA Secretariat, such as:

- Number and type of jobs created or retained in the established enterprises
- Increase in tax revenue
- Benefits to community members from business ownership and auxiliary enterprises and job opportunities

5.2.1.1.2. Administration and governance of the RLF

The KAZA TFCA, through its governance structure/committee of ministers could identify and negotiate with one of the commercial banks operating in the KAZA TFCA partner countries to manage the RLF. The bank could do this as a social responsibility, and the governments would also consider rewarding such a bank with some recognition, such as waiving of some taxes. Ministers responsible for the development of the KAZA TFCA could serve as the Board of Directors, responsible for reviewing loan proposals from eligible community entrepreneurs and contracting a local bank for the loan fund's portfolio management responsibilities, as well as appointing firms to annually audit the RLF.

5.2.2. Promote biodiversity stewardship

Biodiversity stewardship is 'the wise use, management and protection of the biodiversity that has been entrusted into the landowners [23]. Through the biodiversity stewardship, the critical wildlife dispersal corridors that traverse the communal lands would be managed by the local communities, through defined protocols (e.g. the allowable use of land in the WDCs), with some benefits to the landowners/communities. The communal landowners would commit land towards the free movement of wildlife by means of formal agreements entered between the communities and the KAZA TFCA governance structure. The agreements would state the conditions on allowable land uses in the WDCs that do not constrain free transboundary wildlife movements in the TFCA.

The purpose of the proposed biodiversity stewardship is to:

- Ensure that communal areas that provide passage for the dispersing wildlife receive secure conservation status to enable them to effectively link the network of protected areas in the KAZA TFCA.
- Ensure that the WDCs are well managed according to good biodiversity management practices.
- Ensure that landowners/local communities, who commit their land to the biodiversity stewardship option, will enjoy tangible benefits for their conservation actions.
- Allow for conservation compatible land uses to continue, in a sustainable way, in the WDCs.

Communal landowners who would participate in the stewardship programme would access a suite of possible incentives and benefits to offset the opportunity costs of allocating their land to the WDCs, such as:

- Social amenities in support of rural livelihoods (e.g. health, education, water, etc.). The KAZA TFCA should endeavour to mobilise donor/NGOs' support for the development of rural livelihoods for the communities that will commit their land to the WDCs.
- Provision of enterprise development grants or soft loans (e.g. through the RLF).
- Being prioritised for conservation agriculture support.
- Being prioritised for human-wildlife conflict (HWC) mitigation.

The proposed biodiversity stewardship programme would also target the youth, who will be the majority in KAZA TFCA by the mid-twenty-first century. The youth that would participate in the stewardship programme would access a suite of possible incentives and benefits, including training in entrepreneurship development and access enterprise development grants or soft loans.

5.2.3. Reduction of human-wildlife conflicts in the WDCs

An integrated strategy should be adopted in the KAZA TFCA to mitigate HWCs, based on:

a. Land-use planning and community awareness campaigns

The KAZA TFCA needs macro-, meso- and micro-level land use plans to delineate land committed to various categories, including protected areas, conservancies, WDCs, developed areas (government administration and commercial nodes),and communal areas (settlements, cultivated and range lands). This spatial separation is essential in identifying HWC hotspots, requiring targeted HWC mitigation measures. Broad-based awareness campaigns, using multiple media outlets (radio, television, meetings, newsletters, etc.) should be used to inform the local communities and the general public about the location and values of the WDCs.

To enable legal recognition of the delineated WDCs, they should be gazetted in the relevant wildlife legislation in the KAZA partner countries.

b. Targeted fencing

The Model 3 fencing (four-strand electrified fence) encircling clusters of villagers' crops and facilities is intuitively the most desirable fencing that could be adopted in the KAZA TFCA, as part of an integrated approach to mitigating human-elephant conflicts. However, its success will depend on the sustainable mechanisms for regular maintenance and prevention of vandalism.

c. Olfactory deterrents (chilli methods)

The use of chilli-based olfactory repellents to deter elephants from entering crop fields or human habitation should also be opportunistically used on cheap fencing that uses sisal string strung between bush-cut poles or existing trees surrounding crop fields.

5.2.4. Promote harmonised enabling policies and legislation to facilitate slowing down of human population growth

While this approach should be adopted at the KAZA TFCA-wide scale, the primary focus should be on the southern and western provinces of Zambia and Zambezi Region of Namibia,

where the WDCs are greatly threatened by human population growth. The KAZA TFCA partner countries should harmonise policies and legislation on lowering infant and child mortality, which should lead to fertility decline, and broaden access to primary and reproductive health services and improve girls' education to encourage voluntary reduction of fertility.

Specific strategies should include, among others:

a. Targeting the larger population of the youth in the 15–29 years age group, by purposefully creating conditions for increasing investment in human capital development through higher-quality education and health services and job creation as a means of facilitating a rapid decline in fertility. Evidence in African countries shows that fertility levels are generally lower among the most educated and working-class women [24].

b. Encouraging stronger commitment to family planning for improving maternal health and social planning. This commitment should be based on the recognition of everyone's rights of access to sexual and reproductive health services, including KAZA partner countries' regular funding flows for population and family planning programmes over the next two decades.

c. Empowerment of women, through enacting legislative changes, which should include inter alia, increasing the legal age at marriage, adopting new Family Codes to guarantee equal rights and duties for males and females and removing the husband's and/or parents' consent to allow women and young girls to have easy access to family planning services. This will require promotion of reproductive rights, while, at the same time, making sure that women and couples can exert their reproductive choices freely without coercion.

In view of the multiplicity of the strategies recommended for securing WDCs, the KAZA partner countries should prioritise the implementation of strategies that will significantly reduce poaching and habitat fragmentation, as well as promotion of the wildlife-based economy, aimed at tangibly and sustainably contributing to the socioeconomic development of the local communities in order to win them as allies in securing the WDCs in the KAZA TFCA.

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