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Estimating the costs of tsetse control options: An example for Uganda☆

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ABSTRACT

Decision-making and financial planning for tsetse control is complex, with a particularly wide range of choices to be made on location, timing, strategy and methods. This paper presents full cost estimates for eliminating or continuously controlling tsetse in a hypothetical area of 10,000 km^2 located in south-eastern Uganda. Four tsetse control techniques were analysed: (i) artificial baits (insecticide-treated traps/targets), (ii) insecticide-treated cattle (ITC), (iii) aerial spraying using the sequential aerosol technique (SAT) and (iv) the addition of the sterile insect technique (SIT) to the insecticide-based methods (i–iii).

For the creation of fly-free zones and using a 10% discount rate, the field costs per km^2 came to US$283 for traps (4 traps per km^2), US$30 for ITC (5 treated cattle per km^2 using restricted application), US$380 for SAT and US$758 for adding SIT. The inclusion of entomological and other preliminary studies plus administrative overheads adds substantially to the overall cost, so that the total costs become US$482 for traps, US$220 for ITC, US$552 for SAT and US$993 – 1365 if SIT is added following suppression using another method. These basic costs would apply to trouble-free operations dealing with isolated tsetse populations. Estimates were also made for non-isolated populations, allowing for a barrier covering 10% of the intervention area, maintained for 3 years. Where traps were used as a barrier, the total cost of elimination increased by between 29% and 57% and for ITC barriers the increase was between 12% and 30%.

In the case of continuous tsetse control operations, costs were estimated over a 20-year period and discounted at 10%. Total costs per km^2 came to US$368 for ITC, US$2114 for traps, all deployed continuously, and US$2442 for SAT applied at 3-year intervals. The lower costs compared favourably with the regular treatment of cattle with prophylactic trypanocides (US$3862 per km^2 assuming four doses per annum at 45 cattle per km^2).

Throughout the study, sensitivity analyses were conducted to explore the impact on cost estimates of different densities of ITC and traps, costs of baseline studies and discount rates.

The present analysis highlights the cost differentials between the different intervention techniques, whilst attesting to the significant progress made over the years in reducing field costs. Results indicate that continuous control activities can be cost-effective in reducing tsetse populations, especially where the creation of fly-free zones is challenging and reinvasion pressure high.

☆ The views expressed in this publication are those of the author(s) and do not necessarily reflect the views or policies of FAO.

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1. Introduction

For the planner, the field of tsetse and trypanosomosis control poses a particularly complex decision-making problem. First, there is a wide range of intervention techniques to be assessed, which include either tackling the parasite by treating livestock with trypanocides, or controlling the vector through insecticide-treated traps or cattle, aerial spraying, ground spraying, the sterile insect technique (SIT) or combinations of these. Second, planners are faced with important choices relating to the location, scale and strategic objectives of interventions. All choices need to be aimed at optimising the use of resources, and therefore they must be grounded in a solid understanding of the economics of control operations.

Decision-support for spatial targeting of interventions is increasingly being provided by detailed maps on the distribution of human African trypanosomosis (HAT) (Cecchi et al., 2009; Simarro et al., 2010) and its risk (Simarro et al., 2012), as well as by maps of the economic losses caused by African animal trypanosomosis (Shaw et al., 2006; Wint et al., 2011). Modelling tsetse population dynamics has added a further tool for planning and decision-support (Hargrove, 2000, 2004; Vale and Torr, 2005; Kgori et al., 2006).

Records of the costs of different tsetse control activities have been kept since these types of operations began (e.g. Wilson, 1953; Davies, 1971). Most of the analyses were confined to one country and one control operation (Shaw, 2004), and only a few compared the costs of different techniques (Putt et al., 1980; Brandl, 1988; Barrett, 1997; Budd, 1999). Scientific publications normally focused on analysing the core components of field costs such as targets, traps, insecticide, flying time and producing sterile males in relation to the impacts of different techniques on tsetse populations. This reflects the fact that cost-effectiveness of evolving techniques is, by its nature, studied in the field as part of entomological experiments to test the efficacy of different approaches (e.g. Esterhuizen et al., 2011). Other types of cost have received less attention in the literature and there is a tendency to assume that non-core and non-field costs are broadly the same for all technologies. However, this is not necessarily the case, because of both intrinsic differences in how the various techniques work, and extrinsic factors, reflecting project structure, donor exigencies and country- and location-specific organisational attributes (Putt et al., 1980). With the exception of Brandl (1988), who also considered continuous tsetse control, the studies above all dealt exclusively with tsetse elimination schemes. However, a study, adopting the cost calculation methodology of Shaw et al. (2007), undertook a detailed estimate of the modelled cost of continuous control using targets in Kenya (McCord et al., 2012).

The objective of the present study was to produce a set of costings that covered the range of techniques currently being used either to control or to eliminate tsetse, in order to provide an economic insight into decisions on scale and strategic objectives. The methodology used is full costing, which includes field costs, administrative and other overheads, and the costs of initial studies. In order to anchor the work in a real location based on real plans and projects, the analyses have been based on a single country. It takes as its starting point the area initially targeted by the Pan-African Tsetse and Trypanosomosis Eradication Campaign (PATTEC) for the creation of a tsetse-free zone in south-eastern Uganda, located in a crescent around Lake Victoria's north-western shore and south of Lake Kyoga. Using available tsetse and cattle distribution maps (Wint, 2001; Wint and Robinson, 2007) and census data for Uganda, it was estimated that the core infested area of just under 21,000 km^2 contains approximately 910,000 cattle and 4.9 million rural inhabitants, more than half of whom (2.6 million) subsist on less than US$1 a day.

This work forms part of a broader exercise aimed at quantifying and mapping both benefits and costs of interventions against tsetse and trypanosomosis in a range of livestock production systems of eastern Africa (Cecchi et al., 2010; Wint et al., 2011).

2. Materials and methods

2.1. Tsetse species and study area

The most important species of tsetse fly present in the study area is *Glossina fuscipes fuscipes*, though recent surveys indicated that *Glossina pallidipes* is also present near the Kenyan border (Magona et al., 2005). In the cost analysis for the tsetse elimination scenario, all calculations were based on a theoretical, square-shaped intervention area of 10,000 km^2, homogenously infested by a single fly species. Operationally, this is a viable size for the creation of a tsetse-free zone using any one of the intervention techniques. The calculations and modelling were undertaken assuming that only one species of tsetse is present and hence different types of artificial bait or different species of sterile males are not required.

2.2. Tsetse control techniques

Four tsetse control techniques were included in the analysis: stationary baits (insecticide-treated traps or targets, sometimes baited with attractants), mobile baits (insecticide-treated livestock), aerial spraying and SIT. The initial focus of the analysis was on calculating the cost of eliminating tsetse to create tsetse-free zones, in line with the prevailing PATTEC strategy. Elimination is defined as the complete removal of tsetse from a defined area (Hargrove, 2005). An estimate of costs of continuous control operations using baits, aerial spraying or regular treatment using trypanocides was also made. It was assumed that 'control' suppressed but did not eliminate tsetse and hence required repeated application.

2.2.1. Artificial baits

Insecticide-treated traps rather than targets were selected for costing as stationary baits because these are more widely used in operations to control *G. fuscipes* in Uganda (Okoth et al., 1991; Lancien, 1991) and elsewhere (Green, 1994). Traps deployed at a density of 10 per km^2 achieved local reductions of about 99% in tsetse populations (Lancien, 1991; Lancien and Obayi, 1993). Used with odour baits against *morsitans* group flies at a density of 4