

FOOD SECURITY STRATEGIES IN THE KAZUNGULA AND ZAMBEZI HEARTLANDS, AND THEIR LINK WITH CONSERVATION IMPACT AND CLIMATE CHANGE

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¹ Jimmiel Mandima of African Wildlife Foundation provided editorial and factual inputs to the report that are not necessarily attributable to the main author.

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Acronyms

ABCG	Africa Biodiversity Collaborative Group	JCTR	Jezuit Centre for Theological Reflection
ADP	Animal Draught Power	KaZa TFCA	Kavango-Zambezi Trans Frontier Conservation Area
AWF	African Wildlife Foundation	LZNP	Lower Zambezi National Park
CA	Conservation Agriculture	MALI	Ministry of Agriculture and Livestock
CAADP	Comprehensive Africa Agricultural Development Programme	MCC	Milk Collection Centre
CBPP	Contagious Bovine Pleuro Pneumonia	MFI	Micro Finance Institution
CCA	Climate Change Adaptation	MT	Metric Ton
CFU	Conservation Farming Unit	NRM	Natural Resources Management
COMACO	Community Markets for Conservation (WCS project in the Luangwa valley)	NTFPs	Non Timber Forest Products
CPUE	Catch Per Unit Effort	NWFPs	Non Wood Forest Products
CRB	Community Resource Board	OPV	Open Pollinated Variety
DoF	Department of Fisheries	REDD	Reduced Emissions from Deforestation and forest Degradation
EIA	Environmental Impact Assessment	SADC	Southern Africa Development Community
FD	Forestry Department	SCCI	Seed Certification Institute
FISP	Farmer Input Support Programme	SNDP	Sixth National Development Plan
FMC	Fisheries Management Committee	SSA	Sub Saharan Africa
FRA	Food Reserve Agency	ZARI	Zambian Agricultural Research Institute
GART	Golden Valley Agricultural Research Trust	ZAWA	Zambian Wildlife Authority
GMA	Game Management Area	ZCC	Zambian CAADP Compact
HH	Household	ZMK	Zambian Kwacha
HL	Heartland	ZNFU	Zambian National Farmers Union
HWC	Human Wildlife Conflict		
iDE	International Development Enterprises		
ILUA	Integrated Land Use Assessment		

Introduction

This document presents a summary of the findings of a study on food security strategies in two transboundary landscapes (Heartlands) in Southern Africa where the African Wildlife Foundation has been working on conservation and livelihoods work for over 10 years.

The study is part of the work supported by the Africa Biodiversity Collaborative Group (ABCG)², a collaboration between the African Wildlife Foundation AWF), Conservation International (CI) and the Wildlife Conservation Society (WCS). The ABCG is building knowledge on diversification of food security strategies, the role of agricultural landscapes in climate change mitigation and adaptation, and the linkages to conservation.

This study looked in detail into current and alternative food security strategies on the Zambian side of the Heartlands, and their link with conservation and climate change.

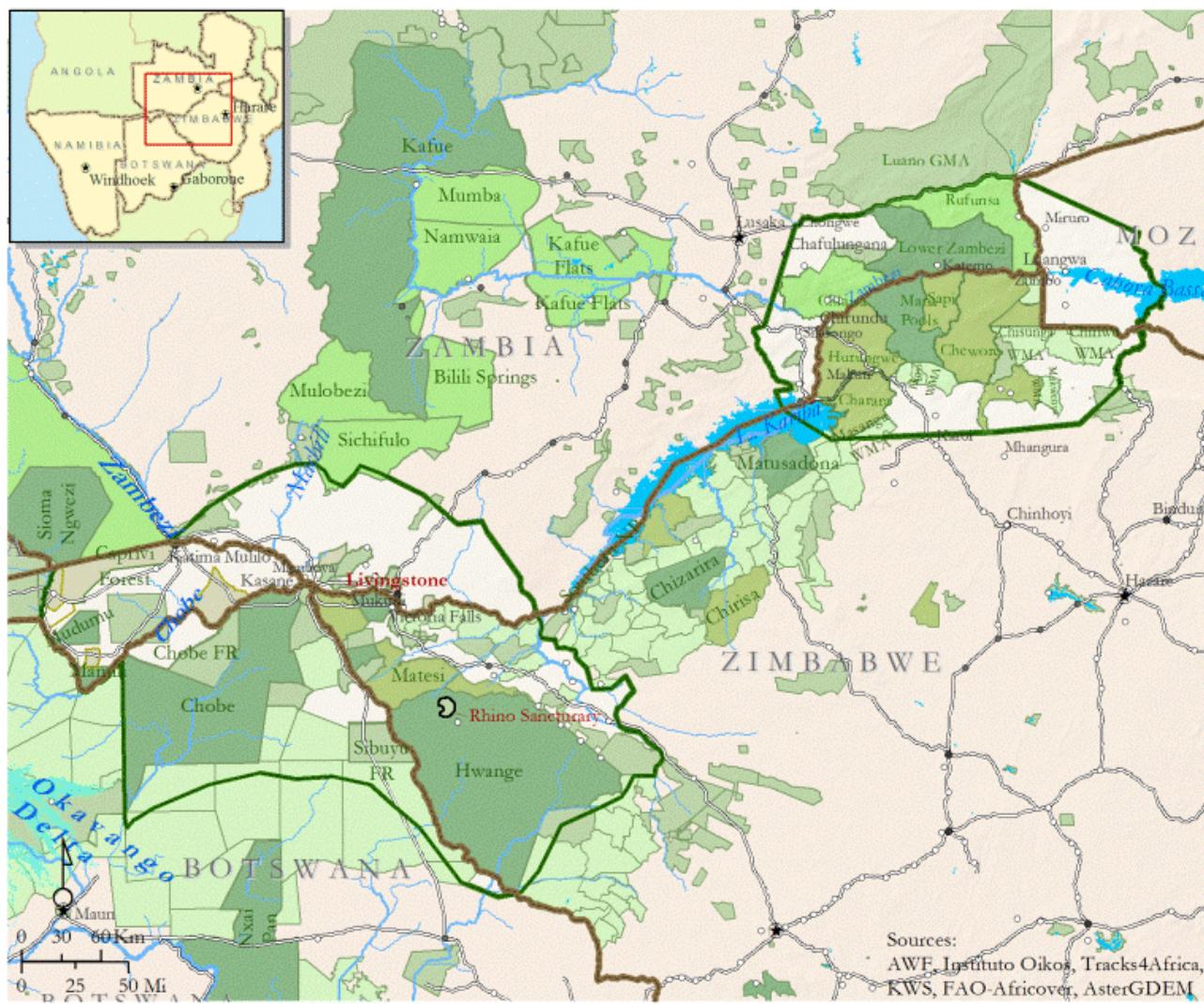
² ABCG's members are U.S.-based international conservation NGOs with field activities in Africa. ABCG's mission is to tackle complex and changing conservation challenges by catalyzing and strengthening collaboration, and bringing the best resources from across a continuum of conservation organizations to effectively and efficiently work toward a vision of an African continent where natural resources and biodiversity are securely conserved in balance with sustained human livelihoods.

Short description of the Zambezi and Kazungula Heartlands

The study looked at two transboundary landscapes (referred to as “Heartlands” (HL)) in the Southern Africa region, Kazungula HL and Zambezi HL. The Kazungula HL is centred around the mid-upper Zambezi and spans 5 countries: Namibia, Angola, Botswana, Zimbabwe and Zambia. The Zambezi HL is located along the middle-lower Zambezi reaches, the area stretching from Lake Kariba to Lake Cahora Bassa reservoirs, spanning three countries: Mozambique, Zimbabwe and Zambia (Figure 1).

The study focused on the Zambian side of each of these Heartlands. These are the areas with the largest population numbers and with key challenges relating to food security and the linkages with conservation. Both Heartlands consist of a mosaic of protected areas, buffer zones (Game Management Areas) and community lands, and include important wildlife corridors. The Heartlands are part of agro-ecological zone I, with average rainfall below 800 mm. Soils in this area are generally poorly suited for agriculture with low natural fertility except in areas along the rivers. Both Heartlands are considered to be highly vulnerable to the impact of climate change. Not only is rainfall low in the area, the variability is high and is expected to increase due to climate change. This will lead to more droughts as well as to more floods caused by increase in extreme rainfall events.

The main administrative districts covered by the Heartlands are Luangwa district, parts of Chongwe and Kafue district and Siavonga for Zambezi Heartland; and Livingstone, Kazungula and part of Sesheke district for Kazungula Heartland. District data for Chongwe and Kafue are not used in the report, because only small parts of those districts fall within the Heartlands.



Kazungula and Zambezi Heartlands: Regional Context

- AWF Office
 - Village
 - AWF Heartland
 - National Park
 - Game Management Area
 - Wildlife Management Area
 - Safari Area
 - Other Protected Area
 - Conservancy

AWF Spatial Analysis
Laboratory, Aug-12



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Figure 1. Location of Kazungula and Zambezi Heartlands.

Traditional food security strategies and impact on livelihoods and on conservation values

DESCRIPTION OF MAIN FOOD SECURITY STRATEGIES

Agriculture

Small-scale agriculture is still the main food security strategy for the rural population in the two Heartlands. It is largely subsistence based, with maize by far the most important subsistence crop as shown in Figure 2.

Yields are generally very low, averaging less than 1 ton/ha for maize and considerably lower for other crops.

The main limiting factor for small rural households is the available labour and the lack of resources to access inputs. Labour productivity in the subsistence systems is low, and available labour for the poorer households is limited to the physically healthy members of the household, with only a minority of HHs having access to a span of oxen or a tractor. Limited access to inputs leads to very low use of fertilizers and use of local or recycled hybrid seeds. Access to good hybrid maize seeds and to fertilizer is mainly restricted to what is provided through the government's Farmer Input Support Programme.

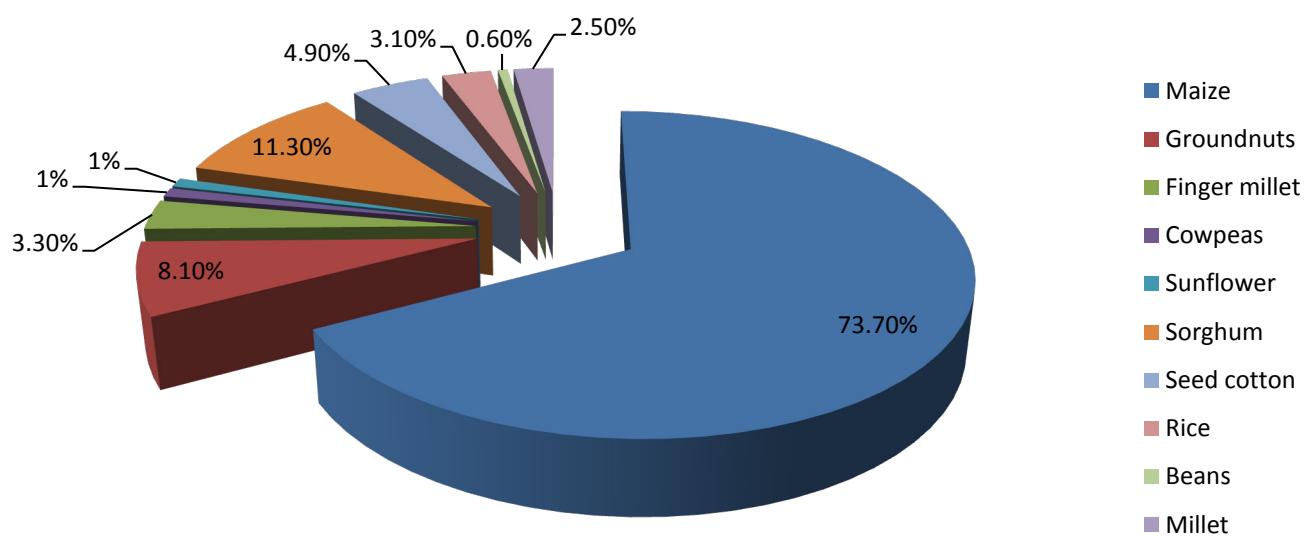


Figure 2. Proportion of land for different crops.

Livestock

Livestock is an important asset in traditional rural livelihoods in most of the Heartland area. Given the high variability of agricultural yields, livestock serve as a type of bank, a coping mechanism. Goats and chicken are regularly sold or bartered for maize meal. Cattle are only sold in extreme emergency situations. Most livestock is managed with minimal inputs: cattle, goats and chickens roam freely during the day and are kept under guard at night. Figure 3 shows the current livestock densities in the Heartlands and per HH.

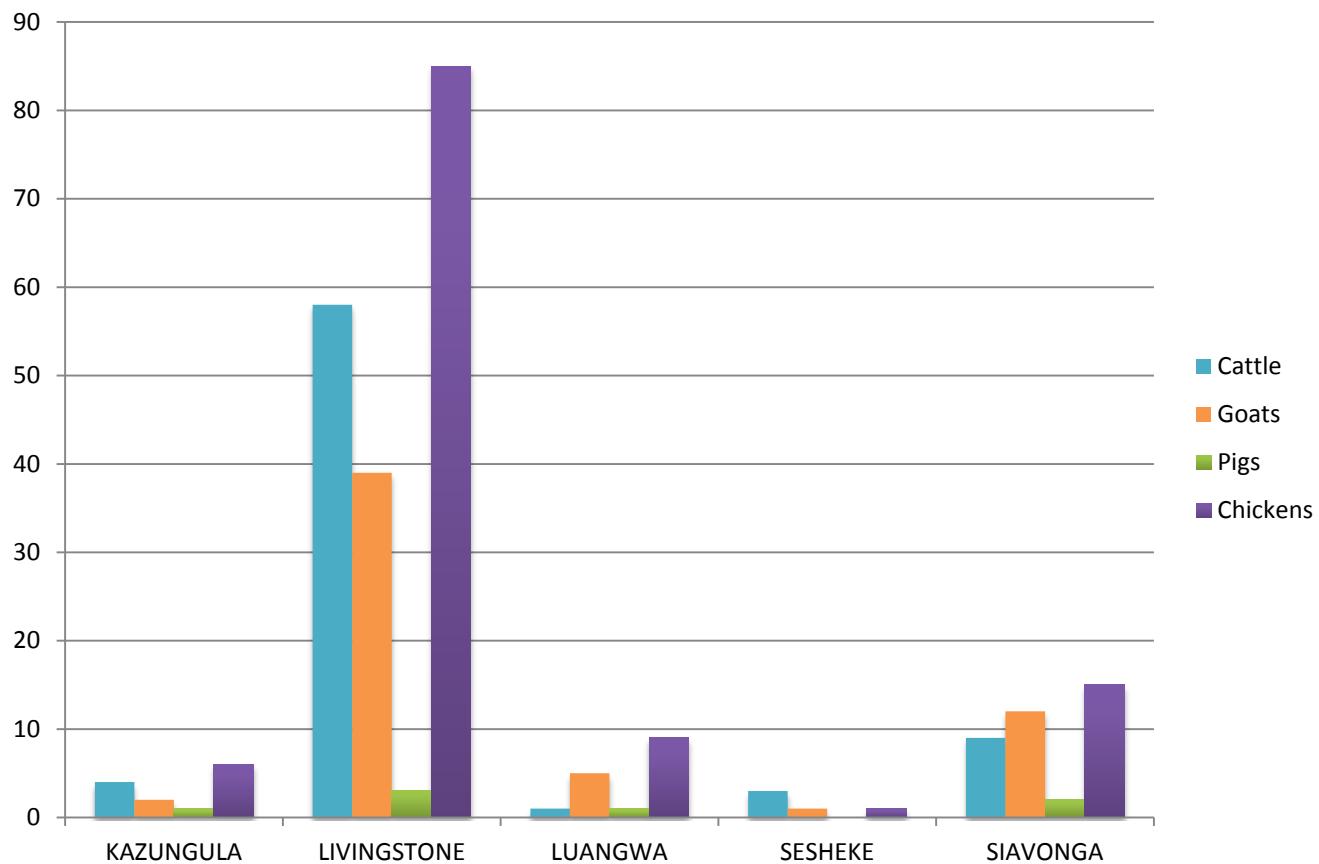


Figure 3. Livestock densities in the Heartland districts.

Source: Author calculations based on data from MALI and CSO.

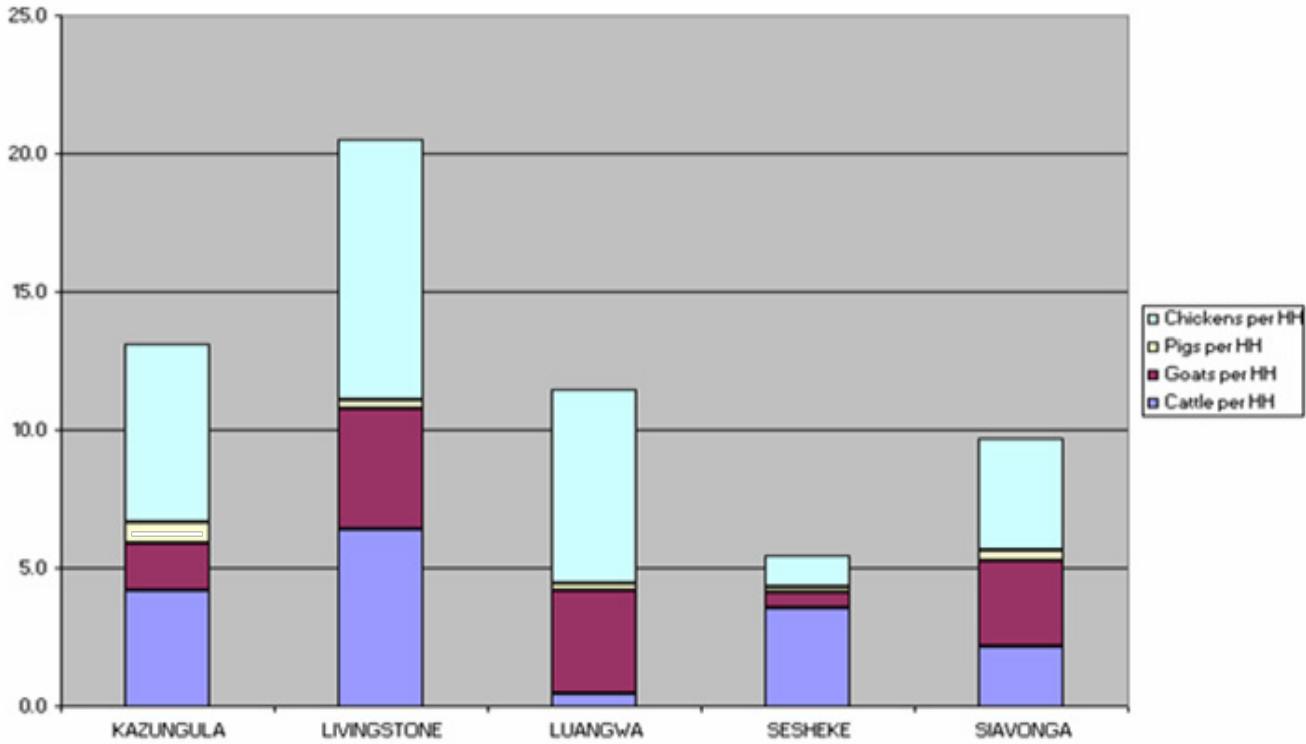


Figure 4. Livestock numbers per HH.

Source: Author calculations.

Capture fisheries

Fishing is the most important food security strategy for much of the population living near the Zambezi, Kafue and Luangwa rivers. The catch is partly consumed, partly sold on local markets.

Subsistence fishing requires a license (USD 5/year), but the majority of fishers (up to 75% according to the framework surveys of Department of Fisheries - DoF) fish illegally without a license. A fish ban is normally in force in most of Zambia's fisheries from 1st of December to 1st of March (three months).

Data from DoF (figure 5) show an ongoing decline in fish catches, a trend that is confirmed by the fishers themselves. The market for fish is good, with fresh fish currently fetching around USD 1 to USD 1.4/kg at landing sites while dried fish average cost is USD2.0/kg.

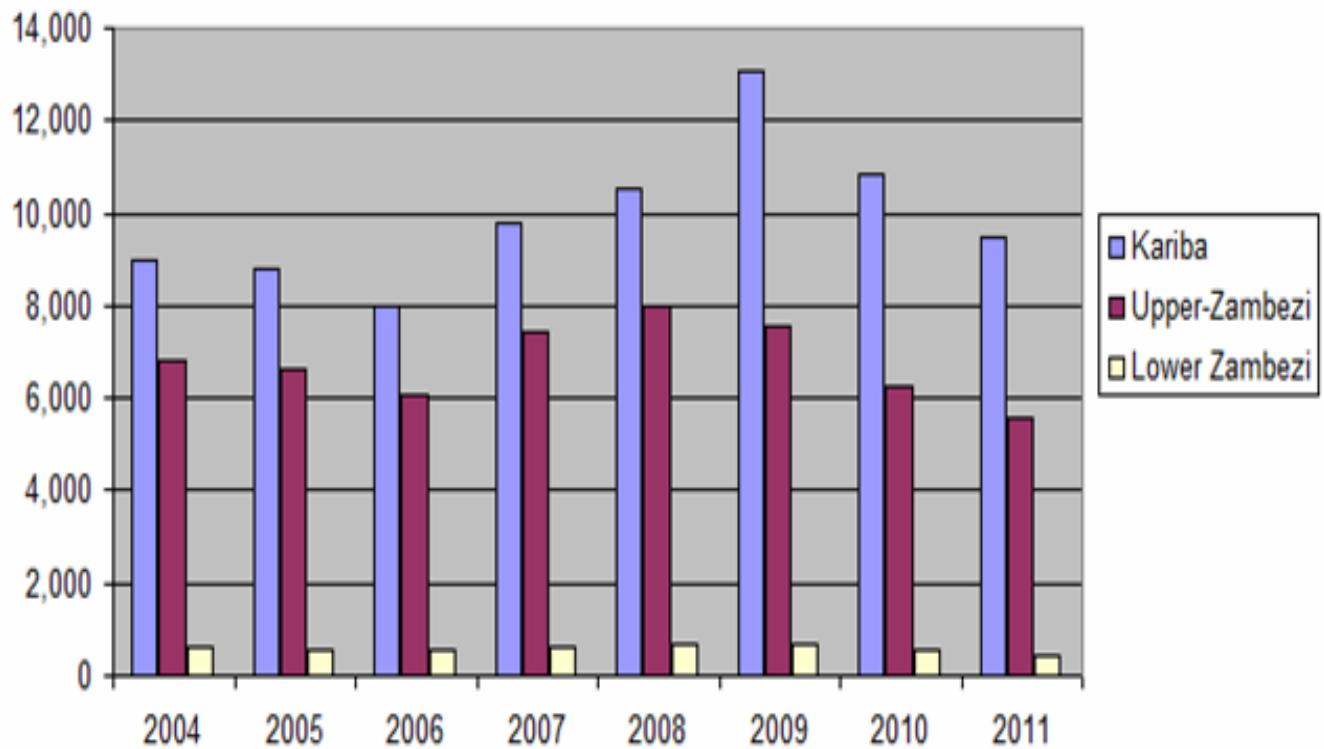


Figure 5. Annual fish production in the three fisheries in the Heartlands.
Source: Department of Fisheries Annual Report (2011)

Aquaculture

Although aquaculture is growing in importance it is not yet an established food security strategy in the Heartlands. A few households on an ad hoc basis have natural or artificial fish ponds, but there is only one known established sizeable non-industrial fish farm in Chiawa GMA. AWF is currently establishing a medium-scale integrated fish farm in the Kazungula Heartland.

Use of forest resources

The main use of forest resources by rural HHs is as **firewood**. This is mostly done for HH domestic use or selling locally, and its impact on forest degradation is negligible (31).

The second main use of forest resources is for the production of **charcoal**. This is practised in all areas in the Heartland albeit in different intensities, but the overall trend is one of increasing production, related to the increased demand from growing urban centres like Lusaka and Livingstone. A license (USD 21) is required to produce charcoal, but it is estimated (31) that more than 95% of all charcoal production is illegal.

Other uses of the forest resources include extracting timber for poles, collecting NWFPs such as wild fruits, tubers, caterpillars and thatch, and beekeeping, although this is only done at a small scale in the HLS.

Wildlife

Hunting for bush meat is commonly practiced in most areas of the Heartlands, and more in the GMAs and open areas around the LZNTP in the Zambezi HL. With only a limited number of licenses for subsistence hunting available every year, illegal hunting (poaching) is widespread and lucrative, with game meat fetching premium prices compared to beef, pork or chicken. No systematic assessment of the actual contribution of this to household income has been done as those involved underplay the level of hunting for fear of prosecution.

Wildlife is also providing income at community level through benefit sharing mechanisms in the GMAs, with communities (through CRBs) entitled to 50% of hunting fees and 20% of concession fees. This income is however not normally distributed to HHs but used to support wildlife management and implement community projects such as construction of boreholes. If the benefits would be distributed to individual HHs they would not contribute much to food security since the amounts would be largely negligible at household level (between USD 2 and USD 15 per HH per year).

Other food security strategies

To cope with food shortages, rural households employ several different income generating strategies that do not directly (although often indirectly) relate to using natural resources. These include employment (mostly limited to seasonal jobs in commercial farms, logging companies and with the tourism industry), self-employment such as crushing stones and remittances from relatives who live / work in urban centres.

RELATIVE IMPORTANCE OF DIFFERENT FOOD SECURITY STRATEGIES

Table 1 represents a visual presentation of the annual food security and labour calendar, which gives an indication of the importance of the different food security strategies through the year.

Figure 6 below depicts the potential income of different food security strategies for an individual household. The figure is based on a mix of anecdotal data collected during the field visits and information derived from various documents. It does as such NOT provide any hard data, but is meant to give some insight on the (potential) importance of current food security strategies, and the opportunity costs at household level related to foregoing activities such as (illegal) charcoal production and poaching.

Table 1. Composite Food Security and Labor Calendar

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall												
Land preparation												
Weeding												
Green maize												
Harvest of food crops												
Cotton sales												
Livestock sales												
Vegetables sales												
Fishing												
Collecting wild foods												
Charcoal production												
Hunting/ poaching												
Casual labor												
Peak hunger months												

Source: Author compilation from information from various documents and from field visits.

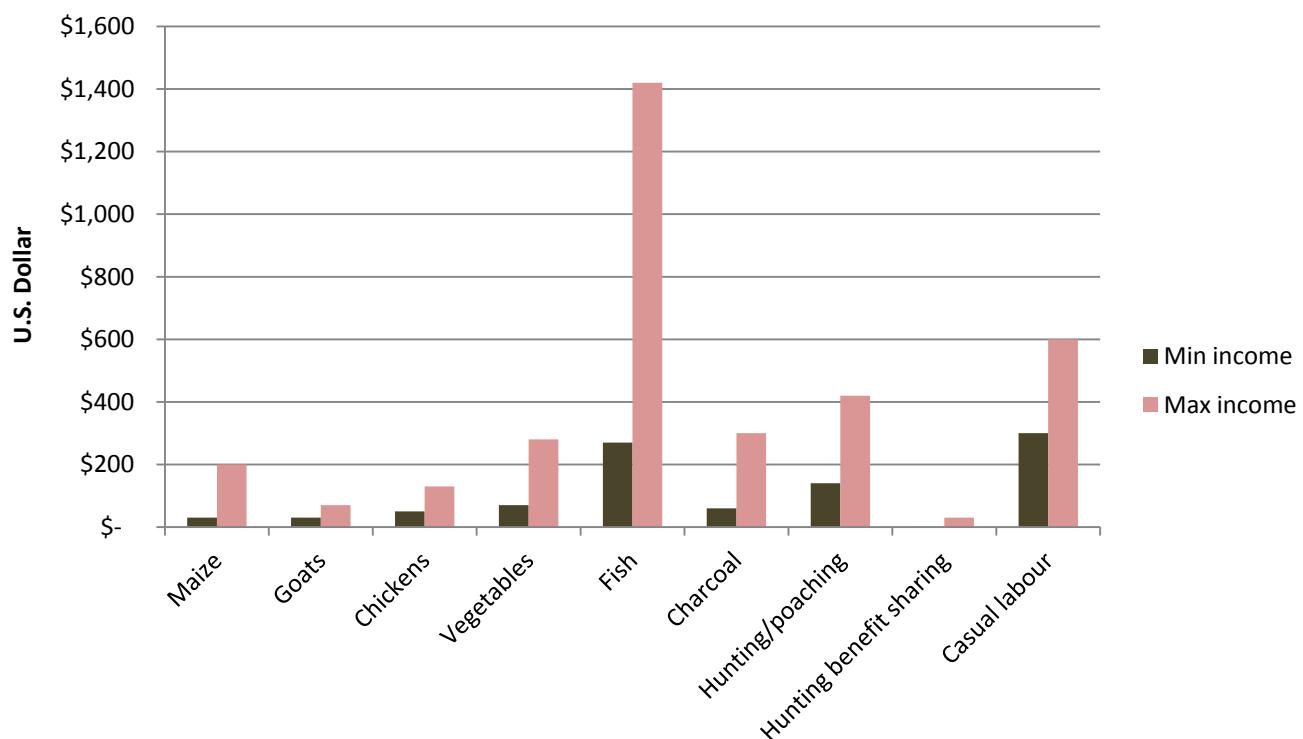


Figure 6. Estimated potential income current food security strategies at HH level

Source: Author calculations.

RELATIONSHIP BETWEEN CURRENT FOOD SECURITY STRATEGIES AND NATURAL RESOURCES

Land

Based on provincial data on areas cultivated it is estimated that expansion of agricultural lands in the Heartlands is at least 3% per year, equivalent to 2,500 ha annually. This expansion is not regulated by a system of land use planning and is the primary cause of deforestation in the Heartlands. Opening new areas for agriculture (and abandoning old fields) also contributes to soil degradation and siltation of rivers.

Forests

While agricultural expansion is the main deforestation driver, firewood collection and charcoal are considered to be the second most important cause of deforestation in the Heartlands. The extent of the problem is difficult to quantify because (i) charcoal production often goes hand in hand with expansion of agricultural land and (ii) up to 95% of charcoal production is illegal and therefore not included in any statistics.

Charcoal production can be sustainable if well managed through for example the coupe system that was used in Zambia until the 1980s. Nowadays, charcoal production is largely unregulated, leading to unsustainable practices, such as cutting all trees in an area and producing charcoal in unsuitable areas such as riverine woodland. It also leads to encroachment into PAs such as the Lower Zambezi National Park.

A third important cause of forest degradation directly related to rural food security is uncontrolled bushfires. Most of these are related to clearing fields for agriculture, charcoal production, promoting green pastures, and as a hunting strategy to drive rodents and hares out of hiding in order to kill them for food during the difficult months from September to December.

Wildlife

Human wildlife conflict is consistently mentioned as the main threat to food security by the population in the Heartlands that live near National Parks or wildlife corridors, with data from ZAWA showing a general trend towards an increase of HWC. Elephants are the main culprits where it concerns destruction of crop fields, while hippos target vegetable gardens, which are usually located near rivers. Monkeys and bush pigs also cause damage but less so than elephants. Sorghum is targeted in particular by birds, and this is often mentioned by the population as one of the reasons why they don't like planting sorghum.

The lack of adequate land use planning is an important factor in the ever increasing number of HWCs. Wildlife corridors have been identified in the Heartlands by AWF and others, but there are no legal enforcement mechanisms to ensure such corridors are protected against encroachment of agricultural fields or even new villages.

The impact of poaching on the wildlife populations is difficult to assess for lack of data, but it is clear that notorious poaching areas such as the outlying areas of the Rufunsa GMA and even the escarpment area of the LZNTP have seen their wildlife numbers decrease drastically over the last decades. In areas where AWF has supported village scout patrols (Sekute chiefdom in Kazungula HL), poaching appears to have been reduced drastically (*personal communication Sekute Community Development Trust*).

Fish resources

Anecdotal evidence from field visits and other studies points very strongly to a situation of over-fishing in much of the Heartland, with total fish production sharply declining in the last 3 years. While there are no consistent time series data on the changes in number of fishers, the few ad hoc fisheries frame surveys conducted have shown a general increase. This conversely resulted in the Catch Per Unit Effort (CPUE) decreasing substantially, which is a strong index for over-fishing.

A major problem in the management of fish resources is that the Zambezi and Luangwa rivers are shared with neighbouring countries (Zimbabwe, Namibia for the Zambezi and Mozambique for the Luangwa). Despite attempts from AWF and others, these countries have not yet harmonised fisheries management and legislation. This leads for example to the situation that Zambian fishers will cross to the other countries during the annual fish ban enforced in Zambia.

CLIMATE CHANGE IMPACT ON CURRENT FOOD SECURITY STRATEGIES

Climate change models predict that temperatures in the Heartland areas will go up by anything between 1°C and 3°C by 2060. Total annual rainfall is projected to not change significantly, but the variability is expected to increase, leading to more droughts as well as to an increase of heavy rainfall events, which in turn may lead to an increase in floods. The vulnerability of the HLs to such climatic changes is high compared to most other parts of the country due to its already limited agricultural potential (lying as they do within agro-ecological zone I) and the fact that many parts of the HLs are already prone to floods.

Specific expected impacts on the various food security strategies are listed in Table 2.

Table 2. Expected impact of climate change on food security strategies in the Heartlands

Food security strategy	Expected impact from climate change
Rainfed agriculture	<ul style="list-style-type: none">Increasing droughts and shorter rainy season will negatively affect yields, in particular of maize which is less drought tolerant than other food crops like sorghum and millet. This will affect all areas in the Heartland.Heavy rainfall events will lead to water-logging as well as increased soil erosion. Both will lead to lower or failed yields. The area likely most affected will be the hilly areas in Zambezi HL, particularly Siavonga.Floods can wash away crops in flood-prone areas, which are quite widespread in particular in the Kazungula Heartland.Temperature increases will lead to increase in plant diseases
Vegetable gardens	<ul style="list-style-type: none">Gardens that use seasonal water from either seasonal streams or small dams may experience more water shortages.Flooding of gardens near the main rivers will become more frequent.
Livestock	<ul style="list-style-type: none">pastures flooded during long periods and therefore not availableincrease in diseasesdroughts will decrease pasture productivitytemperature increases may lead to increased mortality
Fisheries ³	<ul style="list-style-type: none">Changes in water temperatures and water levels may lead to changes in fish composition and quantityFloods lead to reduced fishing and fish
Other	<ul style="list-style-type: none">Human health will be affected (more waterborne diseases, more malaria etc.) which will directly affect their capacity to undertake food security activities.Infrastructure damage from floods, in particular damage to roads and bridges, will lead to less access to markets, and less traders visiting the rural areas. Selling cash crops, fish, charcoal, etc. will be more difficult.Low water levels may lead to reduced hydro-energy outputs, which in turn may affect food security strategies
Wildlife	<ul style="list-style-type: none">Changes in habitat structure and in water availability may lead to wildlife changing its movement patterns and distribution, with potential to result in more HWC.

³ In a study by the World Fish Centre that listed countries according to relative vulnerability of the national economy to climate-change-driven impacts on fisheries, Zambia scored 13th highest vulnerability out of a total of 152 countries. In other words Zambia's fisheries are highly vulnerable.

Analysis of alternative food security strategies with potential conservation benefits

AGRICULTURE

Conservation agriculture

Conservation agriculture (CA) is seen as a key approach to promote sustainable land management and increase small-scale farmer output and hence food security. CA is based on three principles that are believed to enhance biological processes above and below the ground. These are: (1) minimum or no mechanical soil disturbance; (2) permanent organic soil cover (consisting of a growing crop or a dead mulch of crop residues); and (3) intercropping and diversified crop rotations. Through these principles, that are complementary, CA aims to restore soil fertility, use rainwater more efficiently and improve long-term productivity. As such it is a potentially important strategy for improved food security *and* sustainable management in the Heartlands.

A budget analysis (Figure 7) shows that the CA using hand hoes to dig planting basins outperforms conventional farming, while CA using oxen provides the highest return on labour. The key benefit of CA is the fact that it allows for early planting (because land preparation is done before the start of the rains), which in turn allows farmers to make efficient use of the first rains, a very important aspect in the Heartlands where rainfall is only marginally enough for agriculture.

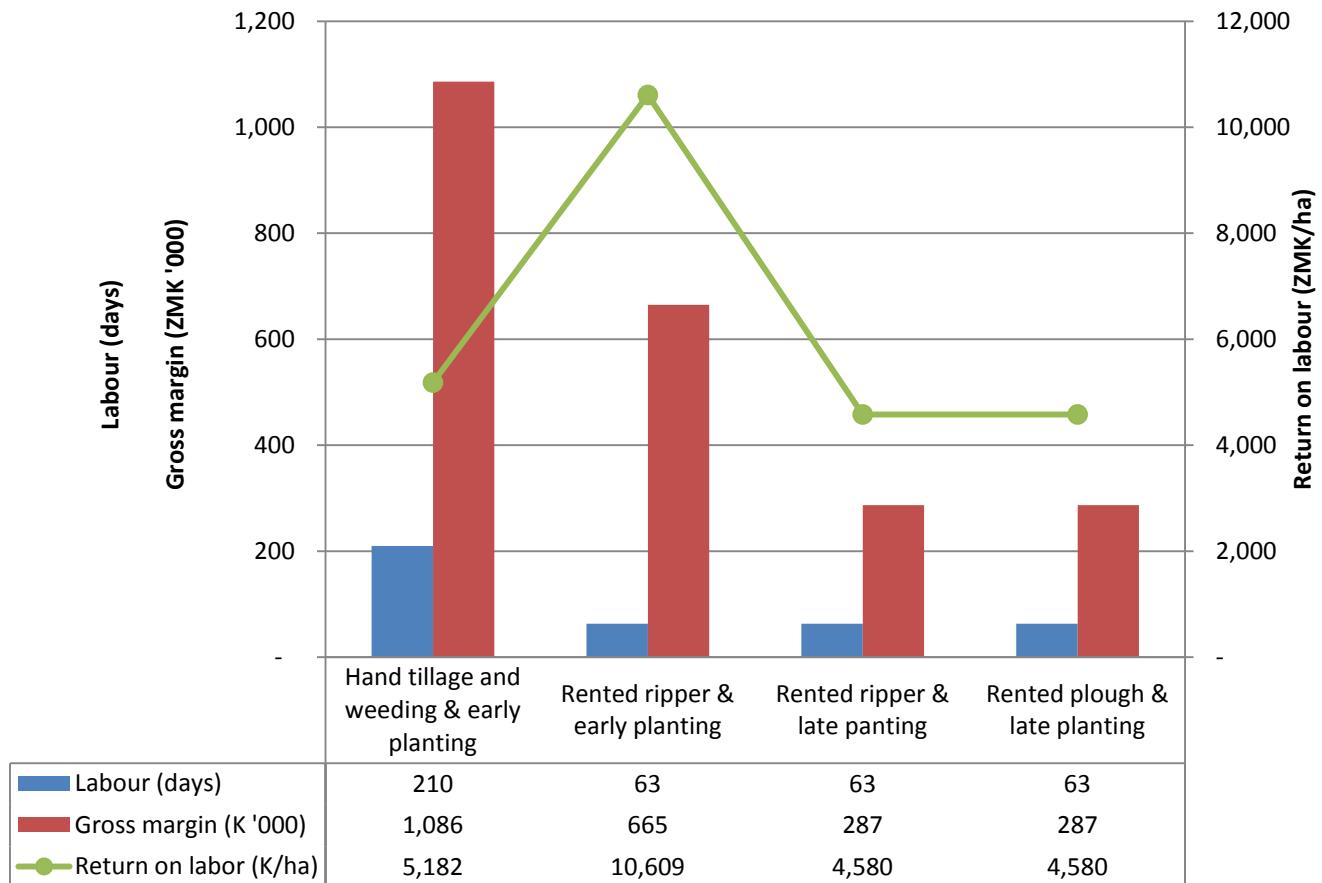


Figure 7. Cost Benefit Comparison CA and non-CA for farmers without ADP.
Source: (60).

There are however considerable challenges related to its promotion: (i) It requires a fundamental shift away from traditional farming methods; (ii) it has a high labour demand (although a reduced peak labour demand); (iii) mulching is difficult to realise in a system with open access grazing; (iv) seeds for e.g. legumes are often difficult to obtain; (v) sustainable yield increases are only realised in the long term (5 to 10 years); and (vi) there are also institutional challenges including non-harmonised approaches to promote CA, a lack of technical expertise amongst extension workers and the farmer input support program (FISP) which is still geared towards traditional maize growing.

The ultimate indicator to assess whether the advantages outweigh the challenges of CA is the level of adoption of CA practices by the small-scale farmers. Such adoption rates are still low, as evidenced by AWF's experience with promoting CA in the Zambezi HL. Two year after direct support to the farmers was stopped only 20% of farmers are still applying some of the CA techniques.

The main potential for conservation leverage of CA lies in the improved land management that in principle allows farmers to continue using their fields indefinitely. The key question however is how smallholder farmers will respond to successful adoption of CA. It will likely lead to more households being able to afford more labour-saving approaches such as the use of herbicides for weeding and a span of oxen with ripper for land preparation, thus allowing them to expand their fields. Even for non-

mechanised CA, expansion is an option since the peak labour demand at the start of the agricultural season is considerably reduced with land preparation done before the start of the rains. The challenge will be to convince farmers that they should further *intensify* their agricultural practice on the existing fields (use of more fertilizer, use of herbicides, using the best possible seeds) rather than increase the size of land under cultivation.

Conservation agriculture has the potential to reduce rural households' vulnerability to expected climate changes, in particular the frequency in droughts. Through better water retention in the zone near the crop's roots, CA fields will be able to produce better than conventional tillage fields in years with low rainfall.

Crop diversification: options for rainfed crops

Table 3 lists some alternative rainfed crops that are currently not cultivated, or cultivated only at a small scale, in the Heartlands, and that have potential to contribute to food security and leverage conservation and/or increase climate resilience.

Table 3. Options for Rainfed Crop Diversification

Crop	Current situation in Heartlands	Advantages	Challenges / disadvantages
Cassava	Hardly grown in the Heartlands but NGO Harvest Help is currently promoting it as an off-season crop	<ul style="list-style-type: none"> • Strong policy support • Good potential markets • Drought resistant • Can help reduce hunger gap if planted early. 	<ul style="list-style-type: none"> • Cultural acceptance might be difficult • High tilling requirement of some varieties may lead to land degradation • Modern processing methods for cassava are not widely accepted
Sorghum	Hardly grown in the Heartlands accept traditionally in the Siavonga district. Even there however, sorghum is more and more displaced by maize.	<ul style="list-style-type: none"> • Good commercial potential • Drought resistant 	<ul style="list-style-type: none"> • Cultural acceptance might be difficult • Successful introduction might lead to expansion of land • HWC: birds are a major problem
Groundnut	Grown in the Heartlands but not at very large scale	<ul style="list-style-type: none"> • Good for intercropping (legume) • Market for processed groundnuts available 	<ul style="list-style-type: none"> • Problem of aflotoxin contamination • Not as drought resistant as cassava / sorghum • Lower return per ha than cassava / sorghum
Pulses / beans (e.g. cow pea, pigeon pea, chick pea)	Only cow pea is grown in any substantial in the Heartlands, primarily in Kazungula and Sesheke districts.	<ul style="list-style-type: none"> • Very good candidates for intercropping and crop rotation in CA fields • Studies showing very high returns per hectare (see annex II for details) 	<ul style="list-style-type: none"> • Cultural acceptance might be difficult. • Value chain for these crops are not very well studied and requires more research
Jatophra (and other biofuel crops)	Biofuels are not or hardly grown within the Heartlands	<ul style="list-style-type: none"> • Grows well even under difficult conditions (e.g. on poor soils) 	<ul style="list-style-type: none"> • It is a first generation bio-fuel and long term commercial perspective are less promising than for second generation bio-fuels • Their promotion can lead to expansion of land under cultivation.
NERICA – New Rice for Africa	A new rice variety developed in West-Africa and therefore still unknown in the Heartlands. The World Bank plans to promote this variety in its Climate Resilience Programme	<ul style="list-style-type: none"> • Low weed growth • Early maturity • Drought tolerance • Tolerance for temporary flooding • Resistance to many common diseases and pests • High responsiveness to mineral fertilisation. 	<ul style="list-style-type: none"> • Tastes different than local varieties and this might be a barrier • It is a hybrid and therefore leads to problems with input supply and possible high dependency on commercial seed producers • Since it is unknown in Zambia, it will require extensive piloting before it should be widely promoted.

Horticulture

Vegetable production is already taking place in the Heartlands at a very small scale and using buckets for irrigation. The main exception is the area around Livingstone where horticulture is strongly promoted by the NGO iDE. They have developed a vegetable value chain that targets the tourism lodges and hotels. iDE supports the chain by ensuring quality control and facilitating access to irrigation equipment, in particular treadle pumps, through a collaboration with micro-credit organisation CETZAM. Horticulture farmers that change from using buckets to treadle pumps increased their average irrigated area from 0.3 to 0.6 ha. Analysis of income generated in the iDE areas show that farmers make net profits of between USD 150 and USD 300 in the first year of adoption of a treadle pump (combined with training provided by iDE). This increases further in subsequent years.

The iDE approach as applied around Livingstone can also be introduced in other areas of the Heartlands e.g. in the Chiawa GMA with its high number of tourism establishments.

The conservation leverage of horticulture is two-ways: it can help reduce expansion of agricultural land and it can reduce HWC since the relatively intensive use of small areas allows for more expensive and robust HWC mitigation measures such as solar-powered electric fences to stop elephants (and other animals like hippos, monkeys) from raiding the vegetable gardens. Horticulture can also help build resilience against climate change since production is not depending directly on rainfall but is controlled through irrigation, although it will be important to locate horticultural gardens in areas that are not flood-prone.

Goat schemes

AWF supports a goat livelihood scheme in Zambezi Heartland, based on introduction of a new commercially more attractive breed of goats that can cross-breed with the local goats. Initial results from the scheme show that the project has so far been very successful. At least 100 offspring (cross-breed) have been produced, and the farmers are getting prices per live goat that are up to three times higher (USD 30 instead of USD 10) than what they get for their much smaller traditional goats.

Goat schemes don't have any direct conservation leverage, and in fact some insight in the carrying capacity of goats is required to ensure that the environment is not degraded. Indirectly, goat schemes could have conservation leverage by reducing the need of rural households to expand agricultural fields or engage in destructive activities such as poaching and charcoal production. Goat keeping can be an important component of a climate change adaptation strategy because they are resilient animals and will be able to provide income when other animals and crops fail due to droughts or floods.

Improved capture fisheries

Capture fisheries is widely practiced in the Heartlands but current practices are not sustainable. One of the problems has been the lack of legislation in support of co-management arrangements. This is likely to change with the adoption of Zambia's new Fisheries Act in 2011, which provides for the creation of Fisheries Management Committees (FMCs) to manage fisheries, with representatives from government, the communities (fishers and fish farmers), traditional leadership and commercial fishing operators.

The new legislation also provides for benefit sharing arrangements related to fish license fees, which will promote the sustainability of the FMCs. AWF is currently piloting the application of this new legislation in the Kazungula Heartland. Several FMCs have been formed and management of the Zambezi fisheries has started with the identification of non-fishing areas that serve as breeding zones.

The potential for direct conservation leverage from promoting decentralised co-management of fisheries resources is high, since it should lead to more sustainable fishing, which will in the medium to long term lead to recovery of fish stocks in the rivers which would constitute a major conservation impact.

Aquaculture

With a strong market for fish, and with the government actively promoting aquaculture, the prospects for fish farming in the Heartlands are very good. The most interesting fish farm types for development in the Heartlands are small-scale enterprises, which produce primarily for sale, but don't normally get involved in producing fingerlings (which is a relatively high tech affair). Fingerlings can be bought in Zambezi HL through a commercial fish farm in Chirundu, and in Kazungula HL through the community medium-scale enterprise supported by AWF.

A cost-benefit analysis of the existing fish farm in Chiawa (with 6 fish ponds) shows good profitability with a potential annual gross margin of USD 17,000, or a little over USD 1,000 for each of the 16 HHs currently involved.

Apart from fish ponds there is also scope for small-scale cage aquaculture in Lake Kariba (Siavonga district). The Department of Fisheries is supporting some proposed cage aquaculture enterprises as part of piloting the implementation of the Aquaculture Development Plan. Their business plans show net profits from around USD 700 in year 1 to USD 20,000 in year 5.

The potential conservation leverage of fish farming is substantial. It will help reduce the pressure on native fishes in the rivers and on Lake Kariba. Fish farming provides an alternative food source to the traditional crop cultivation and in that way contributes to reduction of HWC since elephants are not interested in fish, and simple fencing can keep out hippos and crocodiles. Furthermore, fish farming has good potential to increase resilience to climate change for the local communities in the Heartlands as production is not directly dependent on rainwater and river flows, as is the case with rainfed agriculture and capture fisheries. Instead, like for horticulture, it just requires careful planning to locate fish ponds in non-flood areas with secure ground water recharge even under dry conditions.

FOREST RESOURCES

Improved management of charcoal production

While from a conservation point of view charcoal production should probably best be abandoned all together, the reality in Zambia is that charcoal production will continue for the foreseeable future to

address genuine energy needs in urban centres. The two most promising approaches towards more sustainable charcoal production are:

- Through (re-)introduction of management systems such as the coupe system based on joint forest management principles, in line with the new Forestry legislation currently being finalised.
- Through plantations and woodlots for charcoal production.

The conservation benefits of such approaches are evident through reduced deforestation and degradation of indigenous forests and woodlands.

Beekeeping

Beekeeping in Zambia is concentrated in the North-Western and Northern provinces, where conditions are best. In the Heartlands, beekeeping is possible, but conditions are less than ideal: temperatures in the valley areas are on the high side, all-year water availability in woodlands is limited, not all woodlands are suitable (miombo woodlands are best suited and can only be found in the escarpment area of the Zambezi Heartland). Also, most woodlands are used for other economic activities (timber and charcoal production) while bees thrive best in an undisturbed environment. The potential for beekeeping in the Heartlands is likely to be further reduced with predicted increases in average temperatures due to climate change, which may lead to bees absconding honey production entirely.

Other NTFPs

In general it can be stated that the potential of NTFPs (Non Timber Forest Products) is much higher in the northern half of Zambia than in the Heartlands. Nevertheless, there are some options worth exploring: (i) Processing / marketing of mungongo nuts; (ii) commercialisation of mopane worms; and (iii) commercialisation of wild mushrooms.

Integrated agriculture-livestock-fish farming-forestry systems

While in the above sections the various alternative food security strategies have been discussed by sector, it is important to realise that integrating the agriculture, livestock, fish farming and forestry systems will lead to more sustainable production systems. Agro-forestry techniques such as the use of tree species like *Faidherbia albida* (winterthorn) and *Moringa oleifera* ("drumstick tree") are particularly promising. The main barrier to agro-forestry is the long time it takes to reap the benefits, which lies in the range of 10 to 15 years. It therefore requires long term engagement through awareness raising and technical support. Ideally the long term benefits are combined with direct short term benefits, as would be possible through climate mitigation financing mechanisms.

OTHER INCOME GENERATING ACTIVITIES BASED ON NATURAL RESOURCES

Community tourism enterprises

Tourism is well established in many parts of the Kazungula and Zambezi HLs, with tourism development concentrated around Livingstone town and in the Chiawa GMA respectively. Community-based tourism enterprises are therefore a potential alternative food security strategy.

However, a study on community-based tourism in Zambia (35) concluded that most of these enterprises fail for a variety of reasons, the main problem being the fact that they are often donor-driven instead of market-led. For AWF, in the Chiawa Cultural Village in Zambezi HL, while the private sector was consulted on the project and expressed support, they were not actively and formally involved, and the enterprise is currently struggling to make ends meet for a lack of clients. AWF has learnt from this experience and is currently developing several tourism enterprises (fishing camp, lodge, etc.) in Kazungula HL in partnership with the private sector.

It is also important to maximise the potential for multiplier effects such as supply of vegetables or fish to tourism lodges, development of curio markets in or near lodges, etc. Ultimately such spin-off and multiplier effects may generate added value and have positive impact on local livelihoods than the direct effect of employment creation and benefit sharing from the core enterprise.

The main conservation leverage lies in the assumption that benefits from these enterprises make people realise the value of the wildlife in their area. Whether this assumption will hold is something that needs to be monitored carefully. If it does, the conservation impact can be considerable. AWF works through conservation covenants guided by Quid pro Quo (QpQ) agreements with the local communities and continuous awareness and sensitisation to achieve community buy-in.

Game ranching

Within the Heartlands, possibilities for game ranching exist in particular in parts of the Sekute and Inyambo Chiefdoms (western part of Kazungula HL), as well as the escarpment areas in Rufunsa GMA just outside the boundaries of the LZN in Zambezi HL.

AWF commissioned a study in 2012 on the potential for a wildlife breeding sanctuary in Sekute Chiefdom, which would ultimately operate as a game ranch once viable populations are in place through the breeding program. At present value, the expected investment costs over a period of two years are estimated at USD 2,22 million, the annual operating cost at full operating strength (year 3) is USD125,000 and the projected income at full production (year 8) is USD 629,100, with a break-even point by year 6. If the order of magnitude of these calculations is anywhere near realistic, it means that game ranching could be a very profitable enterprise. It also means however that such an enterprise is likely way beyond the management capacity of the rural communities, let alone individual households, and requires a partnership with a private sector expert on game ranching, which is the approach AWF had modelled this enterprise like.

CLIMATE CHANGE MITIGATION

There is huge potential for climate change mitigation measures at landscape level within AWF's Heartlands. This potential consists of a combination of possible measures that include reforestation, avoided deforestation and degradation (REDD), and sustainable land management (SLM).

Mitigation and carbon financing through Sustainable Land Management

The main aspects of SLM that contribute to reducing and sequestering GHG emissions include (18): (i) enriching soil carbon, (ii) farming with perennials, including incorporating trees like *Faidherbia albida* in annual cropping systems (agro-forestry) and (iii) restoring degraded watersheds and rangelands.

A general study on the economics of agricultural mitigation (24) showed that adoption of agro-forestry could increase sequestration by around 3 to 3.5 tCO₂ / ha / year. The same study also looked at the relation between different agricultural food security strategies and climate change mitigation potential. The ideal strategies are those with high food security and mitigation potential, which are listed in the top right corner of Table 4 below. Conservation farming (especially when promoted on degraded land), agro-forestry and low-tech irrigation (e.g. with treadle pump) would all fit within that category.

Table 4. Relation between Food Security Strategies and Mitigation Potential

Food Security Potential: High Mitigation Potential: Low <ul style="list-style-type: none">◊ Expand cropping onto marginal land◊ GHG emission intensive irrigated crop production	Food Security Potential: High Mitigation Potential: High <ul style="list-style-type: none">◊ Restore degraded land◊ Expand low-energy-intensive irrigation◊ Agroforestry options increasing food security
Food Security Potential: Low Mitigation Potential: Low <ul style="list-style-type: none">◊ Bare fallow◊ Continuous cropping without nutrient replenishment◊ Over-grazing	Food Security Potential: Low Mitigation Potential: High <ul style="list-style-type: none">◊ Expand biofuel production◊ Reforestation/afforestation

Climate change mitigation financing for SLM would have to be based on voluntary markets. With the recent approval of a Verified Carbon Standard (VCS) for SLM, the prospects for financing under such markets have significantly increased, and could lead to estimated payments of up to USD 27 / ha / year (24) for adoption of correct agro-forestry practices.

Challenges related to SLM carbon projects include (18): (i) high transaction costs; (ii) risk aversion of farmers (interventions should therefore also be beneficial to farmer without carbon credit); (iii) access rights to resources need to be clearly defined; and (iv) requirements for strong farmer / community organisations.

REDD and CDM

The potential for REDD+ in Zambia is highest in the areas with relatively dense forest cover such as North-Western Province. However, REDD+ can also be applied in the Heartlands as a financing mechanisms to help reduce forest deforestation and degradation. At the moment, the UN, through the UN-REDD programme, is laying the groundwork for implementation of REDD+ projects through studies on current deforestation levels and the underlying drivers, potential sequestration levels of different forest and woodland types, development of benefit sharing mechanisms etc. REDD+ projects face many of the same challenges as SLM projects, but have leakage as an additional challenge.

Carbon financing for afforestation and reforestation and for energy-related projects (both possible under the Kyoto protocol i.e. the Clean Development Mechanism), are also an option, particularly in relation to interventions to make charcoal production more sustainable, through more efficient production methods and plantation of woodlots that are specifically meant for charcoal production.

Cross-cutting issues

Policy environment

At pan-African level, the African Union (AU) has a New Partnership for Africa's Development (NEPAD) initiative which has developed a Comprehensive Africa Agriculture Development Programme (CAADP) which is probably the most relevant current policy initiative. It is based on four pillars: (i) Land and Water Management; (ii) Market Access; (iii) Food supply and hunger; and (iv) Agricultural Research. Within the context of this study, the first pillar is highly important, as its main aim is to extend the area under sustainable land management and reliable water control systems. Zambia developed its CAADP Compact (ZCC) in 2009, and it is seen as a vehicle to strengthen the implementation of Zambia's National Agricultural Policy. In the current Sixth National Development Plan, the importance of promoting conservation farming, land use planning and water resources management are all included in the agricultural strategies.

At the regional SADC level, one of the most important aspects is the harmonisation of policies and legislation relating to transboundary shared resources. For the Heartlands this concerns in particular the fisheries resources in the Zambezi and Luangwa rivers. In spite of numerous attempts, including from AWF, the process of harmonisation is still a long way off and requires further support and advocacy.

Zambia's new fisheries legislation (2011) creates more opportunities for co-management of fisheries resources and benefit sharing mechanisms, which should contribute to more sustainable use. Similarly, new Forestry legislation that is currently being drafted will formalise Joint Forest Management arrangements that also include benefit sharing mechanisms. Wildlife policies and legislation already include these elements.

Natural resources management planning, compliance & monitoring

AWF has been emphasising land use and NRM planning as an important tool in its effort to secure wildlife corridors. Under AWF's WEALTH programme, a detailed land use / NRM plan was developed for part of Siavonga district and a detailed micro-zoning plan is currently under development in the Chiawa GMA. The key question with all land use and NRM plans concerns the mechanisms put in place or developed to implement the plans and to ensure compliance e.g. with protecting identified wildlife corridors.

The above is closely related to any support that AWF and other stakeholders would provide to promote alternative food security strategies that *potentially* also have good conservation leverage. AWF has realised that conservation benefits from promoting alternative livelihoods are more likely to be achieved if the linkages between the two are made explicit, through a transparent negotiation process with communities, which should result in a "conservation agreement" for food security support from AWF (and its partners) in exchange for commitment to support conservation by the communities. Most importantly, such an agreement should include compliance and monitoring mechanisms, based on

collaboration between involved stakeholders to ensure the “deal” is respected by all sides. AWF is currently piloting this very promising approach in Kazungula HL, where support to an aquaculture enterprise is linked to protection of fish breeding zones in the Zambezi river.

Micro-finance

The opportunities for rural households in the Heartlands to access micro-credits or other financial resources to invest in alternative food security activities are currently very limited. Commercial banks don't lend to small farmers, and of the micro-finance institutions (MFAs) only one, CETZAM, is currently active in the Heartlands.

A very promising development is the collaboration between CETZAM and iDE to develop tailored micro-finance packages for horticulture in Kazungula HL. Loans are tied to specific items of equipment for inputs and are paid directly to local retailers from whom farmers receive their goods. iDE is vetting all candidates for loan applications and as such is reducing the risk for CETZAM. Instead of collateral, a group lending model is used with groups of five to eight farmers taking individual loans (at 4% interest / month) for which the whole group is jointly and severally liable. A similar model could also be applied in the Zambezi HL and could be extended to other food security strategies such as aquaculture and goat schemes.

Insurance schemes for small-scale farmers

Insurances against crop failures for small-scale farmers currently don't exist in Zambia. There are, however, plans to start weather-index insurance schemes targeting small farmers, as part of the World Bank's Strategic Program for Climate Resilience (SPCR) programme. Such schemes have already been successfully introduced in countries such as Malawi, Tanzania and Kenya by the insurance intermediary MicroEnsure. The model is based on the principle that farmers who have taken insurance get paid out compensation if certain pre-defined weather conditions occur, e.g. a certain number of consecutive dry or almost dry days. The system uses weather stations to assess the conditions, and if a certain station reports a condition that triggers compensation payments, all farmers within a certain radius (e.g. 20 km) of that weather station get paid.

An important side effect of crop insurance is the fact that a farmer with such insurance becomes more attractive to lenders (e.g. micro-finance institutions, but also possibly some larger banks) because one of the main causes for non-payment of agricultural loans (failed harvest) is removed from the equation.

Extension services

The Ministry of Agriculture and Livestock (MALI) has a wide network of so-called camps, which are the base stations for their extension workers. However, the Ministry does not have the resources to staff all camps with well-trained extension officers and to provide them with the means to be able to work effectively (e.g. transport). A further problem is that most extension workers are trained primarily in very *technical* aspects of *mainstream* farming methods. They have often received little or no training in facilitation skills, nor in alternative farming methods like conservation farming and organic farming, unless they have been exposed to these through specific projects. Most of them are also new to the

concept of “farming as a business” which is an important concept to ensure that farmers will focus on intensifying production per hectare rather than extensifying land use.

Access to agricultural inputs

Many of the small rural households in the Heartlands do not access any external inputs (seeds, fertiliser) to grow their crops. Yet, according to AWF’s draft agricultural strategy, inorganic fertiliser and quality seeds are important elements for a strategy that promotes increased productivity per ha in order to reduce the need for further expansion of agricultural land. Where fertiliser and hybrid seeds are being used it is almost always obtained at highly subsidised prices through the FISP and through development projects.

There are no easy solutions for this problem. For inorganic fertiliser and hybrid maize seeds, access to micro-credit would allow farmers to buy these inputs in sufficient quantities. For risk averse small farmers however, taking up a loan to buy inputs may constitute a huge barrier. The combination with weather-index insurance would help reduce such risks, but it will require a significant change in mindsets of rural farmers. Also, it wouldn’t resolve the problem that the commercial market is very much focused on maize inputs, and not on for example seeds for other crops within the context of crop rotation.

Obvious alternatives to inorganic fertilisers and hybrid seeds are organic fertilisers and open pollinated seed varieties (OPVs). In an integrated agriculture – livestock system, manure can be produced in relatively high quantities. Through conservation farming, the application of manure can be done very efficiently by only applying it around the seedlings. The NGO Africare is currently experimenting with an interesting approach that looks at producing manure where it is needed (on the fields) through the use of mobile kraals, that are shifted regularly (e.g. once a week) from one field site to another.

The problem of lack of seed security can be addressed through the promotion of local seed banks, managed either by an individual entrepreneur or a seed growers association or cooperative. A local seed bank serves the double aim of increasing local seed security and contributing to conservation of locally important genetic diversity. One complicating factor with seed banks in Zambia is the fact that all seeds (hybrids and OPVs) have to be certified by the seed certification institute SCCI before they can officially be marketed. A more in-depth study on how seed banks fare in Zambia and what the main lessons learnt are is required.

Conclusions and way forward

Small-scale rainfed agriculture is, and will for the foreseeable future, remain the mainstay of food security strategies for the rural population in the Heartlands. Maize is the dominant crop, in spite of the fact the Heartland areas lie in an agro-ecological zone which is at best marginally suitable for maize. Maize yields are low and erratic, and one can conclude that this main food security strategy is neither very viable nor sustainable in the light of climate change. Households don't have access to the inputs required to intensify their production and maintain soil fertility, so they are forced to continuously open up new fields. This continuous expansion of land, further fuelled by an annual population growth of around 3% and limited migration to urban areas, is the main cause of degradation of forest resources in the Heartlands, as well as of the continuous increase in human-wildlife conflicts.

The greatest potential for conservation and food security impact is through promoting more sustainable and intensive agricultural practices that would increase yields per hectare *and* maintain or increase soil fertility levels. For successful interventions, it is important that they are long term and holistic (looking at all aspects of the farming system and the value chain), avoidance of subsidised inputs and promotion of synergies with climate mitigation and related financing options. To maximise conservation benefits, the interventions should take place within the context of an explicit land use framework and conservation agreement.

For the problem of overexploitation of the fisheries resources, AWF's current pilot project on developing aquaculture in combination with the promotion of sustainable fisheries management (outlined in a conservation agreement) is a promising way forward, which can be scaled up and replicated in the Zambezi HL. Transboundary harmonisation of fisheries management will remain a challenge that requires continued efforts on the part of AWF and others. One way forward is to promote attention for fisheries resources in the KaZa trans-frontier conservation area instead of the current biodiversity focus almost exclusively on wildlife.

Possibly the most difficult conservation issue to address is the widespread, destructive and largely illegal charcoal production. The opportunity costs are high, and the demand for charcoal is constantly growing with increased urbanisation, while the capacity of the government to regulate the charcoal trade is weak. Options to explore include the promotion of more sustainable charcoal production models, planting woodlots for charcoal and explicitly targeting current charcoal producers as beneficiaries for interventions in alternative livelihoods e.g. aquaculture and horticulture.

Human-wildlife conflicts will continue to exist in the Heartlands, but can be reduced through support for food security diversification. As already mentioned, fish farming is in this respect a promising alternative addition as only a simple fence is required to keep out hippos and crocodiles. Horticulture can also contribute to reduce HWC, since vegetable gardens are high production areas using a relatively small surface, and hence justify investment in elephant-proof fencing.

Fish farming and horticulture are also good approaches to increase the resilience of HHs against climate change. Rainfed agriculture will become more resilient with the adoption of conservation

agriculture techniques, and crop diversification that include drought tolerant crops like cassava and flood tolerant crops like the NERICA variety of rice. Options for climate mitigation finance within rainfed agriculture are expected to increase, in particular through promotion of SLM practices that include agro-forestry.

AWF's traditional livelihood activities focused on community enterprises have limited potential for significant food security impact as the success depends on a difficult-to-guarantee change in attitude of the local people vis-à-vis wildlife. If these enterprises deliver such an attitude change, their conservation leverage would be substantial.

The role of AWF

AWF's role should focus on promoting and monitoring the potential conservation impact of alternative food security strategies. It should continue using the strategy of strategic partnerships with government institutions, NGOs and private sector stakeholders whose main mission relates to food security and livelihoods improvement, and develop holistic programmes that address both food security and conservation. AWF's role would then be to ensure the balanced attention to conservation and food security with overall positive conservation impact using its suite of tools that include Conservation Agreements, land use frameworks (including mechanisms that encourage compliance such as physical demarcations of wildlife corridors) and improved monitoring mechanisms.

AWF's current monitoring system has room for improvement to include indicators that assess changing *perceptions* of the people with regard to wildlife as a result of AWF activities. Similarly, some of the admittedly difficult issues to measure like the trends in HWC, poaching and charcoal production, changes in land use, etc., are nevertheless important indicators for long term conservation impacts for which rigorous M & E tools need to be developed.

Next steps

Based on the main conclusions, the following next steps are recommended:

1. More analysis of the scope for and viability of identified non-traditional alternative food security options.
2. Develop broad strategic partnerships for collaboration on food security and conservation interventions. This should include approaching iDE and CETZAM to explore the possibilities for collaboration in both Heartlands for horticulture, and (with CETZAM and Dept. of Fisheries) for aquaculture.
3. Further study into mechanisms to help realise the conservation potential of food security strategies, including learning from approaches in other sectors such as Community Led Total Sanitation (CLTS). Such mechanisms could be incorporated in the conservation agreements.
4. Conservation Agriculture should be further promoted in collaboration with GART or other partners, but only through a long term holistic approach, and linked to a Conservation Agreement and a detailed zoning plan for the target area of the intervention.

5. Improvement of AWF's monitoring systems to include more quantitative data on main conservation impacts (reductions in poaching, HWC, charcoal production, forest degradation, etc.) and on changes in Knowledge, Attitudes and Practices of the population.

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