

Proposed key project investments for human wildlife safety management

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1. INTRODUCTION

This Annex summarized the key proposed project investment in human wildlife safety management with the aim to prevent and reduce wildlife damage. The target of different categories is only assumption for illustration. In line with the project principle of an open and participatory approach the specified measures and targets will be agreed in the community action planning for human wildlife safety management.

2. WATER POINT INFRASTRUCTURE DEVELOPMENT AND PROTECTION FOR WILDLIFE AND PEOPLE

2.1 Development of water points for wildlife – general consideration

Issue addressed: Elephants and other wildlife in conservancies and parks like Khaudum depends now on **artificial water points for their survival** as there are not reliable natural water points anymore. Elephants drink up to 200 l per day. Due to climate change and other impacts the water resources getting more scarce in the dry regions like Kunene.

The trough established in Namibia in the parks are very old and not designed to the state of the art.; obsolete, relative inexpensive and easy to construct, aim was to provide clean water before it enters to more natural muddy pools, they are dangerous for baby elephants, at time of max stress when water level are low baby elephants have fallen into the troughs and become stuck, and even died

Figure 10-1: Existing troughs and their pitfalls



KfW 2017

Recent elephants reintroduced increased. Their sustainable presence depends on water points and at the peak of the dry season in September and October there is great stress among the elephants as they search for water. They are so dependent on water supplies and so huge and powerful that they will do anything they can to try to obtain water. They will fight among themselves, they will attack (and even kill) antelopes which are competing for a little water. If a borehole steps pumping they will try to find the water and thus destroy the infrastructure by digging up pipes and knocking down and smashing solar panels and breaking into reservoir tanks unless very well protected.

Troughs for antelopes' and another animal's to replace old troughs the improved design for antelopes and other animals and install separate troughs and reservoirs for elephants (see Chapter 2.4).

Figure 10-2: Inappropriate earlier water point design and appropriate elephant proof water point



Inappropriate design: This sort of dish shaped trough has been developed in Etosha NP. The sides of the trough are not steep, so there is no risk of any animal falling. It is ideal for use by all animals but the principle is that the volume of water will not be enough to sustain elephants, if they have a choice



Appropriate protection of elephant proof water point

Photo: KfW 2017

Objective of practice: To build or modify special water points and troughs and reservoir which are especially suitable for elephants to avoid.

Technical aspects: There is sufficient hydrogeological and design expertise available to assess the sustainable yield of boreholes and construct the most durable ones. The Mission agrees with the design and recommendations:

1. Set up optimal size of pumps and solar panels; stop using diesel powered pumps;
2. Design troughs which are strong that elephants cannot destroy them;
3. separate, elevated, troughs are required for elephants; antelopes will have their own troughs to avoid harassment by elephants

Detailed design see KfW 2017; and for special for elephant troughs under next point,

Costs and financing: Next table is a cost estimate for development and maintenance and matching of water points for wildlife remaining in the wildlife area. It was beyond the task of the mission to identify concert sites.

Table 10-1: Cost and financing of development and maintenance of water points for wildlife -for illustration only

Item	Description	Total budget			Matching		
		Unit cost NAD	Qty	Total NAD	Project	CC	Other
1 Bore hole drill new	Yield: 4.5 to 8 m ³ /h	165,000	2	330,000		90%	
2 Pump	20-44000 NAD	22,000	5	110,000		90%	
3 Solar panel	PC ; 10 250 W panel	6,000	30	180,000		90%	
4 <u>Antelope trough</u>						90%	
10 meter		500,000	1	500,000		90%	
14 meter		750,000	1	750,000		90%	
Modification		400,000	1	400,000		90%	
5 Elephant trough						90%	
Elephant trough with reservoir		1,440,000	3	4,320,000		90%	
Protection	Ringssloot wall	200,000	3	600,000		90%	
6 Basic cost 1				7,190,000		90%	
7 Supervision borehole drilling		140,000				90%	
8 Design and supervision,	12 % of basic cost 1 (No 6)	12%	1	862,800		90%	
9 Total investment costs without VAT (6+8)				8,052,800		90%	
10 Maintenance cost	2% of investment /a for three years; no 6	2%		431,400		0%	50% 50%

2.2 Elephant troughs and reservoirs

Problem addressed: Lessons learned with existing troughs is if not designed specifically for elephants there is conflict between elephants and all other animals at water points like antelopes. And, elephant calves might be trapped in these troughs.

Objective of practice: To build special troughs which are especially suitable for elephants to avoid between elephants and all other animals at water points.

Technical conservations: Key criteria for site selection for establishing elephant waters points are:

1. Natural migration routes;
2. Exclusive wildlife areas;
3. Draw elephants away from conflict areas like settlements and farming areas;
4. High elephant density;
5. Consider existing waters (natural and provided); belt troughs at selected water points where the water yield is sufficient to satisfy the elephants, and which are not too close to each other.
6. Consider seasonality

This following design been developed from troughs used in Kunene Region. It serves two functions - storage reservoir and trough.

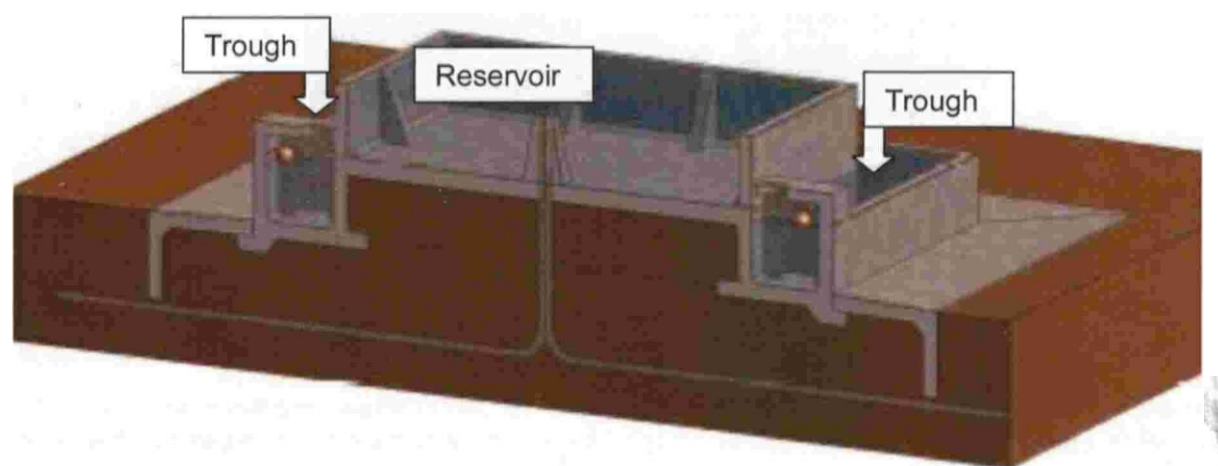
The big reservoir is in the middle, 2.7 m high and 8 m² with a 65m³ storage capacity to cater for high

demand in the hot summer months. It will much simpler, and therefore cheaper, to build square (not circular) troughs for elephants. The elephant trough should ideally be on higher ground, about 100 m away from the antelope trough and 100m from the borehole. The height of the elephant trough (1.2m) will ensure that elephants can easily reach the water. It will also ensure that the water remains clean, which is very important as elephants are quite particular about the quality of the water they drink. The trough has a capacity of 60m³. It will not be possible for elephant calves to be pushed in. It does not matter that baby elephants will be unable to reach the water, as they live on their mothers' milk.

The design has combined both the reservoir and the trough into one single structure, which will mean that there is less to go wrong, and less to maintain. It should also be stronger, and less vulnerable to damage by elephants. The perimeter of the elephant trough (44m) is important as it determines the number of elephants that can stand side by side to drink at the same time.

The reservoir is the raised part of the structure in the illustration below and is surrounded by the elephant trough. The reservoir fills up during the day, when the solar panels are providing electricity to the pumps. The water flows out from the reservoir when elephants drink at night and the water level in the trough goes down.

Figure 10-3: Perspective cross-sectional view of elephant trough, and reservoir



KfW 2017

Cost and financing

Next Table estimates the cost for the system.

Table 10-2: Cost and financing elephant troughs and reservoirs

Item	Unit	Unit cost (NAD)	Qty	Total (NAD)	Financing	Remark
Instalment	LS	1,440,000	1	1,440,000	Project labour from project beneficiary	KfW 2017
Design, water bore testing, supervision	%	12%	1	172,800	Project	KfW 2017
Contingencies	LS			87,200		
Total investment costs				1,700,000		
Maintenance cost	%	5%	3	216,000	Project or wildlife credit of which a share from project beneficiaries	2% of investment; 3 yrs

Source: KfW 2017 include contingencies and maintenance costs.

2.3 Elephant cum domestic water supply

Problem addressed: Developing water points for elephants in villages living near hot spots but suffer from water shortage might be rejected.

Objective of practice: to supply nearly free of charge water for domestic water use from water points developed for elephants.

Technical description

This model was developed /tested by Joe Todd, Consultant. The mission had not an opportunity to study this practice in detailed but found it very appealing to recommend it for further testing. It is basically the same model like the elephant trough with the difference that instead of a reservoir a series of water tanks are installed at the highest elevation point possible. Water are pumped by solar pump. The excess water not used by elephants will be conveyed by an underground pipe. Water will flow by gravity.

Cost and financing: Next Table outlines the estimated costs. The cost of connecting pipe and contribution of the conservancies needs further investigation.

Table 10-3: Cost and financing

Item	Description	Unit cost NAD	Total budget		Matching	
			Qty	Total NAD	Project	CC
Water tank	10 m3/tank	34,000	6	204,000		
Solar pannel	20 m3/day	74,500	3	223,500		
Underground connection pipe	1000 m	75,000	1	75,000	90%	10%
Contingencies	LS			7,500		
Basic costs 1				510,000		
Design and supervision,	%	12		61,200		
Total cost				571,200		
Rounded				600,000		
CC contribution assumption: 10 % is labour and local material; pipe c						

2.4 Elephant proof wall around water infrastructure

Problem addressed: Desert elephants compete with people for scarce water resources. Bulls will drink up to 200liters per day. Desert elephants are known to dig wells using their feet and trunks to access water beneath the surface of dry sandy riverbeds. Depletion of the natural water table with increasing human use has led to less available surface water for consumption. Therefore, man-made water points located close to the riverbeds have become the target for elephants in their quest for fresh water.

Figure A10-4: Elephant damaging water facilities



NASCO 2016



In their search for the source of water, elephants can cause extensive damage to windmills, dams, reservoirs, hand-pumps and wells. As the family homesteads are normally located close to the water source, secondary damage is also caused, and the lives of humans and livestock can be threatened. Elephants also routinely damage borehole infrastructure to access water, even when water is available to them in man-made drinking pools immediately adjacent behaviours, well-digging and breaking-in to boreholes, are attempts by the elephants to access less contaminated drinking water.

Objective and scope of practice: Protected wind and solar pumps, and domestic water facilities provided separate drinking points for livestock and wildlife, especially elephants;

Costs:

An average wall cost about NAD 200,000.:

Maintenance: Water point user associations embrace all users of a water point and are managed by water point committees elected from amongst the members.

3. PREDATOR-PROOF KRAALS

3.1 Stationary predator proof kraals

Problem addressed: Traditional kraals are built with wood, which are not available or expensive in dry areas; and result in deforestation. The lions managed to get into traditional kraal, killing the sheep and goats

Objective and scope of practice: Deterring of predators, especially lions from entering the kraal; project livestock during night time; application in dry area in lion risk zones

Performance criterial of practice: Target: Modified traditional kraal into a modern design has an 90% success rate in deterring lions from entering the kraal, Baseline:

Limitations/constraints: Kraaling is only a partial solution, as livestock needs to disperse widely during the day in search of grazing. Also, it required to group cattle herds. Due to spare vegetation free roaming livestock also in night time? Large number of herds from different owners in one kraal, needs special skills. Hence smaller kraals for households are more appropriate

Zambezi project: NGOs including IRDNR have tested together with conservancy members different kraal types. During 2016, a total of twenty-two lion-proof kraals were built bringing the total number of lion-proof kraals in the Mudumu-South Complex. In an averse one proves team can built up to 100 kraals per year.

Regarding the cost of the kraals, the project changed the kraal size to be based on area required per cow rather than a standard size. Initially 25 x 25 m and the 40 x 40m it was found that the villagers with 80 cattle got the same kraal as the guy with 300 cattle and making it more expensive than it needs to be. Now the project works on a ratio of 5.5 square metres per head including calves. This gives them room to move around and lie down comfortably and of course they are only in there overnight.

Technical description

Different kraals have been tested for the flood plains and upland. On the eastern floodplains kraals are constructed using metal poles with cement and stones due to the flooding conditions. This is more expensive, but a much more challenging environment. Also sing much thicker fencing which is about 50% more expensive. Due to the travelling challenges, it was decided to make the kraals as maintenance free as possible otherwise we would be shuttling to the ends of the earth to fix up water damage.

Maintenance

It is really important that an annual maintenance check is done on all kraals so that they do not deteriorate making them ineffective. The kraal team visit each kraal during the west season and check the fence, the gate, etc. These are kept up to standard.

Figure 10-5: Stationary and mobile kraals in Zambezi



Stationary predator-proof kraal in Zambezi Photo: Hanssen

Cost estimate according to prototypes

Next Table depicts a breakdown of cost items and proposed matching for instalment and maintenance.

Table 10-4: Stationary predator-proof kraal prototypes

Type	Description	Type	Carrying capacity *	Establishment cost			Annual maintenance	
				Unit cost NAD	Beneficiary contr. % **		Repair & service contract % **	NAD
Type A	20x15 m; 300 m ²	Kunene	55	34,600	4%	1,384	10%	3,460
Type B-1	25x25m, wooden poles; 500 m ²	Zambezi upland	91	24,000	50%	12,000	20%	4,800
Type B-2	25x25m, steel poles; 500m ²	Zambezi flood plain	91	48,000	20%	9,600	10%	4,800

** 5.5 square meters per head including calves (Hansen); please note, larger kraals means less fencing length
*** Percentage of investment costs

Kunene type: For dry area lion-proof kraal made from metal poles, wire mesh and other commercially available materials. The structure consists of short posts 2.5 m apart, 1.8 m high with an over-hang to the outside, mesh wire and shade netting surrounding the whole structure. An improved version proposed for project implementation needs two gates at opposite corners, thus allowing livestock managers to erect their own internal fencing. This will avoid the issues and skills required for group herding.

An annual **maintenance check** is required on all kraals so that they do not deteriorate making them ineffective. A kraal team needs to visit each kraal during the wet season and check the fence, the gate, etc. to be kept up to standard. The Project will stipulate that a new service for this maintenance will be in place (see Result 4).

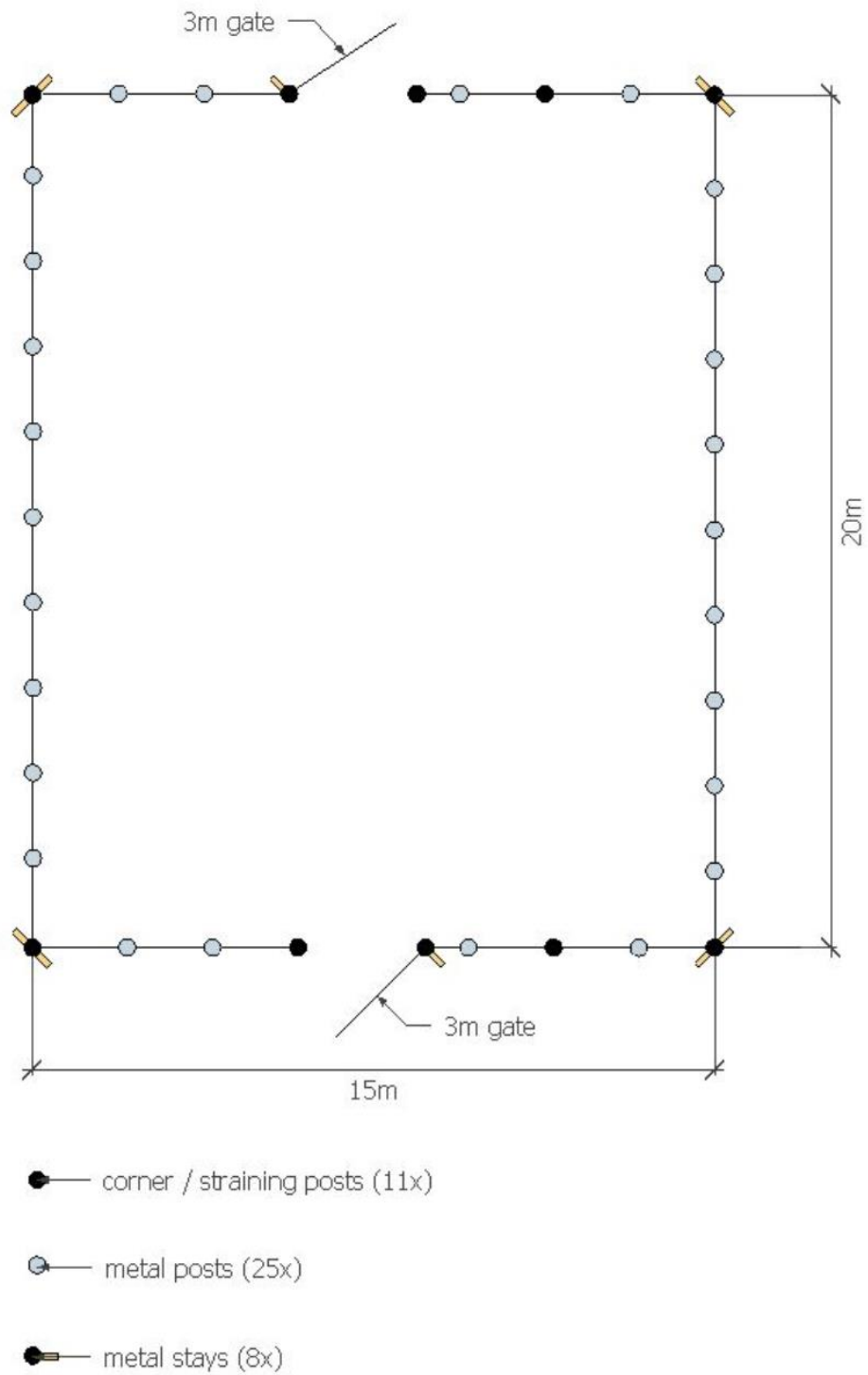
Table 10-5: Unit cost of predator-proof kraal Kunene type

Kraal dimensions; 20 x 15 m, 300m²

Item, description	Unit	Unit cost	Quantity	Total (NAD) rounded
Investment costs				
Corner posts, metal, with over-hang, 2400 x 101	No	324.80	11	3,573
Stay, metal, inclined, 2400 x 48 mm	No	144.70	8	1,158
Posts, metal, with over-hang, 2400 x 48 mm	No	173.90	25	4,348
Diamond mesh, 1800 x 50 x30 m	Set	1,154.20	3	3,463

Item, description	Unit	Unit cost	Quantity	Total (NAD) rounded
Wire steel, 2 mm, 50 kg	Set	723.40	1	723
Wire binding, 1.6 mm, 5 kg	Set	96.96	2	194
Barbed wire (I need 300 m)	Set	329.40	1	329
Gate, security, with overhang, 3000 x 1800(450/45)	Set	1,476.00	1	1,476
Cement, 50 kg	Set	100.00	18	1,800
Shade netting, 80%, 50 m roll	Set	64.85	100	6,485
Solar powered, motion activated, spotlights	Set		8	0
Contingencies	LS			451
Basic cost 1				24,000
VAT	%	15%		3,600
Basic cost 2				27,600
Transport,				5,500
Basic costs 3				33,100
Conservancy, food, labour				1,500
Total costs				34,600
Out of which is beneficiary contribution	%			4%
Annual maintenance costs				
Repair and service contract of basic cost 1	%	10%	24,000.00	2,400

Figure 10-6: sketch map of a predator proof kraal – Type Kunene



Source: Mission based on design by Russel V. IRDNR

Table 10-6: Total cost and financing of predator-proof kraals for illustration

Type	Unit cost	Qty	Total NAD	Beneficiary contribution		Project NAD
	NAD			%	NAD	
Type A	34,600	50	1,730,000	4%	69,200	1,660,800
Type B-1	24,000	100	2,400,000	50%	1,200,000	1,200,000
Type B-2	48,000	100	4,800,000	20%	960,000	3,840,000
Total		250	8,930,000		2,229,200	6,700,800

Project beneficiary contribution: In Zambezi for wooden pole kraal In the Mudumu Complexes, the farmers provide the poles, which is a huge contribution, which is estimated to be have of the investment cost. Transporting the poles is what made it so expensive. The contribution of the farmers on the EF is to dig and provide all the sand to mix in with the cement. If we had to transport sand from town and get it to each kraal site then this would be prohibitive. They also collect all their material and transport it to the kraal sites themselves and they collect the stones/gravel that we get delivered to the Salambala area. Each farmer and/or the conservancy must transport the stones themselves. . All farmers have to participate in the building process. If they do not then we do not build. The participation is really important so that the kraal is not just a donation. It is more like a joint effort. This way the kraal is valued by the cattle owner.

3.2 Mobile bomas and conservation farming

Problem addressed: The Zambezi Region has undergone drought conditions over the past few years, with 2016 being exceptionally dry. It is likely that cattle were left to **graze for extended periods of time to maximise grazing opportunities and minimise the energy required for them to walk to and from their kraals every day**. Interest by the community is driven by food security with cattle protection being secondary.

Pilot project: Conservation Agriculture through mobile kraaling of livestock¹

Mobile bomas were tested by IRDNC since 2018. Kraals are constructed using PVC/canvas sheets and are erected on fields where crops are grown. Cattle housed in mobile kraals during the night trample dung into the substrate. This results in the field being fertilized contributing to improved crop yields. Mobile bomas in mosaic landscapes contribute to conservation as well as human livelihoods in the following ways:

1. Implementing an adaptable method of protection for cattle at night near the fields where they graze, which 100% effective if is properly carried out.
2. Improved fertilization of cropping areas which result in increased yields of staple food crops for food security.

¹ Mainly from Hanssen et al 2017 and personal communication with Lise Hanssen.

3. A reduction in loss of habitat as nitrified fields provide sufficient space for food production. Clearing of new cropping areas when old fields are depleted of nutrients (slash and burn agriculture) is a growing threat to connectivity for all wildlife.
4. Adherence to zonation of land-use, which discourages settlement and cropping in wildlife corridors.

FigureA10- 7: Mobile predator-proof



Mobile predator-proof kraal testing
Photo: Courtesy. Hansen

Impacts: There were no incidents of lions or any other large carnivore or predator breaching the sides of the mobile kraals or even attempting to do so. There were no reports of large carnivores approaching the sides of the mobile kraals. The mobile kraals resulted in 100% protection of almost 800 head of cattle with a collective value of approximately NAD 4 million.

Conclusion: Discussion of the Mission with conservancies in Zambezi confirmed that the Interest by the community is driven by food security with cattle protection being secondary. There is still the feat that lion might enter the mobile kraal. Therefore, there is a need for further testing the focus on conservation farming with mobile kraals. Changing agricultural practices takes years and it will only be with consistent good results and food production that mobile kraaling will become common practice.

3.3 Predator proof living fences

It is therefore proposed that around the stationary kraal stock proof living fences are tested, which could replace in the long run the modified ones.

Stock proof living fences “living wall” kraals have a tradition; however only non-intact ones have been observed by the Mission. IRDNC is currently piloting trial with “living wall” kraals using pollarded Commiphora cuttings to avoid depletion of resources and need for permit from the Directorate of Forestry. Predator-proof living fences will become effective only after at least two years (Hanssen et al 2017). It is therefore proposed that around the stationary kraal stock proof living fences are tested, which could replace in the long run the non-living fence.

Experience from similar regions in Africa suggest this is a new promising innovative low-tech solution. To seal the gaps between posts from Commiphora if fence post cuttings planted properly will develop sprouted twigs and tender young leaves. As the trees continue to grow, their interlocked crowns create an impenetrable barrier, which, unlike chain link alone, cannot be scaled by leopard and small lion, and their root system prevents hyenas from tunnelling in from below. The living walls will last a very long time and cannot be breached. Hence the Project will allocate significant funds to boost the trials scheme of this type of predator proof living fences. General on benefits and technical aspects of living fence posts see Kuchelmeister 1989.

Example from East Africa: By encircling the original boma with chain link fencing, all holes that are typically evident in traditional bomas were eliminated and strengthened the fence. By planting Commiphora sp. as fence posts at 0.5 m intervals, height was added to the fence (as compared to traditional bomas or other fortified fences), as the trees continued to grow and fill in around the top of the chain link fencing. The use of live trees as fence posts also had the added benefit of reducing the costs and maintenance requirements associated with other fortified fencing techniques that would require the repeated purchase of wooden (not rot or termite-resistant) or expensive metal poles to hold the chain link. It is easy to limb Commiphora sp. in the bush; this process does not harm the parent tree. Livestock owners requesting a Living Wall harvest and plant the Commiphora prior to our team's delivery of chain link fencing. The average cost of the chain link for a Living Wall is \$500 (at \$4 per meter, boma circumference varies across.

Laly et al. 2015.

4. SUPPORT IN IMPLEMENTATION OF THE HUMAN-LION CONFLICT MANAGEMENT PLAN - HIGH RISK ZONE

4.1 Justification

A unique free-ranging desert-adapted lion population that has grown from an estimated 30-35 individuals in 1997 to at least 120 in September 2017. The range of this population has correspondingly grown from roughly 7,000 sq. km. to more than 40,000 sq. km. Kunene lions demonstrate unique adaptations to the region's arid and semi-arid environment. However, Kunene lions destroy livestock, compromising the livelihoods of Kunene residents. And threatens residents' personal safety and security. These ongoing problems require long-term, sustainable solutions which will allow Kunene residents to thrive and enable the continued existence of this threatened, uniquely desert-adapted lion population.

The Project will support in implementation of the Human-Lion Conflict Management Plan for North West Namibia (NW Lion Plan) (MET. 2017).

4.2 High risk zone buffer zone

Issue addressed: In four conservancies most affected by human lion conflict in Kunene arise from livestock management practices that leave animals vulnerable to predators, such as allowing livestock to roam freely at night or untended during the day. Communities are reluctant to keep livestock inside protective kraal at night. Due to the low rainfall and lack of sufficient grazing in the region the communities prefer to allow their livestock to also feed at night. This is a key element to the success of Human-Lion-Conflict management that needs to be reconsidered.

Lion-proof kraals:

Solution

Keeping livestock inside protective kraals overnight will not only prevent lions from killing livestock, but it will also prevent the escalation of Human-Lion-Conflict problems. Without free-roaming livestock (all species, including donkeys) at night lions will not identify the area as a “hotspot”, other methods of deterring lions from the area will be more effective and lions are likely to vacate the area.

A **compromise** can be reached between the local livestock farmers, where only those farmers inside the proposed “**high-risk lion corridor** (Figure) **need to herd their livestock and place them inside corrals at night.**

Supplemented by the other preventative measures, such as early warning systems, the proposed “**high-risk lion corridor**” will essentially create a **buffer zone that will deter lions from leaving the safety of their known home ranges.** Without livestock grazing at night to attract them and low numbers of wildlife (due to the livestock controlling the available grazing) lions are unlikely to move into areas utilized by people and livestock.

4.3 Early warning system

Recent developments and progress have made in the design of “early warning” systems². Key element of the design is to establish two experimental “early-warning” systems in the areas of four conservancies (Elephant Song, Sesfontein, Riefontein, and Purros) are located in the high risk corridor. The electronic components of satellite modems have become more affordable, smaller in size and more economical in terms of energy consumption. This allowed for a significant upgrade of the system. The systems consist of:

1. A “early-warning” system and associated infrastructure in accordance with the establishment of

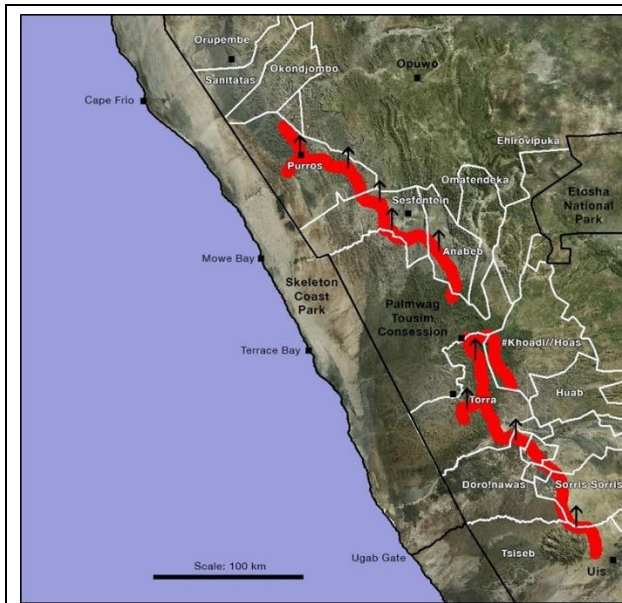
² By the Desert Lion Project guided by Dr. Stander, key lion researcher in Namibia in collaboration with Joe & Gisela Noci, experts in electronic engineering, guidance systems, radio communications and software development (see Stander 2018).

the “High Risk Lion Corridor” as defined in the NW HLC Plan.

2. An infrastructure to allow continued monitoring of the western desertlion population.

The erection of 10 “early-warning” systems will be placed at key locations, or “hot-spots”, in the “High Risk Lion Corridor” where incidents of conflict recurred during the past 15 years (Figure 10-8). These systems will be supplemented by the monitoring of 10 satellite collared lions, proving the basis of monitoring lion movements and allow detection of conflict incidents.

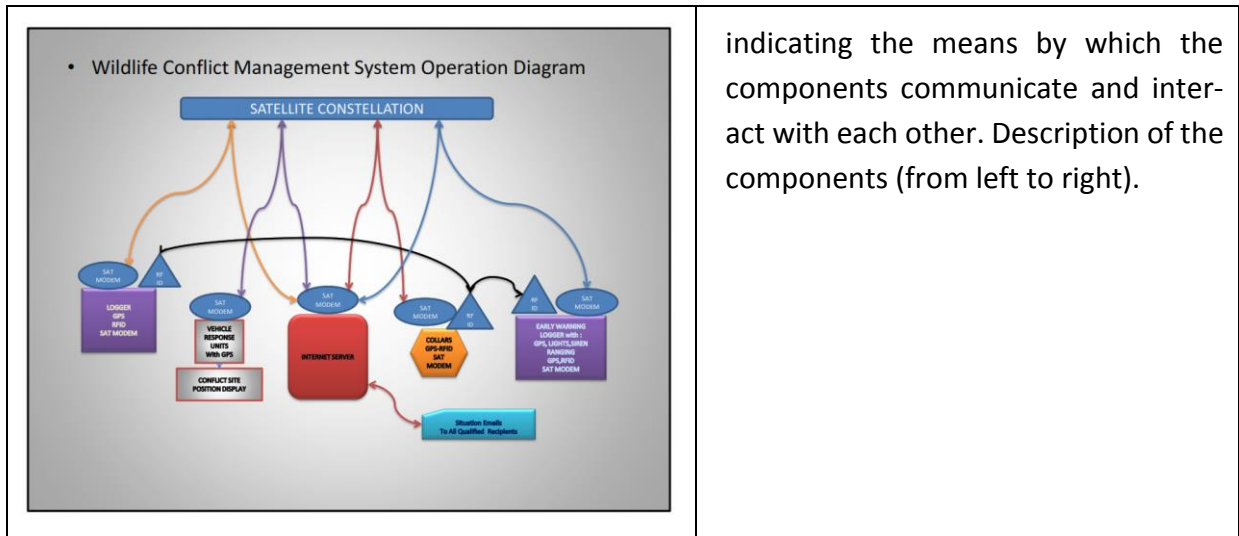
Figure 10-8: “High Risk Lion Corridor” in the North West of Namibia – testing site



The “High Risk Lion Corridor” in the North West of Namibia (red) with the proposed locations of nine “early-warning” systems (↑: from top to bottom – Purros, Tomakas, Ganamub, Elephant Song area, Mba-kondja/Anabeb area, Palm Pos/Spaarwater area, Driefontein/Bergsig area, De Riet/Huab area & Ugab/Brandberg area) and one additional system to deploy where and when needed.

Figure 10-9 outlines the description of the system, its component and operational an overview of the various steps.

Figure 10-9: A schematic layout of the various components of the proposed system





indicating the means by which the components communicate and interact with each other. Description of the components (from left to right).

<p>NOR- MAL LOG- GER</p>	<p>This item is used for the monitoring of the lion population. It will detect any of the collars via the RFID interface and download GPS logs from these collars.</p> <p>The data can be downloaded from the logger also via RF when in close proximity to the units</p> <p>Several units will in addition be equipped with a satellite modem. It will hence be possible to query these loggers via the centralized server as to detection of collared lions in the vicinity of the logger.</p>
<p>VEHI- CLE RE- SPONSE UNIT</p>	<p>The response unit consists of a Satellite Modem, GPS, interface electronics and display.</p> <p>These units will be installed in the vehicles of the Lion Rangers / DLP as well as selected other monitoring points.</p> <p>In case of an HLC incident, a message will be sent by the centralized server to the SatModem in the unit, in response to which the unit will alert the Lion Ranger of the occurrence and location of the incident.</p> <p>In addition, the units can be queried as to their current position at any stage.</p>
<p>CEN- TRAL- IZED SERVER</p>	<p>A centralized server will be located in Swakopmund.</p> <p>The server will receive the messages from all Satellite collars as well as Satellite Modems located in the Logger Units and Vehicle Response Units.</p> <p>The server will maintain a database of this information, and allow access to this data to selected parties for analysis purposes.</p> <p>In addition, the server is central to the following tasks:</p> <ul style="list-style-type: none"> • Query information from a normal logger • Query position of a Vehicle response unit <p>In case of an HLC incident, send the required alert notifications via SatModem to the defined response units as well as via email to qualified recipients</p>
<p>COL- LARS</p>	<p>There are two types of collars.</p> <p>The basic collar is a VHF / GPS Collar. It is configured to do a GPS Fix at selected intervals and save this data on the collar. It is also fitted with an RFID device, whereby it can communicate with a Logger. On detection of a collar, the GPS data is downloaded from the collar by the logger.</p> <p>In case of an Early Warning Logger, the detection of the collar will in addition result in the triggering actions associated with a potential HLC incident.</p>
<p>EARLY WARN- ING</p>	<p>This unit comprises of the Normal Logger, fitted with a satellite modem, but also includes all components as required to</p>

LOG-GER UNIT	trigger the HLC warnings. The unit is described more extensively in the next section
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Brief description of the Early Warning systems: The Early Warning Systems will be installed in “hot spots” in proximity to a community / kraal, thus allowing the community to be alerted of a possible HLC incident and hence taking precautionary measures related to the safety of their livestock. An “Early Warning Logger” will be mounted on top of a 4m pole adjacent to a corral at settlements with high incidents of HLC. This unit consists of an antenna, electronic logger unit, four powerful LED floodlights and a siren. The unit is also fitted with a solar panel and a 12 Volt battery to provide sufficient power throughout the night.

	<p>The logger is mounted so that each of the four LED floodlights point towards one of the four directions (North, East, South and West).</p> <p>The Logger will continuously transmit RFID signals to probe for any RFID Tags (fitted to the lion collars) that may be nearby. Preliminary results indicate that the Logger can detect the lion collars up to a distance of 1 to 2 km away.</p> <p>When the Logger detects a lion collar it will instruct the collar to record a GPS position at shorter time intervals, and to relay the information to the Logger.</p> <p>On receiving this data, the logger calculates the direction and distance of the lion from the settlement, and switches on one or two of the LED floodlights to “point” in the direction of the lions. The siren is activated at the same time. The control / display unit mounted lower down on the Logger Pole indicates the distance of the lions from the settlement</p>
	<p>The floodlights are very powerful and will allow the people to see the lions as well as deter the lions from approaching the corral. In addition, the information provided by the system will allow the farmers to take other precautionary measures (such as to ensure animals are in the corral and /or to activate fireworks in the direction where the lions are).</p> <p>The logger will also download the GPS data logged on the collar. This data will then be accessible to the DLCP to allow the movements of the lions to be better understood.</p>

Typical operational scenario: To further define the system, a typical sequence of events in case of a potential HLC incident is described:

- A lion fitted with a VHF / GPS Collar comes within proximity (3km) of an Early Warning Logger Unit.
- The unit detects the collar and computes the distance to the lion and bearing with respect to north.
- Once the lion comes within a predefined range of the logger, the lights and siren on the logger are activated.
- A message is sent by the SatModem in the logger to the centralized server, informing the server of the detection
- The centralized server sends a message via SatModem to the Vehicle response units, who are then as such notified of the occurrence of the incident and location thereof, allowing immediate deployment,
- In addition, notification is sent by email to qualified recipients
- All data associated with the incident is maintained on the server for later reference

In case of a collar fitted with a SatModem, the HLC monitoring is enhanced in that the location is known to the server on a daily basis. Hence potential HLC situations developing can be predicted using this information in the case where the collared animals are not in proximity to a logger unit.

Cost and financing: Next Table depicts a cost estimate and proposed financing

Table 10-7: Proposed estimate of instalment of Lion early warning system and management for one year

#	Item	Unit	Unit cost (NAD)	Qty	Total Cost (NAD)	Financing (NAD)		
1	Hardware investment					GFC Other *		
1.1	Early warning logger unit	Set	19,800	10	198,000			
1.2	VHF / satellite / GPS collar	Set	20,000	15	300,000			
1.3	VHF / GPS collar	Set	4,800	40	192,000			
1.4	Response Unit	Set	10,000	4	40,000			
1.5	Normal logger unit with Sat modem	Set	10,300	3	30,900			
1.6	Normal logger unit without Sat modem	Set	7,300	2	14,600			
1.7	Centralized server system	No	29,500	1	29,500			
1.8	Subtotal				805,000	805,000		
2	Annual maintenance costs							
2.1	Early warning logging unit	Set	2,470	10	24,700	24,700		
2.2	VHF / satellite / GPS collar	Set	2,892	15	43,380	43,380		
2.3	Response Unit	Set	2,258	4	9,032	9,032		
2.4	Normal logger unit with Sat modem	LS	2,243	3	6,729	6,729		
2.5	System maintenance	LS	20,000	1	20,000	20,000		
2.6	Central server	LS	4,000	1	4,000	4,000		
2.7	Contingencies	LS	12,159	1	12,159	12,159		
2.8	Management fee *				164,000		164,000	
2.9	Annual replacement cost (20% of investment 1.8)				161,000		161,000	
	Subtotal 2.1-2.9				445,000	120,000	325,000	
5	Total					1,250,000	925,000	325,000

* Desert Lion Project)

** From PEA, e.g Wildlife credit

4.4 Lion ranger program

The Human-Lion Conflict Management Plan for North West Namibia (NW Lion Plan) Immediate and urgent re-activation and deployment of a system of Lion Rangers. Conservancies identified as experiencing high levels of HLC

In accordance with the recommendations set-forth in the NW Lion Plan, the Lion Ranger program will begin operating in three communal conservancies: Anabeb, Puros, and Sesfontein in 2018. While the NW Lion Plan focuses on HLC within western Kunene, MET has further designated Ehirovipuka and Omatendeka as conservancies experiencing high-levels of human-lion conflict. Following feedback meetings with each conservancy in October 2017 it was decided that the Lion Ranger program would begin operation in the three conservancies noted, with the others joining in the near future. The Lion Ranger program is headquartered at World's End Environmental Centre in the Palmwag Concession and is supported by the IRDNC Windhoek Office team.

Program objective of the lion ranger program is the long-term sustainable safety management of human and lions and other predators in Kunene to ensure continued desert lion survival and community benefit. This suggests the **re-activation, re-training, and deployment of Lion Rangers**, a program piloted in 2013 but which has gone dormant due to lack of funds and institutional support. The program will support villager, conserving lions; developing skills and knowledge to live safely with lions through the developing local lion

rangers.

The program can built on more than 20 years of research and working with conservancies. It is driven by conservancy and lodge being mostly threatened but also benefiting from lions. The Program is well designed and has in build evidence-based indicators (see in Annex Planning and Monitoring). It offers a unique opportunity to develop a professional service to life in safety with predators.

Performance indicators

In conjunction with other measures

Improve the **safety and security of residents** in focal lion-range conservancies and conserve lions

Indicator	Target:
Reduce livestock losses of all predators in focal lion-range conservancies in Kunene	50% reduction in livestock losses. 90% reduction in lions lost to HLC retaliation.
Manage Kunene’s lion population as an asset to Kunene residents	Income from sightseeing increased by xxx
Standardize high-quality communication of lion ecology, population composition, and movements to conservancy resident	>75% of HLC incidents responded to within 24 hours 80% of the population in HLC have developed higher tolerance and know how do and not to do Communicate >95% of relevant lion movements to affected farmers. Quarterly updates to conservancy committees concerning lion movements and Ranger deployment. Annual report to all conservancy members.

Salient features of the program are:

Training: Lion Ranger training. Initial three-day training sessions

- Session One: The Lion Ranger Program: Introduction to Lion Ranger program; pan-African lion conservation and HLC; Lion physiology, life history, and behaviour; Roles and responsibilities as Lion Rangers; data collection, reporting, and management; action Plan for next six months.

- Session Two: Developing Field Skills: Reports from Lion Rangers with feedback; practical lion identification and tracking in the field; HLC scene investigation skills; farmer support at conflict scenes; field equipment operation and care.
- Session Three: Assessment and Supporting Skills Development; reports from Lion Rangers with feedback; reviews of Lion Ranger performance; practical livestock management techniques; kraal construction and repair; Communicating with farmers and conservancies; basic field first aid.

Tasks of permanently deployed Lion Rangers within conservancies: Lion Rangers in each of the our focal lion-range conservancy will work with routinized responsibilities field-based,

Community-based, and organizational responsibilities. Lion Rangers will receive continuous training and mentoring by Lion Ranger program; including regular ranger review of performance by program and involves conservancy. Lion Rangers will be primarily responsible for activities in their conservancies, but on request may assist Lion Rangers and the Lion Ranger program in other conservancies.

Lion Rangers are oriented around two needs monitoring and interceding in HLC

1. **Monitoring** Kunene lions patrol within conservancies for collecting relevant individual lion demographic, identification, body-condition, movement, and certain other data. This data collection will take place on regular patrols and on-demand as needed. In addition to the Event/Incident Book System through which conservancies monitor wildlife and HWC incidents, Lion Rangers will carry and fill-out forms uniquely designed for lion monitoring and recording human-lion conflict at each relevant sighting. Data from these forms will be communicated back to the Lion Ranger program on a regular basis and aggregated data on both lion monitoring and HLC will be communicated to conservancy committees as agreed-upon by each conservancy and the Lion Ranger program.
2. **Interceding in HLC** Lion Rangers will be responsible for interceding in HLC in efforts to manage, mitigate, and prevent conflicts. The management of HLC means responding to conflict events after they occur, on-site where the conflict took place.

Lion Rangers will be responsible for collecting relevant conflict data from farmers at conflict sites and assisting farmers as fits the situation. Such assistance may include helping farmers to herd livestock and/or return livestock to kraals to prevent further immediate conflict, assisting with the repair of kraals or other livestock infrastructure, and in appropriate cases remaining within the affected area to prevent further immediate lion incursions. Lion Rangers will appropriately support farmers in making HLC **claims to MET**. Each of these types of assistance will contribute to conflict management, mitigation, and short-term conflict prevention.

Long-term conflict prevention strategies will be various and likely will change over time. Initially long-term conflict prevention strategies will focus on assisting farmers in the construction of reinforced 'lion-proof' kraals as is appropriate and helping farmers develop herding techniques suited to limiting human-lion conflict. Field-based responsibilities will be aligned with the recommendations set-forth in the NW Lion Plan

and compliment a host of other strategies taken alongside the Lion Ranger program.

Because lion movements and therefore HLC are somewhat unpredictable, Lion Rangers will also be responsible for communicating lion movements with potentially affected farmers and community members on an as-needed basis. Where lions pose a potential acute threat to conservancy residents livelihoods and well-being, Lion Rangers, working with the both the IRDNC and MET Human-wildlife Conflict Rapid Response Teams, will inform residents of lion movements and take steps to minimize the risk to residents' livelihoods and well-being and take necessary steps to assist residents.

Project duration

The phase one of the program is planned for three year to commence in 2018.

Cost and financing: Since all response team and management staff are working on lion issues and research with conservancies and lodges and lion has high attention by the international wildlife conservation community it is assumed that the Project will financing the programme from year 2019 onward. A proposed contribution of 33 % of the total program is budgeted by the Project. It is proposed that the Project should also co-finance the three other conservancies once co-financing is ensured.

Table 10-8: Cost and financing of lion ranger program (2018-2020)

Description	Unit	Cost estimate per year			Yr	Tot.cost NAD	Cost per year			Financing		
		Unit cost NAD	Q'ty	Total NAD			Yr1 NAD	Yr 2 NAD	Yr 3 NAD	GFC NAD	Other NAD	Remark
Salary: NAD 1500/PM; plus performance based bonus: NAD 1500/NAD/a 5 days/PM/ranger, 50 NAD/day	Person	19,500	12	234,000	3	702,000	234,000	234,000	234,000	234,000	468,000	
Table below		3,000	12	36,000	3	108,000	36,000	36,000	36,000	36,000	72,000	
		70,600	1	70,600	1	70,600	70,600				70,600	
Uniform	Ranger	3,250	12	39,000	1	39,000	39,000				39,000	
Tent, bedroll, sleeping bag, GPS, bin	Ranger	12,320	12	147,840	1	147,840	147,840				147,840	
Minimum service support Assigned already	PM	16,000	12	192,000	3	576,000	192,000	192,000	192,000	192,000	384,000	Part covered: Ultimate Safaris
66% of time	PM	16,000	8	126,720	3	380,160	126,720	126,720	126,720	126,720	253,440	Part covered Highveld Safaris
	PM	16,000	12	192,000	2	384,000		192,000	192,000	192,000	192,000	
	PM	3,000	12	36,000	3	108,000	36,000	36,000	36,000	36,000	72,000	
Assigned already												
Vinjevold 1/2 time @ NAD 2000/day		288,000	1	288,000	3	864,000	288,000	288,000	288,000	288,000	576,000	
Shivute 1/4 time @ NAD 2000/day		144,000	1	144,000	3	432,000	144,000	144,000	144,000	144,000	288,000	
Heydinger 1/2 time @ NAD 2000/day		288,000	1	288,000	3	864,000	288,000	288,000	288,000	288,000	576,000	
Details in proposal	Year	582,000	1	582,000	3	1,746,000	582,000	582,000	582,000	582,000	1,164,000	Part covered by lodges
Firework	CC	5,000	4	20,000	3	60,000	20,000	20,000	20,000	20,000	40,000	
						6,481,600	2,204,160	2,138,720	2,138,720	2,138,720	4,342,880	
10% of basic costs						648,160	220,416	213,872	213,872	213,872	434,288	
						7,129,760	2,424,576	2,352,592	2,352,592	2,352,592	4,777,168	
Rounded						7,200,000				2,400,000	4,800,000	
Percentage of program										33%		

Table 10-9: Cost estimate of for initial training of communal lion rangers

Item	Unit	Unit cost	Qty	Total
Trainees (Ranger)				
Accommodation	Night	150	12	1,800
Perdiem	Day	100	12	1,200
Transport	km	7	1,000	7,000
Subtotal trainees				10,000
Trainer (2 consultants)				
Accommodation	Night	150	24	3,600
Perdiem	Day	100	24	2,400
Transport	km	7	7,800	54,600
Subtotal trainer				60,600
Total				70,600

Major activities are:

1. Procurement of basic equipment and set up infrastructure of scheme;
2. (Re)train and employ Lion Rangers from within Kunene conservancies experiencing high-levels of human-lion conflict;
3. Permanently deploy Lion Rangers within conservancies as a conduit between Kunene lions, individual farmers and local communities, and monitoring and management activities associated with Lion Ranger program;
4. Proactively monitor Kunene lions and intercede in human-lion conflict to manage, mitigate, and prevent conflicts in the conservancies.
5. Standardize high quality communication between the Lion Ranger program and conservancies.
6. Maintain regular communication with the Lion Ranger program.
7. Support and enact the recommendations of the NW Lion Plan.

5. SUSTAINABLE RANGELAND MANAGEMENT FOR WILDLIFE CONSERVATION AND LIVESTOCK DEVELOPMENT

Introduction: This best practice is to demonstrate the reduction of the human-wildlife conflict through introduction of rangeland management in 12 conservancies in Zambezi region³. Which have been developed for the conservancy of Dzoti. Currently real time information via high resolution satellite imagers obtained every two weeks. This early warning system can be used not only for human wildlife conflict but also for index-based drought insurance.

The novelty of the software the system is that not only the prediction of the feeding situation of the domestic

³ This proposal has been prepared together with Bertus Kruger| Technical Advisor: Rangeland Management| ProVision| Corporate Office: Agra).

livestock but also the wildlife can be calculated. Using the event book and wildlife zoning map of Dzoti conservancy the system has been demonstrated to the Mission.

The Project will only cover the HWC measures, matched by a livestock development project) (IRDNC, EU. Currently there are great difficulties in marketing of livestock. With the develop of market cha for both lovesick and wildlife and developing an abattoir to be used for both game and livestock the income for rotation grazing thigh herding is very like to be accepted by the livestock owns in the conservancies.

Best practice rationale: In communal conservancies in general many different and often conflicting natural resource-based land uses are undertaken in the same geographic area. **Error! Reference source not found.** presents a synthesis of the different land uses in Dzoti Conservancy as an example, with an indication of the level of acceptability, complementarity or conflict that exist between them.

Livestock grazing, and human settlements are complementary (green) to each other, as well as livestock grazing, fishing and the use of forest resources. The interaction between livestock grazing and tourism, fishing resources and wildlife corridors are mostly acceptable (and they don't have to compete. Interaction between livestock grazing and cropping, hunting activities and herbivores in wildlife areas can cause conflicts but is expected to be manageable (orange) with proper planning and implementation.

The potentially serious conflict areas are between livestock grazing, tourism development, the presence of predators in wildlife areas and the allocation of exclusive wildlife zones (red).

As the human population in general increases in conservancies, communities continue to spread out to practice agriculture and find pasture for their livestock. The pressures to secure customary land rights for both present and future access to land and the resources thereon put further pressure on a region already characterized by its multiple competing land uses. As a result, there is increased potential for human settlement, cropping and livestock grazing to come into conflict with wildlife-based land uses. Wildlife resources and tourism are extremely important to most communal conservancies. It is important to find a way to reduce these conflicts given the fact that livestock are and always will be an integral part of people's livelihoods.

Due to the reality of different land uses and the real possibility of severe conflict between livestock grazing, human settlement, exclusive wildlife zones, tourism development and predator/livestock interaction, finding sustainable solutions to minimize conflict and maximize people's livelihoods is of paramount importance.

Best practice – project sound rangeland management practices into conservancies that will provide the basis for commercially oriented livestock production, integrated with wildlife management. 12 conservancies in a cluster in Zambezi region has been identified, since there is a need for rangeland improvement and in Dzoti the system is currently being tested and other project are supporting the commercial oriented livestock production.

Rangeland management and wildlife integration plans will be developed and implemented by the resource users themselves with guidance from experienced technical and institutional advisors. Important and valuable land uses like tourism, hunting and exclusive wildlife breeding zones will be taken into consideration

to ensure that conflict between them and livestock will be minimized. By creating a win-win situation for both livestock and wildlife in the conservancy it is believed that the livelihoods of the local people will be significantly enhanced.

Best practice objective: is to support a targeted conservancy to implement sound rangeland management practices for both livestock and wildlife to minimize conflicts and to optimize income from both livestock and wildlife in the long term.

RESULTS AND RELATED ACTIVITIES

Result 1: To develop and implement rangeland management plans that are owned by the communities and accepted on a broad basis by other stakeholders. To achieve this objective, the following major activities are suggested:

- Revisit the existing conservancy zonation maps and adapt it to enable the introduction of a sound rangeland management plan;
- Conduct grass-roots meetings with farmers and all relevant stakeholders to raise awareness about the development of a rangeland management plan. This activity serves to increase local knowledge of the need for sound rangeland management and the importance of implementing good rangeland management principles;
- Create grazing committees or decide on appropriate existing institutions to lead the local implementation of the rangeland management plans;
- Develop sound grazing plans and start with implementation;
- While implementing the plan, conduct continuous monitoring, assessment and adjustment of the plans to adapt to changing conditions.

Result 2: To enhance informed decision-making of communities in conservancies to reduce the occurrence of fodder shortages or droughts. Main activities are:

- Conduct on-going ground verification to ensure improved quality and reliability of rangeland early warning products (maps);
- Produce rangeland condition index maps of conservancies every 10 days between October and May each year and make them available at conservancy level;
- Produce herbaceous fodder availability map for each conservancy at the end of April each year;
- Produce and provide to MET and/or NACSO an overview of rangeland condition indices for all conservancies at the end of the growing season (May).

The Project will cover mainly result 2.

Cost and financing

Table 10-10: Cost and financing of rangeland proposal

No	Item	Unit	Qty	Unit cost (NAD)	Total cost (NAD)	Matching (NAD)	GFC (NAD)	Comments
1	Personnel		18					
1.1.	Project Coordinator	Day	54	6,000	324,000		324,000	1 person x 6 days per month for 12 months
1.2.	Conservancy Coordinators *	PM	36	15,000	540,000	432,000	108,000	4 coordinators x 12 months
1.3.	Rangeland Early Warning Expert	Day	45	6000	270,000		270,000	5 days per month for 12 months
1.4.	Sub-total personnel				1,134,000			
2	Perdiem and travel		108					
2.1.	Domestic air travel (Windhoek to KM and back)	No	9	4000	36,000		36,000	
2.2.	Local travel	km	54,000	6	324,000		324,000	1 500 km per coordinator per month for 12 months
2.3.	Accommodation	No	54	1200	64,800		64,800	5 nights per month for 12 months
2.4.	Sub-total subsistence and travel				424,800			
3	Community meetings *	Event	108	5000	540,000	432,000	108,000	1 meeting per conservancy per month for 12 months
4	Ground-truthing by Early Warning	LS	1	187,500	187,500		187,500	once-off consultancy in the
5	Contingencies	LS	1		63,700	36,000	27,700	
6	Total				2,350,000	900,000	1,450,000	

* Assumption: Early warning system testing is 20% of the overall rangeland management planning

6. COST ESTIMATE DURING PROJECT IMPLEMENTATION - EXPLANATORY

This is for illustration only.

Table A10-11: Cost estimate of some key proposed human wildlife safety management investemens

Type	Unit	Unit cost NAD	Qty	Total NAD	Beneficiary contr.		GFC	Project (NAD)		Remark
					%	NAD		Other	Total	
Stationary predator proof kraal										
Type A (Kunene)	No	34,600	50	1,730,000	4%	69,200	1,660,800			1,660,800 Table above
Type B (Zambesi)	No	Mean	250	8,930,000	25%	2,229,200	6,700,800			6,700,800 Table above
Elephant water point development	No	1,700,000	5	8,500,000			8,500,000			8,500,000 Table above
Elephant proof wall for communal water points	No	200,000	30	6,000,000	50%	3,000,000	3,000,000			3,000,000 Table above
Supplementary tank for elephants and domestic use	No	600,000	5	3,000,000	10%	300,000	2,700,000			2,700,000 Table above
Rangeland management (wildlife and livestock)	No	1,500,000	1	1,500,000			1,500,000			1,500,000 Table above
Lion early warning system (one year)	No	1,250,000	1	1,250,000			925,000	325,000		1,250,000 Table above
Lion ranger program	Ls	7,200,000	1	7,200,000			2,400,000	4,800,000		7,200,000 Table above
Unallocated	LS	8,613,400	1	9,488,400			8,613,400	875,000		9,488,400 Other TBD
Total				47,598,400		5,598,400	36,000,000	6,000,000		42,000,000