



**MAINTAINING**

**ELECTRIC**

**FENCES**

**WILDLIFE MANAGEMENT SERIES**





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**ELECTRIC**

**FENCES**

These guideline booklets are based on field experience and original research reports which are available from the WWF Southern Africa Regional Programme Office (SARPO) 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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A well maintained electric fence in Kanyurira Ward, Guruve District.



### **Background to problem animal management**

Under the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) rural communities participate and benefit from the management of their wildlife and other natural resources.

As one of the benefits from CAMPFIRE, people expect a reduction in the damage to crops, livestock and property by wildlife. Before CAMPFIRE, the Department of National Parks and Wildlife Management (DNPWLM) was responsible for controlling problem animals in the communal areas. They used to shoot one or two animals to scare the others away. Generally this was not very effective and the same herd of animals or another herd would return within a short time.

With CAMPFIRE, greater responsibility to deal with problem animals has been passed on to local communities and rural district councils (RDC's). Because both the RDC's and the producer communities benefit from wildlife, killing problem animals can mean a loss of revenue. Problem Animal Management (PAM) rather than Problem Animal Control (PAC) which involves killing animals, can reduce the amount of crop raiding, as well as bring more revenue to producer communities. Sixteen PAM options for wildlife producer communities are described in the Problem Animal Reporting Manual (WWF Wildlife Management Series Number 1).

A combination of these options can be used to develop an effective problem animal management policy. Using electric fences is one of the most important of these management options for reducing conflict between people and wild animals. Fences also form part of land use planning for wildlife because wildlife producer communities need to make choices about boundaries for wildlife and human settlement.

While the Electric Fencing Projects manual (WWF Wildlife Management Series Number 2) gives details on how to design and plan the construction of an electric fence, the objective of this manual is to provide guidance to people in maintaining a fence once it has been erected.

This manual is divided into four chapters. The first chapter looks at how electric fences and their main components work. The second chapter gives technical guidelines to electric fence maintenance. Chapters three and four consider the organization and planning required to maintain an electric fence. The appendices give several checklists, examples of monitoring forms and useful addresses and contacts for people involved in the maintenance of electric fences.

### **How are electric fences different to ordinary fences?**

In the past, fences were built as physical barriers to prevent the movement of animals. The aim was to build them so that they could not be pushed over by elephants and buffalo. However, in most cases this was not possible.

An electric fence is different. It works by giving animals which touch it an electric shock. This acts as a deterrent to animals which are trying to cross the fence line or push it over. When the fences are well maintained they can be very effective in stopping the movement of large problem animals such as elephant and buffalo. The design of the fence will determine whether it also controls the movement of smaller animals. Generally electric fences do not control predators, monkeys, baboons and birds, all of which can cause problems for farmers.

### **What electric fence models are there?**

There are several different options of using electric fences from which communities can choose according to their needs. These are:

**Model 1:** an irrigated scheme enclosure with only the irrigated fields enclosed,

**Model 2:** fences of 1-6 km are arranged to enclose the dwelling and cultivation plots of one or a few families,

**Model 3:** a fence of a perimeter of 15-20 km is arranged to make an extensive complete enclosure placing fields, grazing lands and homesteads inside the fence,

**Model 4:** an extensive and open-ended fence up to 30km is used to deflect wild animals where they are known to be concentrated,

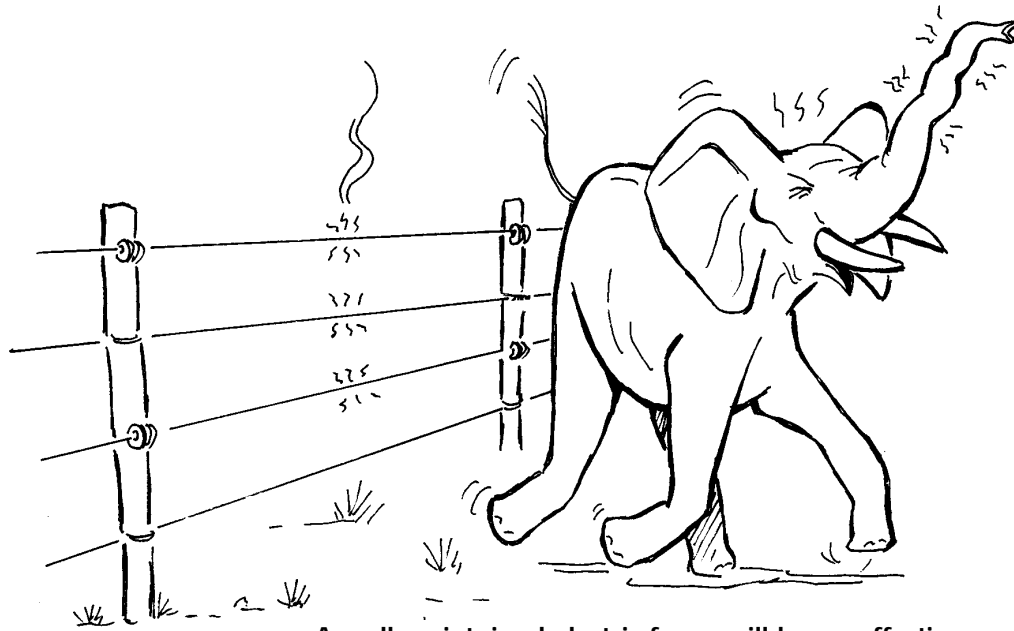
**Model 5:** a simple fence encircles one or more fields

**Model 6:** a small well placed fence to act as a barrier for some known species with restricted movements.

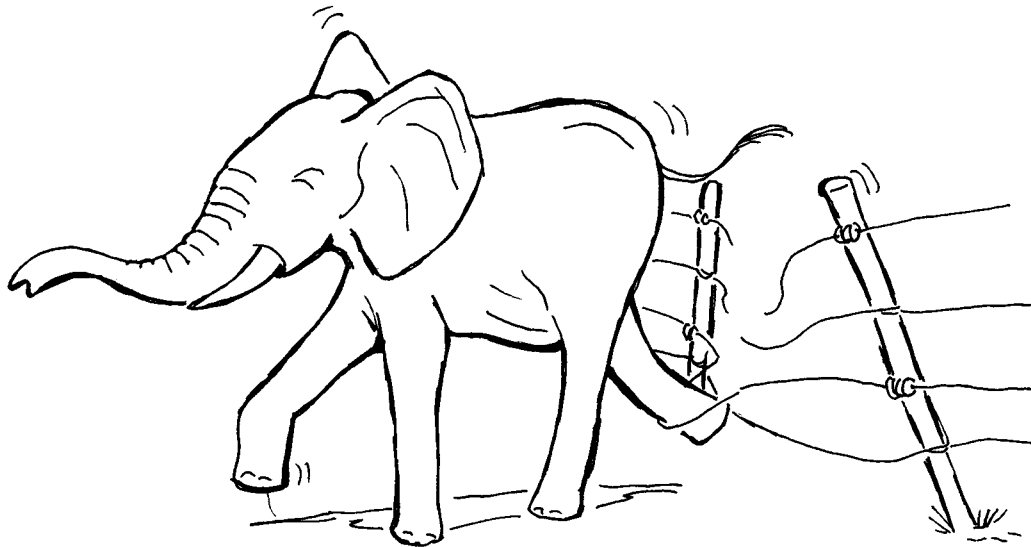
When considering which model of fence to build it is important to consult with the community at large, investigate the problem thoroughly and then consider all the costs and benefits of the different options. These are covered in more detail in the Electric Fencing Projects manual (WWF Wildlife Management Series Number 2).

### **Why is it important to maintain an electric fence?**

If properly maintained, electric fences are very effective in preventing the movement of wildlife. Poor maintenance of an electric fence means that wildlife will challenge the fence more often, causing more breaks and damage. This will reduce the fence's effectiveness and increase overall maintenance costs.



**A well maintained electric fence will be an effective barrier to elephant and other wild animals.**



**A poorly maintained electric fence will not be an effective barrier to elephant and other wild animals.**

Electric fences are effective because they give an animal a shock. If the fence is well maintained, animals will always receive a shock when they touch it. This will condition them not to challenge the fence. If the fence is not always working properly, the animals will not become conditioned and will continue to break in and out of the fence since it is acting only as a weak physical barrier.

#### **Who is responsible for fence maintenance?**

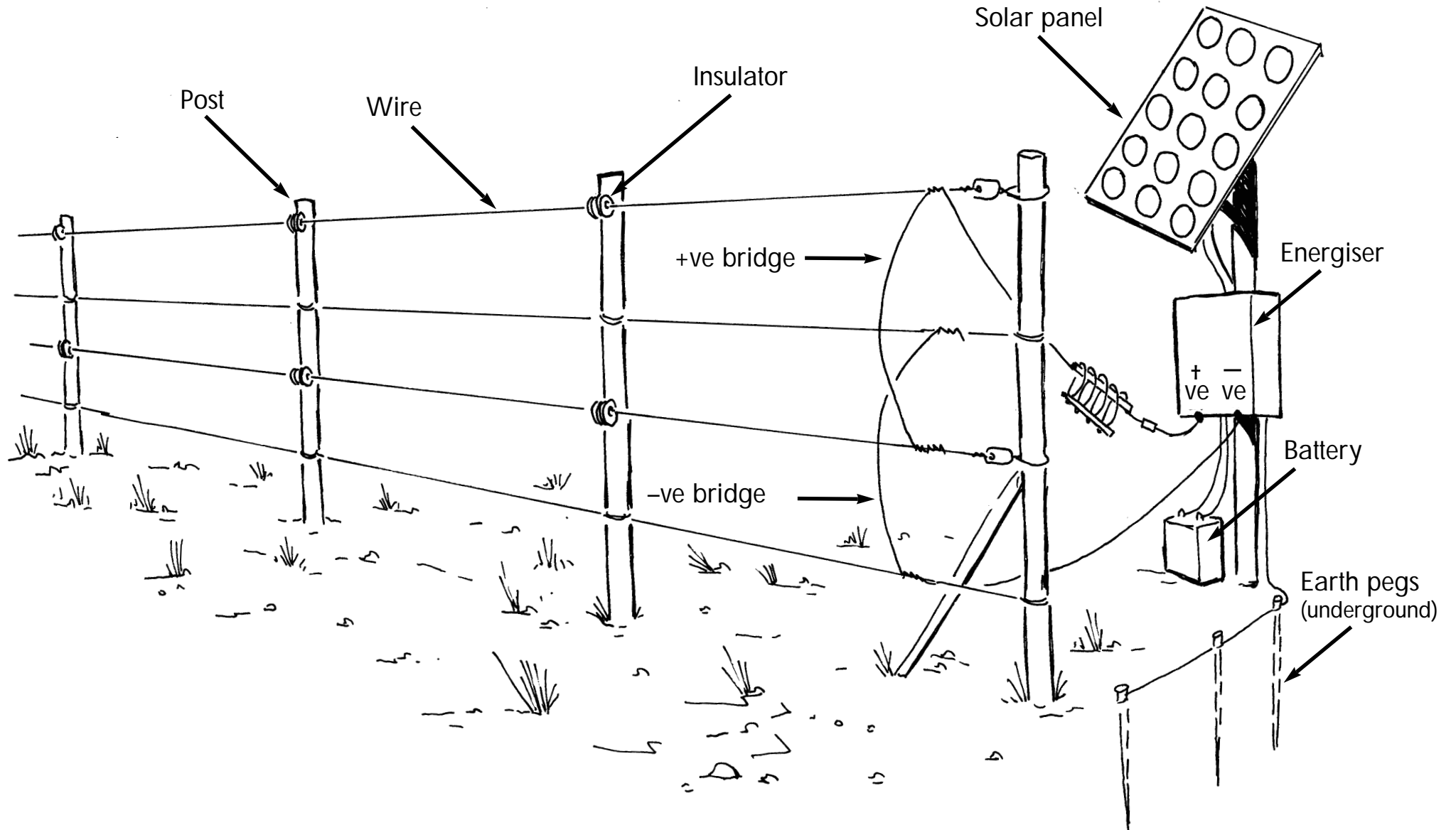
Before an electric fence is built the different stakeholders involved (rural district council, community, safari operators) need to agree on who will own the fence and who will be responsible for its maintenance. If it is to be managed by more than one stakeholder the roles and responsibilities of each stakeholder must be clearly defined. These include:

- who is going to check the fence,
- who is going to purchase replacement parts and
- who will pay for the labour and maintenance costs.

Most maintenance problems of electric fences occur because these basic responsibilities have not been resolved. Planning therefore is an important part of effective electric fence maintenance.



**AN ELECTRIC FENCE**  
showing all the major components



### What are the parts of an electric fence and how do they work together?

An electric fence has many parts which link to form three basic systems enabling it to work. These systems are:

- the power supply,
- the earth system and
- the fence itself.

For good maintenance it is important for you to understand what each of the systems does and how it contributes to the overall functioning of the fence.

#### 1 The power supply system

The electricity running through the fence to make it an 'electric fence' has a source. The source is the sun. The solar panel, battery and energiser work together to convert sunlight rays into electricity in the fence. The power supply system consists of:

- **The solar panel:** This converts sunlight into electricity.
- **The battery:** This stores electricity from the solar panel which is automatically released when it is cloudy and at night when there is low or no power from the solar panel.

- **The energiser:** This powers the fence by changing the electricity (12 volts) from the solar panel or battery into stronger pulses of 6,000 volts or more which is used to electrify the fence.
- **The lightning choke:** This prevents the energiser being damaged by lightning. Sometimes there is also a large fuse next to the choke. This also helps protect the energiser.

#### 2 The earth system

The purpose of an earth system is to ensure that when an animal touches the fence the electric current flows from the fence through the animal into the ground. This gives the animal a shock. If the electricity cannot flow through the animal into the ground the fence will not give the animal a shock. The standard earthing system consists of:

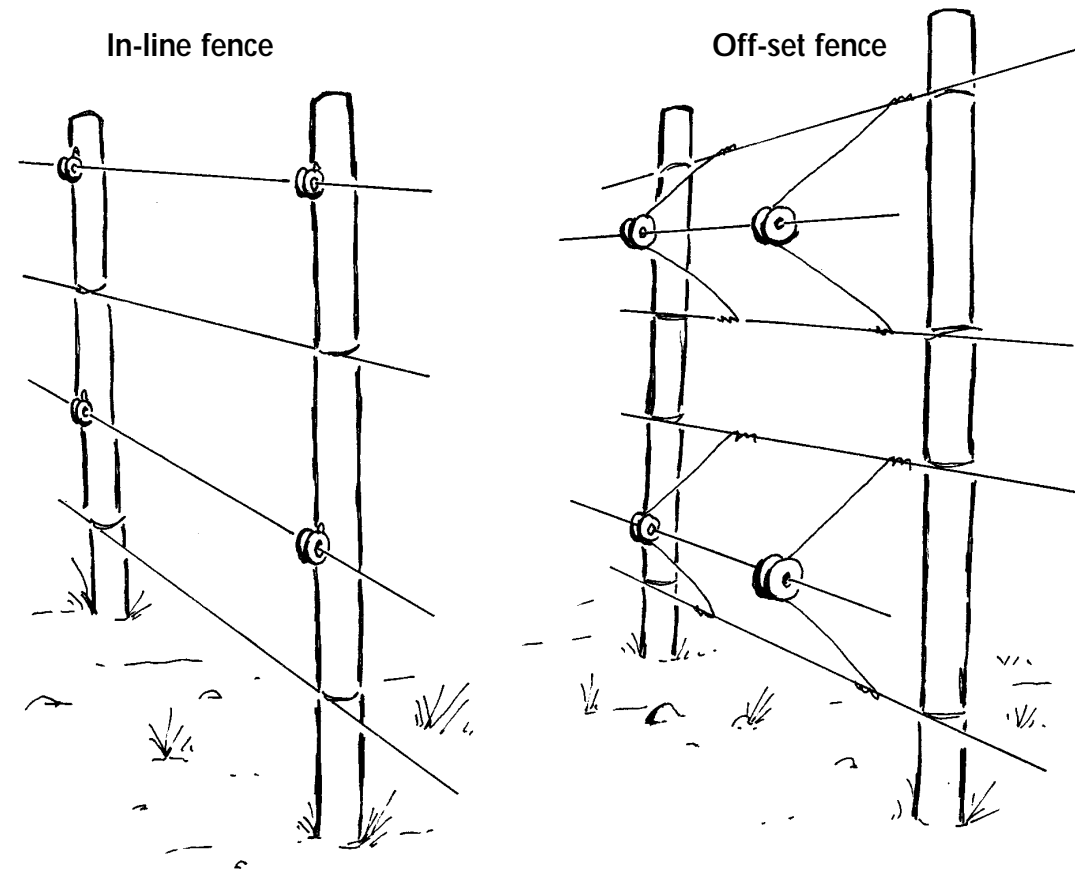
- **Metal conductors:** These usually consists of three or more 1.5 metre long pieces of metal pipe (called 'conductors' because electricity passes easily through them) buried close to the energiser.
- **Earth Pegs:** In addition other earth 'pegs' are buried at regular intervals along the fence to ensure that there is good contact with the ground. These are usually placed in depressions like river crossings and /or in moist places

because water is an extremely good conductor of electricity. Sometimes they are buried with a mixture of salt and clay, to attract and retain moisture.

### 3 The fence system

The last system is the fence itself. Its purpose is to carry electricity and provide a barrier to stop animal movement. The fence system consists of:

- **Posts:** These are the poles which support the wire. They can be made from treated gum poles, metal poles or locally cut timber.
- **Straining posts or corner posts:** These are stronger posts from which the wire is strained. They are also found where the fence changes direction. On a straight section the straining posts are normally about 400 to 500 metres apart.
- **Wire:** The wire carries the electricity and also forms a barrier. In most electric fences the wire is made from high tensile galvanised steel. The galvanising stops the wire from rusting. High tensile steel is used because it does not stretch. A fence designed to stop the movement of large species such as elephant and buffalo will normally have eight strands of wire. There are two basic designs of electric fence. These are in-line and off-set fences.



- **in line fences** which have both the positive and negative wire attached to the fence posts. An animal will get a shock by touching the positive wire.
- **off-set fences** have brackets holding the positive wire away from the main fence. An animal will get a shock by touching either the positive and negative wires at the same time, or by touching the positive wire only. These fences should only be used in flat areas.

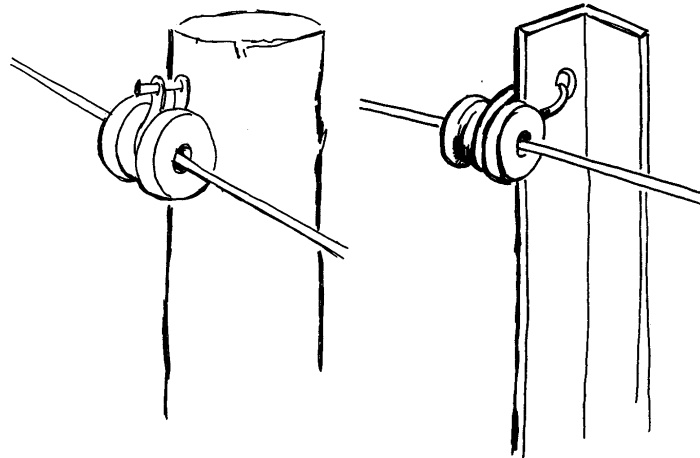
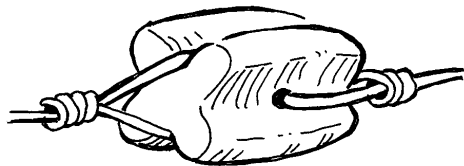
- **Insulators:** These are used to prevent the wires which carry electricity from touching the posts as this would cause a loss of electricity from the fence. There are two kinds of insulators used on an electric fence.
  - positive insulators which are attached to fence posts with a wire that runs through the centre.
  - straining insulators which are used at corner or straining posts. Because these are being pulled by the wire, they are more likely to break or crack than the insulators on the posts.

**Hint:** If an insulator is broken and there are no spare insulators available, a temporary insulator can be made from an old tyre.

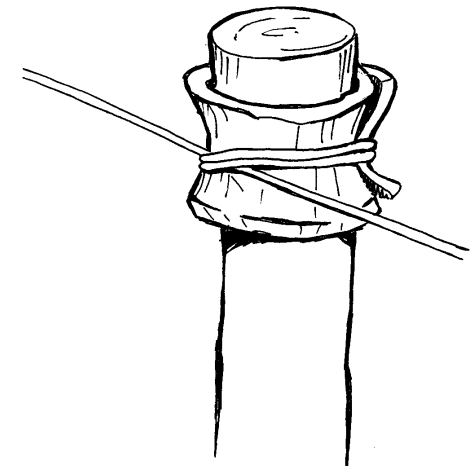
- **Gates:** Allows people, livestock and vehicles to move from one side of the fence to the other. At the gate an insulated cable buried underground carries the electricity from one side of the gate to the other.
- **Offset Brackets:** Offsets brackets are used to hold the positive wire from the main fence. As a result animals get a shock before they touch the main fence.

Two kinds of post insulators

Straining insulator



Temporary post insulator made from an old tyre



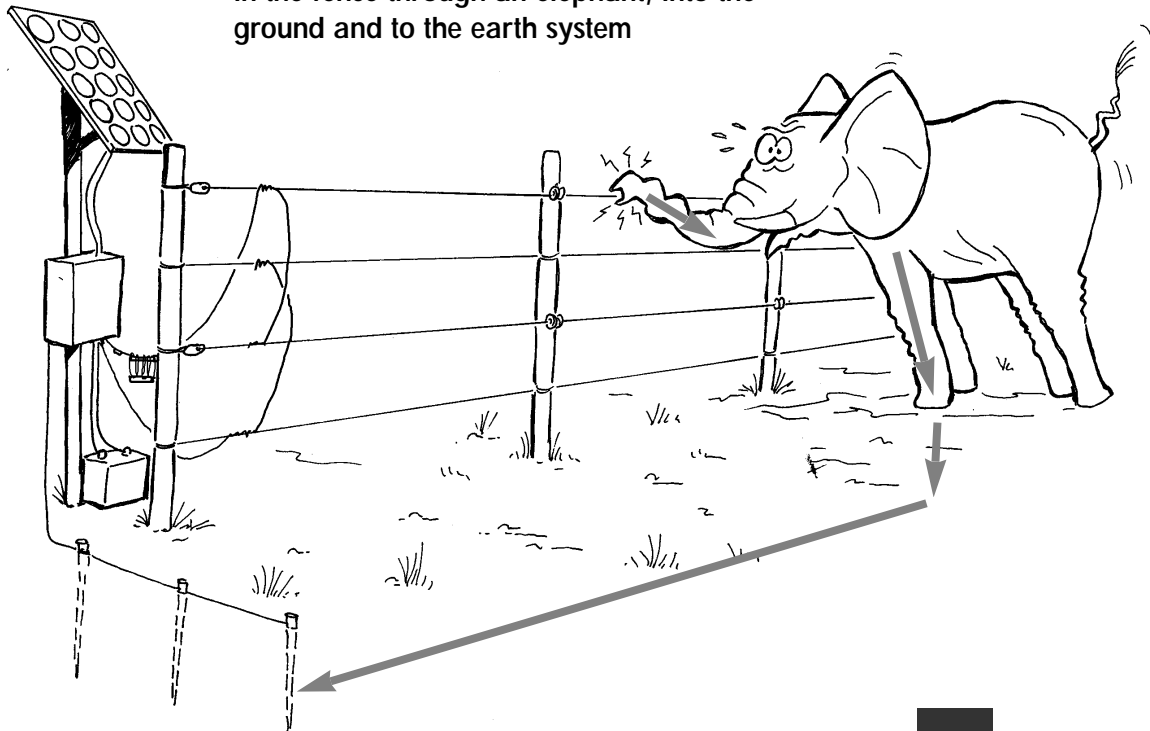


### How does an electric fence work?

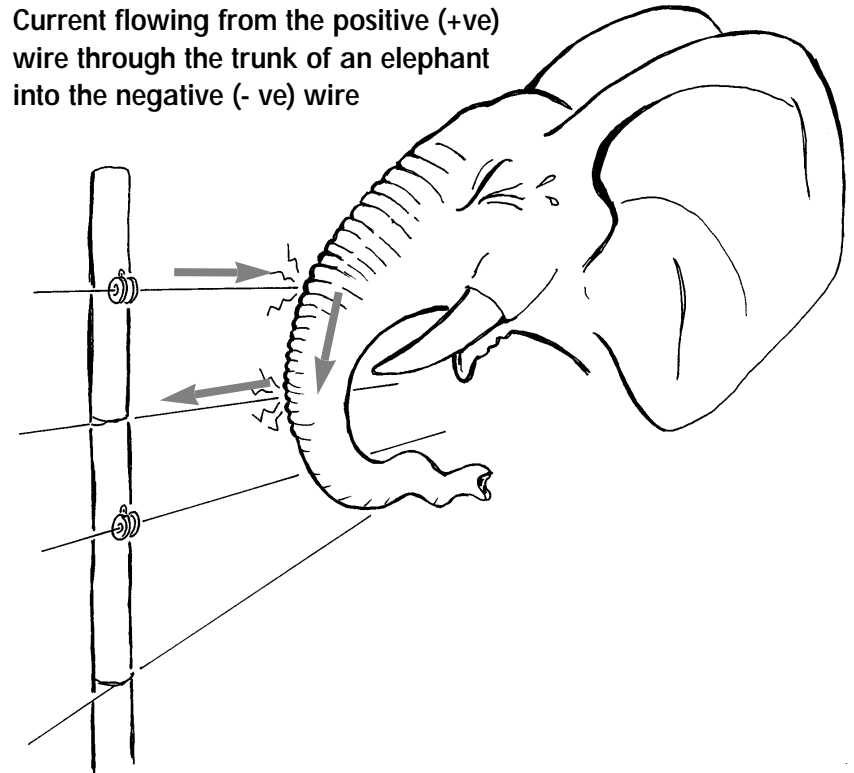
The solar panel converts sunlight into electricity. The electricity is stored in a battery and released by the energiser in pulses of 6,000 volts into the fence. When an animal touches the positive or live wire of the fence it becomes part of the electric circuit and receives a shock. The size of the shock depends on the amount of electricity in the fence and how

much current flows through the animal. If an animal touches the positive and negative wire on the fence, this will form a good circuit and the animal will get a big shock. If the animal only touches the positive wire, the circuit must be completed through the ground to the earth system. The moisture in the ground and the distance of the animal from the earth pegs will determine how big a shock they receive.

Current flowing from the positive (+ve) wire in the fence through an elephant, into the ground and to the earth system



Current flowing from the positive (+ve) wire through the trunk of an elephant into the negative (-ve) wire

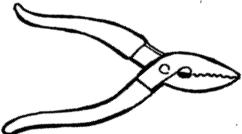

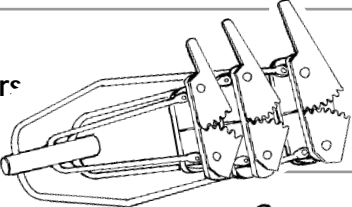
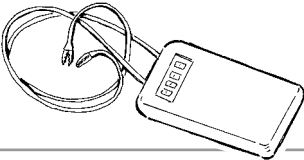


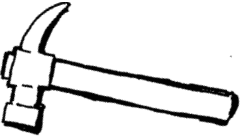
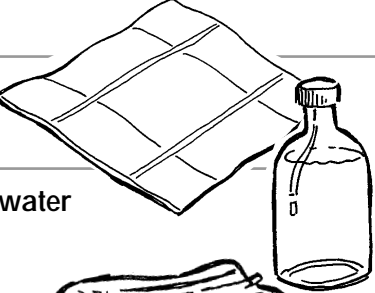
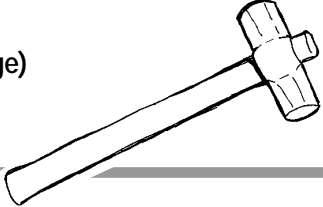



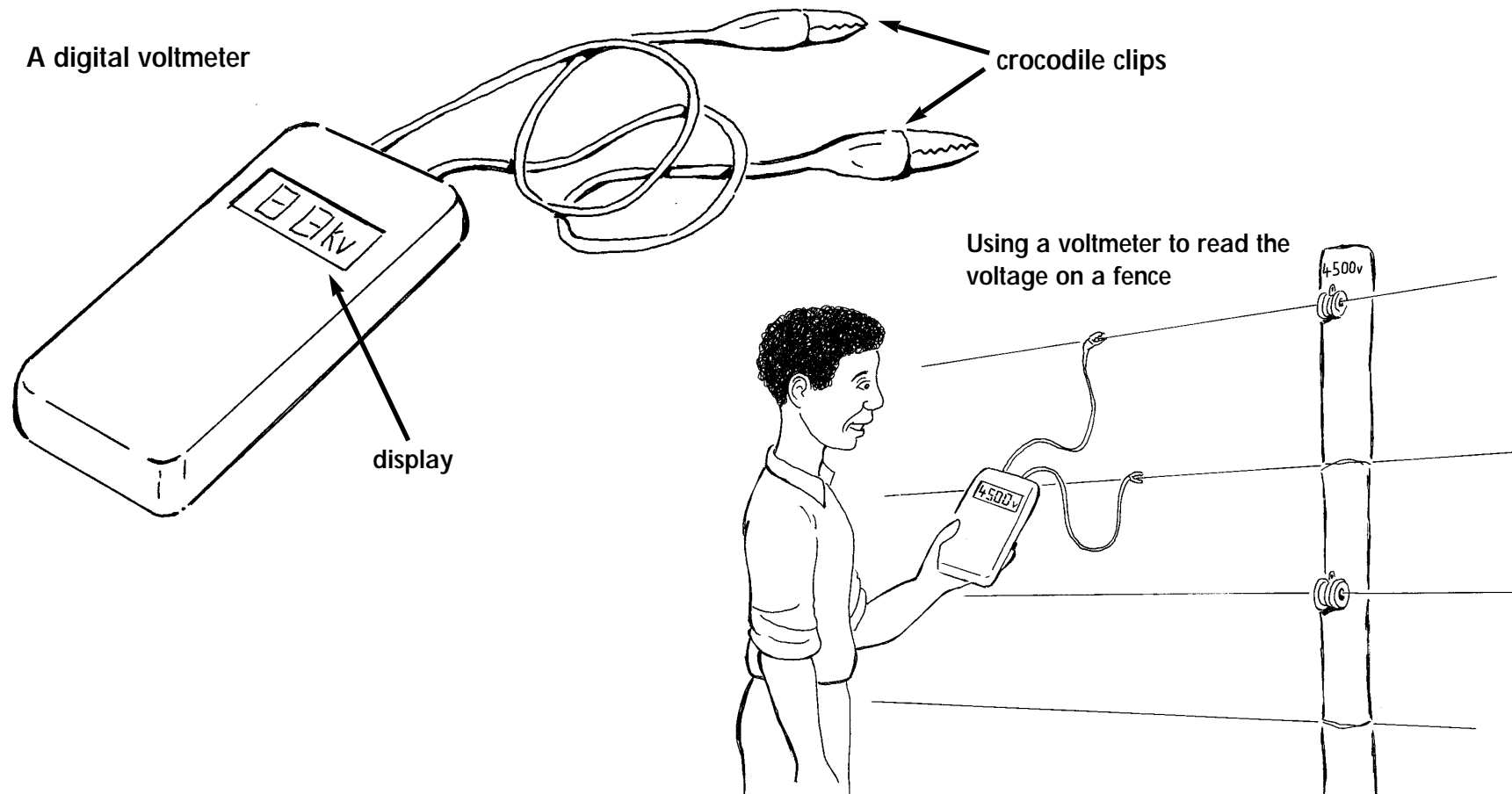
## TECHNICAL GUIDELINES FOR FENCE MAINTENANCE

### What tools are required to maintain an electric fence?

To properly maintain an electric fence, the right tools are needed. These are:

**Note:** If fence monitors are working in teams, each team should have a complete set of tools and equipment necessary for them to carry out their work effectively.

TOOL	PICTURE	USE	TOOL	PICTURE	USE
pinchers/pliers		cutting and tying wire	hoe		clearing grass and weeds along the fence line
wire strainers		pulling wire	voltmeter		measuring the voltage in the fence
axe		removing small branches and trees touching the fence	crowbar		digging holes to replace damaged fence posts
claw hammer (small)		fixing insulators to posts and pulling out nails	cloth		cleaning the solar panel
hammer (large)		heavy work such as knocking in earth pegs	distilled water		keeping the proper level of water in the battery
			Tool bag		to carry all the above tools



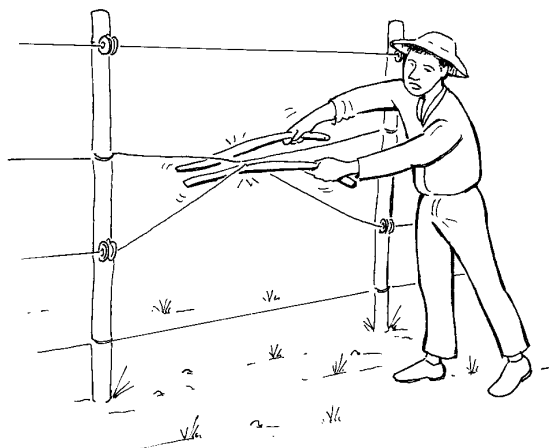
**The Voltmeter:** Most people are familiar with all the tools needed for maintenance except the voltmeter. A voltmeter measures the 'voltage' in the fence. The voltage is a measure of the amount of electricity in the electric fence. The voltmeter is used to check that a fence is working and to assist the fence minders to find faults. To measure the amount of electricity in the fence the red lead of the voltmeter should be connected to the positive or live wire of the fence and the black lead to the

negative wire. The voltage can then be read off the digital display.

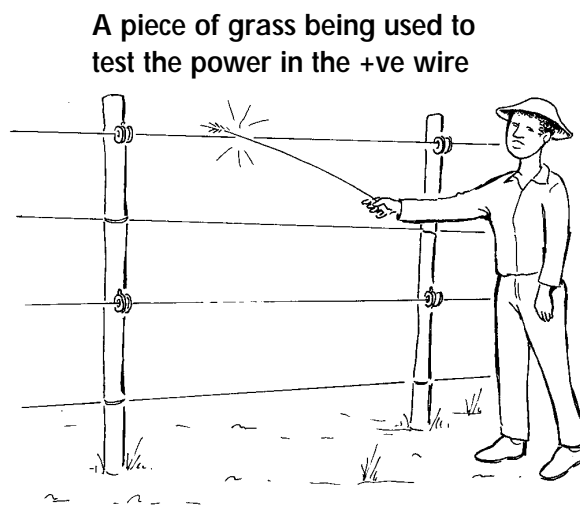
The voltmeter needs a battery to work properly. Fence workers should keep at least one spare voltmeter battery. They should remember that the voltmeter is their most important tool to find out if the fence is working properly. Since it is a sensitive instrument, it should be treated with care at all times.

**Hint:** If a working voltmeter is not available, fence workers can:

- push the positive and negative wires together and watch for the spark. A strong spark means that the fence is working. This will not damage the fence if done carefully. Remember to use dry sticks.
- take a piece of wet grass and touch the positive wire. If the fence is working, the person will feel a tingling in their fingers.



**Fence worker pushing two wires together to get a big spark**



**A piece of grass being used to test the power in the +ve wire**

**Note:** These methods can help the fence worker, but do not replace the need for a working voltmeter.

**How should the power supply and earth system be maintained?**

### 1. The power supply system

The power supply system provides the electricity which makes the fence effective against animals. It consists of:

**The solar panel:** This should be kept clean to ensure maximum conversion of sunlight into electricity. If undamaged, a solar panel should work for many years. However the theft of solar panels is a major problem in all communal lands. It is recommended that solar panels and the power supply should, if possible be positioned at or near a house to discourage thieves. Always make sure that the replacement solar panel is the correct type.

**Electrical connections:** The connections between:

- the solar panel and the battery,
- the battery and the energiser,
- the energiser and the fence, and
- the fence and the earthing system must be kept clean and tight.

**The battery:** The correct level of distilled water must be maintained in the battery. Try to use distilled water obtained from a garage. Always store the water in a clean glass or plastic container. If ordinary water is added to the battery it will eventually lose its capacity to store electricity and the fence will not work.



A clean plastic bucket being used to collect rain water and then being tipped into a clean plastic bottle



**Hint:** If distilled water is not available, boiled water or rain water collected in a clean glass or plastic container can be used.

A well-maintained battery will last for between 18 and 24 months before it needs to be replaced. New batteries should be purchased from reputable dealers and should be covered by a guarantee. Second hand and old batteries should not be used as these will not be effective.

**The energiser:** The energiser should be kept dry, clean and safe. Energisers do occasionally fail. Fence workers should not attempt to repair an energiser but should instead send it to one of the electric fencing companies listed at the back of the manual. It is a good idea to keep a spare energiser so that if one does fail it can be replaced with the spare while the original is sent for repair.

The recommended maintenance schedule for the power supply and earth systems

COMPONENT	ACTION	Daily	Weekly
Solar panel	Clean		•
All electrical connections	Clean and tighten	•	
Battery water	Check level		•
Battery terminals	Clean and tighten		•
Energiser pulse rate	Check speed of "clicks" (2 per second)	•	

### How should the fence be maintained?

The fence forms the barrier which stops the movement of wild animals. Its effectiveness depends on the flow of electricity. Therefore maintaining the correct voltage in the fence is essential.

**Isolating part of the fence:** Sometimes fence minders are required to correct a fault on a part of a fence which is at full power. To do this, without getting a shock, the fence minders must isolate that part of the fence that they wish to work on. This is usually done by placing a wire or other metal object across all the positive wires and at least one negative wire or using cut out switches.

**Grass, weeds and trees:** To be effective the area under the fence must be kept free of grass and weeds. Branches and other vegetation which are near the fence or touching the fence must be removed. If the fence is not kept free of vegetation, electricity will be lost into the ground and the fence will not be effective.

**Broken or cracked insulators:** These cause electricity to be lost through the fencing posts to the ground, especially in the rains. On a long fence cracked insulators can result in a big voltage loss. Cracked insulators should be replaced.

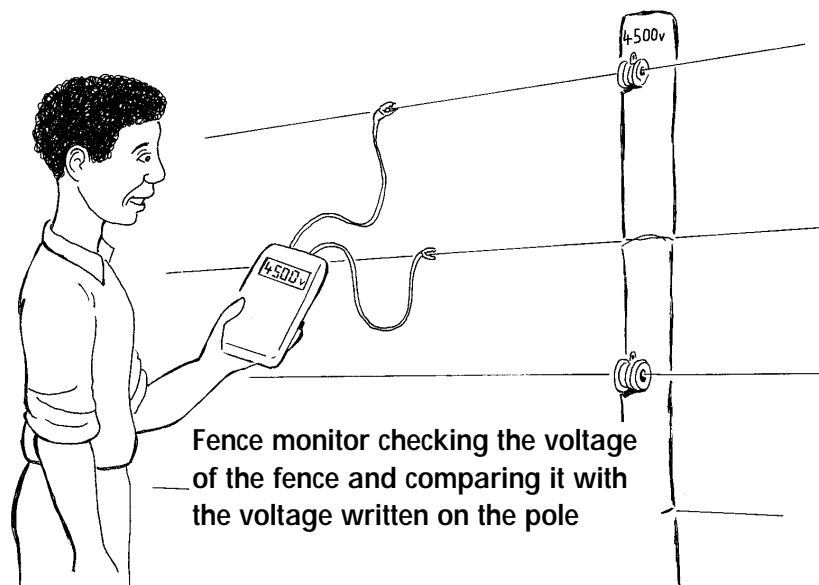
**Wire spacing:** The correct wire spacing must be maintained. If the positive and negative wires touch for any reason there will be a loss of electricity and the fence will not be effective. The fence can be damaged and the wire spacing can be changed by contact with animals, people or by the weather. Small changes to wire spacing can be done by moving insulators. Sometimes when the wires in the fence are no longer tight, they will need to be re-strained. This should be done from the corner or straining posts.

**Broken and weak posts:** Fence posts which are broken or weak should be replaced immediately so that the correct wire spacing is maintained. In older fences the wooden posts may be weakened by termites so that they break easily when the fence is challenged by elephants or buffalo.

The recommended maintenance schedule for the fence				
COMPONENTS	ACTIONS	Daily	Weekly	Monthly
Wire	Check spacing	•		
Vegetation	Clear vegetation		•	
Insulators	Check for broken and cracked insulators	•		
Posts	Check for weak or broken posts			•

### How do I find a fault in an electric fence?

In addition to regularly checking the components of an electric fence, fence workers need to check the performance of the fence. This normally involves measuring the voltage of the fence at known points and comparing the daily results with what the voltage should be. The following section provides a guide to fence workers on how to check the performance of the fence and how to find the problems that are causing the low voltage.



### How do I check a fence for its performance?

The voltage of each fence is different and changes slightly along the fence. When a fence has been built the fence workers should decide on a number of points at which the voltage is regularly measured. The voltage of the fence at these known points can then be used to indicate the normal fence voltage. It is useful to mark the regular measuring points and the expected voltage on the fence. Two points which the fence workers must always use are the beginning (next to the energiser) and the end (the furthest point from the energiser). However each fence is different and its length, design and shape affect how the fence workers choose to monitor its performance.

All faults result in a 'leak' which means that there is a loss of electricity and voltage in the fence. This may be a complete or partial loss. If it is a complete loss, the fence beyond the fault will have no electricity and there will be zero voltage at the next measuring point. If it is a partial loss, the measuring point after the fault will have a low voltage.

### Voltage guidelines

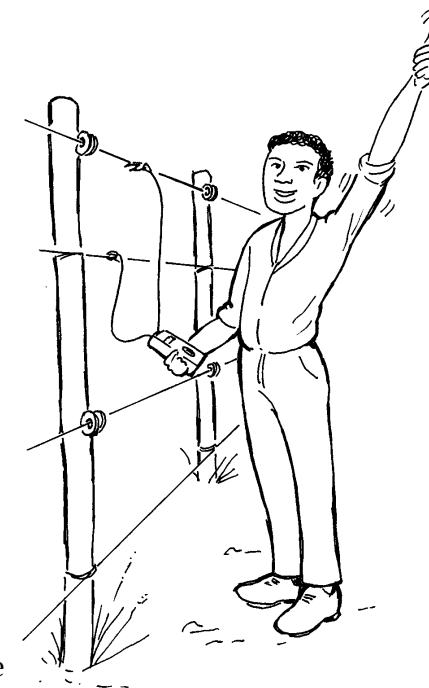
5,000 volts or more	— good fence
3,000 - 5,000 volts	— reasonable fence
under 3,0000 volts	— poor fence
no voltage	— useless fence

### The two different approaches to measuring the performance are:

- **beginning at the end of the fence**

Check the voltage at the end of the fence or the end of a section. If the voltage at the end is normal then the fence worker can be sure that there are no faults between the end and the energiser. The advantage of this method is that the fence worker needs only to take one voltage measurement to determine whether there are any faults.

If the voltage is low at the end of the fence then the maintenance team should then work towards the energiser measuring voltages at regular intervals where they know the normal voltage or at intervals of between 500 or 1,000 metres. Walking along the fence towards the energiser they might actually see the problem: for example a broken wire or a tree which has fallen on the fence. If they see no problem, then they will know that they have passed the fault when the voltage begins to increase again. They must then walk back along the fence measuring the voltage at smaller intervals (50m ) until they identify the problem. If they reach the energiser and the voltage is still zero or low, then the fault is in the power supply system.



An intact working fuse and a blown fuse



- **beginning at the start of the fence**

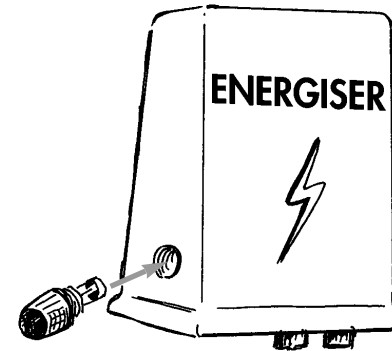
Start by testing the voltage at the beginning of the fence or the section. If it is below normal there is a problem ahead or at the power supply. Start by disconnecting the power supply system from the fence and checking the voltage without the fence. If the voltage is low when the fence is disconnected then the problem is with the power supply. If the voltage from the energiser is normal then reconnect it. Then start walking along the fence checking the voltage at the known points and looking for obvious problems.

The problem along the fence can be identified by walking along the fence line checking the voltage at intervals. The amount of voltage loss at the energiser gives an immediate indication of how large the leak is.

### How do I find a fault in the power supply system

Finding faults in the power supply system is not always easy as they are generally not obvious. It is often easier to find a fault if the fence workers have access to another battery and energiser. This will allow them to replace these components and find the fault much quicker. There are a number of indicators of faults in the power supply system including:

- **The energiser pulse rate:** When the energiser sends a pulse of electricity along the fence it clicks. In a properly functioning electric fence the energiser will click rapidly (approximately 2 times per second). The speed at which the energiser clicks is an indication of whether there is a fault in the power supply systems and/or with the fence.



Energiser showing location of fuse

If the energiser is clicking slowly, it should be disconnected from the fence. If the clicking returns to normal then the fault is in the fence. If it remains slow then there is a problem with the power supply system. The fence workers should start by checking, cleaning and tightening all the connections between the solar panel, battery and energiser. If the pulse rate is still slow then there is a problem with either the solar panel, the battery or the energiser. The first thing that the fence worker must check is the fuse in the energiser. The fuse protects other parts of the energiser from being damaged. Most fuses are made from glass and have metal caps at each end. In a working fuse there will be a piece of wire from one cap to the other. When the fuse has blown to protect the energiser, the wire will have broken or be burnt. Make sure that the replacement fuse is the correct rating.

If the energiser fuse is intact, the only way to find the fault is by replacing each component (solar panel, battery, energiser) of the power supply with one which is known to be working properly. Change only one part each time. When the pulse rate and the voltage return to normal then the component which has been removed is faulty.



- **Overcast weather:** Many days of overcast weather during the rains can result in the solar panel not charging the battery. This will cause a loss of power in the fence even though there is nothing wrong with either the power supply, earthing or fence system. If the fence has been properly maintained, most of the animals will have become conditioned to the electric shock and will not challenge the fence. If the fence has been poorly maintained and the animals are not conditioned, very wet and cloudy days can result in a lot of break-ins along a fence.

**Note: A fully charged battery will keep a medium sized, well maintained fence functioning for approximately one week without a solar panel.**

- **Lightning:** The power supply systems are protected against lightning by the lightning choke. If it is practical, disconnect the power supply before a big storm. Fence workers should always check the power supply systems in their fences after a big storm.

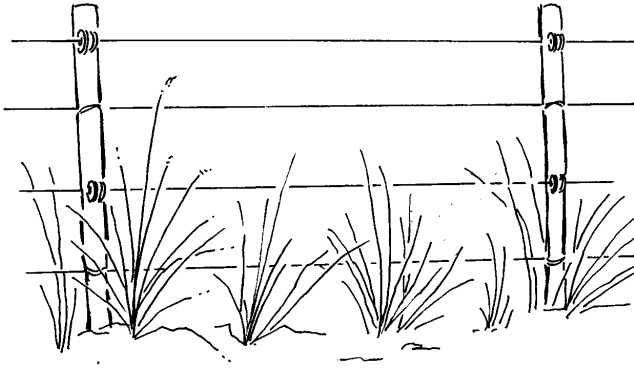
If a fence has not been well maintained or there have been a number of challenges since the last check there might be more than one fault. This means that the fence workers might have to repeat the fault finding exercise more than once until the proper voltage has been restored to the entire fence.

#### What are the common causes of low voltage in an electric fence?

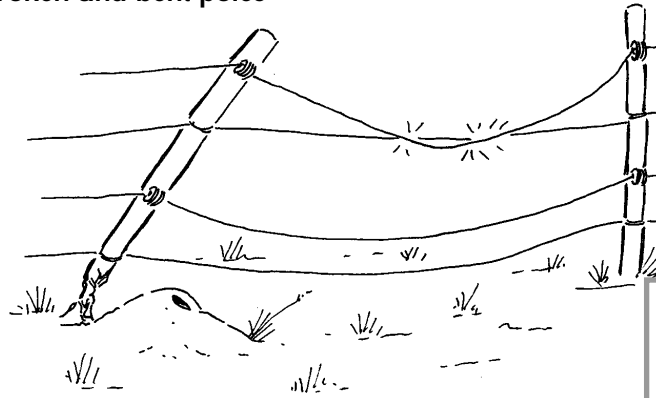
- **grass and weeds touching the fence.** These should be cleared to avoid voltage leakages.
- **broken, cracked and burned insulators.** Insulators break due to exposure to the rain and sun and need to be replaced.
- **broken and bent poles.** In some areas where termites are a problem, poles have to be checked and replaced to avoid the fence drooping.
- **broken and sagging wires.** Wires may be broken due to animal break ins and these need to be repaired to avoid loss of electricity in the sections after the break.
- **poor earth systems.** The earth system has to be checked and if necessary watered to keep it moist for best conductivity.
- **river crossings.** River crossings are prone to washing away during the rainy season and therefore need to be continually checked.
- **home-made gates.** If there are not enough gates in the fence people will make their own gates by forcing the wires apart with sticks. When planning an electric fence there should be consultations with members of the community to determine where gates for vehicles and pedestrians need to be placed.

# The most common causes of low voltage in electric fences

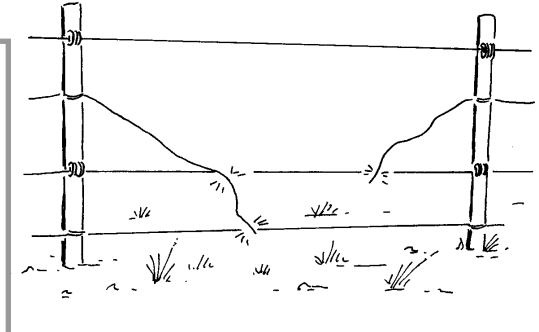
Grass and weeds touching the fence



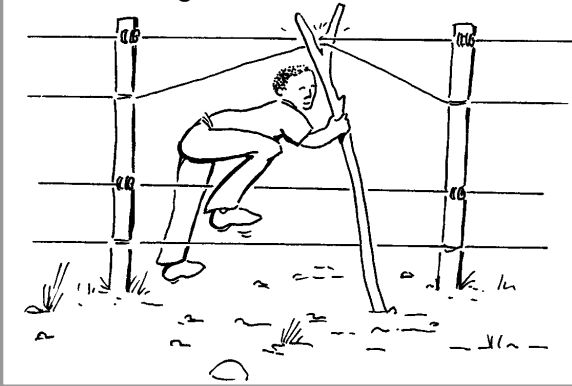
Broken and bent poles



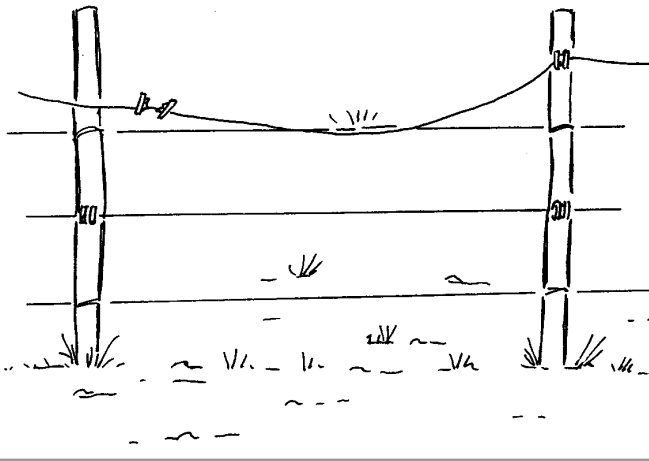
Broken and sagging wires



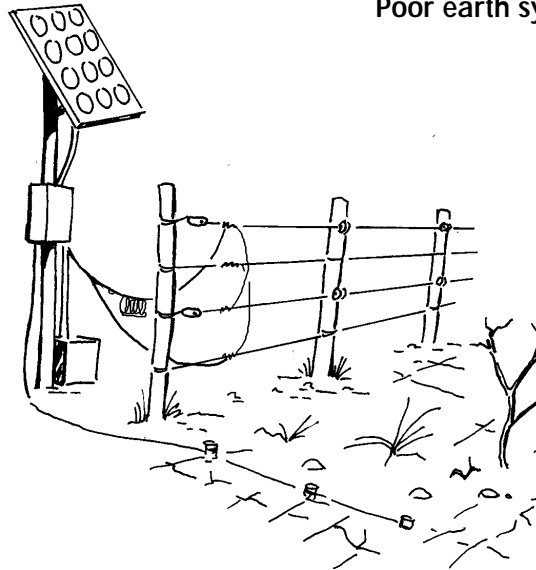
Home-made gates



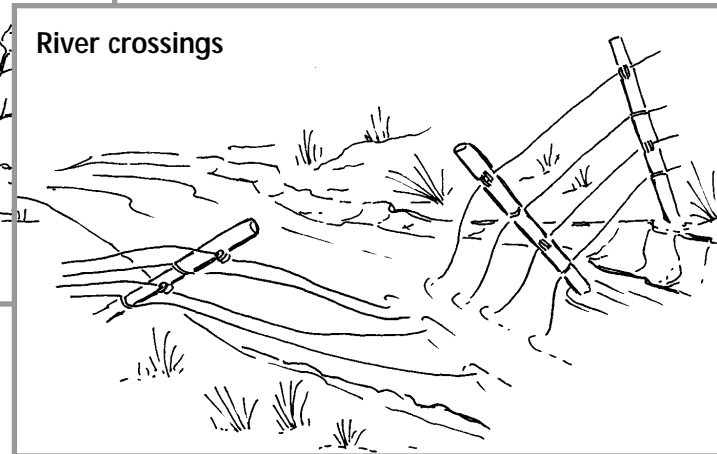
Broken, cracked and burned insulators



Poor earth systems

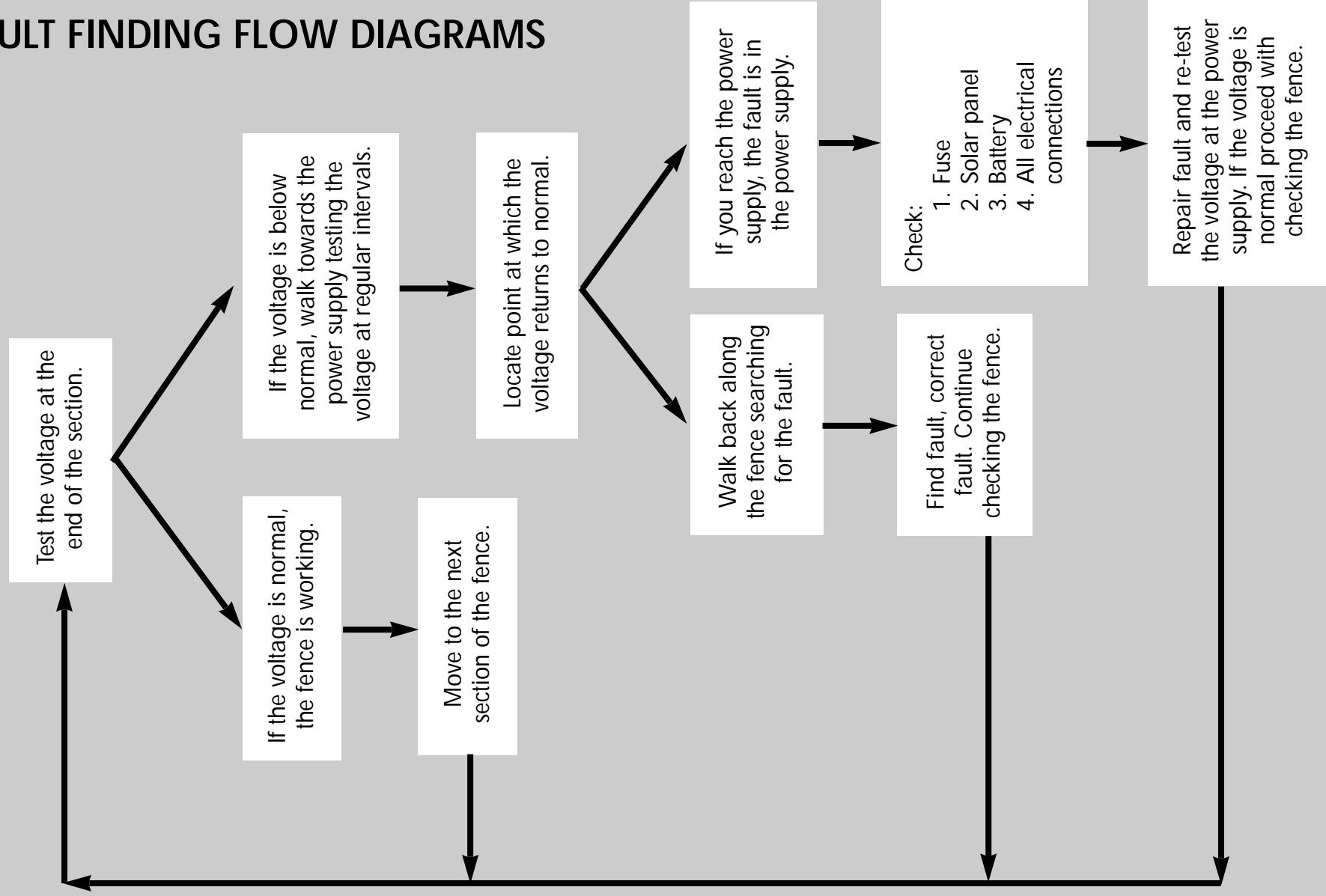


River crossings

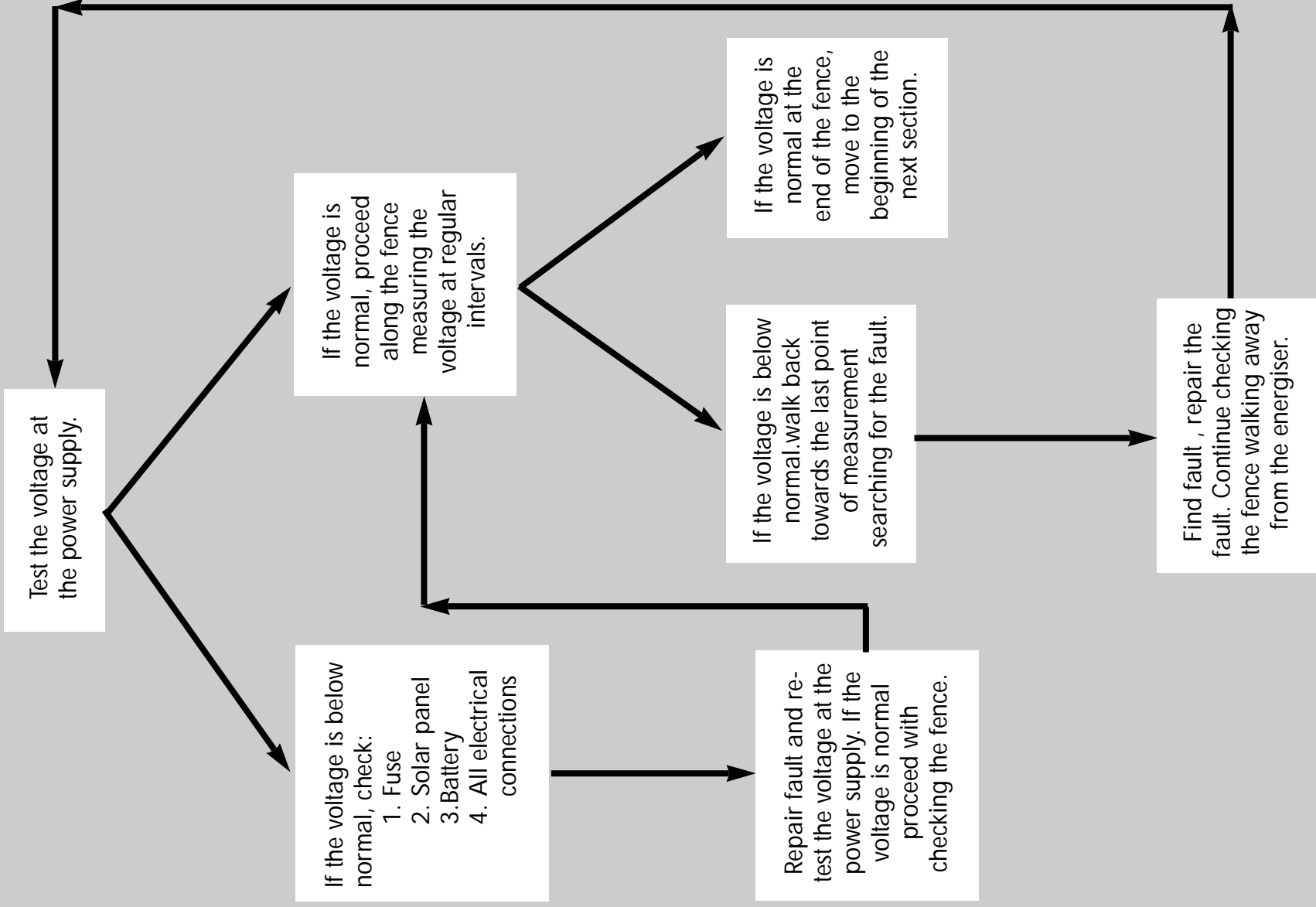


## Method 1: Starting at the end of the fence

# FAULT FINDING FLOW DIAGRAMS



## Method 2: Starting at the power supply





Fence monitors at work in Kanyurira Ward, Guruve District.



### Why is organisation important?

Organizational problems are the biggest single cause for electric fences not being fully maintained and not being effective in deterring problem animals. But organizing fence maintenance is not easy. Even before the construction of an electric fence, the community (ward) and the Rural District Council (RDC) should be working together on how to manage the fence. Most importantly, the responsibilities of each stakeholder should be clearly defined and the human skills and financial resources needed to fulfill their responsibilities put in place.

For example it is not possible for a WWMC to manage an electric fence if it does not have the money to do so or have access to the necessary money. Similarly, it is not realistic to make a district CAMPFIRE co-ordinator responsible for the purchase of spares and the repairs to energisers, because one person will not have the time nor the interest to do this job properly.

As a general rule, the responsibilities for fence maintenance should be held by those most affected by the fence since it is in their own interest to keep the fence working.

### What are the options for organising fence maintenance?

You should select an option from the following which best suits the circumstances in your ward or district.

**WWMC option:** This is the most common option. The WWMC and the community select local persons as fence workers. They are given the necessary training by the construction company or another technical agency. The fence workers are employed and paid by the WWMC and report directly to the WWMC. The WWMC is responsible for the purchase of materials for fence maintenance..

**Sub-contracting option:** This option involves the WWMC sub-contracting the task of fence maintenance to a local person or group of persons. This is a business arrangement and the WWMC only has to budget the total cost of the contract and ensure that it is enforced. The contractors are then responsible to the WWMC and the community for the maintenance of the fence. This option is not commonly used yet. Its advantage is that it creates local enterprise and if there is competition for the contract amongst different persons, it will lower the over-all costs of maintenance.

**Multi-ward options:** In some districts a fence might have to be managed by several wards. In this case and a joint ward management strategy is necessary. A simple arrangement is that each ward manages its own section of fence. However this is probably inefficient and expensive. Another option is that the costs of maintenance are split amongst the wards according to the length of fence in each ward. This will probably reduce the over-all cost of management but some wards will pay more than others.

**Rural District Councils (RDCs) option:** This is an option, but not one which should be used except under exceptional circumstances because it removes the control and ownership of the fence from the ward and community. The RDC can be involved in a joint agreement with the community but the roles of each party should be very clearly defined.

#### **Why do electric fences need to be maintained all year?**

Fence maintenance is an all year round activity. Problem animal reporting systems show that the peak period for crop damage is usually between February and early May. However, WWMCs and fence workers cannot afford to relax during other times of the year. By keeping the fence working properly at all times (more than 5,000 volts) animals will come to respect it as a barrier. This is called conditioning. When animals are conditioned the workload of the fence workers and maintenance costs will be reduced.

#### **How should fence workers be organised?**

As in any business or activity, the people who are directly involved in the daily fence maintenance activities are very important to its performance and success. The following four factors are important in selecting fence maintenance workers:

- **the distance of the fence monitor's home from the fence:** As a general rule fence monitors should live as close to the fence as possible. There are two reasons for this. If they live far away from the fence, they will soon lose interest and not work properly. Secondly, if they live close to the fence their fields and crops will be at greatest risk if the fence does not work properly.
- **their current occupation and commitments:** Persons who already have other jobs (in a store) or are committed to other activities will be unlikely to fulfill their roles as fence workers effectively.
- **their education:** The maintenance of electric fences will be improved if the fence workers have an understanding of electricity and are logical people good at solving problems.
- **their character:** In all situations the character of the individual is important. Persons who are known to be lazy or irresponsible should not be selected as fence workers!

### How should fence workers be monitored?

Often the problem for WWMCs is to ensure that fence workers do their work properly. Monitoring can be improved by:

- **drawing up a formal contract of employment:** The conditions of service should be agreed on before the fence worker starts work. These conditions should include how many hours a day and how many days per week the person will work, whether they are allowed leave and when, who they are responsible to and how much they will be paid.
- **employing a fence worker supervisor:** If there are many fence workers a fence worker supervisor can be employed to monitor the workers on behalf of the WWMC. A fence supervisor who moves around the different sections of the fence can be important in ensuring that workers do their jobs properly. However, WWMCs must balance the cost of an extra person against the benefits which they expect that person to bring to the performance of the fence
- **delegating supervision to a responsible committee member:** An alternative to the fence worker supervisor is to appoint one member of the WWMC as responsible for fence maintenance. It is then this person's role to check up on the workers and the performance of the fence.

Ward 9 WWMC  
CHILAZI DISTRICT

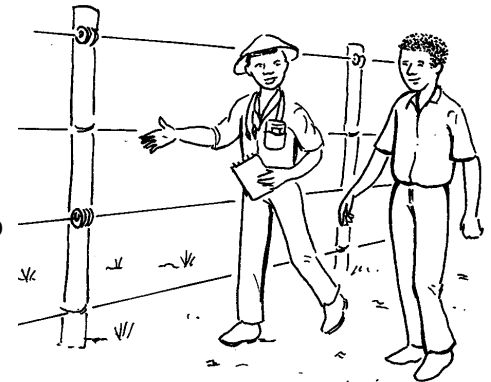
#### Contract of employment for J. Mpofu

This contract runs from 1 January 1998 to 31 December 1998. For the satisfactory completion of the job below you will be paid Z\$700 per month. This contract is subject to one months notice by both parties.

As a fence minder you will have to :

1. Check the fence every working day
2. Repair all faults where possible
3. Complete the fence report form
4. Report on the fence to the fence supervisor

You will work for five hours per day and six days per week.  
Your tools and one uniform will be provided by the WWMC.  
You are entitled to 18 days leave per year.



Fence worker reporting to WWMC member that the fence has been checked and is working well

This helps to maintain communication with the workers and any problems arising can be quickly addressed. It also avoids the community merely paying workers without establishing if they are indeed doing their work.

### What monitoring system should be established for electric fences?

One of the keys to an effective electric fence system is a good but simple monitoring system. A locally controlled monitoring system will allow the WWMC to monitor

- the performance of the fence and
- the performance of the fence workers.

The monitoring system should collect the minimum set of information which allows both of these functions to be fulfilled.

### What is a fence maintenance form?

A fence maintenance report form collects the information which is needed for effective monitoring. The form is completed by the fence workers and can be reviewed and analysed by the WWMC and the fence workers to see how well the fence is working. The form should collect information about:

- voltages at the measuring points
- the number and species of animals which break in and out the fence.
- the locations of the break ins and break outs
- human interference of the fence.

The fence maintenance form should be completed on a daily basis by the fence minders. However, each form is designed to last for one week (see appendix three).



Analysis of these records not only helps with the monitoring of the fence but also allows the WWMC and the fence workers to plan for the future. For example if one section of the fence is continually being broken by animals it will allow them to identify the problem and plan how to solve it.

### **How can the information on the fence maintenance forms be analysed?**

Fence maintenance forms should be analyzed once every three months and a data base on how the fence is working developed. The following summaries can be extracted from the fence forms:

- Total number of break ins
- Average break in per month
- Total break in by sector
- Species with the highest number of break ins
- Average voltage

This data can also be used to provide an indication to the wider community on how the fence is working. (Ideas for presenting or visualising this data to the community are provide in the manual “Communication and Visualisation for Ward Wildlife Committees).

More information about analysing fence maintenance forms and preparing quarterly and annual reports from them for the WWMC and RDC is provided in Appendix 5. These reports will help to address any issues which may arise at ward and district level which have an impact on fence management.

An example of the fence maintenance calendar from Ward 9, Chilazi District.

PLANNED ACTIVITIES	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Fence Monitoring	•	•	•	•	•	•	•	•	•	•	•	•
Adding more gates				•	•	•						
Replacing rotten poles							•	•	•			
Removing weeds and grass in the fence	•	•	•									
Renovations on Kau/ Halazi River confluence								•	•			
Building solar panel house									•	•		
Analysis of fence monitors reports		•			•			•			•	
Writing fence monitors quarterly report		•			•			•			•	
Fence monitors monthly report	•	•	•	•	•	•	•	•	•	•	•	•
Fence monitors annual report											•	
Purchase replacement materials			•									
Inventory of materials and equipment						•						•

### What problems occur in maintaining an electric fence?

Good planning will help overcome the following common problems:

- **delays in the purchase of spares:** Often spares and materials are purchased only after a fence stops working. This reduces the effectiveness of the fence and means that the fence workers cannot do their jobs properly. Budgeting for fence repairs and keeping a stock of materials can ensure that the fence stays working all the time.
- **delays in payment of fence workers:** If fence workers are not paid promptly they cannot be expected to do their job properly. A fence maintenance budget and an agreed payment method will reduce this problem.
- **delays in disbursing wildlife revenue:** If RDCs delay the disbursement of wildlife revenue to wards, these wards will not be able to purchase the spares and pay their workers. A fence maintenance budget presented to the RDC as part of the over-all ward budget will increase the chances of wards getting their money on time as it shows a responsible approach to financial management.
- **delayed or lack of clearance of weeds and grass on the fence:** The effectiveness of fences is reduced by weeds and grass under the fence. A fencing calendar of activities and a budget to pay for the weeding (if necessary) will ensure that clearing the fence line is done effectively and in time.
- **fence monitors not working properly:** Many committees correctly delegate the responsibility for fence maintenance to fence workers. By monitoring the budget, the calendar of activities and the fence reports, the WWMCs can determine whether the fence workers are fulfilling the responsibilities for which they have been paid.

### How can planning improve electric fence maintenance?

Two planning tools can help improve the effectiveness of electric fence maintenance. These are:

- **the calendar of activities**  
The calendar of activities is a check list of all the activities for the fence workers for the whole year. The calendar should be drawn-up by the fence workers with the WWMC at the beginning of the year. The calendar needs to show regular activities such as fence monitoring, reporting and clearing as well as special



activities such as the addition of gates to a fence. The calendar of activities will assist the WWMC and fence workers in setting the budget for the year. For example the calendar of activities given on page 30 shows that more gates are to be added to the fence between April and June. The cost of these gates is shown in the budget.

An additional calendar of activities should be drawn-up that shows the activities and responsibilities of the WWMC.

- **the fence maintenance budget**

The budget for fence maintenance should be realistic and accurate. The fence budget needs to be done as part of the WWMC's overall budget. The budget should be guided by the previous years' expenses and the calendar of proposed activities and should include a figure for inflation, especially of electrical components. The replacement materials necessary for maintenance should be listed and information provided on:

- where they will be obtained,
- who will obtain them and
- how they will be obtained

The format of the budget should include a description, the number required, the cost per unit, the total cost and comments. An example is given on the next page.

### **Why is community awareness and involvement important?**

People living close to electric fences often interfere with them. A common problem is to use the solar panels to charge personal batteries. Then, because the fence battery has not been charging during the day, the fence will not work at night. Thefts of solar panels such as in north Gokwe, energisers and batteries are another common problem. Any theft of panels should be reported immediately to the police.

One way of overcoming such problems is to ensure the participation of the whole community in the maintenance of the fence. This can be done through regular community meetings on fence issues at which, either fence workers or the WWMC feeds back fence reports and receives complaints (or compliments) about the fence. Simplifying and presenting fence reports, budgets and the calendar of activities to community meetings is a useful way of improving wider awareness of the fence.

Fence maintenance budget for Ward 9, Chililazi District January 1998 to December 1998.

Description	Number	Unit cost	Total cost	% of total	Comments
Fence workers	5	\$450 (mnth)	\$27,000	55	Wages
Fence supervisor	1	\$500 (mnth)	\$6,000	13	Wages
New battery	1	\$750	\$750	2	One battery expected to fail
Repairs to energisers	2	\$500	\$1,000	2	\$500 per repair
Wire (steel)	3 rolls	\$720	\$2,160	4	
Wire (soft)	1 roll	\$840	\$840	2	
Gates	4	\$928	\$3,712	8	4 new gates planned
Posts	36	\$16	\$576	1	Replace rotten poles
Pliers	1	\$250	\$250	<1	Replace lost pliers
Insulators (post)	500	\$1.10	\$550	<1	
Insulators (straining)	250	\$1.60	\$400	<1	
Transport	4	\$300	\$1,200	2	4 trips to Harare for spares. Includes T&S.
<b>Total estimated costs</b>			<b>\$44,438</b>	<b>90%</b>	
10% contingency			\$4,445	10%	
<b>TOTAL COSTS</b>			<b>\$48,883</b>	<b>100%</b>	

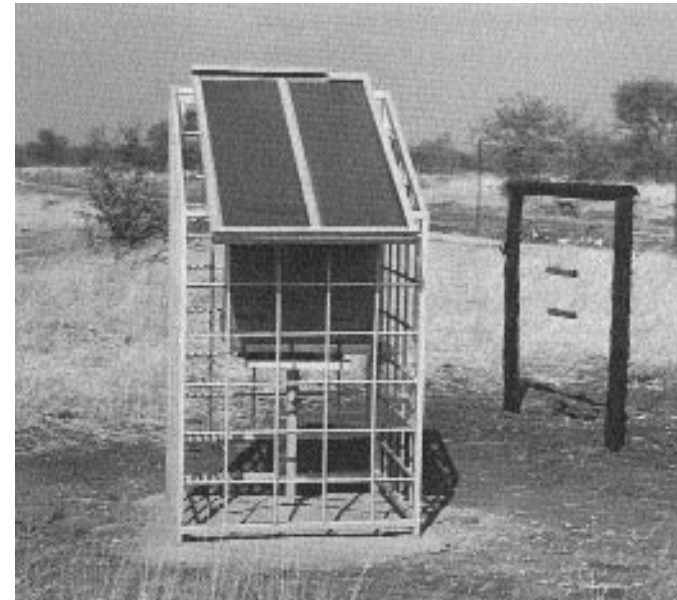
### **What can be done about the theft of parts?**

The theft of parts, especially from the power supply, is becoming a major problem in all the CAMPFIRE districts with electric fencing projects. The loss of these components and the total loss of power in the fence. results in:

- large and unplanned costs to WWMC and RDCs and
- the loss of morale amongst fence minders
- increased number of break-ins and crop damage by wild animals.

Unfortunately there is no single solution to the problem of theft. However, all losses must be reported to the nearest Zimbabwe Republic Police post. The following precautions can be taken to reduce thefts:

- Homesteads: Power supply units can be sited at homesteads which are close to the fence so that there is always somebody around to look after them.
- Permanent night guards: “Guard houses” can be built at the power supply units. Fence minders can be allocated the task of guarding the power supplies. This is an expensive and not very effective strategy.
- Secure cages: Most of the companies building electric fences have designed cages to improve the safety of the power supply unit. The outside of these cages are often electrified which also acts as a deterrent to thieves.



**A solar panel and power supply inside a secure cage.**

- Community awareness: If the community has been involved in the fence and there is a sense of ownership, they will act as the guards. This will reduce the chances of power supply components being stolen.
- Proper maintenance: If the fence has been properly maintained and is providing a service to the community, there are great incentives for people to become involved in preventing the theft of components. If the fence is poorly maintained and does not function effectively then there is much less incentive to prevent or report thefts.
- Serial numbers: It is important that the serial numbers of all the major parts of the fence are recorded. If stolen parts are recovered by the ZRP then the WWMC will be able to identify their equipment and prove that it is theirs.

## APPENDIX ONE

### Checklist for fence equipment, tools and materials

#### A. Replacement materials

- High tensile galvanized steel wire (16 gauge or 2.25-mm )
- Soft galvanized binding wire
- Insulators (straining and post)
- U-nails, nails
- Voltmeter batteries

#### B. Tools:

- Large and small hammers
- Wire strainers
- Pliers / pinchers
- Screw driver
- Axe and hoe
- Voltmeter
- Crowbar
- Cloth
- Distilled water
- Spanner (Number 13)
- Tool-bag

## APPENDIX TWO

### Checklist of Activities

#### Daily check:

- fence line voltage,
- battery water,
- energiser pulse rate,
- solar panel connections,

#### Monthly check:

- vegetation growth,
- check records,
- clean terminals

#### Reporting check:

- Fence maintenance forms filled in daily,
- Quarterly report to the WWMC and RDC,
- Annual report to the WWMC, RDC

**APPENDIX THREE**

A sample fence maintenance report form. The form should be completed by the fence workers after their daily patrol. One form lasts for seven days.

**FENCE MAINTENANCE REPORT FORM**

Week:..... Sector:..... Names:.....

	Date	Breaks In		Breaks Out	
		Nos	Species	Nos	Species
Day 1					
Day 2					
Day 3					
Day 4					
Day 5					
Day 6					
Day 7					

**VOLTAGE:**

Energiser	Date	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Day 1						
Day 2						
Day 3						
Day 4						
Day 5						
Day 6						
Day 7						

After completing this part of the form, complete the checklist on page 38.

**APPENDIX THREE continued**

<b>CHECKS:</b>	
Vegetation removed (tick).....	
Batteries filled (tick).....	
Panels cleaned (tick).....	
Touches (shorts) repaired .....	
Breaks repaired (No.).....	Location:.....
Poles replaced (No.).....	
Verified: Wildlife Manager (WWMC):.....	
Date:.....	

## APPENDIX FOUR

Using the information recorded on the “Fence Maintenance Report Form” is used to determine the current effectiveness of the fence. This will provide vital information for the management and planning of fence maintenance. For example the analyses might show an increasing number of poles which are being replaced over time. This might mean that the WWMC and fence workers plan, both in the budget and the calendar, to replace all the poles in a particular section of fence. The analyses can be carried out by the fence workers and/or the members of the WWMC. The analysis can be done monthly or quarterly. This decision should be made by the WWMC and the fence workers together.

### Fence Form Analysis Outline

The information which is recorded on the Fence Maintenance Form will allow the following analyses to be done:

Analysis	Use	Source of data on the Weekly Fence Maintenance Form
1.0 The length of the reporting period in days / weeks / months	To make a meaningful comparison the analyses need to be done either by day / week / month	Dates given on the form
2.0 The number of reports for the period (reports per month)	Shows whether the reports are being completed by the fence workers	The number of reports available
3.0 The total number of breaks (in and out) for the reporting period.	Shows how many times animals have broken through the fence	The summary of break-ins and break-outs.
3.1 The average number of breaks (in and out) per week/month	Shows the pattern over time of break-ins during the period being analysed	The summary of break-ins and break-outs.
3.2 The total number of breaks (in and out) by sector over the review period.	Shows where the fence is being an effective barrier and where it is not.	The summary of break-ins and break-outs.
3.3 The total number of breaks (in and out) by species over the review period.	Shows which species are causing the greatest problem. In the long-term this might lead to sections being re-designed.	The summary of break-ins and break-outs.
4.0 Total number of repairs over the review period.	Shows the work done by the fence workers.	The summary of repairs and checks.
4.1 The total number of short-circuits repaired.	Shows the work done by the fence workers in the current review period.	The summary of repairs and checks.
4.2 The total number of poles replaced.	Shows the work done by the fence workers.	The summary of repairs and checks.
4.3 The number of times vegetation was removed.	Shows the work done by the fence workers.	The summary of repairs and checks.
5.0 The average voltage by sector for the whole fence over the review period.	Shows how much voltage there was in the different sections of the fence.	The summary of voltage by sector



## APPENDIX FIVE

### Contact Addresses for Electric Fence Design, Construction and Maintenance

	Organisation	Address	Postal Address	Phone number
Design and support	WWF	10 Lanark Road, Belgravia, Harare	Box CY 1409, Causeway, Harare	730599 723870 703902
	Zimbabwe Trust (Harare)	No. 4 Lanark Road, Belgravia, Harare	Box 4027, Harare	722957 730543
	Zimbabwe Trust (Bulawayo)	3 Coghlan Avenue, Khumalo	Box 3235, Bulawayo	69641
Maintenance and repairs	Barrett Electronics	Shop 41, Gilchrist Dr, Marlborough, Harare	Box 6706, Harare	300756
	National Fencing	Corner Tilbury and Workington Roads, Harare	Box ST 436, Southerton, Harare	611800
	National Fencing	3 Wolverhampton Road, Donnington, Bulawayo	Box 886, Bulawayo	69589
	National Fencing	13 Simon Mazorodze Road, Mutare	Box 1432, Mutare	67205
	Salwire	Southern Road, Southerton, Harare	Box 3278, Harare	621791

**Note:** It is important to use reliable agencies to avoid poor quality work at high costs.

This booklet is the sixth in a series of guides on wildlife management and examines in detail, various aspects of electric fence maintenance. It provides background information and guidance to Rural District Councils and should be read along with the other booklets in this series. Together they provide information and guidance to members of villages, wards and rural district councils involved in the management of CAMPFIRE projects. 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 Leases
4. Managing Safari Hunting
5. Quota Setting Manual
6. Maintaining Electric Fences

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.