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D01: Water Supply and Small-scale Agriculture Recommendations for KAZA Angola; Scoping stage

KAZA Infrastructure for Livelihoods Intervention, FP20

Version: Final

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CRIDF

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Disclaimer

The British Government's Department for International Development (DFID) financed this work as part of the United Kingdom's aid programme. However, the views and recommendations contained in this report are those of the consultant, and DFID is not responsible for, or bound by the recommendations made.

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List of Acronyms

Acronym	Long-Form
ACADIR	Associação de Conservação do Ambiente e Desenvolvimento Integrado Rural
CA	Conservations Agriculture
CRIDF	Climate Resilient Infrastructure Development Facility
DFID	Department for International Development
KAZA	Kavango Zambezi Transfrontier Conservation Area
MIDP	(KAZA) Master Integrated Development Plan (2015)
NGO	Non-Government Organisation
WASH	Water, Sanitation and Hygiene
WDA	Wildlife Dispersal Area (of the KAZA MIDP)

Introduction

The Associação de Conservação do Ambiente e Desenvolvimento Integrado Rural (ACADIR), a local NGO in Angola, has applied for funding from the KAZA Secretariat to implement conservation farming in the Luengue-Luiana National Park[1], Angola. The intention is to integrate conservation farming practices with small-scale irrigation, and mitigation of human-wildlife conflicts, especially targeting elephant and hippo. The target area falls within the KAZA Wildlife Dispersal Area known as the Kwando River WDA. To enable the design of a sustainable conservation farming programme in the Luengue-Luiana National Park, there are a number of issues that need to be addressed through an initial KAZA scoping mission, and thereafter a thorough feasibility study. In addition, the extremely limited (or in certain instances, entirely lacking) sanitation and hygiene infrastructure, also needs to be assessed and addressed in consultation with all key stakeholders, including communities and local institutions.

KAZA does not have in-house technical expertise in irrigation engineering and WASH practices and has therefore approached CRIDF to provide support in these areas. CRIDF mobilised a Water Engineer to be part of the KAZA scoping team, with a specific remit to undertake the following tasks:

- Assess the potential for conservation farming in the area, primarily through engagement with local farmers and assessment of potential farming clusters (taking into consideration human-wildlife conflict zones in the Kwando River WDA), determining the capacity within the local institutions to manage and promote conservation farming practises, and identifying all agronomic and socio-economic parameters to be addressed when assessing the viability of the proposed practises.

- Assess the viability of using the proposed 'treadle irrigation pump' system to extract water from the river/wetland and recommending an appropriate design for small-scale irrigation system(s) – taking into consideration environmental, agronomic and socio economic factors as appropriate.

- In consultation with the WASH Advisors, advise on design recommendations that complement the proposed WASH interventions for the beneficiaries – including the water supply needs of the local wildlife/conservation establishments in area.

The areas visited and information gathered are shown in Appendixes 1-4 attached.

[1] Conservation Agriculture will take place within the Park where the communities reside. If done correctly (in line with the recommendations in this report) no degradation of the land within the Park will occur.

Summary of Findings

a) During the mission it became clear that there is an urgent need for Government intervention in this area, socially as well as economically.

b) The roads leading to the area, and in the area, are in a terrible condition. This creates a logistical nightmare – and providing supplies to the region is therefore very difficult. This also prevents the people of this region being actively involved in any economic activities.

Figure 1 **An example of the road conditions**

c) There is currently very limited marketing potential for any produce from the area. The market consists mainly of the few officials (administration, teachers and police) in the area as well as the Defence Force who might purchase some of the fresh products produced by the local farmers. If the tourism sector picked up in the coming years, this could also become a potential market outlet.

d) Jamba itself currently has enough boreholes (5) to supply just enough potable water for its population, but it is debatable as to whether this supply can support any more people. The other villages visited during the site mission have no potable water. They are all dependent on surface water from the river and tributaries of the river. During the wet season the water is of a marginal quality, but during the dry season the water quality is bad, and contains a lot of organic matter. There is anecdotal evidence that water quality may be a primary cause of the reported high fatality rate in the area.

e) There are no social structures present in the villages, but the people are prepared to work together to improve the overall living situation for all. They are also prepared to adopt new techniques in cultivation practices, as long as they believe it is worthwhile and beneficial for them.

f) In the Jamba area and in Bairro 11B only, there is an opportunity to cluster fields together in order to protect them from animals (this includes both wildlife and domestic stock). The fields of the other communities are scattered due to the distribution of better soils for cultivation.

g) Most of the farmers have two types of crops. A rain fed crop (which mostly consists of maize and millet) and a vegetable garden in the flood plains. The rain fed crops are normally on higher laying areas with sandy soils that are not prone to floods. The vegetable gardens are a form of 'recession agriculture' where site selection is based on better quality soils and soil moisture availability. As with all recession agriculture, the opportunity to cultivate is based on access to good soils as the seasonal flood water recedes.

h) In the past, the local communities were always in a position to produce enough food to support them for the whole year, but that is changing due to the drier spells. An increase in animal numbers in the WDA, especially elephants, has also affected crop production and during the last season most crops were severely damaged by wildlife. The re-establishment of large mammal (including elephant) migration routes is a key element of the KAZA strategy, but this does increase the potential for human-wildlife conflict and therefore needs mitigation.

i) The people in the area are already trying their own adaption of agricultural techniques in a search of better/alternate methods of cultivation – something that was witnessed in Bairro 11B. This indicates that they are therefore definitely open to the introduction of improved/conservation agricultural practices.

j) The communities expressed a great need for fencing to protect their fields from animals that destroy their crops and also consume the crop residue. They indicated that they were also prepared to provide all the necessary fencing poles and droppers as well as to construct the fence, if the necessary training is given.

k) There is significant and (reported) increasing human/wildlife conflict.

Conservation Agriculture

The biggest challenge with Conservation Agriculture (CA) in KAZA Member States is the competition for the crop residue after harvest, by both the crop farmer and the livestock farmer. The crop farmer requires crop residue to ensure his next crop and to build up his soil, while the livestock farmer wants it for fodder for the survival of his animals during the dry part of the year. The land tenure system in the communal areas in one Member State, Namibia, allows the crop farmer to fence his land off during the crop season, but as soon as he has harvested his crop the fences must be taken down and everybody is allowed to graze there and he cannot protect or save his residue for the next crop. This differs from the situation in Angola including Jamba; it is possible to fence off the crop area due to the fact that there is currently little livestock (cattle) pressure on the range land. This will most probably change in future, but it is hoped that by this stage the principle of keeping land fenced off for CA purposes will already be readily accepted by all, and the positive results of CA should ultimately provide extra residue that can then be distributed to the animals kept outside the fenced off CA areas.

The possibility to practice CA in this area is considerable. The method currently proposed in the North of Namibia, namely the ripper/ridge technique, would be eminently suitable for this area too. The technique is tried and tested, and in this technique the soil is ripped by a ripper that is modified with two tines which creates a ridge of soil between two ripper rows. The seed is planted in the ripper rows after the farmer puts manure in the ripper row. He thereafter covers the ripper row with crop residue from the previous season. The purpose of this cover is threefold; firstly to protect the soil from the sun, secondly to prevent evaporation from the soil, and thirdly to prevent the growth of weeds. The ridge catches the rainwater and lets it run down to the furrow where the seed is planted. This ensures that there is a concentration of moisture to improve the chance of germination. The residue cover protects the young plant from the sun and more water is available because of reduced evaporation. Legumes (cow-peas and beans) are generally planted on the ridge. These legume crops then bind nitrogen in the soil, which in turn help the main crop become more productive and the farmer gets two crops from the same field. After harvest the crop residue is left on the field to protect the soil from erosion and keep the soil cool to allow the microorganisms and earthworms to flourish.

If soil is not ploughed, weeds sometimes became a major problem. This can lead to increased usage of herbicides where it is accessible and affordable. Clearly increased herbicide use has significant unintended environmental consequences, and if not controlled can lead to degradation of the environment. That being said, due to the communities' poor access to markets, it is unlikely that significant amounts of herbicides (or indeed more damaging pesticides) will be used.

The results of applying CA in North Namibia (where the soil is the same as that found in the Jamba area) are substantial. In some instances the yield is up to ten times more than the average (when compared to conventional methods), and during drier seasons local communities are still able to harvest (whereas those using conventional methods are unable to do so). The estimated yield increase in this part of the world is around three times the average yield.

The cultivars planted do not have as significant effect on the yield as the method of applying CA, although in really dry years a short season cultivar may make the difference between harvesting at least a minimum amount compared to a complete crop failure. Currently the local communities plant mostly maize with some millet in

between. It is recommended that sorghum be introduced as an additional crop due to the fact that it is very drought resistant. Another crop that should also be considered is sunflower as it can provide farmers with oil and is also a crop that survives with very little water. Soya can also be introduced as a rotational crop, which will enhance the soil quality.

Animal-draught implements such as that shown in Figure 2 are available in Namibia and Zambia and can easily be purchased, and introduced into the target area. An implement of this type can be utilised to rip the soils before the rains start – unlike a plough, which can only be utilised once the soils are wet. Due to the fact that the rippers only "plough" on a fraction of the area (compared to the area ploughed by a traditional plough), the energy and power requirements are lower – i.e. the strain on the cattle is much less.

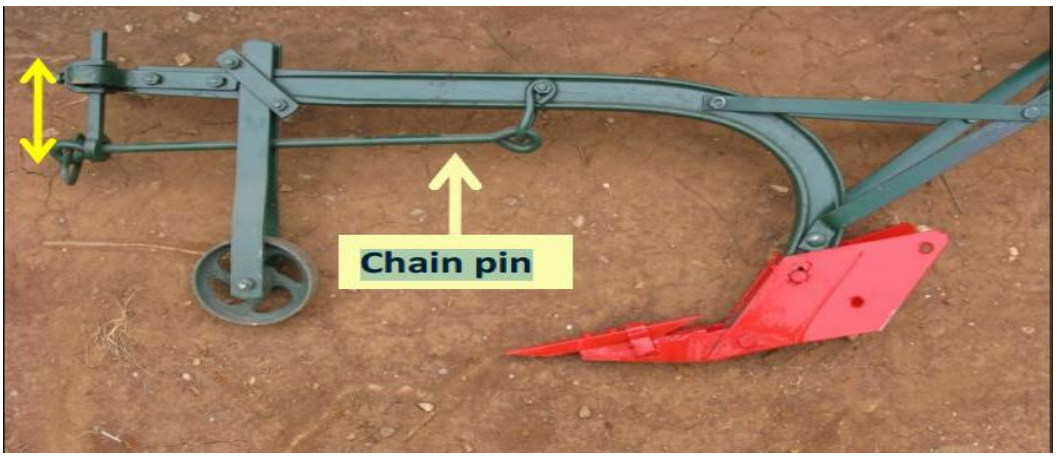

Figure 2 **Picture of a typical Animal Drawing Implement - In this instant a Ripper**

Although not every household has enough cattle to utilise animal drawn implements for their individual plot of land, overall there are sufficient cattle (oxen) in the area to effectively introduce these implements - provided families and neighbours agree to share/rent their cattle.

To successfully introduce CA it is important that the organization implementing the programme will have trained and knowledgeable staff that can transfer the skills to the farmers.

Small Scale Irrigation

Water for irrigation

Irrigation design in this part of the region is often based on in-field delivery systems that provide *all* the water that the plant needs, with (erratic) rainfall being seen as a bonus. Typical volumes of water needed to irrigate a hectare of a crop, at peak demand and considering the climatic conditions in the target area, is around 100 m3 per day (equating to the equivalent of 10mm rainfall per day). Any human-powered water extraction systems are therefore very limited – for example a treadle pump requires between 10 to 20 hours per day to deliver 100m3. Clearly this limits the potential for commercial grain crops under irrigation, and so small hectarages of high value vegetables are the primary target of irrigated areas. It is expected farmers primarily rely on rainfall and moisture in the ground to supply the required water for their irrigated plots, and only resort to supplementary irrigation (i.e. pumping water using the treadle pump) during extremely dry spells, because this requires a substantial amount of energy.

However, there are other options which will provide more water with less effort. One such a system is the rope pump which can be constructed and maintained by communities such as these, living in remote areas. A rope pump consists of a rope with disks or pistons on it at regular distances which is pulls through a pipe of the same diameter as the disks. The lower end of the pipe is under the water and the end of the pipe is flared to allow for easy entering of the disks. The water trap between successive disks is delivered to the top of the pipe where flows into a trough or canal. The rope is joined over a pulley to form one continuous ring. Initially it could only be used on an open well or directly out of a river, but with refinements it is possible to operate it in a borehole too. The advantage of a rope pump as opposed to a treadle pump is that a rope pump does not need to be primed, whereas a treadle pump needs priming if a foot valve is not installed. A rope pump is also not limited to a shallow depth as is the case with a treadle pump because it does not work on the suction principle. The only downside of rope pumps are that pipes, whether steel or uPVC, are not readily available in Jamba and would need to be imported from somewhere else.

Figure 3 **Illustration of tip section of rope pump**

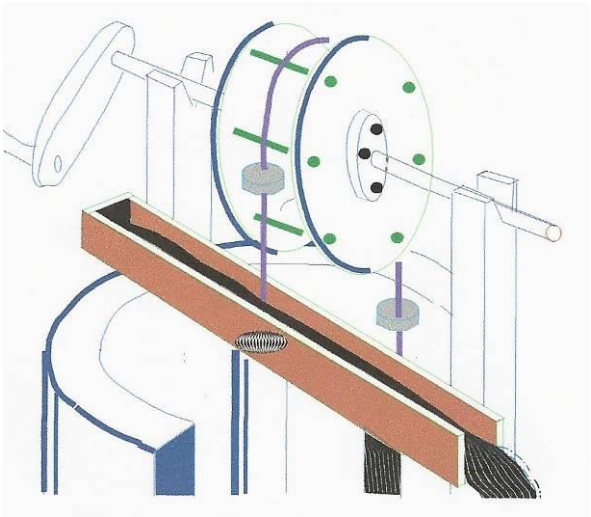

Figure 3 gives an idea of how the top section of a rope pumps looks. Instead of the handle, the pump can also be constructed in such a way that a person can use his legs to operate it.

As previously mentioned, most farmers already have a vegetable garden where they plant other crops – which not only broaden their diet, but also act as a back-up during seasons when rain fed crops fail. To an extent, this is still risky because they do not have the means to irrigate these gardens and they still rely predominantly on rain fed and recession-agriculture systems. Several

sites are located near dambos, which could collect and store water that can then be drawn on during the first part of the dry season. However, this is not a wholly reliable option as the dambo may dry up before the crop is ready for harvesting – in which instance the farmer could potentially lose his crop. The soil types in the flood plain are better than the sandy soils and the water retention capacity in the plains is also better. However, if it does not rain early enough crops planted on the plains are prone to failing.

A request from ACADIR also indicated that they would like some small scale irrigation at the sites near Jamba (Hangue, Vorgan and Makumutcha), which can be showcased to visitors such as the Governor of the Kwando-Cubango Province and Ministers from other Ministries, in the hope of gaining more support from them to roll-out similar schemes more widely.

On the site of Vorgan a well was found with the water level at about 3m below ground level.

Figure 4 **Well at Vorgan**

If this is the case at the other two sites as well, it is possible to establish small gardens that can be irrigated using water from wells; but this depends on what the is yield of these wells and if they have water all year round. A prerequisite is that the beneficiaries must dig the wells themselves because bringing in a drill to the area will be a difficult and expensive task (a drilling machine was seen in Jamba but it wasn't established whether it was in a working condition is not).

Although flood irrigation is not the preferred option normally, the type of soils at these three sites, as well as in the flood plains, makes it a viable option. The local communities also do not have the money to purchase expensive irrigation systems. However, if one or two of these rope pumps are installed, they will then be able to see how it is done and will be able to start making their own pumps and irrigate their own gardens without

spending significant sums money. This will also help with recycling of existing plastic bottles because they can be used as the disks on the rope.

Soils

The soils that were presented at the three sites near Jamba are in depressions, and upon initial inspection appear to have water logging problems, however the local communities assured the team that that is not the case. These soils have a much higher organic content than the sandy soils around the area and as such are much more productive. It is also expected that the nutritional values of the macro and micro elements in these soils are higher than the surrounding soils. Similarly, it is believed that this also holds true for the soils in the flood plains. Figure 5 below shows a photo of typical soils in these areas.

Figure 5 **Soils in the area**

Crops

The local communities already produce a variety of vegetable crops in the area namely, pumpkins, sweet melon, cow peas, sugar beans, sweet potato, cassava, sugarcane, soya, cabbage, tomatoes, cucumber and green maize.

Other crops that can be considered are sweet melon (especially the Honey Dew variety because if harvested correctly, it can be stored for up to three months and still be eaten fresh), butternut squash, beetroot, carrots, chillie and different kinds of leaf vegetables.

It could be possible to introduce fruit trees into the production mix, though a certain amount of caution is required because of limiting factors. These relate to cold spells and to assurance of water supply. Fruits that will grow here are guava, passion fruit, grapefruit, Valencia oranges and tangerines. Papaya (pawpaw) are already in the area but with better management can be much more productive. Bananas can also be considered but not as a commercial crop due to its sensitivity to cold spells.

Figure 6 **Some of the crops in a small floodplain garden**

The above figure indicates some of the crops observed in a small floodplain gardens.

Nut trees like pecan nuts and pistachio nuts can also be considered, but more research should be done before bigger plantations are planted. These crops may also have an export potential in future - if they prove to adapt well. This is because the logistical requirements are much lower than for any other fresh produce (specifically regarding cooling requirements and transport).

Although this area is very hot during the most part of the year, it should be noted that frost does occur from time to time during the winter months and there is therefore a danger that a percentage of one's harvest may be lost due to it. Therefore, frost-sensitive crops must be planted with care during the winter months.

Human/Animal Conflict

In all discussions with the local community, it was noted that the presence of animals is a major problem in the cropping fields as well as the vegetable gardens. Animals that pose a threat to their crops are elephant, hippopotamus, buffalo, kudu, reedbuck, bushbuck, bush pig, and warthog.

The fields can be protected against all of these animals by a well-constructed electric fence. These are expensive, but the costs can be reduced if farmers are prepared to supply the labour and the wooden posts and droppers. This can eliminate half the cost of a newly constructed fence. The solar panels needed to electrify these fences are in high demand on the black market (i.e. highly susceptible to theft) but the people assured the team that they will protect and guard the infrastructure if the proposed project can install an electric fence. This dedication indicates the large need for fencing.

The communities also mentioned that lions, leopards and wild dogs are a threat to their livestock and themselves, when they are out herding the stock. On the range land there is little that can be done to protect the livestock (short of shooting the problem animals) but for their own protection, herders could use prodders/Tasers (if they react quickly enough) to protect themselves from deadly wounds or attacks. However, this has not been tested/proven successful elsewhere in the region. At night animals can be housed in their kraals, which may be inside the electric fence or electrified themselves. In the situation of Bairro 11B the whole village itself can be inside such an electric fence.

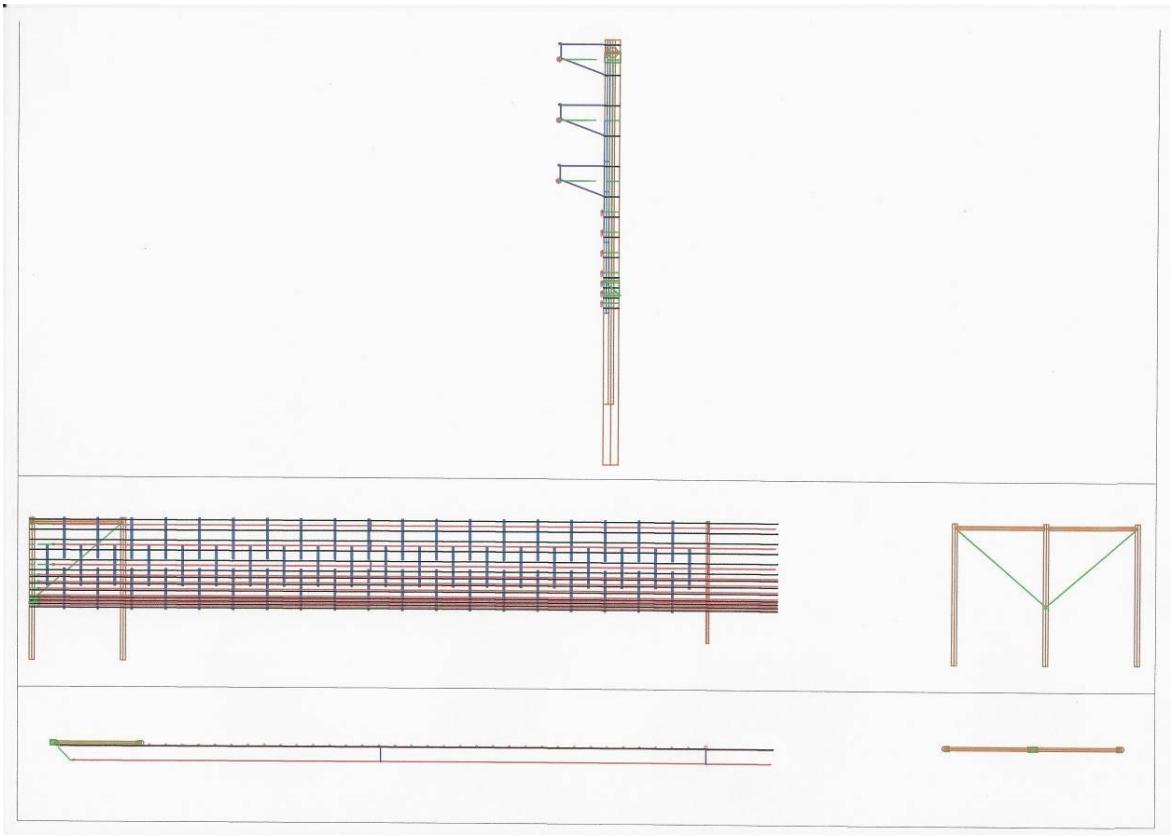

Figure 7 **A typical electric fence**

The human/animal conflict is likely to get worse over time due to the fact that more elephants are migrating into the area from the Chobe area. They are reclaiming the land which had previously been too dangerous for them during the Civil War (and during pervious armed conflict). Thus, for communities in this area to make a living, it is imperative that i) fields and crops are situated in such a way as to minimise the chance of conflict and ii) field crops and garden crops are protected as far as possible from the animals. Due to the fact that the gardens are located in the floodplains, permanent structures are not suitable. However, electric fences could be designed as temporary/removable structures that can easily be shifted or taken down.

Crocodiles were not voluntarily mentioned, but the communities did acknowledge that they lost people due to crocodiles when asked explicitly. This mostly occurs when they collect water or wash their clothes. If water pumps are constructed near the river, it should be taken into account that crocodiles pose as a danger and protective measures should be put in place for the pump operators.

Environment

Currently all the villages that are situated near the river or tributaries utilize the floodplains to produce vegetables for own consumption. None of the villages visited have gardens directly alongside the river, and none of the people utilize any chemical fertilizer or pesticides. Thus the influence on the river system is currently very low. However, with bigger scale developments in the future and better connections to the inland, these types of inputs may become more readily available and the uncontrolled usage of them may influence the river system negatively. It is therefore of utmost importance that these communities be made aware of the dangers of these practises especially because of the pristine condition of the river system in this area. It will also be important that 'Good Agricultural Practises' are followed to ensure that produce is not harmful. It will also be beneficial if the communities learn about the processes of creating compost to avoid the need/usage of chemical fertilizers which could also affect the groundwater.

It will be impossible to keep chemicals out of the region forever, but if farmers can learn about the consequences of using them from the outset, the potential affect that chemicals may have could be lessened.

Potable Water Supply

It is clear that potable water supply to all the villages in the region is a major issue. In one of the villages that were visited, Bairro Novo, there was a borehole but the water quality was such that the installed pump has rusted beyond repair. The community stated this was due to the high salinity levels of the water. The village has therefore reverted to sourcing water from an open lagoon that is not considered safe for human consumption. This is an indication that not all the ground water in the area will be of good quality. However, it is expected that fresh water can be found if holes are drilled deeper – but care should then be taken to case-off the saline water to avoid contamination.

It should also be noted that the water from the borehole at the Administration in Jamba was consumed by the consultant and deemed 'drinkable'.

The water table in the area seems to be very shallow (less than 20m) but to mobilize a Contractor to drill boreholes in each village would be extremely time and cost intensive due to the poor conditions of the roads.

It is recommended that funders interested in supporting potable water supply schemes be sourced to support these communities. The cost per water point from another study in the Calai District in Southern Angola is in the range N$ 650,000 (£30,000 at December 2015 exchange rates).

Provision of water supply to the wildlife in the area does not seem necessary because they tend to migrate to the nearest open water sources and forage in that area until this is also depleted, before moving on.

APPENDIX 1

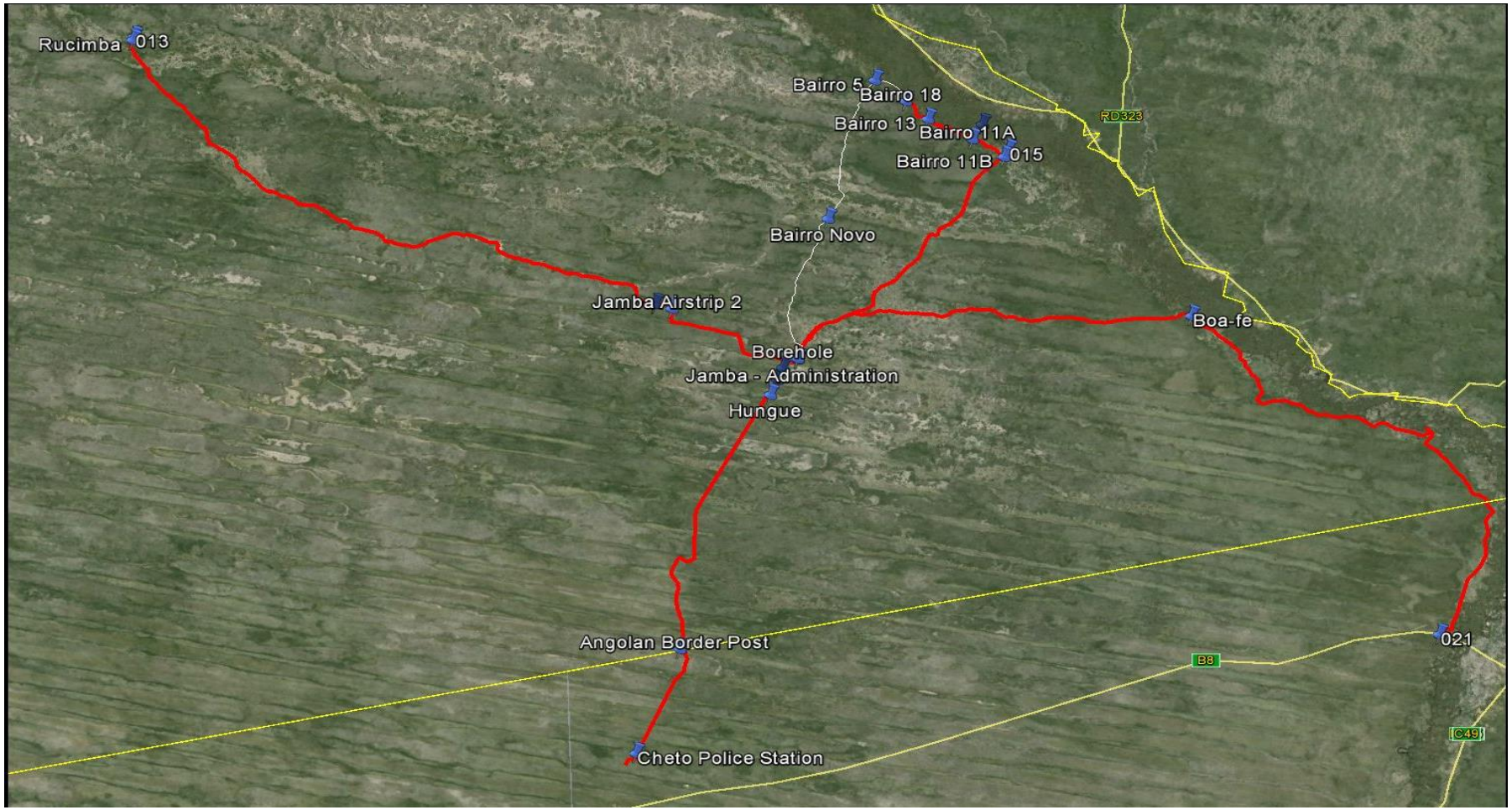

Figure 8 **Overall view of Project Area**

APPENDIX 2

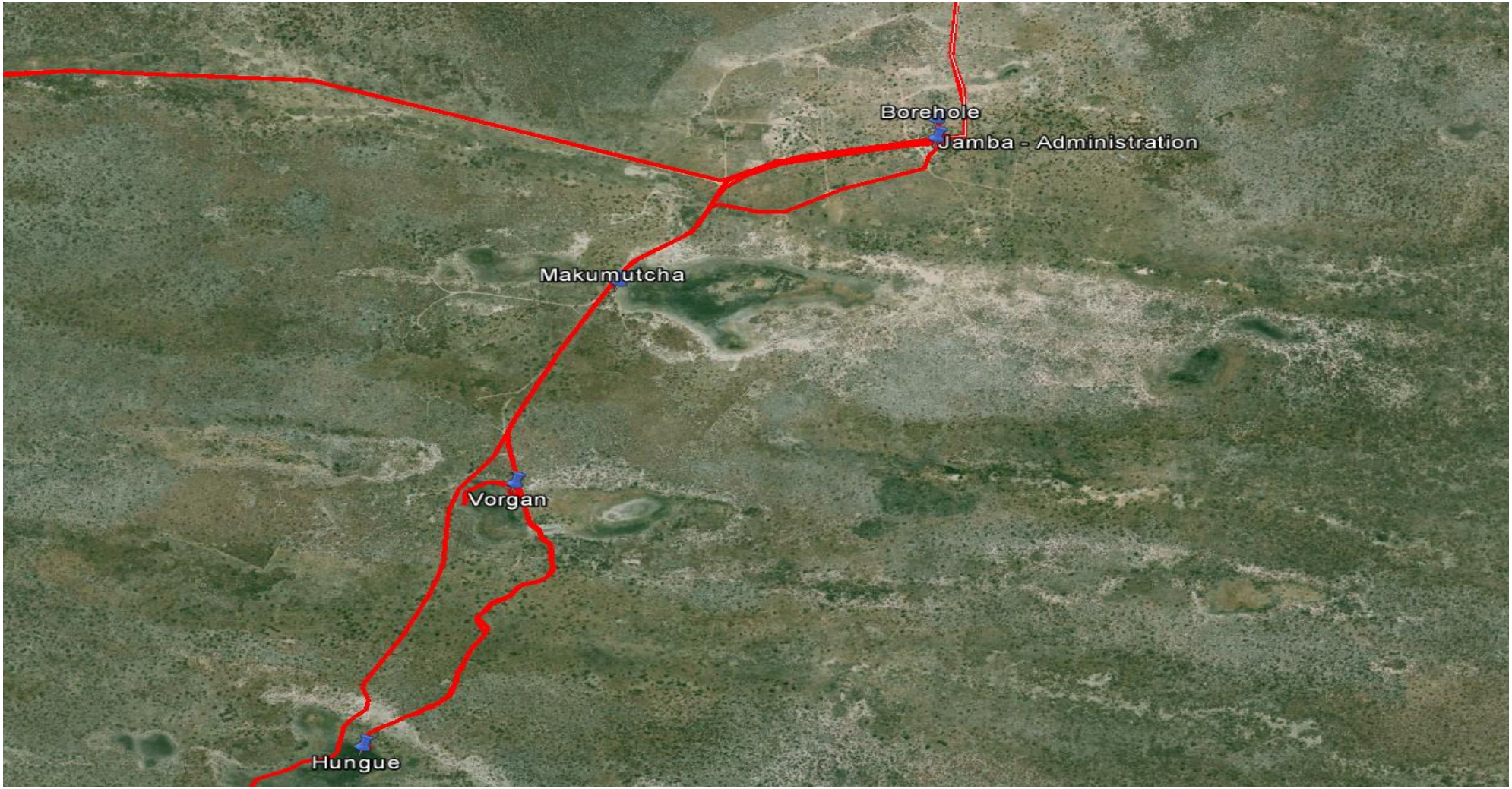

Figure 9 **View of Jamba Area**

APPENDIX 3

Figure 10 **View of Northern Part of Project Area**

APPENDIX 4

Parameter	Hungue	Vorgan	Makumutcha	Bairro Novo	Rucimba	Bairro 11(a)	Bairro 11(b)	Bairro 18	Rungamambue	Boa-fé
Distance from Jamba (km)	3	2.5	1.5	24	84	34	34	28	26	43
Collective size of farmed land (ha)	23	9.25	41.5	1	1ha/hh	1ha/hh	6	1ha/hh	1ha/hh	13
Perimeter (km)	2.6	1.3	3.3				2			
Arrangement of smallholder farms	Clustered	Clustered	Clustered	Scattered	Scattered	Scattered	Clustered	Scattered	Scattered	Clustered
No. of beneficiaries	80	20	310	443	40	720	120	130	190	39
Crops grown	Maize, Sorghum, millet, cowpeas, some vegetable	Maize, millet, sorghum	Maize, sorghum, millet, cowpeas	Maize, sorghum, millet, cowpeas, pumpkin & vegetables	Maize, millet, sorghum, cowpeas, pumpkin	Maize, sorghum, millet, pumpkin, s. potato, sugarcane, cassava, vegetables	Maize, sorghum, millet, pumpkin, sweet potato, sugarcane, cassava, vegetables	Maize, sorghum, millet, soya bean, cowpeas, pawpaw, vegetables	Sorghum, millet, maize, cabbage & other vegetables,	Maize
Livestock kept	Cattle, & a few goats and chickens	Cattle	Cattle, a few goats & chickens	Cattle	Cattle	Cattle, goats, pigs & chickens	Cattle, goats, pigs & chickens	Cattle	Cattle	Cattle
Human-wildlife conflicts	Elephant	Elephant	Elephant	Elephant & Buffalo & Lion	Elephant, Buffalo & Lion	Elephant, Hippo, Reedbuck, Bush pig, crocodile	Elephant, Hippo, Reedbuck, Bush pig, crocodile	Elephant, Kudu, Buffalo, Hippo	Elephant, Hippo, Buffalo	Elephant, Hippo, Bush pig, Baboon
No. months food lasts at household level (under normal rainfall years)	12	12	12	8	10	10	12	8	7	12
Potential for irrigation	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Poor


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