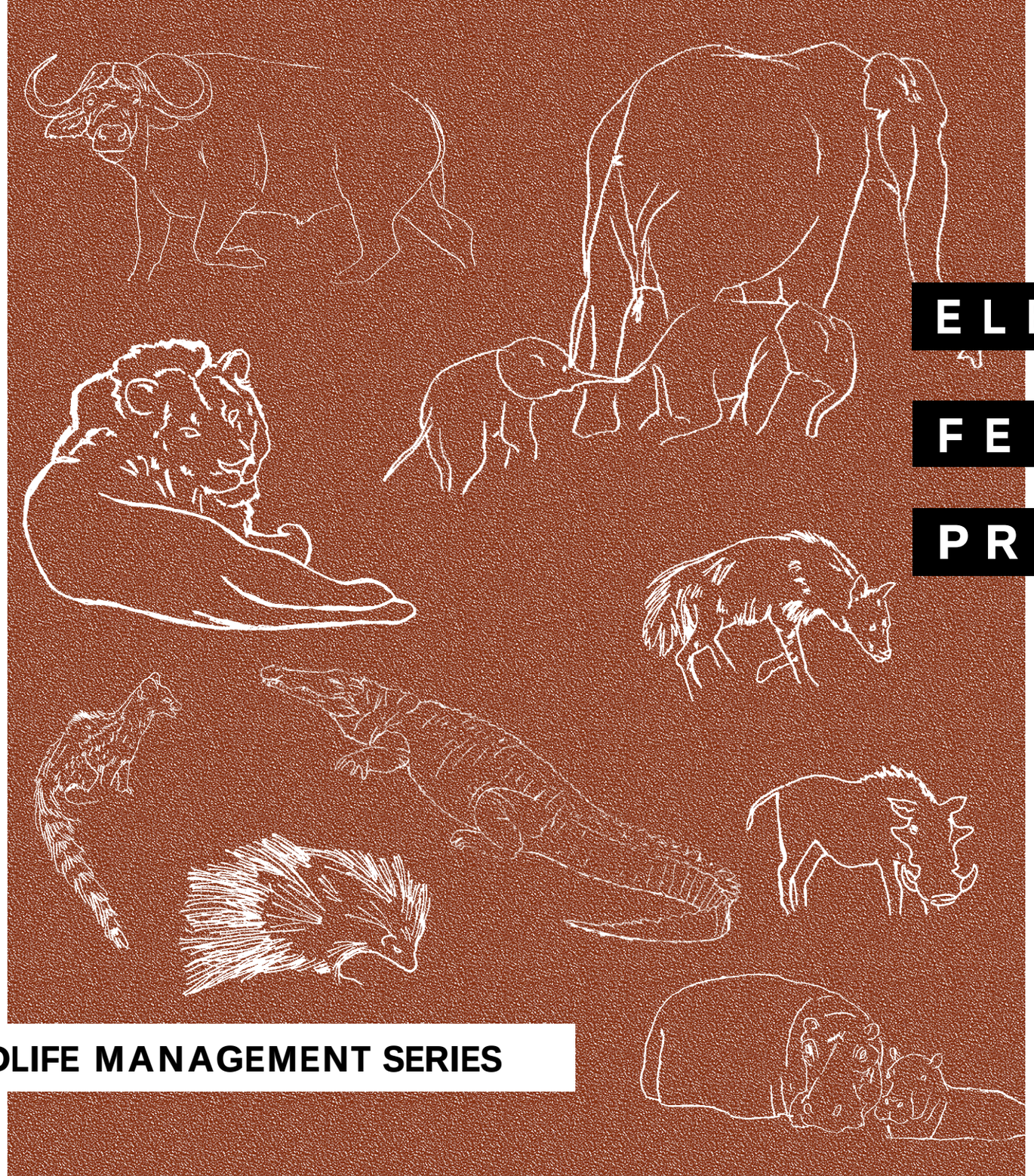

ELECTRIC FENCING PROJECTS

WILDLIFE MANAGEMENT SERIES

WWF®

ELECTRIC FENCING PROJECTS

These guideline booklets are based on field experience and original research reports which are available from the WWF Programme Office in Harare. WWF wishes to acknowledge the important contribution made by the Rural District Councils and their constituent communities in the development of the series.

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CONTENTS

Members of the Masoka Ward Wildlife Committee on a fence inspection visit in Kanyurira ward, Guruve.

Left to right: Gift Chisunga, George Kanederuka, unidentified and Austin Chaukura.

INTRODUCTION

PROBLEM ANIMAL MANAGEMENT and CAMPFIRE

Background to Problem Animal Management

Anyone who has attended a CAMPFIRE meeting knows that it isn't long before someone starts talking about problem animals. As a result of the CAMPFIRE programme, people now expect rural district councils (RDC's) to help them manage and benefit from wildlife. This includes making sure that no-one suffers severe crop or livestock losses as a result of communities deciding to manage wild animals in their district.

So RDC's, rather than the Department of National Parks and Wild Life Management (DNPWLM), are now expected to take measures to reduce or prevent damage caused by problem animals. Until recently though, rural district councils did not have enough information about problem animals on which to base their decisions.

In the past, shooting to scare away or kill was the only form of control. Often the wrong animal was shot or the problem animal returned. And killing an animal meant a possible loss of earnings later through for example a safari hunt.

Problem animal management (PAM), or the measures which may be taken to reduce the disruption to daily living caused by animals, is not an instant cure. It can however lower the amount of crop raiding and bring higher revenue to a community. But it requires rural district councils to make choices about how they deal with problem animals so that the costs are minimised while the benefits are maintained.

This booklet and others in the series aim to fill in some of the gaps in our knowledge about managing problem animals. This manual should be used in conjunction with or as a supplement to an earlier publication in this series "Problem Animal Reporting". A problem animal reporting system should be in place for **at least a year** before attempting a fencing project. The information they contain is taken from the experiences of councils who are trying to cut crop and livestock losses by introducing problem animal management in their wards.

Developing a policy on problem animal management

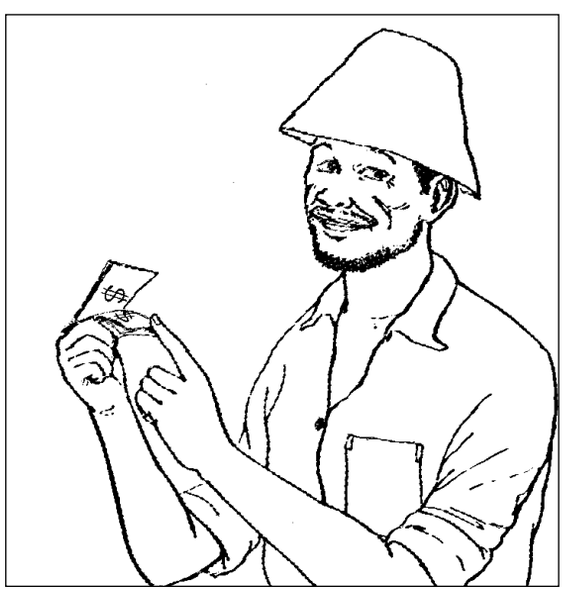
Every rural district council should implement a problem animal management policy, monitored by a PAM committee if necessary. This policy should come about after consultation and discussion with members of the community so that it is clearly understood and accepted by everyone.

The policy should explain the mix of measures which the district has introduced, the reasons for them and their hoped for effects. By monitoring the measures introduced for 1-2 years, it should be possible for rural district councils to quantify the benefits that have occurred.

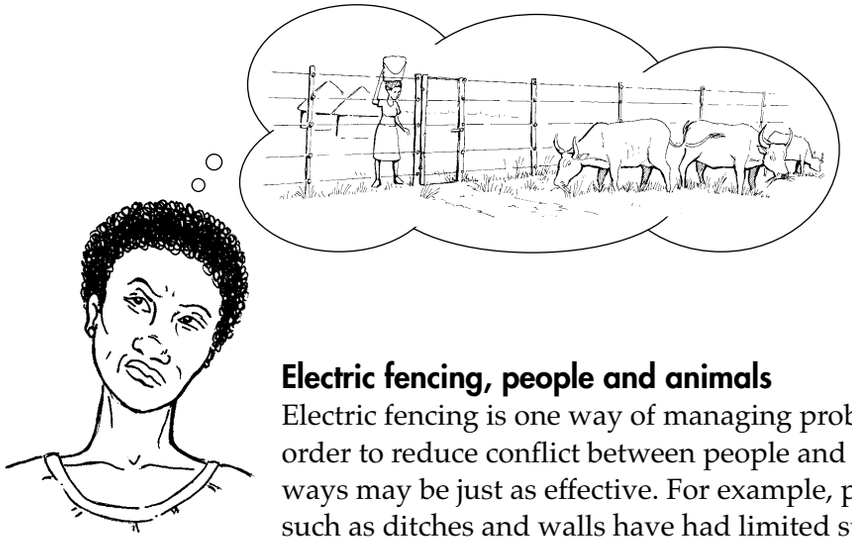
If control shooting to scare or kill is a part of the measures introduced, RDC's should draw up a problem animal control contract with the organisation(s) that will react to problem animal incidents when requested to do so by the responsible council wildlife official. The contract should state precisely the chain of responsibility and conditions governing problem animal control and be available for anyone in the district to see. A rural district council will need to establish similar procedures even if it decides to set up its own problem animal control unit.

There is no simple way of getting rid of problem animals such as elephant. If we did, we would be removing the animal which is a community's most valuable asset. Since 64% of all CAMPFIRE cash is earned from elephants, if there were no elephants in a ward, the potential earnings of the ward would be greatly reduced.

The problems caused by animals raiding crops and killing livestock can never be completely removed. What a council policy should aim for is to introduce measures which will reduce the problem to a level thought acceptable by the community. Before introducing any form of problem animal management, councils should bear in mind that the benefits brought to everyone from these measures should always outweigh the costs of introducing them.



With wise management, problem animals can be turned into an asset for the community.



CHAPTER 1

BACKGROUND ISSUES TO ELECTRIC FENCING

Electric fencing, people and animals

Electric fencing is one way of managing problem animals in order to reduce conflict between people and animals. Other ways may be just as effective. For example, physical barriers such as ditches and walls have had limited success but they are not easy to construct and are very costly. Compensation payments can be made but are difficult to assess and tend to be unfair and sometimes abused. Control shooting, while widely practiced in the past, is ineffective in stopping crop raiding. Incidents of crop raiding are too numerous and widespread for animals to be killed each time. Buffer zones or 'open spaces' between people and animals can be created, but only if there is sufficient land available and this is seldom the case in Zimbabwe.

Electric fencing as a practical solution is working well in the private sector. However, its use under communal management has yet to be fully demonstrated. Nevertheless, provided the project is well planned and coordinated, there is no reason why similar successes should not result.

Why build a fence?

To some people fences represent a physical and psychological barrier to their use of resources behind the fence. To others they represent a solution to the conflict between people and animals. Fencing projects must reconcile these differing views if they are to be successful. Elephants are too valuable to be destroyed as crop raiders because their full value cannot be realised when shot as crop raiders.

Although the capital cost of a fencing project is very high compared to the damage caused by problem animals, fencing projects should not be judged solely by the success they have in reducing crop raiding. In the long term, they also have an important role to play in saving human lives and valuable animals, while maintaining the wildlands upon which the CAMPFIRE programme depends. Yet they must be rigorously designed so as to achieve what they are supposed to achieve.

Interface situations for electric fencing

Conflict between people and animals occurs when:

- settlement and agriculture is next to a 'national park' or 'safari area' - as shown in fig. 1.
- settlement is isolated within a communal wildlife area - as shown in fig. 2.
- settlements are expanding and joining together, fragmenting a wildlife habitat - as shown in fig. 3.

Electric fencing is most useful in the first two situations. It may be difficult to gain acceptance or very costly to implement in the third.

Figure 1: When settlement and agriculture is next to a 'protected area'

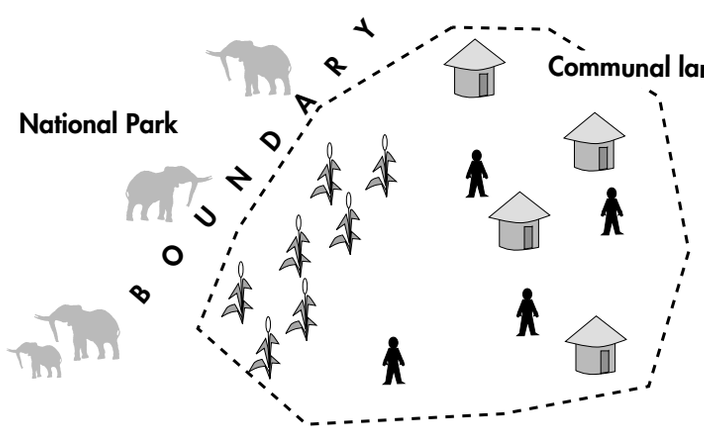


Figure 2: Settlement is isolated within a communal wildlife area

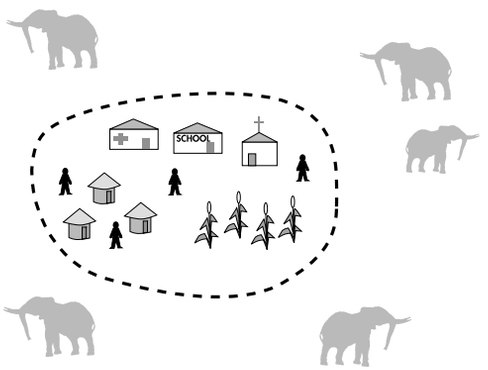
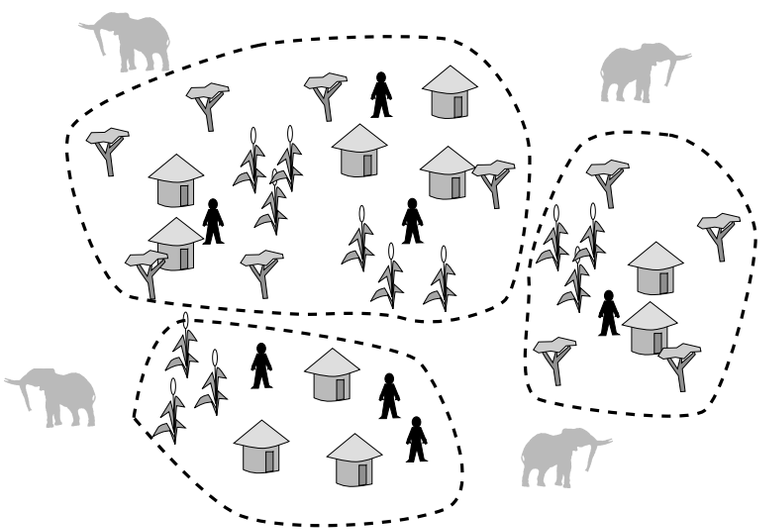


Figure 3: Settlements are expanding and joining together, fragmenting a wildlife habitat



What should I do before starting a fencing project?

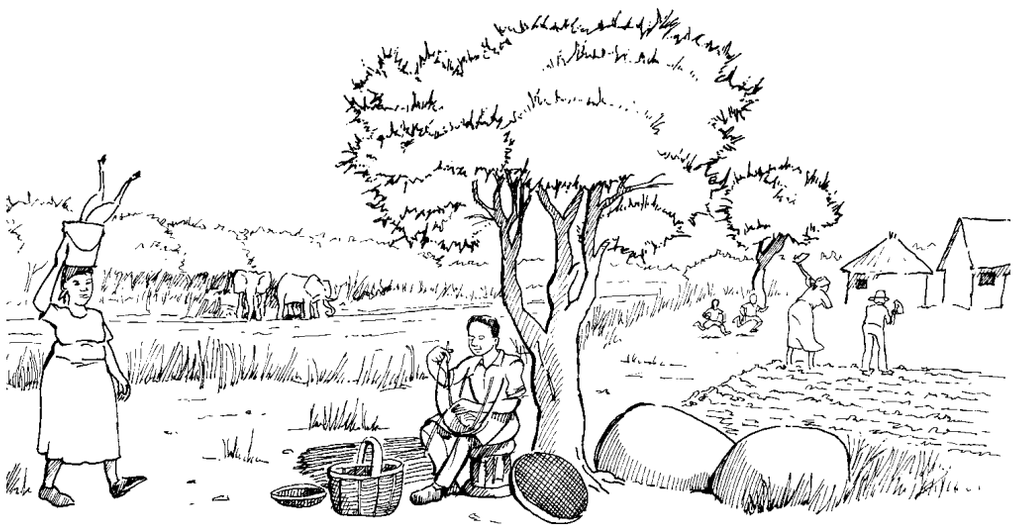
Before you begin a fencing project you should explore whether electric fencing will be a cost effective solution in managing problem animals. This means that you need to:

1. **Assess the damage caused by wildlife in your wards, ideally over a period of 2-3 years through a Problem Animal Reporting (PAR) system.**
   This will tell you
   - which animals cause the damage,
   - where they cause it and
   - when it is likely to occur.

   All this information is important in order to know if it is appropriate to consider fencing, where to fence and what type of fence to use.

2. **Examine with the communities, the different ways of fencing shown in this booklet and decide which model best serves your needs (see pages 12+13).**

3. **When the information from 1 and 2 above are to hand conduct cost benefit analysis (see chapter 4). This is to see if the costs outweigh the advantages of building a fence. (If you are not confident about doing this, consult an economist).**



4. **If the cost benefit result is favourable work out how it will be paid for and maintained. How much each household will effectively 'pay' out of wildlife revenue for its construction and maintenance is the most important thing to the people.**

5. **Try out a pilot electric fence project on a suitable rural community.**

6. **Decide if the pilot project works and learn the associated problems before going ahead with your final plan.**

Setting up a Problem Animal Reporting system is covered in the first guide of this series.

Box 1: Discussing how electric fencing can meet stakeholders requirements

Who takes part

Traditional Leaders (chiefs and headmen)

Community members

Ward Wildlife Committee Chairman

Ward Councillor

Vidco Chairman

District Administration Rep.

Wildlife Manager or Coordinator

Natural Resources Representative

Safari Operators

Dept. NPWLM

AGRITEX

NGOs - Zimtrust

- WWF

- CASS

- other

What they should do

Review problem animal reporting

Discuss conflicting interests, ideas and options

Investigate losses from wildlife

List costs of fencing project

List and discuss different fencing schemes (pages 12-13)

What is needed

A good description of problem animal activity in the district

Statement of objectives and expectations of fence

Nominate/detail planning team

A cost/benefit analysis (pages 25+26)

CHAPTER 2

STEPS IN THE DEVELOPMENT OF AN ELECTRIC FENCE PROJECT

What is the procedure for getting an electric fence project implemented?

STEP 1. RAISING AWARENESS AND DISCUSSING COMMUNITY NEEDS

A meeting may be called by the ward wildlife committee to discuss villagers' concerns about problem animals. This meeting could be organised by the District Wildlife or CAMPFIRE Coordinated-ordinator. Try and make sure a cross-section of the community is present. It is important that every point of view is heard and that they are documented.

Discussions at first should explore the idea of a fence as a possible option because fencing may not be the best solution to the problem. Fencing should be discussed in the context of landuse planning and zoning.

Discussions may carry on over several meetings where conflicting personal interests may emerge, as well as a general picture of the problems people are having with wild animals.

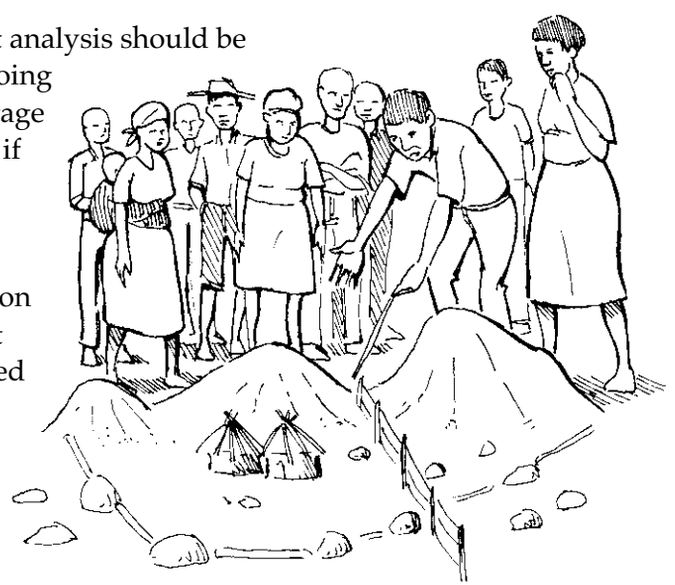
Some meetings may be dominated by certain individuals who do not represent the whole community. However, it is very important that the whole community supports any decisions made at these meetings and not just a few officials or community members.

Box 1 on page 10 gives an outline of who might be invited to these meetings, what should be discussed, and the outcomes which you should work towards.

The actual roles and responsibilities of the different groups should be decided by everyone at the meeting. These decisions can then be made known to the District Board of Management through the Ward Wildlife Committee.

The different models or ways in which a fence can be arranged should be presented and discussed, in order to debate which type of fence may be the most suitable. These arrangements are shown in box 2 on the following two pages.

Finally a cost-benefit analysis should be undertaken before going on to the planning stage in order to work out if a fence will be a cost effective solution to problem animals. (A detailed description of how a cost-benefit analysis can be carried out is given in Chapter 4).

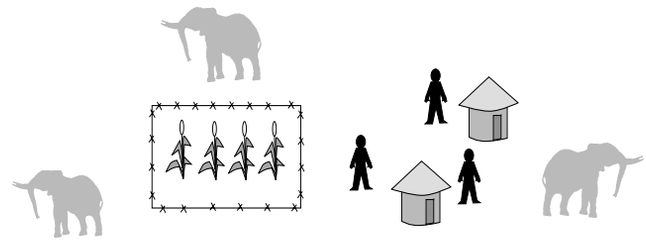


Box 2: Different fencing schemes to consider

Model 1: Irrigation scheme enclosure

Description:
Only the irrigated fields are inside the fence. All dwellings are outside.

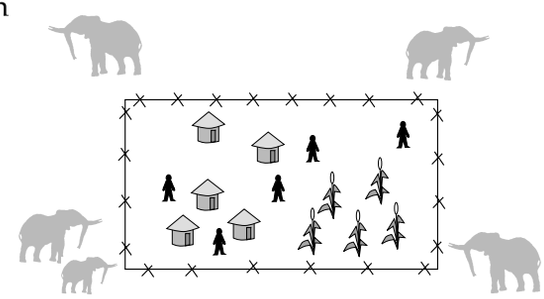
Important points:
This gives the most benefit compared to the costs of other models but leaves dwellings unprotected from wildlife. (It may not be possible where there is not enough land or water available for every farmer in this one area).



Model 2: Small complete wildlife exclosure

Description:
Here the fences, which may be 1-6km long, are arranged to enclose the dwellings and cultivation plots of one or a few families. They may form a group of linked small wildlife exclosures.

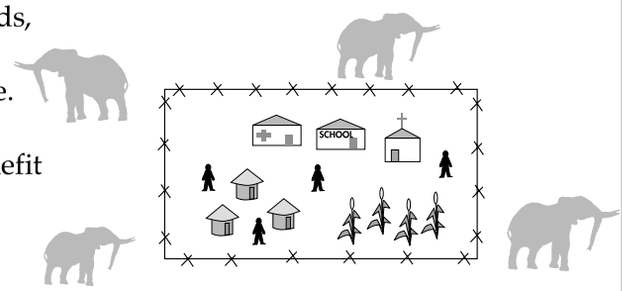
Important points:
This model still needs to be tested since communities have felt it will cost too much compared to the benefits it gives. It differs from model 3,in its size. This style of fence may be difficult for communities to accept but it has some good characteristics.

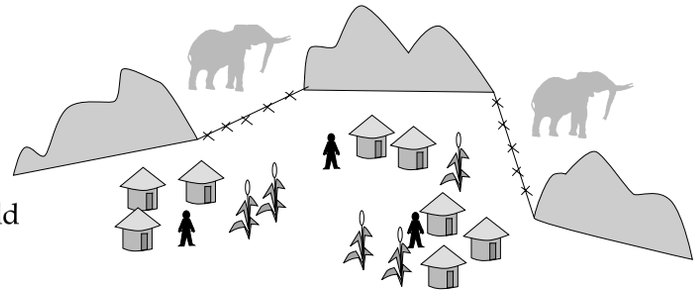


Model 3: Extensive complete exclosure

Description:
A fence perimeter of 15-20 km is arranged to make an extensive complete exclosure which places fields, grazing land, most dwellings, and possibly a school, clinic and water supply inside the fence.

Important points:
Model 3 schemes, which have a good cost/benefit ratio, appear to have been the most successful so far. Communities are kept together and can see that the fence keeps animals out. While the fence is accessible for maintenance, longer fences are more difficult to maintain and require more management. Model 3 schemes may also require some people to move in order to live within the fence.





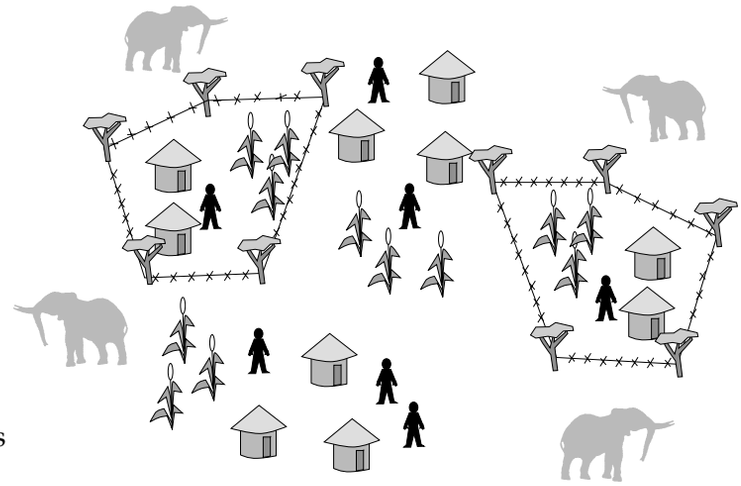
Model 4: Extensive open-ended fence

Description:

An extensive and open-ended fence up to 30km long is built to deflect wild animals.The fence is placed where animals are already restricted or combined with a natural barrier such as an escarpment or a river.

Important points:

Model 4 schemes which cut down on capital costs by linking with a natural barrier have a very good cost/benefit ratio. However settlements may still be vulnerable because of the open ends of the fence and more problem animal reports have been received in model 4 projects compared to model 3. The long fence needed can lead to management problems in its maintenance while there is also a risk of isolating animals on the wrong side after it is built. Some small problem animals may also remain in 'pockets 'of bush inside the fenced area.



Model 5: Small group or individually owned fence

Description:

A very simple fence encircling one or a few fields and/or a few houses.

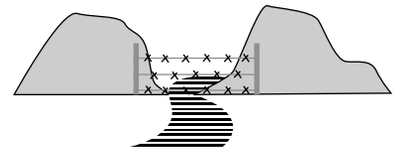
Important points:

It is owned by a very small group of people or a single household. It is very simple to construct and maintain. Much less maintenance is required so costs are low.

Model 6: Small strategic fence or barrier

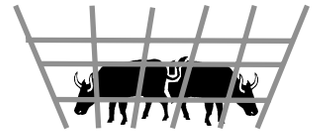
Description:

For some species with known or restricted movements, a small carefully placed fence, such as along a river front garden raided by hippos, around a kraal to protect livestock from lions, or across a river bed to stop elephant, can be built.



Important points:

This style of fencing is very successful when designed to keep out a particular animal and sited in the correct place. This in turn depends on good existing knowledge of the animals responsible for damage and their daily movements.



Box 3: Agency members, tasks and expected results of effective planning

Agency members	Job description	Results
Planning Coordinator (NGO or council representative)	Review local knowledge of animal movement	Rough trace line
Ward Wildlife Chairman	Spoor/Dung counts to assess animals movements/concentrations	Budget for - construction - maintenance
Ward Councillor	Review aerial surveys for - distribution-information - density information - major problem animal species	Management plan (human and financial resources, equipment responsibilities)
Wildlife Manager/Coordinator	Review resource and socio-economic surveys for - area sizes (wards, vidcos) - population statistics - arable in/out - proportions of occupied/unoccupied land in area	Post construction monitoring plan
Funding representative	Review activities of people esp. pastoralism vs cropping	Tender notes
	Review ancestral spirit sites	
	Acquire aerial photographs for terrain appreciation and plotting	
	Acquire maps (1:50 000 topographical) for terrain appreciation and plotting	
	Review costs/benefit appraisal	
	Check tender and contract requirements with funding agency	

STEP 2: PLANNING THE FENCE

When planning a fence, many agencies and individuals must work together. This will ensure that when the fence is erected it will give the expected results. The members of the planning team, the tasks they must set between themselves and the outcomes which must be produced are shown in box 3. Normally this planning process might be organised and chaired by the District Wildlife Coordinator.

Planning a fence involves three related tasks:

TASK 1: Collecting together information

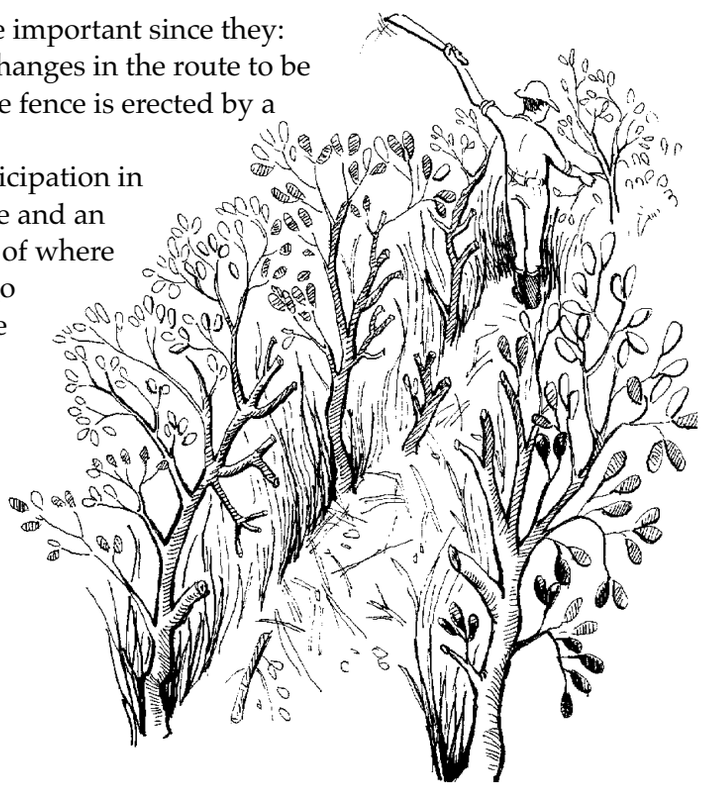
Collecting together information about wild animals and their movement in the area together with the people, their settlements and land-use. This is normally called a Problem Animal Reporting system or PAR and should be established **well before** a fencing project is undertaken. Usually information about one whole season is needed to understand which animals cause the most serious problems and where these problems may occur. This information is needed to make decisions about the route of the fence and the style of fence needed. After reviewing all this information a proposed route for the fence can be marked on either a map or an aerial photograph.

TASK 2: Proposing the route of the fence

Setting up a 'trace' or rough line marking an approximate route of the fence. This can be marked using voluntary community labour so that everyone in the community sees where the fence will go and have time to consider changes to it. When the trace line has been finally agreed, it should be cleared and widened to five metres. Because of the large amount of work involved, this will take place more efficiently if paid community labour is used. It also enhances popular support for the fence.

These initial tasks are important since they:

- still allow for changes in the route to be made before the fence is erected by a contractor
- encourage participation in clearing the line and an understanding of where the fence will go
- gain acceptance for the project



TASK 3: Who will do the work?
Construction and maintenance of the fence

This involves:

Preparing tender notes

Tender notes are a very important part of planning and form the basis of a legal contract if an outside agency builds the fence. Tender notes describe in great detail what is required, where it should go, when it should be built and how it will be paid for. On completion a fence must be checked against the tender notes to make sure that everything has been done correctly. Only then should payment be made. Requirements of funding agencies should be checked before going further.

Within the tender notes (see Appendix 1 on page 36+37 for a specimen set of notes prepared for Nenyunga and Madzivazvido community fences) the following information is required:

i) **General description of the project** and its objectives

ii) **Design guidelines** or minimum performance specifications. These make sure that the contractor works within the limits you set for him and uses the appropriate quality of materials. Design guidelines are important should you wish to make a claim against a contractor if the fence fails after it has been built. For example the energisers needed on an electric fence are very important. To me and you they may all look the same. But a contractor knows he has the choice of supplying cheaper and probably incorrect energisers or more expensive, and reliable ones. If you specify the energy and voltage delivery which is required from the energisers for your fence, the contractor will have to make sure the correct ones are supplied. The design guidelines or minimum specifications you may wish to include in the tender notes are:

- height of fence
- material the fence posts are made from
- energy and voltage delivery
- wire thickness and spacing
- the distance between corner posts or posts that take a 'strain'
- dropper interdistance

iii) The **fence route** given in six figure grid references and marked on a small scale map

iv) **Specifications on materials and construction.** Sometimes you may wish to state exactly what a contractor should do. For example many grades of wire are available but the positive (live) wire on an electric fence should be 'double dipped 2.5mm wire'. Asking the contractor to specify in detail what is being provided and how the fence will be erected, allows you to control the quality of the fence.

v) **Subcontracting**. Subcontracting refers to giving more than one contractor the responsibility for building the fence. This may mean one contractor erecting the fence and another one electrifying it. This can cause problems

since the contractor electrifying the fence may find it has not been built to his liking, resulting in a problem fence for the community. Sub-contracts should only be permitted for non-construction items or occasionally for electrification with the provision that final responsibility rests with the first or primary contractor so as to reinforce his responsibility.

vi) **Labour arrangements**. It is likely that community support for a fence will be greater if they are employed in its construction. On the other hand, a contractor prefers to use his own trained labour over which he has control. A compromise is for a combination of community and contract labour to be specified. In this case a clause should be inserted into the contract placing responsibility for the labour supervision with the contractor and allowing the contractor the responsibility of hiring and firing community labour. This will avoid a contractor being able to blame a community should a fault in the fence arise.

vii) **Training in fence maintenance.** The tender should state that in addition to community workers gaining skills in fence construction, the contractor should provide a specific technical training programme in fault finding, monitoring and maintenance of the fence.

viii) **After construction support.** An after construction support service should be included to make sure that the fence is well constructed and to allow for a gradual withdrawal of technical support. A specified percentage of the contract price should be held as the final payment until six months after the fence is completed.

*viii) **Payment schedule**. A payment schedule should be specified. An example would be:

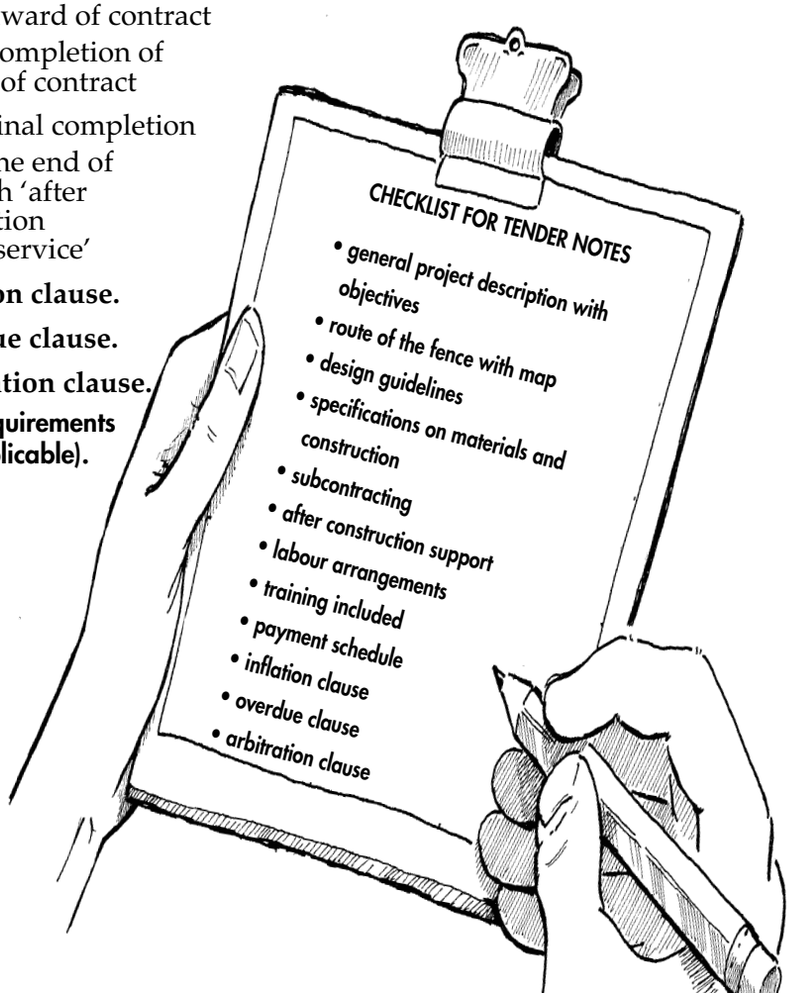
30% on award of contract
30% on completion of first half of contract
30% on final completion
10% at the end of six month 'after construction support service'

*ix) **Inflation clause.**

* x) **Overdue clause.**

*xi) **Arbitration clause.**

*** See specific requirements of donors (if applicable).**



Box 4: Funding and tendering

Agencies/Members	Job description	Results
District Council Representative	Access funds	Letter of agreement/cheque
District Administration Rep.	Open bank account	Cash deposit
Donor representative	Draw up tender notes	Tender evaluation
Ward Wildlife Committee Chairman	Offer public tender	
Joint Venture partner	Evaluate tender offers	
Planning Coordinator		

STEP 3. FUNDING AND TENDERING

There are several options open for communities to raise money. It is however very important that funds are raised initially from within the community. Options for raising money include:

- self help or financing from wildlife dividends
- coordinated-financing by combining RDC money with donor aid to make a larger grant
- soft loans from development banks
- joint ventures with hunting or non-hunting partners
- revolving funds, for example with the repayments of a first 'soft loan' going to fund the next scheme

The agencies involved, the tasks they must carry out and the results needed are shown in box 4.

STEP 4. CONSTRUCTION

Construction of the fence should be carried out by a contractor in liaison with the local Wildlife or CAMPFIRE Coordinated-ordinator in the district.

Councils may wish to engage a consultant to evaluate if the final construction meets tender specifications. The date of this evaluation should be fixed for example one week after completion of a particular section or final completion, so that faults in construction can be distinguished from inadequate maintenance. The agencies, tasks and expected results involved in construction are shown in box 5 (next page).

Box 5: Construction

Agencies/Members	Job description	Results
Local labour	Open trace line	Cleared fence line
Contractor	Construct fence	Completed fence
Ward Wildlife Chairman	Supervise	Trained fence guards

STEP 5. MAINTENANCE

Developing a maintenance plan.

This is a plan to make sure that the fence will be maintained by the community. It should include details about daily maintenance and the tools and components required. Daily maintenance guards should be recruited from within the community and engaged by the Ward Wildlife Committee in a formal written contract. Although at this stage maintenance guards may not have been identified, it is important that the community is made aware of this commitment. Preparations, in terms of contract documents, job descriptions and remuneration, should be made by the Ward Wildlife Committee. The committee will need to decide on the numbers of guards, selection criteria and procedures, and ensure that the guards understand they are accountable to them for fulfiling their duties. The committee in turn is accountable to the members of the ward for making sure that the fence is maintained and should report to the District Wildlife/CAMPFIRE Coordinated-ordinator on the discharge of its duties.

During the growing season the fence line will need to be cleared of grass. This task needs to be formalised in a statement listing those individuals who will undertake this clearing, who will supervise them, and how often it will be done. If this process is not formalised, maintenance in the first season will probably fail, leading to the eventual failure of the fence.

The tools and equipment and expected replacement parts necessary for maintenance should be itemised. Information about where they will be obtained, who will obtain them and how they will be paid for should all be included.

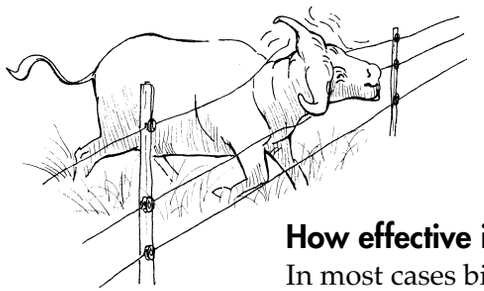
Maintenance of the fence is vital. In the past communities have had problems maintaining a fence because:

- cash was not given as an incentive for hired members of the community to manage the fence
- clearing was not organised to take place regularly along the whole length of the fence
- responsibilities were not understood
- there was no money to pay fence guards and therefore they did not have to account to anyone
- tools and replacement parts were lacking
- there was little technical understanding of the electrical components

In projects where maintenance was unsupervised, a number of serious problems have arisen including theft of solar panels and energisers, failure to clear vegetation touching the fence resulting in electrical shorting, and a failure to keep records about the fence. A lack of maintenance is the main threat to the whole concept of using electric fences, making it doubly important to have an effective maintenance plan for every project.

Suitable fence guards should be identified since their location, occupation and education will influence their efficiency, interest and understanding.

Each guard should receive training in 'troubleshooting' fence problems by the contractor who can demonstrate to them how to solve the most common problems that are likely to occur. These reports should be regularly forwarded to the ward wildlife committee for examination by the chairman who can then report on the state of the fence. Supervision of the fence guards can initially be a part of the 'after construction support service' (page 17 section viii) provided by the contractor.



How effective is an electric fence in reducing crop losses?

In most cases birds and insects cause as much loss to crops as wild animals do.

Elephants

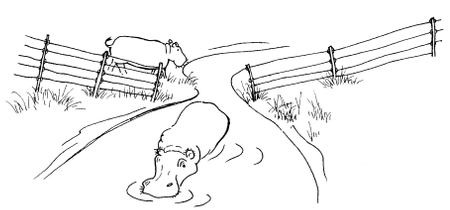
Elephants are the most serious problem animals but can be deterred by a good electric fence. However certain individuals may repeatedly test a fence, resulting in regular breaks but infrequent penetration into the enclosed area. A 1.9m high fence appears to be successful in keeping elephants out.

Buffaloes

Buffaloes can break fences but usually cause little crop damage. They may 'blunder' into a fence but retreat on being shocked. A buffalo is probably more of a threat to people than to crops.

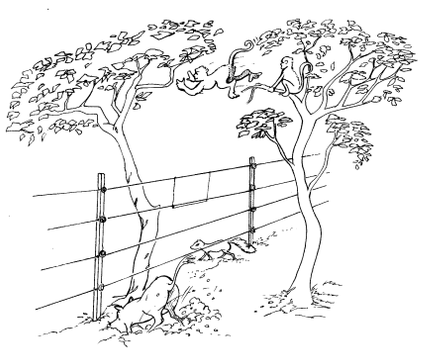
Hippos

Hippos usually stay close to one site and are easily controlled with low electric fences. Hippos may however enter a fenced area at a river crossing.



CHAPTER 3

ELECTRIC FENCING AND PROBLEM ANIMAL SPECIES



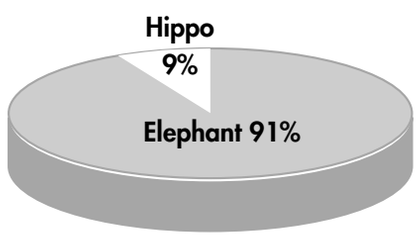
Antelopes

An antelope such as a kudu may break a fence in the course of jumping over it. Antelope though are not usually a problem in crop damage.

Bushpigs, baboons, lions and leopards

Electric fences are not very effective against bushpigs since they may dig under them. Similarly, small carnivores may dig under, or climb and squeeze through small gaps even in a fence where the wires are closely spaced. Baboons and monkeys can easily use trees to climb over the fence. Carnivores do not cause crop damage and primates can be chased away by watchful people during the day, bushpigs are often responsible for extensive crop damage, especially at night.

Animals causing damage outside the fence in Tyunga 1991-2



Estimating costs and benefits of an electric fence in Tsholotsho RDC

Effect	Value	Source of data
Benefits		
reduced crop raiding	PAR data missing therefore calculated at a fence payback period over the life of the project (10 years)	calculated
reduced PAC reaction	$14,500	Safari operator
reduced livestock losses	$55 500	CASS data
Costs		
Clearing fence line	$210 912	Tsholotsho RDC
Fence construction	$675 000	ZimTrust
Maintenance	5% or 11% of construction cost annually	WWF data
No impact		
Hunting quota unchanged	$611 631	DNPWLM

CHAPTER 4

CASE STUDIES OF ELECTRIC FENCING PROJECTS

CASE STUDY 1
An electric fence cost-benefit analysis in Tsholotsho Communal Land

Background

Before the start of CAMPFIRE, Tsholotsho was the communal area in Matabeleland with the highest number of elephant shot on PAC (Problem Animal Control). This represented a considerable loss of potential revenue to the communities. Wildlife living in the adjoining National Park particularly elephant, lion and hyena caused regular disturbance to the inhabitants in the communal lands.

An electric fence was discussed since:

- the Rural District Council saw it as a way of creating a buffer zone for generating wildlife revenue
- people saw it as a measure for reducing crop damage

As a result an environmental review of the whole fence and buffer zone idea was carried out which included a cost-benefit analysis.

Is a fence financially worthwhile?

Estimating costs and benefits

Initially, estimating livestock and crop losses amongst the four main affected wards bordering Hwange National Park proved difficult since no problem animal reporting system was in place. However, from other data the costs and benefits of an electric fence shown on the box on page 24 were identified.

Calculating the value of crops that must be saved

In the absence of PAR data the value of crops that needed to be saved from destruction by elephant annually, in order to cover the costs of the fence over a period of time such as 10 years, was calculated. A ten year payback period over which the fence pays for itself in terms of crops and livestock saved is a reasonable one given the materials used in the construction of the fence.

To the total costs of the fence which was Z$ 885 912 maintenance costs over the 10 year period have been added. These have been worked out at a 5% and 11% level of fence costs and are shown in the table over the page.

	5% $	11% $
Annual maintenance (over 10 years)	442 956	974 503.20
Total fence costs	885 912	885 912
Total costs over 10 year payback period	1 328 868	1 860 415.20
Annual costs	132 886.80	186 041.52

It is now possible to work out the annual amount of crops and livestock that must be saved in order to pay for the fence.

Value and amounts of crops saved each year needed for a 10 year 'payback period'

maintenance costs	**5% of total**	**11% of total**
value of crops	$ 132 886.80	$ 186 041.52
equivalent quantity of maize @ $900 per tonne	148 tonnes	206 tonnes
hectarage@ 1.5 tonnes ha	99 ha	138 ha
equivalent quantity of sorghum at $550 per tonne	242 tonnes	338 tonnes
hectarage @ 1.75 tonnes ha	148 ha	193 ha

Knowing the producer price of maize and sorghum per ton allows us to work out how many tonnes of cereal must be saved to make the fence worthwhile. Knowing the average yield per hectare for the crops in the area meant that it was possible to see how large an area would have to be affected by crop raiding.

The implications for the council are that for the fence to be economically viable it must save annually the equivalent of between 99 and 138 serious incidents where at least a hectare of mature maize has been completely destroyed or between 148 and 193 similar incidents where sorghum was destroyed, depending on the level of council maintenance costs. Large herbivore pests would never inflict this much damage in one community's area. (Refer to the case studies on pages 29, 31, 33 for indices of costs per household protected).

Obviously these figures will vary depending on the payback period the community requires from the fence, the fence maintenance costs, the crops grown, their producer price and the expected yield per hectare. Communities may in fact decide that they need a fence because it also protects themselves from dangerous animals.

Do it yourself:
Cost-benefit analysis of an electric fence

Task 1:
Add together fence clearing and construction costs

Task 2:
Decide over how many years the fence should pay for itself. (The payback period)

Task 3:
Add to the fence total in (1) the annual maintenance bill of 5% and 11% of total (1) for each year during which the fence must pay for itself.

Task 4:
Divide the new total in (3) by the number of years over which the fence must pay for itself (the payback period).

Task 5:
Compare this annual total with the annual damage caused to crops and livestock by problem animals.

Task 6:
If (5) is not possible because PAR data is lacking, find out what crops are grown locally and their producer price.

Task 7:
Divide the annual total cost of the fence during the payback period by the producer price to get the amount of damage to crops equivalent to this figure.

Task 8:
Divide this tonnage by the average yield per hectare for each crop to get the area of crops the fence needs to 'save' to make it viable.

Task 9:
Compare this area with estimates of recent annual local damage to crops.

Other points to consider

- **Donor finance.** The costs to a community may also be lowered considerably if donor finance is made available for the initial capital cost. However in this case councils should remember that at some stage in the future the fence may have to be refurbished using new parts and these costs should be built into any calculations.

- **Livestock losses.** While a similar calculation could be made for livestock, the effect of a fence on predators and its role in reducing livestock losses is not yet clearly understood. It is even possible that a fence might not have a beneficial effect.

- **Maintenance.** Rural District Councils are also responsible for the annual costs of maintaining the electric fence. Depending on the length of fence these costs may reasonably vary between 5% and 11% of the total construction cost. Councils would have to pay for this maintenance out of the revenues generated from safari hunting or other CAMPFIRE activities. They need to know if this is financially possible.

- **Costs.** Comparing fence maintenance costs with revenue expected from CAMPFIRE activities.

Total gross revenue from CAMPFIRE in Tsholotsho = $611 631

Source of $	Levy only	Management	Levy + Management
% of gross	15%	35%	50%
Gross amount	$ 91 745	$ 210 912	$ 305 815
Maintenance			
@ 5% of costs	**$ 132 886.80**	**$ 132 886.80**	**$ 132 886.80**
As a % of gross	**145%**	63%	43%
Maintenance			
@ 11% costs	**$ 186 041.52**	**$ 186 041.52**	**$ 186 041.52**
As a % of gross	**203%**	88%	61%

bold figures = costs exceed revenue

Using the above figures and bearing in mind the annual revenue generated from CAMPFIRE activities in Tsholotsho, a simple cash flow analysis indicates that the RDC would have to retain at least 35% of the gross revenue in order to meet the maintenance costs of the fence. This may prove unacceptable to the community who may wish to use the CAMPFIRE revenue for other purposes. Additionally for the Council it means that so much of the CAMPFIRE management levy of 35% would be used on fence maintenance that there would be little left over to pay for other essential council management activities.

- **Allocating fence costs among wards.** Another factor Rural District Councils need to take into account is how the costs of the fence and its maintenance will be split amongst the different wards. One 'fair' way of allocating maintenance costs which some Districts have used is to split the cost amongst the wards according to the length of fence in each ward. However since wildlife revenue is given to wards according to what they 'produce', this will result in some wards paying more of their wildlife revenue for maintenance than others.

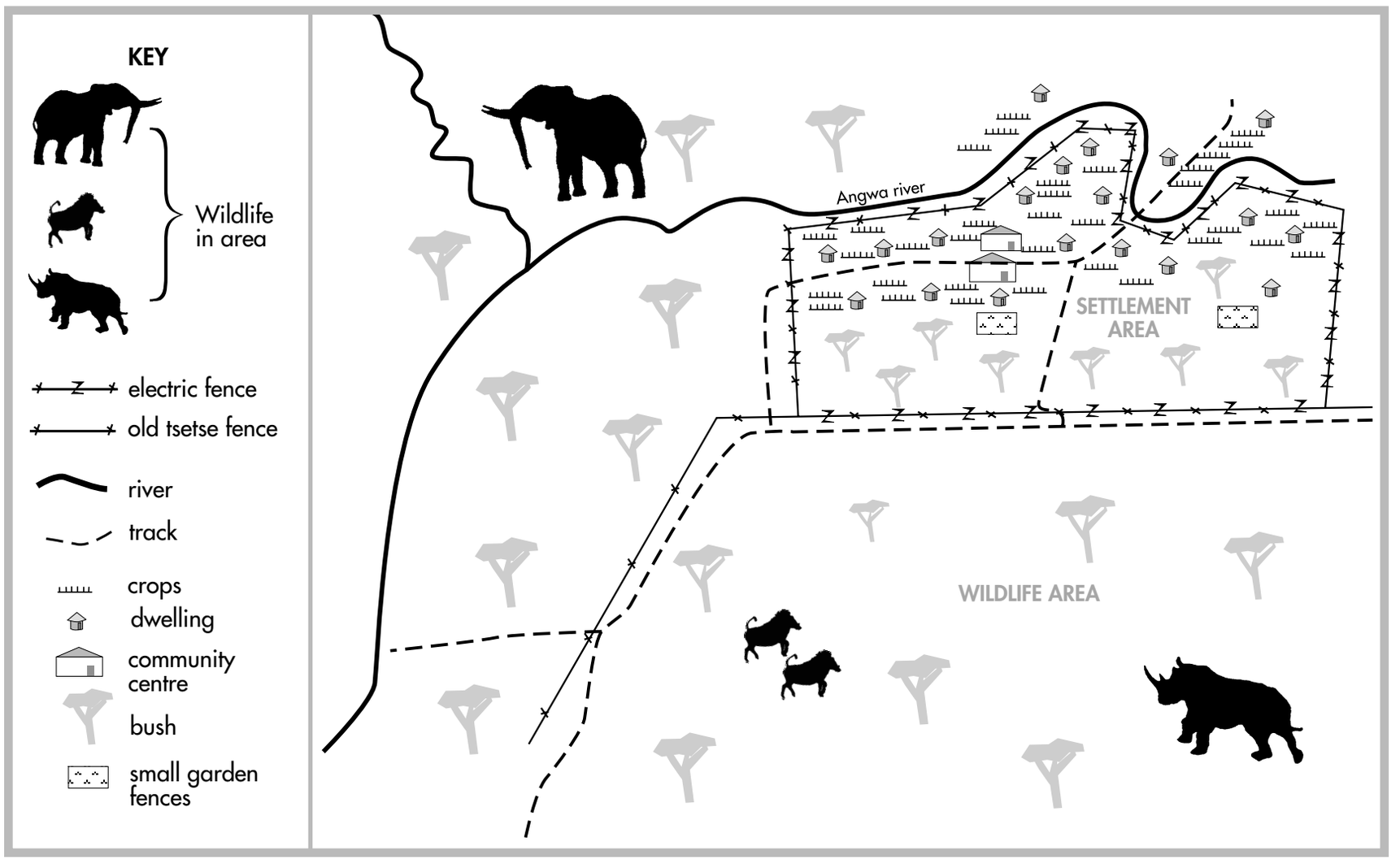
The figures in the table below show how the costs of an electric fence would be divided amongst the four affected wards in Tsholotsho. The analysis shows that all four wards could afford to maintain the fence. However, although the fence would cost householders in ward 1 the most, it would only use up 26% of the revenue. The burden in ward 2 is much heavier and here there may be little money left for householders needs after they have paid for the fence maintenance.

	Ward 1	Ward 2	Ward 3	Ward 4
Length of fence	49kms	37kms	53kms	13kms
Cost of construction	$588 000	$437 000	$629 000	$154 000
Average annual maintenance cost @5% over payback period *	46 828	34 827	49 887	12 236
Annual revenue	179 462	43 333	129 065	44 983
Maintenance as a % of revenue	26%	80%	39%	27%
Number of households in ward	658	950	895	593
Maintenance cost per household per year	$71	$37	$56	$21

* This figure has been calculated as 5% of initial construction costs, rising by 10% every year for 10 years, since it is likely that wages for workers in Zimbabwe will increase by around this annual average during the period. On the other hand, because of fixed quotas and at best only small increases in wildlife, it means that increases in earnings may not be real. That is, increased earning can only be expected from devaluation of the Zimbabwe dollar or perhaps more efficient marketing.

Rural District Councils need to work out carefully where the burden of maintaining the fence will fall, bearing in mind the revenue earned by different wards in previous years and the number of households living in each one. This information should be provided and explained to people in all the wards in order for everyone to understand what the financial impact of building and maintaining a fence will be, before a decision about planning and constructing a fence is made.

The Kanyurira (Masoka) Ward environment showing the settlement and wildlife areas



CASE STUDY 2.
An electric fence in Kanyurira ward, Dande Communal Land, Guruve District

FACTFILE

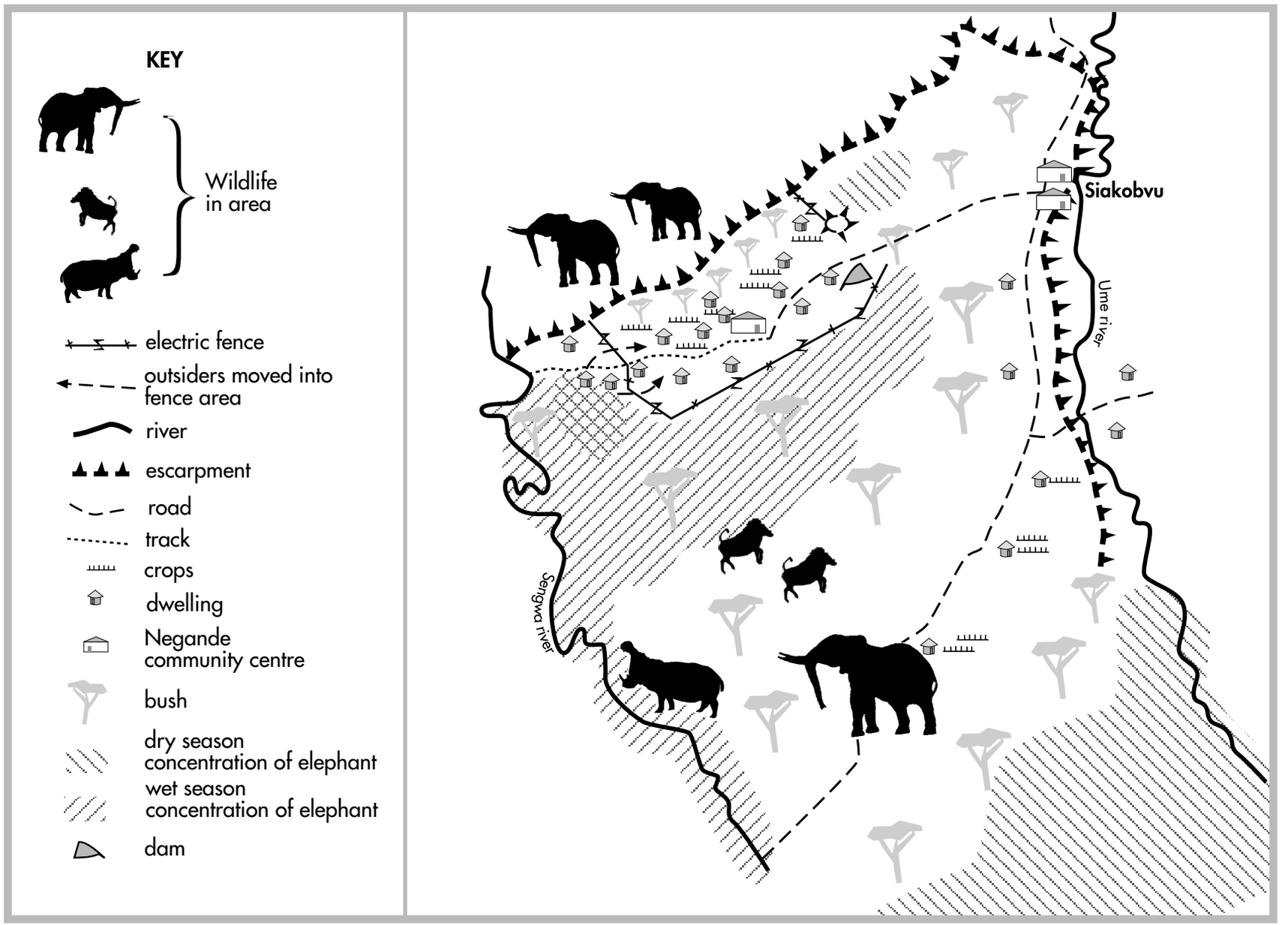
Concept model	3
Description of fence	encircling
Settlement layout	isolated settlement
Target species	Elephant, buffalo
Elephant density	0,4 sq.km in dry season
Fence length	22km
Protected area	25 sq.km
Human population	120 households
Crop raiding history	63 incidents in 1988/89
Design	
wires	5
poles	wooden
height	1.8m
electric	3 in-line positive
Construction formula	private donor grant local labour only
Completed	August 1990
Cost per km fencing	US$ 500
Cost per km protected	US$ 440
Cost per household protected	US$ 91
Maintenance	i) fence guards paid from capital grant ii) community labour for annual clearing

Results

Since the fence was completed, five elephant crop raids have taken place; two in 1991 and three in 1992. Other animal species, for which the fence was not designed, still move freely. Problems which have arisen include the theft of the battery leading to an energiser failure, a lack of monitoring when the voltameter batteries were 'borrowed' and a lack of consistent clearing along the fence in 1991 and 1992 until labour for this was paid for out of wildlife dividends.

Although the fence has acted for much of the time as a partial physical barrier only, it has significantly reduced crop raiding and loss of human life. However the challenge to the fence by elephants has been low, possibly because they are used to the tsetse fences where they were shot (in the past) for breaking fences. In the long term there may be more challenges to the fence especially during times where there is an electricity failure.

Negande community fence showing the general environment, community interests and wildlife concentration areas



CASE STUDY 3.
Negande community fence, Omay Communal Land, Kariba District

FACTFILE

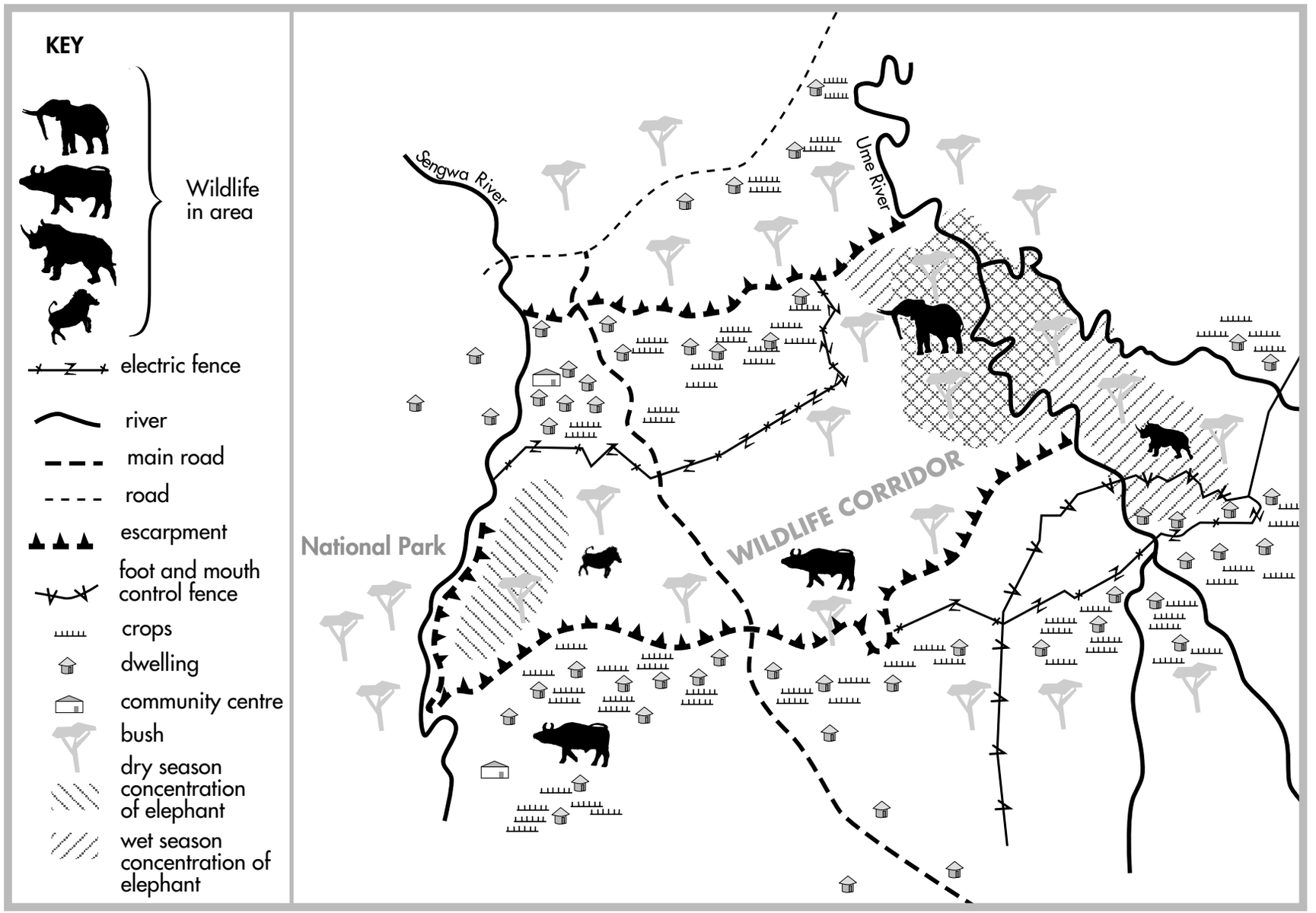
Concept model	3 & 4
Description of fence	partially encircling
Settlement layout	isolated settlement
Target species	Elephant, buffalo,lion
Elephant density	1,7 sq.km in wet season
Fence length	18km
Protected area	44 sq.km
Human population	513 households
Crop raiding history	122 incidents in 1989/90
Design	
wires	7
poles	wooden
height	1.8m
electric	4 in-line +positive
construction formula	NGO grant for construction
	part local labour
completed	September 1991
cost per km	US$ 1185
Cost per km protected	US$ 484
Cost per household protected	US$ 41
Maintenance	no formal strategy

Results

During the first season after completion there were 42 crop raids, a reduction of 65% compared to the previous year. Initially the power supply was discontinuous because of technical problems and the theft of the solar panel. Maintenance problems arose as a result of the responsibilities of those involved in maintenance not being defined or understood and fence guard salaries not being paid. Tools and components for maintenance were not properly organised by the ward wildlife committee and clearing around the fence took place very late.

Had there been normal rainfall in 1991-2 the fence would have been overcome by grass. Nevertheless the fence was effective in reducing crop damage, with most crop raiding taking place around the open end. The closure of this section will decrease crop damage, but may reduce overall cost effectiveness.

North Gokwe community fence showing the people and wildlife distribution



CASE STUDY 4.
Nenyunga and Madzivazvido community fences, North Gokwe Communal Land, Gokwe District.

FACTFILE

Concept model	3,4 & 5
Description of fence	partially encircling
Settlement layout	mosaic
Target species	Elephant, buffalo
Elephant density	0,5 sq.km in wet season
Fence length	30 km
Protected area	88 sq.km
Human population	884 households
Crop raiding history	63 incidents in 1988
Design	
wires	5
poles	steel
height	1.8m
electric	2 offset +positive
completed	May 1992
Cost per km	US$ 1476
Cost per km protected	US$ 503
Cost per household protected	US$ 50
construction formula	District wildlife revenues and donor grant
labour	i) local and contract
Maintenance	fence guards engaged and paid by wards ii) maintenance contract signed between District and wards VIDCO's prepared lists of names for clearance

Results

Some movement occurred through the open sections before they were closed later.
Some settlers did not move voluntarily and were evicted by the council.

Maintenance problems arose as the fence guards employed lived too far from the fence resulting in irregular coverage. The construction of the fence was poor, resulting in intermittent power and breakages in the fence.

CHAPTER 5

CONCLUSIONS

- **Fence projects must consider costs and benefits.**
  Most electric fencing projects have been implemented with little or no financial analysis. This has resulted from either a lack of accurate PAR data or good financial records on the costs of maintenance.

  While a financial analysis can indicate broadly whether a fence is economically justifiable, there may be other disadvantages of living close to wildlife perceived by a community which are not quantifiable and yet may justify its erection.

- **Good management of fences is vital.**
  Results from pilot fencing projects show that their problems are mainly institutional rather than financial, and have to be dealt with according to the circumstances in each district. For example organising maintenance.

- **Fencing works best where wildlife and people live very close to each other.**
  Fencing is the best option for enabling larger concentrations of wildlife to coordinated-exist close to human settlement and farming.

- **All 'stakeholders' in a community must discuss and agree with the fence.**
  During the long period of fence project planning, the best approach may be to aim for a compromise between the opposing objectives of the parties involved: the wildlife orientated ecological advisors, the politically motivated local administrators and the agriculturally affected resident farmers.

- **Fences are only one part of managing problem animals.**
  With increasing immigration of new settlers into areas of 'natural vegetation', conflict between animals, especially elephant and people is increasing. This negative interaction is taking place on a scale which electric fencing has no hope of containing. Nevertheless in those areas where electric fencing is being used as one element of problem animal management, the results are encouraging. Wet season hunting of problem animals, timely payment of dividends from wildlife, landuse planning and zoning are examples of other ways of problem animal management.

Appendix One

EXAMPLE OF TENDER NOTES

MADZIVAZVIDO and CHIREYA COMMUNITY FENCES

General

These notes form the technical basis for the tender advertisement dated 13th June 1992 for the construction and electrification of game fences in the above areas of Gokwe Administrative District. They provide instructions to prospective contractors and form part of a contract which will be signed by the successful contractor and the client, Cheziya Gokwe District Council.

The fencing project is funded jointly by Cheziya Gokwe District Council and Rio Tinto Zimbabwe Ltd. WWF Multispecies Project are providing planning and technical support for the project and any queries relating to technical matters should be referred to WWF.

The fence is in three parts with a fourth as an option to No 3;

1) Construction of seven km of electric fencing as per contract offer 26th December 1991 (Nenyunga and Madzivazvido tender notes). Grid reference PL 553644 to 605661 via 579657 and 588652.
2) Electrification of existing veterinary fence, PL 555625-553644, 2.3kms.
3) Construction of eight km of electric fencing as per 1 above. From 579697 to 650699.

The fences: are "open ended game fences" to control or minimize movement of elephant and buffalo from unsettled areas into the adjacent settlement areas, (see maps 1728 A4, C2 series 1:50 000).

Tender offers should include procurement of relevant materials and equipment, transport to and on site, construction and electrification. The contractor is expected to provide participatory, on site training of local personnel during construction and specific training for selected personnel on completion of the fence with particular reference to electrical fault finding and maintenance.

Design Guidelines

The section constructed from scratch should be a minimum of 1,7 meters high at the top stand. On a single plane there should be 5 strands of which 2 strands should be positive. Standards should be no more than 12 m apart in either steel or wood or combinations of wood and steel.

Electrification will be with solar modules and should deliver a minimum of 6,0 kV under load and stored energy of 4 joules minimum. Section 1 will be electrified from the existing fence.
Positive wires should be "hot, double dipped" 2,4 mm nominal diameter whilst negatives should be normal high tensile 2,25mm nominal diameter.

A 5 meter wide cut line has been made along which all trees and herbaceous vegetation has been cleared (excluding trees of 15 cms diameter).

There will be a requirement for one vehicle gate and 6 pedestrian gates, the position of which will be decided on site.

Specifications/Quality Control: Materials

Contractors should state the specifications, source of supply, origin and dimensions, where applicable of all materials/equipment
listed below:

- wire
- insulators
- standards
- batteries
- droppers (if applicable)
- energizers
- solar panels

Specifications/Quality Control : Construction.

Contractors should submit design details and drawings if applicable under the following headings:

- wire tension (kgs pull), spacing
- corner and straining boxes; design and spacing
- uprights, state dimensions, interval, depth below soil, concrete materials and mix ratio (if applicable)
- insulators; method of attachment; method of attachment of offset brackets, sample to be submitted.
- method of joining wire,(tension and non-tension)
- river crossings; design
- positive wire by-pass at corner posts
- arrangements for mounting solar panel and battery/energizer cabinet
- lightening diverters; position and design
- earth pegs; interval, depth and material
- gate installation; design

Subcontracts

Single sub-contract for construction of the fence may be permitted but this does not obviate any responsibility expressed or implied for the proper construction and correct function or efficiency of the fence. Candidates should state the name of the organisation, company or individual with whom a sub-contract will be made and the capacity of the sub-contractor to undertake the subcontract. The cost of the sub-contract should be stated under a single combined application.

Date
Construction is to begin within 2 months of-the award of the contract to be terminated within 3 months of the start date. Failure to complete the tender will incur a penalty at a rate of 2% of the value of the contract for each week after the due date.

Post Construction Support
An award of the contract includes a service, for a period of 6 months after the completion of fence during which the contractor undertakes to rectify technical defects. A technical defect is defined as:-

i) A defect~not caused by any animal or vegetation touching the wire(s), but caused by a construction defect or fault.

ii) A voltage decrease of more than 20% of the factory stated output of the energizer measured at the energizer or end point of the fence not caused by failure of the power supply units or due to short circuit caused by animals or vegetation. Technical defects must be rectified within a reasonable period of time or two weeks at the most after being notified by the client. Contractors should state their domicile or that of their agent to be responsible for the support service and their intended method of providing this service.

Labour
One half of the labour will be provided from locally employed labour. Quotations should therefore exclude this cost but include the cost of the balance of labour and their supervisory and specialized staff. The contractor will be responsible for food and shelter for all staff. Engagement of community labour does not negate responsibility for the good construction of the fence and supervision therefore remains the responsibility of the contractor. Details of labour contractual requirements can be found in statutory instrument (currently SI 1993 16/85).

Equipment
Applicants should state the mechanical equipment "vehicles" available to them for construction of the fence.

Tenders
Tenders should be offered as a "Fixed offer" to account for price increases which may arise after tender submissions and the award of the contract. Tenders will be awarded within 30 days of the closing date.
Note: Some funding agencies such as USAID have specific tendering and contract requirements. These should be referred to early in the process of tendering.

Costing

Applicants should submit their costing under the following subheadings.

1. Transportation
2. Materials (itemized)
3. Labour
4. Post Construction support service
5. Other

Terms of Payment

30% of total cost on signature of contract. 30% of total cost on completion of first section on 12.8 km including electrification

25% of total cost on completion of fencing including electrification.

15% of total cost on completion on satisfactory 6 month support service period.

Notes:

i) Payment can only be effected once inspection of the part-finished fence is made. This should not take place any longer than seven days after completion or part completion.
ii) See above comments relating to specific donor requirements.

Sealed tenders marked "Gokwe Fence Tender. Not to be opened " should reach;

Cheziya Gokwe District Council,
P.BAG 6054,
Gokwe.

by not later than 30the July 1992.

This booklet is the second in a series of guides on Wildlife Management and examines in detail the different ways in which electric fencing projects can be planned and implemented. It provides background information and guidance to Rural District Councils and NGOs and should be read along with the other booklets in this series. These booklets are linked to training programmes being undertaken by members of the CAMPFIRE Collaborative Group.

Booklets in the Wildlife Management series include:

1. Problem Animal Reporting
2. Electric Fencing Projects
3. Marketing Wildlife
4. Safari Hunting
5. Quota Setting Manual

WWF is a member of the Collaborative Group supporting the CAMPFIRE programme in Zimbabwe and has provided support and training to communities in the establishment of wildlife management systems.