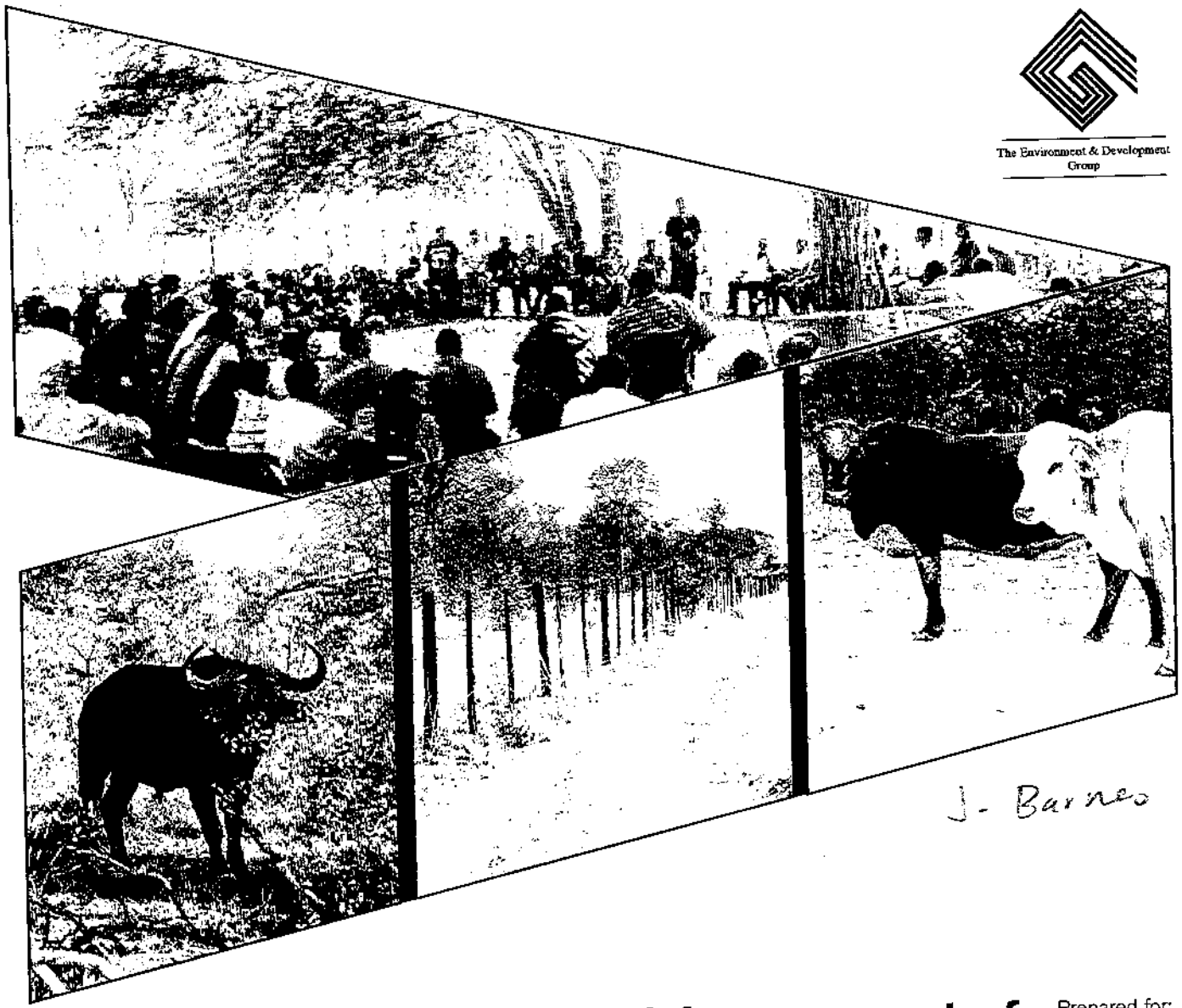
Scott Wilson

in association with

The Environment & Development Group



Environmental Assessment of Veterinary Fences in Ngamiland

Prepared for:

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EIA Guidelines for Future Veterinary Fences in Botswana

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DEPARTMENT OF WILDLIFE & NATIONAL PARKS BOTSWANA

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ENVIRONMENTAL IMPACT ASSESSMENT OF
VETERINARY FENCES IN NGAMILAND

VOLUME 5

GUIDELINES FOR ENVIRONMENTAL IMPACT ASSESSMENT OF PROPOSED VETERINARY FENCES

JOINTLY FUNDED BY
DEPARTMENT FOR INTERNATIONAL DEVELOPMENT
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FINAL REPORT

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EXECUTIVE SUMMARY

These guidelines are divided into two parts – the Fence Planning Process and a Technical Guide to Consultation and Impact Assessment.

Part 1. Fence Planning Process –

Fencing in Botswana – The purposes and descriptions of different types of fences in Botswana are set out.

Legal Requirements - Under the proposed *Environmental Impact Assessment Bill*, the erection of veterinary fences is one of the prescribed agricultural activities for which an EIA must be carried out. The onus for carrying this out is upon the implementing agency, in this case the DAHP and Ministry of Agriculture. The NCS(C)A is the agency that is charged with reviewing and approving any EIA. The steps to be carried out are laid out, together with the contents of the Environmental Impact Statement.

Institutional Framework for Planning – The different institutions involved in veterinary fences are described, including the DAHP, the NCS(C)A, other departments and the proposed Committee on Veterinary Fencing.

Fence Planning and EIA Process – This section includes the identification of fence objectives and the design of the proposed fence, the screening of possible alternatives including alternative disease control methods and alternative routes – a screening checklist is provided – and the scoping of significant issues for study along the fence routes.

Route Selection – The selection of the most appropriate route for a fence with the least environmental and social impacts, is the key to reducing later impacts. If this can be done effectively, then environmental problems after the construction phase will be minimal. The chapter covers route investigations, the identification of possible environmental and social impacts, consultation with stakeholders and affected communities, mitigation of impacts and comparison of impacts.

Construction, Operation and Maintenance and Decommissioning – comprehensive checklists of the types of changes that may be expected to occur at the different stages are provided.

Emergency Fences – a procedure for dealing with emergency fences is proposed. This involves action by the DAHP in identifying the most likely sites where an outbreak could occur, and developing outline proposals for containing primary and secondary outbreaks. If emergency fences are required for this, their routes may be selected, and an EIA prepared and approved. The fence design and route are then stored for immediate implementation in the event of an emergency. This will ensure that there is minimum delay in emergency fence erection, as well as mitigation for any adverse environmental and social impacts.

Part 2. Technical Guide to Consultation and Impact Assessment –

The second part of the guide provides technical information on the processes of consultation and impact assessment. These are based upon the processes and methods used during the study. Whilst these are very extensive they may be too detailed for a routine EIA. They can be adapted for use according to circumstances. The methods include assessing the impacts on wildlife and rangeland ecology, land use and satellite imagery, archaeological impacts, and socio-economic impacts.

The methods used for comparing the livestock disease risks, the environmental and social impacts and cost benefits of each of the alternatives are provided, e.g. using the HACCP (Hazard Analysis Critical Control Point) and RIAM (Rapid Impact Assessment Matrix) methods. The reporting requirements for the Scoping Report, EIA report and Environmental Impact Statement are also outlined.

PART 1: THE FENCE PLANNING PROCESS

1. INTRODUCTION

In 1995 there was an outbreak of Contagious Bovine Pleuro-Pneumonia (CBPP) amongst the cattle in Ngamiland. It is believed that this originated in Northern Namibia and was brought across the border into Botswana through infected cattle. The disease spread southwards throughout Ngamiland more rapidly than expected and was finally stopped at the Kuke fence. In response, the Department of Animal Health and Production (DAHP) erected a series of three east-west cordon fences and double electrified fences along the western and northern borders with Namibia. In the event these were unable to prevent the spread of CBPP, and the decision was taken to slaughter all of the cattle in Ngamiland, a total of some 340,000 head.

The construction of these veterinary fences to control the outbreak generated a great deal of adverse publicity on account of the impacts of the fences upon wildlife populations. This followed earlier construction of cordon fences to control Foot and Mouth Disease (FMD) (e.g. the Kuke fence in 1977) and the Southern Buffalo Fence, built in 1981, to prevent contact between cattle and buffalo, which may carry the FMD virus.

The UK Department for International Development (DFID) has provided assistance to the Department of Animal Health and Production (DAHP), Ministry of Agriculture, in Botswana to strengthen its capacity to implement new animal health and production policies. These new policies are intended to be cost effective, to promote the integration of wildlife management and livestock, and to maximise the sustainable use of Botswana's rangeland. As part of this assistance, DFID agreed to support the assessment of the environmental impacts of the fences upon wildlife populations and the implications this has for conservation and natural resource management in Ngamiland.

A scoping exercise was carried out in 1997, which defined the terms of reference for the full environmental assessment of the fences in Ngamiland. The contract to undertake this work was put out to tender in late 1998, and Scott Wilson, in collaboration with The Environment and Development Group, were awarded the contract in May 1999.

The Terms of Reference specified that guidelines be drawn up for the carrying out of Environmental Impact Assessments (EIAs) of proposals for future veterinary fences throughout the country. This requirement complements the proposed legislation on Environmental Impact Assessment; Veterinary Cordon Fences are included in the schedule of agricultural policies, programmes and projects proposed for inclusion in EIA subsidiary legislation. The Environmental Impact Assessment Bill has been prepared and is awaiting Parliamentary approval.

These guidelines are based upon the experience of carrying out the series of audits and environmental assessments of the fences in Ngamiland. The fences that were assessed during the process showed a variety of issues and problems that may arise out of the construction and operation/maintenance of veterinary cordon fences. These are then explained and clarified in these guidelines, which forms the 5th report in the series resulting from this study.

In addition the TOR specified that the guidelines should cover a fast-track route for environmental impact assessment and approval of emergency cordon fences. However effective the routine livestock disease control measures may be, there is always some risk that an outbreak of diseases such as foot and mouth disease (FMD) or Contagious Bovine Pleuro-Pneumonia (CBPP) may occur and spread rapidly, as was the case in the 1995 CBPP outbreak in Ngamiland. There may therefore be a need in such circumstances to erect cordon fences to prevent any further spread.

The guidelines are divided into two sections addressing the veterinary fence planning process and technical advice on consultation and impact assessment. The former section is more formal, setting out the EIA requirements and procedures, as well as the possible impacts that may be caused by veterinary fences. The latter section draws directly upon the methods developed and used in the EIA of Veterinary Fences in Ngamiland. These may be adapted for use in assessing the impacts of other proposed fences, depending upon the particular circumstances. These are not the only approaches that can be used.

2. FENCING IN BOTSWANA

2.1. Veterinary Cordon Fences

2.1.1. Purpose of Cordon Fences

The purpose of the veterinary cordon fences is to minimise the risk and control the spread of animal diseases, specifically by:

- Preventing the movement of livestock, which may be infected or carriers of animal diseases, especially Foot and Mouth Disease, CBPP, Rinderpest and other diseases, between the two sides of the fence;
- Preventing the contact between livestock and buffalo which may be infected or be carriers of Foot and Mouth Disease;
- Preventing the transfer of diseases from livestock to wildlife.

The additional purpose is to establish and maintain FMD-free zones. The beef from livestock kept in these zones, as well as live animals and meat from ranched wildlife, may be exported, especially to the European Union and other important high value markets for beef.

Cordon fences are not the only means of controlling livestock diseases. Vaccination and surveillance play important roles. Vaccination for Foot and Mouth Disease should be continued in areas that are exposed to incursions by buffalo. Surveillance in both vaccination zones and FMD-free zones is critical for early diagnosis of an outbreak of disease and rapid response to control it.

2.1.2. Types of fence

Several types of cordon fence have been built in Botswana:

- FMD-free zone fences – these are the fences which separate the FMD-free zone from vaccination and surveillance areas, for example, the Kuke fence.
- Buffalo fences – designed to prevent contact between cattle and buffalo, notably the Southern and Northern Buffalo fences surrounding the Okavango delta.
- Border cordon fences – designed to prevent the illegal movement of people and animals across Botswana's international borders, for example the Caprivi Border Cordon Fence in the North and the Western Border Cordon Fence along the Namibian border.
- Emergency fences – erected to control the spread of diseases such as CBPP and FMD, for example the three CBPP fences in Ngamiland (see below)
- Road fences – erected to control the straying of cattle and wild animals across major roads.

2.1.3. Fence descriptions

Fence construction is quite similar for all fences based upon a repeating unit bounded at each end by a "box" with straining posts every 100 m and standards every 10m. Straining posts are reportedly sunk to a depth of 0.6m into the ground. The poles used for the boxes, straining poles and standards are treated Eucalyptus 0.2 to 0.4 m in diameter. Each fence-line comprises 6 equidistant wire strands; the 5 lower strands are 0.224mm in diameter (8gauge) while the top strand is 0.306mm high-tensile steel wire. Between the standards, a number of steel or wooden droppers (400mm diameter) are positioned, sometimes four for every 10 m, sometimes fewer. These droppers are attached to the fencing wires by separate loops of wire.

Fence may consist of just one or two parallel fence-lines approximately 1.4 m in height. Where there are two fence-lines these are usually placed about 10 m apart. The ground between the two fences has been cleared of trees and other vegetation, and access roads are maintained on each side of the fences. At major crossing points, e.g. roads, paths and fire cut lines, gates manned by DAHP personnel have been installed, to monitor and control movements of people and livestock.

Buffalo fences are single fence lines, but are more substantial than other cordon fences. Although only about 1.5m in height, the Northern and Southern Buffalo fences have eight strands, seven of which are

of 0.224mm (8 gauge) wire and the 3rd from the top is substituted by a cable. The same 1km-repeating units used for other fences in Ngamiland are employed but standards are 6m apart with 2 wooden droppers between them.

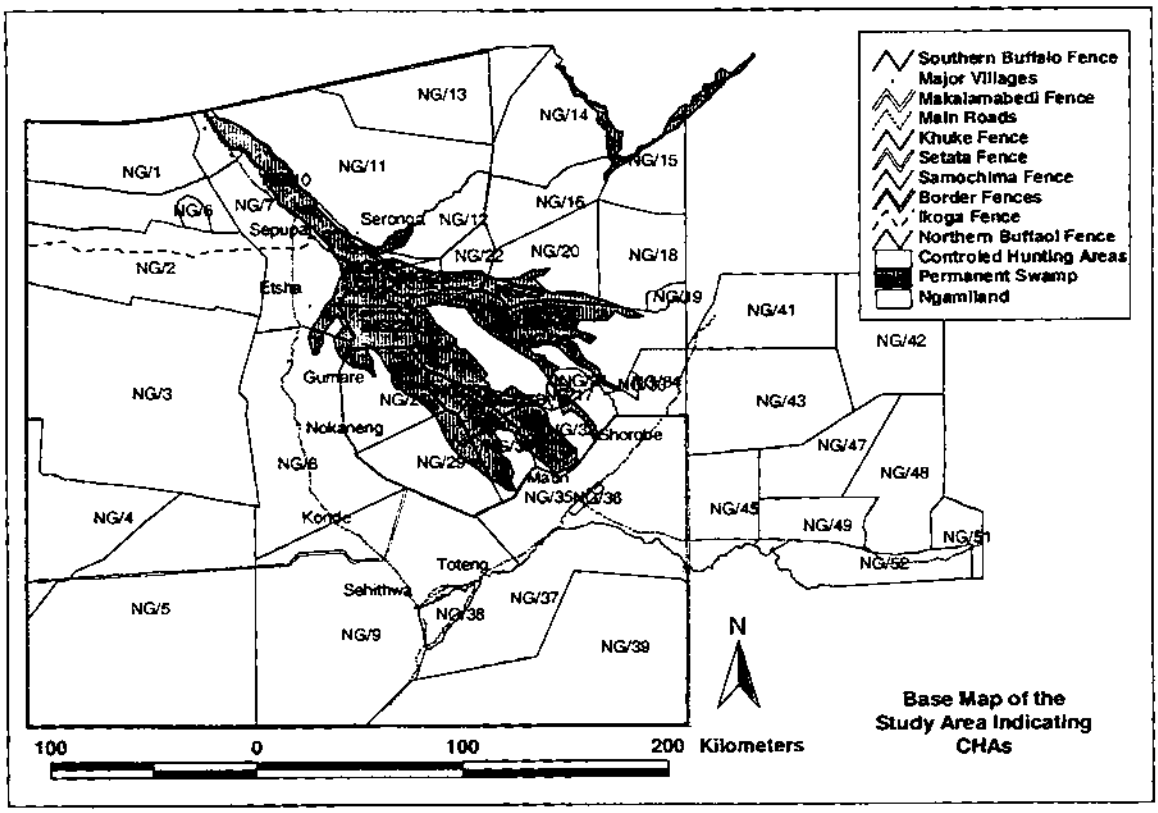
The border fences are even more substantial consisting of two parallel fence-lines with standards placed every 6m and with two wooden droppers between each standard. Straining poles are sunk to a depth of 1.6m. The 3rd wire strand of each fence-line (counting from the top) is replaced by a steel cable. The distance between the two fence lines varies between 10 and 30m.

Each fence-line is also electrified to the outside of the line, i.e. electric wires (two positive and two negative) with appropriate insulators are positioned facing both Namibia and Botswana. Each set of wires (a positive and a negative) is about 12cm apart and the two sets are separated by a distance of about 20cm. It is reported that the voltage is maintained at 6.5 kilovolts with pulses about every second. Solar generators and batteries in well-constructed prefabricated buildings, are positioned at camps at intervals of about 20km along the border fence. The gap between the fences should be maintained clear of tall grass and substantial vegetation to minimise the risks of shorting out the electricity. Access roads run on both sides of the fences with locked gates to provide access for maintenance crews.

Each fence line is maintained by fence maintenance crews stationed at permanent camps along the fence lines. Maintenance crews may also use temporary camps as they move along the line.

2.2. Emergency Fences

The main emergency cordon fences built in Botswana are the three CBPP fences. These were erected progressively in 1995-7 in order to control the spread of CBPP. They were not successful in doing this because of rapid spread of the disease was too fast for the erection of an effective barrier against cattle movements. The alignment of these fences is shown in the figure below.



These emergency fences have remained in place between 1997 and 2000 and have been considered as tool for controlling the spread of diseases in the future. Indeed they would be more effective at this than they were when originally put up because they are in place, and cattle movement restrictions can be implemented almost immediately an outbreak is discovered.

However there are significant environmental and social issues arising from these fences, as has been shown in the environmental audits (Volume 2) of this study. The lessons from these audits show that emergency fences need to be planned and erected as carefully as other cordon fences, albeit with much greater speed. A short-cut planning process is needed to enable such fences to be erected in the event of an emergency. If fences are to remain in place as disease control mechanisms for emergency outbreaks, they should be subjected to an environmental and social audit process after the emergency has passed.

All of livestock disease control policy options considered in Volume 1 of the Environmental Assessment of the Veterinary Fences in Ngamiland involve the decommissioning of one or more of the CBPP emergency fences. However, the Department of Animal Health and Production, should be prepared for future emergencies, and the need to erect emergency fences. Part of this emergency preparedness will involve an analysis of the risks of animal disease and the development of plans to deal with diseases if they occur in different parts of the country. These emergency plans may involve the erection of emergency fences along predetermined fence lines.

2.3. Farm and other fences

In addition to the veterinary cordon fences, there are a number of other fences that have been erected. These include:

- Fences for enclosing and protecting private farms and ranches;
- Fences built for implementation of the New Agricultural Policy 1991, enclosing community lands;
- Fences for enclosing and protecting other property, including National Monuments, e.g. Tsodilo Hills.

Often these fences join up with each other e.g. the fences enclosing the Ghanzi farms, presenting a virtually impenetrable barrier to the movement of livestock and wildlife over long distances. Sometimes farm fences have linked in with cordon fences, using the latter as one side of the farm enclosure. Some of these fences have attracted considerable controversy because of their location, e.g. the Tsodilo Hills fence erected by the National Museums.

Whilst these fences lie outside the scope of this document, many of the environmental and social issues raised by cordon fences apply equally to the above-mentioned fences. They do not require formal EIA but the planning and consultation measures described in this document will make for a more effective and socially acceptable fence.

3. LEGAL REQUIREMENTS

Under the (proposed) Environmental Impact Assessment Bill (Act), the erection of Veterinary Cordon Fences is included as one of the prescribed agricultural activities for which an Environmental Impact Assessment must be carried out. No person or organisation (including government departments) may undertake any of the prescribed activities unless its environmental impacts have been taken fully into account. Penalties can be imposed and the persons or organisations can be required to rehabilitate the environment impacted. The EIA Act puts the onus of ensuring compliance upon the government departments that can grant permits, licences, consents or approvals for prescribed activities for which acceptable EIAs have been carried out. The EIAs have to be accepted and approved by the competent authority, currently designated as the National Conservation Strategy (Coordinating) Agency.

In the case of new veterinary cordon fences, the licensing authority and the proposing organisation will be the Ministry of Agriculture. In order to separate out these two functions within the meaning of the act, the Department of Animal Health and Production is considered the proposing organisation, and the licensing authority is considered to be the Minister of Agriculture.

The steps involved in the preparation of Environmental Impact assessment documentation include:

- Preparation by the proposing organisation of the terms of reference for the erection of a veterinary cordon fence.
- Scoping exercise and consultations with interested parties in government, local authorities, relevant NGOs and affected communities to assess and predict the principal environmental impacts of the erection of the cordon fence in that particular area.
- Presentation of the findings of the scoping exercise to the NCS(C)A who will take the decision on the need for a full EIA.
- Preparation of the full EIA and Environmental Impact Statement (EIS)
- Presentation to and review of the EIS by the NCS(C)A who inform the Minister of Agriculture on its adequacy or the requirement for additional information.
- EIS made available for public inspection and comment
- Minister of Agriculture takes decision on the erection of the new cordon fence, bearing in mind the findings of the EIS, and the mitigation measures proposed, monitoring mechanisms, and environmental auditing by the NCS(C)A.

Under the Act, the EIS shall include the following components:

- Project description
- Outline of alternative sites/routes
- Identification and description of the likely impacts
- Description of mitigation measures
- Proposed monitoring scheme
- Possible effect of impacts on the ability of the proposed project to achieve its objectives
- Any trans-boundary impacts or implications for international conventions to which Botswana is a signatory.

Whilst the Act does lay down certain time scales within which these different steps must be undertaken, these will not be rapid enough for a decision on the erection of an emergency fence.

4. INSTITUTIONAL FRAMEWORK FOR PLANNING

After the erection of the CBPP fences in Ngamiland, the Government of Botswana, in February 1997, set up the Ad Hoc Committee on Fences (ACOF), in order to develop a strategy to address the negative effects of veterinary disease control. The members of the ACOF included:

- Department of Animal Health and Production, DAHP
- Department of Wildlife and National Parks, DWNP
- National Conservation Strategy Co-ordinating Agency, NCS(C)A
- Kalahari Conservation Society, KCS
- Conservation International, CI
- Botswana Wildlife Management Association, BWMA (previously known as Botswana Professional Hunters Association, BOPHA)

Other organisations and individuals were co-opted for particular meetings.

These organisations form the basis for institutional framework for future cordon fences and should be involved in the planning, erection, operation and monitoring of such fences. The key national and local government organisations are described briefly below.

4.1. Department of Animal Health and Production, Ministry of Agriculture. (DAHP)

The DAHP has the overall responsibility for livestock disease control throughout Botswana. It undertakes the planning and design of cordon fences, as part of its disease control strategies for different parts of the country. These strategies are implemented through the DAHP district offices, which will be directed to erect, operate and maintain fences, undertake regular vaccination campaigns and surveillance operations.

Under the EIA Act, the DAHP would be the proposer of any new or emergency fences. It bears the responsibility for:

- Determining the risks of disease and the need for such a fence to minimise these risks to an acceptable level and to control it.
- Developing the terms of reference for the proposed fence,
- Identifying alternative disease control strategies and fence routes.
- Carrying out an environmental scoping of the issues through adequate consultation with stakeholders and affected communities
- If a full EIA is required, commissioning the necessary studies and preparing the EIS
- Publicising the EIS and inviting public comment

Under the Act, the DAHP would apply for approval of the new fence to the Minister of Agriculture, who would ensure that adequate assessment of the environmental and social impacts had been undertaken and that the results were acceptable to the NCS(C)A. The Minister would take the findings into account in his decision.

Once approval has been given, the DAHP would erect or commission the erection of the fence, and be responsible for establishing fence-monitoring mechanisms and for presenting an annual evaluation report on the environmental management of the fence in question. Suggestions for environmental monitoring and reporting on cordon fences are presented in the Environmental Management Plan for Veterinary Fences in Ngamiland – Volume 4 of this study.

4.2. National Conservation Strategy Co-ordinating Agency, Ministry of Local Government, Lands and Housing (NCS(C)A)

The NCS(C)A is to be the competent authority under the EIA Act. It is the institution responsible for the co-ordination of environmental issues and the implementation of the National Policy on Natural Resources Conservation and Development. Its responsibilities are to:

- Establish lists of activities that are likely to cause significant adverse effects upon the environment, or locations, which might be environmentally sensitive, for which the production of an EIS is mandatory. Veterinary Cordon fences have been identified as one of these activities.
- Determine thresholds for these activities for which environmental impact assessment becomes necessary, e.g. the length or siting of a cordon fence.
- Review the terms of reference for new cordon fences and accompanying recommendations made by the Minister of Agriculture and decide whether a full EIA should be undertaken and EIS prepared.
- Review the subsequent EIS, granting approval for its presentation for public scrutiny, or requesting additional information.
- Comment in writing within 30 days, on any recommendations made by the Minister of Agriculture, if it does not agree with them.

In addition the NCS(C)A has the power to revoke or modify the authorisation for the erection of a fence if there is an unanticipated irreversible adverse impact. It also has the authority to require the DAHP to carry out a monitoring programme and evaluation exercise, and to carry out its own environmental audits of the fence.

4.3. Other Departments and local institutions

A number of other government departments and local institutions are likely to have a significant interest in the erection of Veterinary Cordon Fences. They should be consulted as early and as thoroughly as possible during the scoping and full EIA processes. They include the following:

- **Department of Wildlife and National Parks**, Ministry of Commerce and Industry. This department is responsible for the management of wildlife throughout the country. This includes management of the national parks and game reserves and the wildlife management areas. The Department carries out a number of other related activities such as development of CBNRM activities, dealing with poaching and problem animals, and carrying out research into wildlife and range management. The DWNP has a specific interest in that veterinary fences may cut across wildlife migration routes and cause wildlife mortality. They are an important source of information on wildlife numbers, ranges and movements. They must be consulted on any proposed fence that may affect (adversely or beneficially) these activities, especially if a National Park or Game Reserve lies near the proposed fence line.

- **Department of National Museum, Monuments and Art Galleries** is charged with the responsibility of administering the Monuments and Relics Act (1970) to ensure that Botswana's cultural and natural heritage is not needlessly destroyed. This act provides for the better preservation and protection of ancient monuments, ancient workings, relics and other objects of aesthetic, archaeological, historical or scientific value or interest and other matters connected therewith. It is required that before any major construction such as that of the fence is undertaken, an Archaeological Impact Assessment be undertaken to assess any negative impact that could result due to the construction.

- **Department of Lands**, Ministry of Lands and Housing. The Department is responsible for land use planning and zonation. At the District level the Department is represented by Lands Officers who, among other activities, are secretaries to the District Land Use Planning Unit and are advisors to Land Board. These officers are central in the formation of land use plans, district zonation and land allocation procedures. Lands Officers are key people in the drafting of the District Development Plans, these plans should veterinary fence developments.

- **District Administration** Ministry of Local Government, through the District Commissioner, is responsible for local government administration within the district concerned. It has detailed knowledge of the development plans for the district. The District Commissioner assists in district

development through the District Development Committee. The Lands Officers are members of the District Administration.

- **Tribal Administration** is responsible for the traditional and legal rights and social welfare of the communities within its area of jurisdiction. It represents these communities through the democratic principles enshrined in the kgotla and provides one mechanism for consultation with the communities likely to be affected by any proposed fences.

- **Land Board** is responsible for the administration of tribal land. Within its duties are the determination of land-use boundaries, the administration of land claims and the development within a district, including the allocation of boreholes sites, establishing of cattle posts, enclosure of communal ranch land and the granting and administration of concession areas. As the Board members are elected, they can serve a consultative role. The Land Board plays a crucial role in the use of any communal land resource and should therefore be involved in decisions relating to veterinary fences in communal land areas.

- **District Council** is the elected local government institution. In terms of veterinary fences, council has two main functions. The first is consultative as Council legitimately represents the electorate of each district. The second is through the planning activities of the Council Physical and Economic Planners (seconded from Department of Town and Regional Planning and Ministry of Finance and Development Planning respectively).

4.4. *Committee on Veterinary Fences*

It is recommended that the ACOF be reconstituted as a permanent body, the Committee on Veterinary Fences (COVF). Its terms of reference would include out the following tasks:

- Supervision of implementation of the findings of the Environmental Assessment of the Veterinary Fences in Ngamiland
- Receipt of the monitoring reports of the fences provided by DAHP, DWNP and others
- Publication of an annual report on Veterinary Fences
- Appraisal and comment of the plans for emergency cordon fences
- Appraisal and comment of EIAs of any future cordon fences

The members of the COVF should be made up the previous membership of ACOF plus the appropriate local institutions described above, for the particular district/s being considered.

5. FENCE PLANNING AND THE EIA PROCESS

5.1. Fence Objectives and Design

When planning a new cordon fence it is necessary to make the objectives of the fence explicit. The objectives of the fence will then inform its design. In order to do this, a risk assessment exercise should be carried out to identify and if possible quantify the livestock disease risks. Since the fence is likely to be erected to prevent and control the spread of a number of livestock diseases, of which Foot and Mouth Disease, CBPP and Rinderpest are the most serious, the risk assessment should be carried out for each disease. One method of doing this is using the HACCP (Hazard Assessment of Critical Control Points). This is a systematic approach of identifying the Critical Control Points, i.e. the points at which livestock disease control can and must be applied to prevent or eliminate the risk or reduce it to an acceptable level. The methodology for this can be found in Volumes 4 and 6.

The overall objective of livestock disease control is to eliminate, or reduce the risk of, diseases that threaten the life and productivity of livestock and hence the livelihood of their owners. Within this overall objective, the specific objectives for proposed cordon fences are likely to include:

- prevention of unauthorised movement of cattle between different control zones, infected or not.
- provision of known crossing points – gates - where the movement of cattle between zones can be controlled through a system of movement permits
- containment of livestock disease outbreaks within a smaller area, making it easier to deal with outbreaks as they occur
- prevention of illegal import of cattle across national boundaries
- protection of sensitive wildlife areas from the incursion of livestock
- prevention/minimising the opportunities for contact between cattle and buffalo that may be infected and vice versa (preventing transmission of diseases from cattle to wildlife)
- protection of FMD-free zones from livestock disease, which would threaten their status and the opportunities to export beef to more lucrative world markets.

The fence must be designed to achieve these objectives. An obvious example of this is the difference between the fences that are designed to control cattle movements, e.g. the CBPP fences, and those, which are designed to minimise contact between cattle and buffalo, e.g. the Buffalo fences. The design of a fence to protect the FMD-free zone is likely to have greater biological security than other fences, requiring a double fence – to prevent nose-to-nose contact between animals – and be higher than the usual 1.4 m to prevent jumping wildlife from moving between the zones. Electrification of the fence can be added to reduce the risks of wildlife damage to the fence.

Another factor to be taken into account in fence design is the presence of wildlife and the threat to both wildlife and to the integrity of the fence from wildlife. The concept of wildlife friendly fences is discussed in the Issues paper of this study, and a decision will have to be taken to design the fence so that it is permeable to most animals except cattle, or that it is impermeable to most animals.

The third factor in the design of fences is the inclusion of crossing points – gates and stiles - for both humans and livestock. Location and frequency of such crossing points will largely be determined by the consultation process and the requirement of local communities for access to the other side of the fence, e.g. for collection of veldt products. The need for DAHP personnel to staff the gates and monitor animal movements must also be considered.

5.2 Screening of possible alternatives

It is an obligation of the EIA Act that the process includes a consideration of the alternatives. In the context of livestock disease control, this can be interpreted in two ways:

- Alternative livestock disease control methods, such as more intense vaccination coverage, or greater surveillance of the critical control points. The latter might involve greater efforts at encouraging farmer collaboration in early identification of symptoms.
- Alternative routes for the proposed fence, e.g. to avoid specific sensitive areas, or for ease of construction.

These alternatives must be compared for their effectiveness in controlling livestock diseases and for the adverse and beneficial environmental impacts. The balance of the cost-effectiveness and environmental impacts will provide the justification for the choice of the fence and the preferred route. Within a full EIA at least two of the screened alternatives should be compared to the existing situation.

BOX: SCREENING CHECKLIST

When carrying out screening of alternatives for livestock disease control, the following questions may act as a partial checklist:

- How does the livestock disease control option affect the risks of disease – decrease, neutral or increase the risks?
- Does the fence route option cut across recognised land-use boundaries?
- Does the fence route option cut across areas of high agricultural productivity, such as arable land, areas of good grazing or important forests?
- Does the fence route option run close to communities and boreholes, restricting access across the fence to veldt products, water resources and grazing?
- Does the fence route option have an impact upon national parks, nature reserves or designated Wildlife Management Areas?
- Does the fence route option have an impact upon the habitats of endangered species in Botswana?
- Does the fence route option have an impact upon national monuments and protected cultural relics?
- Does the fence route option run through areas known to have rich archaeological resources?
- Would the fence route option have a visual impact upon areas with identified landscape assets or scenic beauty?

5.2. Scoping of significant issues for study along the fence routes

Scoping is defined as a procedure for determining the extent and approach of the study for the selection of fence routes and the assessment of their environmental and social impacts. It involves the following tasks:

- Review of existing literature and documents
- Involvement and consultation with stakeholders - relevant national and district authorities and affected interested parties
- Definition of the alternative fence routes
- Identification of significant issues to be examined in the impact assessment of the alternative routes
- Determination of the terms of reference for the comprehensive impact assessment.

The objectives of the scoping exercise are to ensure that all relevant stakeholders have an opportunity to influence the project at an early stage before the alternatives are selected; to secure a useful assessment and to make the assessment procedures cost-effective.

It is important that the scoping process is multi-disciplinary. Whilst the prime concern of the DAHP as the proposer of the disease control strategy, will be veterinary risk assessment, it is important that other specialists are involved in the route planning process from the beginning. These include land-use specialists, wildlife and rangeland specialists, social and community development specialists, and

archaeologists. Other areas of expertise may be required to address particular issues relevant to the routes chosen. The scoping exercise will define the necessary expertise for the route selection and EIA.

The scoping exercise will define those issues that need to be addressed in greater detail. Issues that are anticipated to have adverse environmental and social impacts may need mitigation measures, which will have to be identified in the full EIA. Scoping is only the beginning of an iterative process. It is not expected that all the important issues will emerge during this stage; the TOR for the full EIA should include provision for additional studies if these become necessary.

6. ROUTE SELECTION

6.1 Route investigations

The starting point for selecting the route for veterinary fences must be the disease control requirements. The factors to be considered here will include:

- Sites/routes of possible entry of disease into the country, or district
- Areas of high disease risk, which need to be isolated from those of lower risk
- Main routes of movement of cattle, e.g. roads and herding routes
- Existing zones of disease control, which may need additional protection, e.g. FMD free zones

This will give the outline routes for the fence in which the area can be divided in order to achieve the livestock disease objective.

Once these outline routes are identified, a more detailed route can be planned based upon the following criteria:

BOX: CRITERIA FOR ROUTE SELECTION

- Where possible fencelines should follow land-forms rather than cutting across them
- Where possible fencelines should not cut through habitats or isolate ecological systems. They should not cut across linkages between ecosystems, especially wildlife migration routes
- Where possible fencelines should follow designated land-use boundaries, rather than cutting through actual or designated land use areas. Where land uses on each side of the fence are less compatible (e.g. agriculture and protected areas) the fence may serve to strengthen the land use boundary. If the land uses are more compatible, the fence may undermine linkages between them.
- Fence routes should avoid known or potential areas of archaeological interest
- Note should be taken of existing communities, and routes which tend to isolate communities or cut access to historic grazing areas, water resources, ancestral lands and veldt products should be avoided
- Routes, which cut communication links between communities that are culturally and economically connected, e.g. between Ikoga and Sepopa, should be avoided.
- Feasibility of erection of the fence across areas of difficult terrain, e.g. noting the difficulties of erecting and maintaining a fence through the permanent or seasonal swamp.

Once the more detailed route has been identified, consultation with the communities lying within 20 km of the proposed fence is required to confirm or make local amendments to the route. Once the route alignment has been agreed with the communities it should be adhered to. Ad hoc decisions on the part of the fence erection team often lead to conflict later.

6.2 Identification of environmental and social impacts

During the route selection process, consideration of possible environmental and social impacts (as shown below in chapters 7 and 8, can complement the criteria listed above. An early consideration of the impacts can serve to minimise the mitigation measures required. A fence route or part alignment that would appear to lead to significant impacts should be reconsidered.

6.3 Consultations

It is essential that an extensive consultation process be undertaken before the route is finalised. The people and organisations that should be consulted include:

- National government institutions such as DWNP, Department of National Museums and Monuments, Department of Lands, Department of Tourism, Botswana Meat Corporation
- Local government institutions, such as the District Administration, Land Board and Tribal Administration
- Stakeholder organisations, such as Botswana Wildlife Management Association (BWMA), Hotels and Tourism Association of Botswana (HATAB), Ranchers Association, Farmers Union,
- Non-governmental environmental organisations such as Kalahari Conservation Society, Conservation International
- Non-governmental community development organisations
- Commercial enterprises – ranches, farms, safari concession holders, lodges and tourism operators whose land is directly bisected by the fence line or is lying adjacent to the fence line
- Communities affected, i.e. those adjacent to the proposed fence line, or those that are dependent upon natural resources (such as wildlife) that may be affected by the fence.

BOX: CONSULTEES WITHIN AFFECTED COMMUNITIES

Within the affected communities there may be a number of key people and social groupings that should be consulted independently, including:

- Members of Parliament
- District councillors
- The chief or village headman
- Village development committee members
- Farmers committee members
- Community trust members
- Women's groups
- Youth groups

Further details of the consultation process are described in Chapter 11.

6.4. Conflict resolution procedure

If conflicts arise about the routing or design of a fence, e.g. one community would prefer one alignment and another community would prefer another, and these routes are mutually incompatible, and if satisfactory technical/design modifications cannot be found to accommodate these community preferences, then a formal conflict resolution procedure needs to be followed. The Committee on Veterinary Fencing will be the responsible body to deal with such conflicts.

- The fence design team from DAHP notifies the Chairman of the Committee on Veterinary Fencing that a conflict has arisen, stating that they are unable to come to a satisfactory solution to resolve the conflict.

- A report describing the nature of the conflict should accompany this notification.

- The Committee shall then consider the issue at the next meeting, requesting a personal representation if deemed necessary.

- The Committee may also request a site visit to acquaint the members with the issue, and will consult with the interested parties, and other organizations and individuals, including the local Member of Parliament and councillors.

- The Committee will then make recommendations to the Minister of Agriculture, DAHP or any other concerned organisation about the resolution of the issue.

- If appropriate, compensation may be considered to resolve the conflict as a last resort, where communities may be compensated for loss of access, grazing rights etc. There is no automatic right to such compensation, and can only be granted on the recommendation of the COVF.

6.5 Mitigation of impacts required

Mitigation is defined as the implementation of practical measures to reduce adverse impacts upon the environment, or to enhance beneficial aspects of the fence. Such mitigation measures should be identified in the full EIA. Where mitigation makes a significant reduction in adverse impacts, it may be necessary to reassess the fence options with the mitigation measures included in the plan.

Examples of mitigation measures which might significantly improve community acceptance of a fence route, would be:

- Inclusion of additional gates and stiles to improve access between each side of the fence
- Fence routes to be equidistant between affected communities, cattle posts and boreholes on each side of the fence
- Inclusion of design features in the fence that allow the passage of key wildlife species.

6.6. Comparison of routes

The overall corridor of the fence route will be largely defined by the fence objectives. Within this fence corridor there may be a number of alternative route alignments. These should be compared against each other in a systematic way, e.g. using an impact matrix, so that the best alignment may be chosen. Methods for comparing alignments are discussed in Chapter 13. A detailed alignment report should be provided with the best option recommended for acceptance by the Minister of Agriculture.

7. CONSTRUCTION

Some impacts occur principally during the construction phase. During fence construction the following impacts of the fence construction process need to be taken into consideration:

Type of change	Principal change	Comment
Physical/Chemical	Changes in soil structure/ chemistry	As a result of grading and access road construction
	Changes in erosion rates	As a result of devegetation and grading cut lines
	Effects of material storage on soil	At stockpiles and camps, very localised
Biological/Ecological		
Rangeland condition	Change in risk, frequency or extent of veldt fires	As a result of workers accidentally starting fires during construction
	Change in vegetation composition, biomass	As a result of devegetation of fence routes, cut-lines and access roads
Wildlife	Change in incidence of illegal hunting	By fence construction workers around routes of fences and camps
	Change in wildlife numbers or distribution	Due to disturbance, or accidental mortality
Sociological/ Cultural /Economic		
Archaeological	Changes to archaeological or cultural resources	Risks of damage to archaeological resources (especially if unknown) due to grading and the sinking of fence-posts etc.
Rural livelihoods	Change in access to the area along fence roads used by community	New access roads provided
	Employment of community residents in fence construction and maintenance	Fence contractors may or may not employ local people
Land Use	Change in illegal off-take levels of wildlife, or disturbance of wildlife used as a tourism resource	Disturbance of wildlife may reduce availability for tourism and other uses of wildlife
Economic	Impact on commercial opportunities for supply of fence construction activities/materials	Contribution to the economy for the supply of materials and labour for building fences. Will be different if Government constructs the fence compared to commercial companies.
	Impact of fence construction on government revenue (macro)	Costs of construction, especially when compared to other options

8. OPERATION AND MAINTENANCE

The principal impacts of fences will be during their operation and maintenance. The following table outlines the main changes that might be expected to occur if the fence continues in place for a number of years.

Type of change	Principal change	Comment
WILDLIFE	Dissection of habitats	Fence cuts and separates important habitats
	Change in use intensity of forage/ other resources by livestock and/or wildlife	Fence may encourage the intensity with which vegetation is used by both wildlife and livestock, causing differences on either side of the fence
	Change in frequency or extent of veldt fires	Fence may act upon the frequency of veldt fires in several ways – a) increasing the risk of accidental or deliberate fires started because of improved access, b) providing a firebrea to prevent fires spreading
	Change in vegetation composition, biomass	Difference in vegetation patterns and biomass may develop due to forced /preferential feeding by wildlife or livestock on one side or the other
	Direct contact with fence leading to mortality	Animals may get caught on a regular or occasional basis on the fence
	Change in competition between livestock and wildlife over forage	Fence may encourage the increase in livestock numbers leading to increased competition with wildlife and vice versa
	Change in distribution or local or larger-scale movements of wildlife species to resources	Fence may prevent seasonal or diurnal migrations of wildlife, causing long-term changes in populations and ever extinctions
	Change in incidence of wildlife-human conflict – herbivores on crops, predators on livestock – leading to impacts on wildlife	Fences may cause build up of animals, e.g. elephants or lions, which then cause damage to crops and livestock. Problem animals then have to be removed or shot.
	Change in transmission of disease from livestock to wildlife	Fences may reduce the risk of disease being passed from livestock to wildlife, e.g. tuberculosis
	Change in incidence of illegal hunting	Presence of fence and access roads provides increased opportunity for poachers, but also improve the access for anti-poacher patrols
	Change in predation rates at fences	Lions have been known to use fences to improve their hunting
	Change in wildlife numbers	Wildlife populations may be adversely affected if their rang is restricted, especially during times of drought. In some areas the fence may protect it for wildlife, by preventing encroachment by livestock
	Change in impact on wildlife due to subsidiary fencing	Farmers may use the cordon fences as part of their ranches and hence increase the overall coverage of the fenced area, and reduce the area available for wildlife
LANDUSE	Dissection of landforms	Landforms such as river valleys, wetlands, sand dunes etc, may be bisected by the fence
	Change in landscape aesthetics/wilderness value	Fences involve cut lines and access roads, which are most apparent from the air, and destroy the landscape and wilderness value. High, double electric fences create more visual impact than single fences
	Effects on distribution of tsetse fly	By restricting the movement of cattle and wildlife, fences may restrict tsetse flies
	Change in access to archaeological sites/public monuments	Fence access roads can improve the access to archaeological sites and public monuments

	Change in condition of archaeological sites	Archaeological sites may be damaged by increased access unless well protected
	Effects on future land use plans	Once established, fence lines tend to become fixed as land-use boundaries and pre-empt land-use plans
	Effects on gazetted/planned land use status	The presence of a fence may change the designated land-use of an area, e.g. by encouraging livestock keeping in an area designated for wildlife management
	Effects on areas of international concern	Fences may affect the management of areas that have an international significance from both cultural and natural resources, e.g. Ramsar and World Heritage Sites.
	Change in arable agricultural potential	Fences may affect the arable potential of an area by bisecting landholdings and reducing access across the area.
	Change in access to water for wildlife	Fences may prevent wildlife from reaching water points, especially during the dry season
	Change in tourism potential	Fences may change the attractiveness of an area for tourism, e.g. by changing wildlife numbers, or reducing wilderness value
	Change in livestock distribution (potential)	Fences may encourage livestock by designation of areas for beef export or not
	Change in national land use potential	Fences may reflect land-use conflicts or synergy across a boundary. Conflicts may reduce the national land use potential.
	Change in international border land use potential	Fences across international boundaries may usefully separate conflicting land-uses, but they may also prevent synergistic cross-border land uses
SOCIAL		
	Change in access to sites of cultural significance	Fence access roads may allow improved access to cultural sites, or they may restrict access for communities wishing to cross fences to go to sites on the other side.
	Effect on competition over land/ wilderness use	Fences may have an effect upon the way in which communities use their land, specifically for tourism development or not.
	Change in access to veldt products	Fences may restrict access for communities to gather veldt products unless appropriate access points and gates are provided
	Change in access to arable land	Access to arable land may be restricted by the fence unless gates are provided
	Change in access to grazing	Access to grazing around some cattle posts may be restricted by a fence line, especially if the fence is placed too close to the cattle post
	Effect on access to fishing grounds	Fence may cut across routes to fishing grounds unless appropriate access points are put in place
	Change in incidence of wildlife-human conflict	Fences may reduce the wildlife access to crops and livestock and hence the incidence of conflict, or they may increase build-up of wildlife numbers at certain points and so increase conflict
	Change in incidence of livestock theft	Fence roads may increase accessibility to livestock for thieves
	Change in access to perennial water resources	Access to perennial water resources may be restricted by the presence of the fence unless appropriate gates etc. are provided
	Employment of community residents in fence maintenance	Fence maintenance camps may provide a source of local employment
	Effect on viability of CBNRM implemented operations	By its impact upon wildlife numbers, and access to designated areas, the fence may affect the viability of community organised wildlife management

	Effect on social relations	The presence of fence construction and maintenance staff may have an effect upon social relations within an neighbouring communities
	Effect on rural administration	Fences may make rural administration more or less difficult by the creation of an artificial boundary
ECONOMIC	Effects on livestock production for export	A fence which increases the FMD-free zone will provide the opportunity for increased income for the livestock owner
	Effect on profitability of livestock industry (macro)	The fence may increase the profitability of the livestock industry by increasing exports and by providing economies of scale for abattoirs etc,
	Effects on non-community safari hunting operations	Fences may affect the viability of commercial safari hunting operations by dividing concession areas and preventing the distribution of wildlife populations
	Effects on non-community photo-tourism operations	Fences may affect the viability of commercial photographic safari operations by dividing concession areas and preventing the distribution of wildlife populations
	Effect on profitability of tourism industry (macro)	Fences may affect the profitability of the tourism industry through adverse publicity about wilderness values and declining wildlife populations
	Impact on commercial opportunities for supply of fence maintenance activities/materials	Fencing contractors may have opportunities for the supply of materials, construction and maintenance of fences
	Impact on economy at regional/national level	Fences may have an effect upon the balance of the contributions made by livestock and tourism industries
	Value of veldt products	Fences may change the value of veldt products by altering the availability of these products, e.g. by restricting access
	Change in value of livestock	The presence of a fence will tend to increase the value of livestock on the side of the fence most protected from the source of disease
	Changes in other disease control costs	Fences may reduce the need for other forms of disease control, e.g. vaccination and surveillance
	Changes in equity in living standards	Fences may or may not encourage an equitable access and use of resources, especially for the poorest, e.g. they may encourage the build-up of non-community owned ranches

9. DECOMMISSIONING

When a fence is decommissioned or taken down, the impacts are essentially a reverse of the construction and operation impacts. Some impacts, however, will not be immediately reversible and will depend upon the length of time for which the fence has been in place. These include:

- **Visual impacts** – the scar of the cut line will be visible for a number of years
- **Archaeological impacts** – the damage done to archaeological resources can never be restored
- **Animal populations** – these may take a number of years to re-establish to former levels provided that other land-use changes have not restricted their range or altered the ecosystem in the meantime
- **Vegetation** – If the fence has been in place for many years, there may be different patterns of vegetation cover on either side of the fence. If the human use of fence roads has increased the incidence of fire, the vegetation cover may have changed. These changes may take many years to reverse if ever.
- **Land-use** – if the fence has led to different patterns of land-use on each side of the fence, it is unlikely that its removal will change these land uses, unless specific measures are taken to encourage such changes
- **Access** – removal of the fence will enable access for communities, livestock and wildlife across the fence, but the access along the fence roads will be lost unless these roads are maintained
- **Community relations** – local employment in fence maintenance camps will cease, but there may be some disturbance of local communities during the decommissioning process.
- **Economic effects** will depend upon the balance of economic land-uses – livestock, arable, wildlife use, tourism and the impacts of removing the fence upon these
- Costs of **alternative livestock disease control measures** – this will depend upon the redeployment of resources – materials and staff needed to maintain the fence and the additional vaccination measures if required.

10. EMERGENCY FENCES

Where possible, the DAHP should identify the areas most likely to suffer an outbreak of the different livestock diseases through the process of livestock disease risk assessment. With such an assessment in hand they will be in a position to develop emergency contingency plans for rapid response in the event of a number of outbreak scenarios with different nodal points.

The most urgent response is containment of the disease outbreak, to limit its spread into neighbouring areas. It is far easier to deal with a primary outbreak, than a series of secondary or tertiary outbreaks. The response to a primary outbreak may involve, quarantine and treatment of the disease of all infected animals and those they might have contacted. In some cases slaughter of the infected and contacted livestock is the only solution. Some sort of emergency quarantine fencing may be required.

The prevention of spread to secondary outbreaks outside the immediate area is critical and this may require the erection of emergency cordon fences. Contingency plans should be drawn up for each of the most likely outbreak scenarios. The identification of key nodal points will help define the general alignments of cordon fences to contain the outbreak, provided that the response is rapid enough.

The contingency planning process should include an environmental assessment of the emergency fence alignments even though they will, hopefully, never have to be built. These emergency alignments should be approved and accepted in the normal way. In the event of an outbreak, the plans can be taken out and given immediate approval by the Minister of Agriculture. Fence erection along the previously approved alignments can be implemented without delay. In the event of an outbreak occurring at a point, which had not been previously anticipated, it is probable that the contingency planning exercise would have identified a combination of approved alignments, which could be implemented without delay.

BOX: EMERGENCY FENCE PROCEDURE

Before an outbreak:

- DAHP identify nodal points where livestock disease risks are most likely to occur
- DAHP develop contingency strategies to contain the outbreaks at these nodal points, including the erection of fences
- DAHP carry out risk and environmental assessments of the emergency fence alignments, including the necessary consultations
- DAHP present the contingency plans and alignments to the NCS(C)A and key stakeholders for comment and approval
- DAHP stockpile fencing materials at key points to facilitate a rapid roll out and erection of fence lines

When an outbreak is reported:

- DAHP assesses the situation – can it be contained without fence erection?
- If not, DAHP asks Minister of Agriculture for approval for immediate erection of particular fences
- Minister of Agriculture informs key NCS(C)A and key stakeholders of his decision
- DAHP erects fence
- Upon the complete elimination of the disease outbreak, DAHP removes the emergency fence and returns the materials to the stockpile.
- Minister of Agriculture reports removal of the fence and return to normal to NCS(C)A and key stakeholders.
- NCS(C)A monitors the process and an impacts which may have occurred, and, with the DAHP, produces a report and recommendations for improving the contingency planning.

PART 2. TECHNICAL GUIDE TO CONSULTATION AND IMPACT ASSESSMENT

11. CONSULTATION

11.1 Objectives of consultation

The objectives of the consultation process are to ensure that all the stakeholders and communities within 20 km of the fence routes:

- Are aware of, understand and accept the need for a veterinary fence in their area
- Have the opportunity to provide specific information about the local area, and the ways in which they use it and its natural resources, so that the most appropriate fence route can be found
- Achieve consensus about the fence so as to minimise any conflict or controversy after the it has been erected
- Identify any groups that may be disadvantaged by the fence so that adequate measures may be put in place to compensate or mitigate the impacts.

Consultation is essential to ensure that the fence routes are planned and implemented with accountability and transparency.

11.2 Levels of consultation

Consultation should be carried out at various stages, during:

- Risk assessment and fence planning process
- Route selection
- Detailed route planning
- Construction
- Fence operation and maintenance – monitoring
- Decommissioning

The level and frequency of consultation will, however, vary from stage to stage depending upon the decision-making requirements of each stage.

11.3 Committee on Veterinary Fences

The Committee on Veterinary Fences offers the principal forum where proposals for new fences may be considered, and where the names of organisational and community stakeholders to be consulted should be agreed. The COVF will advise at what stage the different stakeholders should be consulted. The COVF may co-opt additional members taken from key local or district level organisations when considering particular proposals. These may include the Member of Parliament, the District Councilors, the Land Board, the District Administration, and the Tribal Administration. Key NGOs may also be co-opted.

11.4 Community representatives

Each community within 20 km of the proposed fence route should be consulted at least once during the route selection and detailed route planning stages. Communities further away that may be affected, e.g. by the fence reducing the numbers of wildlife moving into their area, should also be consulted. During the consultation process it is important to discuss the proposals with the following people and groups:

- The Chief
- The Village Development Committee

- The farmers association
- The CBNRM and Community Development Trusts
- Women's groups
- Youth groups
- Minority groups
- People living in outlying cattle posts and lands areas

11.5 Process of consultation

General stakeholder or district kgotla meeting
Because the process of route selection will inevitably involve some trade-offs between communities, it is suggested that the process of community consultation should begin with a general meeting to outline the objectives and possible routes for the fence. This may take the form of a district kgotla meeting, or a wider stakeholder meeting. This meeting will provide an entry point to the individual communities affected. At such a meeting, community representatives to a consultative committee may be selected to facilitate the process and ensure that there are direct communication linkages with those communities. These people will be expected to pass on information about the fence planning process to their communities and feed back the opinions of the people in them to the planners.

Village kgotla meetings and individual consultations
The formal process of consultation should start with the village kgotla meeting, at which the key groups and individuals to be consulted are identified. Subsequently discussions should be held with these groups and individuals, by themselves, so that they may freely express their concerns, without a feeling of being pressurised by the majority opinion.

Site visits
Site visits to local sites or resource areas identified as important should be made to assess the significance and whether avoidance is essential. The siting of stiles and gates to facilitate access to these resources should be carried out with representative community members.

Final consultations
When the final route has been decided, the decision should be taken back to a general stakeholder meeting or kgotla. In some instances, individual village kgotla meetings may be necessary to explain controversial route decisions and mitigation measures.

Consultations during construction of fences
During construction, continued consultation will be necessary with communities in the vicinity of the part of the fence being constructed, or adjacent to the fencing team campsite. The purpose of this is to ensure good relations with the communities, to encourage local employment and to ensure that no further issues have emerged.

If the fencing team encounter new important issues being raised by the community, they should report these to the DAHP and the COVF for reconsideration. On no account should ad hoc decisions about changes of route be made by the fencing team, while under pressure from communities

Consultations during operation of fences
During operation of fences, regular meetings between the DAHP fence foremen and the local communities are important to ensure that the fences are not having adverse social impacts, e.g. about access, and to provide monitoring information about the performance of the fence and its impacts upon wildlife. Meetings can be held to encourage local employment in the fencing maintenance team.

12. IMPACT ASSESSMENT

12.1 Wildlife and Rangeland Impacts

In assessing the impacts of veterinary fences upon wildlife and rangeland, an EIA team should make use of data collected in the past by other researchers and compare them to any additional data to be collected by the team. Such sources of data include reports from DWNP biologists who have undertaken aerial surveys, radio tracking or ground-based studies and researchers working for NGOs such as Conservation International and Kalahari Conservation Society. These data were usually collected for purposes different from those of a fence EIA; such as for setting off take quotas by DWNP, while in some cases the studies were directed at the same ends, but using different methods

The questions to be asked in an EIA of a proposed fence include:

1. Will major habitat types been dissected by the fence?
2. Will there be changes in vegetation composition or biomass, related to changes in use intensity of forage, competition between livestock and wildlife over forage or in the frequency and extent of veldt fires?
3. Will there be changes in wildlife numbers that appear related to the fence?
4. Will there be changes in wildlife distribution and movements, including wildlife movements to key resources, caused by the fence?
5. Will there be increases in wildlife mortality related to direct contact with the fence?
6. Will there be an increase in wildlife mortality due to an increase in
   - The level of wildlife-human conflict and PAC activities
   - The incidence of illegal hunting
   - Predation rates
   - Transmission rates of disease from livestock to wildlife
7. Will there been an increase in the likelihood of any of the above impacts due to subsidiary fencing developed alongside the veterinary fence?

Dissection of habitat types

This broad-level question is not difficult to evaluate. It can be approached by reference to existing vegetation maps and in the case of specific localities, satellite imagery and ground-based observations.

Vegetation changes

A fence can impact upon the vegetation of the surrounding area in three main ways:

- By creating a 'hard edge'
- By changing fire frequencies and occurrence,
- By displacement wildlife populations

It is important to emphasise that fences do not directly change vegetation types or structure. Such changes may however result indirectly from the fact that rural communities tend to aggregate along fences because of the access provided by the fence maintenance roads. Consequently, the fence may over time provide a 'hard edge' between contrasting land uses (e.g. livestock versus wildlife), with paired samples along the fence line providing a valuable framework for establishing the environmental impact of differing land uses. Unless the fence alignment follows a natural ecological boundary, the changes to the vegetation can be usefully assumed to have resulted from the different types of land use.

A 'hard edge' is necessary for such a study and along the fences studied in the EIA simply does not exist, simply because the fence line contrasts in land use are not well defined. For example, while to some extent disputed, the nearest cattle posts to the westernmost portions of the Setata fence are more than 30kms away.

Vegetation floristic composition and cover may be assessed in transects oriented at right angles to the fence line and spaced at 2.5 km intervals. These observations may be taken at the same time as spoor records.

The most likely way in which fences may impact upon the vegetation is in fact by changing the frequency and extent of fires. Quite simply, by increasing vehicular access into formerly remote areas, fences have led to increasing fire frequencies within the region. Increased fires may also result from the burning of vegetation cleared from the fence by maintenance crews, which may subsequently get out of control and burn a much wider area. However, fences may also be argued to act effectively as firebreaks, particularly when the maintenance roads are graded on a regular basis. In this respect, the effect is clearly the opposite of that above.

In order to address this issue the data generated by the burn-scar mapping project within the Department of Meteorological Services, within the Botswana Range Inventory and Monitoring Project (BRIMP) can be consulted. The prevalence of veldt fires depends upon a combination of high woody vegetation cover and the proximity of human populations. In particular the frequency of burn scars starting in the vicinity of the proposed fence line can be established. Fires tend to start from isolated point sources and branch over increasingly wider areas according to the prevailing winds.

Changes in wildlife numbers, distributions and movements
Although there is anecdotal material (much of which cannot be substantiated) to indicate that the fences may affect some species, the only scientifically collected data available come from the DWNP aerial surveys. It is not possible to definitely implicate the fences because the survey data were not collected as part of an experiment to test that hypothesis. It is questionable whether an experiment could in fact have been designed to establish effects of the fences, as it would require a control area that might not be available. An experiment cannot be set up after the fact and the comparison of survey information can only provide evidence of change, not identify causes.

However, it is equally true that the evidence does not exonerate the fences as a possible cause of impact on wildlife populations. This is distinct from the conclusion that would have been reached if no changes had been detectable, in which case one would have to assume that the impact of the fences was minimal.

Trends
Using the DWNP aerial survey data, areas of interest may be digitised to make polygons. The numbers and variances can be calculated for each area for major species such as zebra, giraffe, eland, gemsbok, hartebeest, wildebeest, springbok and ostrich for western Ngamiland and zebra, roan, sable, buffalo for the northern Ngamiland area.

DWNP aerial surveys provided data from 1987, 1990, 1991, 1993, 1994, 1996, 1997 and 1999 (Calef 1988, Bonifica 1992, Craig 1991, DWNP 1993, ULG 1993, ULG 1994a, ULG 1994b). Additional high intensity surveys have been undertaken by the EIA of veterinary Fences in Ngamiland, which provide "post-fence" data. In this case, the significance of differences between estimates before and after the erection of the CBPP fences were tested using Student's t test.

Additional examination of trends
The data from surveys were fitted to exponential regressions to determine whether there were trends prior to the fence erection that may have been continued after 1995 and given that there were significant statistics found by the t tests.

Simulation of trends
The identical boundaries of the polygons were placed in 20 random positions in other parts of the country with similar ecosystems) and estimates and variance calculated for the species in which differences between population sizes before the proposed erection of the fence can be statistically compared. The value of this exercise may be questionable as the results are not strictly comparable because:

- The ecosystems are different
- There may be fewer data available for this exercise, as fewer surveys have been undertaken in the different parts of Botswana.

Aerial surveys - sample counts
Aerial surveys providing the data all follow the sample method of "Standard Reconnaissance Flights" (Norton Griffiths 1987) and Jolly's (1969) method number two for analysis of unequal sample unit sizes. The DWNP surveys have been described in detail in Bonifica (1992) and ULG (1995). Basically this entails flying at a constant height (300 ft above ground level using a radar altimeter) along transects within strata defined by distributions of the major wildlife species. Accurate navigation is maintained using GPS. Observers on each side of the aircraft count the animals in a single fixed strip demarcated by rods or streamers attached to the lift struts. The strip is about 150m wide on each side and this is calibrated for each observer (and for every new survey) by flying over numbers marked on a runway at 10 metre intervals to provide an empirical measure of the strip width. The DWNP surveys follow the same transects every year to facilitate continuity. These are all orientated north-south

The surveys undertaken specifically for the EIA of veterinary fences used the same basic techniques to permit direct comparison of results. However they differed in that transects were positioned according to a randomly chosen point in each stratum and each survey and some transects were orientated east-west or at other angles to allow sampling across important ecological features in smaller strata. The area was stratified into smaller blocks than used in DWNP surveys according to previous wildlife distributions and sample intensities were considerably higher than DWNP surveys.

Blocking of access to key resources and direct wildlife mortality on fences
Fences are undoubtedly responsible for wildlife deaths through entanglement or contact related injuries. Photographs of individuals caught in fences, for example giraffe (*Giraffa camelopardalis*) and ostrich (*Struthio camelus*) all too graphically illustrate the inability of wildlife to pass through the fencing barriers and provide conclusive evidence of their most damaging impacts. However, there are several vital questions that need to be answered in order to assess objectively the mortality and/or blocking impact of fences:

- How many individuals are affected - for example, is it tens or hundreds of individuals?
- Are only certain sections of the fence affected?
- Over what length of time do such impacts prevail, for example, do individuals of a population 'learn' to avoid fence lines over time?

If the latter is correct, one may expect a fairly high initial period of impact/wildlife mortality upon the fence, which then declines over time, as wildlife populations 'adjust ' their movement patterns to compensate for the fence's presence. Clearly this is only possible if home ranges can be adapted to accommodate for such a loss of habitat, which requires that the fence alignment takes full cognisance of wildlife's access to key resource areas. A failure to do so would result in wildlife impacts continuing to occur long after the fence has been erected.

Monitoring over a long period of time is clearly essential to the objective assessment of both of these impacts. The collection of wildlife mortality and fence impact data should occur at least on a monthly basis, to ascertain if the fences disrupt seasonal or migratory movements by cutting across essential ecological resources. Regrettably, these data do not exist at present. Along the Setata fence early fence line monitoring studies were carried out on the ground (e.g. Albertson 1998, DAHP/ DWNP/ OPWT/ CTT 1998, Masunga & Kegoeng 1998, Masunga 1998, Albertson & Monggae 1999) and by aerial reconnaissance (Mughogho 1998). More recently, fence-monitoring protocols initiated under EIA project have allowed the DAHP fencing crews and DWNP patrol staff to record fence impact data on a regular basis on specially designed forms. However, inevitably these represent only snapshots rather than a coherent set of scientific data.

Initially it was hoped that the number of bent droppers and broken fencing wire would provide a useful surrogate measure of the extent of wildlife impact, and entanglement, with the fence. Indeed, perhaps a link, albeit tenuous, could also be established between the frequency of fence damage and wildlife mortality/ injury. However, variation in fencing materials, namely the use of wooden as well as metal droppers, together with the fact that identifying individual fence impact occurrences is extremely difficult, led to the abandonment of such an index. Gemsbok in particular were reported to cause considerable damage to the westernmost sections of the Setata fence, which together with the lack of

maintenance along such portions, meant that it was in fact easier to assess the undamaged portions of fence.

The rangeland component of the EIA study has therefore sought to supplement the existing data by carrying out:

- Vegetation surveys along the CBPP and Northern Buffalo fences
- Systematic spoor counts along the fences and along 100m transects into the surrounding rangeland on either side of the fence.

The early fence line surveys on the Setata fence used a distance of 5kms spacing to systematically site the spoor transects. The EIA team used a distance of 2.5kms along the westernmost portion of the Setata from Reronde to the border, with additional observations made at dropped sections of the fence - mainly to see if animals were making use of the opportunity to cross the fence. Major breakages in the fence, and/or unusual spoor sightings were also noted if they occurred in between these site transects. Provided a full day is devoted to sampling it is possible to cover the entire fence in a single day, which is important if double counting is to be avoided - e.g. elephants can travel large distances at night.

Where possible the knowledge of local trackers, e.g. the Ju/hoan trackers at Caecae, should be used, by them accompanying the fence survey team and forming an integral part of the data collection exercise, as their knowledge and tracking ability far surpasses those of even the most qualified 'professional'. The fence line monitoring surveys undertaken during the EIA sought to use the available hard scientific data, from fence line surveys, and also the view of the affected local communities. Along the Setata fence this meant the involvement of key informants at Caecae established via meetings with the kgosi and the VDC. Spoor counts were made along the westernmost 45 kms of the Setata fence using wildlife trackers from Caecae and the location of key resource areas discussed, both within the field and at Caecae.

Using the spoor data from the above, and animal impact data from the earlier fence line surveys; an environmental file will be generated, and compared with the floristic data from the vegetation surveys. Using the CANOCO program (ter Braak, 1988) the question as to whether certain sections of the fences are more highly impacted upon others can be statistically tested. This mainly applies to the Setata fence and the Northern Buffalo fence.

Changes in wildlife mortality due to changes in wildlife-human conflict, illegal hunting, predation rates and transmission of disease from livestock to wildlife

The DWNP offices may be able to provide information from their records on PAC activities, illegal hunting and reported predation. The records are rarely amenable to quantitative assessment and usually less precise "guesstimates" must be applied.

12.2 Land use impacts

The primary activities required from the land use section would be to:

- Assess current and potential land use for the different areas affected by fences.
- Make recommendations for the route for the fence based upon land use considerations

The land use data may be compiled in a Geographic Information System (GIS). The GIS is convenient as it allows for the combining and assessment of large data sets.

Types and Availability of Data

Initially a number of data sets, useful in detailing present and potential land use, should be identified. Three approaches to generating coverages for the different types of data may be adopted:

- Compilation of existing digital or hard copy data coverages (usually Government of Botswana data).
- Compilation of coverages from earlier studies.
- Generation of new coverages (largely through the use of Landsat TM data).

The coverages, which may be compiled for use in the analysis, are listed in Table 12.1, below.

Table 12.1: Coverages used in the land use analysis

Sector	Coverage
Climate	o 550 mm rainfall isohyet
Groundwater	o Borehole distribution
Surface water	o Areas of permanent swamp o Ephemeral surface drainages
Soils	o Potential of soils for arable agriculture
Gazetted Land Use	o Gazetted use of CHAs. o Designated area of wetlands of international importance.
Community land use	o CHAs being used for CBNRM activities
Physical land use	o Existing agriculture
Human settlement	o Villages and cattle posts
Livestock	o Pre CBPP distribution of cattle
Forestry	o Areas of high potential for forestry
Wildlife	o Biomass of wildlife per CHA. o Distribution of charismatic wildlife species
Cultural	o Key National Museums sites
Sites of high tourism potential	o Rocky outcrops and other sites identified during this study

LandSat TM Coverages
Remote sensing data may be available, e.g. for Ngamiland used in the EIA study. At the start of the study only two sets of remote sensing data were available, both of which are pre CBPP fences and Northern Buffalo Fence erection (1:50,000 aerial photographs (1991 and 1990) and Landsat TM (1994) three bands). Six 1999 scenes (7 bands) were purchased, geo-rectified and compiled into a mosaic. The bands were combined to produce false colour and a NDVI (Normalised Difference Vegetation Index) views of Ngamiland. These data were used for the generation of some of the coverages.

Apart from being essential to the land use interpretation these data were available for the ecological aspects of the study. The Ngamiland mosaic will also form the base of the Regional Management Plan.

Combining Data Sets (Land Use and Land Use Potential)

Existing Land Use
Details on existing land use may be obtained through interviews with key persons, existing map data and interpretation of the LandSat imagery.

Potential Land Use
Land use potential may be generated for different scenarios, for example, in the EIA:

- Agricultural (livestock and arable agriculture), and
- Tourism, CBNRM and Wildlife

These scenarios are closely linked to gazetted land use.

Agricultural potential may be generated by combining coverages after assigning values (ranks) to information in each coverage as described below Table 12.2.

Table 12.2: Data used to generate the Agricultural Potential Map

Sector	Coverage	Rankings	Origin of Data and Comments
Climate	550 mm rainfall isohyet	>550 = 1 <550 = 0	BRIMP rainfall map of Botswana
Groundwater for livestock	Borehole distribution buffered for 4 km	All boreholes used for livestock were ranked "2"	Ngamiland Waterpoint Survey (industrial, urban and village water supply, mining, research, wildlife and monitoring boreholes were excluded)
Soils	Potential of soils for arable agriculture	< moderate = 0 moderate = 2 moderately high = 3	MOA/FOA/UNDP Soil map of Botswana. Digitised by BRIMP. Soil potential map generated by this project
Gazetted Land Use	Gazetted use of CHAs	WMA = 0 Pastoral/Arable/Res.= 1 Agricultural specific (BLDC, TGLP) = 2	IFAD, updated by this study
Physical land use	Existing agriculture	Soils with high irrigation potential = 4, molopo farming = 3, Dryland arable = 2	This study and Landsat imagery
Human settlement	Villages and cattle posts buffered by 5 km, large villages by 10 and towns by 20	All buffered settlement ranked 2	Point data from 50,000 maps, IFAD
Livestock	Pre CBPP range of cattle	0 – 49 cattle/100km^2 grid square = 0; 50 – 999 = 1; 1000 – 2299 = 2; > 2300 = 3	DWNP aerial census data. Averages for surveys.

Tourism potential may be generated in a similar manner to agricultural potential using the following coverages (Table 12.3).

Table12.3: Data used to generate the Tourism and NRU Potential Map

Sector	Coverage	Rankings	Origin of Data and Comments
Gazetted Land Use	Gazetted use of CHAs	Pastoral/Arable/Res.= 0 Agricultural specific (BLDC, TGLP, etc) = 0 Forestry = 2 CBNRM areas = 3 WMAs and Sanctuaries = 4 National Parks and Game Reserves = 5	IFAD, updated by the CBNRM/socio team from this study
Gazetted Land Use	Designated area of wetlands of international importance	Ramsar site = 2 Non Ramsar sites = 0	This study digitised onto Landsat. Description from Ramsar website and NCSA
Water/wetlands	Areas of swamp	Permanent swamp = 3 Seasonal swamp = 1	From Landsat unsupervised classification.
Forestry	Areas of high potential for forestry	High tree biomass on Kalahari sands = 1	From Landsat unsupervised classification. Key areas digitised. Field survey
Wildlife	Biomass of wildlife per CHA	<0.1 tons/km^2 = 0 0.1 – 0.5 = 1 >0.5 – 3 = 2 >3 – 10 = 3 >10 – 35 tons/km^2 = 4	DWNP census data 1992 – 96 (total wet and dry averages for years surveyed)
Wildlife	Distribution of charismatic wildlife species	Distribution of lion, elephant, buffalo = 4 Giraffe, zebra, sable roan and hippo = 3 Gemsbok = 1	DWNP census data 1992 – 96 (total wet and dry averages for years surveyed)
Cultural	Major National Museums sites/ proposed World Heritage Site	Museum sites = 4	Land use maps.
Undeveloped tourism potential	Rocky outcrops and other sites identified during this study	Rocky hills with moderate to low potential = 2 Hills and other sites with high potential = 3	From national soils of Botswana and this study. All sites buffered by 5 km

12.3 Archaeological impacts

A development like a veterinary fence should be subject to an Archaeological Impact Assessment and accepted by the National Museums. Areas of archaeological interest are generally found around ancient fluvial activity – lakes, pans and fossil rivers. If a proposed route passes through any of these, an archaeologist should do a preliminary study. In most instances, this would be a surface survey. After the survey, recommendations are made to whether the construction could go ahead or not. In most cases a watching brief is recommended so that archaeological remains could be rescued during the construction. In other cases where area envisaged for development is found to be rich in archaeological materials, it could be recommended that the alignment of the fence be changed to avoid the site, and the remains preserved *in situ*.

12.4. Socio-Economic impacts

Socio-economic impacts may be assessed through a combination of:

- Earlier socio-economic surveys, censuses and other studies
- Field studies involving discussions with groups in the affected communities
- Household economic surveys and questionnaires.

Ensuring representativeness of field sites
The Socio-economic specialists on the team are primarily interested in consultation with communities in the study field sites. The approach and the mechanisms that they use should ensure as full and as representative a consultation as possible.

Representativeness is needed to reach social groups who may be marginalised and who may not be obvious to outsiders. Such groups may be reticent about expressing their views if approached without the support of leaders, but whose views may be significantly different from those of the majority. However, all the viewpoints in the community are inter-dependent, and as such they are critical to the quality and credibility of the findings. Consultation with community leaders is therefore essential to ensure that such groups are not missed.

- The findings must be representative of how the fence may affect livelihoods, and the scale of this impact - in terms of how widespread the impact is likely to be in the project area, and in terms of severity on livelihood strategies in a field site.

- Representative findings are dependent on field sites being selected that are representative of livelihood strategies in the area and of livelihoods affected by the fence/s in that area.

- Selecting representative field sites requires consultation with and the agreement of traditional leaders, VDC members and other leaders (for example the chairs of CBNRM trusts).

- It is not necessary that this group be representative of all social groups affected by fences in the project area, what is important is that it selects field sites that are representative of the various impacts of the fences.

All social groups in the field sites must be included and consulted. This demands that the team have their own knowledge of what social groups are at risk of being left out of the fieldwork consultation, for example women, youth, and hunter/ gatherers, and ask that they be included.

The table below sets the primary and secondary criteria that were used to ensure representativeness in field site selection in the EIA of veterinary fences in Ngamiland. Further criteria may be added depending upon the situation.

Primary Criteria	Secondary Criteria
• Livelihood strategies;	• Tourism/ wildlife areas
• Land use management;	• Livestock areas
• Options to improve animal health, and	• Mixed cattle/ buffalo areas;
• Access to sites of cultural importance.	• Hunting and gathering areas;
	• Fishing areas
	• Sites of cultural significance

The following process was used by the EIA team to select field sites with a Community Consultative Committee, established at the general kgotla meeting:

- All places affected by each fence route are listed by route option.
- Where appropriate, places are grouped, for example villages and seasonal cattle posts.
- The secondary criteria applicable to each place were noted.
- Two field sites were selected for each route, plus additional sites that have a particular concern or interest

The term field site refers to the geographical area selected for fieldwork; this varies from a single settlement to several villages. It is used inclusively to include households in the field site area.

Households in most areas have several sources of income, and therefore there is considerable overlap in the secondary criteria. However, the main purpose of using the secondary criteria is to ensure that all groups, whose livelihoods are affected by the fences, are included in the selected field sites, and, therefore, that the field sites are representative of the wider population affected by the fences. People in each field site should be consulted about their perceptions of the possible impact of the fence/s on their livelihoods, land use management, grazing and livestock movement (and therefore productivity), and access to sites of cultural importance.

Household economic survey
A survey questionnaire may be necessary for quantitative assessments of the household economy, in order to complement the qualitative social information, and to provide a confirmation of previous studies. It is unlikely that an EIA household economic study would be able to go into the detail that a more specific socio-economic survey would do. Nevertheless, the questionnaire approach may be used to collect data on:

- livestock ownership and income from livestock,
- other sources of income,
- household time allocation, and
- attitude to risk of livestock disease.

However, there may be methodological issues around the statistical representativeness of such surveys. There are also difficulties in the accuracy of the information supplied by the respondents, who may not wish to give an accurate account of the income for various reasons, e.g. qualification for certain relief packages.

13. COMPARISON OF ALTERNATIVES

There are three key areas in which the alternatives should be compared :

- potential to achieve livestock disease control objectives
- environmental and social impacts
- cost-benefit analysis

The decision over which route to choose should depend on the combination of all three, rather than one over-riding the other two. There are a number of methods available for comparing the alternatives, the ones described below are the ones that have been used in the present study. The ways in which they have been used can be seen in Volumes 1 – 3 of the study.

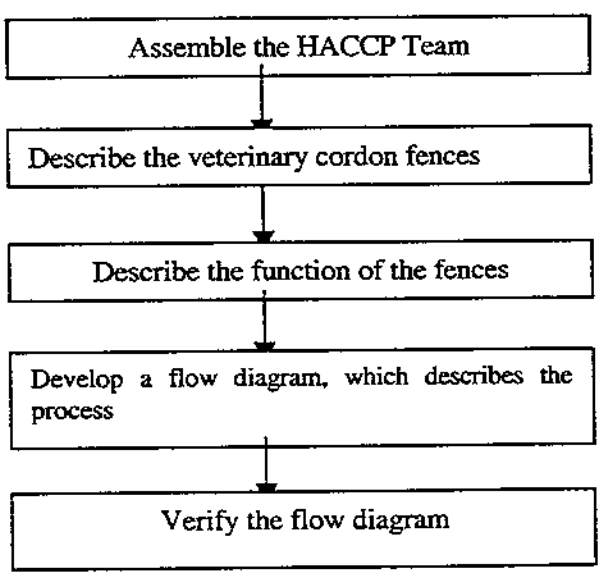
13.1. Comparison of potential to achieve livestock disease control objectives using HACCP methodology

Before comparing the effectiveness of the different route options in controlling livestock disease, an analysis of the risks of livestock disease should be carried out. If possible, this should be a quantitative analysis taking into account the different means of transmission and the probabilities of these means occurring. The risk analysis should compare the overall disease risks with and without the proposed fence.

A comparative assessment of risks of disease and their control by use of veterinary cordon fences may be made using an adaptation of Hazard Analysis Critical Control Point (HACCP) methodology. HACCP is a systematic approach to the identification, evaluation, and control of the hazards associated with particular parts of the proposed fence. The method is based on the following routine:

- Conduct a hazard analysis
- Determine the critical control points (CCPs)
- Establish critical limits
- Establish monitoring procedures
- Establish corrective actions
- Establish verification procedures
- Establish record-keeping and documentation procedures

PRELIMINARY TASKS IN THE DEVELOPMENT OF A HACCP PLAN



Hazard Analysis
Hazards, and their likely occurrence and severity, were identified by the animal health team.

Critical Control Points
A CCP is a step at which control can be applied and is essential to prevent or eliminate a hazard or reduce it to an acceptable level. CCPs were determined and CCP decision trees were produced.

Critical Limits
Where possible, critical limits (maximum and/or minimum value to which a parameter must be controlled at a CCP to prevent, eliminate or reduce to an acceptable level the occurrence of a hazard) were determined to distinguish between safe and unsafe operating conditions at a CCP.

Monitoring procedures
This assignment has required the identification of disease hazards and critical control points to enable judgements to be made on the efficiency of the present fences in controlling disease and to make comparisons with the Status Quo and the alternative disease control options A and B, produced by the EIA. However, this is only the first step of a HACCP procedure, the next is to establish a monitoring procedure which determines and warns when there is a loss of control at a CCP. Monitoring provides written documentation for use in verification.

Corrective actions
When there is a deviation from established critical limits, corrective actions are necessary. They should: determine and correct the cause of non-compliance; record the corrective actions that have been taken. Specific corrective actions should be developed in advance for each CCP and included in the HACCP plan.

Verification procedures
Verification is those activities, other than monitoring, that determine the validity of the HACCP plan and that the system is operating according to the plan. The major science in a HACCP system centres on proper identification of the hazards, CCPs, critical limits and instituting proper verification procedures. A comprehensive, unbiased verification of the HACCP system should be conducted by an unbiased, independent authority.

Record keeping and documentation procedures
These need to be defined and in place to implement the HACCP process. The analysis is based on expert opinion and quantitative data where it can be obtained and is reliable and appropriate. In the analysis, control points and hazards are scored, the scores are weighted according to expert opinion on the relative value of the CCPs and the severity of the hazards.

Separate analyses have been made for CBPP and FMD as the risks are different. The analyses indicate areas of increased risk, level of risk and the degree of control in place to counteract the risk.

Figure 13.1 shows a scheme of the hazards of transmission of FMD from buffalo to cattle and the CCPs. Figure 2 shows a similar scheme for transmission of CBPP from cattle outside Botswana and the CCPs. Tables 13.1 and 13.2 describes which CCPs may be used for FMD and CBPP respectively.

Those hazards and control points which could be observed and, where possible, measured during the field work of this EIA, are recorded and scored with respect to each fence, with regard to FMD and CBPP.

The critical control points for each fence route or livestock disease control option can be compared graphically, showing the balance between control and risk at each point, as illustrated in Volume 1.

Figure 13.1. Hazard: Transmission of SAT FMD endemic in African Buffalo population in Okavango Delta and in Namibia (Mahango and Bwabwata National Parks) to cattle

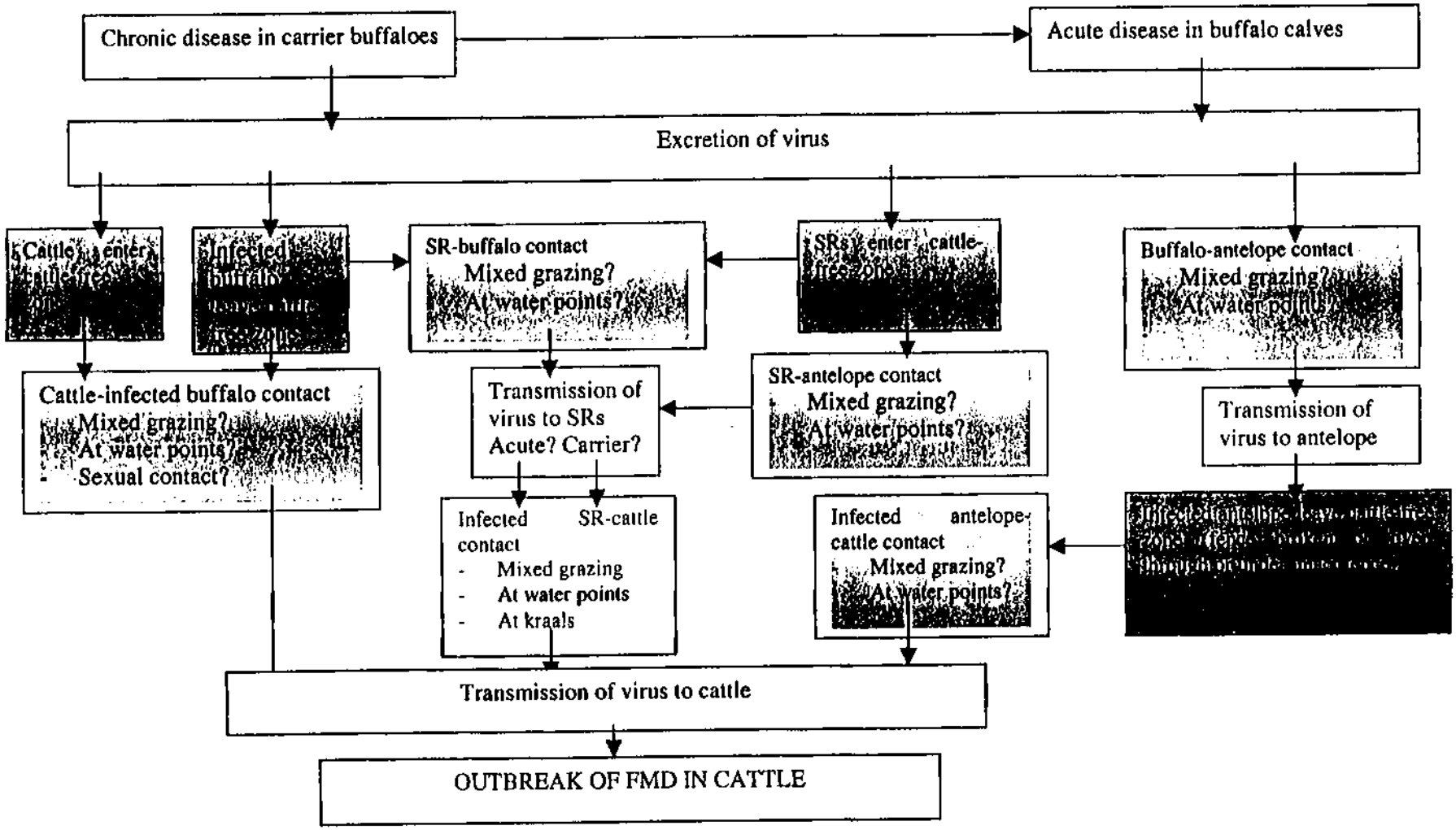


Table 13.1. FMD Control points

[redacted]	Control by fencing:	Single 1.4m Single 1.4m with buffalo cable Double 1.4m with buffalo cable Double 1.4m with buffalo cable and electrification Double 2.6m with buffalo cable and electrification (impermeable barrier) Other options?
	Impact of wildlife on fence: Recorded level of damage to fence:[1] Recorded level of repairs to fence:	 Breaks/10km Repairs/10km
	Monitoring and maintenance of fence:	Weekly Monthly Other?
	Distance between monitoring and repair camps	Kms
	Cattle close to fence:	0 - +++
	SRs close to fence	0 - +++
	Presence of vaccination zone	yes/no
	Presence of surveillance zone	yes/no
[redacted]	Level of surveillance	0 - +++
	Capacity of DAHP and DWNP to keep wildlife and livestock apart	0 - +++
	Vaccination	None Once yearly Twice yearly Three times yearly
	No critical control points	

[1] It may be possible to calculate rate of damage to a fence: for example, rate of damage over the entire life of the portion of fence examined would be:

Breaks per 10km + Repairs per 10km/days since fence was erected = damage rate per day.

Recent damage to portion of fence examined would be:

Breaks per 10km/days since last maintenance visit = recent damage rate per day.

Figure 13.2. Hazard: Transmission of CBPP from cattle in Namibia to cattle in Botswana

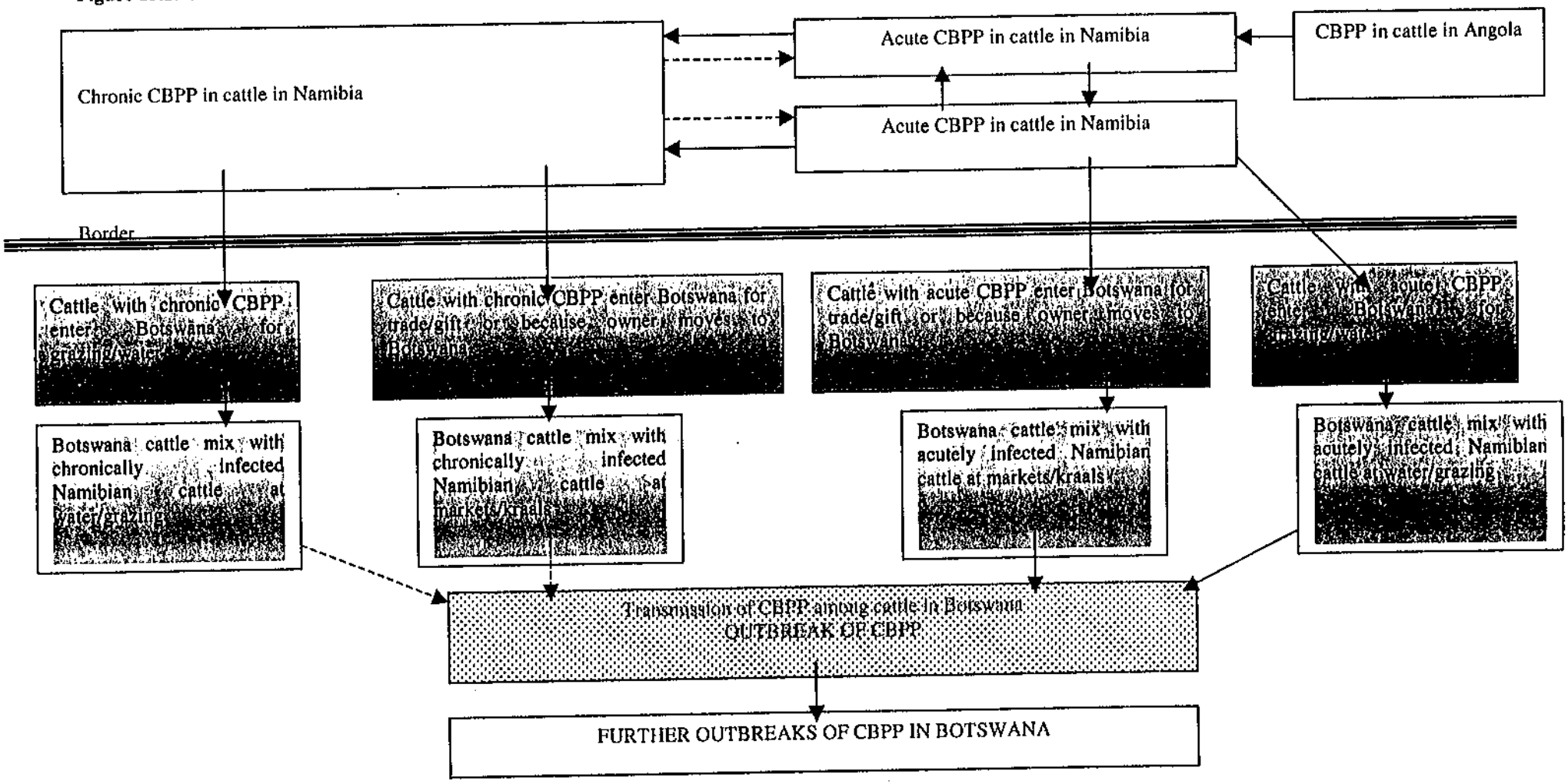
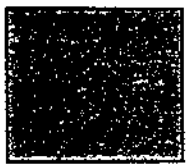
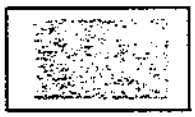
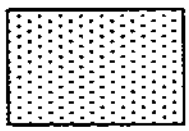


Table 13.2. CBPP Control points

	Control by border fencing:	Single 1.4m Single 1.4m with electrification Double 1.4m Double 1.4m with electrification Other options?
	Impact of wildlife on fence:	Breaks/10km Repairs/10km
	Recorded level of damage to fence:[2] Recorded level of repairs to fence:	Weekly Monthly Other?
	Monitoring and maintenance of fence: Distance between monitoring and repair camps	Kms
	Cattle close to fence on Namibian side:	0 - +++
	Cattle close to fence on Botswana side:	0 - +++
	Presence of vaccination zone	yes/no
	Presence of surveillance zone	yes/no
	Level of surveillance: At grazing and water points and kraals At markets and checkpoints	 0 - +++ 0 - +++
	Control by CBPP fences	Single 1.4m Single 1.4m with electrification Double 1.4m Double 1.4m with electrification Other options?
	Cattle close to fence on north side:	0 - +++
	Cattle close to fence on south side:	0 - +++
	No critical control points	

[2] As for Table 1.

13.2. Comparison of environmental and social impacts using Rapid Impact Assessment Matrices

The methodology is based upon the Rapid Impact Assessment Matrix (RIAM) for EIAs put forward by Pastakia, C. and Jensen, A. in Environmental Impact Assessment Review (1998) **18**, No 5. This claims to be a replicable and transparent methodology, so that judgements about the impacts can be seen and understood. The system was adapted for the Fences audits, EIAs and SEA by using a SWOT analysis as a starting point, and developing a series of potential impacts, which are to be given scores for each fence. The scores attributed should be based upon professional judgement and assessment of the data collected. These impacts are grouped into three phases:

1. Construction
2. Operation and Maintenance
3. Decommissioning

The potential impact matrix is attached and is to be applied to each of the fences, or route options in turn. It may be necessary to ask the same set of questions of different parts of the fence, if the nature of these parts is very different. However, ultimately a composite for the whole fence will need to be developed.

In assessing the particular impacts, the general effects of fences should be applied to the conditions along the particular routes being compared. The SWOT analysis gives some indications of the aspects considered with each impact, and the sources of information. In developing the criteria for judging significance of each impact, there are no international standards to use, so the reasons for assessing the impact in a particular way should be made clear. Some of the impacts are quite complex, e.g. contribution of the fence to national economy, and may only be answered when the economic analysis has been completed. Or one may wish to disaggregate the contributory impacts. Others may require a detailed analysis of the different components, e.g. changes in wildlife populations for which one would need to assess which populations are affected and ask the same questions for each different affected species, before assessing the general impacts.

For each potential impact, five criteria should be addressed. These are grouped and scored as follows:

Criteria for scoring impacts for completion of Rapid Impact Assessment Matrices

Group	Code	Criterion	Scale	Description
A. Criteria that are of importance to the condition, and that individually can change the score obtained	A1.N	Importance of Condition	1	Important to national/ International interests
	A1.D		1	Important to district interests
	A1.S		1	Important to sub-district interests
	A1.L		1	Important only to the local condition
			0	No importance
	A2	Magnitude of change/ effect	+3	Major positive benefit
			+2	Significant improvement in status quo
			+1	Improvement in status quo
			0	No change/status quo
			- 1	Negative change to status quo
			- 2	Significant disbenefit of negative change
			- 3	Major disbenefit or change
B. Criteria that are of value to the situation, but should not individually be capable of changing the score obtained	B1	Permanence	1	No change/ Not applicable
			2	Temporary
			3	Permanent
	B2	Reversibility	1	No change/ Not applicable
			2	Reversible
			3	Irreversible
	B3	Cumulative	1	No change/ Not applicable
			2	Non-cumulative/ single
			3	Cumulative/ Synergistic

In order to do the calculations, first the A1 criteria – importance of the condition to the area of impact – are added together. This gives equal importance (i.e. a score of 1 point each to the national/international, district, sub-district and local levels. By adding these points we can get weighting which reflects the importance. It is possible to score one point only at the national/international level, but be of no importance at the local level.

1. Add (A1.N+A1.D+A1.S+A1.l) = A1
2. Multiply A1 x A2 = AT,
3. Add (B1 + B2 + B3) = BT
4. Multiply AT x BT = ES

The Environmental Score (ES) for all the questions are then summed for the whole fence for the particular aspects, e.g. Livestock issues, Wildlife or Social issues. The scores for the component aspects will show the sensitivity of the fence to different issues.

The next step is to calculate the Range Band for each impact. The Range Band shows the overall significance of the changes occurring as shown below:

Environmental Score	Range Band	Description of Range Band
+ 72 to +108	+ E	Major positive change/impacts
+36 to + 71	+ D	Significant positive change/ impacts
+19 to +35	+ C	Moderately positive change/ impacts
+10 to +18	+ B	Positive change / impacts
+1 to +9	+ A	Slightly positive change / impacts
0	N	No change/ Status quo/ Not applicable
-1 to -9	- A	Slightly negative change / impacts
- 10 to -18	- B	Negative change / impacts
-19 to -35	- C	Moderately negative change/ impacts
-36 to - 71	- D	Significant negative change/ impacts
-72 to - 108	- E	Major negative change/impacts

Within each of the major categories of impact, the range bands can then be grouped, and the numbers of times in which each range band is recorded. This is presented in the Summary table for each fence or option This gives an indication of the scale of overall impact and orientation (positive or negative) of the fence in question. It also highlights what are the most significant types of impact. Use of a bar chart can show this graphically.

Applying the methodology to the fences

The attached matrix shows the potential impacts of fences developed during the EIA of the Veterinary Fences in Ngamiland. They may need additions for application for EIAs of other fence routes in different parts of the country. For assessment of route options, the RIAMs are used to show the most suitable ones. The fence routes with the highest positive scores should be the ones selected, unless there are other reasons, e.g. political or social unacceptability why a route should not be chosen.

The rapid impact assessment matrices (RIAMs) are a means of comparing the positive and negative impacts of the fences. They summarise and score the different wildlife and ecology, land use, social and economic impacts and are expressed as bar charts. The bar charts may be read by considering the impact range band along the x-axis. These are either positive (right hand side) or negative (left hand side), and increase in significance away from the centre point indicating no change. The higher the bars in each impact range band, the greater the number of impacts recorded for each of the four categories of impact. The higher the bars on the right hand side of the chart, the greater the positive benefits of the fence option; conversely if the bars are higher on the left hand side, the higher the proportion of negative impacts of the fence option

When comparing the three charts overleaf, the top chart (leaving the gap open) shows impacts clustered around the no change or slightly positive impact range. The other two show a much wider spread of impacts across all the range bands, especially towards the left hand (negative impact) side. This

indicates that on balance the option of leaving the gap open is environmentally and socio-economically preferable to fencing the gap with either route.

RAPID IMPACT ASSESSMENT MATRIX - OPERATION OF OPTION TO LEAVE GAP OPEN

Components	Impact/Concern	Local	Sub-district	District	National/ international	Geographic area A1	Magnitude of change/ effect A2	Permanence B1	Reversibility B2	Cumulative B3	Environmental Score ES	Range Band
OPERATION AND MAINTENANCE	Leave Gap open											
						0						
Biological/Ecological						1	-1	3	2	1	-6	-A
Ecosystems	Dissection of habitats	1				1	-1	3	2	3	-8	-A
Rangeland condition	Change in use intensity of forage/ other resources by livestock and/or wildlife	1				1	-1	2	2	1	-5	-A
	Change in frequency or extent of veld fires	1				0					0	N
	Change in vegetation composition, biomass					1	-1	2	2	2	-6	-A
Wildlife	Direct contact with fence leading to mortality	1				1	1	2	2	3	7	A
	Change in competition between livestock and wildlife over forage	1				0					0	N
	Change in wildlife numbers					0					0	N
	Change in distribution or local or larger-scale movements of wildlife species to resources					2	1	2	2	2	0	N
	Change in incidence of wildlife-human conflict -- herbivores on crops, predators on livestock -- leading to impacts on wildlife	1	1			1	-1	1	1	1	-3	-A
	Change in incidence of illegal hunting	1				1	-1	1	1	1	-3	-A
	Change in predation rates at fences	1				1	1	2	2	2	6	A
	Change in transmission of disease from livestock to wildlife	1				0					0	N
	Change in impact on wildlife due to subsidiary fencing											
LANDUSE						1	-1	3	2	1	-6	-A
	Dissection of landforms	1				1	-1	3	2	1	-6	-A
	Change in landscape aesthetics/wilderness value	1				0					0	N
	Effects on distribution of tsetse fly					0					0	N
	Change in access to archaeological sites/public monuments					0					0	N
	Change in condition of archeological sites					0					0	N
	Effects on future land use plans					1	1	3	2	2	7	A
	Effects on gazetted/planned land use status	1			1	1	2	3	2	2	14	B
	Effects on areas of international concern					1	1	3	2	1	6	A
	Change in arable agricultural potential	1				1	1	3	2	1	6	A
	Change in tourism potential	1										

RAPID IMPACT ASSESSMENT MATRIX - OPERATION OF OPTION TO LEAVE GAP OPEN

	Change in livestock distribution (potential)					0					0	N
	Change in national land use potential					0					0	N
	Change in international border land use potential					0					0	N
Sociological / Economic						0						
Cultural	Change in access to sites of cultural significance					0					0	N
Sustainable livelihoods	Effect on competition over land/ wilderness use	1				1	1	3	2	2	7	A
	Change in access to veld products					0					0	N
	Change in access to arable land					0					0	N
	Change in access to grazing					0					0	N
	Effect on access to fishing grounds					0					0	N
	Change in incidence of wildlife-human conflict	1				1	1	3	2	2	7	A
	Change in incidence of livestock theft					0					0	N
	Change in access to perennial water resources					0					0	N
	Employment of community residents in fence maintenance	1				1	1	3	2	1	6	A
	Effect on viability of CBNRM implemented operations	1				1	1	3	2	1	6	A
	Effect on social relations					0					0	N
	Effect on rural administration					0					0	N
ECONOMIC												
	Effects on livestock production for export *	0	0	0	0	0	0	1	1	1	0	N
	Effect on profitability of livestock industry (macro)	2	2	2	1	1.75	1	3	2	3	14	B
	Effects on non-community safari hunting operations					0					0	N
	Effects on non-community photo-tourism operations	2	2	1	1	1.5	1	3	2	3	12	B
	Effect on profitability of tourism industry (macro)	0	0	0	0	0	0	0	0	0	0	N
	Impact on commercial opportunities for supply of fence maintenance activities/materials	2	2	2	1	1.75	1	3	2	1	10.5	B
	Impact on economy at regional/national level	1	1	1	1	1	1	3	2	3	8	A
	Value of veldt products	1	0	0	0	0	-1	3	2	2	0	N
	Change in value of livestock	1	1	1	1	1	1	3	2	3	8	A
	Changes in other disease control costs	0	0	0	2	0.5	-3	3	2	3	-12	-B
	Changes in equity in living standards					0					0	N

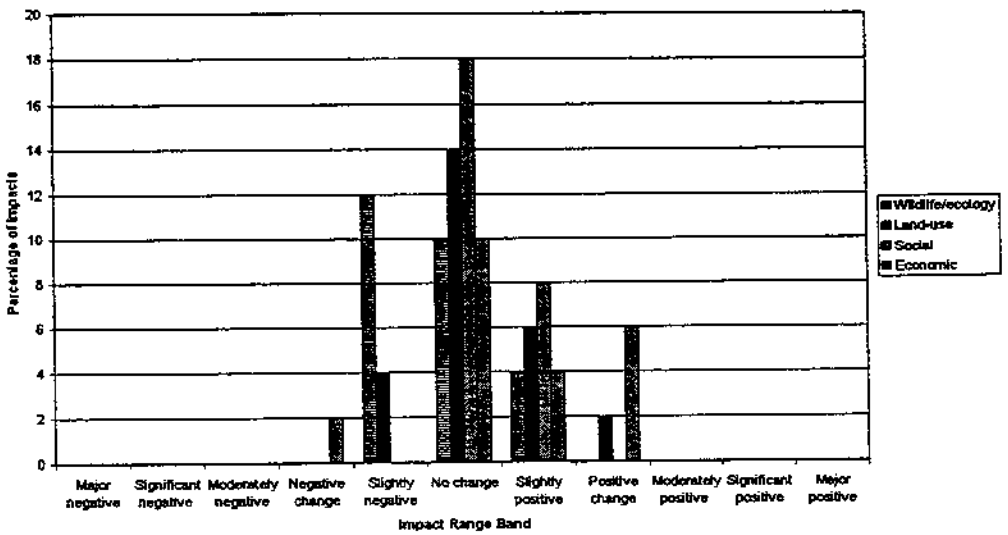
RAPID IMPACT ASSESSMENT MATRIX FOR OPERATION OF RIVER ROUTE TO FENCE THE GAP BETWEEN N. AND S. BUFFALO FENCES

Components	Impact/Concern	Local	Sub-district	District	National/ International	Geographic area A1	Magnitude of change/ effect A2	Permanence B1	Reversibility B2	Cumulative B3	Environmental Score ES	Range Band
OPERATION AND MAINTENANCE												
Biological/Ecological	RIVER ROUTE					0						
Ecosystems	Dissection of habitats	1	1			2	-3	3	2	1	-36	-D
Rangeland condition	Change in use intensity of forage/ other resources by livestock and/or wildlife	1				1	-2	3	2	3	-16	-B
	Change in frequency or extent of veld fires	1				1	-1	2	2	1	-5	-A
	Change in vegetation composition, biomass					0					0	N
Wildlife	Direct contact with fence leading to mortality	1	1			2	-3	2	2	2	-36	-D
	Change in competition between livestock and wildlife over forage	1	1			2	1	2	2	3	14	B
	Change in wildlife numbers	1	1			2	-2	3	3	2	-32	-C
	Change in distribution or local or larger-scale movements of wildlife species to resources	1	1			2	-2	3	3	2	-32	-C
	Change in incidence of wildlife-human conflict -- herbivores on crops, predators on livestock -- leading to impacts on wildlife	1	1			2	1	2	2	2	0	N
	Change in incidence of illegal hunting	1				1	-1	1	1	1	-3	-A
	Change in predation rates at fences	1				1	-2	1	1	1	-6	-A
	Change in transmission of disease from livestock to wildlife	1				1	1	2	2	2	6	A
	Change in impact on wildlife due to subsidiary fencing					0					0	N
LANDUSE												
	Dissection of landforms	1	1			2	-2	3	2	1	-24	-C
	Change in landscape aesthetics/wilderness value	1	1			2	-2	3	2	1	-24	-C
	Effects on distribution of tsetse fly					0					0	N
	Change in access to archaeological sites/public monuments					0					0	N
	Change in condition of archeological sites					0					0	N
	Effects on future land use plans					0					0	N
	Effects on gazetted/planned land use status	1	1			2	0	3	2	2	0	N
	Effects on areas of international concern				1	1	-2	3	2	2	-14	-B
	Change in arable agricultural potential	1				1	1	3	2	1	6	A
	Change in tourism potential	1	1			2	-2	3	2	1	-24	-C

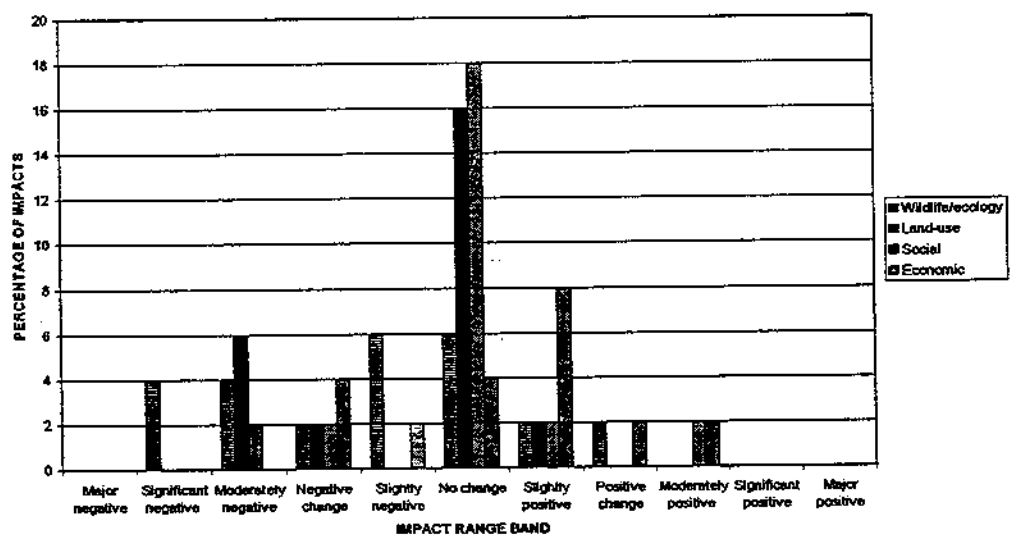
RAPID IMPACT ASSESSMENT MATRIX FOR OPERATION OF RIVER ROUTE TO FENCE THE GAP BETWEEN N. AND S. BUFFALO FENCES

	Change in livestock distribution (potential)					0					0	N
	Change in national land use potential					0					0	N
	Change in international border land use potential					0					0	N
Sociological / Economic						0						
Cultural	Change in access to sites of cultural significance					0					0	N
Sustainable livelihoods	Effect on competition over land/ wilderness use	1				1	-2	3	2	2	-14	-B
	Change in access to veld products					0					0	N
	Change in access to arable land					0					0	N
	Change in access to grazing					0					0	N
	Effect on access to fishing grounds					0					0	N
	Change in incidence of wildlife-human conflict	1				1	1	3	2	2	7	A
	Change in incidence of livestock theft					0					0	N
	Change in access to perennial water resources					0					0	N
	Employment of community residents in fence maintenance	1	1			2	2	3	2	1	24	C
	Effect on viability of CBNRM implemented operations	1	1			2	-2	3	2	1	-24	-C
	Effect on social relations					0					0	N
	Effect on rural administration					0					0	N
ECONOMIC												
	Effects on livestock production for export *	0	0	0	0	0	0	1	1	1	0	N
	Effect on profitability of livestock industry (macro)	2	2	2	1	1.75	1	3	2	3	14	B
	Effects on non-community safari hunting operations	1	1	1	1	1	-1	3	2	3	-8	-A
	Effects on non-community photo-tourism operations	2	2	1	1	1.5	-1	3	2	3	-12	-B
	Effect on profitability of tourism industry (macro)	2	2	1	1	1.5	-1	3	2	3	-12	-B
	Impact on commercial opportunities for supply of fence maintenance activities/materials	2	2	2	1	1.75	2	3	2	3	28	C
	Impact on economy at regional/national level	1	1	1	1	1	1	3	2	3	8	A
	Value of veldt products	1	0	0	0	0	-1	3	2	2	0	N
	Change in value of livestock	1	1	1	1	1	1	3	2	3	8	A
	Changes in other disease control costs	0	0	0	2	0.5	1	3	2	3	4	A
	Changes in equity in living standards	1	1	1	0	0.75	1	3	2	3	6	A

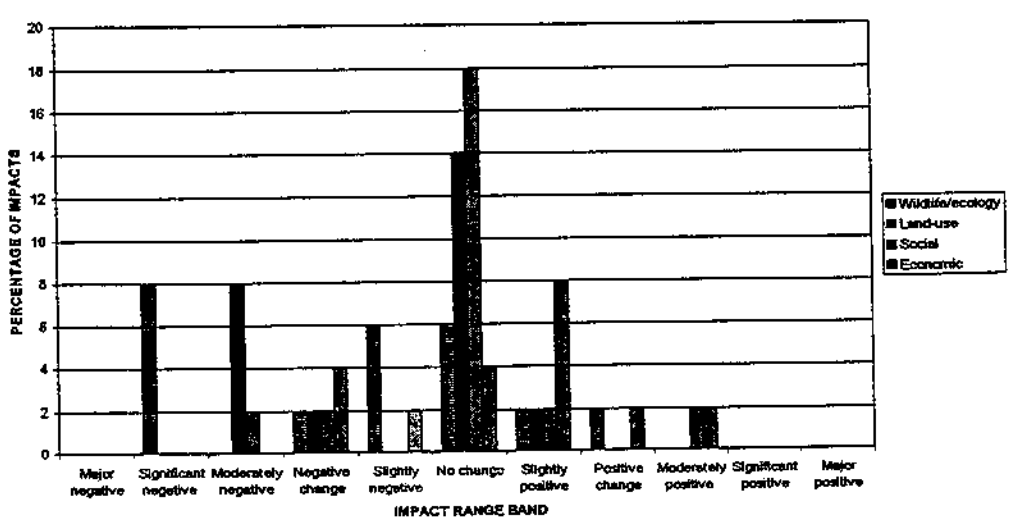
Rapid Impact Matrix for Operation of leaving gap open



RAPID IMPACT MATRIX FOR OPERATION OF FENCING THE GAP ALONG RIVERS



RAPID IMPACT MATRIX FOR OPERATION OF DIRECT ROUTE BETWEEN SOUTHERN AND NORTHERN BUFFALO FENCES



13.3. Cost-benefit analysis

The costs and benefits of each of the livestock disease control options may be compared taking into account the following factors:

- Costs of fence erection
- Costs of fence maintenance
- Costs of other livestock disease control measures, e.g. vaccination and surveillance – these may be changed as a result of changing the disease control zone sizes, and hence for example the numbers of cattle to be vaccinated
- Costs in terms of changes in land use and loss of opportunities for diversification of the rural economy

The benefits may be calculated in terms of:

- Increased value of livestock
- Decreased risk of livestock disease outbreak and the costs needed to control such an outbreak

The following methodology for the economic analysis of animal disease control policy options in Ngamiland has been developed for the EIA of veterinary fences. A framework for the analysis is given in figure 13.3 and linkages are further explained below. Bullet points give principle variables to be assessed for each linkage. This methodology represents the ideal but will to some extent be dependent on data availability.

1. **Impacts of changes to status quo on ecology of affected area in terms of:**
    - Changes in wildlife numbers by species
    - Changes to wildlife migratory patterns and distribution
    - Changes in possible use of affected area by livestock farmers

2. **Impacts of changes to status quo on conditions for rural livelihoods in terms of:**
    - Numbers of cattle that can be accommodated in the affected areas/carrying capacity
    - Number of other livestock that can be accommodated in the affected areas/carrying capacity
    - Changes in risk of cattle diseases
    - Likely impact on arable land use
    - Changes in access to resources such as veldt products and water/mobility of households

3. **Impacts of changes in ecology on the socio-economics of the affected areas**

This is where some of the key analyses will be undertaken on the affected areas looking at:

- Impacts of changes to wildlife numbers/species on numbers of visitors and length of stay
- Income from Wildlife Management Areas
- Impacts of above changes on employment in providing tourism services and sales of crafts etc.
- Impacts on numbers of cattle and other livestock in the affected areas

These impacts may be assessed for a period of 20 years, based on underlying macro-economic data about economic growth, likely prices of cattle versus alternative sources of income and forms of wealth.

4/5 Relationship between changing conditions for rural livelihoods and rural household behaviour.

This will analyse the effects of the primary changes in rural livelihoods as identified in (2) above, on the following:

- Number of cattle held in normal conditions.
- Number of other livestock held in normal conditions.
- Areas under arable cultivation.
- Income from other sources – work in local urban areas, tourism, veldt products, crafts as identified in (3) etc.

The analysis of the numbers of cattle is significantly affected by what happens to the beef market nationally/internationally and this will be taken into account in the time profile. Furthermore, the linkages between cattle holdings and cattle income is complex, with off-take rates affected by drought, income level of the household and other factors. Hence an increase in holdings does not translate simply into an increase in income.

The assessment will estimate the changes in household incomes in normal (and drought) conditions, and how these are affected when there is a disaster such as a cattle disease outbreak.

As the chart shows, this analysis will make use of rural household behaviour models relevant to Botswana, as well as the information collected from the baseline survey.

6. Assessment of economic impacts for different groups.

The results from (5) will be used to identify the changes in welfare – net income in different states of nature – for different groups of rural households. Groups to be looked at include those defined by:

- Level of household consumption or income
- Sources of Income
- Area
- Gender (female headed households)

In addition to income the analysis will look at issues of equity, sustainability and employment.

7/8. Impacts of above changes on populations in the affected areas.

The number of people in the affected areas will be influenced by the changes in household welfare estimated under (6). An assessment will be made of the likely migration resulting from a given option, because conditions have improved, or worsened. Households that move out will be assumed to go to urban areas, or possibly to other rural areas. In either case the change in welfare for them will be taken to be negative and some estimate will be made of how much worse off they are. Conversely if households move into the affected areas, they do so because they are better off and we will attempt to estimate the improvement in their welfare.

The analysis of population movements is complex. As the figure shows, many factors impinge on it and hence we would expect to do some scenario analysis.

Note that these are movements **induced** by the project. Normal migration patterns from rural to urban areas will remain and will affect the aggregate economic impacts (Linkage 9). Also note that there are feedbacks. If induced population movements are very large this affects the welfare of the remaining households. We will try to take account of this, even if it is at a judgmental level.

9. Aggregate economic impact.

This will bring together the benefits/costs of the impacts of the options, spread out over 20 years.

10. Not shown in figure.

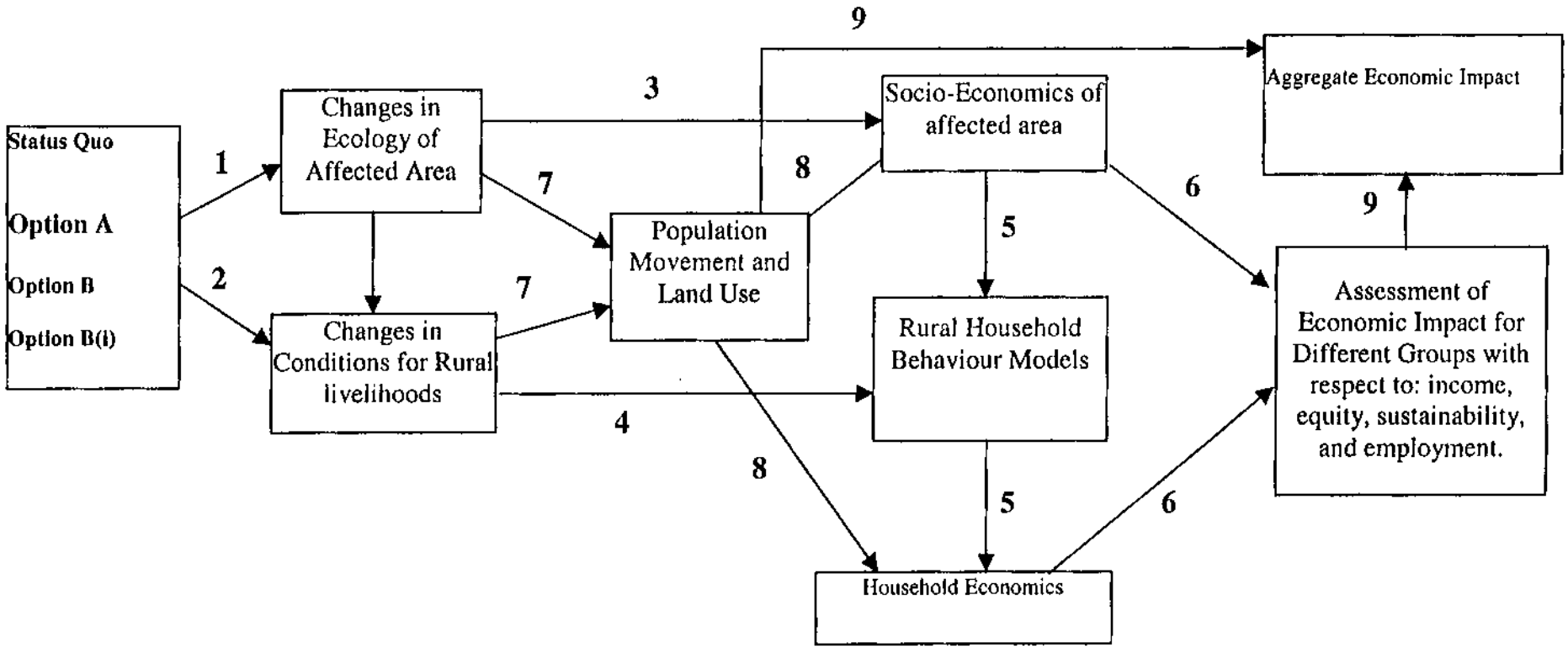
The final analysis will compare impact costs/benefits with the costs of the options (removing/constructing fences, acquiring land, other disease control actions, etc.). Included in the impact cost will be an estimate for expected cost of a disease outbreak based on the risk assessment of the options from the veterinary team. Also included in impact cost/benefit will be an estimate for non-use value of wildlife/natural environment. Results will be reported in Net Present Value (NPV) Terms with discount rates of 10% and sensitivity analyses will be carried out to see what parameters the results are most sensitive to and what minimum values of benefits generate a positive NPV. The comparison of options will also be reported in terms of a number of key parameters including:

- Distribution of benefits/equity
- Leakage of benefits (extent to which benefits accrue to local population)
- Key sustainability indicators
- Employment levels

This analysis will be used to assess the impact of the options for the main stakeholder groups defined by occupation/income sources including cattle farmers, arable farmers, commercial tourist operators, Community based organisations, etc.

As a result of the overall economic analysis, an assessment will be made of the impact of the options on government subsidy to the area. This will include the costs of subsidy to the livestock sector, assistance schemes such as the drought relief programme and any proposed compensation payments to negatively impacted stakeholders.

Fig. 13.3. Framework for Economic Analysis of Animal Disease Control Policy Options



14. REPORTING REQUIREMENTS

In conducting an EIA of a proposed veterinary fence, the following reports, prepared by DAHP, will be required as information for the EIA team:

1. Description of the proposal with a livestock disease risk assessment showing the objectives and need for a fence
2. Description route options for the fence that will achieve the objectives outlined above

With this information, the EIA team should then produce a **Scoping Report**, drawing upon readily available information, which will highlight the following:

- The impacts of the fence routes considered likely to be most significant in the areas through which the routes will pass
- An outline of the data which is available, highlighting the gaps in knowledge and information which will need to be filled by on site investigation
- Details of these investigations required
- A list of stakeholders and communities to be consulted
- If the full EIA is to be undertaken by another group, the Terms of Reference for the detailed study

When the detailed study is complete, the EIA team should produce **an Environmental Impact Assessment Report**, and an **Environmental Impact Statement**. The latter is essentially a summary account of the EIA, and presents the findings and comparison of the routes in a form that is easy to understand for decision-makers and the general public. Supporting reports of the detailed studies and consultations may back up these main reports. The EIA report and the EIS should make recommendations for the route to be chosen and any mitigation measures that may be necessary.