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Methods for the rapid appraisal of African animal trypanosomosis in the Gambia

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Abstract

A technique for the rapid field assessment of African animal trypanosomosis (AAT) was developed during studies in the Gambia. This involved gathering indigenous information from rapid-appraisal questionnaires addressed to local informants, the results of single tsetse surveys and evaluations of the prevalence of trypanosome infections in village cattle. Local informants included livestock owners and herdsmen and trained personnel such as livestock assistants. The answers to the questionnaires were weighted in order to translate them into semi-quantitative ranked estimates (zero, low, medium, high or very severe) of the severity of AAT problems. A similar ranking was also defined for tsetse and prevalence data in the Gambia. The three assessment methods generally gave complementary results leading to similar conclusions about the severity of tsetse-trypanosomosis problems in a survey area; inconsistencies usually suggested that additional information was needed. The rankings of AAT intensity were used to develop management guidelines for minimising the impact of AAT at different levels through control interventions or improved livestock management. The methodology was designed to provide reliable, up-to-date and cost-effective assessments of AAT problems. Emphasis was placed on the importance of the involvement, priorities and perceptions of village livestock owners and herdsmen in making these assessments.

Keywords: Trypanosomosis; Cattle-parasitological diseases; Rapid appraisal; Tsetse surveys; N'Dama cattle; The Gambia

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Introduction

Tsetse-transmitted trypanosomosis is a major constraint to the improved and sustainable production of domestic livestock throughout much of sub-Saharan Africa. N'Dama cattle, Djallonké sheep and Dwarf West African goats (which comprise more than 99% of herds and flocks in the Gambia; DLS/ITC, 1994 Livestock Census) belong to trypanotolerant breeds which can survive and remain productive in the face of persistent tsetse challenge (Murray et al., 1982). These trypanotolerant animals form an important component of the agro-pastoral, mixed-farming system seen in the Gambia, where they provide cash income, a wealth reserve, milk, meat, traction and manure (Itty, 1992; Sumberg, 1992). However, these animals are usually grazed on communal pastures where they may be exposed to attack by tsetse flies and the risk of trypanosomosis infection (Wacher et al., 1993, 1994).

Tsetse challenge is not uniform over time, in all parts of the country or between different habitats within a particular area (Rawlings et al., 1993; Wacher et al., 1993, 1994). Two tsetse species occur in the Gambia: *Glossina morsitans submorsitans* occurs in savanna woodland through much of the country while *Glossina palpalis gambiensis* is a typically riverine species (Rawlings et al., 1993). Studies at the International Trypanotolerance Centre (ITC) identified *G. m. submorsitans* as the main vector of trypanosomosis of livestock (Rawlings et al., 1991, 1993). The role of *Glossina palpalis gambiensis* in African animal trypanosomosis (AAT) transmission is less clear but it is often implicated in the transmission of human sleeping sickness (Jordan, 1986), which disappeared from the Gambia in the 1950s (Rawlings et al., 1993).

Livestock-development projects in sub-Saharan Africa are often required to make decisions concerning the intensity, impact and management of AAT. In the present economic climate, there is an increasing need for uncomplicated, reliable and cost-effective methods for collecting information on which these decisions can be based. We describe a methodology which uses information from rapid-appraisal questionnaires addressed to local informants, one-off tsetse surveys and assessments of the prevalence of trypanosome infections in village livestock. This methodology evolved from intensive, long-term studies of tsetse challenge and prevalence of infections in village N'Dama cattle in the Gambia (Rawlings et al., 1991; Agyemang et al., 1997). Techniques for rapid appraisal of animal-health problems (Ghirotti, 1993; IIED, 1994; Waters-Bayer and Bayer, 1994) and for tsetse (FAO, 1986, 1992) and trypanosomosis (ILCA, 1983) surveys are well documented and many of the techniques for problem analysis and rule-based models have been described by Norton and Mumford (1993).

Our objective is to use three independent field techniques as sources of information for a rule-based model in order to assess the intensity of AAT problems (Table 1). From these assessments, management guidelines were developed in order to identify the need and options for AAT control. We use observations made during an FAO/ITC Training Course for Middle-level Personnel on Trypanosomiasis Assessment and Tsetse Control held in the Gambia in March 1993 (Snow et al., 1995) as a case study to illustrate this methodology. Subsequently, management guidelines based on assessments made during several field exercises were developed during a workshop held in January 1997 with staff from the Gambian Department of Livestock Services and ITC scientists.

Table 1
Appraisal techniques, their objectives and equivalent African animal trypanosomosis (AAT) problem rankings applicable in the Gambia

Overall objective:	To use three independent field techniques to provide information inputs for a rule-based model to assess the intensity of AAT problems and to use this as a basis for developing management guidelines on the need and options for control. Is tsetse-trypanosomiasis challenge zero, low, medium, high or very high?		
Appraisal technique	Questionnaire assessments (RA) based on direct observation and interviews with local informants	Tsetse survey (Ts)	Prevalence of infections in village cattle (Pr)
Technique objective	To make a village-level assessment of animal-health problems facing village livestock populations and the severity of AAT as perceived by the owners	To confirm the presence of tsetse, estimate their density (TTD), determine habitat associations and obtain a preliminary figure for tsetse-trypanosomosis challenge	To examine village cattle for symptoms of AAT and evaluate the prevalence of infections from blood samples
AAT intensity ranking:			
1. Zero	Questionnaire score <25	No tsetse seen	Prevalence= 0
2. Low	Score ≥25 but <50	TTD (tsetse/trap/day) ≤3.0; CI (challenge index) ≤9.0	Prevalence ≤3.0%
3. Medium	Score ≥50 but <70	TTD 3.1–7.0[b]; CI 9.1–21.0	Prevalence 3.1–10.0%
4. High	Score ≥70 but <90	TTD 7.1–20.0[a]; CI 20.1–60.0[b]	Prevalence 10.1–20.0%[a]
5. Very severe	Score ≥90[a]	TTD >20.0; CI >60.1[a]	Prevalence >20.0%

[a] Rank severity of AAT problems determined during the case study.
[b] Mean annual values estimated from the case study results.

2. Methods

2.1. Sources of information

An effective low-cost system for describing tsetse and trypanosomosis problems needs to combine and collate information of variable quality and precision to aid decision-making. Reliable results must also be produced in the shortest possible time.

Primary information, collected at first hand in villages and surrounding areas, comprises two categories — one largely qualitative and the other more quantitative.

The qualitative assessments include:

1. Interviews with local informants, covering local perceptions of animal-health problems and their relative importance, the role and utilisation of livestock and their products, recognition of tsetse and trypanosomosis problems and the practicality of community participation in, and payment for, any control interventions.
2. Direct observation by experienced, trained veterinary or tsetse personnel to assess animal-health problems, the role of livestock in the village economy and wider farming system and indications of the presence and possible intensity of tsetse and trypanosomosis problems.

Although this information is not directly quantitative, a system for translating this data into semi-quantitative, ranked estimates of tsetse-trypanosomosis problems is described in a later section.

The quantitative assessments include:

1. A tsetse survey to establish which species are present, their habitat associations and provide an estimate of fly abundance (FAO, 1986; Rawlings et al., 1993)
2. Examination and blood sampling of livestock to determine the prevalence of trypanosomosis as a direct estimate of the presence and frequency of the disease (Leperre and Claxton, 1994; Agyemang et al., 1997).

Secondary, i.e. indirect, information can be important to both qualitative and quantitative assessments. This may include published and unpublished information available at international, regional, national and provincial or district levels. The sources of material may range from continent-wide tsetse-distribution maps (Ford and Katondo, 1977) to local human- and livestock-census data and departmental reports. Ideally, all these sources of information should cross-check, be complementary, overlap and lead to the same conclusion concerning the severity and impact of AAT problems.

Careful definition of the objectives of surveys is essential. The resources that are needed will depend on the size of the target area and the level of confidence thought to be necessary when making decisions about AAT. The type of survey (identifying localised AAT problems, the focus of more-detailed surveys or monitoring control interventions) will determine the resources necessary and the quantity and quality of the information required.

2.1.1. Participative appraisal of health problems affecting village livestock

Participatory rural appraisal (PRA) has a number of advantages over more-detailed, long-term studies (Norton and Mumford, 1993; Nabasa et al., 1995). PRA can be used to

collect data more quickly and more cost effectively, it uses a wide range of multidisciplinary information, enables on-the-spot assessment, has a high level of community participation and is accessible to many users with or without statistical skills. However, information collected using these techniques may lack some detail and precision.

A village-level appraisal of tsetse-trypanosomosis problems should include both direct observations and PRA interviews to explore local perceptions of the factors that limit livestock productivity. In the Gambia, where the situation is relatively homogeneous (Agyemang et al., 1997), livestock owners and herdsmen in the village communities and livestock assistants employed by the Department of Livestock Services are key informants. In other situations, heterogeneity in livestock-management practices or the farming system in general may make selection of informants more difficult if different ethnic or wealth groups have different objectives, perceptions or preparedness to contribute to improved livestock production.

Information on the role of livestock and tsetse-trypanosomosis problems was derived from standardised questionnaires developed in the Gambia (Appendix A). Questions addressed livestock-owners' perceptions of animal-health problems and vectors of disease, the use of trypanocidal drugs and relative abundance of wild animals (which may be hosts of tsetse and reservoirs for trypanosomes affecting livestock). This qualitative information can be translated into a semi-quantitative scoring system to rank the probable level of AAT problems in the area (Appendix B).

Case study. Field work, as part of a training course for livestock assistants, was conducted in the Dankunku area, Central River Division, The Gambia in March 1993. This area, of ca. 110 km^2, included a deferred-grazing scheme where an increase in tsetse numbers had been reported. Approximately 3500 people and 2000 cattle were resident. The objectives of these exercises are summarised in Table 1.

Four teams of trainees, each including one Gambian livestock assistant to assist effective communication with the local informants, visited separate villages in the area. In each village, interviews were conducted with a senior livestock owner and his colleagues. The questionnaire included a number of unscored questions that provided additional background for a situation report at the end of the exercise. The interviews took 60–90 min to complete. Answers to the questionnaires were scored as described in Appendix B. The scores obtained by the four teams (99, 92, 91 and 103) were very similar and led to the conclusion that AAT problems were very severe (Table 1), a major cause for concern and a significant constraint to increasing livestock ownership and productivity. Tsetse-trypanosomosis challenge appeared to be very high. This situation was clearly recognised by the local livestock owners.

2.1.2. *Technical assessment 1: tsetse survey*

The density and distribution of each species of tsetse in the Gambia was evaluated using traps (FAO, 1992) in representative habitats, including areas regularly grazed by local cattle (Rawlings et al., 1991; Wacher et al., 1993). The trapping results were summarised as tsetse per trap per day (TTD). Since tsetse habitat is likely to be patchily distributed through the survey area, TTD values should be given for each habitat type with, if possible, an estimate of the extent of each habitat type over the whole assessment

area. If a figure is available for the prevalence of infections in tsetse, a challenge index (CI = TTD × prevalence of trypanosome infections) can be calculated. If sufficient data are available on the seasonal changes in tsetse abundance, it will also be possible to adjust data from a single visit to give a value for the expected mean annual catch and mean annual challenge (Rawlings et al., 1991).

Case study. As part of the training course, a tsetse survey was carried out in order to confirm the presence of tsetse, estimate their density (as TTD) and to determine tsetse-habitat associations (Table 1). Twenty-four blue box traps were sited in representative habitats throughout the assessment area, but with emphasis on the deferred-grazing area. They were operated for two days and harvested once daily. Each team of trainees had the responsibility for harvesting a group of 5–7 traps and identifying, sexing and counting the catches. The habitat types were recorded and categorised collections from the traps then grouped accordingly.

Total catches of tsetse included 664 *G. m. submorsitans*, but no *G. p. gambiensis*. Habitats were ranked according to apparent tsetse densities that ranged from 1.6 (cleared farmland) to 81.0 TTD (Mahogany, *Khaya senegalensis*, forest), with a mean of 14.1 TTD. During the previous month, the ITC Entomology Team had dissected a sample of 111 *G. m. submorsitans* from the same area and found a prevalence of mature infections of 6.3% (all were infected in both midgut and proboscis, indicating infections were by the *Trypanosoma congolense* group). This figure compares with a mean, countrywide prevalence of infections in *G. m. submorsitans* of ca. 3% (Rawlings et al., 1991; ITC Entomology Team, unpublished data). The TTD figures for *G. m. submorsitans* were adjusted to give a value for the expected mean annual catch (ITC Entomology Team data; annual mean = March TTD/2.52), and a value for the mean annual challenge:

	TTD (*a*)	Prevalence of infection (*b*) (%)	Challenge index ($a \times b$)
March 1993	14.1	6.3	88.8
Estimated annual mean from March data	5.6	6.3	35.3

A ranking of the severity of trypanosomosis problems in the Gambia (Rawlings et al., 1993) was derived from data collected during ITC's field surveys (Rawlings et al., 1991) and observations on the health and productivity of the village herds (Agyemang et al., 1997). The values obtained during the training exercise were compared with these rankings which are summarised in Table 1. We concluded that the level of tsetse-trypanosomiasis challenge in the Dankunku area was high and seasonally very severe. This was a level that was likely to have a serious impact on the health and productivity of all classes of hoofed livestock.

2.1.3. Technical assessment 2: prevalence of AAT infections in village cattle

External examination of sick animals in a herd — or even only the last animals to return from grazing (Dowler in Kenya and Doku in Ghana, personal communication) — can give an indication of the existence of AAT problems. More-quantitative information requires blood-sampling from herds exposed to the risk of infection (ILCA, 1983). The

dark-ground buffy-coat technique (Murray et al., 1977) was used to evaluate the prevalence of infections in village cattle in the Gambia (Agyemang et al., 1997). The AAT rankings shown in Table 1 were derived from these results, although it is recognised that prevalence may vary with age and nutritional status of cattle (Agyemang et al., 1990).

Case study. Blood samples were taken from sample herds in the survey area by the ITC Animal Health Team during January, February and March 1993. These observations were analysed as a laboratory exercise by the trainees. Prevalences of 15.6%, 11.6% and 8.8% (mean, 12.0%) were observed in the three months although they varied between different villages (range of the mean prevalence 0–14.8%) — emphasising the importance of patterns of cattle–tsetse contact in determining the local epidemiology of AAT (Wacher et al., 1994). The mean prevalence value was compared with the ranking of intensity of AAT problems summarised in Table 1. It was concluded that trypanosomosis prevalence in village N'Dama herds in the Dankunku area was high and probably caused significant productivity losses.

The three assessment methods outlined above — questionnaires to collect information from local informants, rapid surveys of tsetse abundance and the prevalence of trypanosome infections in village livestock — should give complementary results and lead to similar conclusions about the severity of tsetse-trypanosomosis problems in the survey area. Agreement between the three sources of information is called "triangulation" and reinforces the assessors' confidence that PRA and rapid field surveys gather valuable knowledge on which decisions for AAT management can be based. The rankings (Table 1) may also be compared using a sum of squares of the deviations from the mean rank severity ((RA rank − mean rank)^2 + (Tsetse rank − mean rank)^2 + (Prevalence rank − mean rank)^2). For the case study, the sum of squared deviations from the mean was $0.67 = ((5_{\text{RA rank}} - 4.67)^2 + (5_{\text{Ts rank}} - 4.67)^2 + (4_{\text{Pr rank}} - 4.67)^2)$. Where the three assessments give the same ranking, the mean deviation is zero and small deviations (<1.5) indicate good correspondence. Values of 1.5–3 indicate assessments that are reasonably close and differences can probably be resolved by examining data collected during a single field visit or during discussions with local informants. A higher value (>3) clearly indicates that more information, probably from repeated or more intensive surveys, will be necessary in order to make a valid assessment. Agreement between the information sources on the influence of AAT on village-based livestock can be summarised as follows:

- A zero ranking indicates that AAT is not a problem and is not perceived as being a problem by livestock owners in the survey area. Transmission may be zero or is at a very low level and infections are rare in tolerant and sporadic in susceptible stock. Tsetse challenge appears to be zero or very low.
- A low-intensity ranking indicates that AAT is not a problem in the survey area although there might be a risk of infections in equids, exotic and susceptible breeds. Tsetse challenge appears to be very low.
- A medium-intensity ranking indicates that AAT problems exist but are currently not a major threat to most groups of livestock. This is the threshold of regular infections in village N'Dama. Horses and donkeys might, however, be experiencing some morbidity and mortality. Tsetse challenge is low to moderate.

- A high-intensity ranking indicates that persistent AAT problems exist and are currently causing some productivity losses even in trypanotolerant livestock such as village N'Dama cattle. Tsetse challenge ranks moderate to high.
- A very-severe ranking indicates that AAT is a cause for concern and is probably a serious constraint to increasing livestock productivity. This is a relevant rank in the Gambia where there are a few "hot-spots" with significant production losses even in village N'Dama cattle (Rawlings et al., 1993). Tsetse challenge appears to be high to very high.

Case study. The three rapid-assessment exercises in the Dankunku area of the Gambia gave similar and complementary results (Table 1). These led to the conclusion that trypanosomosis was a major cause for concern and was probably a serious constraint on livestock productivity and the adoption of improvements to the local livestock industry. It was recognised as a problem by the local livestock owners who were anxious for measures to be taken to control the disease.

The ranking of AAT problems should be interpreted flexibly and considered in the light of secondary information and on-going trends which may affect tsetse and AAT transmission (Snow et al., 1996a). Extensive, long-term data show a general correlation between the prevalence of trypanosome infections in livestock and tsetse challenge (Rawlings et al., 1991; Leak et al., 1990; Snow et al., 1996b) — but with more limited data, inconsistencies might arise. For example, if both tsetse captures and the prevalence of infections in cattle indicate a low or medium AAT ranking — but the responses to the questionnaire point to a perception of severe problems — the field surveys could have been carried out in a season when challenge was low. Alternatively, village perceptions of AAT may be historically biased and remain unaltered despite changing incidence of the disease. Secondary information on seasonal patterns of challenge in the area could resolve this discrepancy. Similarly, high prevalences in cattle tested in the survey area — but low tsetse captures and questionnaire scores — might indicate that the tested cattle were immigrants from a high-challenge area. Animal trypanosomosis in the Gambia has been extensively studied for more than 10 years and (perhaps not unsurprisingly) no inexplicable discrepancies were found applying this methodology. A lack of correspondence between the three types of assessment that is not immediately explicable is not a negative result of the methodology but may be a consequence of localised and seasonal factors and will demonstrate that additional information is needed in order to make a sound assessment of the intensity of AAT challenge.

3. Management guidelines

The major objective of determining the intensity of AAT problems is to provide a basis for deciding on the most appropriate disease control and livestock management interventions. Losses to livestock enterprises caused by AAT include direct losses from mortality and reduced productivity and the costs of drugs and control measures. Indirect losses result from constraints which the disease places on the adoption of more efficient production systems, such as the introduction of more productive but susceptible livestock or intensified management. The findings of a workshop held in the Gambia to discuss

management guidelines for minimising the impact of AAT, at different levels of severity, are summarised in Table 2.

Even at the lowest level of AAT, there is always a need to remain alert to a potential problem. Current husbandry practices may be important in maintaining low prevalence and the introduction of animals from high-challenge areas — or a change to more susceptible breeds or species — may increase AAT prevalence. The consensus in the workshop was that in low-challenge areas, intensification will continue.

Livestock owners facing even medium-to-high tsetse-challenge situations still attempt to introduce trypanosusceptible zebu cattle from Senegal into their herds. These animals often need regular treatments with drugs. Trypanocidal drugs (diminazine) are widely used in the Gambia to treat sick animals — but the use of chemoprophylactics (isometamidium) was, until very recently, officially discouraged and little used.

There have been no vector-control programmes in the country apart from a small-scale trial carried out by ITC (Snow et al., 1999). Insecticide applied to cattle as sprays and pour-ons has additional benefits in controlling ticks and other flies. Very-severe AAT problems in the Gambia are limited to a small area of around 300 km^2 (Rawlings et al., 1993) with a very-low human-population density and few resident livestock. In this case, an intervention using insecticide-impregnated targets may be more appropriate.

Case study. During the FAO/ITC Training Course, it was concluded that the Dankunku livestock owners had, to some extent, come to terms with the problem. They used trypanotolerant breeds of cattle, sheep and goats, trypanocidal drugs were widely used and owners avoided exposing susceptible horses and donkeys to areas of high challenge. The question of the adoption of (and contributions towards) control interventions was not addressed during the field exercises — but the village-level application of the guidelines described here was tested during a separate study (Snow et al., 1997).

The objective of a control intervention will be to move systematically from one problem ranking to a less-severe one. With increasing severity, the inputs required for the management of AAT and vector control increase whilst the options for development, intensification and introduction of alternative livestock classes decrease. Not all the suggested interventions have been implemented in the Gambia and each would need to be considered in terms of cost-effectiveness, potential adoption by the affected livestock owners, cost recovery, sustainability and likely long-term outcomes. In the case of trypanotolerant breeds, the margin between the cost of any intervention and its benefits is likely to be small, except where tsetse challenge and trypanosome prevalence are very high.

4. Discussion

In order to improve the welfare and security of rural communities in Africa, rapid methods for assessing risk and diagnosing urgent problems are needed for the control of both human and animal disease (Vlassoff, 1991). Definition of the minimum data needed to support a valid decision is part of this process and we suggest that the methodology described here is widely applicable to AAT and other animal health problems. It allows a direct response to real problems at village level, uses field-collected data and identifies

Table 2
A summary of suggested control and management responses to different rank intensities of African mal trypanosomosis (AAT) problems in the Gambia (NA: not considered to be appropriate at this problem level)

AAT problem ranking	Chemotherapy	Chemo prophylaxis	Tsetse control	Intensification options	Livestock breeds
Zero	Do nothing	NA[a]	NA	Intensify production systems, e.g. peri-urban dairying	Introduce new breeds, e.g. exotics and crosses
Low	Treat as and when required	NA	Cost of vector control not justified at this level	Intensify both improved and village-level systems. Improved management could further reduce risk	Introduce new breeds, e.g. pure zebu
Medium	Treat as and when required but frequency of treatment will increase as problem ranking increases	NA	Tsetse control may work technically at this level but would not be cost effective: consider also benefits for tick and nuisance fly control	Village-level intensification, e.g. draught cows, compost pens, etc.	Keep trypanotolerant breeds
High	Treat as and when required	Prophylactic treatment should be considered for oxen, horses and donkeys if these animals are important in the farming system	Tsetse, tick and nuisance-fly control using pour-ons although costs may be high and benefits small	Village-level intensification, e.g. draught cows, compost pens, etc. In-village management can reduce exposure of animals to tsetse; compare herd cattle and equids	Keep trypanotolerant breeds
Very severe	Treatment on demand may be insufficient to prevent significant production losses	Make prophylactics available for all live-stock including herd cattle, oxen, horses and donkeys	Use of insecticide impregnated targets may be justified. Effective vector control would facilitate important development options	Impact on livestock may restrict agricultural development and consequently intensification options are very limited	Keep trypanotolerant breeds — whichever will survive!

[a] NA-not considered to be appropriate at this problem level.

whether there is a problem to be addressed. In addition, it facilitates the collection of standardised field data which can be further used in more-sophisticated databases.

Tsetse infest large areas of sub-Saharan Africa; there are many regions where AAT and tsetse are presumed to be present but there have been no recent surveys to confirm their presence or to determine the intensity of AAT problems. Rapid appraisal is applicable in many situations where an urgent assessment of tsetse and AAT is required. For example:

- where an increased prevalence of AAT is being reported in local livestock and the livestock owners are demanding action;
- where susceptible cattle are becoming increasingly exposed to AAT such as in Burkina Faso where West African zebu are moving south into tsetse infested areas (Kabore et al., 1995); and
- for development projects in areas where the control of medically important diseases has opened opportunities which may be constrained by AAT (Hendrickx and Napala, 1995; Hursey and Slingenbergh, 1995).

The technique described here was developed in a settled, mixed crop-livestock farming system in the Gambia where the local communities were aware of the problems facing their livestock and of their environment (Snow, 1996). It is likely to produce its most-reliable results when applied in similar communities. Discussions during a training course in Ghana (Snow, unpublished data) indicated that the methodology could be applied there with few changes. However, during a recent trial in Guinea (Ceesay, personal communication), the responses of livestock owners were inconsistent until they were asked specifically about trypanosomosis. The technique has proved ideal as a framework for training courses (Snow et al., 1995) and the information collected during such exercises can feed directly into the assessment and decision-making processes.

The area which can be surveyed in a single, short visit will be determined by the resources available to the survey team, human and livestock population densities, patchiness in the distribution of ethnic and livestock management systems and heterogeneity of tsetse habitat and fly distribution. It may be defined by natural, topographic or administrative boundaries or by the area occupied by an affected community. The target area is, however, unlikely to be an entirely isolated community or a place with boundaries that represent any true limits of tsetse or AAT distribution and this may invalidate the notion of an "area-specific" assessment. In the Gambia, 300 km^2could be surveyed in detail in 10–14 d, whereas a country-wide survey of tsetse distribution, covering 10 000 km^2, was 80% complete in six months (Rawlings et al., 1993).

The cost of an assessment may be highly variable. Single visits at times of peak challenge (when positive results are most likely) by trained staff with a wide range of skills are the most cost-effective method of gathering information. Repeat visits will increase costs, but may be necessary if information from different sources is conflicting. An estimate of operating costs made for a 10-day survey of ca. 300 km^2 in 1996 amounted to US $1650. These included local salaries, field allowances, payment of casual labour, vehicle running costs and miscellaneous supplies.

The reliability of the estimate of the severity of AAT will depend on several factors, including the extent of the knowledge of livestock owners and herdsmen. Nevertheless,

the responses may indicate important information gaps (e.g. being unaware of a causal relationship between tsetse and trypanosomosis (Snow, 1996)) which may be essential for the successful implementation of a control intervention. The efficiency of traps in detecting low-density tsetse populations may be critical: catches of tsetse indicate non-zero challenge but a nil catch does not prove their absence. Tsetse catches may also give little indication of an impact on livestock if they feed only rarely on cattle, are not in contact with herds that season (Wacher et al., 1994) or trypanosomes present in these vectors are non-pathogenic to cattle (McNamara and Snow, 1991). Detection of trypanosomes in the blood of cattle is direct confirmation that they have been exposed to tsetse — but it may be more difficult to determine their origin or the pattern of exposure. While the dark-ground buffy-coat technique (Murray et al., 1977) is widely used, low-grade parasitaemias are often missed although more-sensitive diagnostic tests, e.g. Ab-ELISA (Hopkins et al., 1998) and PCR (Masake et al., 1997; Pereira de Almeida et al., 1998) may resolve this problem. Nevertheless, taken together, the three information inputs can give a good idea of the local epidemiology and impact of AAT. Reliable estimates of the prevalence of infection in tsetse and cattle may require large sample sizes, especially where the proportion infected is low (Snedecor and Cochran, 1980), and this may increase costs, especially when repeat visits to the area are necessary.

The technique is intended for use by trained, middle-level and more-senior, veterinary and tsetse-control personnel. Their technical support in the assessment and monitoring AAT will continue to be essential although the implementation of control may become increasingly community-based or privatised. At the very least, there should be a requirement for recovery of the cost of interventions. The PRA and socio-economic assessments are important components to determine the demand for control and for livestock products as well as the costs, benefits and technical possibilities for control. Further, survey inputs could be added to estimate losses due to AAT, and the costs of diagnosis and control. Rapid appraisals involving animal health workers, drug suppliers, livestock owners' associations could be carried out at relatively low cost to provide important, additional information on how sustainable control programmes might be implemented.

Trypanosomosis control can make a major contribution to enhance agricultural productivity in sub-Saharan Africa. However, every situation will have unique features and an appropriate response must be selected and adapted in the light of up-to-date field assessments. Reliability and cost effectiveness are key factors. The technique described here is aimed at providing just this type of information.

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Appendix A. Questionnaire: livestock and tsetse

Objective. To estimate how severe the problem of African animal trypanosomiasis (AAT) is to livestock in the survey area from answers to questionnaires given by local livestock owners or herdsmen and direct observation during a brief field visit. Is tsetse-trypanosomosis challenge extremely high, high, moderate, low or zero?
Name of interviewer: Occupation of interviewer:
Date of interview:

1. Details of informant:
1.1 Name of village: 1.2 Name of informant:
1.3 Is he — A: A cattle herd owner B: A cattle herdsman C: Other
1.4 If he is a herd owner, is he directly involved in the management of his animals? A: Yes B: No
1.5 What kinds of livestock does he own and/or manage? A: Herd cattle B: Oxen C: Sheep D: Goats E: Donkeys F: Horses

2. Interview with local informant:
2.1 Ask your informant to list the most serious problems affecting his cattle. Where he uses dialect names, your local resource person will tell you to which diseases he is referring. A check list follows but mark/tick only those diseases your informant refers to — Do not ask him leading questions such as "Is trypanosomosis or anthrax important?" because he is sure to reply YES!

Disease/problem	Cattle in herd	Oxen
Trypanosomosis		
Contagious bovine pleuropneumonia (CBPP)		
Blackquarter (BQ)		
Haemorrhagic septicaemia (HS)		
Anthrax		
Rinderpest		
Ticks and other ectoparasites		
Worms		
Poor nutrition		
List any other problems mentioned:		

Then ask your informant to tell you, in his opinion, the order of importance of these disease problems — number the boxes you have marked/ticked 1 for the most important problem, 2 for the second most important and so on.

2.2 Do cattle owners/herdsmen recognise trypanosomosis/AAT as a problem distinct from other diseases?
A: Yes B: No

2.3 Has AAT got a special name in the local language? — ask your local resource person.
A: Yes B: No

2.4 How important is AAT to your informant? Refer also to the answers to question 2.1.
A: Severe, the most important problem
B: Among the first three most serious
C: Recognised, but other problems have higher priority
D: Occurs, but not a problem
E: Not present or not recognised

2.5 Ask your informant about zebu cattle:
A: If none are present, have they tried to keep them, but it is impossible to keep them alive?
B: Are they difficult to keep, requiring special management and frequent drug treatments?
C: Are kept without problems with the main herd grazing bush land pastures?
F: They have never tried keeping them in this area

2.6 Ask your informant about horses and donkeys in his village. Is it that:
A: There are no horses or donkeys in the village because it is impossible to keep them alive
B: There are some, but they suffer high mortality and need frequent replacements; they do not breed successfully and there is a high foal mortality and/or they need special management to keep them healthy, e.g. they need to be stalled, grazed near the village and not in the forest
C: The numbers are stable, they do not need to be stalled but they need regular veterinary attention
D: The village has a healthy, breeding population of horses and donkeys
F: People do not keep horses or donkeys because it is not part of their tradition or because they cannot afford them

2.7 Does he use drugs to treat his animals specifically for *trypanosomosis*?
A: Yes B: No
Note: Ask which drug he uses — he may be referring to drugs in general including antihelmintics!

2.8 In the survey area are trypanocidal drugs are used on:
A: All kinds of herd cattle B: Only draught cattle (oxen)
C: Only donkeys and/or horses D: Not used on livestock in the village

2.9 Does your informant recognise tsetse?
A: Yes B: No
Note: It will be a great help to carry specimens of tsetse and other diptera to confirm your informant's identification.

2.10 Do tsetse have a special name in the local language? — ask your local resource person.
A: Yes B: No

2.11 At the time of year when they are most common, are they:
A: Abundant B: Fairly common
C: In a few places D: Seen only rarely
E: Never seen

2.12 Are any of the following kinds of wild animals found in the survey area: Wild pigs (warthog and bushpig), Antelopes (especially bushbuck) and/or Buffalo, Reptiles (crocodiles and monitor lizards)? Are they:
A: Seen often B: Seen only occasionally
C: Seen very rarely D: Never seen

Note: Warthogs are important maintenance hosts for *G. m. submorsitans* but do not generally harbour trypanosomes pathogenic to cattle; bushbuck and buffalo may be important hosts for tsetse and also carry trypanosome species pathogenic to cattle; monitor lizards are often important maintenance hosts for *G. palpalis* and *G. tachinoides*. Other wild animals such as hippopotamus and primates (monkeys and baboons) are usually much less important.

3. Direct observation:

3.1 Look at the cattle: which breed(s) are present in greatest numbers?
A: N'Dama B: Baoulé/West African Shorthorn
C: Muturu/Lagune
B: Zebu/trypanotolerant breed hybrids (Metis)
C: Zebu D: Exotics

Note: A, B and C are trypanotolerant breeds, E and F are susceptible and D may have intermediate tolerance.

3.2 Highlight or circle the proportions of trypanotolerant and trypanosusceptible breeds of cattle in the local herds:

Breed	Proportion				
	Very high >95%	High 65–95%	Mixed 35–65%	Low 5–35%	Very low <5%
3.2a Trypanotolerant	A	B	C	D	E
3.2b Trypanosusceptible	E	D	C	B	A

3.3 During your brief external examination, can you see any obvious symptoms which would lead you to suspect that AAT is present? e.g. pale mucosae (e.g. inside eyelid), enlarged superficial lymph nodes, lachrymation, lethargy, emaciation.
A: Yes B: No

3.4 From your direct observations, what is the natural vegetation type in the area?
A: Moist savanna woodland; broad-leafed trees generally less than 12–15 m high
B: Riverine woodland/gallery forest
C: Rain forest; trees often more than 20 m high, little light reaches ground
D: Dry savanna woodland; mostly thorn trees and Baobabs
E: Sahelian; dry with very few trees

3.5 During your general survey of the area have you seen areas of habitat which may be suitable for tsetse ? Especially important are forest, gallery forest or woodland. Is this habitat:
A: Extensive B: Partially cleared
C: In only small, isolated patches
D: Open with more or less all natural vegetation cleared?
E: Vegetation type unsuitable for tsetse

3.6 From the vegetation type and its condition, which, tsetse species would you expect to find in the survey area? Only West African species are listed:

- palpalis gp: G. palpalis (B), G. tachinoides (A)
- morsitans gp: G. morsitans submorsitans (A), G. longipalpis (C)
- *fusca* gp: *G. fusca* (D), *G. tabaniformis* (D), *G. medicorum* (D), forest species (D)
- Habitat unsuitable for tsetse

Note: Although all tsetse can transmit trypanosomes, their importance as carriers of disease varies with their abundance, the number of feeds they take from man or his livestock and their own susceptibility to trypanosome infection. In the list above their importance has been ranked, A–D, as vectors of AAT.

3.7 From your direct observations during the field visit, such as the numbers of flies in traps or in or following the car, do tsetse appear to be:
A: Abundant
B: Common
C: Occasional/rare (maybe just one seen during trip)
D: None seen

Note: If you see tsetse then you are sure they are present, but not seeing them is no proof that they are not present!

Appendix B. Scoring the questionnaire

Circle or highlight your answers in the following table:

Topic	Question						F or No answer
2. Local informant							
Owner recognition of AAT	2.2		A			B	
Local name for AAT	2.3		A			B	
Importance of AAT	2.4	A	B	C	D	E	F
Zebu cattle	2.5	A	B		C		
Horses and donkeys	2.6	A	B	C		D	F
Drug use	2.7	A			B		
Livestock on which drugs used	2.8	A	B		C	D	
Tsetse recognition	2.9		A		B		
Local name for tsetse	2.10		A			B	
Tsetse abundance	2.11	A	B	C	D	E	
Wild hosts	2.12	A	B	C		D	
3. Direct observation							
Cattle breed	3.1	A,B or C		D	E	F	
Cattle population	3.2a	A	B	C	D	E	
	3.2b	A	B	C	D	E	
Symptoms of AAT	3.3	A		B			
Habitat type	3.4	A or B		C	D	E	
Habitat extent	3.5	A	B	C		D	
Tsetse expected	3.6	A	B	C		D	
Tsetse seen	3.7	A	B	C		D	
Complete the scoring table and multiply the total number of positive answers in each column by the following values:							
		5	4	3	2	1	0
Column totals							see note below
Add the column scores together to give a total score =							

A ranking of the severity of AAT problems based on rapid appraisal questionnaire scores:

- A score of <25 suggests that AAT may be absent from the survey area and that it is certainly not perceived as a problem by the local livestock owners.
- A score of 25 to <50 indicates that AAT may be present but that it is not is not a problem in the survey area. Nevertheless, horses and donkeys may, however, be experiencing problems. Tsetse challenge appears to be low-zero.
- A score of 50 to <70 indicates that although AAT problems exist, they are currently not a major problem for indigenous breeds of livestock. Tsetse challenge is moderate-low.
- A score of between 70 and 90 indicates that AAT problems exist. They are a cause for concern for local livestock owners and are currently causing productivity losses. Tsetse challenge ranks as high.
- A score of >90 indicates that AAT problems are a major cause for concern and are currently probably a serious constraint to increasing livestock ownership and productivity. Tsetse challenge appears to be extremely high.

Note:

- If six or more (>30%) of questions are not answered or rank as F, do not attempt to score the questionnaire but use the answers which you have as the basis of your assessment report.
- If five or fewer questions are not answered, use the answers which you have to estimate missing values (Total/No. questions answered × No. questions not answered) and add this to your total score.

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