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EPIDEMIOSURVEILLANCE FOR ANIMAL DISEASES IN SOUTHERN AFRICA



(credit : P. Van den Bossche)

Edited by P. Van den Bossche, E. Thys and D. Berkvens

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EDITORIAL

Livestock ownership currently supports or sustains the livelihoods of an estimated 700 million rural poor. In marginal areas, the ownership of livestock is often the only asset that keeps poor families from becoming poorer. Besides its intrinsic value, livestock can provide a stream of food and income, help to raise farm productivity and, for the large amount of landless people, is the only livelihood option available. For small-scale farmers, livestock are often the only way of increasing assets and diversifying risk. Despite its importance, livestock ownership and livestock production is jeopardised by a range of animal diseases resulting in increased mortality rates and directly or indirectly affecting production.

Governments often assisted by donors have invested significantly in controlling or eradicating diseases. The PARC project supported financially by the EC has made enormous efforts to eradicate Rinderpest from the African continent. Similarly, large efforts have been made in the control of African Swine Fever. The Belgian Directorate-General for Development Co-operation (DGCD) also has made substantial investments to improve animal health in developing countries. Among the various DGCD projects focusing on animal health, the Assistance to the Veterinary Services of Zambia (ASVEZA) project was a major one and has for many years been instrumental in the development and transfer of methods for the improved control of East Coast Fever, a devastating disease transmitted by ticks, and animal trypanosomiasis, a livestock disease transmitted by tsetse flies. It has also been important in improving disease control for the small-scale subsistence farmers in southern Africa.

Notwithstanding the availability of an arsenal of preventive and curative control tools, control of certain animal diseases in developing countries remains difficult. This is attributed largely to the limited amount of resources allocated to animal health and changing priorities. Developing countries are thus confronted with considerable and continuous challenges to improve the provision of animal health care. A recent study funded by the DGCD has identified some of the major drawbacks related to the provision of animal health care to smallholders in developing countries.

Despite those considerable drawbacks, decisions with regard to animal health are continuously taken at the international, national and local level. In view of the limited resources available in developing countries, those decisions should be taken on a rational basis taking into account prevailing limitations. Although theoretical models of how epidemics-surveillance networks should be developed and should function are available, it remains questionable if such models are appropriate for the circumstances prevailing in most of the sub-Saharan African countries. Hence, instead of adopting such theoretical models preference was given to embark on a thorough study of existing epidemics-surveillance systems and to the adjustment of existing actions, depending on the requirements. This study was funded by the DGCD and conducted by the Animal Health Department of the Prince Leopold Institute of Tropical Medicine of Antwerp (ITMA) in the context of the DGCD-ITMA Agreement. The overall aim of the study was to obtain a better insight of the roles played by the different actors at several animal disease management levels. A total of eight studies were conducted in four southern African countries (Botswana, Malawi, Zambia and Zimbabwe). The four countries were chosen because of their contrasting livestock management systems and differences in disease management practices. The aim of the studies was to describe ongoing epidemics-surveillance activities under the prevailing conditions. Hereby, attention was paid to data collection, data analysis and ensuing disease control practices.

In southern Zambia, a study was conducted to determine the livestock owners' and veterinary field staff's knowledge of and attitude towards an endemic (East Coast Fever, ECF) and epidemic (Foot and Mouth Disease, FMD) disease. In the Central Region of Malawi and eastern Zambia, the diagnostic capacity and capability of livestock owners, veterinary field staff and district, provincial and central veterinary laboratories was assessed. In eastern Zambia also, a study was conducted to quantify and qualify the veterinary information flow from livestock owner up to the level of the national epidemiology unit. In Zimbabwe, recent outbreaks of FMD were studied and the factors contributing to those outbreaks identified. In Botswana, the existing rabies surveillance database was used to demonstrate how modelling can greatly improve disease data interpretation and disease control actions. Also in Botswana, available epidemics-surveillance data were used to demonstrate the importance of regional epidemics-surveillance networks and of risk assessment in animal disease (FMD) management. The outcomes of the studies demonstrated clearly that although each of the countries has an epidemics-surveillance network, some of the cornerstones of such a system are dysfunctional thus jeopardising the network's usefulness.

The findings of the studies will be further discussed during a consultative workshop with stakeholders planned for the end of 2005. The outcomes of this workshop will contribute to the formulation of recommendations that will assist to direct future research and development in the field of livestock disease epidemics-surveillance in developing countries.

This special issue of Tropicultura that will be used as a working document during the planned workshop aims at informing a large audience on some important issues related to the surveillance and control of animal diseases in developing countries. It reflects the interest and commitments of the DGCD in the field of animal health. I am convinced that this document will be of use in the difficult fight against animal disease in developing countries.

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The control of Foot and Mouth Disease in Botswana and Zimbabwe

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Abstract

Foot and Mouth Disease is an OIE list A disease that seriously constraints livestock production in southern Africa. Two important livestock producers and beef exporting countries, Botswana and Zimbabwe, have put in place an effective FMD control system. The system is based on the division of the country in risk zones and appropriate disease surveillance, livestock identification and movement restriction and control in the different risk zones. Vaccination is carried out in the designated vaccination zones.

Keywords: Livestock, Foot and Mouth Disease, Southern Africa, Disease control system

Résumé

La fièvre aphteuse (FMD) est une maladie classée A par l'OIE, qui limite sérieusement la production animale en Afrique australe. Le Botswana et le Zimbabwe, tous deux grands producteurs de bétail et exportateurs de viande de boeuf, ont mis en place un système efficace de contrôle de la FMD. Le système est basé sur la division du pays en zones à risque avec surveillance adaptée de la maladie, sur l'identification du bétail et la limitation des mouvements ainsi que le contrôle dans les différentes zones à risque. La vaccination est effectuée dans les zones de vaccination désignées.

Mots-clés: Bétail, Fièvre aphteuse, Afrique australe, Système de contrôle de maladies

Resumo

A febre aftosa (FMD) é uma doença da lista A da Organização Mundial de Saúde animal (OIE) que restringe seriamente a produção pecuária no sul da África. Dois importantes países produtores pecuários e exportadores de carne bovina, Botsuana e Zimbábue, introduziram um sistema de controle eficaz contra FMD. O sistema baseia-se na divisão do país em zonas de risco e em uma apropriada vigilância da doença, identificação e restrição do movimento do rebanho e controle nas diferentes zonas de risco. A vacinação é realizada nas zonas designadas.

Palavras-chave: Pecuária, Febre aftosa, Sul da África, Sistema de controle de doença

Introduction

Among the diseases listed in the OIE list A, Foot and Mouth Disease (FMD) constitutes a significant constraint to international trade in live animals and animal products. The disease is reported in two-thirds of the OIE member states (Vosloo *et al.*, 2002). Recent outbreaks of FMD (2000 – 2003) have affected millions of animals in Europe, Asia and Africa (*i.e.* in the United Kingdom, Taiwan, South Africa and Zimbabwe). These outbreaks have revived concerns about the adequacy of early detection systems required to prevent such epidemics.

In Africa FMD is highly prevalent. However, many African countries allocate low priority to FMD resulting in an underreporting of the number of outbreaks to the OIE. Six of the seven FMD virus serotypes occur in Africa and three of these (the Southern African Territories (SAT 1, 2 and 3) are unique to Africa. They are mainly found in southern Africa and are associated with the African buffalo (*Syncerus caffer*) which acts as reservoir of infection to domestic animals (Sutmoller *et al.*, 2000).

As a result of effective control, some countries of southern Africa have gained access to the lucrative beef and other livestock markets in Europe resulting in huge economic benefits. Zimbabwe and Botswana, for example, are two countries that through the establishment of a range of effective measures to control FMD have benefited from such exports.

FMD control measures in Botswana and Zimbabwe

The organization of veterinary services

Botswana – In Botswana, the backbone of animal disease control is the Diseases of Animals Act (28 January 1977). The Act provides for the prevention and control of animal diseases, the regulation of imports and exports, the movement of animals and animal related products and, under certain circumstances, the quarantine of animals.

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The country is compartmentalized into disease control zones with cordon fences between the different zones (Figure 1).

These fences, initially aimed at preventing close contact between the African buffalo and domestic livestock, are mostly found in the northern part of the country where the most important reservoir of the FMD virus is almost exclusively found.

The country has 19 veterinary districts, divided over 6

regional offices. One or more disease control zone may fall within a veterinary district. Each district is further divided into extension areas each comprising 8-10 crushpens manned by an animal health technician under the supervision of a state veterinarian.

Zimbabwe – In Zimbabwe, disease surveillance, monitoring and reporting relies on a country-wide network of Veterinary Offices (Figure 2).

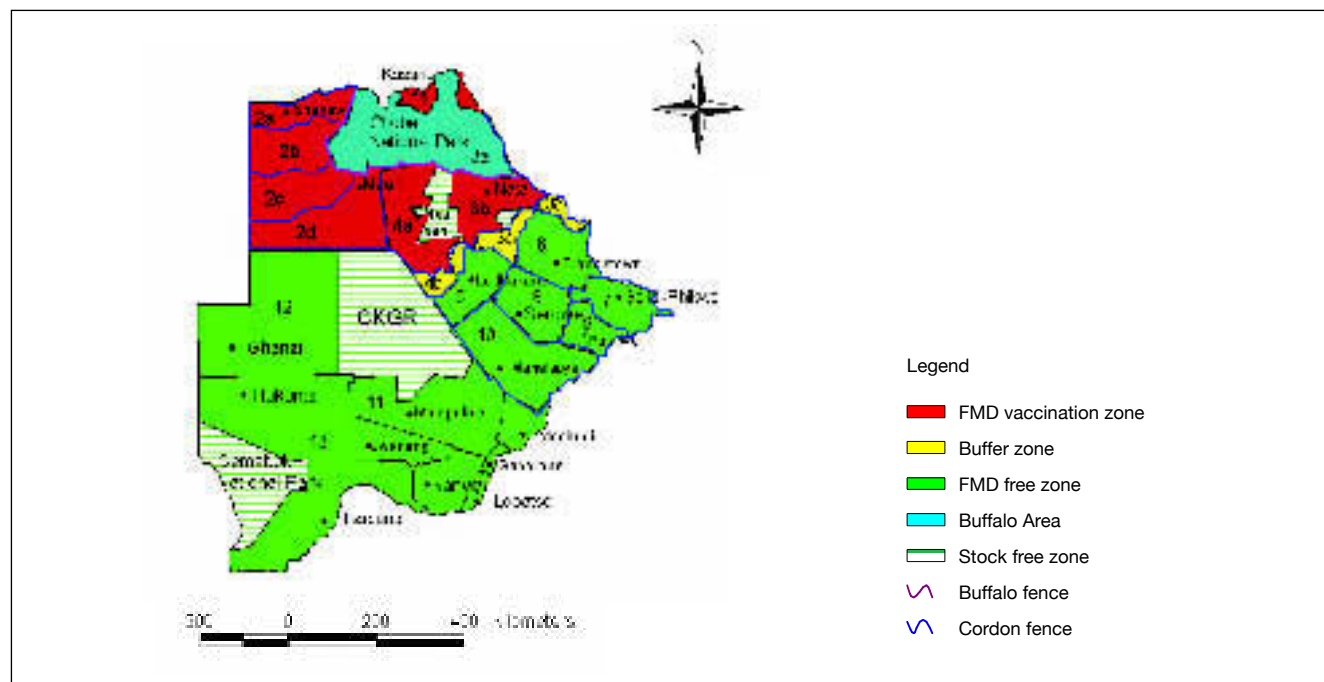


Figure 1: Map of Botswana showing disease control zones and cordon fences.

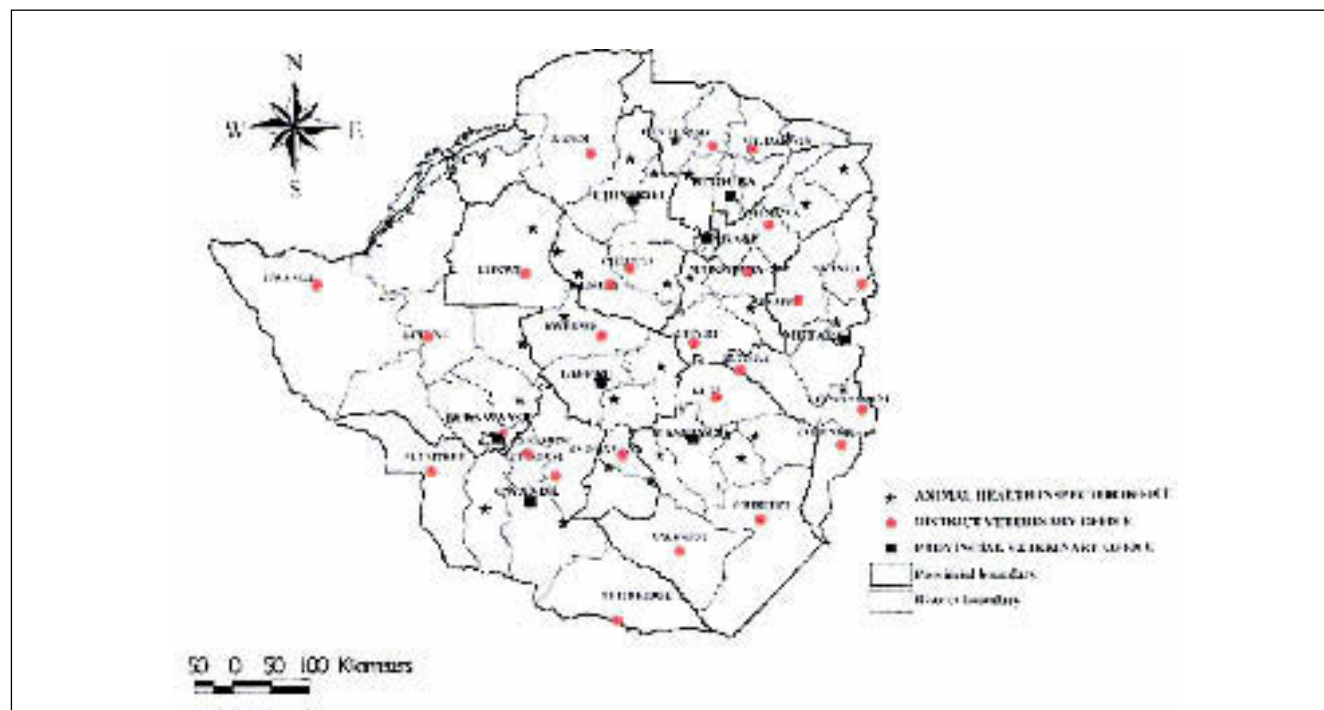


Figure 2: Location of veterinary offices in Zimbabwe.

They comprise 8 Provincial Veterinary Offices and 3 Provincial Diagnostic Laboratories (at Bulawayo, Mutare and Masvingo). There are 54 District veterinary offices of which most are headed by Veterinarians, 8 sub-district offices in the Commercial Farming Areas and 308 Animal Health Management Centres in Communal areas. A network of 632 dip tanks for tick control are located in both Commercial and Communal areas.

The control of FMD in Botswana

Historically, Botswana had three regions where FMD outbreaks were likely to occur (Falconer, 1972). They were Ngamiland and the Chobe area (now zones 2 and 1 respectively), the Boteti river area (now zone 4a) and the Nata area (now zone 3b), (Figure 1). From the early 1950s physical barriers in the form of livestock fences were strategically constructed within these regions to prevent spread of the disease from infected buffalo to susceptible livestock. Until 1963, movement controls were supported by apthisation. The latter involved the artificial infection of animals within the FMD control areas with live virus obtained from infected animals.

Vaccination -- In 1965, a policy of annual vaccination, using attenuated vaccines incorporating the SAT1 and SAT3 serotypes, was initiated (Falconer, 1972). This vaccine was altered in 1969 by including the SAT3 serotype. Currently, vaccination of cattle using the trivalent vaccine is conducted twice per year (March/April and October/September) within disease control zones 2b-2d, 4a and 3b. In zones 1 and 2a vaccination is performed three times a year (March, July and November). The latter is due to the higher risk of cattle-buffalo contact. During each FMD vaccination campaign, all cattle from the vaccinated zones are

branded for identification purposes. Because of their apparently insignificant role in the epidemiology of FMD in Botswana, goats and sheep are not vaccinated. Pigs are also not vaccinated since there are very few in the communal areas.

Fencing and inspections -- A buffalo fence separates the national parks from the vaccination zones (Figure 1). In the event of buffalo incursions into any of the vaccination zones 2, 4a and 3b, oral inspection or mouthing for FMD lesions of all cattle belonging to crushpens in the vicinity of the incursions/sightings is performed at intervals of two weeks until the area has been cleared of the buffalo and the absence of the disease in livestock confirmed.

Movement control -- The movement of animal and animal product between disease control zones is regulated by movement protocol and sanctioned through official movement permits. Internal movement permits can be issued by state veterinarians and animal health technicians from the districts. International movement permits, on the other hand, are issued by state veterinarians based at the veterinary headquarters in Gaborone. Strategically positioned disease control gates and animal quarantine facilities around the country allow for inspection of permits and animals before further movement.

Livestock traceability and identification -- Since 1999, Botswana also benefits from a computerized system of individual animal identification based on the reticular bolus. This "Livestock Identification and Traceability System" (LITS) is currently adopted in cattle only, but it is intended that it will be gradually transferred to other livestock species in the country (Figure 3).



A



B

Figure 3: The new "Livestock Identification and Traceability System". Insertion of the bolus (A) and identification of each animal as it passes through the crushpen using a static reader (B) (Printed with permission from VEES, Department of Animal health and Production).

General disease surveillance – Disease surveillance is conducted by state veterinarians, animal health technicians and private veterinarians in the course of their normal daily duties conduct.

The control of FMD in Zimbabwe

In Zimbabwe, FMD is a notifiable disease under the Animal Health Act (AHA) (Foot and Mouth) Regulations, (1971) and by the Animal Health (General) Regulations, (1994).

Zoning and fencing -- For the purposes of FMD control, Zimbabwe is zoned using a network of approximately 3000 km of cattle and 1500 km of game fences. Four different zones are distinguished (Figure 3). They are (i) the infected zones (National parks where wildlife including African buffalo are found), (ii) the vaccination zones (Red zones) immediately adjacent to the infected areas, (iii) the buffer zones (Green zones) adjacent to the red zones and (iv) the clear zones and European Union (EU) catchment (export) areas. The clear and catchment areas are further sub-divided into smaller units usually based on district boundaries, and have different brand-marks. (Figure 4).

coded brand upon transfer.

A new computerized individual cattle identification system was initiated in 2001. All farmers were encouraged to join the Livestock traceability scheme through the country. Unfortunately, the implementation of program was interrupted because of the FMD outbreaks in 2001.

Vaccination -- In the vaccination zone, vaccination using the trivalent vaccine occurs twice per year (May-June and November-December). Theoretically all cattle in the vaccination zones should be inoculated. Failure to bring all animals for vaccinations is an offence.

Movement control -- Movement permits are required before animals can be allowed to move. They are issued after pre-loading inspection for animals that go for direct slaughter. Animals will be slaughtered only after the transport permits have been handed over to the veterinary personnel at the abattoir. Movement between FMD zones also requires the necessary permits. Permits to move from the buffer zone to the catchment zone will only be issued after animals have tested negative serologically for FMD followed by pre-loading inspection and date-code branding.

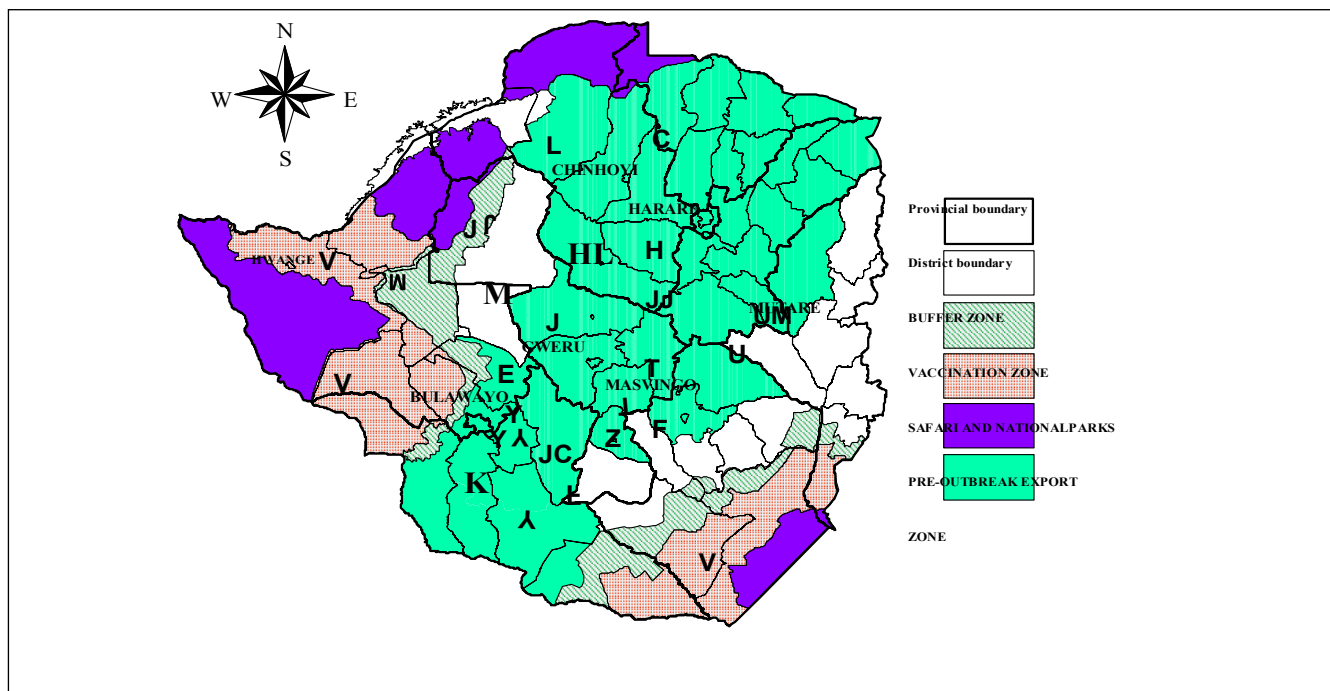


Figure 4: Location of FMD control zones, prior to the 2001 FMD outbreaks, in Zimbabwe.

Livestock traceability and identification – To ensure animal identification and allocation to a specific FMD zone, all Zimbabwean cattle above six months of age are required to have a veterinary brand of their zone/district of origin. Inspections for brands are conducted during dipping sessions in communal areas and during farm inspections in commercial areas. To allow for controlled movement between buffer zone and clear zone, animals from the buffer zone receive a date

Animals within the catchment zone are free to move to any part of the country after being issued with a movement permit. Only when they move to the red zone vaccination before transfer will occur and they will not be allowed out of the red zone except when transported for direct slaughter. During and FMD outbreak movement of livestock is restricted severely.

Surveillance -- The inspection of cattle in communal areas occurs at least every fortnight at the time of dipping. Commercial farms, registered at the District offices, are visited once every three months. Besides the programmed disease surveillance, general surveillance occurs when Veterinary Officers and other veterinary staff are requested to attend to sick animals and when conducting their routine advisory work at farms. Furthermore, animal inspection occurs prior to issuing movement permits and at auction sales. After animals have been inspected, a "report form" is completed. One copy of the report form will be filed at the District Office whereas the other copy will be sent to the Information Management Unit of the Department of Veterinary services.

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Recent outbreaks of Foot and Mouth Disease in Botswana and Zimbabwe

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Abstract

Preventing the spread of FMD is based on various interventions that attempt to minimize the contact between infected and not infected animals and restrict the movement of possible virus carriers. Such measures have proven to be highly effective when adhered to. The recent outbreaks of FMD in Botswana and Zimbabwe are examples of the need for a swift and integrated approach when such an outbreak occurs. This approach is based on clinical inspection of animals (game and domestic) at risk to identify infected animals, the identification of the index case(s), strict movement controls, vaccination and slaughter. Such interventions can prevent the spread of the disease but are logistically, financially and sometimes politically very demanding. Failure to implement such control measures may result in the rapid spread of the disease and considerable economic loss.

Keywords: Livestock, Game, Foot and Mouth Disease, Southern Africa, Disease control, Integrated approach

Résumé

La prévention de la diffusion de la fièvre aphteuse (FMD) est basée sur diverses interventions qui tentent de minimiser le contact entre animaux infectés et non infectés et de limiter les mouvements des porteurs de virus potentiels. De telles mesures ont prouvé être hautement efficaces quand elles sont appliquées. Les épizooties récentes de FMD au Botswana et au Zimbabwe sont des exemples de la nécessité d'une approche rapide et intégrée lors de telles apparitions de la maladie. Cette approche est basée sur l'inspection clinique des animaux à risque (sauvages ou domestiques) dans le but d'identifier les animaux infectés; sur l'identification de premiers cas; sur le contrôle strict des déplacements; sur la vaccination et sur l'abattage. De telles interventions peuvent empêcher la diffusion de la maladie, mais sont logistiquement, financièrement et, parfois, politiquement très exigeantes. L'échec de la mise en oeuvre de telles mesures de contrôle peut aboutir à une diffusion rapide de la maladie et à des pertes économiques considérables.

Mots-clés : Bétail, Gibier, Fièvre aphteuse, Afrique australe, Contrôle des maladies, Approche Intégrée

Resumo

A prevenção da disseminação da febre aftosa (FMD) baseia-se em várias intervenções as quais tentam minimizar o contato entre animais infectados e não infectados e restringir o movimento de possíveis portadores do vírus. Tais medidas provam ser altamente eficazes quando adotadas. Os recentes surtos de FMD em Botswana e no Zimbábue são exemplos da necessidade de uma abordagem rápida e integrada quando tais surtos ocorrem. Esta abordagem é baseada na inspeção clínica dos animais (selvagens e domésticos) para possível identificação de animais infectados, identificação de caso(s) índice, rigoroso controle de movimentos, vacinação e abate. Tais intervenções podem prevenir a disseminação da doença, mas são logisticamente, financeiramente e às vezes politicamente muito exigentes. Falhas na implementação destas medidas de controle podem resultar em rápida disseminação da doença e em uma considerável perda econômica.

Palavras-chave: Gado, Selvagem, Febre aftosa, Sul da África, Controle de doença, Abordagem integrada.

Introduction

Botswana and Zimbabwe are two southern African countries that rely heavily on agricultural exports of animal origin. The uncontrolled presence of Foot and Mouth Disease (FMD) in any of these countries has disastrous repercussions.

In Botswana, the first official records of FMD date back to the period between 1850 and 1900

(Thomson, 1994). Between 1933 and 1980, Botswana experienced FMD outbreaks at two years intervals. Notable exceptions were the periods between 1950 to 1957 and 1968 to 1977 where there was a lapse of 6 and 8 years respectively between outbreaks. The last reported outbreak of FMD in Botswana, before 2002, was in September 1980.

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Zimbabwe also has a long history of FMD outbreaks and up to 2001 managed to control the disease effectively. For example, the June/July 1999 FMD outbreaks which occurred on two ranches in the buffer zone of Chiredzi District (Masvingo Province) were controlled successfully. Recent changes in the political and economic scene, however, have had important repercussions on the functioning of veterinary services and the control of FMD. This is clearly demonstrated by the FMD outbreaks occurring between 2001 and 2003.

Recent FMD outbreaks and their control

The Matebeleland North Province outbreak in 2001 (Zimbabwe)

On 18 August 2001, FMD was reported in cattle at Dunstall Feedlot in Bulawayo, Matebeleland North Province. Immediately after reporting, large portions of the Province were put under quarantine while control measures, which included vaccinations and restrictions on animal movements, were instituted. Detailed investigations indicated that about 300 steers, intended for slaughter and purchased from the buffer zone in Matebeleland North by Cold Storage Company (CSC) a week before the 18th of August, were taken to Dunstall feedlot. Some of the animals

were transported to three other properties (Maphaneni Ranch and other properties south of Gwanda) of the CSC in Matebeleland south Province. Trace-backs from Dunstall feedlot revealed that the infected steers came from an infected area in Lupane (Figure 1).

The SAT2 serotype was involved. The oldest lesions seen were estimated to have been between five and seven days old on 18th August, and about 40% of the Steers exhibited lesions. Urgent tracings of all movements from Dunstall feedlot were conducted and all properties involved were subjected to veterinary inspections. All properties that had received animals from Dunstall were found infected, and became source of infection themselves. By October 2001, 1536 cases had been confirmed and 7634 cattle vaccinated. From November 2001 up to March 2002 no new cases were reported.

The Matsiloje extension area (Francistown District) outbreak in 2002 (Botswana)

After the Zimbabwean Department of Veterinary Services announced the outbreak of FMD in Matebeleland North Province in August 2001, Botswana instituted FMD surveillance in the Francistown and Selibe-Phikwe veterinary districts bordering Zimbabwe. Furthermore, a countrywide passive surveillance involving visual

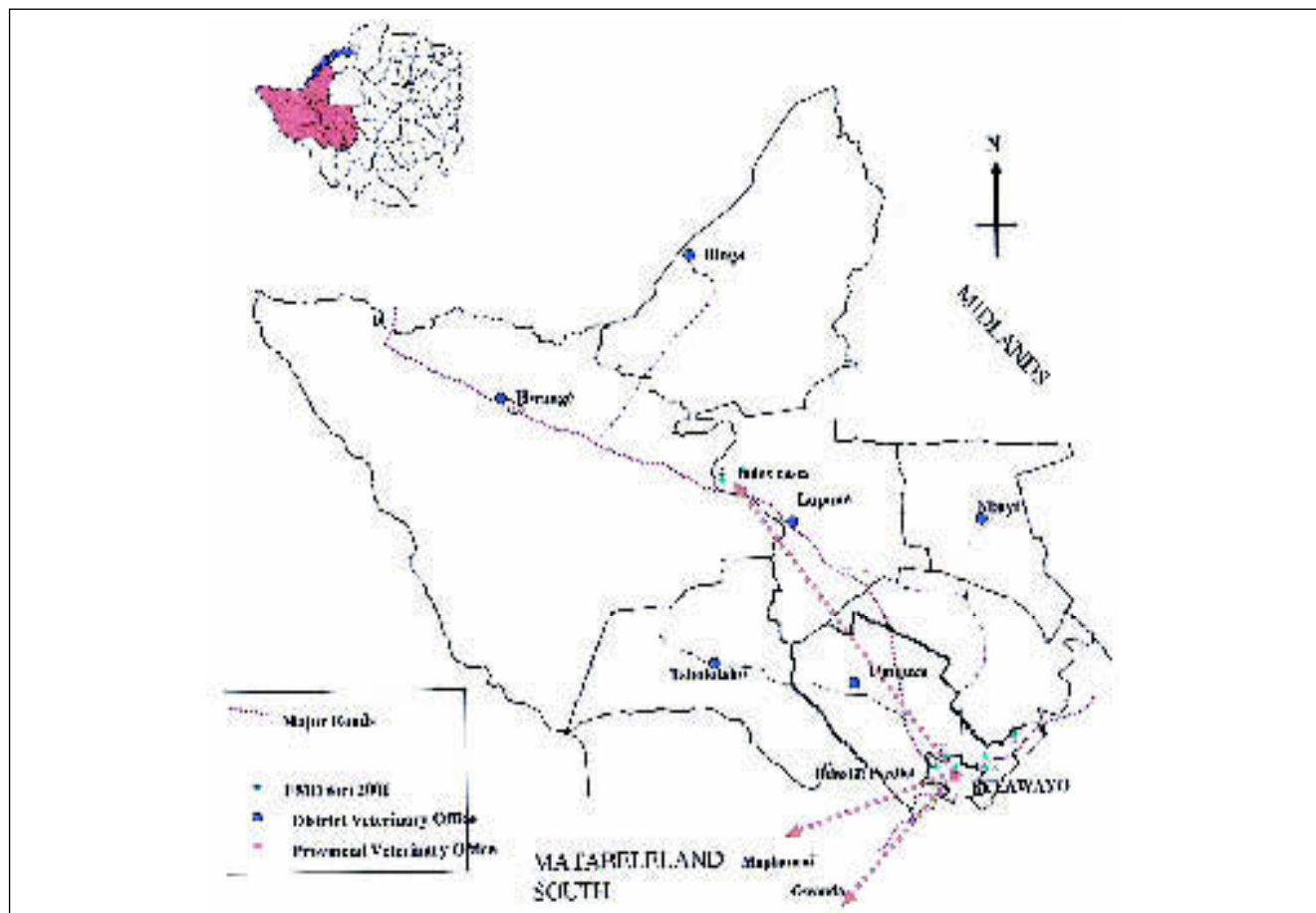


Figure 1: Trace-back from Dunstall feedlot to index case in Lupane and further spread to Matebeleland South Province.

inspection of all cloven hoofed livestock was initiated and the public was sensitized through all media available. On 7 February 2002, a surveillance team reported cattle showing signs suggestive of FMD at Lephaneeng crush in the Matsiloje extension area (Figure 2).

from the Botswana Defense Force, Botswana Police Services and the Special Support Group (SSG). On 27 February 2002, a second FMD case was detected at Rakop1 crushpen within the infected zone (Figure 2). All animals from the infected crushpens were impounded

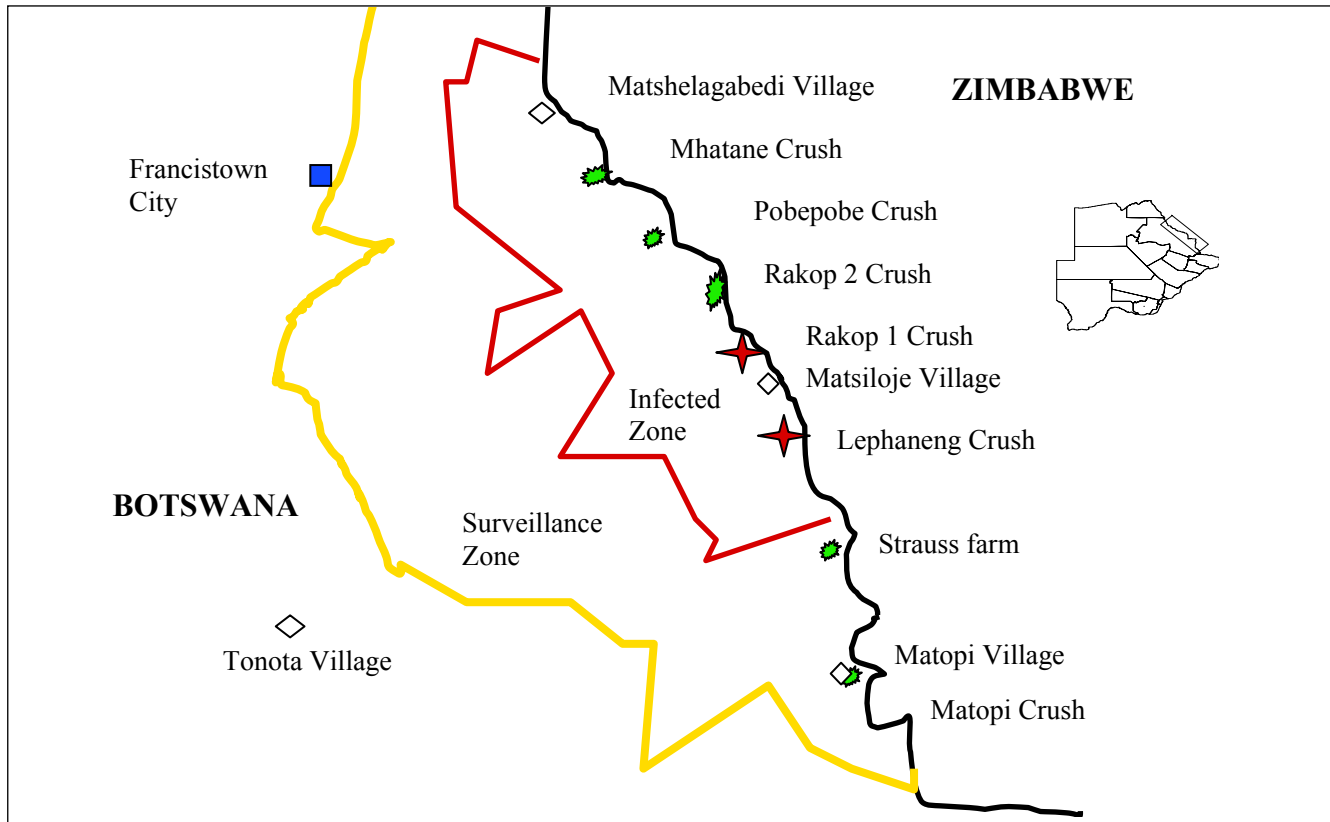


Figure 2: The delineated control zones during the 2002 FMD outbreak. Only the infected crushes and those alongside the border have been shown.

The district veterinary officer supported the diagnosis and a veterinary team from headquarters in Gaborone arrived the same day. A total of 66 out of 8000 cattle clinically inspected were found to have lesions characteristic of FMD. The estimated date of first infection was estimated to be 31 January 2002.

Foot and Mouth Disease (serotype SAT 2) was officially diagnosed on 9 February and later confirmed by the Institute for Animal Health, Pirbright. The virus isolated from the Matsiloje outbreak area was genetically closely related to the Zimbabwe isolates collected near Bulawayo in August 2001 (Knowles & Davies, 2002).

Immediately after confirmation of the outbreak, the whole of Matsiloje extension area was considered infected zone and delineated based on the existing physical barriers in the area. The adjacent surveillance zone extended up to 20 km from the perimeter of the infected zone. Pickets were established at 5 kilometers intervals around the perimeters of both zones. Roadblocks for disinfection were set up at all access points as well as on all major roads leading into zones 6 and 7. Extensive use was made of logistical support

whereas in other crushpens with absence of clinical infection, vaccinations were carried out with the trivalent vaccine. Cattle in the infected zone were vaccinated and branded "I" for identification purposes. The total goat and sheep population (6,594 goats and 761 sheep) of the infected zone were clinically inspected and serologically tested but results were negative. Furthermore, 56 Impala (*Acepyceros melampus*) and 5 Greater Kudu (*Tragelaphus strepsiceros*) also yielded negative FMD results on clinical and serological tests. In the immediate surveillance zone, clinical inspections of approximately 30,000 cattle were carried out five times at intervals of two weeks with negative results. In the outer surveillance zone, 330 000 cattle were clinically inspected and a total of 34 200 sera collected. Clinical and serological results were negative. Subsequently, the Cabinet approved the strategy recommended by the Department of Animal Health and Production to destroy the cattle population in the infected zone. By 21 May, all 12,197 cattle in the infected zone had been killed and disposed of by deep burial. All 131 pigs in the infected zone were also destroyed and buried even though no lesions were observed on clinical inspections.

The Masvingo Province outbreak in 2002-2003 (Zimbabwe)

In August 2002, new FMD outbreaks were reported in a communal area of Masvingo Province of Zimbabwe. The infected area was located close to a conservancy where buffalo were reported to have mixed with cattle (Figure 3) since sections of the fence of the conservancy were destroyed. Furthermore, people had settled in the conservancy and cattle were observed grazing inside the conservancy. Poaching was common and routine patrolling and maintenance of the fence was not conducted. Concurrently, livestock movements had intensified as a result of the land reform program and were difficult to control. This and other factors such as shortage of vaccines and limited resources contributed to the quick spread of the disease in the province and subsequently to other provinces (Figure 3).

The serotype involved in all the outbreaks was the SAT 2. Animal movement restrictions were intensified in affected areas by setting up road blocks on major roads. Control measures used were based on vaccinations of cattle in the 10 km radius and quarantine in the 20-40 km radius. As the disease spread, mass vaccinations in affected Districts (about 140 000 were vaccinated in Masvingo Province) were

conducted. Individual identification of vaccinated animals was done by branding with an inverted “V” brand and those with clinical signs with an “S” brand. No animals were slaughtered.

The Matopi crushpen (Francistown District) outbreak in 2003 (Botswana)

Matopicroshpen is located approximately 15 kilometers south of Lephaneng crushpen where 66 cases of FMD were diagnosed during the Matsiloje outbreak (see above). On 6 January 2003, a farmer at Matopi crushpen reported extensive lameness amongst his cattle. The day after, FMD was diagnosed based on observed clinical signs in 9 out of 900 cattle at the same crushpen. The estimated date of first infection was 23 December 2002. The diagnosis was confirmed by the BVI and the Institute for Animal Health, Pirbright.

Upon diagnosis of the disease, the infected and surveillance zones were determined and delineated following existing physical barriers. Biosecurity measures similar to the ones implemented in 2002 were adopted. Clinical inspection in a targeted 25 km x 30 km zone revealed 14 more cases in Matopi crush. Two cases were identified in Tsiteng crush 8 km south of Matopi crush and on 24 January a case was

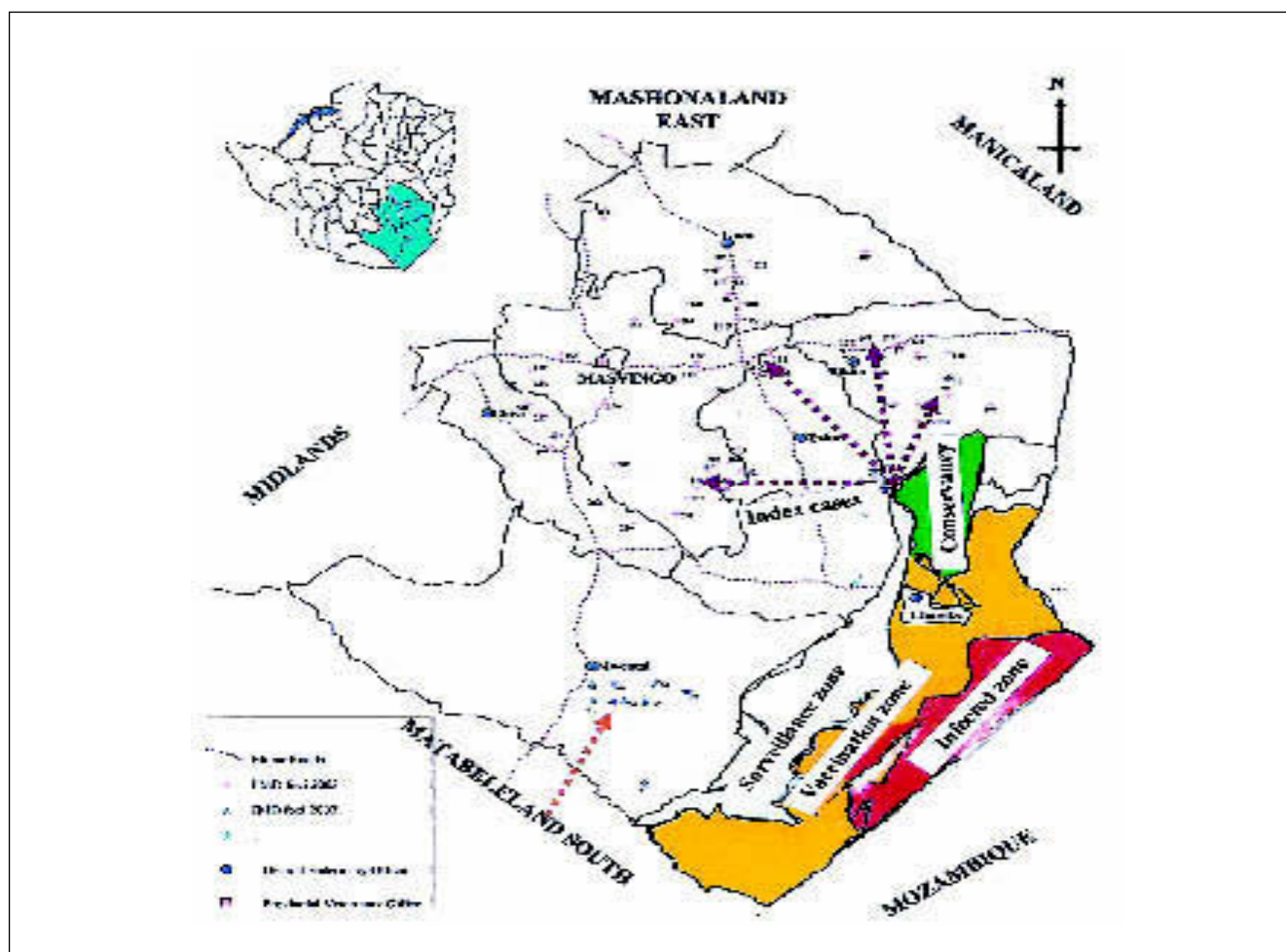


Figure 3: Spread of FMD from index cases near a conservancy in Masvingo Province.

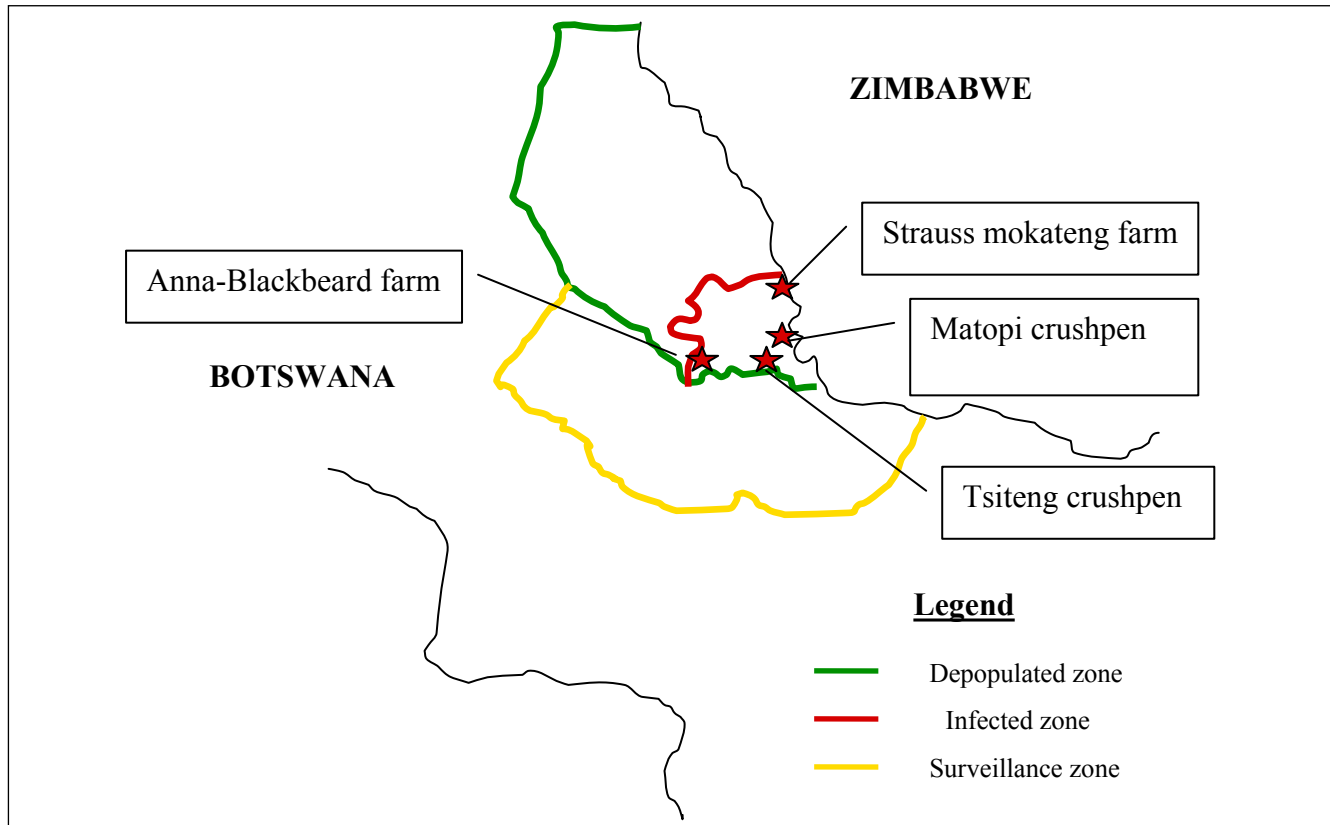


Figure 4: The delineated control zones during the 2003 FMD outbreak. Only infected crushes are shown.

recorded at Anna Blackbeard farm approximately 10 km south of Tsiteng. This brought the total number of bovine cases in the delineated infected zone to 26 in an estimated cattle population of 5000. Still within the infected zone, a surveillance team spotted and shot a lame emaciated wild Kudu. Samples obtained from the cattle and Kudu cases were confirmed positive for FMD serotype SAT 1. Subsequently, a total of 389 goats and 32 sheep (representing the total population in the area) were clinically inspected and sampled. Both clinical and serological results were negative for FMD. A sample of 123 cloven-hoofed wildlife species (97 Impala and 26 Kudu), also from within the infected zone, were clinically and serologically tested and also found to be free of FMD. The spread of the disease was finally halted by destruction of all the 3 864 cattle and 58 pigs in the infected zone.

Discussion

Foot and Mouth Disease is a highly contagious transboundary disease that can spread rapidly within the livestock population. Experiences in southern Africa, especially in Botswana and Zimbabwe, have proven that through a combination preventive and curative measures outbreaks can be controlled

effectively. Together, those measures constitute an early warning system and delay the spread of infected animals into a susceptible population when an outbreak occurs. The experiences of the recent outbreaks in Botswana and Zimbabwe clearly show that for an effective control all components contributing to this effectiveness need to be present. This requires important financial, logistical and sometimes political commitments. Failure to allocate sufficient resources may result in a fast and devastating spread of the disease.

Acknowledgements

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Modeling Foot and Mouth Disease risk factors in Botswana

Mokopasetso, M.

Abstract

Various factors may contribute to the spread of an infectious transboundary disease such as FMD. Careful assessment of the risk of importing the virus in an area may help focus preventative measures. In the case of FMD two modes of transmission *i.e.* airborne and contact should be considered. To determine the likelihood of contact or airborne transmission of FMD into herds kept under communal livestock management practices in Botswana two models were developed. The outcome of the models showed that contact transmission is the most likely way of disease introduction and spread in the livestock herds of the communal areas of Botswana. Conditions favouring airborne transmission are not present.

Keywords: Livestock, Foot and Mouth Disease, Southern Africa, Modelling, Risk factors

Résumé

Différents facteurs peuvent contribuer à la diffusion d'une maladie infectieuse transfrontalière telle que la fièvre aphteuse (FMD). L'évaluation précise du risque d'importation du virus dans une zone peut aider à mettre au point les mesures préventives. Dans le cas de la fièvre aphteuse, deux modes de transmission sont à considérer: celle par voie aérienne et celle par contact. Pour déterminer la probabilité de contact ou de transmission par voie aérienne de la fièvre aphteuse dans des troupeaux de bétail gérés communautairement au Botswana, deux modèles ont été développés. Le résultat des modèles a montré que la transmission par contact est la voie la plus probable d'introduction et de diffusion de la maladie dans les troupeaux de bétail des zones communautaires du Botswana. Les conditions favorisant la transmission par voie aérienne n'y sont pas présentes.

Mots-clés : Bétail, Fièvre aphteuse, Afrique australe, Modélisation, Facteurs de risque, Elevage communautaire

Resumo

Vários fatores podem contribuir para disseminar uma doença contagiosa sem fronteiras como a febre aftosa (FMD). A avaliação cuidadosa do risco de importação do vírus em uma área pode ajudar no foco de medidas preventivas. No caso da febre aftosa dois modos de transmissão - pelo ar e por contato - devem ser considerados. Para determinar a probabilidade de transmissão da febre aftosa por contato ou pelo ar dentro de rebanhos mantidos sob práticas de manejo comunal em Botswana dois modelos foram desenvolvidos. O resultado dos modelos mostrou que a transmissão por contato é a via mais provável de introdução e disseminação da doença nos rebanhos das áreas comunitárias de Botswana. Condições que favoreçam a transmissão pelo ar não estão presentes.

Palavras-chave: Gado, Febre aftosa, Sul da África, Modelizando, Fatores de risco

Introduction

Effective control and prevention of a transboundary infectious disease such as Foot and Mouth Disease (FMD) relies largely on the careful assessment of the risk of introducing the virus in an area. Various factors may contribute to the spread of the virus. In the Matsiloje and Matopi areas of Botswana, for example, illegal transboundary movements of infected livestock from a neighbouring country resulted in a disease outbreak. Further transmission of the virus into the susceptible herd can be the result of contact or can occur via the air. To determine the likelihood of contact or airborne transmission of FMD in Botswana into herds kept under communal livestock management practices two models were developed. The likelihood of each mode of transmission in the circumstances prevailing in Botswana was determined.

Material and methods

Model parameters for contact transmission

To develop the model for contact transmission of FMD virus, certain assumptions had to be made. First, it was assumed that 10 cattle per month entered into Botswana from a neighbouring country. This figure can be considered a reasonable estimate and was based on estimates made by the Botswana Department of Animal Health and Production. Furthermore, it was assumed that FMD was present in the neighbouring source population at a prevalence of 0.1 and that on average 1 infected animal was smuggled into Botswana per month. Once the infected animal was introduced into the susceptible population, the number of infective animals that this animal produced during its entire infective period was defined as R_0 .

Under communal grazing practices in Botswana, the following factors were considered to determine the level of contact between the infected animal and the susceptible population:

- An infected animal will be kept within the susceptible herd and graze in a small cluster. However, it will share pasture as well as water sources with other herds in the communal area and hence mix temporarily with animals from other susceptible herds.
- Close contact between infected and not-infected animals is more likely to occur overnight when animals are kraaled, at watering points or when animals are packed into crush races during routine vaccinations.

Based on the above factors and review of the literature (Ferguson *et al.*, 2001) an average R_0 -value of 1.3 was used.

Model parameters for airborne transmission

The main factor determining the level of airborne transmission of FMD virus is the maximum distance over which a plume containing infective virus produced by an infected cattle herd on one side of a cordon fence can travel and successfully infect susceptible animals on the other side of the fence. Due to lack of field data, a lot of assumptions had to be made to simplify the model and yet obtain an appreciation of the likelihood of airborne transmission. Values for the parameters of the model were derived from published data (Table 1).

To allow for a comparison between the airborne and the animal contact model, the same prevalence in the source population ($P = 0.1$) was assumed.

Based on meteorological data from the region, an average wind speed of 2 m/s was used in the model. It was also assumed that the susceptible animals were located downwind from the infected herds.

Under an extensive husbandry system, cattle graze over extensive areas and therefore are seldom stationary in

one area for a long period of time. For the purposes of the model, 6 hours was assumed to be a reasonable upper limit for the length of time that the susceptible herd had to graze in one area in order to receive the plume of virus from the infected herd. The infected animals also have to be at the appropriate place at the exact time and graze there for the same period of time.

The quantity of virus excreted by a certain number of infected animals over a certain time period is given by:

$$Q_t = \log(N_a \bullet 10^q \bullet \frac{t}{24})$$

Where Q_t is the quantity of virus excreted over a time period

N_a is the number of infected animals excreting virus

q is the quantity of virus produced per 24 hours per animal

t is the time period the infected animal(s) stays and excretes virus

To simplify the model, the total amount of virus (Q_t) was assumed to be released all at once. Furthermore, it was assumed that the plume underwent biological decay at the two given decay rates (Table 1) until reaching the susceptible animal(s).

The time (T) that the plume would take to reach the target population was calculated by using the "IF" command of Microsoft excel as presented in the following formula:

$$= IF \left\{ \left[\frac{(1 - Q_t)}{-decay_1} \right] \leq 10, \frac{(1 - Q_t)}{-decay_1}, \frac{[1 - (Q_t - 10 \bullet decay_1)]}{(-decay_2)} + 10 \right\}$$

Where Q_t is the quantity of virus excreted over a time period

$decay_1$ is the virus decay per minute up to 10 minutes

$decay_2$ is the virus decay per minute after 10 minutes

Table 1: Parameters used to model the airborne transmission of FMD

Parameter	Value
Quantity of virus excreted per 24 hrs per animal ($\log TCID_{50}$)*	3.5 ^a
Virus decay per minute up to 10 minutes (\log) at 55% RH	2.5 ^b
Virus decay per minute after 10 minutes (\log) at 55% RH	0.044 ^b
Minimum dose of airborne FMD virus infection for cattle ($\log TCID_{50}$)	1 ^a
Wind speed (m/s)	2
Hours animal stays in one place	6

^a Based on data from Sørensen *et al.* (2000).

^b Based on data from Donaldson (1972).

* $TCID_{50}$ is the 50% tissue culture infectious dose (The dilution of material which would infect 50% of inoculated cell cultures).

The maximum distance was calculated using the following formula:

$$d = s \times T$$

Where: d is the maximum distance
 s is the wind speed

For successful transmission to occur, the minimum dose of virus that must be inhaled by the target animal was 10 TCID₅₀ (Table 1). In this study case a plume containing

$$\frac{10^{3.5} \times 6}{24} = \frac{10^{3.5}}{4}$$

virus was assumed to be excreted by an infected animal and inhaled by a single animal after being subjected to decay. The decay is a function of *i.a.* time and thus distance. The distance at which the viral dose reaches 10^{1.0} was thus the maximum distance over which an animal could become infected. This maximum distance determined the area in which the susceptible animal had to move during a period of six hours for transmission to occur. This parameter was used to judge the likelihood of airborne transmission.

Results

Contact transmission model

Since it was assumed that one infected animal ($P = 0.1$) entered into Botswana per month and with an estimated R_0 -value of 1.3 the infection will spread into a susceptible herd.

Airborne model

According to the airborne transmission model and assuming one infected animal excreted a plume of virus for 6 hours, a maximum distance of 91 meters between the source and the target will allow for effective airborne transmission of the virus (Table 2).

Discussion

It is a widely accepted that the most common mechanism of FMD transmission is through physical or close contact between infected and susceptible animals, often as a result of movement of infected animals (Pharo, 2002; Cleland *et al.*, 1995). Graves *et al.* (1971) demonstrated transmission of FMD virus from an experimentally infected steer to susceptible steers

through moderate physical contact. Their observations indicate that transmission occurred on the first day after a contact period of at least 21 hours. The animal could transmit the virus for 7 – 8 days with the most infectious period on the third day after infection. This observation was supported by the work of Scott *et al.* (1966) who could not demonstrate transmission after day 8. These findings indicate that although contact transmission is the most efficient mode of FMD dissemination, introduction of an infected animal does not necessarily imply that every susceptible contact animal will become infected. The cattle stocking density in Matsiloje/Matopi area is around 6 – 10 animals per square kilometer. This is relatively low and as a consequence very low contact rates between herds can be expected within the communal pastures. This and the fact that animals are likely to be kraaled longer during the rainy season may explain why the observed outbreaks were restricted to a few kraals and did not spread from herd to herd. James & Rossiter (1989) indicated that chance was a very important aspect in the establishment and spread of a disease, particularly when the number of infected individuals in the populations is low.

The indication from our airborne model is that increasing the prevalence increases the likelihood of airborne transmission (by increasing the maximum distance within which a susceptible animal has to graze around for six hours). However, an increase in the prevalence also implies an increase in the number of infected animals smuggled across the cordon fence and thus an increase in the number of susceptible animals infected through contact transmission. Furthermore, under the communal grazing system it is highly unlikely for animals to graze in one area for a continuous period of six hours. In our model we assumed the source of airborne virus to be cattle. This was based on the fact that in the area surrounding Matsiloje there are no intensive pig farms that could have provided a source of virus for airborne transmission. Gloster *et al.* (1981) and Donaldson *et al.* (1982) indicated that in most outbreaks where airborne infection has been implicated, pigs have been identified as the source of infection and cattle as the species most likely to be affected downwind. Sørensen *et al.* (2000) were able to show through computer-simulated studies that the single most important factor in airborne transmission was the species of origin of airborne virus. Only when pigs were affected did transmission of airborne

Table 2: The estimated maximum distance over which successful transmission of FMD virus occurs given that an infected animal excretes virus for 6 hours.

Hours animal stays (t)	Quantity of virus excreted (Q _i) Log TCID ₅₀	Time to log 1 (T) Minutes	Distance (d) Meters
6	2.8979	0.76	91.10

virus occur over distances of 3 kilometers. The non-involvement of pigs in the two outbreaks would thus serve to further support the suspicion of introduction

and spread of disease through animal contact rather than airborne.

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The diagnostic capacity of veterinary field staff in the Nkhotakota District of Malawi

Chikungwa, P.

Abstract

The limited capacity of the Malawian public sector to efficiently deliver animal health services and the inaccurate disease database were highlighted as some of the challenging constraints during the 1999 National Livestock Development Master Plan (NLDMP) survey. Veterinary Assistants (VA) distributed in the dip tanks and veterinary stations throughout the country are supposed to generate the livestock disease information which is channelled to the policy decision makers at headquarters. A study was conducted to assess the diagnostic capacity of those VAs and to determine the livestock owners' ability to detect sick animals. The study focused on the diagnosis of tsetse-transmitted bovine trypanosomosis in Nkhotakota District.

Results showed that VAs were able to identify animals in poor conditions but no relationship was observed between their diagnosis and the actual trypanosomal infection status of the animals. Livestock owners were aware of disease problems but lacked ability to detect animals in poor condition.

Keywords: Malawi, Animal health services, Livestock disease information, Diagnostic capacity, Trypanosomosis

Résumé

La capacité limitée du secteur public malawien à fournir efficacement des prestations de service en santé animale et l'imprécision de la base de données sur les maladies ont été reconnues comme des contraintes importantes à l'occasion de l'enquête de 1999 dans le cadre du Programme National de Développement de l'Élevage (NLDMP). Les Assistants Vétérinaires (VA) qui sont répartis dans tout le pays au niveau des dipping-tanks et des stations vétérinaires, sont supposés générer l'information sur les maladies du bétail qui est, ensuite, canalisée vers les responsables de la politique au quartier général. Une étude a été réalisée pour évaluer la capacité diagnostique de ces VA et déterminer les aptitudes des propriétaires de bétail à détecter les animaux malades. L'étude s'est concentrée sur le diagnostic de la trypanosomose bovine, transmise par la mouche tsé-tsé, dans la Zone Nkhotakota.

Les résultats ont montré que les VA étaient capables d'identifier des animaux en mauvaise condition, mais aucune relation n'a été observée entre leur diagnostic et le statut réel des animaux en matière d'infection par la trypanosomose. Les propriétaires de bétail étaient conscients des problèmes de maladie, mais ne possédaient pas la capacité à détecter des animaux en mauvaise condition.

Mots-clés : Malawi, Services de santé animale, Information sur les maladies du bétail, Capacité diagnostique, Trypanosomose.

Resumo

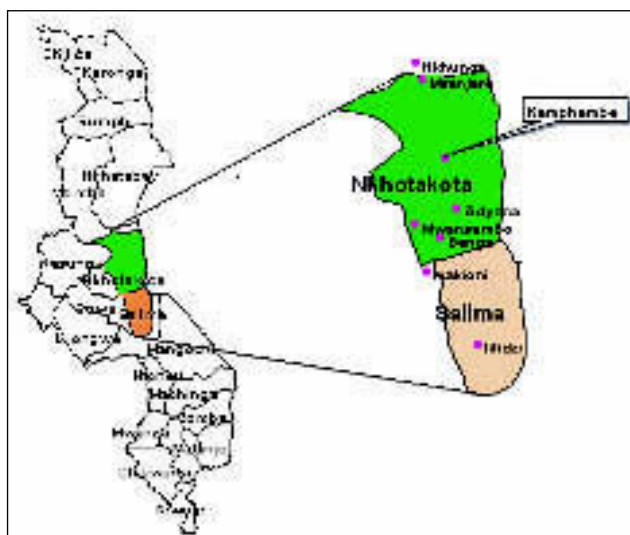
A capacidade limitada do setor público malawiano de prestar serviços de saúde animal eficientes e o inacurado banco de dados de patologias foram destacados como alguns dos desafios limitantes durante a Pesquisa do Plano Piloto de Desenvolvimento da Pecuária Nacional em 1999. Assistentes veterinários (VA) distribuídos nas áreas de tanques de imersão e postos veterinários por todo país, devem fornecer a informação sobre a doença do rebanho a qual é transmitida à responsáveis pela decisão política em quartéis-generais. Um estudo foi conduzido para avaliar a capacidade de diagnóstico dos VA e a habilidade dos proprietários de gado para detectar animais doentes. O estudo concentrou-se no diagnóstico da tripanossomiase bovina transmitida por tsé-tsé no distrito de Nkhotakota. Os resultados mostraram que os VA foram capazes de identificar animais doentes mas não foi observada relação entre o diagnóstico e o quadro existente de infecção tripanossomial dos animais. Os proprietários de gado estavam informados quanto aos problemas da doença mas careciam de habilidade para detectar animais em más condições.

Palavras-chave: Malawi, Serviços de saúde animal, Informação de doença do gado, Capacidade de diagnóstico, Tripanossomiase

In Malawi also, the animal health policy aims at protecting the national herd against diseases of national economic importance by maintaining an effective and comprehensive disease surveillance programme. Unfortunately, the limited financial capacity of the department of veterinary services has affected seriously the diagnostic capacity of this department. Especially for endemic parasitic diseases such as tsetse-transmitted trypanosomiasis and tick-borne diseases the necessary tools to identify infected animals are not available at the field level. Hence, information on the prevalence of those diseases relies almost entirely on the verdict of the veterinary field staff and is based on visual inspection of the animal. To determine the diagnostic value of this physical inspection in the diagnosis of tsetse-transmitted trypanosomiasis a trial was conducted at the edge of the Nkhotakota game reserve.

Material and methods

The study was conducted in August 2003 in Kamphambe dipping area (34° 15' 49" E 12° 58' 05" S) of Nkhotakota District (Figure 1). The area is located between the eastern edge of Nkhotakota Game Reserve and shores of Lake Malawi. A total cattle population of 1319 animals was recorded in the area during the census conducted in May 2003. In a survey conducted between 1995 and 1997, trypanosomal infections were detected in cattle sampled within the vicinity of Nkhotakota Game Reserve (Van den Bossche *et al.*, 2000). Apart from trypanosomiasis, other common endemic diseases in cattle include tick-borne diseases particularly theileriosis (ECF) and anaplasmosis. Helminth infections and malnutrition (especially in dry season) are also major causes of production losses and deaths particularly in young calves and small ruminants. The delivery of animal health services to the area is generally perceived as poor due to inadequate coverage and limited resources by the Veterinary Assistant



Selection of veterinary assistants, livestock owners and experimental animals

Twenty-five cattle owners were randomly selected with the assistance of the Veterinary Assistant of the area and the local authority of the Livestock Development Committee (LDC). The cattle owners were smallholders with small herds, keeping on average 10 cattle per herd. A random sample of 75 animals was selected from a total of 281 presented on the day of sampling.

Every selected animal was examined physically for about 5 minutes in a crushpen by the VA's and the livestock owners. The condition of each animal was determined by giving it a score on a 1 to 4 (1= very poor 2= poor 3= good and 4= excellent) by the VA's and the cattle owners. Furthermore, depending on their clinical assessment, VA's were asked to diagnose the disease of the animals they considered sick.

From each of the 75 experimental animals blood was collected from the jugular vein and examined using the buffy coat method (Paris *et al.*, 1982). The packed cell volume (PCV) was determined after centrifugation. The buffy coat of centrifuged blood was also extruded on a filter paper (Whatmann n°3) for PCR-analysis (Gevsen *et al.*, 2003).

Data were analysed using the logistic regression analysis. Use was made of the statistical package, Stata version 8.0 (Stata Corp., 2003).

Results

The parasitological examination gave negative results in all the 75 sampled animals.

However, a total of 13 trypanosomal infections (17.3%) were detected by PCR. The trypanosome species detected were *Trypanosoma congolense* (12) and *T. vivax* (1). The average PCV of the negative animals was $28.1 \pm 3.9\%$ and of the positive animals $27.6 \pm 4.2\%$. Ten of the PCR-negative animals were anaemic ($PCV \leq 24\%$). Of the 13 PCR-positive animals, four had a $PCV \leq 24\%$.

The VA's diagnosed 32.5% of the PCR-positive cases as either trypanosomiasis or a combination of trypanosomiasis and another disease. The VA's also diagnosed 30.8% of the PCR negative cases as trypanosomiasis positive. There was no relationship between VA's diagnosis and the PCR results ($P = 0.725$). There was also no difference in diagnosis between the nine VA's ($P = 0.8765$).

Out of the total number of trypanosomiasis negative animals, the VA's assessed 45.7% as being in poor or very poor condition and 54.3% in good or excellent condition. The VA's assessed 45.8% of the trypanosomiasis infected animals to be in poor or very poor condition. There was no relationship between the VA's health assessment and the trypanosomal infection status ($P=0.364$). The relationship between VA's animal health assessment and the animal's PCV was, however, significant ($P < 0.0001$). On the other hand, the relationship between animal health assessment by the livestock owners and PCV was not significant ($P = 0.105$).

Discussion

In this study no infected animals could be detected using the parasitological diagnostic methods. This is not surprising considering the low sensitivity of parasitological diagnostic test for trypanosomiasis (Paris *et al.*, 1982). The latter is especially the case when the parasitaemia is low as is often observed during the chronic phase of an infection.

Although many animals were identified by the VA's as being infected with trypanosomes, the analysis shows that the capacity of the VA to clinically identify animals infected with trypanosomes is very low. This is again not surprising since animals infected with trypanosomes do not show pathognomic signs. Under field conditions such incorrect diagnosis are likely to result in a substantial proportion of unnecessary treatments with trypanocidal drugs. These findings clearly show the limited capability of the VA's in the

provision of both preventive and curative services to the smallholders. Diagnosis of a common and important disease such as trypanosomiasis will only improve after basic diagnostic equipments such as a microscope, glass slides, sample collection bottles, etc., are made available to the VA or a laboratory in the area where the VA is working.

Furthermore, inadequate coverage due to lack of transport limits the VA's delivery of diagnostic services and extension in disease control. Depending on the importance of the dip tank, VA's may have to cover areas between 8 to 20 km radius. Apart from few VA's who benefit from motorbikes and bicycles provided by previous livestock projects (*i.e.* SADC animal disease control and National livestock Development Project), most VA's do not have a reliable mode of transport.

Irrespective of the VA's diagnostic capabilities, their capacity to identify animals in poor condition seems to be satisfactory. This is reflected in the correlation between their condition score and the animal's PCV. This again reinforces the need for basic diagnostic equipment or diagnostic facilities. The VA seems indeed capable of identifying animals that are in poor condition but do not have the sufficient tools to identify the reason for this poor condition.

In conclusion, the study clearly shows the need for diagnostic facilities for the management of important livestock diseases such as trypanosomiasis. Relying on the assessment of, often experienced, veterinary staff in disease surveillance is likely to result in disease data of poor quality. This is certainly so for diseases with few pathognomic symptoms. The situation may improve by providing veterinary field staff with minimal diagnostic equipment and consumables and, if possible, promote the development of crush-side tests for the diagnosis of parasitic diseases such as trypanosomiasis.

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who rendered technical support in various ways to support work and to all the Veterinary assistants and livestock owners who participated in this survey for their willingness and cooperation.

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Knowledge and disease management skills of cattle owners on East Coast Fever and Foot and Mouth Disease in Kazungula and Livingstone Districts of Zambia

Chisembele, C.

Abstract

Effective animal disease control and prevention should be based on accurate information from the field. Part of this field information can be obtained from the cattle owners. In order to assess their disease knowledge, a survey focusing on East Coast Fever (ECF) and Foot and Mouth Disease (FMD) was organised among 302 cattle owners from the Kazungula and Livingstone Districts of the Southern Province of Zambia. The cattle owners' level of knowledge of ECF was low (34%) with most of those able to describe the disease belonging to the endemic zone where ECF caused high death rates in cattle. A larger proportion of the cattle owners (46%) were able to give an adequate description of FMD symptoms. It reached up to 61% in the FMD high-risk zone. Reporting to the animal health service providers appeared to be low.

The results of the survey showed that attempts should be made to improve the cattle owners' knowledge and response to important diseases by carrying out more extension and sensitization activities. This is especially so in areas of low infection or where the disease was experienced long time ago.

Keywords: Zambia, Animal health services, cattle owners, Livestock disease information, East Coast Fever, Foot and Mouth Disease

Résumé

Un contrôle et une prévention efficace de maladies animales doivent être basés sur des informations précises provenant du terrain. Une partie de cette information peut être obtenue des propriétaires de bétail. Pour évaluer leurs connaissances en maladies, une enquête se concentrant sur l'«East Coast Fever» (ECF) et sur la fièvre aphteuse (FMD), a été organisée parmi 302 propriétaires de bétail des districts de Kazungula et de Livingstone au Sud de la Zambie. Le niveau de connaissance des propriétaires de bétail en matière d'ECF était bas (34 %) et la plupart de ceux capables de décrire la maladie appartenaient à la zone endémique où l'ECF a causé des taux élevés de mortalité parmi le bétail. Une plus grande proportion de propriétaires de bétail (46 %) était capable de donner une description adéquate des symptômes de la FMD. Cette proportion était supérieure (61 %) dans la zone à haut risque de FMD. La transmission de l'information aux prestataires de services de santé animale est apparue faible. Les résultats de l'enquête ont montré que des tentatives devraient être faites pour améliorer les connaissances des propriétaires de bétail et leur réaction aux maladies importantes, en effectuant plus d'activités de vulgarisation et de sensibilisation. C'est particulièrement le cas dans les zones où l'infection est faible ou où la maladie n'a été expérimenté qu'il y a très longtemps.

Mots-clés : Zambie, Services de santé animale, propriétaires de bétail, Information sur les maladie du bétail, « East Coast Fever», Fièvre aphteuse

Resumo

Um controle efetivo e prevenção de doença animal deve ser baseado em informação precisa proveniente do campo. Parte desta informação de campo pode ser obtida através dos proprietários de gado. A fim de avaliar o conhecimento dos mesmos, uma pesquisa sobre a febre da costa leste (ECF) e febre aftosa (FMD) foi organizada entre 302 proprietários de gado dos distritos de Kazungula e Livingstone na Zâmbia. O nível de conhecimento dos proprietários de gado sobre ECF foi baixo (34%) mas a maioria destes foi capaz de descrever a doença como pertencente a zona endêmica na qual ECF causou altas taxas de mortalidade no gado. A maioria dos proprietários de gado (46%) puderam descrever de forma adequada os sintomas da FMD. Esse valor atingiu níveis de até 61% na zona de alto risco desta doença. A informação fornecida para os provedores do serviço de saúde animal pareceu ser fraca. Os resultados da pesquisa mostraram que mais tentativas deveriam ser feitas para melhorar o conhecimento e a resposta dos proprietários de gado à doenças importantes através de mais atividades de extensão e sensibilização. Este é o caso especialmente em áreas de baixa infecção ou onde a doença ocorreu há muito tempo.

Palavras-chave: Zâmbia, Serviços de saúde animal, Proprietários de gado, Informação sobre doença do gado, Febre da costa leste, Febre aftosa

Introduction

Zambia, like many other southern African countries, is affected by a number of livestock diseases for which concerted efforts are needed to ensure their prevention and control. Among the most important diseases are Foot and Mouth Disease (FMD), and Bovine Theileriosis (East Coast Fever- ECF- or Corridor disease).

FMD is one of the most contagious viral diseases affecting cattle. In Zambia, it was recorded for the first time in 1933 and the country has since experienced repeated outbreaks caused by the SAT 1, 2 and 3 strains and European types A and O (Chilonda *et al.*, 1999a). Three high-risk areas have been identified where FMD epidemics occur repeatedly: the southern border (Kazungula and up westwards towards Sesheke); the Kafue flats and the Northern border with Tanzania (Overby *et al.*, 1983). The last outbreak in Kazungula was in 2001. In Zambia, FMD is controlled by vaccination, fully funded by the government (Chilonda *et al.*, 1999b).

ECF is a very important tick-borne disease caused by protozoon *Theileria parva* and responsible for killing a large number of cattle each year (Billiouw *et al.*, 1999). The disease seems to have been introduced in Northern Zambia in 1922 (Coetzer *et al.*, 1994) and in Southern Province between the years 1977-1978 (Nambota, 1994). It currently persists in several areas of the country (Makala *et al.*, 2003). A total of 683 cases were recorded in Southern Province in 2002 (Provincial Veterinary Office). Control measures outlined for Theileriosis are: tick control, the application of the preventive infection and treatment method, and treatment following infection. All these measures are financed by the cattle owners themselves as the disease is not recognised as one of national importance (Chilonda *et al.*, 1999b).

Successful prevention and control of these diseases requires an integrated approach by all key players. At the district level they are the cattle owner and the service providers. The latter include the Community Livestock Auxiliary (CLA), the Veterinary Assistant (VA) at camp level, the District Veterinary Office (DVO) and in certain cases local Non-Governmental Organisations (NGO) (Van den Bossche *et al.*, 2004). To outline efficient prevention and control methods, the service providers need to collect accurate data from the field, particularly from the cattle owners themselves, whose knowledge and management skills related to the various diseases appear to be crucial.

In order to assess the cattle owner's level of knowledge and understanding of disease prevention and management, a survey focusing on ECF and FMD was

organised in Kazungula and Livingstone Districts of the Southern Province of Zambia. The study hypothesises that despite the devastating impacts of ECF in the endemic and epidemic zones and the threat to the non-infected areas, most cattle owners are not as aware of this disease as they are of FMD, a disease that has been present for a much longer period in the Livingstone and Kazungula Districts. It also hypothesised that poor understanding of the dynamics of ECF has resulted in poor disease management skills among the cattle owners and a low reporting to the animal health service providers during outbreaks.

Materials and Methods

Overview of study area and disease background

Kazungula and Livingstone Districts are located in the southern part of the Southern Province at an altitude of about 900 meters above sea level. The Districts experience rainfall of less than 700 mm per year. They share international borders with Zimbabwe, Botswana and Namibia in the southeast, south and southwest respectively. Livingstone district is surrounded completely by Kazungula district, with the exception of the border. Administratively, the two districts fall under the same District Veterinary Office, which is based in Livingstone city (Figure 1).

In Kazungula and Livingstone Districts, ECF has been endemic in the northern part only. However, from 1998 onwards the disease started moving towards the central and western parts of the Districts (Livingstone district annual report, 1998) where it caused high mortalities. In 2002, the disease was reported for the first time in the southern part of Kazungula District and in 2003 it was reported further west in Kazungula camp. Taking into account the dynamics of the disease, the study area was divided into an epidemic, endemic and non-infected zones (Figure 2).

Kazungula is the only district in the Southern Province in which FMD has continuously been detected since 1942. The disease is endemic in Sikaunzwe, Kazungula and Simonga camps. These areas thus represent the FMD high-risk zone in this study. Makunka, Ngwezi and Bombwe camps are in the low-risk area and do sometimes experience spillovers. These camps are, together with Mukuni and Nyawa camps (far from the endemic area), considered the FMD low-risk zone. The high-risk situation is associated with the presence of buffaloes in the area and international borders giving rise to transhumance and livestock cross-border movements (see Figure 3).

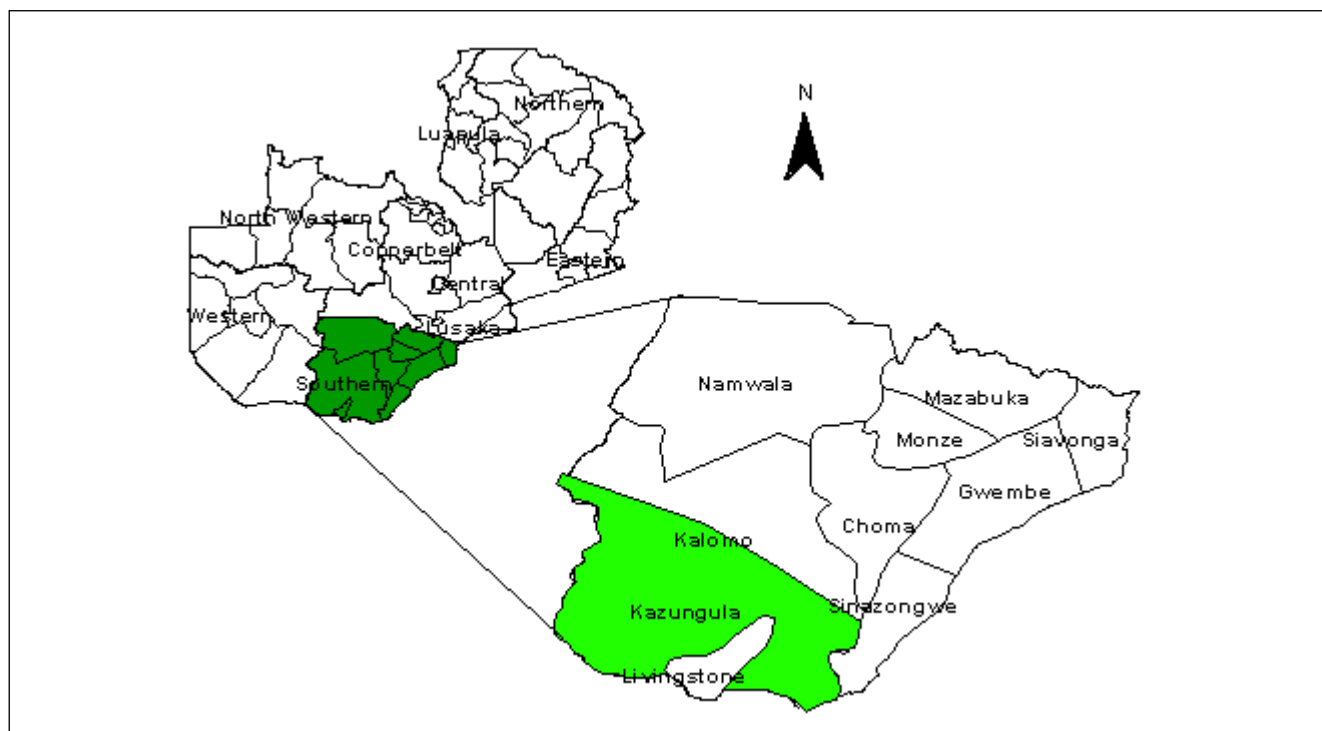


Figure 1: Map of Zambia showing the location of the Kazungula and Livingstone Districts.

Survey design and sample selection

A single visit multiple-questions survey was used in this study with trained enumerators of the Veterinary Department conducting face-to-face interviews using structured questionnaires in the local languages.

The survey design was primarily based on stratifying the area into ECF non-infected (high risk), ECF epidemic and ECF endemic zones. Eight veterinary camps were selected under these strata in Kazungula and Livingstone Districts. A total of 302 cattle owners

were interviewed with 129 coming from the ECF non-infected area, 76 from the epidemic area and 97 from the endemic area. The selection of the cattle owners was entirely based on voluntary turn up following announcements given by the local VA and their headmen about the ensuing interviews.

Beside questions aiming to obtain an insight into the cattle owner's experience in terms of cattle losses, the possible cause, and the number presently owned, the

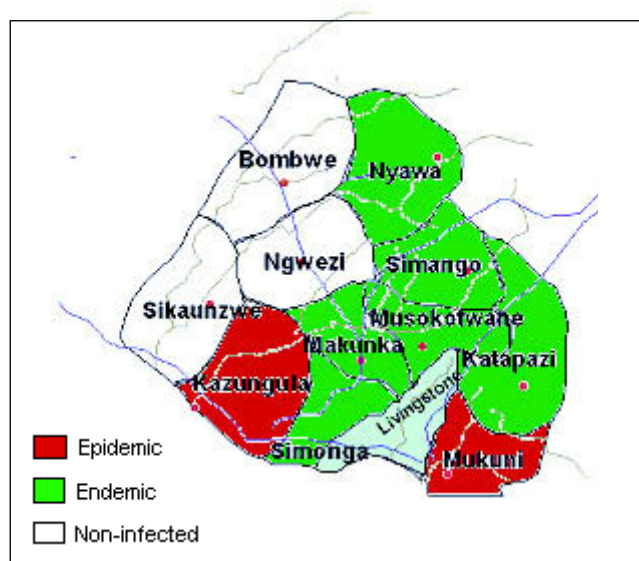


Figure 2: Map showing the ECF endemic, epidemic and non-infected areas of Kazungula District

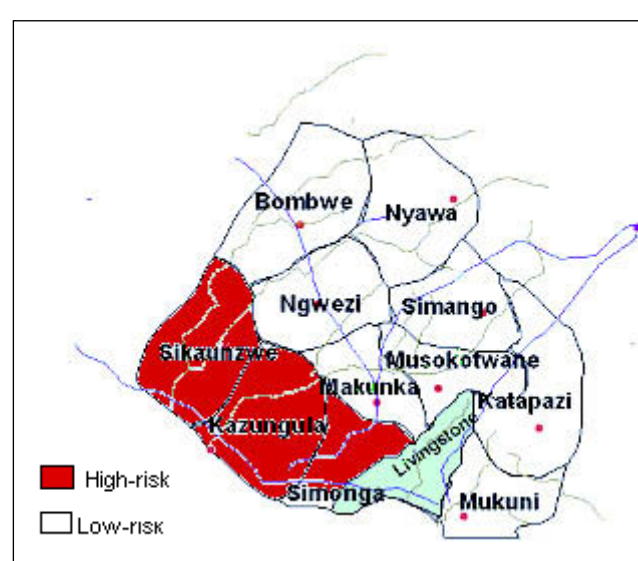


Figure 3: Map indicating the FMD high-risk and low-risk areas of Kazungula District.

questionnaire focused on the ability of the respondent to identify ECF and FMD and their response to outbreaks. Their knowledge of symptoms of these diseases were ranked into four categories with those knowing very well being ranked first, those knowing well being ranked second, others ranked under average and lastly those not knowing being ranked fourth. These categories were created by referring to the documented clinical symptoms, which were compared to the responses given by the cattle owners (see Table 1).

endemic zone, on the other hand, 74% were able to describe the symptoms with only 4% of these being able to describe the symptoms very well. There was a significant difference between the non-infected and endemic zones in the number of cattle owners who were able to describe the symptoms very well and those who could not ($P<0.011$), those who were able to describe the symptoms well and those who were not ($P<0.001$), and between those who were able to give an average description and those who were not ($P<0.001$). Results indicate that almost all the cattle

Table 1: Symptoms description ranking of ECF and FMD

Symptoms ranking		ECF	FMD
1	Very well	- Swollen parotid glands, lacrimation and increased mucous discharge	- Limping, sores on tongue and hooves and failure to eat - Sores on mouth and around hooves and salivation
2	Well	- Swollen lymph nodes, salivation, dull and droopy ears - Lacrimation, profuse salivation, nasal discharge and droopy ears - Swelling of lymph nodes and dull	- Limping, dullness and not eating - Salivation and unable to walk
3	Average	- Coughing, salivation, dyspnoea and droopy ears	- Sores around mouth and tongue - Hooves coming out - Failure to graze
4	Does not know	- Just heard about the disease - Does not know disease	- Just heard about it - Does not know disease

Statistical analysis

The analysis of data was carried out in STATA (Release 7.0 College Station, TX: Stata Corporation) using multinomial logistic regression, Chi-square, and Logistic regression under the Generalised Linear Model (GLM).

Results

Cattle owner's awareness of ECF

Only 34% of the interviewed cattle owners claimed they could identify ECF. The majority of them belonged to the endemic zone (69%) while the highest number not able to identify belonged to the non-infected zone (57%). Table 2 shows that most cattle owners in the non-infected (88%) and epidemic (80%) zones had poor knowledge of the symptoms of ECF. In the

owners claiming to be able to identify ECF were able to describe the symptoms between very well and average except for two (1%) from the non-infected and epidemic zones.

Cattle owners' interventions during out-breaks of ECF

In total, 35% of cattle owners in both the epidemic and endemic zones did nothing during outbreaks in their areas. Out of this group only 8% belonged to the group that had experienced the disease. From the 65% who did something, 34% only reported the outbreak to the VA. The majority of the latter (85%) belonged to the endemic zone. 14% reported to have only attended extension meetings. The remaining 13% undertook interventions 3 to 9 (Table 3). Statistical analysis revealed that the ability of cattle owners

Table 2: Ranking of the cattle owners in each zone according to their response on ability to describe ECF symptoms (number and percentage)

Zone	Symptoms description (cattle owner %)				n
	Very well	Well	Average	Poor	
Non-infected	1 (1%)	4 (3%)	10 (8%)	114 (88%)	129 (100%)
Epidemic	1 (1%)	2 (3%)	12 (16%)	61 (80%)	76 (100%)
Endemic	4 (4%)	22 (23%)	46 (47%)	25 (26%)	97 (100%)
	6 (2%)	26 (9%)	70 (23%)	200 (66%)	302 (100%)

to undertake conventional control measures was significantly dependent on the zone ($P < 0.026$). On the other hand, 43% of cattle owners in the non-infected zone (not in table) were using the conventional control measures.

Ability of the respondents to describe the symptoms very well and the lack of ability to describe them at all does not significantly depend on the zone ($P < 0.066$). The majority of cattle owners who claimed to be able to identify FMD were able to describe the symptoms

Table 3: Different interventions undertaken by the cattle owners of the epidemic and the endemic ECF zones

Intervention Number	Cattle owner intervention	%	Epidemic (n)	Endemic (n)
1	Report to VA*	34	9	50
2	Report to CLA**	1	0	1
3	Report to VA/buy recommended drugs	5	2	7
4	Buy recommended drugs	3	0	5
6	Start dipping, restrict cattle movements and attend meetings	6	2	8
7	Start dipping	1	0	2
9	Report to VA and sell off unaffected animals	1	1	0
10	Attend meetings	14	20	5
11	Does nothing	35	42	19

* VA Veterinary Assistant; ** CLA: Community Livestock Auxiliary

Cattle owners' awareness of FMD

53% of the cattle owners claimed to be able to identify FMD with 60% belonging to the high-risk zone. Table 4 shows that 42% of them were ranked as being able to describe the symptoms very well while 46% could not describe the symptoms at all. 46% of cattle owners in the high-risk zone were able to describe the FMD symptoms very well while 40% were not able to describe them at all. In the low-risk zone, only 37% of cattle owners were able to describe the symptoms and majority (54%) were not.

very well (80%) with only 1% of those who claimed so not being able to.

Cattle owners' intervention during out-breaks of FMD

With the exception of attending meetings, more interventions take place in the FMD high-risk zone. A total of 29% of cattle owners responded that they had reported suspected disease outbreaks to the VA (Table 5). In both zones, most of the farmers indicated to have attended sensitisation meetings while 31% claimed to have done nothing at all during outbreaks (Table 5).

Table 4: ranking of the cattle owners in each zone according to their response on ability to describe FMD symptoms (number and percentage)

Zone	Symptoms ranking (% cattle owners)				Total n
	Very well	Well	Average	Poor	
High-risk	78 (46%)	11 (7%)	11 (7%)	68 (40%)	168
Low-risk	50 (37%)	8 (6%)	4 (3%)	72 (54%)	134
Total	128 (42%)	19 (6%)	15 (5%)	140 (46%)	302

Table 5: Different interventions undertaken by the cattle owners of low and high FMD risks zones in case of outbreak

Intervention number	Cattle owner intervention	% Cattle owners	High-risk (n)	Low-risk (n)	Total (n)
1	Report to VA	15	37	3	40
2	Report to VA and restrict animal movements	3	7	0	7
3	Report to VA and attend meetings	11	24	5	29
4	Report to CLA	0	1	0	1
5	Attend meetings	40	31	78	109
6	Do nothing	31	68	16	84
Total		100	168	102	270

Table 6: Percentage and number of cattle owners taking and not taking their cattle for vaccinations

Control number	Intervention	% Cattle owners	High-risk n	Low-risk n	Total n
1	Take for vaccination	81	120	98	218
2	No vaccination	19	48	4	52
Total		100	168	102	270

A total of 81% of the respondents brought their cattle for vaccination. This activity did not apply to the cattle owners in Nyawa and Mukuni camps (32 cattle owners) where vaccination activities are not carried out. The difference between the number of cattle owners taking their animals for vaccinations in the two risk zones was not significant ($P < 0.635$) (Table 6).

Comparison of cattle owners' ability to describe symptoms of ECF and FMD symptoms

For ECF and FMD, chi-square analysis revealed a significant difference between the group of cattle owners who were able to describe the symptoms very well ($P = 0.004$), between the group that was ranked average under both diseases ($P = 0.029$), and the group that could not describe symptoms of both diseases ($P = 0.001$). There was no significant difference between the group that was classified under knowing the symptoms of the two diseases well ($r = 0.158$).

Discussion

Cattle owners' awareness of ECF

Despite the devastating effects that ECF has had on their cattle population, the level of ECF awareness among cattle owners in Kazungula and Livingstone Districts was quite low (34%). The cattle owner's ability to describe the symptoms of the disease was significantly dependent on the zone they belong to.

The majority who managed to give a description of the symptoms of ECF (71%) belonged to the endemic zone. This knowledge seems to be the result of the previous experience they have had with the disease. Most cattle owners in the three zones gave what was termed as average descriptions of the symptoms of ECF, since they could differentiate the disease from other endemic diseases in their areas. According to Norval *et al.* (1992), the presence of other diseases with similar symptoms makes the identification of ECF by cattle owners difficult. Among those who lost their animals to ECF, only 21% could give an acceptable description of symptoms diagnostic of ECF (Coetzer *et al.*, 1994).

Cattle owners' intervention in case of ECF outbreak

Only 41 % of the cattle owners who experienced ECF claimed to have informed the VA or CLA of their area. Not reporting or late reporting can be related to poor knowledge about the disease and subsequent poor diagnostic ability (Perry *et al.*, 1989). In some cases, cattle owners initially institute their own treatment (both conventional and traditional) before informing the local extension staff and only report to them when they do not see any improvement. This hampers the efficacy of the interventions by service providers. Additionally, inappropriate use of anti-theilerial drugs due to factors such as high cost, lack of knowledge about proper use and combinations leads to inadequate treatment (McHardy *et al.*, 1985; D'haese *et al.*, 1999).

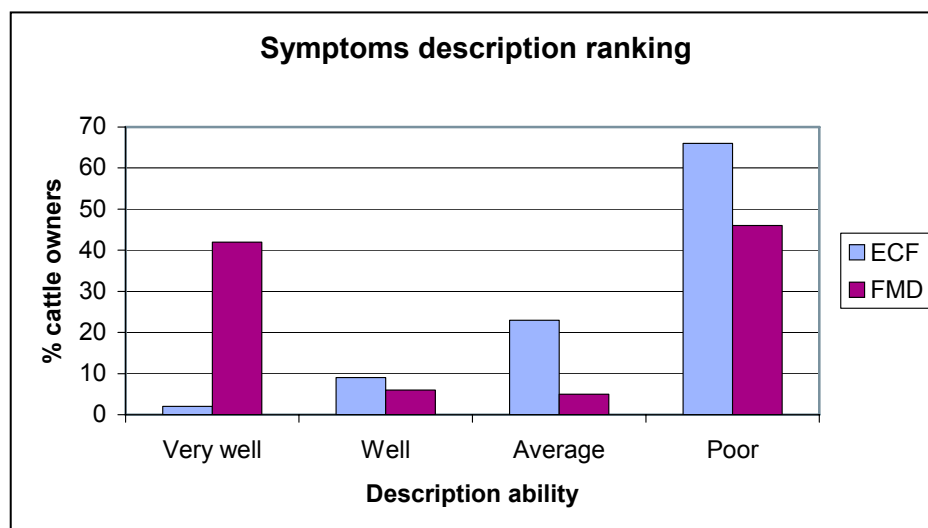


Figure 4: Comparison of farmers' ability to describe symptoms of ECF and FMD according to the ranking of the symptoms.

Only 20 % of the respondents attended extension meetings. Hence, poor knowledge of ECF symptoms can be due to poor information flow, especially among cattle farmers who do not experienced the disease, or experienced it some time back.

Attitudes towards FMD compared to ECF

The cattle owners' ability to adequately describe the symptoms of FMD was found to be significantly higher than that of ECF. This could be attributed to the fact that FMD has been endemic in the area far much longer and that the symptoms of FMD are pathognomic for this disease and therefore do not constitute a big problem in terms of differential diagnosis with other diseases in the area.

The control of FMD, according to the disease control policy is an activity fully undertaken by government, and only requires the cattle owners' cooperation in presenting their animals. This raises some questions among cattle owners as to why the government takes the responsibility for the control of a disease that causes negligible number of deaths compared to ECF whose effects are more devastating. Nevertheless, a large proportion of the cattle owners (81%) takes their animals for vaccinations even in the low-risk area. This may be due to the fact that cattle owners do not have to pay for FMD vaccinations and that ECF is still quite new to the FMD endemic zone.

In conclusion, cattle owners in the survey area generally do not have sufficient knowledge of ECF. Most of the

cattle owners of the ECF endemic zone, where high losses have been experienced, are able to describe the disease. However, the majority of respondents were not able to differentiate ECF from other endemic diseases in their areas. They nevertheless seem to have a better knowledge of FMD, a disease with which they have experiences for a much longer time and whose symptoms are easier to differentiate.

Reporting to the animal health service providers appears to be low. This delays interventions and hampers the implementation of appropriate diagnostic techniques necessary to have a good insight into the epidemiology and dynamics of the diseases in the area.

This study can therefore conclude that a number of issues need to be addressed by the government in order to streamline the collection of data from cattle owners. The most important being the improvement of their knowledge and response to important diseases such as ECF and FMD by carrying out more extension and sensitisation activities. This is especially so in areas of low infection or where the disease occurred long time ago.

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Reporting livestock disease information in Zambia: constraints and challenges

Mataa, L.

Abstract

A desk and field study was conducted to quantify the flow of veterinary information between the livestock owner and the various levels of the veterinary department in Zambia. The studies were conducted in the Eastern Province, a major livestock keeping area. Results from the survey indicate that, although information is exchanged, reporting to the highest level is erratic. The repercussions of such irregular reporting are discussed.

Keywords: Zambia, Animal health services, Livestock disease information, reporting

Résumé

Une étude de bureau et de terrain a été réalisée pour évaluer quantitativement le flux d'information vétérinaire entre le propriétaire de bétail et les divers niveaux du département vétérinaire en Zambie. Les études ont été conduites dans la Province Orientale, très importante zone d'élevage. Les résultats de l'enquête indiquent que, bien que l'information soit échangée, la transmission au niveau le plus élevé est irrégulière. Les répercussions d'une telle transmission irrégulière sont discutées.

Mots-clés : Zambie, Services de santé animale, Information sur les maladies du bétail, transmission d'information

Resumo

Estudos teórico e de campo foram conduzidos para quantificar o fluxo de informação veterinária entre os proprietários de gado e os vários níveis do departamento de veterinária na Zâmbia. Os estudos foram realizados na província do leste, a principal área de criação de gado deste país. Os resultados da pesquisa indicam que, embora haja troca de informação, esta chega de forma errática ao nível superior. A repercussão destes relatórios irregulares são discutidas.

Palavras-chave: Zâmbia, Serviços de Saúde Animal, Informação de doença do gado, Relatório

Introduction

The Zambian veterinary services are represented over 59 veterinary districts each consisting of a number of veterinary camps distributed over the nine political provinces. The veterinary reporting system implemented by the Zambian Department of Veterinary and Livestock Development (DVLD) consists of an upward flow of information from the field to the veterinary headquarters followed by a feedback to each of the levels (Figure 1) at monthly intervals.

In the field, veterinary information generated by the livestock farmer is captured at the level of veterinary camp. This information is transmitted from the veterinary camp to the District Veterinary Office, the next level in the information flow. From the district, information is transmitted to the Provincial Livestock Epidemiology and Information Centre (PLEIC) which reports to the National Livestock Epidemiology and Information Centre (NALEIC) at the national headquarters of the Department of Veterinary and Livestock Development (DVLD). The flow of information forms the basis for the animal disease control strategies. Furthermore, as a member of the international community, Zambia

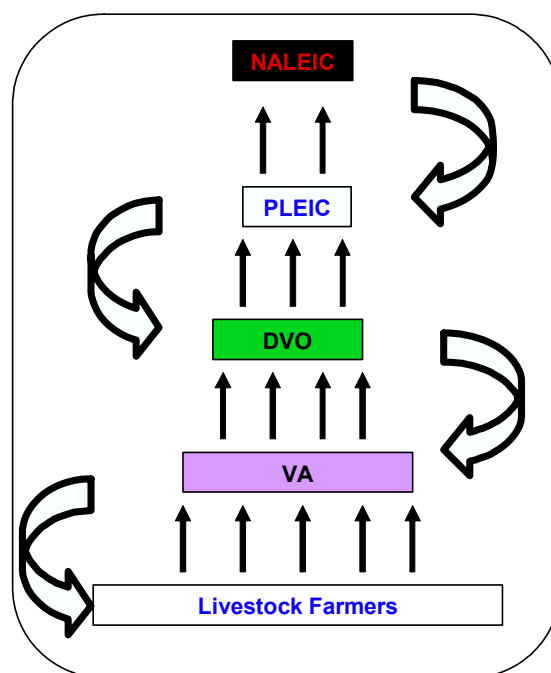


Figure 1: Theoretical flow and feedback of information in the Department of Veterinary and Livestock Development.

is obliged to report new epidemics and the control measures taken thereof through “prompt and comprehensive” international disease reporting. It is in this vein that the NALEIC regularly reports to the Office International des Epizooties (OIE) in Paris, France, the United Nations Food and Agriculture Organisation (FAO) in Rome, Italy, the African Union’s Inter-African Bureau for Animal Resources (IBAR) in Nairobi, Kenya and the Southern Africa Development Community (SADC) in Gaborone, Botswana.

To determine the frequency of veterinary reporting between the livestock owner and various management levels of the veterinary services a study was conducted.

Materials and Methods

Study Area

The study was undertaken in the Eastern Province of Zambia, an area comprising of 6 veterinary districts.

Agriculture is the major traditional economic activity, with most of the population practicing mixed farming. Farmers concentrate on cattle keeping and other small stock. The region is one of the most important livestock production areas in the country.

Study Design

The study consisted of a desk study and a field study. The desk study aimed at reviewing of existing information flow by studying the veterinary reports in the archives of the provincial and district DVLD registries in the Eastern Province of Zambia. Reports in the DVLD’s archives submitted by the provincial- and

district veterinary officers as well as those submitted by veterinary camp assistants during the period January 2003 to August 2004 were reviewed. The main purpose of this study was to obtain an insight into the frequency of the reporting, the composition of the reports and to appreciate the constraints and challenges of the veterinary information reporting system.

During the field study, structured questionnaires were administered to 50 randomly selected livestock farmers in Chipata and Petauke Districts. Questionnaires were also administered to 5 veterinary camp assistants and the DVOs of Chipata and Petauke.

- The livestock farmer questionnaire aimed at obtaining an overview of the farmer’s interactions with the veterinary assistant and to capture what the farmer normally reports to the veterinary assistant.
- The veterinary camp questionnaire intended to reflect the day-to-day operations of the veterinary camp assistant, what sort of data is collected and how they are channeled to the district.
- The DVO questionnaire aimed at establishing how the Districts were managing their respective veterinary camps and what type of support services they were offered by the District in the execution of their duties.

The purpose of the one-on-one interview with the NALEIC head was to determine the type of information captured by NALEIC and how this information is processed and analysed.

The data generated by the questionnaires were analysed using the statistical package STATA 7.0.

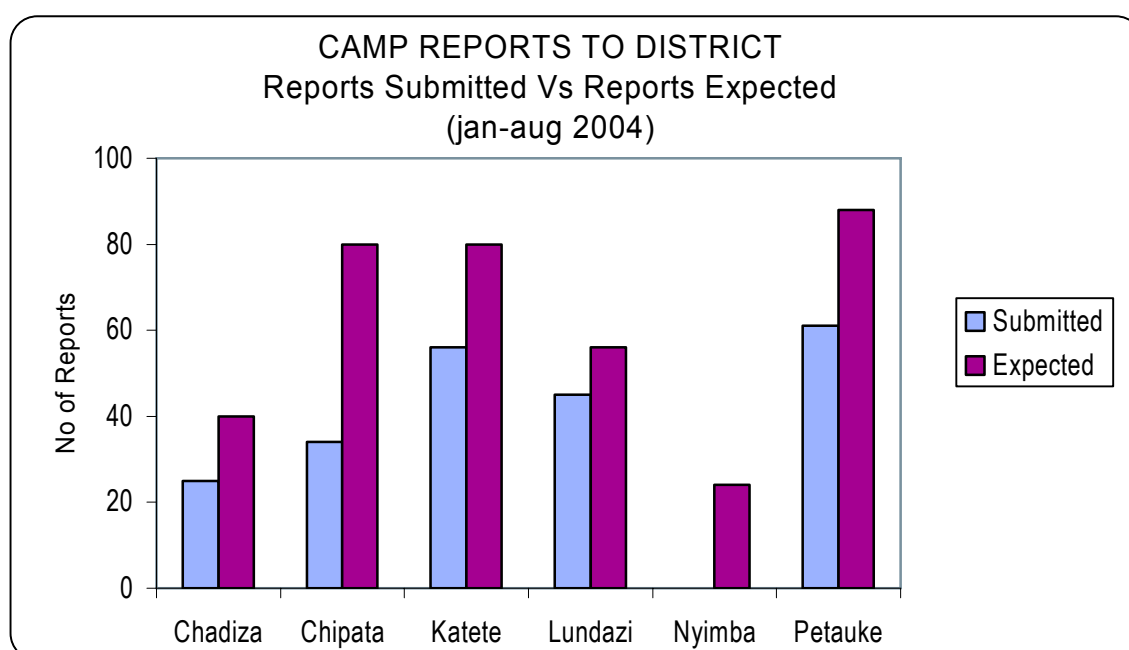


Figure 2: Observed and expected number of reports submitted by the veterinary camps between January and August 2004 to each of the districts.

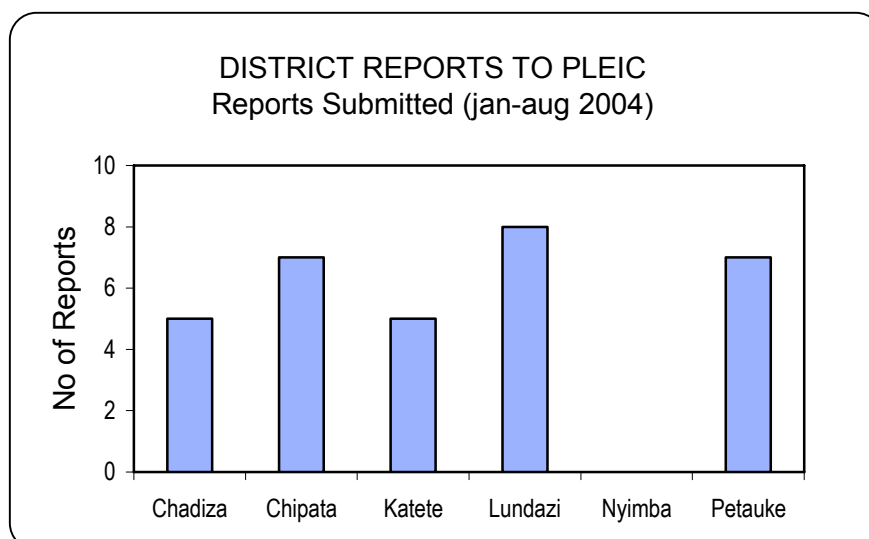


Figure 3: Total number of monthly reports submitted by the district to the Eastern PLEIC between January and August 2004.

Results

Frequency of reporting

Livestock farmers have the self-motivation to report disease information to their local veterinary camp assistant as they appreciate the importance of keeping the veterinary assistant informed of the status of their herd health. About 70% of all livestock owners that were interviewed report directly to a representative of the DVLD.

Reporting from the veterinary camps to the District is variable. In all Districts under study a substantial number of reports (for the period January – August 2004) has not been submitted (Figure 2). Substantial differences exist between the reporting frequency of the different Districts (Figure 2).

The rate of submission of camp reports between districts was highest for camps in Lundazi (80% or 45 reports out of the 56 expected) followed by those in Katete and Petauke (70%), Chadiza (62%) and then Chipata (42%). It was lowest for camps in Nyimba (0%).

The total number of monthly reports submitted (expected number is 8) to the Eastern PLEIC by each district in the Province between January – August 2004 also differed between Districts (Figure 3). Only one District (Lundazi) had submitted all its monthly reports at the moment of the study. Serious delays in report submission were observed in Chadiza, Katete and Nyimba Districts.

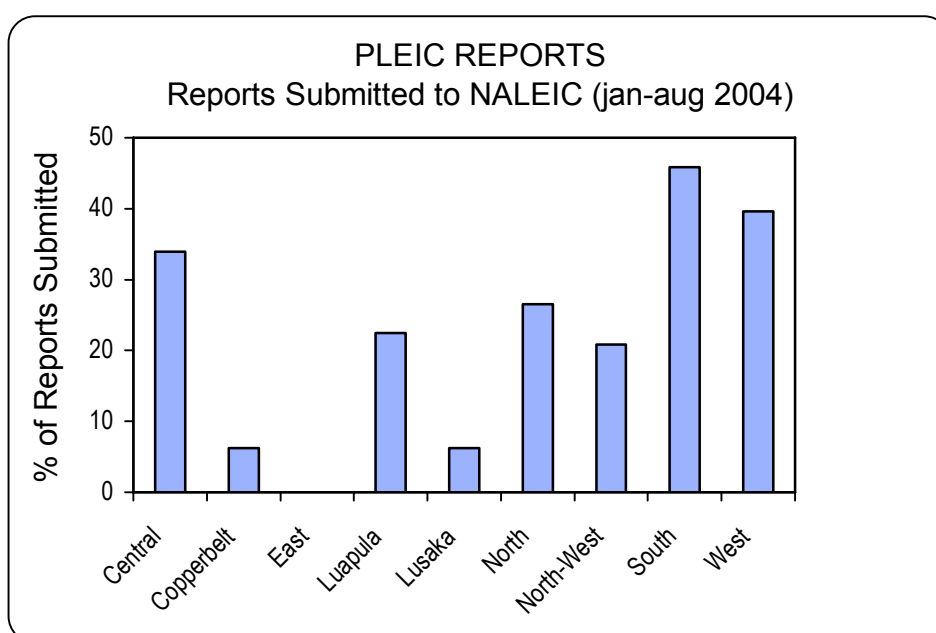


Figure 4: Proportion of the expected number of monthly reports submitted by each PLEIC to the NALEIC between January and August 2004.

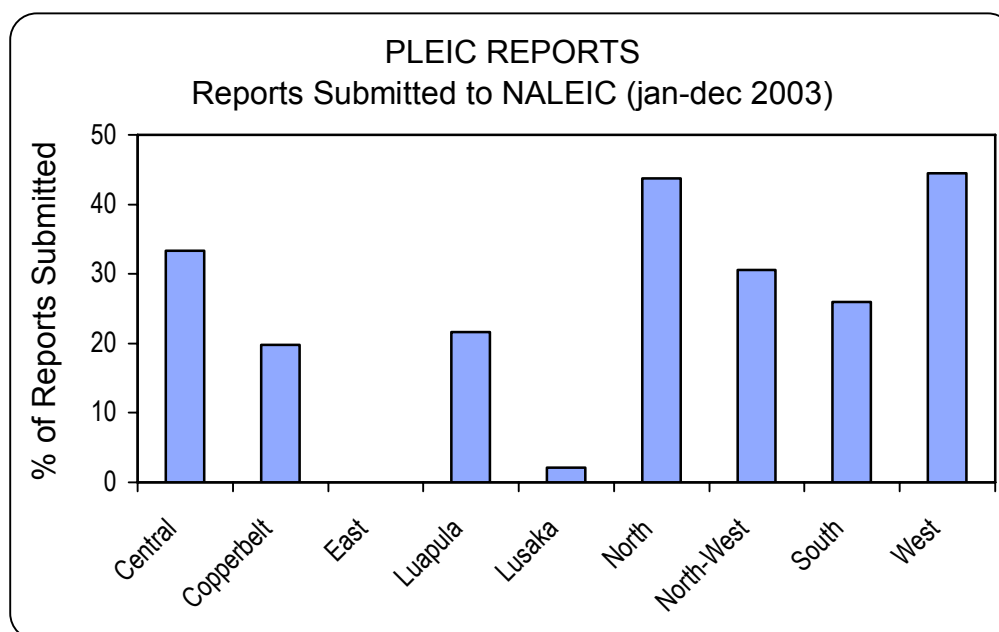


Figure 5: Proportion of the expected number of monthly reports submitted by each PLEIC to the NALEIC in 2003.

The rate of submission of district reports was highest for Lundazi (100% or 8 reports out of the 8 expected) followed by Chipata and Petauke (87%). It was low for Chadiza and Katete (62%) and lowest for Nyimba (0%). Each year the National Livestock Epidemiology and Information Centre (NALEIC) is expected to receive a total of 708 monthly reports from the 59 veterinary districts countrywide. The percentage of reports submitted by each PLEIC in the country to NALEIC in the period January – August 2004 is shown in Figure 4.

The percentage of reports submitted by each to NALEIC during the period January – December 2003 is shown in Figure 5.

Discussion

On average, the rate at which reports from veterinary camps are submitted to the district is 65% (i.e. 65% of the expected number). The rate of report submission from the districts to the PLEIC is 80%, and the rate of submission of reports from the PLEIC's to the NALEIC is only 21%. Hence, only about a tenth (11%) of the data generated at the ground level ever reach the NALEIC. Such low level of reporting from the field must have repercussions for the timely reporting of livestock disease information to the international

organizations. Since the activities of the DVLD are to a large extent guided by the information obtained and analysed by the NALEIC, decision making in the field of veterinary interventions must be difficult. Similar problems must be encountered when formulating an appropriate livestock sector development policy.

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DEPARTMENT OF ANIMAL HEALTH

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The over-all goal of the Department of Animal Health (DAH) is to generate, distribute and apply scientific knowledge of tropical diseases in livestock, and to strengthen the capacities in this field in developing countries, in order to contribute to the improvement of health and living conditions of the human populations. Particular focus will therefore be put on those livestock diseases which endanger food security, or which can be transmitted to humans.

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The main research priorities are:

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- Taenia / cysticercosis: health impact in animals and humans, diagnosis, immunity, epidemiology and control
- Gastro-intestinal helminths: mechanisms of drug resistance, epidemiology and control
- Disease control: decision-making, system approaches, interactions with human health (zoonoses)
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4. Training

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- Distance learning: joint web-based Master programme in collaboration with the University of Pretoria, South Africa
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